SACRED HEART COLLEGE (AUTONOMOUS)

Department of Mathematics

M.Sc. Mathematics

Course plan

Academic Year 2015 – 16

Semester 1

COURSE PLAN
COURSE: P1MATT01: LINEAR ALGEBRA

Course Teacher: Didimos K. V.

COURSE OBJECTIVES

To understand vector spaces, linear transformation, eigen values and eigen vectors of a linear operatior.

Text Book

1. Kenneth Hoffman / Ray Kunze (Second Edition), Linear Algebra, Prentice-Hall of India Pvt. Ltd., New Delhi, 1992.
   Total Hours : 75

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No of Hours	Topic	Method	Remarks/Reference
2	Vector spaces	Lecture, Group Discussion, Problem SolvingLecture	Module-1 (12 Hours)
2	Subspaces	Lecture, Group Discussion, Problem Solving	
2	Basis and dimension	Lecture, Group Discussion, Problem Solving	
2	Co-ordinates	Lecture, Group Discussion, Problem Solving	
4	Summary of row-equivalence	Lecture, Group Discussion, Problem Solving	
2	Linear transformations	Lecture, Group Discussion, Problem Solving	Module-II (25 Hours)
4	The algebra of linear transformations	Lecture, Group Discussion, Problem Solving	
2	Isomorphism	Lecture, Group Discussion, Problem Solving	
5	Representation of transformations by matrices	Lecture, Group Discussion, Problem Solving	
5	Linear functionals	Lecture, Group Discussion, Problem Solving	
4	Double dual	Lecture, Group Discussion, Problem Solving	
3	Transpose of a linear transformation.	Lecture, Group Discussion, Problem Solving	
2	Commutative Rings	Lecture, Group Discussion, Problem Solving	Module-III (15 Hours)
1	Determinant functions	Lecture, Group Discussion, Problem Solving	
4	Permutation	Lecture, Group Discussion, Problem Solving	

5	Uniqueness of determinants	Lecture, Group Discussion, Problem Solving	
3	Additional properties of determinants	Lecture, Group Discussion, Problem Solving	
1	Introduction to elementary canonical forms	Lecture, Group Discussion, Problem Solving	Module-IV (23 Hours)
3	Characteristic values	Lecture, Group Discussion, Problem Solving	
4	Annihilatory polynomials	Lecture, Group Discussion, Problem Solving	
4	Invariant subspaces	Lecture, Group Discussion, Problem Solving	
3	Simultaneous triangulations	Lecture, Group Discussion, Problem Solving	
3	Simultaneous diagonalisation	Lecture, Group Discussion, Problem Solving	
3	Direct sum decompositions	Lecture, Group Discussion, Problem Solving	
2	Invariant direct sums	Lecture, Group Discussion, Problem Solving	

1. **Additional Reading List**

1. Klaus Jonich. Linear Algebra, Springer Verlag.
2. Paul R. Halmos, Linear Algebra Problem Book, The Mathematical Association of America.

COURSE PLAN

P1MATT02 - Basic Topology

COURSE OBJECTIVES

To introduce Topological space and study the basic properties associated with the space. To introduce the concept of separation axioms.

Text Book: K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd,1984.

Sessions	Topic	Method
1.	Introductory Session – sets, functions and logics.	Lecture
2.	Introductory session - metric spaces and open balls.	Lecture
3.	Module 1 - Introduction to topological spaces	Lecture
4.	Examples of topological spaces	Lecture,
5.	Different types of topological spaces.	Lecturing
6.	Convergence of sequence in spaces	
7.	Convergence of sequence in spaces	Lecture,
8.	Problems on convergence and countability	Lecturing
9.	Introducing base of a topological spaces	Lecturing
10.	Theorems and properties on base	Lecture
11.	Axiom of second countability and theorems	Lecturing
12.	Subbase and their properties	Lecture
13.	Sub spaces	Lecturing
14.	theorems on subspaces	Lecture,
15.	Problems on base and subbase	Lecture, Group Discussion, Problem Solving
16.	Open, closed and clopen sets	Lecture,
17.	Neighbourhood, interior points, accumulation points and closure axiom.	Lecture,
18.	Propositions on Neighbourhood, interior points, accumulation points and closure axiom.	Lecture,

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

41.	Module3 – Introduction	Lecture,
42.	Concept of connectedness	Lecture,
43.	Examples of connectedness	Lecture, Group Discussion, Problem Solving
44.	Theorems on connectedness	Lecture
45.	Propositions	Lecture,
46.	Theorems and Propositions	Lecture,
47.	Components and maximally connected sets	Lecture,
48.	Theorems	Lecture,
49.	Local connectedness - introduction	Lecture,
50.	Examples of local connectedness	Lecture, Group Discussion, Problem Solving
51.	Theorems of local connected space	Lecture,
52.	Path connectedness - introduction	Lecture,
53.	Examples of path connectedness	Lecture, Group Discussion, Problem Solving
54.	Theorems of path connected space	Lecture,
55.	Comparative study between spaces	Lecture,
56.	Comparative study between spaces	Lecture,
57.	Problems solving	Lecture,
58.	Problems solving	Lecture, Group Discussion, Problem Solving
59.	Problems solving	Lecture, Group Discussion, Problem Solving
60.	Module 4 - Introduction	

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

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.

COURSE PLAN
P1MATT03 , MEASURE THEORY AND INTEGRATION

Sl.No	No. of Sessions/hrs	Topics to be taught	Method of teaching
1	2	Fundamentals of real analysis.	Lecture , assignment, seminar.
2.	2	Lebesgue Measure and its properties.	Lecture , assignment.
3	2	Problems based on Lebesgue Measure.	Lecture.
4	2	Leabesgue measurable sets.	Lecture.
5	2	Lebesgue Measure and its properties.	Lecture, assignment.
6	1	Problems based on Lebesgue Measure.	Lecture , Seminar.
7	1	Example of a non- measurable set.	Lecture.
8	2	Measurable Functions and its properties.	Lecture.
9	2	Problems based on Measurable Functions.	Lecture.
10		**Test paper on module -1**	
11	2	Riemann integral , Examples.	Lecture .
12	2	Lebesgue integral of a simple function , properties.	Lecture , assignment.
13	2	Lebesgue integral of a bounded measurable function over a measurable set of finite measure, properties.	Lecture , assignment.
14	2	Lebesgue integral and Riemann integral.	Lecture.
15	1	Bounded convergence theorem.	Lecture.
16	1	Integral of a non negative measurable function.	Lecture.
17		**First internal**	
18	1	Fatous Lemma.	Lecture.
19	1	Monotone convergence theorem.	Seminar.
20	3	Integrability of non negative measurable function and related propositions.	Lecture, seminar.
21	2	Problems based on integral of non negative functions.	Lecture , seminar, assignment.
22	2	General Lebesgue integral and its properties.	Seminar.
23	2	Lebesgue convergence theorem and its general version.	Lecture , seminar
24	2	Problems based on the general integral.	Lecture.
25		**Test paper on module -2**	
26	2	Introduction of abstract measurable space and measure space.	Lecture
27	1	Propositions, finite and sigma finite measure spaces	Lecture, seminar.
28	1	Set of finite measure , a set of sigma finite measure , complete measure.	Lecture , seminar

29	2	Measurable functions and its properties , problems.	Lecture .
30	2	Integral of a non negative simple function with respect to a measure , properties.	Lecture , assignment.
31	2	Integral of a non anegative measurable function with respect to a measure,properties.	Lecture , assignment..
32	2	Fatous Lemma.	Lecture.
33	3	Monotone convergence theorem,followed by two propositions.	Lecture, seminar.
34	2	Lebegue convergence theorem and problems.	Lecture.
35	2	General convergence theorem.	Lecture,seminar .
36	1	Signed measure , positive set , negative set , null set followed by two lemmas.	Lecture.
37	1	Hahn decomposition theorem.	Lecture , seminar assignment.
38	1	Jordan decomposition theorem.	Lecture , assignment.
39	2	Problems based on Hahn and Jordan decomposition theorems.	Lecture , seminar.
		Test paper -3	
41	2	Cartesian product,rectangle, measurable rectangle , elementary sets , problems.	Lecture , seminar.
42	2	**T**he class of all elementary sets is an algebra.	**Lecture.**
42	1	**Product** space , product measure.	Lecture.
43	1	**X-**section and y- section of set and their measurability.	Lecture,seminar .
44	2	**x- section and y-section of a set and their measurability.**	Lecture , assignment.
45	2	**Integral of a non negative measurable function w.r.t. product measure** and related theorems.	Lecture.
46	1	**Fubinis theorem and examples**	Lecture , seminar
47		**Model examination.**	

COURSE PLAN
P1MATT04: ORDINARY DIFFERENTIAL EQUATION

Sessions	Topic	Method
1	Introductory Session	Lecture,Group discussion
2	Basic theory of Linear systems in normal form-two equations in 2 unknown functions	Lecture,Group Discussion,Problem solving
3	Problems	Group Discussion,Problem solving
4	Theorems, Wronskian,Problems	Lecture,Group Discussion,Problem solving
5	Non homogenous Linear systems and problems	Lecture,Group Discussion,Problem solving
6	Homogenous linear system with constant coefficients - Introduction	Lecture,Group Discussion,Problem solving
7	Case 1- when the roots of the characteristic equations are real and distinct and problems	Lecture,Group Discussion,Problem solving
8	Case 2- when the roots of the characteristic equations are conjugate complex and problems	Lecture,Group Discussion,Problem solving
9	Case 3- when the roots of the characteristic equations are real and equal and problems	Lecture,Group Discussion,Problem solving
10	Basic concepts of Matrices and vectors,Inverse	Lecture,Group Discussion,Problem solving
11	Linear dependendence and independence Characteristric values and vectors,problems	Lecture,Group Discussion,Problem solving
12	Introduction – The Marix method for homogenous linear systems with constant coefficients	Lecture,Group Discussion,Problem solving
13	Case of two distinct characteristic values and problems	Lecture,Group Discussion,Problem solving
14	Case of a double characteristic values and problems	Lecture,Group Discussion,Problem solving
15	Theorems and problems	Lecture,Group Discussion,Problem solving
16	Test	1 Hour
17	Introduction and review of Power series	Lecture,Group Discussion
18	Radius of Convergence, problems	Lecture,Group Discussion,Problem solving
19	Sum ,Scalar product and Cauchy product of series ,problems	Lecture,Group Discussion,Problem solving
20	Series solution of first order differential equations,problems	Lecture,Group Discussion,Problem solving
21	Problems	Group Discussion,Problem solving

22	Second order Linear equations: ordinary points-Introduction and problem	Lecture,Group Discussion,Problem solving
23	Problems	Group Discussion,Problem solving
24	Regular singular points and problems	Lecture,Group Discussion,Problem solving
25	Method of Frobenius series and problems	Lecture,Group Discussion,Problem solving
26	Problems	Group Discussion,Problem solving
27	More on Regular singular points and problems	Lecture,Group Discussion,Problem solving
28	Problems	Group Discussion,Problem solving
29	Gauss's Hypergeometric equations and problems	Lecture,Group Discussion,Problem solving
30	Problems	Group Discussion,Problem solving
31	Problems	Group Discussion,Problem solving
32	Introduction to Picard's Existence and uniqueness Theorem-The form of a Differential Equation	Lecture,Group Discussion,Problem solving
33	Picard's iteration Technique and some examples	Lecture,Group Discussion,Problem solving
34	Estimation of the Picard's iterates and Problems	Lecture,Group Discussion,Problem solving
35	Problems	Group Discussion,Problem solving
36	CIA-I	1 hour
37	Introduction to Boundary Value problems – Definition and examples	Lecture,Group Discussion,Problem solving
38	Non trivial solutions of Strum Liouville problems	Lecture,Group Discussion,Problem solving
39	Problems	Group Discussion,Problem solving
40	Characteristic values and Characteristic functions	Lecture,Group Discussion,Problem solving
41	Theorems and problems	Lecture,Group Discussion,Problem solving
42	Problems	Group Discussion,Problem solving
43	Orthogonality of Functions and examples	Lecture,Group Discussion,Problem solving
44	Orthogonality of Characteristic Functions and examples	Lecture,Group Discussion,Problem solving
45	Theorem and problems	Lecture,Group Discussion,Problem solving
46	Problems	Group Discussion,Problem solving
47	Orthonormal systems and examples	Lecture,Group Discussion,Problem solving
48	The expansion of a function in a series of ortho-normal functions	Lecture,Group Discussion,Problem solving
49	Theorem and Problems	Lecture,Group Discussion,Problem solving
50	Problems	Group Discussion,Problem solving

51	Introduction of Laplace transforms	Lecture,Group Discussion,Problem solving
52	Laplace transforms of basic functions	Lecture,Group Discussion,Problem solving
53	Problems	Group Discussion,Problem solving
54	Applications to Differential Equations - examples	Lecture,Group Discussion,Problem solving
55	More Examples	Lecture,Group Discussion,Problem solving
56	Problems	Group Discussion,Problem solving
57	Derivatives of Laplace transforms ,examples	Lecture,Group Discussion,Problem solving
58	Problems	Group Discussion,Problem solving
59	Integrals of Laplace transforms ,examples	Lecture,Group Discussion,Problem solving
60	Problems	Group Discussion,Problem solving
61	Properties of Laplace transforms and problems	Lecture,Group Discussion,Problem solving
62	Convolutions and example	Lecture,Group Discussion,Problem solving
63	More examples and Abel's Mechanical Problem	Lecture,Group Discussion,Problem solving
64	Continuation of Abel's Mechanical Problem	Lecture,Group Discussion,Problem solving
65	Analysing Abel's Mechanical Problem	Lecture,Group Discussion,Problem solving
66	Problems	Group Discussion,Problem solving
67	The unit step function-Introduction	Lecture,Group Discussion,Problem solving
68	Principle of Superposition and example	Lecture,Group Discussion,Problem solving
69	The Impulse function -Introduction	Lecture,Group Discussion,Problem solving
70	Examples	Lecture,Group Discussion,Problem solving
71	Problems	Group Discussion,Problem solving
72	CIA-II	2 Hours
73	Discussion Of CIA-II	
74	Revision	
75	Revision	

P1MATT05: COMPLEX ANALYSIS
COURSE PLAN

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 Objectives:
To develop in a rigorous and self contained manner the elements of complex variables and to furnish an introduction to applications and residues and conformal mappings

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

Sessions	Topic	Method	Remarks/Reference
1	Introductory Session		
2	Introduction of Complex Numbers		
3	Conformality: arcs and closed curves		
4	analytic functions in regions,		
5	Problems		
6	conformal mapping,		
7	length and area	Student Seminar 1	
8	Linear transformations: linear group		
9	The cross ratio, symmetry		
10	Problems	Student Seminar 2	
11	oriented circles		
12	Family of circles		
13	Problems	Student Seminar 3	
14	Elementary conformal mappings: the use of level curves		
15	a survey of elementary mappings, elementary Riemann surfaces		
16	Mapping $w = z^2$		
17	Mapping $w = e^z$		
18	Problems	Student Seminar 4	

19	Line integrals, rectifiable arcs		
20	line integrals as functions of arcs		
21	Cauchy's theorem for a rectangle		
22	Cauchy's theorem in a disk		
23	Cauchy's integral formula: the index of a point with respect to a cloud curve		
24	Assignment Question	Discussion	
25	The integral formula,		
26	Higher derivatives		
27	Problems		
28	Problems		
29	Seminar		
30	First Internal Examination	Examination	
31	Local properties of analytical functions		
32	Removable singularities		
33	Taylor's theorem		
34	Zeroes and poles		
35	the local mapping		
36	The maximum principle		
37	The general form of Cauchy's theorem		
38	Chains and cycles		
39	simple connectivity		
40	Homology		
41	General statement of Cauchy's theorem		
42	General statement of Cauchy's theorem		
43	Locally exact differentiation		
44	multiply connected regions		
45	Problems		
46	Problems		
47	Problems		
48	Problems		
49	Problems		
50	Problems		
51	Assignment Questions	Discussion	

52	Calculus of Residues Introduction		
53	The residue theorem		
54	Problems		
55	Problems		
56	Problems		
57	the argument principle, evaluation of definite integrals		
58	Problems		
59	Problems		
60	Problems		
61	Harmonic functions		
62	the mean value property,		
63	Poisson's formula,		
64	Schwarz theorem		
65	The reflection principle		
66	Second Internal Examination		
67	Problems		
68	Problems	Discussion	
69	Problems	Discussion	
70	Problems	Discussion	
71	Problems	Discussion	
72	Problems	Discussion	
73	Revision		
74	Revision		
75	Course feedback		

References :

1. Chaudhary. B, The elements of Complex Analysis, Wiley Eastern.
2. Cartan. H (1973), Elementary theory of Analytic functions of one or several variable, Addison Wesley.
3. Conway .J.B, Functions of one Complex variable, Narosa publishing.
4. Lang. S, Complex Analysis, Springer.
5. H.A. Priestly, Introduction to Complex Analysis, Clarendon press, Oxford, 1990.