Session: 2026-27			
Part A – Introduction			
Subject	Statistics		
Semester	VI		
Name of the Course	Operations Research		
Course Code	CC-A6		
Course ID	240/STAT/CC601		
Course Type: (CC/MIC/ MDC/ /VOC/AEC/VA C/SEC)	CC		
Course Learning Outcomes(CLOs)	After completing this course, the learner will be able to: 1. Understand the nature, scope, models, and limitations of Operations Research. 2. Formulate and solve Linear Programming Problems using graphical and simplex methods. 3. Formulate transportation problems and find initial feasible solutions using different methods. 4. Solve the assignment problem using optimization techniques.		
Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	25	5	30
End Term Assessment Marks	50	20	70
Examination Time	3 Hours	---	100

Part B - Course Content

Instructions for Paper- Setter Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking Course Learning Outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topic	Contact Hours
I	Basics of operation research: Nature and definition of O.R, Scope of O.R., Phases of O.R, Models in O.R, Classification of models, Uses and limitation of O.R.	**45 hrs**
II	Formulation of General Linear Programming Problem and their examples. Graphical method and Simplex method for LP problems. Duality.	
III	Transportation Problem: Formulation of T.P., BFS to TP, Determination of initial feasible solution North-West corner rules Row minima method, column minima method, Matrix minima method (Least cost entry method).	
IV	Vogel's Approximation method (or Unit cost penalty method). Travelling Salesman Problem and its examples. Assignment Problems: Solution using the Hungarian Method and Unbalanced Assignment Problems.	

Practical

The practical component of the course has two parts — **30 hrs**

(A) Problem Solving- Questions related to the following problems will be solved and their record will be maintained in the Practical Notebook.

1. To formulate the LPP.
2. To solve the LPP by graphical method
3. To solve the LPP for Simplex method.
4. To solve the transportation problem.
5. To solve the assignment problem.
6. Determination or initial BFS by North West corner Rules, Row minima Method and vogel's Approximation method.

(B) The following practical will be done using mathematical software (such as

Python with libraries like NumPy, SciPy, and Matplotlib or R) and their record will be maintained in the practical note book:

1. To formulate the Linear Programming Problem (LPP) using Python.
2. To solve the Linear Programming Problem by the Graphical Method using Python.
3. To solve the Linear Programming Problem using the Simplex Method in Python.
4. To formulate and solve the Transportation Problem using Python.
5. To solve the Assignment Problem using Python.
6. To determine the initial Basic Feasible Solution (BFS) of the Transportation Problem using Python by applying: North-West Corner Rule Row Minima Method,Vogel's Approximation Method (VAM).

Suggested Evaluation Methods

Internal Assessment:

➢ **Theory 25**

- Class Participation: 5
- Seminar/presentation/assignment/quiz/class test etc.: 10
- Mid-Term Exam: 10

➢ **Practicum 5**

- Seminar/Demonstration/Viva-voce/Lab records etc.: 5

End Term Examination:

➢ **Theory 50**

- Written Examination

➢ **Practicum 20**

- Lab record, viva-voce, write up and execution of the program

Part C-Learning Resources

Recommended Books:

1. J. K. Sharma (2008), *An Introduction to Operations Research*, Macmillan India Ltd.
2. K. Swarup and P. K. Gupta and Man Mohan (1997), *Operations Research*, Sultan Chand & Sons.
3. P. K. Gupta and D. S. Hira (2008), *Operations Research*, S. Chand & Company Ltd.
4. H. A. Taha (2017), *Operations Research: An Introduction (10th Edition)*, Pearson Education.
5. R. Panneerselvam (2012), *Fundamentals of Operations Research*, PHI Learning Pvt. Ltd.