B.Sc., MATHEMATICS

Syllabus

Program Code: UMT

2023 - Onwards

MANNAR THIRUMALAI NAICKER COLLEGE

(AUTONOMOUS)

Re-accredited with "A+" Grade by NAAC

PASUMALAI, MADURAI – 625 004

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS), MADURAI – 625 004

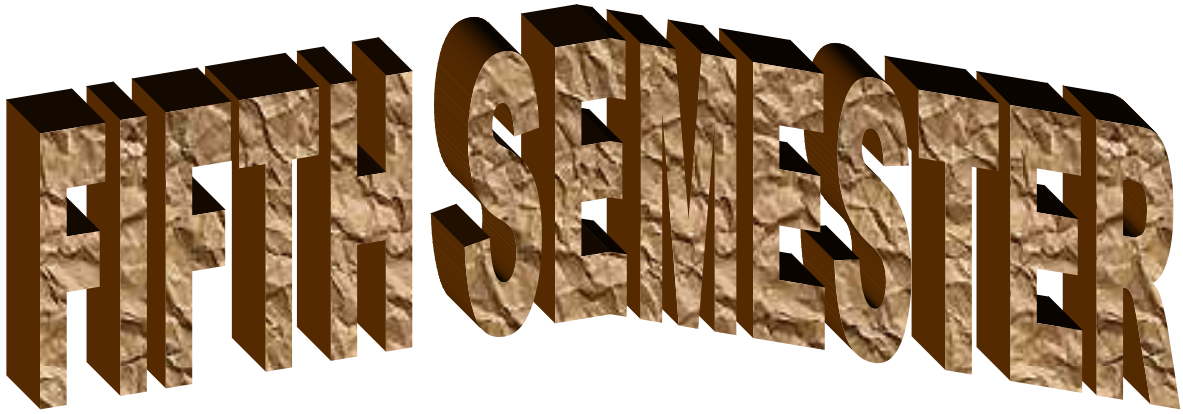
B.SC MATHEMATICS CURRICULUM

(For the students admitted from the academic year 2023-2024 onwards)

Course Code	Title of the Course	Hrs	Credits	Maximum Marks		
				Int	Ext	Total
FIRST SEMESTER						
Part – I	**Tamil / Alternative Course**					
23UTAGT11	தமிழ் இலக்கிய வரலாறு - I	6	3	25	75	100
Part – II	**English**					
23UENGE11	General English - I	6	3	25	75	100
Part - III	**Core Courses**					
23UMTCC11	Algebra and Trigonometry	5	5	25	75	100
23UMTCC12	Differential Calculus	4	4	25	75	100
Part - III	**Elective Courses**					
23UPHEA11	Allied Physics - I	3	3	25	75	100
23UPHEP11	Allied Physics Practical - I	2	1	25	75	100
Part IV	**Non Major Elective**					
23UMTNM11	Mathematics for Competitive Examination - I	2	2	25	75	100
Part IV	**Foundation Course**					
23UMTFC11	Fundamentals of Mathematics	2	2	25	75	100
	Total	30	23	200	600	800
SECOND SEMESTER						
Part – I	**Tamil / Alternative Course**					
23UTAGT21	தமிழ் இலக்கிய வரலாறு – II	6	3	25	75	100
Part – II	**English**					
23UENGE21	General English - II	6	3	25	75	100
Part - III	**Core Courses**					
23UMTCC21	Analytical Geometry (Two and Three Dimensions)	5	5	25	75	100
23UMTCC22	Integral Calculus	4	4	25	75	100
Part - III	**Elective Course**					
23UPHEA21	Allied Physics - II	3	3	25	75	100
23UPHEP21	Allied Physics Practical - II	2	1	25	75	100
Part IV	**Non Major Elective**					
23UMTNM21	Mathematics For Competitive Examination - II	2	2	25	75	100
Part IV	**Skill Enhancement course**					
23UMTSP21	Office Automation - Lab	2	2	25	75	100
	Total	30	23	200	600	800

Course Code	Title of the Course	Hrs	Credits	Maximum Marks		
				Int	Ext	Total
THIRD SEMESTER						
Part – I	**Tamil / Alternative course**					
23UTAGT31	தமிழக வரலாறும் பண்பாடும்	6	3	25	75	100
Part – II	**English**					
23UENGE31	General English - III	6	3	25	75	100
Part - III	**Core courses**					
23UMTCC31	Vector Calculus and Applications	5	5	25	75	100
23UMTCC32	Differential Equations and Applications	5	5	25	75	100
Part - III	**Elective course**					
23UMTEC31	Mathematical Statistics	4	3	25	75	100
Part - IV	**Skill Based courses**					
23UMTSP31	Web Designing	1	1	25	75	100
23UMTSP32	Data Analysis Using SPSS (Lab)	2	2	25	75	100
Part - IV	**Mandatory course**					
23UEVSG41	Environmental Studies	1	-	-	-	-
	Total	30	22	175	525	700
FOURTH SEMESTER						
Part – I	**Tamil / Alternative course**					
23UTAGT41	தமிழும் அறிவியலும்	6	3	25	75	100
Part – II	**English**					
23UENGE41	General English - IV	6	3	25	75	100
Part - III	**Core courses**					
23UMTCC41	Industrial Statistics	6	6	25	75	100
23UMTCC42	Elements of Mathematical Analysis	4	4	25	75	100
Part - III	**Elective course**					
23UMTEC41	Transformation Techniques	3	3	25	75	100
Part - IV	**Skill Based courses**					
23UMTSC41	Introduction to Data Science	2	2	25	75	100
23UMTSP41	Programming In C++ (Lab)	2	1	25	75	100
Part - IV	**Mandatory course**					
23UEVSG41	Environmental Studies	1	2	25	75	100
	Total	30	24	200	600	800

Course Code	Title of the Course	Hrs	Credits	Maximum Marks		
				Int	Ext	Total
FIFTH SEMESTER						
Part - III	**Core courses**					
23UMTCC51	Abstract Algebra	5	4	25	75	100
23UMTCC52	Real Analysis	5	4	25	75	100
23UMTCC53	Mathematical Modelling	5	4	25	75	100
Part - III	**Core project**					
23UMTPR51	Project with Viva - voce	4	4	25	75	100
Part - III	**Elective course – I**					
23UMTEC51	Optimization Techniques	4	3	25	75	100
Part - III	**Elective course – II**					
23UMTEC52	Graph Theory and Its Applications	5	3	25	75	100
Part - IV	**Mandatory course**					
23UVLEG51	Value Education	2	2	25	75	100
23UMTIN51	Internship	-	1	25	75	100
	Total	30	25	200	600	800
SIXTH SEMESTER						
Part - III	**Core courses**					
23UMTCC61	Linear Algebra	5	5	25	75	100
23UMTCC62	Complex Analysis	6	5	25	75	100
23UMTCC63	Mechanics	5	4	25	75	100
Part - III	**Elective course – I**					
23UMTEC61	Numerical Methods with Applications	5	3	25	75	100
Part - III	**Elective course – II**					
23UMTEC62	Discrete Mathematics	5	3	25	75	100
Part - IV	**Skill course**					
23UMTSP61	R Language - Lab	4	2	25	75	100
Part - V	**Extension activities**					
23UNCET61, 23UNSET61, 23UPEET61, 23URRET61 & 23UYRET61	N.C.C, N.S.S, Physical Education, R.R.C & Y.R.C	-	1	25	75	100
	Total	30	23	175	525	700
	Grand total	180	140	1150	3450	4600


FIFTH SEMESTER

Course Name	Abstract Algebra			
Course Code	23UMTCC51	**L**	**P**	**C**
Category	Core	5	-	4

COURSE OBJECTIVES:

- Concepts of Sets, Groups and Rings.
- Construction, characteristics and applications of the abstract algebraic structures

UNIT - I **15**

Introduction to groups- Subgroups- cyclic groups and properties of cyclic groups- Lagrange's Theorem- A counting principle – Examples

UNIT - II **15**

Normal subgroups and Quotient group- Homomorphism- Automorphism -Examples.

UNIT - III **15**

Cayley's Theorem-Permutation groups - Examples

UNIT - IV **15**

Definition and examples of ring- Some special classes of rings- homomorphism of rings- Ideals and quotient rings- More ideals and quotient rings.

UNIT - V **15**

The field of quotients of an integral domain-Euclidean Rings - The particular Euclidean Ring – Examples

Total Lecture Hours **75**

BOOKS FOR STUDY:

- **Topics in Algebra**–I.N.Herstein, Wiley Eastern Ltd. Second Edition (1st January 2006)
  Unit I : Chapter 2 Section 2.4 and 2.5
  Unit II : Chapter 2 Section 2.6 to 2.8
  Unit III : Chapter 2 Section 2.9 and 2.10
  Unit IV : Chapter 3 Section 3.1 to 3.5
  Unit V : Chapter 3 Section 3.6 to 3.8

BOOKS FOR REFERENCES:

- John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed.,Pearson, 2002.
- M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
- Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed.,Narosa, 1999.

WEB RESOURCES:

- https://www.open.edu/openlearn/mod/resource/view.php?id=72698
- https://nptel.ac.in/courses/106/104/106104149/
- https://nptel.ac.in/courses/111/106/111106113/

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED			ENTREPRENEURSHIP					
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		✓	GLOBAL				
Changes Made in the Course	Percentage of Change		**10%**	No Changes Made			New Course					

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Explain groups, subgroups and cyclic groups	**K1 to K4**
CO2	Explain about Normal subgroup, Quotient groups, Homomorphisms and Automorphisms and verify the functions for homomorphism and automorphism properties	**K1 to K4**
CO3	Explain Permutation groups and apply Cayley's theorem to problems	**K1 to K4**
CO4	Explain Rings, Ideals and Quotient Rings and examine their structure	**K1 to K4**
CO5	Discuss about the field of quotient of an integral domain and to Explain in detail about Euclidean Rings	**K1 to K4**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**3**	**3**	**2**	**3**	**1**	**-**				
CO2	**3**	**3**	**2**	**3**	**1**	**-**				
CO3	**3**	**3**	**2**	**3**	**2**	**-**				
CO4	**3**	**3**	**2**	**3**	**1**	**-**				
CO5	**3**	**3**	**2**	**3**	**2**	**-**				

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO 1	**3**	**3**	**1**		
CO 2	**3**	**3**	**1**		
CO 3	**3**	**3**	**1**		
CO 4	**3**	**3**	**1**		
CO 5	**3**	**3**	**1**		
WEIGHTAGE	**15**	**15**	**5**		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	**3**	**3**	**1**		

LESSON PLAN:			
UNIT	**Abstract Algebra**	**HRS**	**PEDAGOGY**
I	Introduction to groups- Subgroups- cyclic groups and properties of cyclic groups- Lagrange's Theorem-A counting principle – Examples	**15**	**Chalk & Talk**
II	Normal subgroups and Quotient group- Homomorphism-Automorphism -Examples.	**15**	**Chalk & Talk**
III	Cayley's Theorem-Permutation groups - Examples	**15**	**Chalk & Talk,PPT**
IV	Definition and examples of ring- Some special classes of rings-homomorphism of rings- Ideals and quotient rings- More ideals and quotient rings.	**15**	**Chalk & Talk Seminar**
V	The field of quotients of an integral domain-Euclidean Rings - The particular Euclidean Ring – Examples	**15**	**Chalk & Talk**

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 Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
	CO2	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
CI AII	**CO3**	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K3,K3)
	CO4	**K1 – K4**	2	K1,K2	2(K4,K4)	2(K4,K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.6**	**25**
	K2	2	10		12	**21.4**	
	K3		10	16	26	**46.4**	46.4
	K4			16	16	**28.6**	28.6
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.6**	**7.2**
	K2	2			2	**3.6**	
	K3		10	16	26	**46.4**	46.4
	K4		10	16	26	**46.4**	46.4
	Marks	**4**	**20**	**32**	**56**	**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**	**Section A (MCQs)**		**Section B (Either / or Choice) With K - LEVEL**	**Section C (Either / or Choice) With K - LEVEL**
			No. of Questions	**K – Level**		
1	CO1	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
2	CO2	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
3	CO3	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
4	CO4	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
5	CO5	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(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 (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5			5	**3.6**	4
K2	5	20		25	**17.8**	18
K3		30	32	62	**44.3**	44
K4			48	48	**34.3**	34
Marks	**10**	**50**	**80**	**140**	**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

Q. No.	**Unit**	**CO**	**K-level**		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K2**	
		OR		
13. b)	**Unit - III**	**CO3**	**K2**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K3**	
		OR		
16. b)	**Unit - I**	**CO1**	**K3**	
17. a)	**Unit - II**	**CO2**	**K4**	
		OR		
17. b)	**Unit - II**	**CO2**	**K4**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K4**	
		OR		
20. b)	**Unit - V**	**CO5**	**K4**	

Course Name	Real Analysis			
Course Code	23UMTCC52	**L**	**P**	**C**
Category	Core	5	-	4

COURSE OBJECTIVES:

- Real Numbers and properties of Real–valued functions
- Connectedness, Compactness, Completeness of Metric spaces.
- Convergence of sequences of functions, Examples and counter examples

UNIT - I **15**

Connected sets – Bounded sets – Totally bounded sets – Complete metric space

UNIT - II **15**

Compact metric spaces, continuous functions on a compact metric space, continuity of inverse functions, uniform continuity.

UNIT - III **15**

Calculus: Sets of measure zero, definition of the Riemann integral, existence of the Riemann integral-properties of Riemann integral.

UNIT - IV **15**

Derivatives-Rolle's theorem, Law of mean, Fundamental theorems of calculus.

UNIT - V **15**

Taylor's theorem-Point wise convergence of sequences of functions, uniform convergence of sequences of functions

Total Lecture Hours **75**

BOOKS FOR STUDY:

Methods of Real Analysis-Richard R.Goldberg (John Wiley & sons, 2nd edition) (Indian edition –Oxford and IBH Publishing Co, New Delhi, 1st January 2020)

Unit I : Chapter 6 Section 6.2 to 6.4
Unit II : Chapter 6 Section 6.5 to 6.8
Unit III : Chapter 7 Section 7.1 to 7.4
Unit IV : Chapter 7 Section 7.5 to 7.8
Unit V : Chapter 8, 9 Section 8.5 and 9.1 to 9.2

BOOKS FOR REFERENCES:

1. Principles of Mathematical Analysis by Walter Rudin, Tata McGraw Hill Education, Third edition (1 July 2017).
2. Mathematical Analysis Tom M A postal, Narosa Publishing House, 2ndedition (1974), Addison-Wesley publishing company, New Delhi.

WEB RESOURCES:

- **https://nptel.ac.in**

Nature of Course	EMPLOYABILITY	✓	SKILL ORIENTED		ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL	✓	GLOBAL	
Changes Made in the Course	Percentage of Change	**60%**	No Changes Made		New Course			

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Explain the concepts of open and close sets, Connectedness, Completeness and	**K1 to K4**
CO2	Explain the concepts of Compactness continuity of inverse functions and Uniform continuity	**K1 to K4**
CO3	Define the sets of measure zero and to explain about the existence and properties of Riemann integral	**K1 to K4**
CO4	Explain the concept of differentiability and to explain Rolle's theorem, Law of mean, and Fundamental theorem of calculus	**K1 to K4**
CO5	Explain the point wise and uniform convergence of sequence of function and to derive the Taylor's theorem	**K1 to K4**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	1	3	1	-				
CO2	3	3	1	3	1	-				
CO3	3	3	1	3	1	-				
CO4	3	3	1	3	1	-				
CO5	3	3	1	3	1	-				

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	1	1		
CO 2	3	1	1		
CO 3	3	1	1		
CO 4	3	1	1		
CO 5	3	1	1		
WEIGHTAGE	3	1	1		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	3	1	1		

LESSON PLAN:			
UNIT	**Real Analysis**	**HRS**	**PEDAGOGY**
I	Connected sets – Bounded sets – Totally bounded sets – Complete metric space	**15**	**Chalk & Talk, PPT**
II	Compact metric spaces, continuous functions on a compact metric space, continuity of inverse functions, uniform continuity.	**15**	**Chalk & Talk, e-lectures**
III	Calculus: Sets of measure zero, definition of the Riemann integral, existence of the Riemann integral-properties of Riemann integral.	**15**	**Chalk & Talk, nptel vides**
IV	Derivatives-Rolle's theorem, Law of mean, Fundamental theorems of calculus.	**15**	**Chalk & Talk, PPT**
V	Taylor's theorem-Point wise convergence of sequences of functions, uniform convergence of sequences of functions	**15**	**Chalk & Talk, nptel videos**

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 Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
	CO2	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
CI AII	**CO3**	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K3,K3)
	CO4	**K1 – K4**	2	K1,K2	2(K4,K4)	2(K4,K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.6**	**25**
	K2	2	10		7	**12.5**	
	K3		10	16	23	**41.04**	46.4
	K4			16	24	**42.86**	28.6
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.6**	**7.2**
	K2	2			2	**3.6**	
	K3		10	16	26	**46.4**	46.4
	K4		10	16	26	**46.4**	46.4
	Marks	**4**	**20**	**32**	**56**	**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**	**Section A (MCQs)**		**Section B (Either / or Choice) With K - LEVEL**	**Section C (Either / or Choice) With K - LEVEL**
			No. of Questions	**K – Level**		
1	CO1	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
2	CO2	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
3	CO3	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
4	CO4	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
5	CO5	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(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 (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5			5	**3.6**	4
K2	5	20		25	**17.8**	18
K3		30	32	62	**44.3**	44
K4			48	48	**34.3**	34
Marks	**10**	**50**	**80**	**140**	**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

Q. No.	**Unit**	**CO**	**K-level**		
Answer **ALL** the questions			**PART – A**		**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K2**	
		OR		
13. b)	**Unit - III**	**CO3**	**K2**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K3**	
		OR		
16. b)	**Unit - I**	**CO1**	**K3**	
17. a)	**Unit - II**	**CO2**	**K4**	
		OR		
17. b)	**Unit - II**	**CO2**	**K4**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K4**	
		OR		
20. b)	**Unit - V**	**CO5**	**K4**	

Course Name	Mathematical Modelling			
Course Code	23UMTCC53	**L**	**P**	**C**
Category	Core	5	-	4

COURSE OBJECTIVES:

- Construction and Analysis of Mathematical models found in real life problems.
- Modelling through differential and difference equations

UNIT - I **15**

Mathematical Modelling: Simple situations requiring mathematical modelling, the technique of mathematical modelling, characteristics of mathematical models, Mathematical modelling through Geometry

UNIT - II **15**

Mathematical Modelling through differential equations: Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models.

UNIT - III **15**

Mathematical Modelling, through system of Ordinary differential equations of first order: Prey-predator models, Competition models, Epidemics: simple epidemic model, Susceptible-infected- susceptible (SIS) model, SIS model with constant number of carriers. Model with removal and model with immigrations Medicine: Model for Diabetes Mellitus.

UNIT - IV **15**

Need for Mathematical modelling through difference equations-Basic theory of linear difference equations with constant coefficients: Complementary functions and solutions

UNIT - V **15**

Mathematical Modelling through difference equations in Economics and Finance- Harrod Model, cob web model ,Application to Actuarial Science

Total Lecture Hours **75**

BOOKS FOR STUDY:

- J N Kapur, **Mathematical Modeling,** New Age International publishers(2015)

Unit – I: Chapter 1 – section 1.1. to 1.5

UNIT- II: Chapter 2 – section 2.1 to 2.4

Unit – III: Chapter 3 – Section 3.1.1, 3.1.2, 3.2, 3.5.1

Unit – IV: Chapter 5 - Sections 5.1 and 5.2

Unit – V: Chapter 5 - Section 5.3 (5.3.3 not included)

BOOKS FOR REFERENCES:

- Mathematical Modeling by Bimalk. Mishra and Dipak K.Satpathi. Ane Books Pvt. Ltd(1 Januuary 2009)
- Mathematical Modeling Models, Analysis and Applications, by Sandip Banerjee, CRC Press, Taylor & Francis group, 2014
- Mathematical Modeling applications with Geogebra by Jonas Hall & Thomas Ligefjard, John Wiley & Sons, 2017
- Mark M. Meerschaert: Mathematical Modeling, Elsevier Publ., 2007.
- Edward A. Bender: An introduction to mathematical Modeling, CRC Press,2002
- Walter J. Meyer, Concepts of Mathematical Modeling, Dover Publ., 2000

WEB RESOURCES:

- **https://nptel.ac.in**
- **https://www.researchgate.net/publication/357313926_Lecture_Notes_on_Mathematical_Modeling**
- **https://pages.pomona.edu/~ajr04747/Spring2012/Math183/Notes/Math183Spring2012Notes.pdf**

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED				ENTREPRENEURSHIP				
Curriculum Relevance	LOCAL		REGIONAL			NATIONAL		✓	GLOBAL			
Changes Made in the Course	Percentage of Change			No Changes Made				New Course				✓

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Explain simple situations requiring Mathematical Modelling and to Determine the characteristics of such models	**K1 to K4**
CO2	Model using differential equations in-terms of linear growth and Decay models	**K1 to K4**
CO3	Model using systems of ordinary differential equations of first order, to discuss about various models under the categories 'Epidemics' and 'Medicine'	**K1 to K4**
CO4	Explain in detail about difference equations	**K1 to K4**
CO5	Model using difference equations	**K1 to K4**

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	3	2	2				
CO2	2	3	3	3	2	2				
CO3	2	3	3	3	2	2				
CO4	3	2	2	2	-	1				
CO5	2	3	3	3	2	2				
3- STRONG				2 – MEDIUM					1 - LOW	

CO / PO MAPPING:					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	3	2		
CO 2	2	3	2		
CO 3	2	3	2		
CO 4	2	3	2		
CO 5	2	3	2		
WEIGHTAGE	10	15	10		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	2	3	2		

LESSON PLAN:			
UNIT	Mathematical Modelling	HRS	PEDAGOGY
I	Mathematical Modelling: Simple situations requiring mathematical modelling, the technique of mathematical modelling, characteristics of mathematical models, Mathematical modelling through Geometry	15	Chalk & Talk, PPT
II	Mathematical Modelling through differential equations: Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models.	15	Chalk & Talk, PPT
III	Mathematical Modelling, through system of Ordinary differential equations of first order: Prey-predator models, Competition models,. Epidemics: simple epidemic model, Susceptible-infected- susceptible (SIS) model, SIS model with constant number of carriers. Model with removal and model with immigrations Medicine: Model for Diabetes Mellitus.	15	Chalk & Talk, PPT, e-lectures
IV	Need for Mathematical modelling through difference equations-Basic theory of linear difference equations with constant coefficients: Complementary functions and solutions	15	Seminar
V	Mathematical Modelling through difference equations in Economics and Finance- Harrod Model, cob web model ,Application to Actuarial Science	15	Chalk & Talk, PPT

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 Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
	CO2	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
CI AII	**CO3**	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
	CO4	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.6**	**25**
	K2	2	10		12	**21.4**	
	K3		10	16	26	**46.4**	46.4
	K4			16	16	**28.6**	28.6
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.6**	**7.2**
	K2	2			2	**3.6**	
	K3		10	16	26	**46.4**	46.4
	K4		10	16	26	**46.4**	46.4
	Marks	**4**	**20**	**32**	**56**	**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	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
2	CO2	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
3	CO3	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
4	CO4	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
5	CO5	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(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 (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5			5	**3.6**	4
K2	5	20		25	**17.8**	18
K3		30	32	62	**44.3**	44
K4			48	48	**34.3**	34
Marks	**10**	**50**	**80**	**140**	**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

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	Unit - I	CO1	K2	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K2**	
		OR		
13. b)	**Unit - III**	**CO3**	**K2**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K3**	
		OR		
16. b)	**Unit - I**	**CO1**	**K3**	
17. a)	**Unit - II**	**CO2**	**K4**	
		OR		
17. b)	**Unit - II**	**CO2**	**K4**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K4**	
		OR		
20. b)	**Unit - V**	**CO5**	**K4**	

Course Name	Project with Viva - voce			
Course Code	23UMTPR51	**L**	**P**	**C**
Category	Project	4	-	4

Course Description

The Project is conducted by the following Course Pattern.

Guidelines For Internship:

1. There will be one Faculty guide.
2. A Group of two students join to do a project
3. The students should submit a Project Report (Maximum 30 Pages).
4. The Marks for Project Report will be awarded only on the basis of the Project Report with Viva - Voce.

Internal

Presentation Submission	**25**

External

Project Report Viva Voce	**75**
Total	**- 100**

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED			ENTREPRENEURSHIP					
Curriculum Relevance	LOCAL		REGIONAL		✓	NATIONAL			GLOBAL			
Changes Made in the Course	Percentage of Change			No Changes Made		✓	New Course					
*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**												

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Apply the skill of presentation and communication techniques	**K1 to K4**
CO2	Motive as an individual or in a team in development of projects.	**K1 to K4**
CO3	Analyze the available resources and to select most appropriate one	**K1 to K4**
CO4	Make use of the fundamentals of Mathematics to search the related literature survey	**K1 to K4**
CO5	Explain the real life problems by using Mathematics and its Application.	**K1 to K4**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	3	3	3	1	3				
CO2	1	2	2	1	2	1				
CO3	2	2	3	3	2	1				
CO4	3	2	3	2	1	2				
CO5	3	3	3	3	3	3				

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO 1	3	2	1		
CO 2	3	2	1		
CO 3	3	2	1		
CO 4	3	2	1		
CO 5	3	2	1		
WEIGHTAGE	15	10	5		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	3	2	1		

Course Name	Optimization Techniques			
Course Code	23UMTEC51	**L**	**P**	**C**
Category	Elective	4	-	3

COURSE OBJECTIVES:

- To illustrate linear problem, special forms and game theory.
- To evaluate game theory and linear problems.
- To compare different types of methods in solving linear problem
- To solve linear programming problem.
- To design real life problem into a linear problem.

UNIT - I **12**

Linear Programming Problem - Mathematical formulation of the problem – Solution by Graphical Method, The Simplex method and Method of penalty: Big M Method

UNIT - II **12**

Duality – Duality and Simplex Method- Problems.

UNIT - III **12**

General Transportation problem – LP formation of a Transportation Problem – Finding an Initial Basic Feasible Solution – MODI method for both balanced and unbalanced TP- The Assignment Problem

UNIT - IV **12**

Game theory – Two Person Zero Sum Game – saddle point – Game with saddle point – Solution of game by using formula, Graphical method, Dominance Property

UNIT - V **12**

Problem of Sequencing-Processing n Jobs through Two Machines – Processing n Jobs through k Machines -Replacement of Equipment that deteriorates gradually- Replacement of Equipment that fails suddenly.

Total Lecture Hours **60**

BOOKS FOR STUDY:

- Kanti Swarup , P.K. Gupta and Man Mohan, **Operations Research,** Sultan Chand and Sons Publications, New Delhi, Reprint 2006.

Unit I -Chapter 2

Chapter 3 Section 3.1 to 3.5

Chapter 4 Section 4.1 to 4.4

Unit II -Chapter 5: Section 5.1 to 5.4 and 5.7,

Unit III - Chapter 10: Section 10.1 to 10.12

Chapter11: Section 11.1 to 11.4

Unit IV - Chapter17: Section 17.1 to 17.7

Unit V - Chapter 12: Section 12.1 to 12.5

Chapter 18: Section 18.1 & 18.2

BOOKS FOR REFERENCES:

- Dr.S.Arumugam and ISAAC, **Topics in Operations Research -Linear Programming**,New Gamma Publishing House, Palayamkottai, June 2012.
- P.R.Vital and V.Malini, **Operations Research**, Margham Publications, Chennai, 2002.
- .Hamdy A.Taha – **Operations Research, An Introduction**, 8th Edition , Prentice-Hall India ,2006.

WEB RESOURCES:

- **https://mrcet.com/downloads/digital_notes/ME/IV%20year/Operations%20Research.pdf**
- **http://lipas.uwasa.fi/~tsottine/lecture_notes/or.pdf**
- **https://mrcet.com/downloads/digital_notes/ME/IV%20year/Operations%20Research.pdf**

Nature of Course	EMPLOYABILITY	✓	SKILL ORIENTED		ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		No Changes Made	✓	New Course			

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Solve linear programming problems by various methods	**K1 to K4**
CO2	Analyze different environments that needs decision using duality concepts to find solution.	**K1 to K4**
CO3	Develop the solution to Transportation and Assignment Problem	**K1 to K4**
CO4	Explain the game theory problems	**K1 to K4**
CO5	Solve replacement and sequencing problem	**K1 to K4**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	1	1				
CO2	3	3	2	2	1	1				
CO3	3	3	2	2	1	-				
CO4	3	3	2	2	1	1				
CO5	3	3	2	2	1	-				

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	2		
CO 2	3	3	2		
CO 3	3	3	2		
CO 4	3	3	2		
CO 5	3	3	2		
WEIGHTAGE	15	15	10		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	3	3	2		

LESSON PLAN:

UNIT	Optimization Techniques	HRS	PEDAGOGY
I	Linear Programming Problem - Mathematical formulation of the problem – Solution by Graphical Method, The Simplex method and Method of penalty: Big M Method.	15	Chalk & Talk
II	Duality – Duality and Simplex Method- Problems.	15	Chalk & Talk

III	General Transportation problem – LP formation of a Transportation Problem – Finding an Initial Basic Feasible Solution – MODI method for both balanced and unbalanced TP- The Assignment Problem	**15**	**Chalk & Talk, PPT**
IV	Game theory – Two Person Zero Sum Game – saddle point – Game with saddle point – Solution of game by using formula, Graphical method, Dominance Property	**15**	**Chalk & Talk Seminar**
V	Problem of Sequencing-Processing n Jobs through Two Machines – Processing n Jobs through k Machines - Replacement of Equipment that deteriorates gradually- Replacement of Equipment that fails suddenly.	**15**	**Chalk & Talk PPT**

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 Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
	CO2	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
CI AII	**CO3**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
	CO4	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.6	25
	K2	2	10		12	21.4	
	K3		10	16	26	46.4	46.4
	K4			16	16	28.6	28.6
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.6	7.2
	K2	2			2	3.6	
	K3		10	16	26	46.4	46.4
	K4		10	16	26	46.4	46.4
	Marks	4	20	32	56	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	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
2	CO2	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
3	CO3	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
4	CO4	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
5	CO5	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(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 (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5			5	**3.6**	4
K2	5	20		25	**17.8**	18
K3		30	32	62	**44.3**	44
K4			48	48	**34.3**	34
Marks	**10**	**50**	**80**	**140**	**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

Q. No.	**Unit**	**CO**	**K-level**		
Answer **ALL** the questions			**PART – A**		**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K2**	
		OR		
13. b)	**Unit - III**	**CO3**	**K2**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K3**	
		OR		
16. b)	**Unit - I**	**CO1**	**K3**	
17. a)	**Unit - II**	**CO2**	**K4**	
		OR		
17. b)	**Unit - II**	**CO2**	**K4**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K4**	
		OR		
20. b)	**Unit - V**	**CO5**	**K4**	

Course Name	Graph Theory and Its Applications			
Course Code	23UMTEC52	**L**	**P**	**C**
Category	Elective	5	-	3

COURSE OBJECTIVES:

- Understand the fundamental concepts of graph theory.
- Learn about the connectivity and separability of graphs.
- Develop an understanding of vector spaces of a graph.
- Gain knowledge about matrix representation of a graph.

UNIT - I	**BASICS**	**15**

Graphs - Subgraphs - Isomorphism and degrees - Walks and connected graphs - Cycles in graphs - Cut vertices and cut edges.

UNIT - II	**EULERIAN AND HAMILTONIAN GRAPHS**	**15**

Eulerain graphs - Fleury's algorithm - Hamiltonian graphs - Weighted graphs.

UNIT - III	**BIPARTITE GRAPHS, MATRICES AND VECTOR SPACES ASSOCIATED WITH GRAPHS**	**15**

Bipartite graphs - Marriage problem - Trees - Connector problem. Matrix representations – Vector spaces associated with graphs –Cycle space – Cut-set space.

UNIT - IV	**PLANAR GRAPHS**	**15**

Planar graphs - Euler formula - Platonic solids - Dual of a plane graph - Characterization of planar graphs.

UNIT - V	**COLOURINGS AND DIRECTED GRAPHS**	**15**

Vertex colouring - Edge colouring - An algorithm for vertex colouring – Directed graphs.

Total Lecture Hours	**75**

BOOKS FOR STUDY:

- S. A. Choudum, **A First course in Graph Theory**, Macmillan Publishers India Pvt Ltd, 2000.

Unit – I : Chapter 1: Section 1.1 – 1.7
Unit – II : Chapter 2: Section 2.1 – 2.4
Unit – III : Chapter 3: Section 3.1 – 3.4 & Chapter 4: Section 4.1
Unit – IV : Chapter 5: Section 5.1 – 5.5
Unit – V : Chapter 6: Section 6.1- 6.3 & Chapter 7: Section 7.1

BOOKS FOR REFERENCES:

- F. Harary, Graph Theory, Narosa Publishing Company, 2001.
- Narsingh Deo, Graph Theory with applications to Engineering & Computer Science, Prentice Hall of India ,New Delhi, 1997.

WEB RESOURCES:

- **https://d3gt.com/** - **Learn Graph Theory Interactively**
- **https://www.mathsisfun.com/graph/index.html**
- **https://brilliant.org/courses/graph-theory-intro/**
- **http://mathworld.wolfram.com/GraphTheory.html**
- **https://www.javatpoint.com/graph-theory** - **Graph Theory Tutorial**

Nature of Course	EMPLOYABILITY	✓	SKILL ORIENTED		ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL	✓	GLOBAL	
Changes Made in the Course	Percentage of Change	**35%**	No Changes Made		New Course			

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES :		**K LEVEL**
After studying this course, the students will be able to:		
CO1	define and classify graphs based on various parameters such as degree, isolated and pendent vertices, and isomorphisms.	**K1 to K4**
CO2	identify and explain the properties of trees, including pendent vertices, distances and centres, rooted and binary trees, spanning trees, and fundamental circuits.	**K1 to K4**
CO3	demonstrate an understanding of the connectivity and separability of graphs, including Euler graphs, Hamiltonian paths and circuits, and the various types of cut sets	**K1 to K4**
CO4	explain the concepts of vector spaces of a graph, and their applications	**K1 to K4**
CO5	use matrix representation of a graph and to solve problems related to graph theory	**K1 to K4**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	1				
CO2	3	3	2	2	2	1				
CO3	3	3	3	2	2	1				
CO4	3	3	3	2	2	1				

CO5	3	3	2	2	2	1				
3- STRONG				2 – MEDIUM					1 - LOW	

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	2	1		
CO 2	3	2	1		
CO 3	3	2	1		
CO 4	3	2	1		
CO 5	3	2	1		
WEIGHTAGE	15	10	5		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	3	2	1		

LESSON PLAN:

UNIT	Graph Theory and Its Applications	HRS	PEDAGOGY
I	Graphs - Subgraphs - Isomorphism and degrees - Walks and connected graphs - Cycles in graphs - Cut vertices and cut edges.	15	Chalk & Talk
II	Eulerain graphs - Fleury's algorithm - Hamiltonian graphs - Weighted graphs.	15	Chalk & Talk
III	Bipartite graphs - Marriage problem - Trees - Connector problem. Matrix representations – Vector spaces associated with graphs –Cycle space – Cut-set space.	15	Chalk & Talk, PPT
IV	Planar graphs - Euler formula - Platonic solids - Dual of a plane graph - Characterization of planar graphs.	15	Chalk & Talk Seminar
V	Vertex colouring - Edge colouring - An algorithm for vertex colouring – Directed graphs.	15	Chalk & Talk PPT

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 Either or Choice**	**Section C Either or Choice**
			No. of. Questions	**K - Level**		
CI	**CO1**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
AI	**CO2**	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
CI	**CO3**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
AII	**CO4**	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.6**	**25**
	K2	2	10		12	**21.4**	
	K3		10	16	26	**46.4**	46.4
	K4			16	16	**28.6**	28.6
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.6**	**7.2**
	K2	2			2	**3.6**	
	K3		10	16	26	**46.4**	46.4
	K4		10	16	26	**46.4**	46.4
	Marks	**4**	**20**	**32**	**56**	**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	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
2	CO2	K1 – K4	2	K1,K2	2(K3,K3)	2(K3,K3)
3	CO3	K1 – K4	2	K1,K2	2(K2,K2)	2(K4,K4)
4	CO4	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
5	CO5	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(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 (Either or Choice	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		30	32	62	44.3	44
K4			48	48	34.3	34
Marks	10	50	80	140	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

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K2**	
		OR		
13. b)	**Unit - III**	**CO3**	**K2**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K3**	
		OR		
16. b)	**Unit - I**	**CO1**	**K3**	
17. a)	**Unit - II**	**CO2**	**K3**	
		OR		
17. b)	**Unit - II**	**CO2**	**K3**	
18. a)	**Unit - III**	**CO3**	**K4**	
		OR		
18. b)	**Unit - III**	**CO3**	**K4**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K4**	
		OR		
20. b)	**Unit - V**	**CO5**	**K4**	

Course Name	Internship			
Course Code	23UMTIN51	**L**	**P**	**C**
Category	Summer Internship	-	-	1

Course Description

The students have to attend a 30 hours of Internship of their own choice to be carried out in II year summer vacation.

Guidelines For Internship:

5. The Project is conducted by the following Course Pattern. The internship period should be minimum 30 hours.
6. Each group should produce permission letter as well as the attendance certificate.
7. There will be one Faculty guide.
8. The students should submit an Internship Training Report (Maximum 30 Pages).
9. The Marks for Internship Training will be awarded only on the basis of the Internship Training Report.
10. Prior permission may be obtained from the organization in advance by the students concerned and information shall be passed onto the colleges thus enabling the training supervision by the concerned faculties authorized by the college.
11. Daily postal or electronic reporting should be obtained to ensure coherent and comprehensive training during the training period.
12. A final report [Institutional Training Record – ITR] containing the introduction of the industry, the profile of the company and a valid conclusion indicating the benefits of the training shall be given not exceeding 30 [A4] pages [in a spiral- bound form/pre-printed record designed for this purpose]

Internal

Presentation Submission	**25**

External

Project Report Viva Voce	**75**
Total	**- 100**

Nature of Course	EMPLOYABILITY		SKILL ORIENTED	✓	ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL	✓	REGIONAL		NATIONAL		GLOBAL	
Changes Made in the Course	Percentage of Change		No Changes Made		New Course	✓		

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Explain the student to the environment and expectations of performance on the part of private/public companies or government entities	**K1 to K4**
CO2	Able to develop work habits and attitudes necessary for job success. Build a record of work experience	**K1 to K4**
CO3	Explore career alternatives by Integrating theory and practice and learn to appreciate work and its function in the economy.	**K1 to K4**
CO4	Expose the student to professional role models by developing communication, interpersonal and other critical skills	**K1 to K4**
CO5	Examine employer-valued skills such as teamwork, communications and attention to detail.	**K1 to K4**

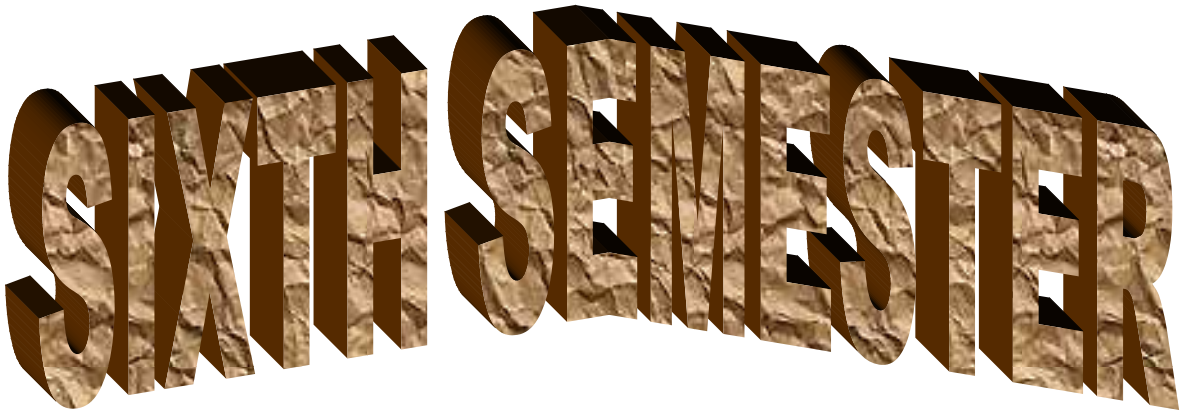
MAPPING WITH PROGRAM OUTCOMES:

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**2**	**3**	**3**	**3**	**1**	**3**				
CO2	**1**	**2**	**2**	**1**	**2**	**1**				
CO3	**2**	**2**	**3**	**3**	**2**	**1**				
CO4	**3**	**2**	**3**	**2**	**1**	**2**				
CO5	**3**	**3**	**3**	**3**	**3**	**3**				

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO 1	**3**	**2**	**1**		
CO 2	**3**	**2**	**1**		
CO 3	**3**	**2**	**1**		
CO 4	**3**	**2**	**1**		
CO 5	**3**	**2**	**1**		
WEIGHTAGE	**15**	**10**	**5**		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	**3**	**2**	**1**		


SIXTH SEMESTER

Course Name	Linear Algebra			
Course Code	23UMTCC61	**L**	**P**	**C**
Category	Core	5	-	5

COURSE OBJECTIVES:

- Vector Spaces, linear dependence and independence of vectors, Dual spaces, Inner product and norm – orthogonalization process.
- Linear transformations. Various operators on vector spaces

UNIT - I	**15**
Vector spaces – Subspaces – Linear Combinations and linear span - Systems of Linear equations – Homogenous Equations – Non- homogenous Equations – Elementary Matrices – Row reduced - Echelon form.	
UNIT - II	**15**
Linear Dependence and Linear independence – Bases – Dimensions	
UNIT - III	**15**
Linear transformations, null spaces and ranges – Matrix representation of a linear transformation – invertibility and isomorphisms – dual spaces	
UNIT - IV	**15**
Eigen values, eigen vectors, diagonalizability – invariant subspaces – Cayley– Hamilton theorem	
UNIT - V	**15**
Inner products and norms–Gram Schmidt Orthogonalization Process - Orthogonal complements	
Total Lecture Hours	**75**

BOOKS FOR STUDY:

- **Linear Algebra** - Stephen H Friedberg, Arnold J Insel and Lawrence E Spence, 5th edition (2018) Pearson

Unit-I	Chapter 1:	Section 1.1 to 1.4,
	Chapter 3:	Section 3.1, 3.3 and 3.4
Unit- II	Chapter 1 :	Section 1.5 and 1.6
Unit –III	Chapter 2 :	Section 2.1,2.2, 2.4 and 2.6
Unit-IV	Chapter 5 :	Section 5.1,5.2 and 5.4
Unit –V	Chapter 6 :	Section 6.1 and 6.2

BOOKS FOR REFERENCES:

- I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd. Second Edition, 2006.
- N.S.Gopalakrishnan, University Algebra, New Age International Publications, Wiley Eastern Ltd.
- John B.Fraleigh, First course in Algebra, Addison Wesley.
- Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
- David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
- S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
- Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.

WEB RESOURCES:

- **https://nptel.ac.in**

Nature of Course	EMPLOYABILITY	✓	SKILL ORIENTED		ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL	✓	GLOBAL	
Changes Made in the Course	Percentage of Change	**30%**	No Changes Made		New Course			

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Acquire a detailed knowledge about vector spaces and subspaces	**K1 to K4**
CO2	Explain the concepts of Linear Dependence, Linear Independence, Bases and Dimension of basis	**K1 to K4**
CO3	Explain the concept of Linear Transformations, their Matrix representation and the notion of dual spaces	**K1 to K4**
CO4	Find the Eigen values and Eigen vectors, to apply the concepts for diagonalisation	**K1 to K4**
CO5	Explain about Inner product and norms and to apply Gram Schmidt Orthogonalization Process to problems on inner product spaces	**K1 to K4**

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	-	-				
CO2	3	3	3	3	-	-				
CO3	3	3	2	3	1	-				
CO4	3	3	3	3	-	-				
CO5	3	3	3	3	1	-				
3- STRONG				2 – MEDIUM					1 - LOW	

CO / PO MAPPING:					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	1		
CO 2	3	3	1		
CO 3	3	3	1		
CO 4	3	3	1		
CO 5	3	3	1		
WEIGHTAGE	15	15	5		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	3	3	1		

LESSON PLAN:

UNIT	Linear Algebra	HRS	PEDAGOGY
I	Vector spaces – Subspaces – Linear Combinations and linear span - Systems of Linear equations – Homogenous Equations – Non-homogenous Equations – Elementary Matrices – Row reduced - Echelon form.	15	Chalk & Talk PPT
II	Linear Dependence and Linear independence – Bases – Dimensions	15	Chalk & Talk
III	Linear transformations, null spaces and ranges – Matrix representation of a linear transformation –invertibility and isomorphisms – dual spaces	15	Chalk & Talk PPT
IV	Eigen values, eigen vectors, diagonalizability – invariant subspaces – Cayley– Hamilton theorem	15	Chalk & Talk PPT
V	Inner products and norms – Gram Schmidt Orthogonalization Process - Orthogonal complements	15	Chalk & Talk Seminar

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 Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
	CO2	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
CI AII	**CO3**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
	CO4	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.6**	**25**
	K2	2	10		12	**21.4**	
	K3		10	16	26	**46.4**	46.4
	K4			16	16	**28.6**	28.6
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.6**	**7.2**
	K2	2			2	**3.6**	
	K3		10	16	26	**46.4**	46.4
	K4		10	16	26	**46.4**	46.4
	Marks	**4**	**20**	**32**	**56**	**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	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
2	CO2	K1 – K4	2	K1,K2	2(K3,K3)	2(K3,K3)
3	CO3	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
4	CO4	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
5	CO5	K1 – K4	2	K1,K2	2(K4,K4)	2(K4,K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(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 (Either or Choice	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		20	48	68	48.6	48
K4		10	32	42	30.0	30
Marks	10	50	80	140	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

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K2**	
		OR		
13. b)	**Unit - III**	**CO3**	**K2**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K4**	
		OR		
15. b)	**Unit - V**	**CO5**	**K4**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K3**	
		OR		
16. b)	**Unit - I**	**CO1**	**K3**	
17. a)	**Unit - II**	**CO2**	**K3**	
		OR		
17. b)	**Unit - II**	**CO2**	**K3**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K4**	
		OR		
20. b)	**Unit - V**	**CO5**	**K4**	

Course Name	Complex Analysis			
Course Code	23UMTCC62	**L**	**P**	**C**
Category	Core	6	-	5

COURSE OBJECTIVES:

- Apply concept and consequences of analyticity and C-R equations.
- Understand the concept of mappings and transformations.
- Compute complex contour integrals and applying Cauchy's integral in various versions.
- Understand zeros and singularities of an analytic function, apply their properties in the evaluation of definite integral.

UNIT - I Analytic functions **18**

Functions of a Complex variable – Limits –Theorem on limits –Continuity – Derivatives – Differentiation formulas – Cauchy Riemann equation – conditions for differentiability – Polar coordinates– Analytic functions– Harmonic functions.

UNIT - II Conformal mapping **18**

Mappings – Mapping by exponential function – Linear transformation – The transformation $w = \frac{1}{z}$

- Mappings by $\frac{1}{z}$ - Linear fractional transformations (bilinear)

UNIT - III Complex Integration **18**

Contour integrals– Some examples – Simply and Multiply connected domains– Cauchy integral formula – Formula for derivatives– Liouville's theorem –Fundamental theorem of Algebra– Maximum modulus principle.

UNIT - IV Sequences and Series **18**

Convergence of sequences – Convergence of series– Taylor's series – Laurent series– Absolute and uniform convergence of power Series – Continuity of sums of power series–Integration & differentiation of power series

UNIT - V Residues and Improper integrals **18**

Isolated singular points – Residues– Cauchy Residue theorem – Residue at infinity – The three types of isolated singular points – Residues at poles – Zeros of analytical functions – Zeros and poles – Evaluation of real improper integrals (excluding poles on the real axis).

Total Lecture Hours **90**

BOOKS FOR STUDY:

Complex Analysis , Complex variables and application, Seventh Edition by James Ward Brown and Ruel V. Churchill, Mc-Graw Hill Book Co., International Edition, 2009.

Unit-1; Chapter-2
Unit-2: Chapter-8
Unit-3: Chapter-4
Unit-4: Chapter-5
Unit-5: Chapter-6 & Chapter-7 (Page no.251-259)

BOOKS FOR REFERENCES:

- Linear Algebra – Stephen H Friedberg, Arnold J Insel and Lawrence E Spence, 5th Edition 920180, Pearson.
- S. Ponnusamy and H. Silverman, Complex variables with applications, Birkhauser, 2006
- Theodore W. Gamelan, Complex Analysis, Springer Verlag, 2008
- Joseph Bak and Donald J. Newman, Complex analysis, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.
- P.Duraipandian & Kayalal Pachiyappa, S.Chand & Company PVT.LTD ,New Delhi, 2016

WEB RESOURCES:

- **https://nptel.ac.in**
- **https://faculty.etsu.edu/gardnerr/5337/notes.htm**
- **https://www.math.ucdavis.edu/~romik/data/uploads/notes/complex-analysis.pdf**

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED			ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		✓	GLOBAL		
Changes Made in the Course	Percentage of Change	**35%**		No Changes Made			New Course			

* Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Explain about analytic functions, their differentiation and continuity and to verify the Harmonic functions using analyticity conditions	**K1 to K4**
CO2	Explain the concept of Conformal mappings and mappings by linear transformations and linear fractional transformations	**K1 to K4**
CO3	Explain about the integrations of functions over simply and multiply connected domains and to derive the Cauchy integral formula, Liouvlle's theorem, Fundamental theorem of Algebra and Maximum Module Principle	**K1 to K4**
CO4	Find the convergence the sequences and series, to derive Taylor's and Laurent's series	**K1 to K4**
CO5	Find the nature of singularities, to find the residue of a given function at a given singular point, to Explain about zeros and poles and to evaluate real improper integrals (Excluding poles on the real axis)	**K1 to K4**

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	1	1				
CO2	3	3	3	2	1	1				
CO3	3	3	3	2	1	1				
CO4	3	3	3	2	1	1				
CO5	3	3	3	2	1	1				
3- STRONG				2 – MEDIUM					1 - LOW	

CO / PO MAPPING:					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	2		
CO 2	3	3	2		
CO 3	3	3	2		
CO 4	3	3	2		
CO 5	3	3	2		
WEIGHTAGE	15	15	10		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	3	3	2		

LESSON PLAN:

UNIT	Complex Analysis	HRS	PEDAGOGY
I	Functions of a Complex variable – Limits –Theorem on limits – Continuity – Derivatives – Differentiation formulas – Cauchy Riemann equation – conditions for differentiability – Polar coordinates– Analytic functions– Harmonic functions	18	Chalk & Talk, PPT
II	Mappings – Mapping by exponential function – Linear transformation – The transformation $w = \frac{1}{z}$ Mappings by $\frac{1}{z}$ - Linear fractional transformations (bilinear)	18	Chalk & Talk, PPT
III	Contour integrals– Some examples – Simply and Multiply connected domains– Cauchy integral formula – Formula for derivatives– Liouville's theorem –Fundamental theorem of Algebra– Maximum modulus principle.	18	Chalk & Talk, PPT
IV	Convergence of sequences – Convergence of series– Taylor's series – Laurent series– Absolute and uniform convergence of power Series – Continuity of sums of power series–Integration & differentiation of power series	18	Chalk & Talk, PPT
V	Isolated singular points – Residues– Cauchy Residue theorem – Residue at infinity – The three types of isolated singular points – Residues at poles – Zeros of analytical functions – Zeros and poles – Evaluation of real improper integrals (excluding poles on the real axis).	18	Seminar

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 Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
	CO2	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
CI AII	**CO3**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
	CO4	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.6**	**25**
	K2	2	10		12	**21.4**	
	K3		10	16	26	**46.4**	46.4
	K4			16	16	**28.6**	28.6
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.6**	**7.2**
	K2	2			2	**3.6**	
	K3		10	16	26	**46.4**	46.4
	K4		10	16	26	**46.4**	46.4
	Marks	**4**	**20**	**32**	**56**	**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	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 – K4	2	K1,K2	2(K2,K2)	2(K4,K4)
2	CO2	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
3	CO3	K1 – K4	2	K1,K2	2(K3,K3)	2(K3,K3)
4	CO4	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
5	CO5	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(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 (Either or Choice	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		30	32	62	44.3	44
K4			48	48	34.3	34
Marks	10	50	80	140	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

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K2**	
		OR		
12. b)	**Unit - II**	**CO2**	**K2**	
13. a)	**Unit - III**	**CO3**	**K3**	
		OR		
13. b)	**Unit - III**	**CO3**	**K3**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K4**	
		OR		
16. b)	**Unit - I**	**CO1**	**K4**	
17. a)	**Unit - II**	**CO2**	**K3**	
		OR		
17. b)	**Unit - II**	**CO2**	**K3**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K4**	
		OR		
20. b)	**Unit - V**	**CO5**	**K4**	

Course Name	Mechanics			
Course Code	23UMTCC63	**L**	**P**	**C**
Category	Core	5	-	4

COURSE OBJECTIVES:

- Understand the concepts of Newton's laws of Motion and equilibrium of a particle
- Explain the concepts of equivalent systems of forces, reduction of coplanar forces into force and couple.
- Discuss Conservative field of force, Simple Harmonic Motion along a horizontal and vertical line
- Analyze the concepts of Projectiles
- Understand central orbits and conic as a centered orbit

UNIT - I Force and Equilibrium of a Particle **15**

Force: Newton's laws of motion – Resultant of two forces on a particle - Equilibrium of a Particle: Equilibrium of a particle – Limiting equilibrium of a particle on an inclined plane

UNIT - II Forces on a Rigid Body and A Specific Reduction of Forces **15**

Forces On a rigid body: Moment of force – General motion of a body- equivalent systems of forces- Parallel forces- forces acting along a triangle- A specific reduction of forces-Reduction of forces . Reduction of coplanar forces into a force and couple.

UNIT - III Work, Energy and Power and Rectilinear Motion Under varying Force **15**

Work, Energy and Power: Work – Conservative field of force – Power -Rectilinear Motion under Varying Force: Simple Harmonic Motion - along a horizontal line – along a vertical line.

UNIT - IV Projectiles **15**

Projectiles: Forces on a projectile – Projectile projected on an inclined plane

UNIT - V Collision of Elastic Bodies **15**

Collision of Elastic Bodies – Impact of a fixed plane Direct impact of two spheres – oblique impact of two spheres. Loss of kinetic energy by impact.

Total Lecture Hours **75**

BOOKS FOR STUDY:

The Elements of Statics and Dynamics "S.L.LONEY", PART I , Statics

Unit I : **Chapter 1,2 (Page No. 1-22)**
Chapter 7 (Page No. 68-79)
Unit II : **Chapter 4,5,6 (Page No. 39-67)**

The Elements of Statics and Dynamics "S.L.LONEY", PART II, Dynamics

Unit III : **Chapter 6 (Page No. 76-92)**
Chapter 11 (Page No.147-156)
Unit IV : **Chapter 7 (Page No. 93-109)**
Unit V : **Chapter 8 (Page No. 110-126)**

REFERENCE BOOKS :

- J.L. Meriam and L. G. Kraige, **Engineering Mechanics: Statics**, Seventh Edition,Wiley and sons Pvt ltd., New York, 2012.
- J.L. Meriam, L. G. Kraige, and J.N. Bolton, **Engineering Mechanics: Dynamics**, 8thedn, Wiley and sons Pvt ltd., New York, 2015.
- A. K. Dhiman, P.Dhinam and D. Kulshreshtha, **Engineering Mechanics** (Statics and Dynamics),McGraw Hill Education(India) Private Limited, New Delhi, 2015.
- **Mechanics** - P.Duraipandian, Lakmi Duraipandian and Muthamizh Jayapragasam,, S.Chand and co. Private limited - Reprint 2016.

WEB RESOURCES :

- **https://nptel.ac.in**
- **https://www.researchgate.net/publication/322738790_Engineering_Mechanics_Statics_Lecture_Notes_Handwritten**
- **https://www.freebookcentre.net/physics-books-download/Lecture-Notes-on-the-Dynamics-of-Particles-and-Rigid-Bodies.html**

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED			ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL			NATIONAL		✓	GLOBAL	
Changes Made in the Course	Percentage of Change		**60%**	No Changes Made			New Course			

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Define Resultant, Component of a Force, Coplanar forces, like and unlike parallel forces, Equilibrium of a Particle, Limiting equilibrium of a particle on an inclined plane.	**K1 to K4**
CO2	Define Moment of a force and Couple with examples. Define Parallel Forces and Forces acting along a Triangle, Solve problems on frictional forces.	**K1 to K4**
CO3	Define work, energy, power, rectilinear motions under varying forces. Define Simple Harmonic Motion and find its Geometrical representation.	**K1 to K4**
CO4	Define Projectile, impulse, impact and laws of impact. Prove that the path of a Projectile is a parabola. Find the direct and oblique impact of smooth elastic spheres.	**K1 to K4**
CO5	Calculate the loss of kinetic energy of the colliding bodies in both direct and oblique impact.	**K1 to K4**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	1	1				
CO2	3	2	3	2	1	1				
CO3	3	2	3	2	1	1				
CO4	3	2	3	2	1	1				
CO5	3	2	3	2	1	1				

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	2		
CO 2	3	3	2		
CO 3	3	3	2		
CO 4	3	3	2		
CO 5	3	3	2		
WEIGHTAGE	15	15	10		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	3	3	2		

LESSON PLAN:

UNIT	Mechaincs	HRS	PEDAGOGY
I	Force: Newton's laws of motion – Resultant of two forces on a particle Equilibrium of a Particle: Equilibrium of a particle – Limiting equilibrium of a particle on an inclined plane	15	Chalk & Talk

II	Forces on a Rigid Body: Moment of a Force – General motion of a body – Equivalent systems of forces- Parallel Forces– Forces acting along a Triangle - A specific reduction of Forces: Reduction of coplanar forces into a force and couple – Problems involving frictional forces	**15**	**Chalk & Talk PPT**
III	Work, Energy and Power: Work – Conservative field of force – Power - Rectilinear Motion under Varying Force: Simple Harmonic Motion - along a horizontal line – along a vertical line.	**15**	**Chalk & Talk PPT**
IV	Projectiles: Forces on a projectile – Projectile projected on an inclined plane.	**15**	**PPT, SEMINAR**
V	Collision of Elastic Bodies – Impact of a fixed plane Direct impact of two spheres – oblique impact of two spheres. Loss of kinetic energy by impact.	**15**	**SEMINAR**

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 Either or Choice**	**Section C Either or Choice**
			MCQs			
			No. of. Questions	**K - Level**		
CI AI	**CO1**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
	CO2	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
CI AII	**CO3**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
	CO4	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.6**	**25**
	K2	2	10		12	**21.4**	
	K3		10	16	26	**46.4**	46.4
	K4			16	16	**28.6**	28.6
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.6**	**7.2**
	K2	2			2	**3.6**	
	K3		10	16	26	**46.4**	46.4
	K4		10	16	26	**46.4**	46.4
	Marks	**4**	**20**	**32**	**56**	**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**	**Section A (MCQs)**		**Section B (Either / or Choice) With K - LEVEL**	**Section C (Either / or Choice) With K - LEVEL**
			No. of Questions	**K – Level**		
1	**CO1**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
2	**CO2**	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
3	**CO3**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
4	**CO4**	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
5	**CO5**	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K3,K3)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(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 (Either or Choice**	**Section C (Either/ or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5			5	**3.6**	3
K2	5	20		25	**17.8**	18
K3		30	48	78	**55.7**	56
K4			32	32	**22.9**	23
Marks	**10**	**50**	**80**	**140**	**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

Q. No.	**Unit**	**CO**	**K-level**		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K2**	
		OR		
13. b)	**Unit - III**	**CO3**	**K2**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K3**	
		OR		
16. b)	**Unit - I**	**CO1**	**K3**	
17. a)	**Unit - II**	**CO2**	**K4**	
		OR		
17. b)	**Unit - II**	**CO2**	**K4**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K3**	
		OR		
20. b)	**Unit - V**	**CO5**	**K3**	

Course Name	Numerical Methods with Applications			
Course Code	23UMTEC61	L	P	C
Category	Elective	5	-	3

COURSE OBJECTIVES:

- To develop the skills in solving algebraic, transcendental, difference equations.
- To solve differential equations numerically.
- To solve integral equations numerically.
- To lay foundation of computational mathematics for post graduate courses.
- To learn theory and applications of numerical methods in a large number.

UNIT - I **15**

Solution of numerical, algebraic and transcendental equation: The bisection method – Iteration Method - Method of false position - Gauss elimination method – Gauss Jordan and Gauss Jacobi methods.

UNIT - II **15**

Finite differences – forward, backward and central differences – The operator E – Relation between E and the operator D and other difference operators – Differences of a polynomial – Factorial Polynomial

UNIT - III **15**

Interpolation - Newton's forward, backward interpolation formula – Gauss forward, backward formula – Stirling's formula – Divided difference - Lagrange's interpolation formula .

UNIT - IV **15**

Numerical differentiation – Newton's forward and backward difference formula – Maxima and minima of the function

UNIT - V **15**

Numerical Integration – Newton's Cote formula – Trapezoidal rule – Simpson's one third rule – Simpson's three eighth rule – Weddle's rule

Total Lecture Hours **75**

BOOKS FOR STUDY:

- Kandasamy, P. K. Thilagavathy, and K. Gunavathy - "**Numerical Methods**", S.Chand & Company Ltd., Edn. 2006.

  Unit I : Chapter 3 : 3.1, 3.3, 3.4,
  Chapter 4: 4.2, 4.7, 4.8,4.9
  Unit II : Chapter 5 : 5.1, 5.3- 5.4
  Unit III : Chapter 6.1-6.3, 7.3-7.5,8.2,8.7
  Unit IV : Chapter 9 :9.1- 9.3, 9.6
  Unit V : Chapter 9 : 9.7-9.9, 9.13-9.15

BOOKS FOR REFERENCES:

- Prasun KrNayak, **Numerical Analysis** (Theory and Application), Second Edition, Asian Books Private Limited, New Delhi,2012.
- S.S Sastry, **Introductory Methods of Numerical Analysis**, Third Edition, Prentice Hall of India Pvt Ltd, New Delhi,1998.

WEB RESOURCES:

- **https://nptel.ac.in/courses/122/102/122102009/**
- **https://nptel.ac.in/courses/111/107/111107105/**
- **https://www.mathcity.org/_media/msc/notes/numerical-analysis-m-usman-hamid.pdf**

Nature of Course	EMPLOYABILITY	✓	SKILL ORIENTED		ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL	✓	GLOBAL	
Changes Made in the Course	Percentage of Change	**10%**	No Changes Made		New Course			

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Solve transcendental equation by using various methods.	**K1 to K4**
CO2	Apply difference operators for equal and unequal intervals	**K1 to K4**
CO3	Construct the linear interpolation equations.	**K1 to K4**
CO4	Apply numerical differentiation for finding maximum and minimum of a function	**K1 to K4**
CO5	Analyse various rules in numerical integration	**K1 to K4**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	2	3	1				
CO2	3	3	2	2	2	1				
CO3	2	3	3	2	3	1				
CO4	3	3	2	2	2	1				
CO5	3	3	3	2	3	1				

3- STRONG	2 – MEDIUM	1 - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	2	1		
CO 2	3	2	1		
CO 3	3	2	1		
CO 4	3	2	1		
CO 5	3	2	1		
WEIGHTAGE	15	10	5		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	3	2	1		

LESSON PLAN:

UNIT	Numerical Methods with Applications	HRS	PEDAGOGY
I	Solution of numerical, algebraic and transcendental equation: The bisection method – Iteration Method - Method of false position - Gauss elimination method – Gauss Jordan and Gauss Jacobi methods.	15	Chalk & Talk
II	Finite differences – forward, backward and central differences – The operator E – Relation between E and the operator D and other difference operators – Differences of a polynomial – Factorial Polynomial.	15	Chalk & Talk, PPT
III	Interpolation - Newton's forward, backward interpolation formula – Gauss forward, backward formula – Stirling's formula – Divided difference - Lagrange's interpolation formula.	15	Chalk & Talk
IV	Numerical differentiation – Newton's forward and backward differenc formula – Maxima and minima of the function.	15	Chalk & Talk
V	Numerical Integration – Newton's Cote formula – Trapezoidal rule – Simpson's one third rule – Simpson's three eighth rule – Weddle's rule	15	Chalk & Talk Seminar

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 Either or Choice**	**Section C Either or Choice**
			No. of. Questions	**K - Level**		
CI	**CO1**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
AI	**CO2**	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
CI	**CO3**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
AII	**CO4**	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
Question Pattern CIA I & II		**No. of Questions to be asked**	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.6**	**25**
	K2	2	10		12	**21.4**	
	K3		10	16	26	**46.4**	46.4
	K4			16	16	**28.6**	28.6
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.6**	**7.2**
	K2	2			2	**3.6**	
	K3		10	16	26	**46.4**	46.4
	K4		10	16	26	**46.4**	46.4
	Marks	**4**	**20**	**32**	**56**	**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	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
2	CO2	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
3	CO3	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
4	CO4	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
5	CO5	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(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 (Either or Choice	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		30	32	62	44.3	44
K4			48	48	34.3	34
Marks	10	50	80	140	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

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K2**	
		OR		
13. b)	**Unit - III**	**CO3**	**K2**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K3**	
		OR		
16. b)	**Unit - I**	**CO1**	**K3**	
17. a)	**Unit - II**	**CO2**	**K4**	
		OR		
17. b)	**Unit - II**	**CO2**	**K4**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K4**	
		OR		
20. b)	**Unit - V**	**CO5**	**K4**	

Course Name	Discrete Mathematics			
Course Code	23UMTEC62	L	P	C
Category	Elective	5	-	3

COURSE OBJECTIVES:

- To learn logical connectives and prepositions
- To know about normal forms
- To apply rules of inference
- To understand about relations
- To know about lattices and Boolean algebra

UNIT - I Mathematical logic **15**

Propositions – Connectives – Conditional and Bi-conditional propositions – Tautology and Contradiction – Equivalence of propositions- Duality Law – Algebra of Proposition - Tautological implication.

UNIT - II Normal forms and Inference Theory **15**

Normal forms – Disjunctive normal form – Conjunctive normal forms – Principal Disjunctive normal form – Principal Conjunctive normal form- Theory of inference – Rules of inference (Quantifiers – Excluded).

UNIT - III Set Theory **15**

Relations – Types of Relations – Operations of relations ¬– Composition of relations – properties of relations – Equivalence classes – Partition of a set.

UNIT - IV Lattices **15**

Lattices – Principle of duality – Properties of lattices – Lattice as Algebraic system – Sub Lattices -Lattice Homomorphism.

UNIT - V Boolean Algebra **15**

Boolean Algebra – Additional Properties of Boolean Algebra – Dual and Principle of Duality – Subalgebra – Boolean Homomorphism – Logic Gates – Combination of Gates – Karnaugh Map Method.

Total Lecture Hours **75**

BOOKS FOR STUDY:

- T.Veerarajan, **Discrete Mathematics with Graph Theory and Combinatorics**, The Mc-Graw Hill Publishing company limited, New Delhi.

Unit I – Chapter 1(Page 1-8 & 10-15)

Unit II – Chapter 1 (Page 8-10, 15-30 & 35-40)

Unit III – Chapter 2 (Page 66-72 & 77-85) (Quantifiers - Excluded)

Unit IV – Chapter 2 (Page 96 - 101)& Problems

Unit V – Chapter 2 (Page 103 – 106, 110,111 & 114-116) & Problems

BOOKS FOR REFERENCES:

- Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata MCGraw Hill
- J. P. Trembly &Manohar, Discrete Mathematical Structures with applications to Computer science, 1st Edition, McGraw Hill Education, 2017.
- J K Sharma, Discrete Mathematics, Macmillan Publishers India Limited, 2004

WEB RESOURCES:

- **https://home.iitk.ac.in/~arlal/book/mth202.pdf**
- **https://www.tutorialspoint.com/discrete_mathematics/discrete_mathematics_tutorial.pdf**
- **https://archive.nptel.ac.in/courses/111/107/111107058/**

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED		ENTREPRENEURSHIP				
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL	✓	GLOBAL			
Changes Made in the Course	Percentage of Change		**40%**	No Changes Made		New Course				

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Discuss various connectives of logics	**K1 to K4**
CO2	Prepare the PDNF and PCNF for the logic statements	**K1 to K4**
CO3	Analyze the theory of inference in logical statements	**K1 to K4**
CO4	Classify the relations between the set of elements.	**K1 to K4**
CO5	Explain lattice and Boolean algebra concepts	**K1 to K4**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	1	1				
CO2	3	3	2	2	2	2				
CO3	3	3	3	3	2	2				

CO4	3	3	3	2	2	3				
CO5	3	3	3	2	2	3				

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	2	1		
CO 2	3	2	1		
CO 3	3	2	1		
CO 4	3	2	1		
CO 5	3	2	1		
WEIGHTAGE	15	10	5		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	3	2	1		

LESSON PLAN:

UNIT	Discrete Mathematics	HRS	PEDAGOGY
I	Propositions – Connectives – Conditional and Bi-conditional propositions – Tautology and Contradiction – Equivalence of propositions- Duality Law – Algebra of Proposition - Tautological implication.	15	Chalk & Talk
II	Normal forms – Disjunctive normal form – Conjunctive normal forms – Principal Disjunctive normal form – Principal Conjunctive normal form- Theory of inference – Rules of inference (Quantifiers – Excluded).	15	Chalk & Talk
III	Relations – Types of Relations – Operations of relations ¬– Composition of relations – properties of relations – Equivalence classes – Partition of a set.	15	Chalk & Talk
IV	Lattices – Principle of duality – Properties of lattices – Lattice as Algebraic system – Sub Lattices -Lattice Homomorphism.	15	Chalk & Talk
V	Boolean Algebra – Additional Properties of Boolean Algebra – Dual and Principle of Duality – Subalgebra – Boolean Homomorphism – Logic Gates – Combination of Gates – Karnaugh Map Method.	15	Chalk & Talk

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 Either or Choice**	**Section C Either or Choice**
			No. of. Questions	**K - Level**		
CI	**CO1**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
AI	**CO2**	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
CI	**CO3**	**K1 – K4**	2	K1,K2	2(K2,K2)	2(K3,K3)
AII	**CO4**	**K1 – K4**	2	K1,K2	2(K3,K3)	2(K4,K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Either / Or Choice)**	**Section C (Either / Or Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2			2	**3.6**	**25**
	K2	2	10		12	**21.4**	
	K3		10	16	26	**46.4**	46.4
	K4			16	16	**28.6**	28.6
	Marks	**4**	**20**	**32**	**56**	**100**	**100**
CIA II	**K1**	2			2	**3.6**	**7.2**
	K2	2			2	**3.6**	
	K3		10	16	26	**46.4**	46.4
	K4		10	16	26	**46.4**	46.4
	Marks	**4**	**20**	**32**	**56**	**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	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1 – K4	2	K1,K2	2(K2,K2)	2(K4,K4)
2	CO2	K1 – K4	2	K1,K2	2(K3,K3)	2(K3,K3)
3	CO3	K1 – K4	2	K1,K2	2(K2,K2)	2(K3,K3)
4	CO4	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
5	CO5	K1 – K4	2	K1,K2	2(K3,K3)	2(K4,K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(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 (Either or Choice	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		30	32	62	44.3	44
K4			48	48	34.3	34
Marks	10	50	80	140	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

Q. No.	Unit	CO	K-level		
Answer **ALL** the questions				**PART – A**	**(10 x 1 = 10 Marks)**
1.	**Unit - I**	**CO1**	**K1**		
				a)	b)
				c)	d)
2.	**Unit - I**	**CO1**	**K2**		
				a)	b)
				c)	d)
3.	**Unit - II**	**CO2**	**K1**		
				a)	b)
				c)	d)
4.	**Unit - II**	**CO2**	**K2**		
				a)	b)
				c)	d)
5.	**Unit - III**	**CO3**	**K1**		
				a)	b)
				c)	d)
6.	**Unit - III**	**CO3**	**K2**		
				a)	b)
				c)	d)
7.	**Unit - IV**	**CO4**	**K1**		
				a)	b)
				c)	d)
8.	**Unit - IV**	**CO4**	**K2**		
				a)	b)
				c)	d)
9.	**Unit - V**	**CO5**	**K1**		
				a)	b)
				c)	d)
10.	**Unit - V**	**CO5**	**K2**		
				a)	b)
				c)	d)

Answer **ALL** the questions		**PART – B**		**(5 x 5 = 25 Marks)**
11. a)	**Unit - I**	**CO1**	**K2**	
		OR		
11. b)	**Unit - I**	**CO1**	**K2**	
12. a)	**Unit - II**	**CO2**	**K3**	
		OR		
12. b)	**Unit - II**	**CO2**	**K3**	
13. a)	**Unit - III**	**CO3**	**K2**	
		OR		
13. b)	**Unit - III**	**CO3**	**K2**	
14. a)	**Unit - IV**	**CO4**	**K3**	
		OR		
14. b)	**Unit - IV**	**CO4**	**K3**	
15. a)	**Unit - V**	**CO5**	**K3**	
		OR		
15. b)	**Unit - V**	**CO5**	**K3**	

Answer **ALL** the questions		**PART – C**		**(5 x 8 = 40 Marks)**
16. a)	**Unit - I**	**CO1**	**K4**	
		OR		
16. b)	**Unit - I**	**CO1**	**K4**	
17. a)	**Unit - II**	**CO2**	**K3**	
		OR		
17. b)	**Unit - II**	**CO2**	**K3**	
18. a)	**Unit - III**	**CO3**	**K3**	
		OR		
18. b)	**Unit - III**	**CO3**	**K3**	
19. a)	**Unit - IV**	**CO4**	**K4**	
		OR		
19. b)	**Unit - IV**	**CO4**	**K4**	
20. a)	**Unit - V**	**CO5**	**K4**	
		OR		
20. b)	**Unit - V**	**CO5**	**K4**	

Course Name	R Language - Lab			
Course Code	23UMTSP61	**L**	**P**	**C**
Category	Skill	-	4	2

COURSE OBJECTIVES:

- To Install and use R for simple programming
- To Exercise the fundamentals of statistical analysis in R environment
- To analyse data for the purpose of exploration using Descriptive and Inferential Statistics
- To visualize data in R .
- To develop program in R

List of Programs:

1. Write a program to find list of even numbers from 1 to n using R-Loops.
2. Write a program to find mean and standard deviation.
3. Write a program to find factorial of a given number.
4. Write a program to find the sum of the first 100 natural numbers.
5. Write a program to add and multiply two matrices.
6. Write a program to create a function to print squares of numbers in sequence.
7. Write a program to join columns and rows in a data frame using cbind() and rbind() in R.
8. Write a program to implement different String Manipulation functions in R.
9. Write a program to implement different data structures in R (Vectors, Lists, Data Frames)
10. Conducting a hypothesis test for the variance of a population using the chi-square distribution.
11. Conducting a hypothesis test for the difference between two variances using the Fdistribution.
12. Perform t – test for equality of mean.
13. Write a program to read a csv file and analyze the data in the file in R.
14. Create pie chart and bar chart using R.
15. Create a data set and do statistical analysis on the data using R.

BOOKS FOR STUDY:

- 1. Norman Matloff, The Art of R Programming, UC Davis 2009
- 2. R for Everyone, Lander, Pearson.

BOOKS FOR REFERENCES:

- 1. Paul Murrell, R Graphics, Chapman & Hall/CRC, 2006
- 2. Gardener, M. Beginning R: The statistical programming language, 2017, WILEY.
- 3. Lawrence, M., & Verzani, J. Programming Graphical User Interfaces in R, 2016,CRC Press.

WEB RESOURCES:

- **https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf**
- **https://onlinecourses.nptel.ac.in/noc19_ma33/preview**
- **https://onlinecourses.nptel.ac.in/noc21_ma75/preview**
- **https://www.tutorialspoint.com/r/r_tutorial.pdf**
- **FULL R PROGRAMMING METERIAL_2.pdf (stmarysguntur.com)**
- **https://www.jnec.org/labmanuals/it/te/sem1/R-lab.pdf**
- **https://www.r-project.org**
- **https://www.slideshare.net/GRajendra/r-programming-lab-manual**

Nature of Course	EMPLOYABILITY		SKILL ORIENTED	✓	ENTREPRENEURSHIP			
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change	**20%**	No Changes Made		New Course			

* Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.

COURSE OUTCOMES:		**K LEVEL**
After studying this course, the students will be able to:		
CO1	Use R software for simple programming	**K1 to K4**
CO2	Manipulate data in efficient way using appropriate techniques	**K1 to K4**
CO3	Develop programs using add-on packages	**K1 to K4**
CO4	Analyze data sets using R – programming capabilities	**K1 to K4**
CO5	Use R Graphics to visualize the result obtained from statistical operations	**K1 to K4**

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	2	2				
CO2	3	2	3	2	1	2				
CO3	3	2	3	2	2	2				
CO4	3	2	2	2	1	2				
CO5	3	2	2	2	2	2				

3- STRONG **2 – MEDIUM** **1 - LOW**

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	2	2		
CO 2	3	2	2		
CO 3	3	2	2		
CO 4	3	2	2		
CO 5	3	2	2		
WEIGHTAGE	15	10	10		
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	3	2	2		

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)							
Internal	**Cos**	**K Level**	**Syntax & Semantics**	**Programming principles**	**Concept Applications**	**Coding& Implementation**	**Debugging & Output**
CIA	**CO1**	**K1**	**5**				
	CO2	**K3**		**5**			
	CO3	**K4**			**5**		
	CO4	**K4**				**5**	
	CO5	**K2-K4**					**5**
Question Pattern CIA		No. of Questions to be asked	**2**	**2**	**2**	**2**	**2**
		No. of Questions to be answered	**2**	**2**	**2**	**2**	**2**
		Marks for each question	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
		Total Marks for each section	**5**	**5**	**5**	**5**	**5**

Distribution of Marks with K Level CIA									
	K Level	**Syntax & Semantics**	**Programming principles**	**Concept Applications**	**Coding**	**Debugging & Output**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
CIA	**K1**	5					**5**	**20**	**20**
	K2		5				**5**	**20**	**20**
	K3			5			5	20	20
	K4				5	5	10	20	20
	Marks	**5**	**5**	**5**	**5**	**5**	**25**	**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

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)							
S. No.	**Cos**	**K Level**	**Syntax & Semantics**	**Programming principles**	**Concept Applications**	**Coding& Implementation**	**Debugging & Output**
1	CO1	**K1**	**15**				
2	CO2	**K2**		**15**			
3	CO3	**K3**			**15**		
4	CO4	**K4**				**15**	
5	CO5	**K4**					**15**
No. of Questions to be Asked			**2**	**2**	**2**	**2**	**2**
No. of Questions to be answered			**2**	**2**	**2**	**2**	**2**
Marks for each question			**7.5**	**7.5**	**7.5**	**7.5**	**7.5**
Total Marks for each section			**15**	**15**	**15**	**15**	**15**

Distribution of Marks with K Level								
K Level	**Syntax & Semantics**	**Programming principles**	**Concept Applications**	**Coding**	**Debugging & Output**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	15					**15**	**20**	**20**
K2		15				**15**	**20**	**20**
K3			15			15	20	20
K4				15	15	30	40	40
Marks	**6**	**9**	**15**	**15**	**30**	**75**	**100**	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.								