DEPARTMENT OF MATHEMATICS

Semester : IX **Integrated M.Sc. Mathematics** **Academic Year : 2019 -20**

Subject: 060090902 Calculus of Variations and Integral Equations

Teaching Schedule

Course Objectives: To introduce the methods and concepts to solve integral equations and problems through calculus of variations.

Course outcomes: Upon completion of the course, students shall be able to

CO1: familier with concept of variations.

CO2: derive some classical differential equations by using principles of calculus of variations.

CO3: have acquired sound knowledge of Green's function, fredholm and Volterra integral equations of calculus of variations.

CO4: solve simple IVP and BVP by using calculus of several variable.

CO5: reduce the differential equation to integral equations.

CO6: exposed to the decomposition method.

Unit	Sub Unit	No. of Lect.(s)	Topics	Reference Chapter/ Additional Reading	Teaching Methodology to be used	Active Learning Activities	Evaluation Parameter
Unit 1: Introduction of calculus of variations							
[16]	1.1	1	Maxima and minima	Ch#2 Methods of Applied Mathematics By Francis B. Hildebrand	Chalk & Talk	**For Slow Learner:** Students must write answer of question(s) given by teacher after completion of each method and verified by teacher to resolve any query of students. **For Active Learner:** Student will solve exercise given in book after completion of Unit.	Unit Test -1 Assignment-1
	1.2	1	Boundary conditions and Transition conditions				
	1.3	2	Variational notation				
	1.4	2	Constraints and Lagrange multipliers				
	1.5	2	Variable and points				
	1.6	2	Strum-Liouville problems				
	1.7	1	Hamilton's principle				
	1.8	1	Lagrange's equations				
	1.9	1	Generalized dynamical entitites				
	1.10	1	constraints in dynamical				

			systems				
	1.11	1	Small vibrations about equilibrium				
	1.12	1	Normal coordinates				
Unit 2: Variational problems							
[12]	2.1	2	Variational problems of deformable bodies	Ch#2 Methods of Applied Mathematics By Francis B. Hildebrand	Chalk & Talk	**For Slow Learner:** Students must write answer of question(s) given by teacher after completion of each method and verified by teacher to resolve any query of students. **For Active Learner:** Student will solve exercise given in book after completion of Unit.	Unit Test -1 and 2 Assignment-2
	2.2	1	Useful transformations				
	2.3	3	Variational problem for elastic plate				
	2.4	3	Rayleigh-Ritz method				
	2.5	3	Semi direct method				
Unit 3: Introduction to Integral Equations							
[12]	3.1	1	Relations between differential and integral equations	Ch#3 Methods of Applied Mathematics By Francis B. Hildebrand	Chalk & Talk	**For Slow Learner:** Students must write answer of question(s) given by teacher after completion of each method and verified by teacher to resolve any query of students. **For Active Learner:** Student will solve exercise given in book after completion of Unit.	Unit Test -2 Assignment-3
	3.2	1	The Green's function				
	3.3	1	Linear Equations in cause and effect				
	3.4	1	the influence function				
	3.5	2	Fredholm equations with separable kernels				
	3.6	1	Hilbert - Schmidt theory				
	3.7	1	Iterative methods for solving equations of the second kind				
	3.8	1	The Neumann series				
	3.9	1	Fredholm theory				
	3.10	1	Singular Integral Equations				

	3.11	1	Iterative Scheme for solving Volterra Integral Equation of second kind				
Unit 4: Methods to solve in integral equations							
[12]	4.1	2	Iterative approximations to characteristic functions	Ch#3 Methods of Applied Mathematics By Francis B. Hildebrand	Chalk & Talk	**For Slow Learner:** Students must write answer of question(s) given by teacher after completion of each method and verified by teacher to resolve any query of students. **For Active Learner:** Student will solve exercise given in book after completion of Unit.	Internal Examination Assignment-4
	4.2	2	Approximations of Fredholm equations by sets of algebraic equations				
	4.3	2	Approximate method of undermined coefficients				
	4.4	2	The method of collocation				
	4.5	2	The method of weighting functions				
	4.6	1	The method of least squares				
	4.7	1	Approximation of the kernel				

Text books:

1. Hilderbrand F. B., “Methods of Applied Mathematics”, Prentice Hall Inc., 2nd Edition,1965.
2. Kanwal R.P., “Generalized Functions: Theory and Technique”, Academic Press, New York, 1983.
3. Mikhlin S.G., “Linear integral equation (translated from Russian)”, Hindustan Book Agency, 1960.

Reference books:

1. Lovitt W.V.: “Linear integral equation”, Dover Pub., 1st Ed. 1950.
2. Sneddon I.N.: “Mixed boundary value problems in potential theory”, North Holland, 1966.

Course Objectives and Course Outcomes Mapping:

- Be familiar with the concepts of integral operator and functional: CO1, CO2

- Have acquired sound knowledge of Green's functions and Fredholm and Volterra equations: CO3, CO4, CO5,CO6.

Course Units and Course Outcomes Mapping:

Unit No.	Unit	Course Outcomes					
		CO1	CO2	CO3	CO4	CO5	CO6
1	Introduction of calculus of variations	✓	✓				
2	Variational problems		✓				✓
3	Introduction to Integral Equations			✓	✓	✓	✓
4	Methods to solve in integral equations				✓	✓	✓

Programme Outcomes (PO)

PO1: Knowledge

Provides knowledge about the fundamentals of pure, applied and computing mathematics and its applications to students that creates the opportunities in industries and research centers.

PO2: Core Competence

Creates competency in science and mathematics to formulate, analyses and solve problem and/or also to pursue advanced study or research.

PO3: Breadth

Trains students having good knowledge in unearth core of academia and industry by the roots of mathematics.

PO4: Evaluation

Imparts in students to raise trial and error-based curiosity and problem-solving functionality with research based advanced tutorial for higher level decision makings tools.

Programme Outcomes and Course Outcomes mapping:

Programme Outcomes	Course Outcomes					
	CO1	CO2	CO3	CO4	CO5	CO6
PO1	✓	✓				
PO2		✓	✓	✓		
PO3			✓	✓	✓	✓
PO4				✓	✓	✓