SACRED HEART COLLEGE (AUTONOMOUS)

Department of Mathematics

M.Sc. Mathematics

Course plan

Academic Year 2018 – 19

Semester 1

	Programme Outcome
PO 1	Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability.
PO 2	Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and to the society at large.
PO 3	Make choices based on the values upheld by the institution, and have the readiness and know-how to preserve the environment and work towards sustainable growth and development.
PO 4	Develop an ethical view of life and have a broader (global) perspective transcending the provincial outlook.
PO5	Explore new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process.

PROGRAMME SPECIFIC OUTCOMES	
PSO1	Assimilate and analyse advanced concepts in Mathematics.
PSO2	Develop problem-solving skills and apply them independently to solve problems in pure and applied mathematics.
PSO3	Develop skills to mathematically model real-time problems and apply mathematical tools to solve them.
PSO4	Inculcate an aptitude for research.

PROGRAMME	**M.Sc. MATEMATICS**	**SEMESTER**	**1**
COURSE CODE AND TITLE	**16P1MATT01: LINEAR ALGEBRA**	**CREDIT**	**4**
HOURS/WEEK	**4**	**HOURS/SEM**	**72**
FACULTY NAME	**Dr. DIDIMOS K. V.**		

CO	CO STATEMENT	PO/PSO	CL	KC	CLASS HRS.	LAB HRS.
CO1	Recalling vector spaces, subspaces, basis and dimension and understanding coordinates and summary of row equivalence.	PO1/PSO 1	U	C	12	0
CO2	Understanding linear transformations their algebra and representation of transformations by matrices.	PO1/PSO 1	U	C	25	0
CO3	Assimilate ideas of canonical forms, characteristic values and annihilating polynomials.	PO1/PSO 1	U	C	15	0
CO4	Developing ideas of simultaneous triangulation and diagonalisation and direct sum decomposition.	PO1/PSO 1	U	C	23	0

CO -PO/PSO Mapping

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

Mapping Strength

0- No Mapping strength
1- Low
2- Medium
3- High

Sessions	Topic	Method	COURSE OUTCOME
1	Vector spaces	Lecture, Group Discussion, Problem Solving	CO1
2	Vector spaces	Lecture, Group Discussion, Problem Solving	CO1
3	Subspaces	Lecture, Problem Solving	CO1
4	Subspaces	Lecture, Group Discussion, Problem Solving	CO1
5	Basis	Lecture, Group Discussion, Problem Solving	CO1
6	Dimension	Lecture	CO1
7	Co-ordinates	Lecture, Group Discussion, Problem Solving	CO1
8	Co-ordinates	Lecture, Group Discussion, Problem Solving	CO1
9	Summary of row-equivalence	Lecture, Group Discussion, Problem Solving	CO1
10	Summary of row-equivalence	Lecture, Group Discussion, Problem Solving	CO1
11	Summary of row-equivalence	Lecture, Group Discussion, Problem Solving	CO1
12	Summary of row-equivalence	Lecture, Group Discussion, Problem Solving	CO1
13	Linear transformations	Lecture, Group Discussion, Problem Solving	CO2
14	Linear transformations	Lecture, Group Discussion, Problem Solving	CO2
15	The algebra of linear transformations	Lecture, Group Discussion, Problem Solving	CO2
16	The algebra of linear transformations	Lecture, Group Discussion, Problem Solving	CO2
17	The algebra of linear	Lecture, Group Discussion,	CO2

	transformations	Problem Solving	
18	The algebra of linear transformations	Lecture, Group Discussion, Problem Solving	CO2
19	Isomorphism	Lecture, Group Discussion, Problem Solving	CO2
20	Isomorphism	Lecture, Group Discussion, Problem Solving	CO2
21	Representation of transformations by matrices	Lecture, Group Discussion, Problem Solving	CO2
22	Representation of transformations by matrices	Lecture, Group Discussion, Problem Solving	CO2
23	Representation of transformations by matrices	Lecture, Group Discussion, Problem Solving	CO2
24	Representation of transformations by matrices	Lecture, Group Discussion, Problem Solving	CO2
25	Representation of transformations by matrices	Lecture, Group Discussion, Problem Solving	CO2
26	Linear functionals	Lecture, Group Discussion, Problem Solving	CO2
27	Linear functionals	Lecture, Group Discussion, Problem Solving	CO2
28	Linear functionals	Lecture, Group Discussion, Problem Solving	CO2
29	Linear functionals	Lecture, Group Discussion, Problem Solving	CO2
30	Linear functionals	Lecture, Group Discussion, Problem Solving	CO2
31	Double dual	Lecture, Group Discussion, Problem Solving	CO2

32	Double dual	Lecture, Group Discussion, Problem Solving	CO2
33	Double dual	Lecture, Group Discussion, Problem Solving	CO2
34	Double dual	Lecture, Group Discussion, Problem Solving	CO2
35	Transpose of a linear transformation.	Lecture, Group Discussion, Problem Solving	CO2
36	Transpose of a linear transformation.	Lecture, Group Discussion, Problem Solving	CO2
37	Transpose of a linear transformation.	Lecture, Group Discussion, Problem Solving	CO2
38	Commutative Rings	Lecture, Group Discussion, Problem Solving	CO3
39	Commutative Rings	Lecture, Group Discussion, Problem Solving	CO3
40	Determinant functions	Lecture, Group Discussion, Problem Solving	CO3
41	Permutation	Lecture, Group Discussion, Problem Solving	CO3
42	Permutation	Lecture, Group Discussion, Problem Solving	CO3
43	Permutation	Lecture, Group Discussion, Problem Solving	CO3
44	Permutation	Lecture, Group Discussion, Problem Solving	CO3
45	Uniqueness of determinants	Lecture, Group Discussion, Problem Solving	CO3

46	Uniqueness of determinants	Lecture, Group Discussion, Problem Solving	CO3
47	Uniqueness of determinants	Lecture, Group Discussion, Problem Solving	CO3
48	Uniqueness of determinants	Lecture, Group Discussion, Problem Solving	CO3
49	Uniqueness of determinants	Lecture, Group Discussion, Problem Solving	CO3
50	Additional properties of determinants	Lecture, Group Discussion, Problem Solving	CO3
51	Additional properties of determinants	Lecture, Group Discussion, Problem Solving	CO3
52	Additional properties of determinants	Lecture, Group Discussion, Problem Solving	CO3
53	Introduction to elementary canonical forms	Lecture, Group Discussion, Problem Solving	CO4
54	Characteristic values	Lecture, Group Discussion, Problem Solving	CO4
55	Characteristic values	Lecture, Group Discussion, Problem Solving	CO4
56	Characteristic values	Lecture, Group Discussion, Problem Solving	CO4
57	Annihilating polynomials	Lecture, Group Discussion, Problem Solving	CO4
58	Annihilating polynomials	Lecture, Group Discussion, Problem Solving	CO4
59	Annihilating polynomials	Lecture, Group Discussion, Problem Solving	CO4
60	Annihilating polynomials	Lecture, Group Discussion, Problem Solving	CO4

61	Invariant subspaces	Lecture, Group Discussion, Problem Solving	CO4
62	Invariant subspaces	Lecture, Group Discussion, Problem Solving	CO4
63	Simultaneous triangulations	Lecture, Group Discussion, Problem Solving	CO4
64	Simultaneous triangulations	Lecture, Group Discussion, Problem Solving	CO4
65	Simultaneous diagonalization	Lecture, Group Discussion, Problem Solving	CO4
66	Simultaneous diagonalization	Lecture, Group Discussion, Problem Solving	CO4
67	Simultaneous diagonalization	Lecture, Group Discussion, Problem Solving	CO4
68	Direct sum decompositions	Lecture, Group Discussion, Problem Solving	CO4
69	Direct sum decompositions	Lecture, Group Discussion, Problem Solving	CO4
70	Direct sum decompositions	Lecture, Group Discussion, Problem Solving	CO4
71	Invariant direct sums	Lecture, Group Discussion, Problem Solving	CO4
72	Invariant direct sums	Lecture, Group Discussion, Problem Solving	CO4
73	Revision	Group Discussion, Problem Solving	CO1/CO2 CO3/CO4
74	Revision	Group Discussion, Problem Solving	CO1/CO2 CO3/CO4
75	Revision	Group Discussion, Problem Solving	CO1/CO2 CO3/CO4

ASSIGNMENTS/EXERCISES – DETAILS & GUIDELINES

	Date of submission/completion	**Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc.)**	**Course Outcome**
1.	12 September 2018	oblems on the applications of ear transformation	CO2/CO4

REFERENCES

- Klaus Jonich. Linear Algebra, Springer Verlag.
- Paul R. Halmos, Linear Algebra Problem Book, The Mathematical Association of America.
- Kenneth Hoffman / Ray Kunze (Second Edition), Linear Algebra, Prentice-Hall of India Pvt. Ltd., New Delhi, 1992.

PROGRAMME	**MSC MATHEMATICS**	**SEMESTER**	**1**
COURSE CODE AND TITLE	**16P1MATT02: BASIC TOPOLOGY**	**CREDIT**	**4**
HOURS/WEEK	**5**	**HOURS/SEM**	**75**
FACULTY NAME	**JEENU KURIAN**		

CO	**CO STATEMENT**	**PO/ PSO**	**CL**	**KC**	**CLASS HRS**
CO1	Analyse the concept of Topological spaces, base and subbase.	PO1/PSO1	U	C	21
CO2	Apply the concept of continuity and quotient spaces on different topology.	PO1/PSO1	U	C	18
CO3	Understand the concept of local connectedness and path connected.	PO1/PSO1	U	C	18
CO4	Differentiate levels of spaces based on axioms.	PO1/PSO1	U	C	18

CO -PO/PSO Mapping

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

Mapping Strength

0- No Mapping strength
1- Low
2- Medium
3- High

SESSIONS	TOPIC	METHOD	COURSE OUTCOME
1.	Introductory Session – sets, functions and logics.	Lecture	CO1
2.	Introductory session - metric spaces and open balls.	Lecture	CO1
MODULE 1			
3	Examples of topological spaces	Lecture	CO1
4.	Examples of topological spaces	Lecture	CO1
5.	Different types of topological spaces.	Lecturing	CO1
6.	Convergence of sequence in spaces	Lecturing	CO1
7.	Convergence of sequence in spaces	Lecture,	CO1
8.	Problems on convergence and countability	Lecturing	CO1
9.	Introducing base of a topological spaces	Lecturing	CO1
10.	Theorems and properties on base	Lecture	CO1
11.	Axiom of second countability and theorems	Lecturing	CO1
12.	Subbase and their properties	Lecture	CO1
13.	Sub spaces	Lecturing	CO1
14.	theorems on subspaces	Lecture,	CO1
15.	Problems on base and subbase	Lecture, Group Discussion, Problem Solving	CO1
16.	Open, closed and clopen sets	Lecture, Group Discussion, Problem Solving	CO1

17.	Neighbourhood, interior points, accumulation points and closure axiom.	Lecture, Group Discussion, Problem Solving	CO1
18.	Prepositions on Neighbourhood, interior points, accumulation points and closure axiom.	Lecture, Group Discussion, Problem Solving	CO1
19.	Theorems on Neighbourhood, interior points, accumulation points and closure axiom.	Lecture	CO1
20.	Problems on topological spaces	Lecture, Group Discussion, Problem Solving	CO1
21.	Problems on open and closed sets	Lecture, Group Discussion, Problem Solving	CO1
MODULE 2			
23.	Continuity and related concepts	Lecture, Group Discussion, Problem Solving	CO2
24.	Continuity and related concepts	Lecture, Group Discussion, Problem Solving	CO2
24.	Propositions on continuity	Lecture	CO2
25.	Theorems on continuity	Lecture	CO2
26.	Projection maps	Lecture, Group Discussion, Problem Solving	CO2
27.	Theorems on projection map	Lecture,	CO2
28.	Homeomorphism introduction	Lecture, Group Discussion, Problem Solving	CO2
29.	Embedding introduction	Lecture	CO2
30.	Making functions continuous	Lecture, Group Discussion, Problem Solving	CO2
31.	Quotient space	Lecturing	CO2
32.	prepositions	Lecturing	CO2
33.	Spaces with special properties	Lecturing	CO2
34.	Lebesgue covering Lemma	Lecture	CO2
35.	Concepts of Separable, first countable, hereditary	Lecturing	CO2
36.	Theorems on second countable space	Lecture	CO2

37.	Theorems on first countable space	Lecture	CO2
38.	Hereditary property of space	Lecture	CO2
39.	Problems	Lecture, Group Discussion, Problem Solving	CO2
40.	Problems	Problem Solving	CO2
41.	Module3 – Introduction	Lecture,	CO3
42.	Concept of connectedness	Lecture	CO3
43.	Examples of connectedness	Lecture, Group Discussion, Problem Solving	CO3
44.	Theorems on connectedness	Lecture	CO3
45.	Propositions	Lecture	CO3
46.	Theorems and Propositions	Lecture,	CO3
47.	Components and maximally connected sets	Lecture,	CO3
48.	Theorems	Lecture,	CO3
49.	Local connectedness - introduction	Lecture,	CO3
50.	Examples of local connectedness	Lecture, Group Discussion, Problem Solving	CO3
51.	Theorems of local connected space	Lecture,	CO3
52.	Path connectedness - introduction	Lecture,	CO3
53.	Examples of path connectedness	Lecture, Group Discussion, Problem Solving	CO3
54.	Theorems of path connected space	Lecture,	CO3
55.	Comparative study between spaces	Lecture,	CO3
56.	Comparative study between spaces	Lecture,	CO3
57.	Problems solving	Lecture, Group Discussion, Problem Solving	CO3
58.	Problems solving	Lecture, Group Discussion, Problem Solving	CO3
59.	Problems solving	Lecture, Group Discussion, Problem Solving	CO3
MODULE 4 - INTRODUCTION			

61.	Basic definitions examples on separation axioms	Lecture	CO4
62.	Basic definitions examples on separation axioms	Lecture	CO4
62.	Theorems and proposition	Lecture	CO4
63.	Theorems and proposition	Lecture	CO4
64.	Theorems and proposition	Lecture	CO4
65.	Theorems and proposition	Lecture	CO4
66.	Compactness and separation axioms	Lecture	CO4
67.	Theorems and proposition	Lecture	CO4
68.	Theorems and proposition	Lecture	CO4
69.	Problem solving session	Lecture, Group Discussion, Problem Solving	CO4
70.	Problem solving session	Lecture, Group Discussion, Problem Solving	CO4
71.	Problem solving session	Lecture, Group Discussion, Problem Solving	CO4
72.	Problem solving session	Lecture, Group Discussion, Problem Solving	CO4
73.	Problem solving session	Lecture, Group Discussion, Problem Solving	CO4
74.	Problem solving session	Lecture, Group Discussion, Problem Solving	CO4
75.	Problem solving session	Lecture, Group Discussion, Problem Solving	CO4

INDIVIDUAL ASSIGNMENTS/SEMINAR – DETAILS & GUIDELINES

	DATE OF COMPLETION	**TOPIC OF ASSIGNMENT & NATURE OF ASSIGNMENT (INDIVIDUAL/GROUP – WRITTEN/PRESENTATION – GRADED OR NON-GRADED ETC)**	**COURSE OUTCOME**
1	31-07-2018	Assisgnment on basic concepts of topology and continuity	CO1, CO2
2	25^{th} to 29^{th} Sep	Seminar on theorems and problems in Separation Axioms	CO4

REFERENCES:

- Munkers J.R, Topology – A first course, Prentice Hall of India Pvt.Ltd., New Delhi, 2000.
- J.L.Kelly, General Topology.Van Nostrand, Reinhold Co.,NewYork, 1995.
- Stephen Willard, General Topology,Addison – Wesley.
- Dugundji, Topology, Universal Book Stall, New Delhi.
- George F Simmons, introduction to Topology and Modern Analysis, Mc Graw-Hill Book Company, 1963.

PROGRAMME	MSC MATHEMATICS	SEMESTER	1
COURSE CODE AND TITLE	16P1MATT03: MEASURE THEORY AND INTEGRATION	CREDITS	4
HOURS/WEEK	4	HOURS/SEM	75
FACULTY NAME	PROF. M P SEBASTIAN		

	COURSE OUTCOMES	PO/ PSO	CL
CO1	Understand the basics of Measure theory.	PO1/PSO1	U
CO2	Apply Measure theory in the other disciplines.	PO1/PSO1	U
CO3	Apply Measure theory for Integration with respect to an arbitrary measure.	PO1/PSO1	U
CO4	Understand the importance of Measure theory in the study of Real and Complex analysis.	PO1/PSO1	U
CO5	Apply measure theory in probability.	PO1/PSO1	U
CO6	Apply measure theory in the study of L^Pspaces.	PO1/PSO1	U

CO -PO/PSO Mapping

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

Mapping Strength

0- No Mapping strength
1- Low
2- Medium
3- High

SL. NO	NO. OF SESSIONS/HRS	TOPICS TO BE TAUGHT	METHOD OF TEACHING	VALUE ADDITION	CO
1	2	Fundamentals of real analysis.	Lecture, assignment, seminar.	Q & A Session	CO3
2.	2	Lebesgue Measure and its properties.	Lecture, assignment.		CO1,CO3
3	2	Problems based on Lebesgue Measure.	Lecture.		CO1 , CO3
4	2	Leabesgue measurable sets.	Lecture.		CO1,CO3
5	2	Lebesgue Measure and its properties.	Lecture, assignment.		CO1, CO2
6	1	Problems based on Lebesgue Measure.	Lecture, Seminar.		CO1,CO2
7	1	Example of a non- measurable set.	Lecture.		CO1, CO2, CO4

8	2	Measurable Functions and its properties.	Lecture.		CO1 , CO3 , CO4
9	2	Problems based on Measurable Functions.	Lecture.		CO1 ,CO3
10	2	Riemann integral, Examples.	Lecture		CO1, CO3
11	2	Riemann integral, Examples.	Lecture		CO1, CO3
12	2	Lebesgue integral of a simple function, properties.	Lecture, assignment.		CO1, CO2 ,CO3
13	2	Lebesgue integral of a bounded measurable function over a measurable set of finite measure, properties.	Lecture, assignment.		CO1, CO2 ,CO3
14	2	Lebesgue integral and Riemann integral.	Lecture.		CO1 ,CO2
15	1	Bounded convergence theorem.	Lecture.		CO2, CO3 ,CO4
16	1	Integral of a non-negative measurable function.	Lecture.	Quiz	CO2, CO3, CO4
First internal					
17 - 18	1	Fatous Lemma.	Lecture.	Q & A Session	CO2 , CO3
19	1	Monotone convergence theorem.	Seminar.		CO2,CO3, CO4
20	3	Integrability of non- negative measurable function and related propositions.	Lecture, seminar.		CO2, CO3
21	2	Problems based on integral of non-negative functions.	Lecture, seminar, assignment.		CO2 ,CO3,CO4
22	2	General Lebesgue integral and its properties.	Seminar.		CO2 , CO3
23	2	Lebesgue convergence	Lecture ,		CO2, CO3

		theorem and its general version.	seminar		
24	2	Problems based on the general integral.	Lecture.		CO2, CO3
25	1	**Test paper on module -2**			
26	2	Introduction of abstract measurable space and measure space.	Lecture		CO1, CO2, CO4
27	1	Propositions, finite and sigma finite measure spaces	Lecture, seminar.		CO1, CO2, CO3
28	1	Set of finite measure, a set of sigma finite measure, complete measure.	Lecture , seminar		CO2 , CO3
29	2	Measurable functions and its properties, problems.	Lecture		CO1 ,CO3
30	2	Integral of a non-negative simple function with respect to a measure, properties.	Lecture, assignment.		CO1, CO2 , CO3
31	2	Integral of a non-negative measurable function with respect to a measure, properties.	Lecture, assignment.		CO1 , CO3
32	2	Fatous Lemma.	Lecture.		CO1, CO3
33	3	Monotone convergence theorem, followed by two propositions.	Lecture, seminar.		CO1 , CO3
34	2	Lebegue convergence theorem and problems.	Lecture.		CO1 , CO3
35	2	General convergence theorem.	Lecture, seminar.		CO1, CO2, CO3
36	1	Signed measure, positive set, negative set, null set followed by two lemmas.	Lecture.		Co1 , co3
37	1	Hahn decomposition theorem.	Lecture, seminar assignment.		CO1, CO2 ,CO3
38	1	Jordan decomposition theorem.	Lecture, assignment.		CO1 , CO3
39	2	Problems based on Hahn and Jordan decomposition theorems.	Lecture, seminar.		CO1 CO3, CO4
40		**TEST PAPER -3**			
41	2	Cartesian product, rectangle, measurable rectangle, elementary sets, problems.	Lecture, seminar.		CO1 , CO2 , CO3
42	2	**T**he class of all elementary sets is an algebra.	Lecture.		CO1, CO2, CO3

42	1	Product space, product measure.	Lecture.		CO1 , CO2 , CO3
43	1	X-section and y- section of set and their measurability.	Lecture, seminar.		CO1 ,CO3
44	2	X-section and y-section of a set and their measurability.	Lecture, assignment.		CO1,CO2,CO3
45	2	Integral of a non-negative measurable function w.r.t. product measure and related theorems.	Lecture.		CO1 , CO2 CO3
46	1	Fubinis theorem and examples	Lecture , seminar		CO1,CO2, CO3
47	1	Model Examination			
	Total = 75 hours				

INDIVIDUAL ASSIGNMENTS/SEMINAR – DETAILS & GUIDELINES

	Date of completion	**Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc.)**	**Course Outcome**
1	26-07-2018	Assignment - problems from module-1	CO1, CO2
2	21th to 25th Sep	Seminar on topics from module 4	CO3

COURSE- 4

PROGRAMME	**MSC MATHEMATICS**	**SEMESTER**	**1**
COURSE CODE AND TITLE	**16P1MATT04: ORDINARY DIFFERENTIAL EQUATION**	**CREDITS**	**4**
HOURS/WEEK	**4**	**HOURS/SEM**	**75**
FACULTY NAME	**APARNA V**		

	COURSE OUTCOMES	**PO/ PSO**	**CL**
CO1	Explain the basic theory of linear systems and its solution	PO1/PSO1	U
CO2	Understand the concept of power series solution	PO1/PSO1	U
CO3	Understand the Picard's existence theorem	PO1/PSO1	U
CO4	Understanding the concept of Strum Liouville problem and methods of solving it	PO1/PSO1	U
CO5	Introduce the concept of Laplace transforms and techniques of solving it	PO1/PSO1	U

CO -PO/PSO Mapping

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

Mapping Strength

0- No Mapping strength
1- Low
2- Medium
3- High

SESSIONS	TOPIC	METHOD	VALUE ADDITION	CO	PSO
1	Introductory Session	Lecture, Group discussion	Q & A Session	CO1	PSO1
2	Basic theory of Linear systems in normal form-two equations in 2 unknown functions	Lecture, Group Discussion, Problem solving		CO1	PSO1
3	Problems	Group Discussion, Problem solving		CO1	PSO1
4	Theorems, Wronskian, Problems	Lecture, Group Discussion, Problem solving		CO1	PSO1
5	Non homogenous Linear systems and problems	Lecture, Group Discussion, Problem solving		CO1	PSO1
6	Homogenous linear system with constant coefficients - Introduction	Lecture, Group Discussion, Problem solving		CO1	PSO1
7	Case 1- when the roots of the characteristic equations are real and distinct and problems	Lecture, Group Discussion, Problem solving		CO1	PSO1
8	Case 2- when the roots of the characteristic equations are conjugate complex and problems	Lecture, Group Discussion, Problem solving		CO1	PSO1, PSO2
9	Case 3- when the roots of the characteristic equations are real and equal and problems	Lecture, Group Discussion, Problem solving		CO1	PSO1, PSO2
10	Basic concepts of Matrices and vectors, Inverse	Lecture, Group Discussion, Problem solving		CO1	PSO1
11	Linear dependence and independence Characteristic values and vectors, problems	Lecture, Group Discussion, Problem solving		CO1	PSO1
12	Introduction – The Matrix method for homogenous linear systems with constant coefficients	Lecture, Group Discussion, Problem solving		CO1	PSO1
13	Case of two distinct characteristic values and problems	Lecture, Group Discussion, Problem solving		CO1	PSO1
14	Case of a double characteristic values and problems	Lecture, Group Discussion, Problem solving		CO1	PSO1
15	Theorems and problems	Lecture, Group	Quiz	CO1	PSO1

		Discussion, Problem solving			
16	**Test - 1 Hour**				
17	Introduction and review of Power series	Lecture, Group Discussion		CO2	PSO1
18	Radius of Convergence, problems	Lecture, Group Discussion, Problem solving		CO2	PSO1
19	Sum ,Scalar product and Cauchy product of series ,problems	Lecture, Group Discussion, Problem solving		CO2	PSO1
20	Series solution of first order differential equations, problems	Lecture, Group Discussion, Problem solving		CO2	PSO1
21	Problems	Group Discussion, Problem solving		CO2	PSO1
22	Second order Linear equations: ordinary points-Introduction and problem	Lecture, Group Discussion, Problem solving		CO2	PSO2
23	Problems	Group Discussion, Problem solving		CO2	PSO2
24	Regular singular points and problems	Lecture, Group Discussion, Problem solving		CO2	PSO2
25	Method of Frobenius series and problems	Lecture, Group Discussion, Problem solving		CO2	PSO2
26	Problems	Group Discussion, Problem solving		CO2	PSO1
27	More on Regular singular points and problems	Lecture, Group Discussion, Problem solving	Q & A Session	CO2	PSO3
28	Problems	Group Discussion, Problem solving		CO2	PSO1
29	Gauss's Hypergeometric equations and problems	Lecture, Group Discussion, Problem solving		CO2	PSO2
30	Problems	Group Discussion, Problem solving		CO2	PSO1
31	Problems	Group Discussion, Problem solving		CO2	PSO1
32	Introduction to Picard's Existence and uniqueness Theorem-The form of a Differential Equation	Lecture, Group Discussion, Problem solving		CO3	PSO1
33	Picard's iteration Technique and some examples	Lecture, Group Discussion,		CO3	PSO1

		Problem solving			
34	Estimation of the Picard's iterates and Problems	Lecture, Group Discussion, Problem solving		CO3	PSO1
35	Problems	Group Discussion, Problem solving		CO3	PSO1
36	CIA-I	1 hour			
37	Introduction to Boundary Value problems – Definition and examples	Lecture, Group Discussion, Problem solving		CO4	PSO1
38	Non trivial solutions of Strum Liouville problems	Lecture, Group Discussion, Problem solving		CO4	PSO1
39	Problems	Group Discussion, Problem solving		CO4	PSO1
40	Characteristic values and Characteristic functions	Lecture, Group Discussion, Problem solving		CO4	PSO1
41	Theorems and problems	Lecture, Group Discussion, Problem solving		CO4	PSO1
42	Problems	Group Discussion, Problem solving		CO4	PSO1
43	Orthogonality of Functions and examples	Lecture, Group Discussion, Problem solving		CO4	PSO2
44	Orthogonality of Characteristic Functions and examples	Lecture, Group Discussion, Problem solving		CO4	PSO2
45	Theorem and problems	Lecture, Group Discussion, Problem solving		CO4	PSO1
46	Problems	Group Discussion, Problem solving		CO4	PSO1
47	Orthonormal systems and examples	Lecture, Group Discussion, Problem solving		CO4	PSO2
48	The expansion of a function in a series of ortho-normal functions	Lecture, Group Discussion, Problem solving		CO4	PSO2
49	Theorem and Problems	Lecture, Group Discussion, Problem solving		CO4	PSO1
50	Problems	Group Discussion, Problem solving		CO4	PSO1
151	Introduction of Laplace transforms	Lecture, Group Discussion,		5	PSO1

		Problem solving			
52	Laplace transforms of basic functions	Lecture, Group Discussion, Problem solving		CO4	PSO1
53	Problems	Group Discussion, Problem solving		CO4	PSO1
54	Applications to Differential Equations - examples	Lecture, Group Discussion, Problem solving		CO4	PSO2
55	More Examples	Lecture, Group Discussion, Problem solving		CO4	PSO2
56	Problems	Group Discussion, Problem solving		CO4	PSO2
57	Derivatives of Laplace transforms ,examples	Lecture, Group Discussion, Problem solving		CO4	PSO2
58	Problems	Group Discussion, Problem solving		CO4	PSO2
59	Integrals of Laplace transforms ,examples	Lecture, Group Discussion, Problem solving		CO4	PSO2
60	Problems	Group Discussion, Problem solving		CO4	PSO2
61	Properties of Laplace transforms and problems	Lecture, Group Discussion, Problem solving		CO4	PSO1
62	Convolutions and example	Lecture, Group Discussion, Problem solving		CO4	PSO1
63	More examples and Abel's Mechanical Problem	Lecture, Group Discussion, Problem solving		CO4	PSO1
64	Continuation of Abel's Mechanical Problem	Lecture, Group Discussion, Problem solving		CO4	PSO1
65	Analysing Abel's Mechanical Problem	Lecture, Group Discussion, Problem solving		CO4	PSO2
66	Problems	Group Discussion, Problem solving		CO4	PSO2
67	The unit step function- Introduction	Lecture, Group Discussion, Problem solving		CO4	PSO2
68	Principle of Superposition and example	Lecture, Group Discussion, Problem solving		CO4	PSO2
69	The Impulse function -	Lecture, Group		CO4	PSO2

	Introduction	Discussion, Problem solving			
70	Examples	Lecture, Group Discussion, Problem solving		CO4	PSO2
71	Problems	Group Discussion, Problem solving		CO4	PSO2
72	CIA-II	2 Hours			
73	Discussion Of CIA-II				
74	Revision				
75	Revision				

INDIVIDUAL ASSIGNMENTS/SEMINAR – DETAILS & GUIDELINES

	Date of completion	**Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)**	**Course Outcome**
1	27-07-2018	Assignment on linear system of ode's	CO1, CO2
2	25^{th} to 29^{th} Sep	Seminar on Laplace transforms	CO5

COURSE – 5

PROGRAMME	**MSC MATHEMATICS**	**SEMESTER**	**1**
COURSE CODE AND TITLE	**16P1MATT05: COMPLEX ANALYSIS**	**CREDITS**	**4**
HOURS/WEEK	**4**	**HOURS/SEM**	**72**
FACULTY NAME	**SANIL JOSE**		

	COURSE OUTCOMES	POs / PSOs	CL
CO1	Understand analytic function as a mapping on the plane, Mobius transformation and branch of logarithm.	PO1/PSO1	U
CO2	Understand Cauchy's theorems and integral formulas on open subsets of the plane.	PO1/PSO1	U
CO3	Understand the concept of homotopy and homotopic version of Cauchy's theorem and simply connectivity.	PO1/PSO1	U
CO4	Understand how to count the number of zeros of analytic function giving rise to open mapping theorem and Goursat theorem as a converse of Cauchy's theorem.	PO1/PSO1	U
CO5	Know about the kind of singularities of meromorphic functions which helps in residue theory and contour integrations.	PO1/PSO1	U
CO6	Handle integration of meromorphic function with zeros and poles leading to the argument principle and Rouche's theorem.	PO1/PSO1	U
CO7	Understand analytic function as a mapping on the plane, Mobius transformation and branch of logarithm.	PO1/PSO1	U

CO -PO/PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2						2			
CO 2	2						1			
CO 3	2						2			
CO 4	2						1			
CO 5	2						1			
CO 6	2						1			
CO 7	2						1			

Mapping Strength

0- No Mapping strength
1- Low
2- Medium
3- High

NO.	TOPIC	METHODS	VALUE ADDITIONS	COURSE OUTCOMES
1	INTRODUCTION	Lecture		
2	The spherical representation of complex numbers	Lecture		CO1
3	Riemann Sphere, Stereographic projection	Lecture, Problem Solving		CO1
4	Distance between the stereographic projections	Lecture, Problem Solving		CO1
5	Elementary Theory of power series	Lecture,		CO1
6	Abel's Theorem on convergence of the power series,	Lecture Problem Solving		CO1
7	Hadamard's formula	Lecture, Problem Solving		CO1
8	Abel's limit Theorem	Lecture, Problem Solving		CO1
9	Arcs and closed curves	Lecture, Problem Solving		CO1
10	Analytic functions in regions	Lecture, Problem Solving		CO1
11	Conformal mappings	Lecture, Problem Solving		CO1
12	Length and area	Lecture		CO1
13	Linear transformations	Lecture, Problem Solving		CO1
14	The cross ratio, Symmetry	Lecture, Problem Solving		CO1
15	Oriented circles,	Lecture, Problem Solving		CO1
16	Families of circles.	Lecture, Problem Solving		CO1

17	Seminar	Lecture, Problem Solving		CO1
18	Seminar	Lecture, Problem Solving		CO1
19	Seminar	Lecture, Problem Solving		CO1
20	Test paper	Test		CO1
21	Answer discussion	Lecture, Problem Solving	Discussio n	CO1
22	Line integrals	Lecture, Problem Solving		CO2
23	Rectifiable arcs	Lecture, Problem Solving		CO2
24	Line integrals as functions of arcs	Lecture, Problem Solving		CO2
25	Cauchy's theorem for a rectangle	Lecture, Problem Solving		CO2
26	Cauchy's theorem in a disk,	Lecture, Problem Solving		CO2
27	Cauchy's integral formula	Lecture, Problem Solving		CO2
28	Cauchy's integral formula 2	Lecture, Problem Solving		CO2
29	Cauchy's integral formula	Lecture		CO2
30	Tutorial	Lecture, Problem Solving	Quiz	CO2
31	Seminar	Lecture, Problem Solving		CO2
32	Seminar	Lecture, Problem Solving		CO2
33	Seminar	Lecture, Problem Solving		CO2
34	Seminar	Introduction		CO2
35	Seminar	Lecture, Problem		CO2

		Solving		
36	Seminar	Lecture, Problem Solving		CO2
37	Seminar	Lecture, Problem Solving		CO2
38	Test paper	Lecture, Problem Solving		CO2
39	Answer discussion			CO2
40	Differentiation under the sign of integration	Lecture, Problem Solving		CO3
41	Morera's Theorem, Liouville's Theorem,	Lecture, Problem Solving		CO3
42	Morera's Theorem, Liouville's Theorem,	Lecture, Problem Solving		CO3
43	Fundamental Theorem	Lecture, Problem Solving		CO3
44	Cauchy's estimate	Lecture, Problem Solving		CO3
45	Removable singularities, Taylor's theorem, zeroes and poles 1	Lecture, Problem Solving		CO4
46	Removable singularities, Taylor's theorem, zeroes and poles 2	Lecture, Problem Solving		CO4
47	Weirstrass Theorem on essential singularity,	Lecture, Problem Solving		CO4
48	The local mapping,	Lecture, Problem Solving		CO4
49	The maximum principle.	Lecture, Problem Solving		CO4
50	Schwarz lemma	Lecture, Problem Solving		CO4
51	Seminar	Lecture, Problem Solving		CO4
52	Seminar	Lecture, Problem Solving		CO4
53	Seminar	Lecture, Problem Solving		CO4

54	Seminar	Lecture, Problem Solving		CO4
55	Test paper	Lecture, Problem Solving		CO4
56	Answer discussion	Lecture, Problem Solving		CO4
57	Chains and cycles,	Lecture, Problem Solving		CO 5
58	Simple connectivity, homology,	Lecture, Problem Solving		CO 5
59	General statement of Cauchy's theorem	Lecture, Problem Solving		CO 5
60	Proof of Cauchy's theorem,	Lecture, Problem Solving		CO 5
61	Locally exact differentiation	Lecture, Problem Solving		CO 5
62	Multiply connected regions	Lecture, Problem Solving		CO 5
63	The residue theorem	Lecture, Problem Solving		CO 6
64	The argument principle,	Lecture, Problem Solving		CO 6
65	Evaluation of definite integrals.	Lecture, Problem Solving		CO 6
66	Evaluation of definite integrals.	Lecture, Problem Solving		CO 6
67	Evaluation of definite integrals.	Lecture, Problem Solving		CO 6
68	Seminar	Lecture, Group Discussion		CO 6
69	Seminar	Lecture, Group Discussion		CO 6
70	Seminar	Lecture, Group Discussion		CO 6
71	Seminar	Lecture, Group Discussion		CO 6

72	Seminar	Lecture, Group Discussion		CO 6

GROUP ASSIGNMENTS/ACTIVITES – DETAILS & GUIDELINES

	Date of completion	**Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc.)**	**Course Outcome**
1	2/8/2018	PROBLEMS IN MODULE 3	CO 4

INDIVIDUAL ASSIGNMENTS/SEMINAR – DETAILS & GUIDELINES

	Date of completion	**Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc.)**	**Course Outcome**
1	4/10/2018	Problems from module 1 and 2	CO 1, CO 2 , CO 3
2	28/9/2018	Problems from module 4	CO 5 , CO 6

REFERENCES:-

- Chaudhary. B, The elements of Complex Analysis, Wiley Eastern.
- Cartan. H (1973), Elementary theory of Analytic functions of one or several variable,
- Addison Wesley.
- Conway .J.B, Functions of one Complex variable, Narosa publishing.
- Lang. S, Complex Analysis, Springer.

RECOMMENDED READING

- Walter Rudin. Real and Complex Analysis. Mc Graw Hill Book Co. 1966
- E.C. Titchmarsh. The Theory of Functions. Oxford University Press. London.
- S. Ponnusamy. Foundation of Complex Analysis. Narosa Publishing House. 1997.
- E.T.Copson, Complex variables.
- Shanti Narayan. Complex variables.
- Churchill and Brown, Complex variables and applications, McGraw-Hill Pub. Company.
- Murray R. Spiegel , complex variable, Schaum's out line special Indian edition TMH Education New Delhi.