Register Number:……..

KUMARAGURU
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B.E. DEGREE EXAMINATIONS: APRIL / MAY 2023

(Regulation 2018)

Sixth Semester

MECHANICAL ENGINEERING

U18MET6002**:** Operations Research

COURSE OUTCOMES

CO1: Apply linear programming model and assignment model to domain specific situations

CO2: Analyze the various methods under transportation model and apply the model for testing the closeness of their results to optimal results

CO3: Apply the concepts of PERT and CPM for decision making and optimally managing projects

CO4: Analyze the various replacement and sequencing models and apply them for arriving at optimal decisions

CO5: Analyze and apply appropriate inventory techniques in domain specific situations

CO6: Analyze and apply appropriate queuing theories in domain specific situations

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	Summarize the requirement of good solution in operations research.	CO1	[K_2]
2.	Describe the feasible region in linear programming method.	CO1	[K_2]
3.	Specify the applications areas of linear programming method.	CO1	[K_2]
4.	List the three types of methods used to obtain initial basic feasible solution in transportation problem.	CO2	[K_1]
5.	Differentiate between CPM and PERT in network analysis.	CO3	[K_2]
6.	Define critical path in a network diagram.	CO3	[K_2]
7.	Specify the requirements to use group replacement method.	CO4	[K_2]
8.	State the reasons for carrying inventory.	CO5	[K_2]
9.	Compare (M/M/1):(G/N/∞) and (M/M/C):(G/∞/∞) models of queuing theory.	CO6	[K_2]
10.	Mention the components in the queuing system	CO6	[K_2]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11. a) Apply the graphical method to solve the following linear programming problem. 10 CO1 [K_3]

Maximize $Z = 15x_1 + 10x_2$
subject to the constraints
(i) $4x_1 + 6x_2 \leq 360$,
(ii) $3x_1 + 0x_2 \leq 180$,
(iii) $0x_1 + 5x_2 \leq 200$
and $x_1, x_2 \geq 0$.

b) Describe the methodology of operations research in detail, with flow chart. 6 CO1 [K_3]

12. a) A company has three production facilities *S*1, *S*2 and *S*3 with production capacity of 7, 9 and 18 units (in 100s) per week of a product, respectively. These units are to be shipped to four warehouses *D*1, *D*2, *D*3 and *D*4 with requirement of 5, 6, 7 and 14 units (in 100s) per week, respectively. The transportation costs (in rupees) per unit between factories to warehouses are given in the table below: 10 CO2 [K_3]

	*D*1	*D*2	*D*3	*D*4	Supply
*S*1	19	30	50	10	7
*S*2	70	30	40	60	9
*S*3	40	8	70	20	18
Demand	5	8	7	14	

Calculate the initial basic feasible solution for given problem by using a) Least cost method and b) Vogel's approximation method.

b) A computer centre has three expert programmers. The centre wants three application programmes to be developed. The head of the computer centre, after carefully studying the programmes to be developed, estimates the computer time in minutes required by the experts for the application programmes as follows: 6 CO1 [K_3]

		Programmers		
		A	B	C
Programmes	1	120	100	80
	2	80	90	110
	3	110	140	120

Assign the programmers to the programmes in such a way that the total computer time is minimum.

13. a) An insurance company has decided to modernize and refit one of its branch offices. The major elements of the project have been identified, as follows, along with their durations and immediately preceding elements. The activities are *A*: Design new premises, *B*: Obtain tenders from the contractors, *C*: Select the contractor, *D*: Arrange details with selected contractor, *E*: Decide which equipment is to be used, *F*: Arrange storage of equipment, *G*: Arrange disposal of other equipment, *H*: Order new equipment, *I*: Take delivery of new equipment, *J*: Renovations take place, *K*: Remove old equipment for storage or disposal, *L*: Cleaning after the contractor has finished, *M*: Return old equipment for storage

8 CO3 [K3]

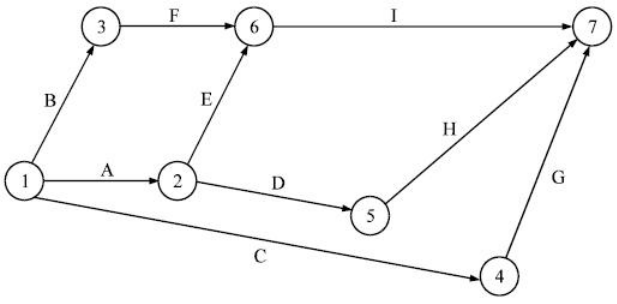
Activity	Duration (weeks)	Immediate Predecessors
A	14	-
B	4	*A*
C	2	*B*
D	1	*C*
E	2	*A*
F	3	*E*
G	2	*E*
H	4	*E*
I	3	*H,L*
J	12	*K*
K	4	*D,F,G*
L	2	*J*
M	2	*H,L*

(a) Construct an arrow diagram for this project with E and L values.
(b) Determine the critical path and critical activities.
(c) Calculate the total project completion time.

b) The following network diagram represents activities associated with a project:

8 CO3 [K3]

Activities	A	B	C	D	E	F	G	H	I
Optimistic time, t_0	5	18	26	16	15	6	7	7	3
Pessimistic time, t_p	10	22	40	20	25	12	12	9	5
Most likely time, t_m	8	20	33	18	20	9	10	8	4



Determine the following:
(a) Expected completion time and variance of each activity
(b) The earliest and latest expected completion times of each event.
(c) The critical path.

14. a) A firm is considering the replacement of a machine having cost price of Rs.12,200, and its scrap value is Rs.200. From experience the running (maintenance and operating) costs are found to be as follows: 8 CO4 [K3]

Year	1	2	3	4	5	6	7	8
Running cost (Rs)	200	500	800	1200	1800	2500	3200	4000

Compute the time period in which the machine should be replaced.

b) A book binder has one printing press, one binding machine and manuscripts of 7 different books. The times required for performing printing and binding operations for different books are shown below: 8 CO4 [K3]

Book	1	2	3	4	5	6	7
Printing time (hours)	20	90	80	20	120	15	65
Binding time (hours)	25	60	75	30	90	35	50

Decide the optimum sequence of processing of books in order to minimize the total time required to bring out all the books.

15. a) Describe about the various variable involved in inventory problems. 8 CO5 [K3]

b) The production department of a company requires 3,600 kg of raw material for manufacturing a particular item per year. It has been estimated that the cost of placing an order is Rs 36 and the cost of carrying inventory is 25 per cent of the investment in the inventories. The price is Rs 10 per kg. Help the purchase manager to determine an ordering policy for raw material. 8 CO5 [K3]

16. a) Discuss in detail about the ABC inventory control technique. 8 CO5 [K3]

b) A television repairman finds that the time spent on his jobs has an exponential distribution with a mean of 30 minutes. If he repairs the sets in the order in which they came in, and if the arrival of sets follows a Poisson distribution with an approximate average rate of 10 per 8-hour day, what is the repairman's expected idle time each day? How many jobs are ahead of the average set just brought in? 8 CO6 [K3]

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