Q.6 i. Explain different performance measures of a queuing system. **4**

ii. A departmental store has a single cashier. During the rush hours, customers arrive at the rate of 20 customers per hour. The average number of customers that can be processed by the cashier is 24 per hour. Find **6**

(a) Probability that the cashier is idle.
(b) Average number of customers in the queuing system.
(c) Average time a customer spends in the system.
(d) Average number of customers in the queue.
(e) Average time a customer spends in the queue waiting for service.

OR iii. Solve the following game and find the strategies of both the players. Also find value of the game. **6**

	B1	B2	B3	B4
A1	3	2	4	0
A2	3	4	2	4
A3	4	2	4	0
A4	0	4	0	8

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Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering
End Sem Examination Dec-2023
ME3CO30
Industrial Engineering & Operations Research

Programme: B.Tech. Branch/Specialisation: ME

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. The chart used to review the overall sequence of an operation by focusing either the movement of operators or materials is called- **1**

(a) SIMO chart (b) NEMA chart
(c) Flow process chart (d) Gaunt chart

ii. The correct order of procedure in method study is- **1**

(a) Select–Record–Examine–Develop–Define–Install – Maintain
(b) Select–Define–Examine–Develop–Record–Install – Maintain
(c) Select–Record–Develop–Examine–Define–Install – Maintain
(d) Select–Record–Examine–Define– Develop – Install – Maintain

iii. In motion and time study which of the following is used in product analysis? **1**

(a) Process chart (b) Work place layout
(c) Man operation chart (d) Multi-man process chart

iv. Total work content = **1**

(a) Basic work content + Excess time
(b) Basic work content – Excess time
(c) Basic work content + Ineffective time
(d) Basic work content – Ineffective time

v. Which of the following is not the phase of OR methodology? **1**

(a) Formulating a problem (b) Constructing a model
(c) Establishing controls (d) Controlling the environment

vi. In graphical representation the bounded region is known as _____ region. **1**
(a) Solution
(b) Basic solution
(c) Feasible solution
(d) Optimal

vii. When the total supply is not equal to total demand in a transportation problem then it is called- **1**
(a) Balanced (b) Unbalanced
(c) Degenerate (d) None of these

viii. Optimal solution of an assignment problem can be obtained only if- **1**
(a) Each row & column has only one zero element
(b) Each row & column has at least one zero element
(c) The data is arrangement in a square matrix
(d) None of these

ix. Identify the odd one out with respect to queuing theory. **1**
(a) Shelving (b) Reneging
(c) Balking (d) Jockeying

x. Game theory models are classified by the- **1**
(a) Number of players
(b) Sum of all payoffs
(c) Number of strategies
(d) All of these

Q.2 i. What is meant by micro motion and memo motion study? **4**

ii. Explain the following: **6**
(a) SIMO Charts
(b) Man-Machine Charts
(c) Multiple activity chart

OR iii. Explain the steps involved in time study? What is Time study equipment? **6**

Q.3 i. Write the advantages and limitations of time study. **4**

ii. Explain basic work content and excess work content. What are the reasons for excess work content? **6**

OR iii. Explain the various allowances and how are they determined in the context of time study. **6**

Q.4 i. Discuss the objective of Operations Research. **4**

ii. A company manufactures two products, *X* and *Y* by using three machines *A*, *B*, and *C*. Machine *A* has 4 hours of capacity available during the coming week. Similarly, the available capacity of machines *B* and *C* during the coming week is 24 hours and 35 hours respectively. One unit of product *X* requires one hour of Machine *A*, 3 hours of machine *B* and 10 hours of machine *C*. Similarly, one unit of product *Y* requires 1 hour, 8 hour and 7 hours of machine *A*, *B* and *C* respectively. When one unit of *X* is sold in the market, it yields a profit of Rs. 5/- per product and that of *Y* is Rs. 7/- per unit. Solve the problem by using graphical method to find the optimal product mix. **6**

OR iii. Solve the following problem using simplex method **6**
Maximise $Z = 23\ a + 32\ b$ subjected to:
$10\ a + 6\ b \leq 2500$
$5\ a + 10\ b \leq 2000$
$1\ a + 2\ b \leq 500$
And both a and b are ≥ 0.

Q.5 i. List out the differences and similarities between Resource allocation model and Transportation model in linear programming. **4**

ii. Explain the procedure of getting basic feasible solution by using VAM. **6**

OR iii. There are 3 jobs A, B, and C and three machines X, Y, and Z. All the jobs can be processed on all machines. The time required for processing job on a machine is given below in the form of matrix. Make allocation to minimize the total processing time. **6**

Jobs	X	Y	Z
A	11	16	21
B	20	13	17
C	13	15	12

Marking Scheme
Industrial Engineering & Operations Research (T)
- ME3CO30 (T)

Q.1	i)	c) Flow process chart	**1**
	ii)	(a)Select–Record–Examine–Develop–Define–Install – Maintain	**1**
	iii)	a) Process chart	**1**
	iv)	a) Basic work content + Excess time	**1**
	v)	d) Controlling the environment	**1**
	vi)	c) feasible solution	**1**
	vii)	b) Unbalanced	**1**
	viii)	b) Each row & column has at least one zero element	**1**
	ix)	a) Shelving	**1**
	x)	d) all of these	**1**

Q.2	i.	micro motion ……..	2 Marks
		memo motion study……	2 Marks
	ii.	Explain the following:	
		SIMO Charts……	2 Marks
		Man-Machine Charts……	2 Marks
		Multiple activity chart……	2 Marks
OR	iii.	Explain the steps involved in time study? ……	4 Marks
		What is Time study equipment?.....	2 Marks

Q.3	i.	Write the advantages ……	2 Marks
		and limitations of time study……	2 Marks
	ii.	Explain basic work content ……	2 Marks
		and excess work content. ……	2 Marks
		Reasons for excess work content ……	2 Marks
OR	iii.	Various allowances ……	3 Marks
		Determined in the context of time study. ……	3 Marks

Q.4	i.	4 objectives of Operations Research…….	(1 Marks *5)
	ii.	Formulating Problem…….	3 Marks
		Solution using graphical method…	3 Marks
OR	iii.	Drawing 1st table (IBFS)……	3 Marks
		Drawing 2nd table (optimal Solution)……	3 Marks

Q.5	i.	differences ……	2 Marks
		and similarities ……	2 Marks
	ii.	Procedure …… VAM. ……	(As per explanation)
OR	iii.	Make allocation……	4 Marks
		Finding minimum total processing time. ……	2 Marks

Q.6	i.	Different ……. queuing system.	4 Marks
	ii.	i) Probability that the cashier is idle. ……	1 Marks
		ii) Average ……..system. ……	1 Marks
		iii) Averag……..the system. ……	1 Marks
		iv) Average……queue. ……	1 Marks
		v) Average time ….. for service. ……	2 Marks
	iii.	Solving the game……	2 Marks
		and find the strategies of both the players. ……	2 Marks
		Also find value of the game. ……	2 Marks

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[2]

[3]

P.T.O.