

COURSE TEMPLATE

1.	Department /Centre proposing the course	Mathematics
2.	Course Title (<i>< 45 characters</i>)	OPTIMIZATION METHODS AND APPLICATIONS
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	MAL 103
6.	Status (<i>category for program</i>)	DC for Maths and PLC for Others

7.	Pre-requisites (course no./title)	NIL
----	---	-----

8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	MAL 526
8.2	Overlap with any UG/PG course of other Dept./Centre	CHL 774, MEL 221
8.3	Supercedes any existing course	MAL 210

9.	Not allowed for (indicate program names)	Nil
----	--	-----

10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
-----	------------------------------	---

11.	Faculty who will teach the course B Chandra, S Dharmaraja, Aparna Mehra, B S Panda, SCS Rao	
12.	Will the course require any visiting faculty?	No

13.	Course objective (<i>about 50 words</i>): This is the first course in optimization designed to provide a quantitative approach to study various models and methods of linear programming and nonlinear programming. The course aims to demonstrate how the powerful capabilities of optimization can enable in reducing costs, improving efficiency, using resources effectively and providing benefits in many other key dimensions in engineering / industry / managerial / decision making problems.	
-----	---	--

14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Linear programming - formulation through examples from engineering / business decision making problems, preliminary theory and geometry of linear programs, basic feasible solution, simplex method, variants of simplex method. Duality and its principles, interpretation of dual variables, dual simplex method. Linear integer programming, applications in real decision making problems, methods to solve linear integer programs, transportation problems: theory and methodology, assignment problems. Zero-sum matrix games, saddle point,	
-----	---	--

	linear programming formulation of matrix games, network optimization problems LPP formulation. Nonlinear programming, Lagrange function, KKT optimality conditions, sufficiency of KKT under convexity, quadratic programming, Wolfe's method, applications of quadratic programs.
--	--

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Linear programming problems (LPP), formulations, notion of optimal solution, graphical interpretation of optimality	2
2	Convex sets, convex functions in context of LPP, extreme point, basic feasible solutions (BFS), fundamental theorem of LPP, relationship between extreme point of feasible set and BFS of LPP.	5
3	Initial BFS and a method of improving current BFS, simplex algorithm, artificial variable and its interpretation in context of feasibility, case of unbounded LPP, two phase method.	8
4	Dual linear program, duality theorems, complementary slackness theorem, Economic interpretation of dual variables, dual simplex method.	5
5	Linear integer program, applications, cutting plane algorithm, branch and bound algorithm	6
6	Transportation programming problems (TPP), uni-modular matrix, optimal solution of TPP, assignment problems, Hungarian Method	5
7	Matrix games, notion of saddle point, rule of dominance, LPP and matrix game equivalence, Network optimization, formulation (only) of network optimization problems as LPP.	3
8	Nonlinear programming, Lagrange function, KKT optimality conditions, sufficiency of KKT under convexity	3
9	Quadratic programming problems (QP), Wolfe's method, dual of QP, applications of QP in support vector machines and other related areas	5
10		
11		
12		
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. V Chvatal, Linear Programming, W. H. Freeman Publishers, 1983.
2. M S Bazarra, J J Jarvis, H D Sherali, Linear Programming and Network Flows, Wiley, 2009.
3. H A Taha, Operations Research: An Introduction, 9TH ED., Pearson, 2006.

19. Resources required for the course (*itemized & student access requirements, if any*)

19.1	Software	Nil
19.2	Hardware	Nil
19.3	Teaching aides (videos, etc.)	Nil
19.4	Laboratory	Nil
19.5	Equipment	Nil
19.6	Classroom infrastructure	Microphone, Blackboard and Projector.
19.7	Site visits	Nil

20. Design content of the course (*Percent of student time with examples, if possible*)

20.1	Design-type problems	Nil
20.2	Open-ended problems	Nil
20.3	Project-type activity	15% (Some assignments involving understanding, modeling and solving some real life problems, like case study, can be included along side the regular exams. Also, some computer programming base assignments can be designed).
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	80-90% theory based analytic examples/problems

Date: 3-1-2014

(Signature of the Head of the Department)