Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2021

Course: OPERATION RESEARCH — **Semester: II**
Program: MBA (FIN/HRM/MKTG/O&PM) — **Time: 03 Hours**
Course code: DSQT7002 — **Max. Marks: 100**
Instructions: All the sections are compulsory.

SECTION A

1. **Each Question will carry 5 Marks**
2. **Instruction: Complete the statement /Select the correct answer(s)**

S.No	Question:	CO
Q 1	**a)** A basic feasible solution is said to be .... if the values of all the basic variables are nonzero and positive. **b)** If two constraints do not intersect in the positive quadrant of the graph, then **i)** the problem is infeasible **ii)** the solution is unbounded **iii)** one of the constraints is redundant **iv)** none of the above	CO1
Q2	**a)** In the two-phase method, an ……………………… variable is never considered for re-entry into the basis. **b)** A variable which does not appear in the basic variable column of simplex table is **i)** never equal to zero **ii)** always equal to zero **iii)** called a basic variable **iv)** none of the above	CO1
Q3	**a)** The maximum amount that should be paid for one additional unit of a resource is called its………………… **b)** If dual has an unbounded solution, primal has **i)** no feasible solution **ii)** unbounded solution **iii)** feasible solution **iv)** none of the above	CO1
Q4	**a)** In the assignment problem, the number of allocations in each row and column are……………………… **b)** If an opportunity cost value is used for an unused cell to test optimality, it should be **i)** equal to zero **ii)** most negative number **iii)** most positive number **iv)** any value	CO1

Q5	**a)** The expected monetary value criterion is used for decision making under……………..environment. **b)** A saddle point exists when **i)** maximin value = maximax value **ii)** minimax value = minimum value **iii)** minimax value = maximin value **iv)** none of the above	**CO1**
Q6	**a)** The random numbers generated by a computer software are uniformly distributed fractions between ………………. and ……………………. **b)** Customer behaviour in which the customer moves from one queue to another in a multiple channel situation is **i)** balking **ii)** reneging **iii)** jockeying **iv)** alternating	**CO1**

SECTION B

1. **Each question will carry 10 marks**
2. **Instruction: Write short / brief notes**

Q1 Solve the following LP problems using the simplex method.

$$Maz\ Z = x_1 + x_2 + x_3$$

Subject to

$$3x_1 + 2x_2 + x_3 \leq 3$$
$$2x_1 + x_2 + 2x_3 \leq 2$$
$$x_1, x_2, x_3 \geq 0$$

CO2

Q2 The following table provides all the necessary information on the availability of supply to each warehouse, the requirement of each market, and the unit transportation cost (in ₹) from each warehouse to each market

Market

		P	Q	R	S	Supply
Warehouse	A	6	3	5	4	22
	B	5	9	2	7	15
	C	5	7	8	6	8
	Demand	7	12	17	9	

The shipping clerk of the shipping agency has worked out the following schedule, based on his own experience: 12 units from A to Q, 1 unit from A to R, 9 units from A to S, 15 units from B to R, 7 units from C to P and 1 unit from C to R.

(a) Check and see if the clerk has the optimal schedule.
(b) Find the optimal schedule and minimum total transport cost.

CO2

Q3	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 '×'	**CO2**

Flight Number

Pilot		1	2	3	4	5
	A	8	2	x	5	4
	B	10	9	2	8	4
Pilot	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?

Q4 A glass factory that specializes in crystal is developing a substantial backlog and for this the firm's management is considering three courses of action: To arrange for subcontracting (S1), to begin overtime production (S2), and to construct new facilities (S3). The correct choice depends largely upon the future demand, which may be low, medium, or high. By consensus, management ranks the respective probabilities as 0.10, 0.50 and 0.40. A cost analysis reveals the effect upon the profits. This is shown in the table below: **CO3**

Demand	Probability	Course of Action		
		S1 (Subcontracting)	S2 (Begin Overtime)	S3 (Construct Facilities)
Low (L)	0.1	10	-20	-150
Medium (M)	0.5	50	60	20
High (H)	0.4	50	100	200

Show this decision situation in the form of a decision tree and indicate the most preferred decision and its corresponding expected value.

Q5 Arrivals at telephone booth are considered to be Poisson 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**

a) What is the probability that a person arriving at the booth will have to wait?
b) The telephone department will install a second booth when convinced that an arrival would expect waiting for at least 3 minutes for a phone call. By how much should the flow of arrivals increase in order to justify a second booth?
c) What is the average length of the queue that forms from time to time?
d) What is the probability that it will take a customer more than 10 minutes altogether to wait for the phone and complete his call?

SECTION-C

1. **Each Question carries 20 Marks.**
2. **Instruction: Write long answer.**

Q1 What is the principle of duality in linear programming? Explain its advantages.

Consider the following product mix problem:

Let x1 denote number of units of Product 1 to be produced daily and x2 the number of units of Product 2 to be produced daily. The production of Product 1 requires one hour of processing time in department D1. Production of 1 unit of Product 2 requires 2 hours of processing time in department D1 and one hour in department D2. The number of hours available in department D1 are 32 hours and in department D2, 8 hours. The contribution of one unit of Product 1 is Rs. 200 and of Product 2 is Rs. 300.

The solution to this LP model is given below:

		C_j	200	300	0	0
C_B	Basic Variable	Solution Value X_B	X_1	X_2	s_1	s_2
200	X_1	32	1	2	1	0
0	s_2	8	0	1	0	1
Z=6400		C_j -Z_j	-100	-200	0	6400

Given the dual of the primal model. Obtain the optimum solution to the dual LP model from the above table. Interpret the dual variables.

CO4