UNIVERSITY OF DELHI

DEPARTMENT OF OPERATIONAL RESEARCH

COURSE NAME: Bachelor of Multidisciplinary (Hons.) in Operational Research as Major
(SEMESTER -I)
based on

Undergraduate Curriculum Framework 2022 (UGCF)
(Effective from Academic Year 2022-23)

University of Delhi

Course name: Bachelor of Multidisciplinary (Hons.) in Operational Research as Major

Course Title	Nature of the Course	Total Credits	Components			Eligibility Criteria/ Prerequisite	Contents of the course and reference is in
			Lecture	Tutorial	Practical		
Introduction to Operational Research and Linear Programming	DSC-01	4	3	0	1	**Class XII Pass with Mathematics as a subject**	**Annexure-I**
Production and Inventory Management	DSC-02	4	3	0	1	**Class XII Pass with Mathematics as a subject**	**Annexure-II**

ANNEXURE-I

DSC-01. Introduction to Operational Research and Linear Programming

Course Objectives:

The Objective of the paper is to introduce the basic concepts of Operational Research and Linear Programming to the students.

Course Learning Outcomes:

After completion of the course, students will possess knowledge and skills required to

- Gain an understanding of key concepts of Operational Research and Linear Programming and their role in various organizations.
- Describe the basic concepts of convex analysis and explain the theoretical foundations of various issues related to linear programming modelling.
- Formulate real-world problems as a linear programming model and describe the theoretical workings of the graphical and simplex method, demonstrate the solution process by hand and solver.
- Implement advanced and more economic algorithm to solve linear programming problems.

Contents:

Unit I: Basics of Operational Research: Origin & Development of Operational Research, Definition and Meaning of Operational Research, Different Phases of an Operational Research Study, Scope and Limitations of Operational Research, Mathematical Formulation of Real Life Problems.

Unit II: Introduction to Linear Programming, Linear Programming Problem Formulation, Solution by Graphical Method. Concepts of Basis and Basic Feasible solution. Convex sets, Extreme points, Hyperplanes and Halfspaces, Convex cones, Polyhedral sets and cones.

Unit III: Theory of Simplex Method, Simplex Algorithm, Two phase Method, Charne's-M Method.

Unit IV: Degeneracy in Linear Programming, Charnes' Perturbation method, Revised Simplex method.

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Reference/Suggested Readings:

- Hadley, G. (2002). *Linear programming*. New Delhi: Narosa Publishing House.
- Hadley, G. (2002). *Linear Algebra*. New Delhi: Narosa Publishing House.
- Hillier, F.S., & Lieberman, G. J. (2010). *Introduction to operations research- concepts and cases* (9th ed.). New Delhi: Tata McGraw Hill (Indian print).
- Taha, H. A. (2017). *Operations research - An Introduction* (10th ed.). Pearson Education.

- Ravindran, A., Phillips, D. T., & Solberg, J. J. (2005). *Operations research- principles and practice* (2nd ed.). New Delhi: Wiley India (P.) Ltd. (Indian print).

Practical/Lab to be performed on a computer using OR/Statistical packages

1. To solve Linear Programming Problem (LPP) using Graphical Method with
   (i) Unbounded solution.
   (ii) Infeasible solution.
   (iii) Alternative or multiple solutions.
2. Solution of LPP with simplex method.
3. Problem solving using Charnes-M method.
4. Problem solving using Two Phase method.
5. Illustration of following special cases in LPP using Simplex method
   (i) Unrestricted variables.
   (ii) Unbounded solution.
   (iii) Infeasible solution.
   (iv) Alternative or multiple solutions.
6. Solution to linear programming problem through revised simplex method.

Teaching Plan:

Week 1-3: Basics of Operational Research: Origin & Development of Operational Research, Definition and Meaning of Operational Research, Different Phases of an Operational Research Study, Scope and Limitations of Operational Research, Mathematical Modelling of Real Life Problems.
Week 4-5: Introduction to Linear Programming, Linear Programming Problem Formulation, Solution by Graphical Method.
Week 6-8: Concepts of Basis and Basic Feasible solution, Convex sets, Extreme points, Hyperplanes and Halfspaces, Convex cones, Polyhedral sets and cones.
Week 9-11: Theory of Simplex Method, Simplex Algorithm, Two phase Method, Charne's-M Method.

Week 12-13: Degeneracy in Linear Programming, Charnes' Perturbation method.

Week 14-15: Revised Simplex method-Standard form-I and Standard form-II.

Facilitating the achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	(i) Explain the meaning, origin and development of Operational	(i) While introducing each topic some	• Class discussion

	Research. (ii) Understand the scope and development of Operational Research (iii) Mathematical modelling of real world problems.	examples will be laid out and discussed with the students encouraging them to discover the relevant concepts. (ii) Give extensive examples during lectures. (iii) Give periodic assignments. (iv) Encourage students to participate in class discussion. (v) Encourage students to give short presentation. (vi) Encourage students to apply concepts to solve real-world problems.	and presentations • Weekly Assignments • Student presentation • Mid-Term examination, • Group activities involving students to solve real-world problems using solver • Hold both announced and unannounced quizzes • End-term examination
2.	(i) Formulate real-world problems as linear programming model. (ii) Describe the theoretical workings of the graphical method for linear programming and demonstration by hand and solver. (iii) Explain the theoretical foundations of various topics related to linear programming modelling.		
3.	(i) Describe the theoretical workings of the simplex method for linear programming and demonstration of the iterations by hand and solver.		
4.	(i) Explain the concept of Degeneracy in Linear Programming and a method for resolving it. (ii) Explain the revised simplex algorithm and its economic importance over simplex algorithm.		

ANNEXURE-II

DSC-02: Production and Inventory Management

Course Objectives:

The objective of this course is to introduce fundamental concepts in production and inventory management and at the same time, develop the students' modelling and analytical skills.

Course Learning Outcomes:

After completion of the course, students will possess knowledge and skills required to

- Gain an understanding of key concepts of Production and Inventory management and its role in various organizations.
- Apply selective inventory control techniques and understand its significance.
- Determine optimal order quantity for various deterministic and probabilistic inventory models.
- Understand quantity discount models in inventory management.
- Formulate and develop Production Planning and Scheduling models.
- To apply and extend production and inventory models to analyse real world systems.

Contents:

Unit I: Introduction to Production and Inventory Management, Different types of costs in inventory system, Selective inventory classification (VED, XML, FNSD, ABC) and its use in controlling inventory.

Unit II: Deterministic continuous review models: Economic order quantity (EOQ) model with and without shortages, Finite replenishment rate Inventory models without and with planned shortages. Determination of reorder point, Quantity discount models.

Unit III: Probabilistic inventory models: Single period probabilistic inventory models with discrete and continuous demand.

Unit IV: Introduction to Production Planning and Scheduling, Aggregate production plan, Formulation of lot size production problem: Wagner and Whitin algorithm. Basic concepts of Just-in-Time (JIT) and Material Requirement Planning (MRP).

Reference/Suggested Readings:

- Axsäter, S. (2015). *Inventory control* (3rd Edition). Springer.

- Buffa, Elwood S., & Sarin, Rakesh, K. (2009). *Modern Production/Operations Management* (8th ed.). Wiley, India.
- Hadley, G., & Whitin, T. M. (1963). *Analysis of inventory systems*. Prentice-Hall.
- Heizer, J., & Render, B. (2011). *Operations Management* (10th ed.). Pearson's Publication.
- Johnson, L.A., & Montgomery, D.C. (1974) *Operations Research in Production Planning, Scheduling and Inventory Control*. Wiley, New York.
- Naddor, E. (1966). *Inventory Systems*. Wiley.
- Silver, E. A., Pyke, D. F., & Peterson, R. (1998). Inventory management and production planning and scheduling (3rd ed.). Wiley.
- Waters, D. (2008). Inventory control and management. (2nd ed.). John Wiley & Sons.

Practical/Lab to be performed on a computer using OR/Statistical packages

1. Problems based on selective inventory classification. (ABC and FNS analysis)
2. To find optimal inventory policy for EOQ model.
3. To find optimal inventory policy for EOQ model with finite supply.
4. To find optimal inventory policy for EOQ model with backorders.
5. To solve all units quantity discounts model.
6. To solve Incremental quantity discount model
7. To find optimal inventory policy for Probabilistic inventory model with discrete demand.
8. To find optimal inventory policy for Probabilistic inventory model with continuous.
9. Solution of procurement/production scheduling model.

Teaching Plan:

Week 1-3: Introduction to Inventory Management, Concepts and problems in Inventory Systems, various forms and functional role of Inventory, different types of costs in inventory system. Selective inventory classification (VED, XML, FNSD, ABC) and its use in controlling inventory.

Week 4-6: Formulation and solution of Economic order quantity (EOQ) models with and without lead time, and with and without shortages. Determination of reorder level.

Week 7-8: Finite replenishment rate Inventory models without and with planned shortages. Determination of reorder level.

Week 9-10: Inventory models with all units quantity discount, and Incremental quantity discount.

Week 11-12: Single period probabilistic inventory models with discrete and continuous demand.

Week 13-15: Introduction to Production Planning and Scheduling, Aggregate production plan, Formulation of lot size production problem: Wagner and Whitin algorithm. Basic concepts of Just-in-Time (JIT) and Material Requirement Planning (MRP).

Facilitating the achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	(i) Explain the meaning of Production and Inventory management, various forms and functional role of Inventory. (ii) Understand different types of costs in inventory systems. (iii) Apply various Selective inventory control techniques to classify inventory items into broad categories.	(i) While introducing each topic some examples will be laid out and discussed with the students encouraging them to discover the relevant concepts. (ii) Give extensive examples during lectures. (iii) Give periodic assignments. (iv) Encourage students to participate in class discussion. (v) Encourage students to give short presentation. (vi) Encourage students to apply concepts to solve real-	• Class discussion and presentations • Weekly Assignments • Student presentation • Mid-Term examination, • Group activities involving students to solve real-world problems using solver • Hold both announced and unannounced quizzes • End-term examination
2.	(i) Calculate the Economic Order Quantity (EOQ) for various Deterministic Inventory models without and with lead time. (ii) Compute the Reorder Level (ROL) and to determine time of replenishment with known and unknown patterns of demand for inventory items. (i) Understand quantity discount models and determine the EOQ for the same.		
3.	(i) Understand probabilistic inventory models. (ii) Develop Single period probabilistic inventory models with discrete and continuous demand.		

4.	(i) Introduction to Production Planning and Scheduling, Aggregate production plan (ii) Formulation of lot size production problem: Wagner and Whitin algorithm. (iii) Understand the basic concepts of Just-in-Time (JIT) and Material Requirement Planning (MRP).	world problems.	