Name: **Enrolment No:**	**UPES SAP ID:**

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December, 2020

Course: Operations Research **Semester: VII**
Program: B.Tech – Mechanical **Time: 3 hours**
Course Code: IPEG 351 **Max. Marks: 100**
No. of Pages: 06

Note:

1. The paper consists of 3 sections A, B and C.
2. For Section A, type your answers in the browser directly
3. For Sections B and C, scan and upload your answers.
4. In Section C, Q1 has internal choice.

Section A

Q1.	i. Which of the following is not the phase of OR methodology? A. Formulating a problem B. Constructing a model C. Establishing controls D. Controlling the environment ii. Hungarian Method is used to solve a. A transportation problem b. A travelling salesman problem c. A LP problem d. Both a & b iii. In Degenerate solution value of objective function_____. a. increases infinitely b. basic variables are nonzero c. decreases infinitely d. One or more basic variables are zero iv. Identify the type of the feasible region given by the set of inequalities x - y <= 1 x - y >= 2 where both x and y are positive. a. A triangle b. A rectangle c. An unbounded region d. An empty region	**5**	**CO1**

	v. An assignment problem can be viewed as a special case of transportation problem in which the capacity from each source is__and the demand at each destination is _____. A. 1; 1 B. Infinity; infinity C. 0; 0 D. 1000; 1000 E. -1; -1		
Q2.	i. In game theory, a situation in which one firm can gain only what another firm loses is called a a. nonzero-sum game. b. prisoners' dilemma. c. zero-sum game. d. cartel temptation. ii. In game theory, the outcome or consequence of a strategy is referred to as the a. payoff. b. penalty. c. reward. d. end-game strategy iii. For a salesman who has to visit n cities which of the following are the ways of his tour plan a. n! b. n+1! c. n-1! d. n iv. An initial transportation solution appears in the table.	**5**	**CO1**

	C	D	Factory Capacity
A	10	0	10
B	15	25	40
Warehouse Demand	25	25	50

Can this solution be improved if it costs \$5 per unit to ship from A to C; \$7 per unit to ship from A to D; \$8 to ship from B to C; and \$9 to ship from B to D?

a. Yes, this solution can be improved by \$50.
b. Yes, this solution can be improved by \$100.
c. No, this solution is optimal.
d. Yes, the initial solution can be improved by \$10.

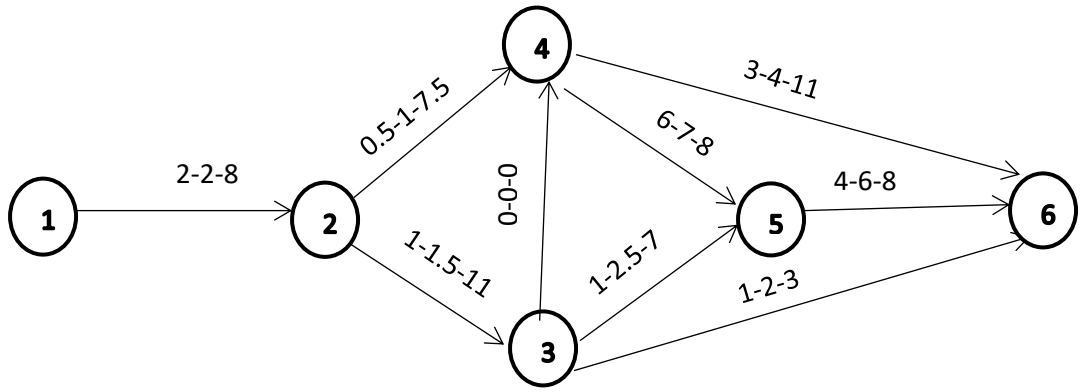
	v. With the transportation technique, the initial solution can be generated in any fashion one chooses. The only restriction is that a. the edge constraints for supply and demand are satisfied. b. the solution is not degenerate. c. the solution must be optimal. d. one must use the northwest-corner method		
Q3.	Find the sequence that minimizes the total elapsed time required to complete the following tasks on two machines.	**5**	**CO2**
Q4.	Solve the following game by using the principle of dominance.	**5**	**CO2**
Q5.	Find the range of values of p and q that will render the entry a saddle point for the game.	**5**	**CO4**

Task	A	B	C	D	E	F	G	H	I
M1	2	5	4	9	6	8	7	5	4
M2	6	8	7	4	3	9	3	8	11

Player B

	I	II	III	IV	V	VI
1	4	2	0	2	1	1
2	4	3	1	3	2	2
3	4	3	7	–5	1	2
4	4	3	4	–1	2	2
5	4	3	3	–2	2	2

Player A	Player B		
	B_1	B_2	B_3
A_1	2	4	5
A_2	10	7	q
A_3	4	P	6

Q6.	Consider the network shown in figure. The three time estimates for activities are given along the arrows. Determine the critical path and calculate the floats.  	**5**	**CO2**
	Section B		
Q1.	Consider the following liner programming problem. Minimize $Z = X_1 - X_2$ Subject to $X_1 + X_2 \geq 2$ $X_1 + 2X_2 \leq 8$ $X_1 \geq 0, \quad X_2 \geq 0,$ Identify the feasible region on a graphical representation of the problem and answer the following question: (a) What is the optimal solution (i) To the given problem? (ii) When the objective function is maximize $Z = X_1 + X_2$? (iii) When X_1 and X_2 are unrestricted in sign? (b) How should the first constraint be altered so that a feasible unbounded solution would exist for condition (iii) above for both cases (i) and (ii)?	**10**	**CO4**
Q2.	Customers arrive at a clinic at the rate of 8/hour (Poisson Arrival) and the doctor can serve at the rate of 9/hour (exponential). a. What is the probability that a customer does not join the queue and walks into the doctor's room? b. What is the probability that there is `no queue? c. What is the probability that there are 10 customers in the system? d. What is the expected number in the system? e. What is the expected waiting time in the queue?	**10**	**CO3**
Q3.	A glass factory specializing in crystal is developing a substantial backlog and the firm's management is considering three courses of action: (S_1) arrange for sub-contracting, (S_2) construct new facilities. The correct choice depends largely upon future demand which	**10**	**CO4**

<table>
<tr>
<td></td>
<td>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 that is shown in the table.

<table>
<tr><td rowspan="2">Profit (Rs. '000)
If demand is</td><td colspan="3">Courses of action</td></tr>
<tr><td>S_1
(Subcontracting)</td><td>S_2
(Overtime)</td><td>S_3
(Construct facilities)</td></tr>
<tr><td>Low (p = 0.10)
Medium (p = 0.50)
High (p = 0.40)</td><td>10
50
50</td><td>-20
60
100</td><td>-150
20
200</td></tr>
</table>
Show this decision situation is in the form of a decision tree and indicates the most preferred decision and corresponding expected value.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4.</td>
<td>Shankar has three positions to fill and has four candidates. He has assessed the suitability of candidates to the positions (in a scale of 10) and solves an assignment problem (maximization). Here, the rows are the positions and the columns are the people. The fourth row is a dummy row. An intermediate iteration is shown in the table below.

<table>
<tr><td>1</td><td>2</td><td>0</td><td>3</td></tr>
<tr><td>3</td><td>5</td><td>7</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td></tr>
</table>
a. Find the optimal allocation? His boss now introduces a fourth position and Shankar is asked to consider the same four candidates for the position. The suitability of the new candidate to the four position is [6 3 9 5].
b. Solve the assignment problem with four candidates optimally. Does the allocation change with the introduction of the new candidate?</td>
<td>10</td>
<td>CO4</td>
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<tr>
<td>Q5.</td>
<td>The Embeeyeh company, planning to expand, decides to recruit MBA's. Three of the twelve posts advertised require specialized knowledge of finance and carry a salary of Rs. 30,000. A further four need software knowledge carry a salary of Rs. 40,000 while the remaining require knowledge in human resource management and carry a salary of Rs. 25,000. It is decided that any selected candidate should be paid either one's current salary or the company's minimum salary, whichever is higher.
Of the short-listed applicants, all posse's knowledge in human resource management, three in finance and software, five in finance only and four in software only. The present salaries of three groups are Rs 25000, Rs 30,000, and Rs 35,000, respectively others earn Rs 20,000 or less.
Formulate a transportation problem to minimize the total salaries paid to the recruited employees.</td>
<td>10</td>
<td>CO3</td>
</tr>
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Section C			
Q1	XYZ Company has three departments – Assembly, Painting and Packing, and can make three types of almirahs. An almirah of type 1 requires on hour of assembly, 40 minutes of painting and 20 minutes of packing time, respectively. Similarly, an almirah of type 2 needs 80 minutes, 20 minutes and one hour, respectively. The almirah of type 3 requires 40 minutes each of assembly, painting and packing time. The total available time at assembly, painting and packing departments is 600 hours, 400 hours and 800 hours, respectively. Determine the number of each type of almirahs that must be produced in order to maximize the profit. The unit profit for types 1, 2 and 3 is Rs 40, Rs 80 and Rs 60, respectively. Suppose that the manager of XYZ company is thinking of renting the production capacities of the three departments to another almirah manufacturer – ABC Company. ABC Company is interested in minimizing the rental charges. On the other hand, the XYZ Company would like to know the worth of production hours to them, in each of the departments to determine the rental rates. (a) Formulate this Problem as an LP problem and solve it to determine the number of each type of almirahs that should be produced by the XYZ Company in order to maximize its profit. (b) For LP problem in (a), formulate its dual and interpret your results. **OR** At a service station a study was made over a period of 25 days to determine both the number of automobiles being brought in for service and the number of automobiles serviced. The results are given below. No. of automobiles arriving and serviced: 0 1 2 3 4 5 Frequency of arrivals (days): 2 4 10 5 3 1 Frequency of daily serviced (days): 3 2 12 3 4 1 Simulate the arrival/ service pattern for a ten-day period and estimate the mean number of automobiles that remain in service for more than a day. (Use the random numbers: 09, 54, 42, 01, 80, 06, 26, 67, 79, 49, 16, 36, 76, 68, 91, 97, 85, 56, 84. Use the first ten for arrivals and the next ten for service).	**20**	**CO3**