

# MA 401: OPTIMIZATION AND CALCULUS OF VARIATIONS

Teaching Scheme			Credits	Marks			Duration of End Semester Examination
L	T	P/D		Sessional	End Semester Exam	Total	
2	2	0	3	40	60	100	3 hrs

## COURSE OBJECTIVES:

The objective of this course is to present different methods of solving optimization problems in the three areas of linear programming, nonlinear programming, and classical calculus of variations. In addition to theoretical treatments, there will be some introduction to numerical methods for optimization problems.

## COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	<p><b>Introduction:</b> A survey of some simplified examples of common real world situations leading to optimization problems, basic formulation and theory of optimization problems.</p> <p><b>Linear programming:</b> Linear programming (optimization of linear functions subject to linear constraints): basic theory; simplex method, duality, practical techniques.</p>	6
II	<p><b>Linear programming:</b> Basic LPP - solution techniques (Simplex, Artificial Basis), complimentary slackness theorem, fundamental theorem of duality, degenerate solutions, cycling, applications - elements of dynamic programming including hamiltonian, bellman's optimality principle.</p> <p><b>Transportation and Assignment Problems:</b> Solution of a balanced transportation problem, degeneracy in transportation problems and alternate solutions, mathematical problems in formulation of assignment problems.</p>	7
III	<p><b>Nonlinear programming:</b> Nonlinear programming (optimization of nonlinear functions subject to constraints) with lagrange multipliers, Karush-Kuhn-Tucker optimality conditions, convexity, duality.</p> <p><b>Approximation methods for nonlinear programming:</b> Line search methods, gradient methods, conjugate gradient methods, Networking techniques – PERT and CPM.</p>	6

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IV	<p><b>Calculus of Variations:</b> Basic definitions -functional, extremum, variations, function spaces; necessary conditions for an extremum, euler-lagrange equation, convexity and it's role in minimization, minimization under constraints; existence and nonexistence of minimizers, applications - isoperimetric problems, geodesics on the surface.</p>	6
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## Text Books:

1. C. B. Gupta, "*Optimization Techniques in Operation Research*," I. K. International Publishing House Pvt. Ltd.
2. A. S. Gupta, *Calculus of Variations and Applications*, PHI Prantice hall India.
3. Mukesh Kumar Singh, "*Calculus Of Variations*", Krishna Prakashan Media (P) Ltd.
4. J. K. Sharma, *Operations Research – Problems and Solutions*, Macmillian Pub.

## Reference books:

1. I. M. Gelfand and S. V. Fomin, "*Calculus of Variations*" Dover Publications Inc Mineola, New York.
2. Purna Chand Biswal, "*Optimization in Engineering*, Scitech Publications India Pvt. Ltd.
3. B. S. GREWAL, *Higher Engineering Mathematics*, Krishna Publications.
4. G. Hadly, *Linear Programming*, Narosa Publishing House.
5. Kanti Swarup, P. K. Gupta and Manmohan, "*Operations Research*," Sultan Chand & Sons.