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**Question Paper Code : 91827**

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019  
Fourth/Fifth/Sixth/Seventh/Eighth 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)  
(Also Common to PTME 6015 – Operations Research for B.E. (Part-Time) –  
Seventh Semester – Mechanical Engineering – Regulations – 2014)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions

PART – A

(10×2=20 Marks)

1. What is sensitivity analysis of LP models ?
2. Distinguish between primal and dual LPs.
3. State the simplifying assumptions made in sequencing in relation to machines.
4. What is total float ?
5. What are deterministic inventory models ?
6. A component has a demand of 9,000 units/year. The cost of one procurement is Rs. 100/- and the holding cost per unit per year is Rs. 2.40. Find the economic order quantity.
7. What is service discipline ? Mention the most common service discipline.
8. List the methods to generate random numbers.
9. What is mixed strategy ?
10. What is dynamic programming ?

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PART - B

(5×13=65 Marks)

11. a) Solve the following LPP graphically.

Maximize  $Z = 0.1x_1 + 0.5x_2$

Subject to  $2x_1 + 5x_2 \leq 80$

$x_1 + x_2 \leq 20$

$x_1, x_2 \geq 0.$

(OR)

- b) Solve the following LPP by simplex method.

$Z = x_1 - x_2 + 3x_3$

Subject to  $2x_1 + x_2 + x_3 \leq 10$

$2x_1 - x_3 \leq 2$

$2x_1 - 2x_2 + 3x_3 \geq 0$

$x_1, x_2, x_3 \geq 0.$

12. a) Draw the network for the following project :

Activity	A	B	C	D	E	F	G	H	I	J	K	L
Immediate Predecessor	-	A	A	B	B	C	C	F	D	G, H	E	I
Duration (Weeks)	10	9	7	6	12	6	8	8	4	11	5	7

Find the critical path and the project duration.

(OR)

- b) A machine operator has to do turning and threading on a number of different jobs. Time to perform these operation in minutes are as follows :

Job	1	2	3	4	5	6
Time for turning	3	12	5	2	9	11
Time for threading	8	10	9	6	3	1

Find the sequence of processing the jobs to minimize the total time. Also find the elapsed time and idle time for the two operations.

13. a) Find the optimal order quantity for a product for which the price breaks are as follows :

Quantity	$0 \leq q \leq 500$	$500 \leq q \leq 750$	$750 \leq q$
Unit cost in Rs.	10	9.25	8.75

The monthly demand for the product is 200 units, storage cost is 2% of the unit cost per year and ordering cost is Rs. 10 per order.

(OR)



b) Data on inventory of 3 items are as follows :

Item	Holding Cost in Rs./Year	Ordering Cost in Rs./Order	Unit cost in Rs.	Demand in units per year
1	20	50	6	10,000
2	20	40	7	12,000
3	20	60	5	7,500

Determine approximately the economic order quantities for a total average of the inventory of these items of Rs. 1,000.

14. a) Trucks arrive at the depot every 18 minutes for service, the service time is 34 min. Determine :

- i) The probability that the depot is empty.
- ii) Average queue length assuming that the capacity of the depot is limited to 3 trucks only.

(OR)

b) A company is manufacturing small boring machines. The average daily production is 15 machines. There is deviation in production due to variation in supply of raw materials by vendors. The probability distribution of the production per day is as follows :

Production per day	11	12	13	14	15	16	17	18	19
Probability	0.05	0.07	0.08	0.15	0.30	0.15	0.08	0.07	0.05

The daily production is transported by a truck which can house not more than 15 machines. The truck is operated only once a day.

Find :

- i) Average number of machines waiting in the company due to lack of space on the truck.
- ii) Average empty space on the truck due to reduced production by simulation for next 15 days.

Use the following random numbers :

76 59 17 86 78 42 56 19 58 25  
61 44 24 38 12

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15. a) Solve the following game graphically :

		B			
		Y1	Y2	Y3	Y4
A	X1	19	6	7	5
	X2	7	3	14	6
	X3	12	8	18	4
	X4	8	7	13	-1

(OR)

b) An equipment costs Rs. 500. Operation and maintenance costs are nil for the first year and increases by Rs. 100 per year thereafter. If money is worth 5% every year, determine the best age for replacement of the equipment. Assume resale value as negligible.

PART – C

(1×15=15 Marks)

16. a) Solve the following transportation problem by Vogel's approximation method :

		Destination				Availability
		1	2	3	4	
Sources	I	21	16	25	13	11
	II	17	18	14	24	13
	III	32	27	18	41	19
Demand		6	10	12	15	43

(OR)

b) A family is making a trip from place 1 to place 10. The family is having a choice of routes and haltages between the two places. Data on cost is as follows :

	1	2	3	4	5	6	7	8	9	10
1	-	7	5	4	-	-	-	-	-	-
2	-	-	-	-	8	3	9	-	-	-
3	-	-	-	-	10	7	6	-	-	-
4	-	-	-	-	4	5	6	-	-	-
5	-	-	-	-	-	-	-	6	8	-
6	-	-	-	-	-	-	-	7	4	-
7	-	-	-	-	-	-	-	3	6	-
8	-	-	-	-	-	-	-	-	-	5
9	-	-	-	-	-	-	-	-	-	4

Find the route of minimum cost.