14. a) At a central warehouse, vehicles arrive at the rate of 18 per hour and the arrival rate follows Poisson distribution. The unloading time of the vehicles follows exponential distribution and unloading rate is 6 vehicles per hour. There are 4 unloading crew persons. Determine P_0, p_3, Lq, Ls, Wq, and Ws. **(2+2+2+2+2+3)**

(OR)

b) The arrival rate of customers at the single window booking counter of a two wheeler agency follows Poisson distribution and the service time follows exponential (negative) distribution and hence, the service rate also follows Poisson distribution. The arrival rate and the service rate are 25 customers per hour, and 35 customers per hour, respectively. Find the following :

i) Utilization of the booking clerk

ii) Average number of waiting customers in the queue.

iii) Average number of waiting customers in the system.

iv) Average waiting time per customers in the queue

v) Average waiting time per customers in the system. **(3+2.5+2.5+2.5+2.5)**

15. a) Solve the game optimally using linear programming using the payoff matrix of the Player A is shown in Table Q. 15 a.

		Player B		
		1	2	3
Player A	1	6	8	2
	2	8	2	10
	3	4	10	12

(OR)

b) Solve the following LP problem using dynamic programming technique :

Maximize $Z = 10\,X_1 + 30\,X_2$

Subject to $3X_1 + 6X_2 \leq 168$

$0X_1 + 12X_2 \leq 240$

X_1, and $X_2 \geq 0$

27/04/18 FN

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 41371

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Fourth/Fifth/Sixth/Seventh Semester
Mechanical Engineering
ME 6015 – OPERATIONS RESEARCH

(Common to Mechanical Engineering (Sandwich)/Automobile Engineering/ Manufacturing Engineering/Mechanical and Automation Engineering/ Mechatronics Engineering/Production Engineering/ Robotics and Automation Engineering)
(Regulations 2013)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Define an unbounded solution in LP.
2. List the assumptions in linear programming models.
3. Differentiate between PERT and CPM with respect to suitability.
4. Name the algorithm used to find the shortest path in a network model.
5. List the various costs of an inventory system.
6. Write the EOQ formula for purchase model with instantaneous replenishment and without shortages.
7. Define the term jockeying used in queuing theory with an example.
8. Differentiate between the term reneging and balking in queuing theory.
9. What is meant by recursive function in dynamic programming ?
10. Write the criteria for decision making under uncertainty.

PART – B (5×13=65 Marks)

11. a) Solve the following LP problem using two phase simplex method :

Maximize $Z = 20\,X_1 + 10\,X_2 + 15\,X_3$

Subject to $8X_1 + 6X_2 + 2X_3 \leq 60$

$5X_1 + 1X_2 + 6X_3 \geq 40$

$2X_1 + 6X_2 + 3X_3 \leq 30$

X_1, X_2 and $X_3 \geq 0$

(OR)

b) Solve the following LP problem using the results of its dual problem :

Maximize $Z = 40\,X_1 + 30\,X_2 + 25\,X_3$

Subject to $4X_1 + 2X_2 + 5X_3 \geq 30$

$3X_1 + 6X_2 + 1X_3 \geq 20$

$1X_1 + 3X_2 + 6X_3 \geq 36$

X_1, X_2 and $X_3 \geq 0$

12. a) Determine the maximal flow from node 1 to 6 for the pipe network shown in Figure -Q 12 a with flow capacities between various pair of locations in both ways.

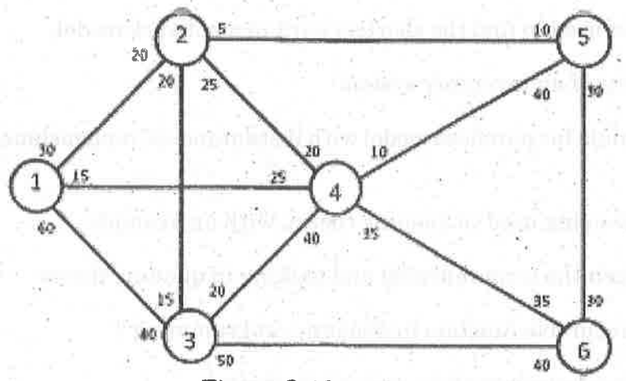

Figure Q 12a

(OR)

b) Construct the project network for project summarized in Table Q12b. Calculate the expected duration and variance of each activity and determine the critical path and expected project completion time. (5+4+4)

Table – Q 12b

Activity	Predecessor (s)	Duration (week)		
		a	m	b
A	–	6	7	8
B	–	1	2	9
C	–	1	4	7
D	A	1	2	3
E	A.B	1	2	9
F	C	1	5	9
G	C	2	2	8
H	E,F	4	4	4
I	E, F	4	4	10
J	D, H	2	5	14
K	I, G	2	2	8

13. a) An industry produces a particular product with a demand rate r = 14,000 units /year, production rate k = 35,000 units/year, set up cost C_o = Rs. 500 per set-up and carrying cost C_c = Rs. 15/unit/year. Find the EBQ and cycle time.

(OR)

b) A company currently purchases one of its items for Rs. 2/unit without quantity discount. The ordering cost is Rs. 20/order and the carrying cost is 20% of its purchase price/unit/year. The annual demand is 2500 units. A new vendor offers quantity discount for the same item as per the following quantity discount scheme in Table – Q 13b. Find the best order quantity.

Table Q. 13b :

Quantity	Price (Rs)/Unit
$0 \leq Q_1 \leq 1500$	p
$1500 \leq Q_2 \leq 2500$	97 % of p
$2500 \leq Q_3$	95% of p

PART – C **(1×15=15 Marks)**

16. a) A transportation problem involving three sources and four destinations is shown in Table- Q. 16 a. The cell entries represent the cost of transportation per unit. Determine the initial basic feasible solution using the following methods :

i) Northwest corner method. **(4)**

ii) By lest cost cell method. **(5)**

iii) Vogel's Approximation Method (VAM)/ penalty method. **(6)**

Table – Q. 16 a

		Destination				
		1	2	3	4	Supply
Source	1	3	1	7	4	300
	2	2	6	5	9	400
	3	8	3	3	2	500
Demand		250	350	400	200	1200

(OR)

b) Determine the minimum spanning tree of the distance network as shown in Figure – Q 16b using PRIM algorithm.

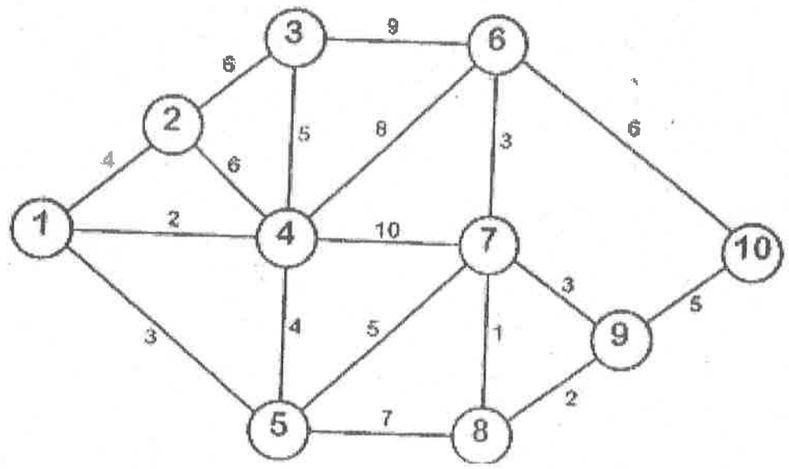

Figure – Q 16b