Q. Code:490784

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

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Fourth Semester

MA22455 – QUEUING THEORY AND OPTIMIZATION

(Artificial Intelligence and Data Science)

(Regulation 2022)

TIME:3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Identify, formulate Linear Programming Problems and analyze the same	**3**
CO 2	Analyze and evaluate the various methods under transportation, assignment models.	**3**
CO 3	Acquire skills in analyzing queueing models.	**3**
CO 4	Design networks using Queueing theories in domain specific situations.	**3**
CO 5	Apply optimization techniques to problems in Machine Learning.	**3**

PART- A(20x2=40Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	What is a traffic intensity in a queuing system?	**1**	**2**
2.	For what value of ρ is a MM1 queue stable?	**1**	**2**
3.	What is an effective arrival rate in a Markovian queue?	**1**	**2**
4.	In a Pizza shop 30 customers arrive every hour and on average, a customer spends around 5 minutes in the shop. Use Little's formula to find out the long run number of customers in the shop.	**1**	**2**
5.	Explain briefly some non-Markovian Queues.	**2**	**2**
6.	If a service provided by a shop is in four stages, which standard distribution shall we use to represent it?	**2**	**2**
7.	If a service time is uniformly distributed between 10 and 14 minutes, then what is the variance ?	**2**	**2**
8.	How many arrival rates are there to a node in a network of queues?.	**2**	**2**
9.	Can an unbounded Feasible region have an optimal solution in an LPP?	**3**	**2**

10.	How do we identify an entering variable in a simplex algorithm?	**3**	**2**	
11.	If all elements in a pivot column of a simplex table are non-positive, what type of solution will the LPP have?	**3**	**2**	
12.	Is the feasible region formed by constraints or objective function of an LPP?	**3**	**2**	
13.	How do we convert an unbalanced TPP to a balanced one?	**4**	**2**	
14.	If a TPP has 4 sources and 4 destinations how many basic variables are minimum to guarantee a non-degenerate solution?	**4**	**2**	
15.	In an assignment problem with cost entries $c_{ij}=10*(i+j)$, if the optimal assignment is 1 to II , 2 to IV , 3 to I , 4 to V and 5 to III, what is the optimal cost?	**4**	**2**	
16.	Can a travelling salesman problem matrix be rectangular?	**4**	**2**	
17.	Let v=2xy. Find the Hessian of v?	**5**	**2**	
18.	Let $u=x^2-y^2$. Is u convex?.	**5**	**2**	
19.	Compute the gradient of $f(x,y)=2x^2+8xy+2y^2$.	**5**	**2**	
20.	What is the connection between steepest descent and gradient?	**5**	**2**	

PART- B (5x 10=50Marks)

		Marks	CO	RBT LEVEL
21. (a)	Browsers use an online free website to compile Python programs. Programs arrive in Poisson fashion at the rate of 10 per minute and are compiled in Exponential fashion at the rate of 15 per minutes. (i) how many programs need to wait. (ii) what is the average waiting time for a program. (iii) What is the probability of more than 10 programs in queue (iv) if the website is losing 2000 rs per minute if the compiler is idle, what is the amount lost in 1 hr on a holiday evening?	**(10)**	**1**	**3**
	(OR)			
(b)	Patients arrive at a clinic according to Poisson distribution at a rate of 30	**(10)**	**1**	**3**

patients per hour. The waiting room does not accommodate more than 15 patients. Examination time per patient is exponential with mean rate of 20 per hour. a) Find the effective arrival rate at the clinic. b) What is the probability that an arriving patient will not wait? c) What is the expected waiting time until a patient is discharged from the clinic?

22. (a) A salon has 2 beauticians who serve sequentially 3 customers an hour in exponential way and all customers go through both the beauticians first for hair cut and then for wash. When customers arrive in Poisson fashion at a rate of 4 per hour, What is the (i) Number of waiting customers at a random time , (ii) Average number of customers in the salon at a random time (iii) What is the probability of both beauticians being free (iv) What is the probability of 4 customers in the salon **(10) 2 3**

(OR)

(b) A Railway marshalling yard operates with a single bay where trains arrive in Poisson fashion at the rate of 4 per hour and wait if bay is busy in an area with infinite waiting space. Find the mean number of trains, mean waiting time if **(10) 2 3**

(i) Service Time is normally distributed with mean 12 min and SD 3 min

(iii) Service Time is uniformly distributed between 8 and 12 minutes

23. (a) Solve $Max\, Z = 5x_1 + 10x_2 + 8x_3$ **(10) 3 3**

$$s.t\, 3x_1 + 5x_2 + 2x_3 \geq 60;\ 4x_1 + 4x_2 + 4x_3 \leq 72, x_1, x_2, x_3 \geq 0$$

(OR)

(b) Solve the LPP $Max\, Z = 12x + 9y$ **(10) 3 3**

$$s.t\, 6x + 3y \leq 30;\ 9x + 6y \leq 18;\ 3x + 3y \leq 18, x, y \geq 0$$

24. (a) Solve the Transportation Problem to obtain the optimum solution. **(10) 4 3**

	D1	D2	D3	D4	SUPPLY
S1	8	6	10	9	35
S2	9	12	13	7	50
S3	14	9	16	5	40
DEMAND	45	20	30	30	

(OR)

(b) A Travelling salesman has to visit five cities. He wishes to start from a particular city, visit each city once and then return to his starting point. The travelling cost (in Rs.) of each city from a particular city is given below: Find the optimum solution. **(10) 4 3**

	A	B	C	D
A	∞	2	5	7
B	6	∞	3	8
C	8	7	∞	4
D	12	4	6	∞

25. (a) (i) Use Newton's method to solve $2x^3 - x - 5, x_0 = 1.5$, **(10) 5 3**

(ii) Find the optimum of $f(x, y) = x^3 + y^3 - 12x - 3y + 20$

(OR)

(b) Use KKT Conditions to solve the NLP Min f(x,y)=x+2y **(10) 5 3**

s.t $x^2 + y^2 \le 4; x \le y$.

PART- C (1x 10=10Marks)
(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	$Solve\ Max\ Z = 9x + 8y \ \ s.t\ 6x + y \le 12; 3x + y \le 8; 4x + 6y \ge 24; x, y \ge 0.$	**(10)**	**3**	**3**

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