20MSM510T					Calculus of Variation and Integral Equations					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the Fredholm and Volterra Integral Equations.
- To classify the initial and boundary value problems and evaluate.
- To apply variation problem technique for solving differential equations and extremum problems.
- To explain the significance of Eigen-values and Eigen-vectors.

UNIT 1 CALCULUS OF VARIATION – PART 1 **10 Hrs.**

Variational problems with fixed boundaries - Euler's equation for functional containing first-order derivative and one independent variable. Extremals, Functional dependent on higher order derivatives. Functional dependent on more than one independent variable. Variational problems in parametric form. Invariance of Euler's equation under coordinate transformation.

UNIT 2 CALCULUS OF VARIATION – PART 2 **10 Hrs.**

Variational problems with moving boundaries. Functional dependent on one and two functions. One sided variations. Sufficient conditions for an extremum — Jacobi and Legendre conditions. Second variation. Variational principle of least action. Applications.

UNIT 3 INTEGRAL EQUATIONS – PART 1 **10 Hrs.**

Linear integral equations: Volterra integral equations, Fredholm integral equations, Some basic identities, Types of kernels: Symmetric kernel, Separable kernel, Iterated kernel, Resolvent kernel, Initial value problems reduced to Volterra integral equations, Solution of Volterra integral equation using: Resolvent kernel, Successive approximation, Neumann series method.

UNIT 4 INTEGRAL EQUATIONS – PART 2 **10 Hrs.**

Boundary value problems reduced to Fredholm integral equations, Solution of Fredholm integral equations using separable kernel, Resolvent kernel. Methods of successive approximation and successive substitution to solve Fredholm equations of second kind. Solution of Homogeneous Fredholm integral equation: Eigen values, Eigen vectors.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand theory of calculus of variations to solve initial and boundary value problems.
CO2 – Summarize the concept of Kernels.
CO3 – Apply the concept of Eigen-values and Eigen-vectors.
CO4 – Explain the principle of least action.
CO5 – Analyze the maxima and minima of a functional.
CO6 – Construct linear integral equations of first and second type (Volterra and Fredholm).

TEXT / REFERENCE BOOKS

1. I. M. Gelfand and S.V. Fomin, Calculus of variations, Prentice Hall. Inc., 1963.
2. William Vernon Lovitt, Linear integral equations, Dover Publication Inc. Newyork, 2005.
3. M. Rahman, Integral equations and their applications, WIT Press, Boston, 2007.
4. Lev D. Elsgole, Calculus of Variations, Dover Publication Inc. Newyork, 2007.
5. S.G. Mikhlin, Integral equations, Pergamon Press, 1965.