Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
MA0M20B	Mathematical Optimization	BTECH MINOR S4	3	1	0	4	2020

i) COURSE OVERVIEW:

This course introduces basic theory and methods of optimization which have applications in all branches of engineering. Linear programming problems and various methods and algorithms for solving them are covered. Also introduced in this course are transportation and assignment problems and methods of solving them using the theory of linear optimization. Network analysis is introduced which has applications in planning, scheduling, controlling, monitoring and coordinating large or complex projects involving many activities. The course also includes a selection of techniques for non-linear optimization.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Learning Level
CO 1	Solve linear programming problems using graphical or simplex method.	Apply
CO 2	Solve linear programming problems using duality theorems	Apply
CO 3	Solve transportation and assignment problems using appropriate optimization techniques	Apply
CO 4	Solve sequencing and scheduling problems and gain proficiency in the management of complex projects involving numerous activities using appropriate techniques.	Apply
CO 5	Solve non-linear optimization problems by identifying and classifying them using appropriate methods.	Apply

iii) SYLLABUS

Linear Programming Problem – Graphical solution, Simplex Method, Big-M method.

Two-phase method, Degeneracy and unbounded solutions of LPP, Duality in LPP, Dual Simplex Method.

Transportation Problem, Finding basic feasible solutions–MODI method. Assignment problem, Hungarian method for optimal solution, Solution of unbalanced problem. Travelling salesman problem

Introduction, Problem of Sequencing, Scheduling Project Management-Critical path method (CPM), Project evaluation and review technique (PERT), Optimum scheduling by CPM, Linear programming model for CPM and PERT. Nonlinear programming problems- graphical illustration. unconstrained and unconstrained optimization problems- gradient search. The Karush –Kuhn Tucker conditions- Quadratic programming-modified simplex method-restricted entry rule, Separable programming.

iv) TEXT BOOKS

1. Frederick S Hillier, Gerald J. Lieberman, Introduction to Operations Research, Seventh Edition, McGraw-Hill Higher Education, 1967.
2. Kanti Swarup, P. K. Gupta, Man Mohan, Operations Research, Sultan Chand Sons, New Delhi, 2008.

OTHER REFERENCES

1. Singiresu S Rao, Engineering Optimization: Theory and Practice ,New Age, International Publishers, 1996
2. H A Taha, Operations research : An introduction , Macmillon Publishing company,1976
3. B. S. Goel, S. K. Mittal, Operations research, Pragati Prakashan, 1980
4. S.D Sharma, "Operation Research", Kedar Nath and RamNath - Meerut , 2008.
5. Phillips, Solberg Ravindran ,Operations Research: Principles and Practice,

(v) COURSE PLAN

Module	Contents	No. of hours
I	Convex set and Linear Programming Problem – Mathematical Formulation of LPP-Basic feasible solutions, Graphical solution of LPP-Canonical form of LPP, Standard form of LPP, slack variables and Surplus variables, Artificial variables in LPP-Simplex Method Big-M method.	12
II	Two-phase method -Degeneracy and unbounded solutions of LPP Duality of LPP -Solution of LPP using principle of duality Dual Simplex Method.	12
III	Balanced transportation problem -unbalanced Transportation Problem-Finding basic feasible solutions – Northwest corner rule, least cost Method-Vogel's approximation method. MODI method Assignment problem, Formulation of assignment problem Hungarian method for optimal solution, Solution of unbalanced problem. Travelling salesman problem	12
IV	Introduction, Problem of Sequencing, the problem of n jobs and two machines -problem of m jobs and m machines Scheduling Project Management-Critical path method (CPM) Project evaluation and review technique (PERT), Optimum scheduling by CPM, Linear programming model for CPM and PERT.	12
V	Examples, Graphical illustration, One variable unconstrained Optimization-Multiple variable unconstraint optimization-- gradient search-The Karush –Kuhn Tucker condition for constraint optimization -Quadratic programming-modified simplex method-	

	Separable programming	12
	Total hours	60

i) ASSESSMENT PATTERN

Bloom's Taxonomy Level	Continuous Assessment Exams (Marks)		End Semester Exam (Marks)
	CA Exam I	CA Exam II	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			
Create			

ii) CONTINOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	**10 marks**
CA Exams (2 numbers)	:	**25 marks**
Assignment/Project/Case study etc.	:	**15 marks**
Total	:	**50 marks**

iii) CONTINUOUS ASSESSMENT EXAMINATION PATTERN

- **Two tests of 50 marks** each (half the syllabus to be covered in each exam – 2 ½ modules)
- Duration – **2 hours**

iv) END SEMESTER EXAMINATION PATTERN

Duration – **3 hours**

Total marks -**100**