# Course: B. Tech COMPUTER SCIENCE AND ENGINEERING
## (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)
## Subject: Optimization Techniques
## Subject Code: ETCS-305
## Semester: V

**Time: 03 Hours** **Max Marks: 70**

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**Instructions to the Students:**

1. This Question paper consists of two Sections. All sections are compulsory.
2. Section A comprises 10 questions of short answer type. All questions are compulsory. Each question carries 2 marks.
3. Section B comprises 8 long answer type questions out of which students must attempt any 5. Each question carries 10 marks.
4. Do not write anything on the question paper.

| Q. No. | | SECTION –A (SHORT ANSWER TYPE QUESTIONS) | Marks |
|---|---|---|---|
| 1. | a | How do you solve a maximization problem as a minimization problem? | (2) |
| | b | State the Kuhn–Tucker conditions. | (2) |
| | c | Discuss the matrix form of Linear Programming Problem. | (2) |
| | d | Discuss the characteristics of Canonical Form of LPP. | (2) |
| | e | List down the steps for solving Assignment problem using Hungarian Method. | (2) |
| | f | Discuss the operating characteristics of queuing system. | (2) |
| | g | Discuss in detail the principal of Optimality. | (2) |
| | h | Discuss Integer Programming Problems (IPP) also describe the methods for solving the IPP. | (2) |
| | i | What is the role of simulation in optimization? Discuss the types of simulation. | (2) |
| | j | Discuss the application, advantage and limitation of the simulation. | (2) |

**SECTION –B (LONG ANSWER TYPE QUESTIONS)**

| | | | |
|---|---|---|---|
| 2. | a) | State the various methods available for solving a multivariable optimization problen with equality constraints. | (5) |
| | b) | State five engineering applications of optimization. | (5) |

3. Solve the following optimization problem using Dual Simplex Method: (10)

Min $Z = 5x_2 + 6x_3$

Subject to, $x_1 + x_2 \geq 2,$

$4x_1 + x_2 \geq 4,$

$x_1, x_2 \geq 0$

4. Find the optimum solution of following transportation problem using North West Corner Rule (10)

| | $D_1$ | $D_2$ | $D_3$ | Supply |
|---|---|---|---|---|
| $S_1$ | 4 | 8 | 8 | 76 |
| $S_2$ | 16 | 24 | 16 | 82 |
| $S_3$ | 8 | 16 | 24 | 77 |
| Demand | 72 | 102 | 41 | |

? 5. Find the Optimum Integer Solution to the following IPP. (10)

$$Max\ Z = x_1 + x_2$$

$$Subject\ to\ \ 3x_1 + 2x_2 \leq 5$$

$$x_2 \leq 2$$

$$x_1,\ x_2 \geq 0\ and\ x_1, x_2\ are\ integers$$

6. A sample of 100 arrivals of a customer at a retail sales depot is according to the following distribution. (10)

| Time between arrival (Minutes) | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2 | 6 | 10 | 25 | 20 | 14 | 10 | 7 | 4 | 2 |

A study of the time required to service customers by adding up the bills, receiving payments and placing packages, yields the following distribution.

| Time between Service (Minutes) | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 |
|---|---|---|---|---|---|---|
| Frequency | 12 | 21 | 36 | 19 | 7 | 5 |

Estimate the average percentage of customer waiting time and average percentage of idle time of the server by simulation for the next 10 arrivals.

7. Use two-phase simplex method to solve the following LPP (10)

$$Max\ Z = 5x_1 + 3x_2$$

$$Subject\ to\ \ 2x_1 + x_2 \leq 1$$

$$x_1 + 4x_2 \geq 6$$

$$x_1,\ x_2 \geq 0$$

8. Arrivals at a telephone booth are considered to be Poisson, with an average time of 10 minutes between one arrival and the next. The length of a phone call is assumed to be distributed exponentially with average time per call equal to 3 minutes. (10)

   (a) What is the average length of the queue that forms from time to time?

   (b) The telephone department will install a second booth when convinced that an arrival would have to wait at least 3 minutes for the phone. By how much time must the flow of arrivals be increased in order to justify a second booth?

   (c) Estimate the fraction of a day that the phone will be in use.

   (d) Find the average number of units in the system.

9. a) Describe in details the steps of Monte-Carlo Technique or Monte-Carlo Simulation. (3)

   b) Solve the following optimization problem using Dynamic programming: (7)

? Max $Z = u_1 . u_2 . u_3$

Subject to, $u_1 + u_2 + u_3 = 10,$

$u_1, u_2, u_3 \geq 0$

===END OF PAPER===