Ex/PG/ProdE/T/127B/2017

M.E. PRODUCTION ENGINEERING 1ST YEAR 2ND SEMESTER EXAMINATION, 2017

ADVANCED TOPICS OF OPERATIONS RESEARCH

Time: **Three hours** Full marks: **100**

Answer any THREE questions from GROUP A and any TWO questions from GROUP B. All questions carry equal marks.

GROUP - A

1. (a) Solve the following problem using genetic algorithm. (14)

Maximize $f(x_1,x_2) = (x_1 - 2)^2 + (x_2 - 1)^2$
Subject to the constraints $0 \le x_1, x_2 \le 7$.
Perform at least three iterations.

b) Write a short note on artificial bee colony optimization technique. (6)

2. (a) Using dynamic programming method, solve the following LP problem: (12)
Maximize $z = 5x_1 + 8x_2$
Subject to $x_1 \le 3$, $x_2 \le 5$, $4x_1 + 5x_2 \le 12$, $x_1, x_2 \ge 0$

(b) State the roles of reproduction, crossover and mutation operators in genetic algorithm. (8)

3. (a) Using the Interval Halving method, solve the following NLP problem: (12)
Minimize $f(x) = x(x - 3)$ in the interval (0, 6.00) within 10% of the exact value.

(b) Write down the procedural steps of Simulated Annealing technique. (8)

4. (a) Using dynamic programming method, solve the following problem: (10)
Maximize $z = x_1^2.x_2^2.x_3^2$
Subject to $x_1 + x_2 + x_3 = 10$, $x_i \ge 0$ for i = 1,2,3

(b) Solve the following NLP problem using Dichotomous Search method:
Minimize $f(x) = x(x - 2.5)$ in the interval of (0, 3.00) within 10% of the exact value assuming δ = 0.001. (10)

5. A company manufactures two products, each of which requires time on three different machines. Only integer amounts of each can be made. The company wants to find the output that maximizes total profit, given the specifications shown in the following table: (20)

Total machine hours available	Machine hours per unit		
	Machine	Product 1	Product 2
24	A	2	3
18	B	3	1
25	C	4	5
Profit per unit		4	3

EX/PG/PROD E/T/127B/2017

MASTER OF PRODUCTION ENGINEERING EXAMINATION, 2017

(1st Year 2nd Semester)

ADVANCED TOPICS OF OPERATIONS RESEARCH

Time: Three Hours Full Marks:100

Answer any THREE questions from GROUP A and any TWO questions from GROUP B. All questions carry equal marks.

GROUP B

Answer any TWO questions

6. a) Obtain the dual of the following LPP:

Maximize $Z= 3x_1 +5x_2 +7x_3$

Subject to: $x_1 + x_2 + 3x_3 \leq 10$

$4x_1 - x_2 +2x_3 \geq 15$

$x_1, x_2 \geq 0$ and x_3 is unrestricted in sign.

b) What is the significance of dual variables?

c) Show that dual of a dual of an LPP is the Primal LPP.

d) What is sensitivity analysis? Discuss its significance.

e) How do you determine the optimal level of service with respect to cost analysis of a queuing system?

(6+2+4+4+4)

7. A manufacturer can produce four items P, Q, R and S.The unit profit of the items are Rs. 70,65, 80 and75 respectively.The items P, Q, R and S consume 4, 4, 3 and 7 kg raw material of first kind respectively. Raw material of first kind for production of the items is limited to 90 kg per week.The items P, Q, R and S consume 6, 3, 5 and 4 kg raw material of second kind respectively. Raw material of second kind for production of the items is limited to 120 kg per week. The items P, Q, R and S consume 5,2, 3 and 3 hrsof machine time respectively. Machine time for production of the items is limited to 60 hrs per week.The items P, Q, R and S consume 6,5, 1 and 2 hrs of labour time respectively. Labour time for production of the items is limited to 100 hrs per week.

The optimal simplex tableau is given as follows:

Basis Vb Cb	x1	x2	x3	x4	S1	s2	s3	s4	bi
x2	-1/2	1	0	2	1/2	0	-1/2	0	15
S2	-5/2	0	0	-1/3	1/6	1	-11/6	0	25
x3	2	0	1	-1/3	-1/3	0	2/3	0	10
S4	13/2	0	0	-23/3	-13/6	0	11/6	1	15

i) Construct the Primal and Dual LPP.

ii) Construct the optimal simplex tableau for Primal and Dual LPP.

iii) Determine the ranges of raw materials, and labour hour and machine hour for which the optimal solution remains unchanged.

iv) Determine the range of unit profit of items for which optimal solution remains unchanged.

(2+6+6+6)

8. a) What are the operating characteristics of a queuing system?

b) What are the application areas of queuing theory?

c) What are the priority rules in queuing system?

d) What are the various queuing models according to Kendwal's notation?

e) One service station can service a breakdown machine in two hours on the average. Breakdown machines are arrived at the service station at an average rate of two machines per hour. Assuming breakdown machine arrivals rate are Poisson distributed and the servicing times are exponentially distributed, determine the followings:

i) The probability that the system is idle;

ii) The probability that there will be five breakdown machines in the system;

iii) The expected numbers of breakdown machines waiting in the queue as well as in the system;

iv) The average waiting time of a breakdown machine in the queue as well as in the system.

(4+3+3+4+6)
