

Date: 05/09/2019

To  
The Principal  
Shri. Mohatadevi Shikshan Sanstha  
Pragati Mahavidyalaya  
Sawkheda, Tq. Sillod  
Dist. Aurangabad

**Subject:** Application to Run Certificate Course in "*Operations Research*"

Respected Sir,

I am writing to seek your kind approval to introduce a certificate course entitled "*Operations Research*" for the students of the Mathematics Department. The course is designed to be a comprehensive 32-hour program aimed at providing our students with a solid foundation in operations research principles and techniques.

Given the increasing relevance of operations research in various fields, this course will greatly benefit our students by enhancing their problem-solving skills and analytical capabilities. It will also prepare them for future academic and professional pursuits where operations research plays a crucial role.

The proposed schedule for the course is as follows:

- **Course Title:** *Operations Research*
- **Duration:** 32 hours
- **Academic Year:** 2019-20

I believe that offering this course will not only enrich our curriculum but also equip our students with valuable skills relevant to their future endeavors.

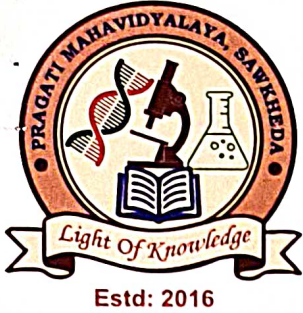
I request your approval to run this course and to make the necessary arrangements for its implementation. I am confident that this addition will be highly beneficial for our students and align with our institution's commitment to academic excellence.

Thank you for considering this proposal. I look forward to your positive response.

Yours sincerely,



Head of Department, Mathematics  
Pragati Mahavidyalaya  
Sawkheda, Tq. Sillod  
Dist. Aurangabad



Shri Mohatadevi Shikshan Sanstha, Aurangabad.

# PRAGATI MAHAVIDYALAYA

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Contact: 9822021784, 8888611717

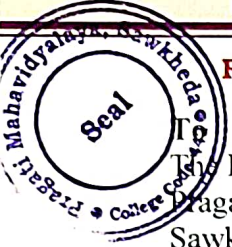
**Mrs. Kaveri Palkar**  
President

**Mrs. Archana Mukhekar**  
Secretary

**Dr. Varsha Phalke**  
Principal

Ref No.: PMS/2019-2020/05

Date : 06 / 09 / 2019



The Head of Department, Mathematics  
Pragati Mahavidyalaya  
Sawkheda, Tq. Sillod  
Dist. Aurangabad

**Subject: Sanction for Certificate Course in "Operations Research"**

Dear Sir,

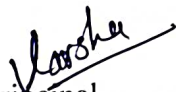
I am pleased to inform you that your proposal to introduce the certificate course entitled "Operations Research" for the Mathematics Department students has been approved.


This course is approved. The administration supports this initiative and believes it will be a valuable addition to our academic offerings, enhancing the students' learning experience and professional preparedness.

Please proceed with the necessary preparations for the course, including scheduling, resource allocation, and communication with the students. Should you require any additional support or resources, feel free to contact the administration office.

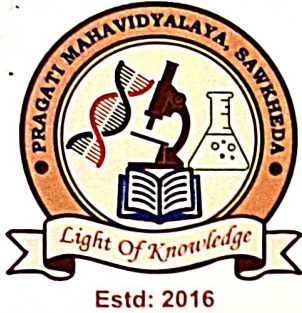
We appreciate your efforts in contributing to the academic growth of our students and look forward to the successful implementation of this course.

Yours sincerely,

  
Principal  
Shri. Mohatadevi Shikshan Sanstha  
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## NOTICE

**Subject: Introduction of Certificate Course in Operations Research**

Dear Students,

We are pleased to announce the introduction of a new certificate course entitled "**Operations Research**" for the academic year 2019-20. This course is designed to enhance your analytical and problem-solving skills through an in-depth study of operations research techniques.

### Course Details:

- **Title: Operations Research**
- **Duration: 32 hours**

### Key Highlights:

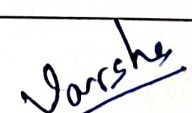
- Comprehensive coverage of operations research principles.
- Practical applications and problem-solving sessions.
- Certification upon successful completion.

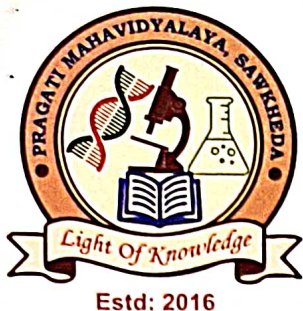
This course will be a valuable addition to your academic journey, providing you with essential skills applicable in various fields. We encourage all interested students to enroll and take advantage of this opportunity to expand your knowledge and skills.

For further details or to enroll, please contact the Mathematics Department office.

We look forward to your active participation.

  
Head of Department, Mathematics

  
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## Syllabus of Certificate Course in Operations Research

Duration: 32 Hours

Academic Year: 2019-20

### Course Objectives:

- To provide a comprehensive understanding of operations research techniques.
- To develop problem-solving and analytical skills applicable to real-world scenarios.
- To introduce students to various methods and tools used in operations research.

### Syllabus Overview:

#### 1. Introduction to Operations Research (4 Hours)

- Definition and Scope
- Historical Development
- Applications in Different Fields
- Overview of Operations Research Techniques

#### 2. Linear Programming (8 Hours)

- Formulation of Linear Programming Problems
- Graphical Method
- Simplex Method
- Duality Theory
- Sensitivity Analysis
- Applications and Case Studies

#### 3. Transportation and Assignment Problems (4 Hours)

- Transportation Problem Formulation and Solutions
- Assignment Problem Formulation and Solutions
- Hungarian Method
- Applications and Case Studies

#### 4. Integer Programming (4 Hours)

- Introduction to Integer Programming
- Formulation and Solutions
- Branch and Bound Method
- Applications and Case Studies

#### 5. Network Optimization (4 Hours)

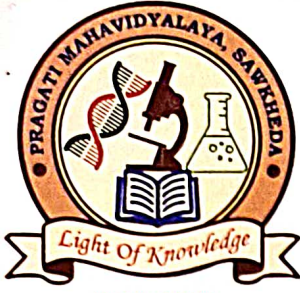
- Network Models and Terminology
- Shortest Path Problem
- Maximum Flow Problem
- Minimum Spanning Tree
- Applications and Case Studies

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## 6. Decision Theory (4 Hours)

- Decision-Making Under Certainty, Risk, and Uncertainty
- Decision Trees
- Utility Theory
- Applications and Case Studies

## 7. Queuing Theory (4 Hours)

- Basic Queuing Models
- Single Server and Multiple Server Systems
- Applications in Service Industries
- Performance Measures and Applications

## 8. Simulation (4 Hours)

- Introduction to Simulation Techniques
- Monte Carlo Simulation
- Application of Simulation in Operations Research
- Case Studies and Practical Examples

## Teaching Methodology:

- **Lectures:** To cover theoretical aspects and concepts.
- **Case Studies:** To provide practical insights and applications.
- **Assignments and Problem Solving:** To reinforce learning through practical exercises.
- **Interactive Sessions:** To address queries and facilitate discussions.

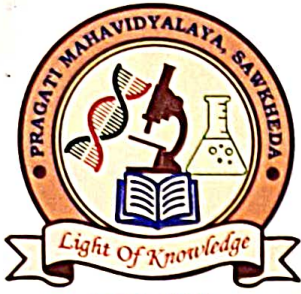
## Assessment:

- **Assignments:** 30%
- **Project/Case Study:** 30%
- **Final Exam:** 40%

*Varsha*

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## Final examination of the *Operations Research*

### Multiple-Choice Questions

1. What is the primary objective of linear programming?

- a) To minimize the constraints
- b) To maximize the profit or minimize the cost
- c) To increase the number of variables
- d) To solve non-linear equations

2. Which of the following methods is used for solving a linear programming problem graphically?

- a) Simplex Method
- b) Branch and Bound Method
- c) Dual Method
- d) Graphical Method

3. In the Simplex Method, what is the term for the variables that are introduced to convert inequalities into equalities?

- a) Slack Variables
- b) Surplus Variables
- c) Artificial Variables
- d) Basic Variables

4. What does the Dual of a linear programming problem involve?

- a) Converting maximization problems into minimization problems
- b) Switching the objective function with the constraints
- c) Changing the problem's constraints to its objective function
- d) Reversing the roles of the decision variables and constraints

5. Which method is used to solve the transportation problem?

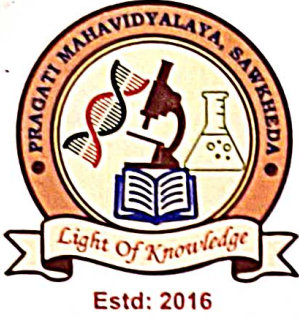
- a) Hungarian Method
- b) North-West Corner Rule
- c) Simplex Method
- d) Branch and Bound Method

6. In an Assignment Problem, what is the goal of the Hungarian Method?

- a) To find the minimum cost or maximum profit assignment
- b) To assign tasks randomly
- c) To balance the workload among all tasks
- d) To maximize the number of assignments

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7. What type of problem involves integer variables only?

- a) Linear Programming Problem
- b) Non-Linear Programming Problem
- c) Integer Programming Problem
- d) Dynamic Programming Problem

8. The Branch and Bound method is commonly used to solve which type of problem?

- a) Transportation Problem
- b) Assignment Problem
- c) Integer Programming Problem
- d) Linear Programming Problem

9. Which algorithm is used to find the shortest path in a network?

- a) Bellman-Ford Algorithm
- b) Dijkstra's Algorithm
- c) Kruskal's Algorithm
- d) Prim's Algorithm

10. What is the main feature of a Minimum Spanning Tree?

- a) It spans all vertices with the minimum possible total edge weight
- b) It contains all possible paths between every pair of vertices
- c) It minimizes the number of vertices
- d) It maximizes the number of edges

11. Decision Trees are used to analyze decisions involving

- a) Risk
- b) Profit
- c) Time
- d) Space

12. In Decision Theory, what does a "payoff matrix" represent?

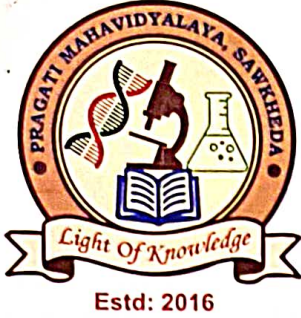
- a) Possible outcomes for each decision alternative
- b) The cost of each decision
- c) The probabilities of decision alternatives
- d) The total number of decisions made

13. What is the primary aim of Queuing Theory?

- a) To minimize the number of servers
- b) To analyze and optimize wait times in a system
- c) To maximize customer dissatisfaction
- d) To eliminate all types of queues

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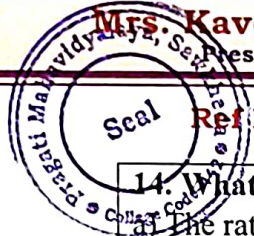
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14. What does the term "utilization" refer to in Queuing Theory?

- a) The ratio of the number of customers served to the number of servers
- b) The ratio of the service time to the total time
- c) The ratio of the arrival rate to the service rate
- d) The total number of queues in a system

15. Monte Carlo Simulation is used primarily for

- a) Solving linear equations
- b) Estimating probabilities and outcomes
- c) Creating decision trees
- d) Optimizing linear programming models

16. In Linear Programming, what is the term for constraints that restrict the feasible region?

- a) Objective Constraints
- b) Binding Constraints
- c) Non-binding Constraints
- d) Redundant Constraints

17. The term "dual price" in linear programming refers to

- a) The cost of increasing the right-hand side of a constraint by one unit
- b) The maximum value of the objective function
- c) The number of feasible solutions
- d) The minimum number of constraints required

18. The Simplex Method iterates through

- a) Basic feasible solutions
- b) Non-basic feasible solutions
- c) All possible solutions
- d) Random solutions

19. Which of the following is NOT a property of a network flow problem?

- a) Capacity Constraints
- b) Flow Conservation
- c) Balanced Supply and Demand
- d) Non-linearity

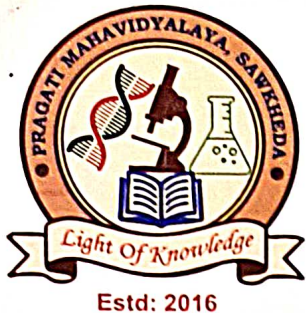
20. In an Assignment Problem, if the cost matrix is 5x5, how many assignments can be made?

- a) 5
- b) 10
- c) 25
- d) 30

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21. What does "sensitivity analysis" in linear programming assess?

- a) Changes in the objective function's coefficients
- b) Stability of the problem's feasible region
- c) Variations in the constraints' right-hand sides
- d) The sensitivity of the solution to changes in parameters

22. Which method is used to solve non-linear optimization problems?

- a) Simplex Method
- b) Gradient Descent
- c) Transportation Method
- d) Hungarian Method

23. In Integer Programming, if a solution must be binary (0 or 1), it is called

- a) Continuous Integer Programming
- b) Binary Integer Programming
- c) Mixed-Integer Programming
- d) Fractional Integer Programming

24. In the context of Queuing Theory, what does "arrival rate" refer to?

- a) The rate at which customers arrive at the service facility
- b) The time taken to service a customer
- c) The number of servers available
- d) The average number of customers in the queue

25. Which concept is used to evaluate the best decision under uncertainty?

- a) Expected Value
- b) Standard Deviation
- c) Probability Distribution
- d) Confidence Interval

26. What does a "slack variable" represent in a linear programming problem?

- a) The extra capacity available in a resource constraint
- b) The amount of excess demand in a supply constraint
- c) A variable used to convert inequalities into equalities
- d) A variable that is always zero in the solution

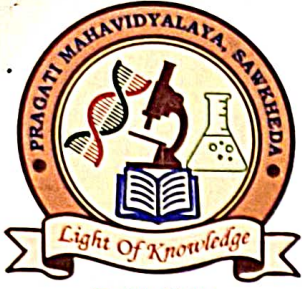
27. In a Transportation Problem, what does the "North-West Corner Rule" help determine?

- a) The initial feasible solution
- b) The optimal solution
- c) The dual variables
- d) The cost coefficients

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28. What is the purpose of using a "decision tree" in decision-making?

- a) To analyze all possible outcomes and their probabilities
- b) To find the optimal allocation of resources
- c) To solve linear programming problems
- d) To determine the minimum cost solution

29. In a queuing system, the "service rate" is

- a) The rate at which customers are served
- b) The rate at which customers arrive
- c) The total waiting time for customers
- d) The number of customers in the system

30. Which technique is used to approximate solutions to complex problems by simulating random samples?

- a) Integer Programming
- b) Linear Programming
- c) Monte Carlo Simulation
- d) Dynamic Programming

## Answer Key

1. b) To maximize the profit or minimize the cost
2. d) Graphical Method
3. a) Slack Variables
4. b) Switching the objective function with the constraints
5. b) North-West Corner Rule
6. a) To find the minimum cost or maximum profit assignment
7. c) Integer Programming Problem
8. c) Integer Programming Problem
9. b) Dijkstra's Algorithm
10. a) It spans all vertices with the minimum possible total edge weight
11. a) Risk
12. a) Possible outcomes for each decision alternative
13. b) To analyze and optimize wait times in a system
14. c) The ratio of the arrival rate to the service rate
15. b) Estimating probabilities and outcomes
16. b) Binding Constraints
17. a) The cost of increasing the right-hand side of a constraint by one unit
18. a) Basic feasible solutions

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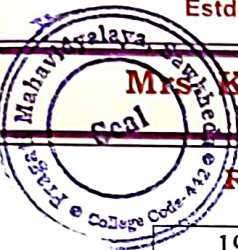
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19. d) Non-linearity
20. a) 5
21. d) The sensitivity of the solution to changes in parameters
22. b) Gradient Descent
23. b) Binary Integer Programming
24. a) The rate at which customers arrive at the service facility
25. a) Expected Value
26. a) The extra capacity available in a resource constraint
27. a) The initial feasible solution
28. a) To analyze all possible outcomes and their probabilities
29. a) The rate at which customers are served
30. c) Monte Carlo Simulation

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