GIET MAIN CAMPUS AUTONOMOUS GUNUPUR – 765022

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B.TECH 5th SEMESTER EXAMINATIONS, NOV/DEC 2019

BBSBS5061 OPTIMIZATION IN ENGINEERING

Common to BIOTECH/CHEMICAL/CSE/IT/MECHANICAL Branches

Time : 3 Hours Maximum : 100 Marks

Answer ALL Questions

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions) 10 x 2=20 Mark

Q.1. Answer *All* Questions

a	For analyzing a problem, decision makers should study (a) its quantitative aspects (b) its qualitative aspects (c) both (a) and (b) (d) neither (a) nor (b)	[CO1] [PO1]
b	An optimization model (a) provides the best solution (b) provides decision in its limited context (c) helps in evaluating various alternatives (d) all of the above	[CO1] [PO1]
c	Which of the following is not a characteristic of linear programming (a) resources must be limited (b) only one objective function (c) parameter value remains constant throughout the planning period (d) the problem must be a minimization type	[CO1] [PO1]
d	The distinguishing feature of LP model is (a) relationship among all variables is linear (b) it has single objective function and constraint (c) value of decision variables is non-negative (d) all of the above	[CO1] [PO1]
e	Alternative solutions exist of an LP model when (a) one of the constraints is redundant (b) objective function equation is parallel to one of the constraints (c) two constraints are parallel (d) all of the above	[CO2] [PO1]
f	If the artificial variable is present in the "basic variable" column of optimal simplex table, then the solution is (a) infeasible (b) unbounded (c) degenerate (d) none of the above	[CO2] [PO1]
g	The dummy source or destination in a transportation problem is added to (a) satisfy rim conditions (b) prevent solution from becoming degenerate (c) ensure that total cost does not exceed a limit (d) none of the above	[CO3] [PO1]
h	An assignment problem is a special case of transportation problem where (a) number of rows equals number of columns (b) all rim conditions are 1 (c) values of each decision variable is either 0 or 1 (d) all of the above	[CO3] [PO1]
i	The point of inflexion occurs at $x=x_0$ provided (a) $f^n(x_0)=0$ for n odd (b) $f^n(x_0)>0$ for n odd (c) $f^n(x_0)\neq 0$ for n odd (d) none of the above	[CO4] [PO1]
j	The calling population is assumed to be infinite when (a) arrivals are independent of each other (b) capacity of the system is infinite (c) service rate is faster than arrival rate (d) all of the above	[CO4] [PO1]

PART – B: (Short Answer Questions) 10X2=20 Marks

Q.2. Answer *ALL* questions

a	Explain how and why operations research methods have been valuable in aiding executive decisions.	[CO1] [PO1]
b	How is infeasible solution recognized in graphical method of solving LP problem?	[CO1] [PO1]
c	Define slack and surplus variable in a linear programming problem.	[CO2] [PO1]
d	State the general rules for formulating a dual LP problem from its primal.	[CO2] [PO1]
e	What is the role of sensitivity analysis in linear programming?	[CO3] [PO1]
f	What is degeneracy in transportation problem?	[CO3] [PO1]
g	How would you deal with the assignment problems when some assignments are prohibited?	[CO3] [PO1]
h	What is meant by unbalanced transportation problem?	[CO4] [PO1]
i	Define the concept of busy period in queuing theory.	[CO4] [PO1]
j	What is meant by Kuhn-Tucker conditions?	[CO4] [PO1]

PART – C: (Long Answer Questions) 4X15=60 Marks

Answer _ALL_ questions

Q.3

a Use graphical method to solve the following LP problem: **[CO1] [PO2]**

Maximize $Z=5x_1+4x_2$

subject to the constraints

$x_1-2x_2 \geq 1$

$x_1+2x_2 \geq 3$

and $x_1, x_2 \geq 0$

8+7 Marks

b Use Big-M method to solve the following LP problem **[CO1] [PO2]**

Minimize $Z=5x_1+3x_2$

subject to the constraints

$2x_1+4x_2 \leq 12$

$2x_1+2x_2 = 10$

$5x_1+2x_2 \geq 10$

and $x_1, x_2 \geq 0$

OR

c A firm manufactures two products A and B on machine I and II as shown below: **[CO1] [PO2]**

Machine	Product A	Product B	Available Hours
I	30	20	300
II	5	10	110
Profit per unit (Rs)	6	8	

Find the dual of the above product-mix problem and solve using Big-M method. 8+7 Marks

d Solve the following LP problem and show that the problem has unbounded solution. **[CO1] [PO2]**

Maximize $Z = 3x_1+5x_2$

subject to the constraints

$x_1-2x_2 \leq 6$, $x_1 \leq 10$, $x_2 \geq 1$ and $x_1, x_2 \geq 0$

Q.4

a A company has factories at F_1, F_2 and F_3 that supply products to warehouses at W_1, W_2 and W_3. The weekly capacities of the factories are 200, 160 and 90 units respectively. The weekly warehouse requirements are 180, 120 and 150 units respectively. The unit shipping costs (in rupees) are as follows: **[CO2] [PO2]**

	W_1	W_2	W_3	Supply
F_1	16	20	12	200
F_2	14	8	18	160
F_3	26	24	16	90
Demand	180	120	150	450

8+7 Marks

Determine the optimal distribution for the company in order to minimize its total shipping cost.

b Solve the following integer programming problem using Branch and Bound method. **[CO2] [PO2]**

Maximize $Z=x_1+x_2$

subject to the constraints

$3x_1+2x_2 \leq 5$

$x_2 \leq 2$

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

OR

c An airline company has drawn up a new flight schedule that involves five flights. To assist in allocating five pilots to the flights, it has asked them to state their preference scores by giving each flight a number out of 10. The higher the number, the greater is the preference. A few of these flights are unsuitable to some pilots owing to domestic reasons. These have been marked with 'x'. **[CO2] [PO2]**

	Flight number					
		1	2	3	4	5
Pilot	A	8	2	x	5	4
	B	10	9	2	8	4
	C	5	4	9	6	x
	D	3	6	2	8	7
	E	5	6	10	4	3

What should be the allocation of the pilots to flights in order to meet as many preferences as possible?

8+7 Marks

d A product is manufactured at four factories A, B, C and D. Their unit production costs are Rs. 2, Rs. 3. Rs. 1 and Rs. 5 respectively. Their production capacities are 50, 70, 30 and 50 units respectively. These factories supply the product to four stores, demands of which are 25, 35, 105 and 20 units respectively. Unit transportation cost in rupees from each factory to each store is given in the table below: **[CO2] [PO2]**

	Stores				
		I	II	III	IV
Factories	A	2	4	6	11
	B	10	8	7	5
	C	13	3	9	12
	D	4	6	8	3

Determine the extent of deliveries from each factory to each store so that the total production and transportation cost is minimum.

Q.5

a Use dynamic programming to solve the following problem Minimize **[CO3] [PO2]**

$$Z = y_1^2 + y_2^2 + y_3^2$$

subject to constraint $y_1+y_2+y_3 \geq 15$ and $y_1, y_2, y_3 \geq 0$

8+7 Marks

b In a railway marshaling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the interarrival time follows an exponential distribution and the service time (the time taken to hump a train) distribution is also exponential with an average of 36 minutes. Calculate (a) expected queue length (b) probability that the queue size exceeds 10. **[CO3] [PO2]**

OR

c Use dynamic programming to find the values of **[CO3] [PO2]**
Maximize $Z = y_1 y_2 y_3$
subject to the constraint
$y_1 + y_{2+} y_3 = 5$ and $y_1, y_2, y_3 \geq 0$

8+7 Marks

d Arrivals at telephone booth are considered to be Poissson with an average time of 10 minutes between one arrival and the next. The length of phone calls is assumed to be distributed exponentially with a mean of 3 minutes. **[CO3] [PO2]**

(a) What is the probability that a person arriving at the booth will have to wait?
(b) What is the average length of the queue that forms from time to time?

Q.6

a Solve the following problem by using the method of Lagrange multipliers **[CO4] [PO2]**
Minimize

$$Z = x_1^2 + x_2^2 + x_3^2$$

subject to constraints
$x_1+x_2+3x_3=2$
$5x_1+2x_2+x_3=5$
and $x_1, x_2, x_3 \geq 0$.

8+7 Marks

b Maximize the function $f(x) = -3x^2+21.6x+1.0$ with a minimum resolution of 0.50 over six functional evaluations. The optimal value of f(x) is assumed to lie in the range $25 \geq x \geq 0$. Use Fibonacci search method. **[CO4] [PO2]**

OR

c Minimize: $f(x)=x^4-15x^3+72x^2-1135x$ **[CO4] [PO2]**
Terminate the search when $|f(x_n)-f(x_{n-1})| \leq 0.50$. The initial range of x is $1 \leq x \leq 15$.
Use Golden Section Search method.

d Use Kuhn-Tucker condition to solve the following non-linesr optimization problem. 8+7 Marks **[CO4] [PO2]**

$$f(x) = 12x_1 + 21x_2 + 2x_1x_2 - 2x_1^2 - 2x_2^2$$

Subject to the constraints
$x_2 \leq 8$
$x_1+x_2 \leq 10$
and $x_1, x_2 \geq 0$

---End of Paper---