SACRED HEART COLLEGE (AUTONOMOUS)

Department of Mathematics

M.Sc. Mathematics

Course plan

Academic Year 2018-19

Semester 2

PROGRAMME OUTCOMES

	Programme Outcomes
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.

COURSE PLAN- ABSTRACT ALGEBRA

PROGRAMME	**Msc Mathematics**	**SEMESTER**	**2**
COURSE CODE AND TITLE	**16P2MATT06:ABSTRACT ALGEBRA**	**CREDIT**	**4**
HOURS/WEEK	**5**	**HOURS/SEM**	**90**
FACULTY NAME	**JEET KURIAN MATTAM**		

COURSE OUTCOMES

C.O.	C.O. Statement	P.O./P.S.O.	CL	KC	Class Hrs	Lab Hrs.
CO1	Developing ideas of finitely genearted abelian groups, Sylow theorems and applications	P.O 1/P.S.O 1	U	C	26	0
CO2	Understanding the concept of rings of polynomials, facrorisation of polynomials and ideal structure	P.O 1/P.S.O 1	U	C	33	0
CO3	Asssimilating the idea of extension fields, algebraic extensions and geometric constructions.	P.O 1/P.S.O 1	U	C	14	0
CO4	Developing ideas of automorphisms of fields, isomorphism extension theorem and Galois theory.	P.O 1/P.S.O 1	U	C	17	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

Text Book

1.A First Course in Abstract Algebra by John B Fraleigh 3rd Edition

Additional references

1) Contemporary Abstract Algebra by Joseph Gallian

2) Topics in Algebra by I.N.Herstein

3) Algebra by Michael Artin

4) Abstract Algebra by David S Dummit and Richard M Foote.

Proofs of theorems to be avoided in bridge course. Only concept and examples required

Sessions	**Topic**	**Method**	C.O
1	Bridge Course: Chapter 1 of text	Group Discussion followed by a Lecture session.	C.O1
2	Bridge Course : Chapter 2 of text excluding direct products	Interactive session including GD	C.O1
3	Bridge Course: chapter 4 of text.	Lecture session with Examples	C.O1
4	Bridge Course: Chapter 5 of text.	Lecture session with Examples	C.O1

5	Bridge Course: Section 27.1-27.20	Lecture session	C.O1
5	Bridge Course: Section 27.1-27.20	Lecture session	C.O1
6 MODULE I BEGINS	Definition 11.1, Theorem 11.2 and example 11.3	Lecture session	C.O1
7	Example 11.4, Theorem 11.5, Corollary 11.6 and example 11.7	Interactive session and Lecture	C.O1
8	Definition 11.8, Theorem 11.9, Example 11.10, Example 11.11	Lecture	C.O1
9	Theorem 11.12, Example 11.13, Definition 11.14, Theorem 11.15	Lecture	C.O1
10	Theorem 11.16, Theorem 11.17 and selected exercises of Exercise 11	Lecture	C.O1
11	Exercise 11 continued	Lecture	C.O1

12	Definition 16.1, Example 16.2, Theorem 16.3	Interactive session	C.O1
13	Examples 16.4- 16.8	Assignment and seminar for the students.	C.O1
14	Example 16.11, Theorem 16.12, Definition 16.13 and Theorem 16.14	Lecture	CO1
15	Definition 16.15 and theorem 16.16 and example 16.17	Lecture	C.O1
16	Theorem 36.1, Definition 36.2	Lecture	C.O1
17	Theorem 36.3 and Corollary 36.4	Lecture	C.O1
18	Definition 36.5, Lemma 36.6 and Corollary 36.7	Lecture	C.O1
19	The three Sylow Theorems (Statements only) Example 36.12 and Example 36.13	Lecture	C.O1

20	Theorem 37.1 and definition 37.2 and example 37.3	Lecture	C.O1
21	Theorem 37.4, Lemma 37.5 and Theorem 37.6	Lecture	C.O1
22	Theorem 37.7 and Lemma 37.8	Lecture	C.O1
23	Example 37.9- Example 37.12	Lecture	C.O1
24	Example 37.13-Example 37.15	Lecture	C.O1
25	Examples continued and selected exercises of Exercise 37	Lecture	C.O1
26	FIRST CIA	Written Test; Descriptive.	
27 MODULE 2 BEGINS	Definition 22.1 and Theorem 22.2	Lecture	C02
28	Example 22.3, R[x,y], and theorem 22.4	Lecture	C02

29	Examples 22.6-22.10	Lecture	C02
30	Theorem 22.11	Seminar	C02
31	Selected Exercises of Exercise 22	Seminar	C02
32	Selected Exercises of Exercise 22	Seminar	C02
33	Theorem 23.1		**C02**
34	Example 23.2 and Corollary 23.3	Lecture	C02
35	Example 23.4 and corollary 23.5	Lecture	C02
36	Corollary 23.6, Definition 23.7 and Example 23.8	Lecture	C02
37	Example 23.9, Theorem 23.10, Theorem 23.11 and Corollary 23.12	Lecture	C02
38	Example 23.13,23.14 and a similar problem in exercises	Lecture	C02

39	Theorem 23.15 and example 23.16	**Lecture**	C02
40	Corollary 23.17	Lecture	C02
41	Definition 27.21, Example 27.22,27.23 and Theorem 27.24	Lecture	C02
42	Theorem 27.25 and example 27.26	Lecture	C02
43	Example 27.26 and theorem 27.27 and selected exercises of exercise 27	Lecture	C02
44	Theorem 23.18, Corollary 23.19 and theorem 23.20	**Lecture**	C02
45	Example 23.21 and selected exercises of Exercise 23	Seminar	C02
46	Example 23.21 and selected exercises of Exercise 23	Seminar	C02
47	Definition 29.1 and Theorem 29.3	Lecture	C02

48	Example 29.4, 29.5, Definition 29.6,Examples 29.7-29.10.	Lecture	C02
49	Definition 29.11 and theorem 29.12, Theorem 29.13	Lecture	C02
50	Definition 29.14, Example 29.15, Simple Extensions	Lecture	C02
51	Example 29.16, Definition 29.17 and Theorem 29.18		C02
52	Example 29.19 and selected exercises of Exercise 29	Lecture	C02
53	selected exercises of Exercise 29	Seminar	C02
54	Theorem 30.23, Definition 31.1,31.2	Lecture	C02
55	Theorem 31.3,31.4	Lecture	C02
56	Corollary 31.6,31.7, Examp;e 31.8,31.9	Lecture	C02

57	Example 31.10, Theorem 31.11	Lecture	C02
58	Theorem 31.12, Corollary 31.13, Definition 31.14 and Theorem 31.15	Lecture	C02
59	Corollary 31.16, Theorem 31.17 and theorem 31.18	Lecture	C02
60	Selected exercises of Exercise 31		C02
61MODULE III BEGINS	Theorem 32.1 and Corollary 32.5	Seminar	C03
62	Theorem 32.6	Lecture	C03
63	Corollary 32.8, Theorems 32.9-32.11	Seminars	C03
64	Theorem 33.1, Corollary 33.2, Theorem 33.3	Lecture	C03
65	Definition 33.4, Theorem 33.5, Corollary 33.6 and Example 33.7	Lecture	C03

66	Lemma 33.8 and Lemma 33.9	Lecture	C03
67	Theorem 33.10, Corollary 33.11 and Theorem 33.12		C03
68	Definition 48.1, Example 48.2, Theorem 48.3	Lecture	C03
69	Corollary 48.5, Corollary 48.6 and Example 48.7	Lecture	C03
70	Definition 48.8, Example 48.9, 48.10, 48.11 and Definition 48.12	Lecture	C03
71	Example 48.13, Theorem 48.14, Theorem 48.15, Definition 48.16, Example 48.17		C03
72	Theorem 48.19, Selected Exercises of Exercise 48		C03
73	Theorem 49.3**(** Statement only) and Corollary 49.5		C03
74	SECOND CIA		C03

75 MODULE IV BEGINS	Definition 50.1, Example 50.2, Theorem 50.3	Lecture	C04
76	Definition 50.4, Example 50.5, Corollary 50.6, 50.7	Lecture	C04
77	Example 50.8 and 50.9. Selected Exercises of Exercise 50.	Lecture	C04
78	Definition 51.1, Theorem 51.2, Corollary 51.3.	Lecture	C04
79	Example 51.4, Theorem 51.6, Definition 51.7 and Example 51.8	Lecture	C04
80	Theorem 51.9 and Corollary 51.10	LECTURE	C04
81	Lemma 51.11, Definition 51.12 and Theorem 51.13	LECTURE	C04
82	Theorem 51.14	LECTURE	C04
83	Theorem 51.15	LECTURE	C04

84	Definition 53.1, Theorem 53.2	LECTURE	C04
85	Example 53.3, Definition 53.5	LECTURE	C04
86	Theorem 53.6	LECTURE	C04
87	Theorem 53.6 (Continued)	LECTURE	C04
88	Theorem 53.7 and Example 53.8	LECTURE	C04
89	REVISION		
90	REVISION		

COURSE PLAN- ADVANCED TOPOLOGY

PROGRAMME	**Msc Mathematics**	**SEMESTER**	**1**
COURSE CODE AND TITLE	**16P2MATT07: ADVANCED TOPOLOGY**	**CREDIT**	**4**
HOURS/WEEK	**5**	**HOURS/SEM**	**75**
FACULTY NAME	**JEENU KURIAN**		

CO	**CO Statement**	**PO/PSO**	**CL**	**KC**	**Class Hrs.**
CO1	Understand Urysohn Characterization of Normality ,Tietze Characterization of Normality, Products and co-products.	PO1/PSO 1	U	C	21
CO2	Analyze embedding and Metrisation, Evaluation Functions in to Products, embedding Lemma and Tychnoff Embedding, The Urysohn Metrisation Theorem.	PO1/PSO 1	U	P	12
CO3	Develop the idea of convergence and related properties of nets and filters.	PO1/PSO 1	U	C	21
CO4	Understand compactness, variations of compactness.	PO1/PSO 1	U	C	21

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						2			

Mapping Strength

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

Sessions	Topic	Method	Course Outcome
1.	Introductory Session – separation axioms	Lecture	CO1
2.	Urysohn characterisation of normality	Lecture	CO1
3.	Definition and proposition	Lecture	CO1
4.	Urysohn's Lemma	Lecture,	CO1
5.	Theorem and Lemma	Lecture,	CO1
6.	Theorems and Lemma	Lecture,	CO1
7.	Tietz characterisation of normality: proposition	Lecture,	CO1

8.	Proposition	Lecture,	CO1
9.	Definition and proposition	Lecture,	CO1
10.	Proposition	Lecture	CO1
11.	Theorem and proposition	Lecture,	CO1
12.	Products and co products – Cartesian products of family of sets: Basic definitions	Lecture	CO1
13.	Proposition	Lecture,	CO1
14.	Proposition	Lecture,	CO1
15.	Theorem	Lecture,	CO1
16.	Theorem	Lecture,	CO1
17.	Definition and Theorem	Lecture,	CO1
18.	Product topology – Basic definitions	Lecture, Group Discussion, Problem Solving	CO1
19.	Theorems	Lecture,	CO1

20.	Theorems and propositions	Lecture,	CO1
21.	Propositions and definitions	Lecture,	CO1
22.	Productive properties - Basic definitions	Lecture,	CO1
23.	Theorems and Lemma	Lecture,	CO1
24.	Theorems and Lemma	Lecture,	CO1
25.	Theorems and Lemma	Lecture,	CO1
26.	Theorems and Lemma	Lecture,	CO1
27.	Theorems and Lemma	Lecture,	CO1
28.	Module 2 – Embedding and metrisation	Lecture,	CO2
29.	Definitions	Lecture, Group Discussion, Problem Solving	CO2
30.	Theorems and Propositions on evaluation function	Lecture,	CO2
31.	Theorems and Propositions on	Lecture,	CO2

	evaluation function		
32.	Theorems and Propositions on evaluation function	Lecture,	CO2
33.	Embedding Lemma and Tychonoff embedding – Basic Definitions	Problem Solving	CO2
34.	Theorem	Lecture,	CO2
35.	Theorem	Lecture,	CO2
36.	Lemma	Lecture,	CO2
37.	Proposition	Lecture,	CO2
38.	Urysohn metrisation Theorem - Basic Definitions and theorem	Lecture,	CO2
39.	Corollary and problems	Lecture, Group Discussion, Problem Solving	CO2
40.	Module 3 – Nets and filters introduction, Basic definition	Lecture,	CO3
41.	Theorems and proposition	Lecture,	CO3

42.	Theorems and proposition	Lecture,	CO3
43.	Topology and convergence of nets – Basic definitions	Lecture,	CO3
44.	Theorems and corollaries	Lecture,	CO3
45.	Theorems and corollaries	Lecture,	CO3
46.	Theorems and Propositions	Lecture,	CO3
47.	Theorems and propositions	Lecture,	CO3
48.	Filters and their convergence – Basic definitions	Lecture,	CO3
49.	Theorems and corollaries	Lecture,	CO3
50.	Theorems and Propositions	Lecture,	CO3
51.	Theorems and Propositions	Lecture,	CO3
52.	Ultrafilter and compactness	Lecture,	CO3
53.	Ultrafilter and compactness	Lecture,	CO3
54.	Theorems and propositions	Lecture,	CO3
55.	Problems	Lecture,	CO3

56.	Module 4 - Introduction	Lecture	CO4
57.	Variation of compactness - Basic definitions	Lecture,	CO4
58.	Theorems, corollaries and propositions	Lecture,	CO4
59.	Theorems, corollaries and propositions	Lecture,	CO4
60.	Theorems, corollaries and propositions	Lecture,	CO4
61.	Theorems, corollaries and propositions	Lecture,	CO4
62.	Theorems, corollaries and propositions	Lecture,	CO4
63.	Local compactness - Definitions	Lecture,	CO4
64.	Propositions and corollaries	Lecture,	CO4
65.	Propositions and corollaries	Lecture,	CO4
66.	Propositions and corollaries	Lecture,	CO4
67.	Compactification- Basic definitions	Lecture,	CO4

68.	Theorems and proposition	Lecture,	CO4
69.	Propositions and corollaries	Lecture,	CO4
70.	Theorems	Lecture,	CO4
71.	Theorems	Lecture,	CO4
72.	Propositions	Lecture,	CO4
73.	Propositions	Lecture,	CO4
74.	Problems	Group discussion	CO4
75.	Problems	Group discussion	CO4
76.	Problems	Group discussion	CO4
77.	Problems	Group discussion	CO4
78.	Problems	Group discussion	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	10th Jan 2019	Assisgnment product topology, Nets and Filters	CO1, CO3

2	19^{th} to 25^{th} Feb 2019	Seminar on theorems and problems in Compactness of topological spaces	CO4

References:

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

PROGRAMME	**MSC MATHEMATICS**	**SEMESTER**	**2**
COURSE CODE AND TITLE	**16P2MATT08: ADVANCED COMPLEX ANALYSIS**	**CREDIT**	**4**
HOURS/WEEK	**5**	**HOURS/SEM**	**72**
FACULTY NAME	**PROF. SANIL JOSE**		

Course Prerequisites:

Calculus, Analysis

Guidelines/Suggestions for Teaching Methods and Student Learning Activities:

This course is taught as a lecture course with student participation and use of computers

COURSE OUTCOMES		PO /PSO
CO 1	Understand the concepts of power series to expand a complex function as Taylors and Laurantz series	PO1, PSO1
CO 2	Perceive entire functions, Jensen's formula, the genus and order of an entire function, Hadamard Factorization theorem.	PO1, PSO1
CO 3	Interpret Harmonic functions, Basic properties of harmonic functions and Harmonic functions on the disk and discuss Reiman Mapping theorem	PO1, PSO1
CO 4	Analysis Elliptic functions and Weistrass function	PO1, PSO1

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						2			

Mapping Strength

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

Basic Reference

1. AHLFORS V. LARS, COMPLEX ANALYSIS, McGRAW- HILL INTERNATIONAL EDITIONS, 3RD EDITION

Hour wise planning

Sessions	Topic	Method	VALUE ADDITIONS
1	INTRODUCTION		
2	ELEMENTARY THEORY OF POWER SERIES		CO 1
3	SEQUENCE AND SERIES		CO 1
4	UNIFORM CONVERGANCE		CO 1
5	POWER SERIES		CO 1
6	ABEL'S LIMIT THEOREM		CO 1

7	POWER SERIES EXPNSION		CO 1
8	WEISTRASS THEOREM		CO 1
9	TAYLOR'S THEOREM		CO 1
10	LAURENT'S THEOREM		CO 1
11	PARTIAL FRACTIONS		CO 1
12	INFINITE PRODUCTS		CO 1
13	CANNONICAL PRODUCTS		CO 1
14	GAMMA FUNCTION		CO 1
15	GAMMA FUNCTION		CO 1
16	SEMINAR		CO 1
17	SEMINAR/ PROBLEM DISCUSSION		CO 1
18	SEMINAR/ PROBLEM DISCUSSION		CO 1
19	SEMINAR/ PROBLEM DISCUSSION		CO 1
20	SEMINAR/ PROBLEM		CO 1

	DISCUSSION		
21	JENSON'S FORMULA		CO 2
22	HADAMARD'S THEOREM		CO 2
23	THE REIMANN ZETAFUNCTION		CO 2
24	EXTENSION TO THE ENTIRE PLANE		CO 2
25	FUNCTIONLA EQUATION		CO 2
26	THE ZEROS OF ZETA FUNCTION		CO 2
27	THE ZEROS OF ZETA FUNCTION		CO 2
28	THE ZEROS OF ZETA FUNCTION		CO 2
29	ARZELA'S THEOREM		CO 2
30	ARZELA'S THEOREM		CO 2
31	SEMINAR		CO 2
32	SEMINAR/ PROBLEM DISCUSSION		CO 2
33	SEMINAR/ PROBLEM DISCUSSION		CO 2

34	SEMINAR/ PROBLEM DISCUSSION		CO 2
35	SEMINAR/ PROBLEM DISCUSSION		CO 2
36	SEMINAR/ PROBLEM DISCUSSION		CO 2
37	SEMINAR/ PROBLEM DISCUSSION		CO 2
38	SEMINAR/ PROBLEM DISCUSSION		CO 2
39	SEMINAR/ PROBLEM DISCUSSION		CO 2
40	THEREIMANN MAPPING THEOREM		CO 3
41	THEREIMANN MAPPING THEOREM		CO 3
42	THEREIMANN MAPPING THEOREM		CO 3
43	BOUNDARY BEHAVIOUR		CO 3
44	USE OF REFLECTION PRINCIPLE		CO 3
45	ANALYTIC ARCS		CO 3

46	CONFORMAL MAPPING OF POLYGONS		CO 3
47	SCHWARZ CHRISTOFFEL FORMULA		CO 3
48	MEAN VALUE PROPERTY		CO 3
49	MEAN VALUE PROPERTY		CO 3
50	HARNACK'S PRINCIPLE		CO 3
51	HARNACK'S PRINCIPLE		CO 3
52	HARNACK'S PRINCIPLE		CO 3
53	SUBHARMONIC FUNCTIONS		CO 3
54	SUBHARMONIC FUNCTIONS		CO 3
55	SEMINAR/ PROBLEM DISCUSSION		CO 3
56	SEMINAR/ PROBLEM DISCUSSION		CO 3
57	SEMINAR/ PROBLEM DISCUSSION		CO 3
58	SEMINAR/ PROBLEM DISCUSSION		CO 3

59	SEMINAR/ PROBLEM DISCUSSION		CO 3
60	SEMINAR/ PROBLEM DISCUSSION		CO 3
61	SIMPLY PERIODIC FUNCTIONS		CO 4
62	DOUBLY PERIODIC FUNCTIONS		CO 4
63	THE FOURIER DEVELOPMENT		CO 4
64	THE PERIOD MODULE		CO 4
65	UNIMODULAR TRANSFORMATIONS		CO 4
66	CANNONICAL BASIS		CO 4
67	WEISTRASS FUNCTION		CO 4
68	WEISTRASS FUNCTION		CO 4
69	WEISTRASS FUNCTION		CO 4
70	WEISTRASS FUNCTION		CO 4
71	SEMINAR/ PROBLEM DISCUSSION		CO 4

72	SEMINAR/ PROBLEM DISCUSSION		CO 4
73	SEMINAR/ PROBLEM DISCUSSION		CO 4
74	SEMINAR/ PROBLEM DISCUSSION		CO 4
75	SEMINAR/ PROBLEM DISCUSSION		CO 4
76	SEMINAR/ PROBLEM DISCUSSION		CO 4
77	REVISION		CO 4
78	REVISION		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	4/1/2019	PROBLEMS ON POWER SERIES	CO 1
2	28/1/2019	PROBLEMS IN HARMONIC FUNCTIONS	CO 3

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	2/2/2019	PROBLEMS IN ELLIPTIC FUNCTIONS	CO 4
2	**9/2/2019**	PROBLEMS IN MODULE 2	**CO 2**

References:

1. John. B. Conway, Functions of Complex Variables, SpringerVerlag, New York, 1973. (Indian Edition: Narosa)

2. S. Lang, Complex Analysis, McGraw Hill (1998).

3. S. Ponnusamy & H. Silverman, Complex Variables with Applications, Birkhauser

4. A. Priestley, Introduction to Complex Analysis, Oxford University Press Tristan Needham, Visual Complex Analysis, Oxford University Press(1999)

5. V. Karunakaran, Complex Analysis, Narosa Publishing House,

COURSE PLAN- FUNCTIONAL ANALYSIS

Course	**FUNCTIONAL ANALYSIS**
Course code	**16P2MATT09**
Semester	**2**
Total hours	**75**
Credits	**4**
Faculty	**Prof. M P Sebastian**

Course Outcomes

CO1	Understand the basics of Functional analysis	PO1, PSO1
CO2	Apply Functional analysis in the other disciplines.	PO1, PSO1
CO3	Understand theory of Operators and Functionals using Linear Algebra.	PO1, PSO1
CO4	Discover the link of Functional analysis with geometry , differential equations etc.	PO1, PSO1

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						2			

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	CO	Value addition
1	1	Fundamentals of Linear Algebra and Metric spaces.	Lecture , Seminar , Assignment	CO3,CO1	
2.	3	Normed space and Banachspace , examples and their properties , problems.	Lecture , assignment	CO1,CO3	
3	2	Finite dimensional normed spaces and their sub spaces , problems.	Lecture	CO1 , CO3	
4	2	Compactness and finite dimension , problems.	Lecture	CO1,CO3	
5	2	Linear operators, examples and their properties, problems.	Lecture, assignment	CO1, CO2,CO3	
6		Test paper.			

7	2	Bounded and continuous linear operators and examples.	Lecture	CO1, CO2, CO4	
8	2	Problems based on bounded linear operators.	Lecture	CO1 , CO3 , CO4	
9	1	Linear functionals , examples.	Lecture	CO1 ,CO3	
10		First internal			
11	2	Bounded linear Functionals and their properties, problems.	Lecture	CO1, CO3,CO4	
12	2	Linear Operators andFunctionals on a finite dimensional normed space , problems.	Lecture , assignment	CO1, CO2 ,CO3	
13	2	Normed space of Operators and Functionals.	Lecture , assignment	CO1, CO2 ,CO3	
14	2	Examples of dual spaces.	Lecture	CO1 ,CO2, CO3	
15		Test paper on module 2			
16	2	Inner product spaces and Hilbert spaces , examples , problems.	Lecture	CO2, CO3, CO4	
17	2	Further properties of inner product spaces.	Lecture , seminar	CO2, CO4	
18	2	Orthogonal complement and direct	Lecture	CO2 , CO3	

		sum , problems.			
19	2	Orthogonal sets and sequences.	seminar	CO2,CO3, CO4	
20	2	Bessel inequality, Gram- Schmidt process for ortho normalisation.	Lecture, seminar	CO2, CO3	
21	2	Total ortho normal sets and sequences , problems.	Lecture , seminar, assignment	CO2 ,CO3, CO4	
22	2	Rieszs theorem .	seminar	CO2 , CO3	
23	2	Sesqui linear functional and Riesz representation theorem.	Lecture , seminar	CO2, CO3	
24	3	Problems based on Riesz theorem and Riesz representation theorem.	Lecture	CO2, CO3	
25	3	Hilbert adjoint and its properties.	Lecture , seminar	CO2 ,CO3 ,CO4	
2	3	Problems based on Hilbert adjoint operators.	Lecture , assignment , seminar	CO2 , CO3 , CO4	
27	3	Self adjoint , normal and unitary operators, problems.	Lecture , assignment	CO1 , CO2	
28		Test paper on module 3.			

29	2	Zorns Lemma and its applications.	Lecture	CO1 ,CO3	
30	2	Hahn Banach theorem for real vector space.	Lecture	CO1, CO2 , CO3	
31	2	Generalised Hahn Banach theorem, problems.	Lecture , assignment	CO1 , CO3	
32	3	Hahn Banach theorem for a normed space.	Lecture	CO1, CO3	
33	3	Problems on Hahn Banach theorems	Lecture, seminar	CO1 , CO3	
34	3	Adjoint operator, relation between adjoint operator and Hilbert adjoint.	Lecture	CO1 , CO3	
35	2	Reflexive spaces, canonical mapping.	Lecture,seminar	CO1, CO2, CO3	
36	2	Important theorems and problems.	Lecture	Co1 , co3	
37	2	Bairs category theorem, Uniform boundedness theorem.	Lecture , seminar assignment	CO1, CO2 ,CO3	
38	3	Problems on Uniform boundedness theorem	Lecture , assignment	CO1 , CO3	
39		Model examination			

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	2/1/2019	PROBLEMS FROM MODULE 1	CO 1
2	29/1/2019	PROBLEMS FROM MODULE 2	CO 2

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	5/2/2019	PROBLEMS FROM MODULE-4	CO 3

Text book : Introductory Functional Analysis with applications

AUTHOR: ERWIN KREYSZIG, Wiley Classic Library Edition Published 1989

REFERENCES: i) DAY M M , normed linear spaces 3rd edn

ii) TAYLOR A E , introduction to functional analysis

COURSE PLAN-REAL ANALYSIS

PROGRAMME	**M.Sc. MATEMATICS**	**SEMESTER**	**2**
COURSE CODE AND TITLE	**16P2MATT10: REAL ANALYSIS**	**CREDIT**	**4**
HOURS/WEEK	**5**	**HOURS/SEM**	**75**
FACULTY NAME	**Dr. DIDIMOS K. V.**		

CO	CO Statement	PO/PSO	CL	KC	Class Hrs.	Lab Hrs.
CO1	Studying functions of bounded variations, rectifiable curves, paths and equivalence of paths.	PO1/PSO 1	U	C	12	0
CO2	Developing the ideas of Riemann-Stieljes integral and studying integration and differentiation.	PO1/PSO 1	U	C	25	0
CO3	Assimilating the ideas of uniform convergence and continuity, uniform convergence and integration, uniform convergence and differentiation.	PO1/PSO 1	U	C	15	0
CO4	Analysing power series, exponential and trigonometric functions.	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			
CO 5	2						2			

Mapping Strength

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

No of Hours	Topic	Method	Course Outcome
1	A quick review on continuity, uniform continuity, convergence of sequence and series.	Lecture, Group Discussion, Problem Solving Lecture	CO1/ CO2/ CO3/ CO4
2	A quick review on continuity, uniform continuity, convergence of sequence and series.	Lecture, Group Discussion, Problem Solving Lecture	CO1/ CO2/ CO3/ CO4
3	A quick review on continuity, uniform continuity, convergence of sequence and series.	Lecture, Group Discussion, Problem Solving Lecture	CO1/ CO2/ CO3/ CO4

4	A quick review on continuity, uniform continuity, convergence of sequence and series.	Lecture, Group Discussion, Problem Solving Lecture	CO1/ CO2/ CO3/ CO4
5	A quick review on continuity, uniform continuity, convergence of sequence and series.	Lecture, Group Discussion, Problem Solving Lecture	CO1/ CO2/ CO3/ CO4
6	Introduction properties of monotonic functions	Lecture, Group Discussion, Problem Solving	CO1
7	Introduction properties of monotonic functions	Lecture, Group Discussion, Problem Solving	CO1
8	functions of bounded variation	Lecture, Group Discussion, Problem Solving	CO1
9	functions of bounded variation	Lecture, Group Discussion, Problem Solving	CO1
10	total variation	Lecture, Group Discussion, Problem Solving	CO1
11	total variation	Lecture, Group Discussion, Problem Solving	CO1
12	additive property of total variation	Lecture, Group Discussion, Problem Solving	CO1

13	additive property of total variation	Lecture, Group Discussion, Problem Solving	CO1
14	total variation on (a, x) as a functions of x	Lecture, Group Discussion, Problem Solving	CO1
15	total variation on (a, x) as a functions of x	Lecture, Group Discussion, Problem Solving	CO1
16	functions of bounded variation expressed as the difference of increasing functions	Lecture, Group Discussion, Problem Solving	CO1
17	functions of bounded variation expressed as the difference of increasing functions	Lecture, Group Discussion, Problem Solving	CO1
18	continuous functions of bounded variation	Lecture, Group Discussion, Problem Solving	CO1
19	continuous functions of bounded variation	Lecture, Group Discussion, Problem Solving	CO1
20	curves and paths	Lecture, Group Discussion, Problem Solving	CO1
21	curves and paths	Lecture, Group Discussion, Problem Solving	CO1
22	rectifiable path and arc length	Lecture, Group Discussion, Problem Solving	CO1

23	rectifiable path and arc length	Lecture, Group Discussion, Problem Solving	CO1
24	additive and continuity properties of arc length	Lecture, Group Discussion, Problem Solving	CO1
25	equivalence of paths	Lecture, Group Discussion, Problem Solving	CO1
26	Definition and existence of the integral	Lecture, Group Discussion, Problem Solving	CO2
27	Definition and existence of the integral	Lecture, Group Discussion, Problem Solving	CO2
28	Definition and existence of the integral	Lecture, Group Discussion, Problem Solving	CO2
29	Definition and existence of the integral	Lecture, Group Discussion, Problem Solving	CO2
30	Definition and existence of the integral	Lecture, Group Discussion, Problem Solving	CO2
31	properties of the integral	Lecture, Group Discussion, Problem Solving	CO2
32	properties of the integral	Lecture, Group Discussion, Problem Solving	CO2
33	properties of the integral	Lecture, Group Discussion, Problem Solving	CO2

34	properties of the integral	Lecture, Group Discussion, Problem Solving	CO2
35	properties of the integral	Lecture, Group Discussion, Problem Solving	CO2
36	Integration and differentiation	Lecture, Group Discussion, Problem Solving	CO2
37	Integration and differentiation	Lecture, Group Discussion, Problem Solving	CO2
38	Integration and differentiation	Lecture, Group Discussion, Problem Solving	CO2
39	Integration and differentiation	Lecture, Group Discussion, Problem Solving	CO2
40	Integration and differentiation	Lecture, Group Discussion, Problem Solving	CO2
41	integration of vector valued functions	Lecture, Group Discussion, Problem Solving	CO2
42	integration of vector valued functions	Lecture, Group Discussion, Problem Solving	CO2
43	integration of vector valued functions	Lecture, Group Discussion, Problem Solving	CO2
44	integration of vector valued functions	Lecture, Group Discussion, Problem Solving	CO2

45	integration of vector valued functions	Lecture, Group Discussion, Problem Solving	CO2
46	Discussion of main problem	Lecture, Group Discussion, Problem Solving	CO3
47	Discussion of main problem	Lecture, Group Discussion, Problem Solving	CO3
48	uniform convergence	Lecture, Group Discussion, Problem Solving	CO3
49	uniform convergence	Lecture, Group Discussion, Problem Solving	CO3
50	uniform convergence	Lecture, Group Discussion, Problem Solving	CO3
51	uniform convergence	Lecture, Group Discussion, Problem Solving	CO3
52	uniform convergence	Lecture, Group Discussion, Problem Solving	CO3
53	uniform convergence	Lecture, Group Discussion, Problem Solving	CO3
54	uniform convergence and continuity	Lecture, Group Discussion, Problem Solving	CO3
55	uniform convergence and continuity	Lecture, Group Discussion, Problem Solving	CO3

56	uniform convergence and continuity	Lecture, Group Discussion, Problem Solving	CO3
57	uniform convergence and continuity	Lecture, Group Discussion, Problem Solving	CO3
58	uniform convergence and continuity	Lecture, Group Discussion, Problem Solving	CO3
59	uniform convergence and integration	Lecture, Group Discussion, Problem Solving	CO3
60	uniform convergence and integration	Lecture, Group Discussion, Problem Solving	CO3
61	uniform convergence and integration	Lecture, Group Discussion, Problem Solving	CO3
62	uniform convergence and differentiation	Lecture, Group Discussion, Problem Solving	CO3
63	uniform convergence and differentiation	Lecture, Group Discussion, Problem Solving	CO3
64	uniform convergence and differentiation	Lecture, Group Discussion, Problem Solving	CO3
65	uniform convergence and differentiation	Lecture, Group Discussion, Problem Solving	CO3
66	the Stone-Weierstrass theorem (without proof)	Lecture, Group Discussion, Problem Solving	CO3

67	Power series	Lecture, Group Discussion, Problem Solving	CO4
68	the exponential and logarithmic functions	Lecture, Group Discussion, Problem Solving	CO4
69	the exponential and logarithmic functions	Lecture, Group Discussion, Problem Solving	CO4
70	the trigonometric functions	Lecture, Group Discussion, Problem Solving	CO4
71	the algebraic completeness of complex field	Lecture, Group Discussion, Problem Solving	CO4
72	Fourier series.	Lecture, Group Discussion, Problem Solving	CO4
73	Revision	Group Discussion	
74	Revision	Group Discussion	
75	Revision	Group Discussion	

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 March 2019	Problems on Real analysis	CO2/CO3

Text Books:

1. Tom Apostol, Mathematical Analysis (second edition), Narosa Publishing House.
2. Walter Rudin, Principles of Mathematical Analysis (Third edition), International Student Edition.

Additional Reading List

1.Royden H.L, Real Analysis, 2nd edition, Macmillan, New York.

2. Bartle R.G, The Elements of Real Analysis, John Wiley and Sons.

3. S.C. Malik, Savitha Arora, Mathematical Analysis, New Age International Ltd.

4. Edwin Hewitt, Karl Stromberg, Real and Abstract Analysis, Springer International,

1978.