Lecture Plan

Name of the college: Government College of Arts , Science & Commerce, Sanquelim, Goa.

Name of Faculty: Navnita Nilkanth Sawant	**Subject:** Mathematical Methods	
Paper code: MAT-521	**Program: M.Sc.**	**Division:**
Academic year: 2024 - 2025	**Semester: I**	**Total Lectures: 68**

Course Objectives:

1. **To prepare students to handle solving problems involving variational problem with fixed boundaries and moving boundaries**
2. **Understand different solution techniques and use tools like fourier transforms, fourier series in problem solving**

Expected Course Outcome: Student will be able to

1) Learn Theory and application of Fourier Series
2) Comprehend techniques of applying Fourier Transform
3) Understands basic concepts of variational problems
4) Understand Fourier Transform

Student Learning Outcome:

1) Evaluate the fourier series expansion for different periodic function
2) Analyse the properties of a fourier transform
3) Determine the fourier transform of a function
4) Discuss the sufficient condition for extremum

Month	Lecture From	Lecture To	No. of lectures allotted	Topic, Subtopic to be covered	Exercise/ Assignment	ICT Tools	Reference books
June	24/06/2024	29/06/2024	02	**Improper Integral:** Review, Properties and L^2 convergence	1)Discussing the convergence of improper integral .	Smart Board	1)J.W.Brown and R.V.Churchill,Fourier series Boundary Value Problem, McGraw Hill.(2012)
July	01/07/2024	06/07/2024	04	**Fourier Series:** Piecewise continuous function, fourier cosine series, periodic extension, fourier sine series.	1)Finding the fourier sine series and fourier cosine series for the given function.	Smart Board	1)J.W.Brown and R.V.Churchill,Fourier series Boundary Value Problem, McGraw Hill.(2012)
July	08/07/2024	13/07/2024	04	Example on fourier sine and cosine series, Pointwise and uniform convergence of fourier series.	1)Discussing the uniform convergence and pointwise convergence of the fourier series.	Smart Board	1)J.W.Brown and R.V.Churchill,Fourier series Boundary Value Problem, McGraw Hill.(2012)
July	15/07/2024	20/07/2024	04	Differentiation and Integration of fourier series, Piecewise smooth function, Dirichlet kernel, properties of Dirichlet kernel	1)Integrate the given fourier series	Smart Board	1)J.W.Brown and R.V.Churchill,Fourier series Boundary Value Problem, McGraw Hill.(2012)

July	22/07/2024	27/07/2024	04	An integration formula and lemmas. Fourier Integral Theorem and exercise on it.		Smart Board	1)J.W.Brown and R.V.Churchill,Fourier series Boundary Value Problem, McGraw Hill.(2012)
July-August	29/07/2024	03/08/2024	04	**Fourier Transforms and its properties:** Fourier Transform of $L^1(IR)$ function, fourier cosine and sine transform, Examples.	1)Finding the fourier transform of given $L^1(IR)$ function by using definition 2) Find the fourier sine and cosine transform of given $L^1(R)$ function by using definition	Smart Board	1) K.SankaraRao, Introduction to partial differential equations, Prentice Hall of India, 1995
August	05/08/2024	10/08/2024	04	Properties of fourier transform: Linearity, Change of scale, Shifting property, Modulation Property, Differentiation, Integartion, Partial differentiation, and Example on it.	1)Finding fourier transform by using properties of fourier transform.	Smart Board	1) K.SankaraRao, Introduction to partial differential equations, Prentice Hall of India, 1995
August	12/08/2024	17/08/2024	04 Independent Day	Convolution Theorem and Parseval's Identity for fourier transform, Examples.	Solving problem by using convolution theorem and	Smart Board	1) K.SankaraRao, Introduction to partial differential equations,

					Parseval's Identity for fourier transform		Prentice Hall of India, 1995
August	19/08/2024	24/08/2024	04	**<u>Variational Problem:</u>** Functional, Closness of function in sense of n^{th} order proximity, Continuity of functional in sense of k^{th} order proximity, Increment in functional, p^{th} order distance between two curves, linearity of functional.	1)Finding p^{th} order distance between two curves. 2)Finding Increment of functional by using definition 3)Discussing the continuity of functional	Smart Board	1)Lev Elsgolts, Introduction to the calculus of variation, MIR publications, 2003
August	26/08/2024	31/08/2024	04	Variational of functional, uniqueness of variational of functional, maxima and minima of functional, fundamental lemma of calculus of variation.	1)Finding maxima and Minima of functional	Smart Board	1)Lev Elsgolts, Introduction to the calculus of variation, MIR publications, 2003
September	02/09/2024	07/09/2024	04 Ganesh Chaturti Break	Eulers- Lagrange equations, Forms of Eulers equation, Particular cases of Eulers equation, variational problem with fixed boundaries. Brachistochrone's Problem	1)Solving variational problem with fixed boundaries.	Smart Board	1)Lev Elsgolts, Introduction to the calculus of variation, MIR publications, 2003
September	09/09/2024	14/09/2024	04 Ganesh Chaturti Break	Functional for several dependent variable, Functional depending on Higher derivative, Examples.	1)Solving variational problem for the functional dependent on several	Smart Board	1)Lev Elsgolts, Introduction to the calculus of variation, MIR publications, 2003

					dependent and functional dependent on higher derivative.		
September	16/09/2024	21/09/2024	04	Functional dependent on several independent variables, Isoperimetric problems, Examples	-Solving Isoperimetric problem	Smart Board	1)Lev Elsgolts, Introduction to the calculus of variation, MIR publications, 2003
September	23/09/2024	28/09/2024	04	Elementary variational problems with moving boundaries, Orthogonality condition.	-Solving variational problem with moving boundaries	Smart Board	1)Lev Elsgolts, Introduction to the calculus of variation, MIR publications, 2003
September-October	30/09/2024	05/09/2024	04 Gandhi Jayanti	Extremal with cusps, one sided variation, field, slope of field, central field, centre of field, extremal field, examples.	Finding proper field, central field, Extremal field and centre of field for the given domain.	Smart Board	1)Lev Elsgolts, Introduction to the calculus of variation, MIR publications, 2003
October	07/10/2024	12/10/2024	04	Jacobis sufficient condition, analytic form of jacobis condition, Legendre's condition, Weierstrass function E.		Smart Board	1)Lev Elsgolts, Introduction to the calculus of variation, MIR publications, 2003
October	14/10/2024	19/10/2024	04	Eigen Value and Eigen functions, Hamiltonian of the functional.	1)Finding eigen value and eigen function for the given variational problem	Smart Board	1)Lev Elsgolts, Introduction to the calculus of variation, MIR publications, 2003

October	21/10/2024	26/10/2024	04	Revision		Smart board	1)Lev Elsgolts, Introduction to the calculus of variation, MIR publications, 2003 2)J.W.Brown and R.V.Churchill,Fourier series Boundary Value Problem, McGraw Hill.(2012) 3) K.SankaraRao, Introduction to partial differential equations, Prentice Hall of India, 1995

*** Assessment Rubrics**

Component	Max Marks
ISA 1	20
ISA 2	20
ISA 3	20
Practical	Nil
Project	Nil
Semester End Exam	40