SACRED HEART COLLEGE (AUTONOMOUS)

Department of Mathematics

M.Sc. Mathematics

Course plan

Academic Year 2016 – 17

Semester 3

COURSE PLAN
COURSE: MULTIVARIATE CALCULUS AND INTEGRAL TRANSFORMS

Course Instructors
Prof. Sanil Jose

Course Prerequisites:

Calculus, Analysis, Partial differentiation

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 an idea about Fourier series and Fourier transforms
- To learn about directional derivatives and chain rule
- To study the idea of differentiation in multi variable functions
- To learn how integration is introduced in multi variable functions

Text Books
Text 1: Tom APOSTOL, Mathematical Analysis, Second edition, Narosa Publishing House.
Text 2: WALTER RUDIN, Principles of Mathematical Analysis, Third edition – International Student Edition.

	TOPIC
1	INTRODUCTION
2	THE WEIRSTRASS THEOREM
3	OTHER FORMS OF FOURIER SERIES
4	THE FOURIER INTEGRAL THEOREM
5	THE EXPONENTIAL FORM OF FORIER SERIES
6	INTEGRAL TRANSFORMS
7	CONVOLUTION
8	SEMINAR
9	SEMINAR
10	PROBLEMS
11	PROBLEMS
12	TUTORIAL
13	SEMINAR
14	QUESTION PAPER REVISION
15	THE DIRECTIONAL DERIVATIVE
16	CONTINUITY
17	TOTAL DERIVATIVE

18	TOTAL DERIVATIVE AS PARTIAL DERIVATIVES
19	TOTAL DERIVATIVE AS PARTIAL DERIVATIVES
20	APPLICATION TO COMPLEX NUMBERS
21	APPLICATION TO COMPLEX NUMBERS
22	MATRIX FORM
23	MATRIX FORM
24	JACOBIAN MATRIX
25	CHAIN RULE MATRIX FORM
26	CHAIN RULE MATRIX FORM
27	SEMINAR
28	SEMINAR
29	PROBLEMS
30	PROBLEMS
31	TUTORIAL
32	MEAN VALUE THEOREM
33	MEAN VALUE THEOREM
34	SUCCIFIENT CONDITION FOR DIFFERENTIABILITY
35	SUCCIFIENT CONDITION FOR DIFFERENTIABILITY
36	MIXED DERIVATIVE THEOREM
37	INVERSE FUNCTION THEOREM
38	IMPLICIT FUNCTION THEOREM
39	EXTREMA OF REAL VALUED FUNCTIONS
40	EXTREMA OF REAL VALUED FUNCTIONS
41	SEMINAR
42	SEMINAR
43	PROBLEMS
44	PROBLEMS
45	TUTORIAL
46	SEMINAR
47	SEMINAR
48	SEMINAR
49	SEMINAR
50	SEMINAR
51	SEMINAR
52	SEMINAR
53	SEMINAR
54	SEMINAR
55	PRIMITIVE MAPPING
56	PARTITION OF UNITY
57	PARTITION OF UNITY
58	CHANGE OF VARIABLES
59	DIFFERENTIAL FORMS
60	STOKES THEOREM
61	STOKES THEOREM

62	STOKES THEOREM
63	SEMINAR
64	SEMINAR
65	SEMINAR
66	SEMINAR
67	SEMINAR
68	SEMINAR
69	SEMINAR
70	SEMINAR
71	SEMINAR
72	SEMINAR

References:-

1. Limaye Balmohan Vishnu, Multivariate Analysis, Springer.

2. Satish Shirali and Harikrishnan, Multivariable Analysis, Springer

COURSE PLAN FOR FUNCTIONAL ANALYSIS

Text book :Introductory Functional Analysis with applications

Author: ERWIN KREYSZIG,Wiley Classic Library Edition Published 1989

Course objectives

1.Students will have a better perspective on mathematics as per modern requirement.

2.Students enhance their logical ,reasoning ,analytical and problem solving skills. **3**.The students possess an ethical view of life, and have a broader perspective transcending the provincial outlook.

4.Students are able to effectively communicate the knowledge of their study and research in their respective disciplines to their employers and to the society at large.

5.The students possess a passion for exploring new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process.

6.To understand the basics of Functional analysis

7.To apply Functional analysis in the other disciplines.

8.To understand theory of Operators and Functionals using Linear Algebra.

9.To discover the link of Functional analysis with geometry , differential equations etc.

Sl.No	**No. of Sessions/hrs**	**Topics to be taught**	**Method of teaching**
1	1	Fundamentals of Linear Algebra and Metric spaces.	Lecture , Seminar , Assignment
2.	3	Normed space and Banach space , examples and their properties , problems.	Lecture , assignment
3	2	Finite dimensional normed spaces and their sub spaces , problems.	Lecture
4	2	Compactness and finite dimension , problems.	Lecture

5	2	Linear operators, examples and their properties, problems.	Lecture, assignment
6		**Test paper.**	
7	2	Bounded and continuous linear operators and examples.	Lecture
8	2	Problems based on bounded linear operators.	Lecture
9	1	Linear functionals , examples.	Lecture
10		**First internal**	
11	2	Bounded linear Functionals and their properties, problems.	Lecture
12	2	Linear Operators and Functionals on a finite dimensional normed space , problems.	Lecture , assignment
13	2	Normed space of Operators and Functionals.	Lecture , assignment
14	2	Examples of dual spaces.	Lecture
15		**Test paper on module 2**	

16	2	Inner product spaces and Hilbert spaces , examples , problems.	Lecture
17	2	Further properties of inner product spaces.	Lecture , seminar
18	2	Orthogonal complement and direct sum , problems.	Lecture
19	2	Orthogonal sets and sequences.	seminar
20	2	Bessel inequality, Gram-Schmidt process for ortho normalisation.	Lecture, seminar
21	2	Total ortho normal sets and sequences , problems.	Lecture , seminar, assignment
22	2	Rieszs theorem .	seminar
23	2	Sesqui linear functional and Riesz representation theorem.	Lecture , seminar
24	3	Problems based on Riesz theorem and Riesz representation theorem.	Lecture
25	2	Hilbert adjoint and its properties.	Lecture , seminar

2	3	Problems based on Hilbert adjoint operators.	Lecture , assignment , seminar
27	2	Self adjoint , normal and unitary operators, problems.	Lecture , assignment
28		**Test paper on module 3.**	
29	2	Zorns Lemma and its applications.	Lecture
30	2	Hahn Banach theorem for real vector space.	Lecture
31	2	Generalised Hahn Banach theorem, problems.	Lecture , assignment
32	1	Hahn Banach theorem for a normed space.	Lecture
33	3	Problems on Hahn Banach theorems	Lecture, seminar

34	1	Adjoint operator, relation between adjoint operator and Hilbert adjoint.	Lecture
35	2	Reflexive spaces, canonical mapping.	Lecture,seminar
36	2	Important theorems and problems.	Lecture
37	2	Bairs category theorem, Uniform boundedness theorem.	Lecture , seminar assignment
38	1	Problems on Uniform boundedness theorem	Lecture , assignment
39		**Model examination**	

COURSE PLAN

DIFFERENTIAL GEOMETRY

Course Teacher: Didimos K. V.

COURSE OBJECTIVES

To understand the geometry of n-dimension Euclidean space.

Text Book

1. **Text Book: John A. Thorpe, Elementary Topics in Differential Geometry**

.

No of Hours	Topic	Method	Remarks/Reference
2	Graphs and level sets	Lecture, Group Discussion, Problem SolvingLecture	Module-1 (20 Hours)
2	vector fields	Lecture, Group Discussion, Problem Solving	
4	The tangent space	Lecture, Group Discussion, Problem Solving	
6	Surfaces	Lecture, Group Discussion, Problem Solving	
6	Vector fields on surfaces, orientation.	Lecture, Group Discussion, Problem Solving	
4	The Gauss map	Lecture, Group Discussion, Problem Solving	Module-II (15 Hours)
5	Geodesics	Lecture, Group Discussion, Problem Solving	
6	Parallel transport	Lecture, Group Discussion, Problem Solving	
6	The Weingarten map	Lecture, Group Discussion, Problem Solving	Module-III (20 Hours)
7	Curvature of plane curves	Lecture, Group Discussion, Problem Solving	
7	Arc length and line integrals	Lecture, Group Discussion, Problem Solving	

7	Curvature of surfaces	Lecture, Group Discussion, Problem Solving	Module-IV (20 Hours)
7	Parametrized surfaces	Lecture, Group Discussion, Problem Solving	
6	local equivalence of surfaces and Parametrized surfaces	Lecture, Group Discussion, Problem Solving	

References:-

1. Serge Lang, Differential Manifolds
2. I.M. Siger, J.A Thorpe, Lecture notes on Elementary topology and Geometry, Springer (1967)
3. S. Sternberg, Lectures on Differential Geometry, Prentice-Hall, 1964.
4. M. DoCarmo, Differential Geometry of curves and surfaces.
5. Goursat, Mathematical Analysis, Vol – 1(last two chapters)

COURSE PLAN
NUMBER THEORY

Course Teacher: Didimos K. V.

COURSE OBJECTIVES

To understand arithmetic functions, prime number theorm.
To understand algebraic integers in a number field and factorization of ideals.

Text Book

1. Introduction to Analytic Number Theory, Tom M Apostol, Springer International Student Edition.
2. Algebraic Number Theory and Fermat's Last Theorem, Ian Stewart and David Tall, Third Edition.

No of Hours	Topic	Method	Remarks/Reference
1	The Mobius function, The Euler totient function	Lecture, Group Discussion, Problem SolvingLecture	Module-1 (25 Hours)
2	The Dirichlet product of arithmetical functions, Dirichlet inverses and Mobius inversion formula	Lecture, Group Discussion, Problem Solving	
2	The Mangoldt function Multiplicative functions and Dirichlet multiplication	Lecture, Group Discussion, Problem Solving	
2	The inverse of completely multiplicative functions	Lecture, Group Discussion, Problem Solving	
3	The Liovillie's function ,The divisor function, Generalized convolutions	Lecture, Group Discussion, Problem Solving	
1	The big oh notation, Asymptotic equality of functions	Lecture, Group Discussion, Problem Solving	

3	Euler's summation formula, Some elementary asymptotic formulas	Lecture, Group Discussion, Problem Solving	
3	The average order of d(n), The average order of the divisor function, Average order of $\phi(n)$	Lecture, Group Discussion, Problem Solving	
1	An application of distribution of lattice points visible from the origin	Lecture, Group Discussion, Problem Solving	
2	Averageorder of $\mu(n)$ and of $\Lambda(n)$	Lecture, Group Discussion, Problem Solving	
2	The partial sums of a Dirichlet product	Lecture, Group Discussion, Problem Solving	
3	Application to$\mu(n)$ and $\Lambda(n)$	Lecture, Group Discussion, Problem Solving	
1	Chebyshev's functions $\Psi(x)$ and $\theta(x)$	Lecture, Group Discussion, Problem Solving	Module-2 (18 Hours)
1	Relation connecting $\Psi(x)$ and $\pi(x)$	Lecture, Group Discussion, Problem Solving	
2	Some equivalent forms of prime number theorem	Lecture, Group Discussion, Problem Solving	
2	Inequalities of $\pi(n)$ and p_n	Lecture, Group Discussion, Problem Solving	
2	Definition and basic properties of congruences	Lecture, Group Discussion, Problem Solving	
1	residue classes and complete residue systems	Lecture, Group Discussion, Problem Solving	

1	liner congruences	Lecture, Group Discussion, Problem Solving	
2	Reduced residue systems and Euler – Fermat theorem	Lecture, Group Discussion, Problem Solving	
1	Polynomial congruences modulo	Lecture, Group Discussion, Problem Solving	
3	Lagrange's theorem, applications of Lagrange's theorem	Lecture, Group Discussion, Problem Solving	
1	Simultaneous linear congruences	Lecture, Group Discussion, Problem Solving	
1	The Chinese reminder theorem.	Lecture, Group Discussion, Problem Solving	
2	Trivial FactorizationsFactorization into Irreducibles	Lecture, Group Discussion, Problem Solving	
3	Examples of Non-Unique Factorization into Irreducibles	Lecture, Group Discussion, Problem Solving	
4	Prime Factorization	Lecture, Group Discussion, Problem Solving	Module-3 (17 Hours)
5	Euclidean Domains	Lecture, Group Discussion, Problem Solving	
3	Euclidean Quadratic Fields.	Lecture, Group Discussion, Problem Solving	
6	Prime Factorization of Ideals	Lecture, Group Discussion, Problem Solving	Module-4 (15 Hours)

6	The Norm of an Ideal	Lecture, Group Discussion, Problem Solving	
3	Nonunique Factorization of Cyclotomic Fields.	Lecture, Group Discussion, Problem Solving	

1. Additional Reading List

1. Hardy G.H and Wright E.M, Introduction to the Theory of numbers, Oxford, 1981
2. Leveque W.J, Topics in Number Theory, Addison Wesley, 1961.
3. J.P Serre, A Course in Arithmetic, GTM Vol. 7, Springer-Verlag, 1973
4. D Marcus, Number Fields (Springer-Verlag, New York-Heidelberg)