SRM Institute of Science and Technology
College of Engineering and Technology
DEPARTMENT OF MATHEMATICS
SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

Slot-A1 (ODD)

Academic Year: 2021-2022

Test: CLAT-1
Course Code & Title: 18MAB204T / Probability ang Queueing Theory
Year & Sem: II & IV

Date: 07/04/2022
Duration: 50 min
Max. Marks: 25

Course Articulation Matrix:

At the end of this course, learners will be able to:			Program Outcomes (PO)											
Course Outcomes (CO)		Learning Bloom's Level	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Apply the concepts of probability and random variables in engineering problems.	4	3	3										
CO2	Identify random variables and model them using various distributions.	4	3	3										
CO3	Infer results by using hypothesis testing on large and small samples	4	3	3										
CO4	Examine F test, Chi Square test in sampling techniques and analyse the performance measures of queuing models.	4	3	3										
CO5	Determine the transition probabilities and classify the states of Markov chain.	4	3	3										
CO6	Apply probability techniques and implement them in the study on sampling distributions, queueing models and Markov chain	4	3	3										

Part – A (3 x 4 = 12 Marks)
Answer all the questions

Q. No.	Question	Marks	BL	CO	PO	PI Code
1	Let X be a continuous RV with pdf $f(x) = \begin{cases} k(x-x^2), & 0 \le x \le 1,\ k>0 \\ 0, & otherwise \end{cases}$. Find (i) k (ii) μ_r' and hence find the mean.	4	1	1	1	1.2.2
2	If the RV takes the values $-1, 0, 1$ with equal probabilities $\frac{1}{3}$, find the MGF of X and hence find the mean and variance.	4	3	1	1	1.2.2
3	A RV X has an exponential distribution defined by the pdf $f(x) = \begin{cases} e^{-x}, & 0 < x < \infty \\ 0, & otherwise \end{cases}$. Find the density function of $Y = 3X + 5$	4	2	1	1	1.2.2

Part-B (1 x 13= 13 Marks)
Answer all the questions

Q. No.	Question	Marks	BL	CO	PO	PI Code
4 (a)	The distribution function of a discrete RV is given below. x: 1, 2, 3, 4 $p(x)$: $15k$, $10k$, $30k$, $6k$ Find (i) k (ii) $E(X)$ (iii) $P(X > 2/X < 4)$ (iv) $F(x)$	7	3	1	1	1.2.2
(b)	A fair die is tossed 300 times. Use Tchebycheff's inequality to find a lower bound for the probability of getting 40 to 60 fours.	6	3	1	2	2.5.1

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Slot-A1 (EVEN)

Academic Year: 2021-2022

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Year & Sem: II & IV

Date: 07/04/2022
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CO4	Examine F test, Chi Square test in sampling techniques and analyse the performance measures of queuing models.	4	3	3										
CO5	Determine the transition probabilities and classify the states of Markov chain.	4	3	3										
CO6	Apply probability techniques and implement them in the study on sampling distributions, queueing models and Markov chain	4	3	3										

Q.No	Question	Marks	BL	CO	PO	PI Code
	Part – A (3 x 4 = 12 Marks) Answer all the questions					
1	A random variable X has the pdf $f(x) = \begin{cases} Kx^2, & 1 \le x \le 2 \\ 0, & otherwise \end{cases}$. Find (i) K (ii) $\mu_r{}'$ and hence find the mean.	4	1	1	1	1.2.2
2	If a random variable X has the MGF $M_X(t) = \frac{3}{3-t}$, obtain the mean, variance and μ_3.	4	3	1	1	1.2.2
3	The pdf of a random variable X is given by $f(x) = \begin{cases} 2x, & 0 < x < 1 \\ 0, & elsewhere \end{cases}$. Find the pdf of $Y = 2X^3$	4	2	1	1	1.2.2
	Part-B (1 x 13= 13 Marks) Answer all the questions					
4 (a)	If the CDF of a random variable X is given by $F(x) = \begin{cases} 0, & x < 0 \\ \frac{x^2}{16}, & 0 < x < 4 \\ 1, & x \ge 4 \end{cases}$. Find (i) the density function $f(x)$ (ii) $E(X)$ (iii) $P(X > 1 / X < 3)$ iv) $P(X \le 2)$	7	3	1	1	1.2.2
(b)	If X is the number obtained in a throw of a fair die, find $P\{\lvert X-\mu \rvert > 2.5\}$ using Tchebycheff's inequality.	6	3	1	2	2.5.1

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DEPARTMENT OF MATHEMATICS
SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

Slot-A2 (ODD)

Academic Year: 2021-2022

Test: CLAT-1
Course Code & Title: 18MAB204T / Probability ang Queueing Theory
Year & Sem: II & IV

Date: 07/04/2022
Duration: 50 min
Max. Marks: 25

Course Articulation Matrix:

At the end of this course, learners will be able to:			Program Outcomes (PO)											
Course Outcomes (CO)		Learning Bloom's Level	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Apply the concepts of probability and random variables in engineering problems.	4	3	3										
CO2	Identify random variables and model them using various distributions.	4	3	3										
CO3	Infer results by using hypothesis testing on large and small samples	4	3	3										
CO4	Examine F test, Chi Square test in sampling techniques and analyse the performance measures of queuing models.	4	3	3										
CO5	Determine the transition probabilities and classify the states of Markov chain.	4	3	3										
CO6	Apply probability techniques and implement them in the study on sampling distributions, queueing models and Markov chain	4	3	3										

Part – A (3 x 4 = 12 Marks)
Answer all the questions

Q. No.	Question	Marks	BL	CO	PO	PI Code
1	A continuous random variable X has the density function $f(x) = \begin{cases} K(1+x), & 0<x<2 \\ 0, & otherwise \end{cases}$. Find (i) K (ii) $\mu_r{}'$ and hence find the mean.	4	1	1	1	1.2.2
2	X is a discrete random variable having the following probability distribution. x: 1, 2, 3 ; $p(x)$: 1/4, 2/4, 1/4 Find the MGF of X and hence find mean and variance.	4	3	1	1	1.2.2
3	Let X be a random variable with density function $f_X(x) = \begin{cases} \frac{x}{12}, & 1<x<5 \\ 0, & otherwise \end{cases}$. Let $Y = 2X^3$. Find the pdf of Y.	4	2	1	1	1.2.2

Part-B (1 x 13= 13 Marks)
Answer all the questions

Q. No.	Question	Marks	BL	CO	PO	PI Code
4(i)	If the probability distribution of X is given as x: 1, 2, 3, 4 ; $p(x)$: $4k$, $3k$, $2k$, k Find (i) k (ii) $E(X)$ (iii) $P(X>1 / X<4)$ (iv) $F(x)$	7	3	1	1	1.2.2
(ii)	A fair die is tossed 720 times. Use Tchebycheff's inequality to find a lower bound for the probability of getting 90 to 150 fives.	6	3	1	2	2.5.1

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Slot-A2 (EVEN)

DEPARTMENT OF MATHEMATICS

SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

Academic Year: 2021-2022

Test: CLAT-1
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Year & Sem: II & IV

Date: 07/04/2022
Duration: 50 min
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CO4	Examine F test, Chi Square test in sampling techniques and analyse the performance measures of queuing models.	4	3	3										
CO5	Determine the transition probabilities and classify the states of Markov chain.	4	3	3										
CO6	Apply probability techniques and implement them in the study on sampling distributions, queueing models and Markov chain	4	3	3										

Q.No	Question	Marks	BL	CO	PO	PI Code
	Part – A (3 x 4 = 12 Marks) **Answer all the questions**					
1	A random variable X has the pdf $f(x) = \begin{cases} Cx^2(1-x), & 0 \le x \le 1 \\ 0, & otherwise \end{cases}$. Find (i) C (ii) μ_r' and hence find the mean.	4	1	1	1	1.2.2
2	If the MGF of a random variable X is $M_X(t) = \frac{2}{2-t}$, obtain the mean, variance and μ_3.	4	3	1	1	1.2.2
3	The pdf of a random variable X is given by $f(x) = \begin{cases} 3x^2, & 0 < x < 1 \\ 0, & elsewhere \end{cases}$. Find the pdf of $Y = 3X + 1$.	4	2	1	1	1.2.2
	Part-B (1 x 13= 13 Marks) **Answer all the questions**					
4 (a)	The CDF of a random variable X is given by $F(x) = \begin{cases} 0, & x < 0 \\ x^2, & 0 \le x \le 1 \\ 1, & x > 1 \end{cases}$. Find (i) $f(x)$ (ii) $E(X)$ (iii) $P(X > \frac{1}{4} / X < \frac{3}{4})$ (iv) $P(X \le \frac{1}{2})$	7	3	1	1	1.2.2
(b)	A discrete random variable X takes the values 1, 2, 3 with probabilities 1/18, 16/18, 1/18. Evaluate $P\{\lvert X-\mu\rvert \ge 2\sigma\}$ using Tchebycheff's inequality.	6	3	1	2	2.5.1

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DEPARTMENT OF MATHEMATICS

SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

SLOT-A1

EVEN

Academic Year: 2021-2022

Test: CLAT-2
Course Code & Title: 18MAB204T / Probability ang Queueing Theory
Year & Sem: II & IV

Date: 24 /05/2022
Duration: 100 min
Max. Marks: 50

Course Articulation Matrix:

At the end of this course, learners will be able to:			Program Outcomes (PO)											
Course Outcomes (CO)		Learning Bloom's Level	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Apply the concepts of probability and random variables in engineering problems.	4	3	3										
CO2	Identify random variables and model them using various distributions.	4	3	3										
CO3	Infer results by using hypothesis testing on large and small samples	4	3	3										
CO4	Examine F test, Chi Square test in sampling techniques and analyse the performance measures of queuing models.	4	3	3										
CO5	Determine the transition probabilities and classify the states of Markov chain.	4	3	3										
CO6	Apply probability techniques and implement them in the study on sampling distributions, queueing models and Markov chain	4	3	3										

Part – A (5 x 4 = 20 Marks)
Answer all the questions

Q. No.	Question	Marks	BL	CO	PO	PI Code
1	Suppose that X is a Poisson distribution and $P(X=2)=\frac{2}{3}P(X=1)$. Evaluate $P(X=3)$.	4	1	2	1	1.2.2
2	The probability that an applicant for a driver's licence will pass the road test on any given trial is 0.7. Find the probability that he will pass the test before the fourth trial.	4	2	2	1	1.2.2
3	Ten oil tins are taken from an automatic filling machine. The mean weight of the tins is 15.8 kg and S.D. 0.50 kg. Does the sample mean differ significantly from the intended weight 16 kg?	4	2	3	2	2.8.1
4	A sample of 90 students is taken from a large population. The mean height of the students in this sample is 150 cm. Can it be reasonably regarded that, in the population, the mean height is 155 cm, and S.D is 9 cm?	4	2	3	2	2.8.1
5 (i)	The amount of time that a watch will run without having to be reset is a RV having exponential distribution with mean 120 days. Find the probability that such a watch will have to be set in less than 24 days.	2	1	2	1	1.2.2
(ii)	Write down the 99% confidence limits of a population proportion in terms of the corresponding sample proportion.	2	1	3	1	1.2.2

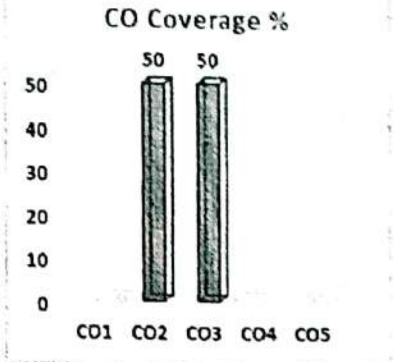
Part-B (3 x 10 = 30 Marks)
Answer Any THREE Questions

Q. No.	Question	Marks	BL	CO	PO	PI Code
6	Fit a Binomial distribution for the following distribution and hence find the theoretical frequencies x: 0, 1, 2, 3, 4 f: 5, 29, 36, 25, 5	10	3	2	1	1.2.2
7	If X is normally distributed with mean 8 and S.D. 4. Find (i) $P(5 \le X \le 10)$, (ii) $P(X \ge 15)$ and (iii) $P(X \le 5)$.	10	3	2	1	1.2.2

8	A sample of 100 bulbs of brand A gave a mean lifetime of 1200hrs with a S.D. of 70 hrs, while another sample of 120 bulbs of brand B gave a mean life time of 1150 hrs with a S.D. of 85 hrs. Can we conclude that brand A bulbs are superior to brand B bulb at 5% and 1% level of significance?	10	4	3	2	2.8.1
9	The following data gives the marks obtained by 10 students in two tests, one held before coaching and the other after coaching. Does the data indicate that the coaching was effective in improving the performance of students?	10	4	3	2	2.8.1

Test I	55	60	65	75	49	25	18	30	35	54
Test II	63	70	70	81	54	29	21	38	32	50

Course Outcome (CO) and Bloom's level (BL) Coverage in Questions



Evaluation Sheet

Name of the Student:

Register No.

R	A														

Part - A (5x4=20 Marks)			
Q. No	**CO**	**Marks Obtained**	**Total**
1	2		
2	2		
3	3		
4	3		
5 (i)	2		
5 (ii)	3		
Part- B (3x 10= 30 Marks)			
6	2		
7	2		
8	3		
9	3		

Consolidated Marks:

CO	Marks Scored
CO2	
CO3	
Total	

Signature of the Course Teacher

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DEPARTMENT OF MATHEMATICS
SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

SLOT-A1
ODD

Academic Year: 2021-2022

Test: CLAT-2
Course Code & Title: 18MAB204T / Probability ang Queueing Theory
Year & Sem: II & IV

Date: 24/05/2022
Duration: 100 min
Max. Marks: 50

Course Articulation Matrix:

At the end of this course, learners will be able to:			Program Outcomes (PO)											
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CO3	Infer results by using hypothesis testing on large and small samples	4	3	3										
CO4	Examine F test, Chi Square test in sampling techniques and analyse the performance measures of queuing models.	4	3	3										
CO5	Determine the transition probabilities and classify the states of Markov chain.	4	3	3										
CO6	Apply probability techniques and implement them in the study on sampling distributions, queueing models and Markov chain	4	3	3										

Part – A (5 x 4 = 20 Marks)
Answer all the questions

Q. No.	Question	Marks	BL	CO	PO	PI Code
1	The probability that a bomb dropped from a plane will strike the target is 1/8. If 6 bombs are dropped, find the probability that at least 1 will strike the target.	4	1	2	1	1.2.2
2	Suppose that the amount of waiting time a customer spends at a restaurant has an exponential distribution with a mean value of 6 minutes. Find the probability that a customer will spend more than 12 minutes in the restaurant.	4	2	2	1	1.2.2
3	4% of the products supplied by a manufacturer are defective. A random sample of 600 products contained 36 defectives. Test whether there is any significant difference.	4	2	3	2	2.8.1
4	A sample of 400 members gave a mean of 6.75. Ca it be reasonably regarded as a sample drawn from a normal population of mean 6.8 and S.D of 1.5?	4	2	3	2	2.8.1
5 (i)	In the busy time the probability of getting telephone connection is 0.05. What is the probability of one getting connection in the 5^{th} attempt?	2	1	2	1	1.2.2
(ii)	A bag contains defective articles, the exact number of which is not known. A sample of 100 from the bag gives 10 defective articles. Find the 95% condifidence limits for the proportion of defective articles.	2	1	3	1	1.2.2

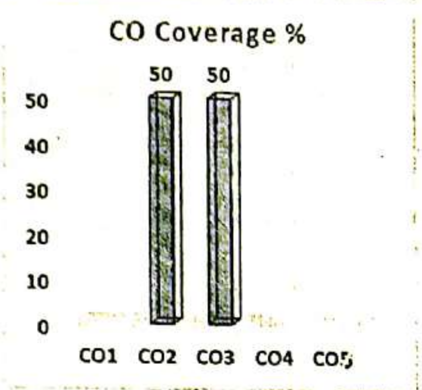
Part-B (3 x 10 = 30 Marks)
Answer Any THREE questions

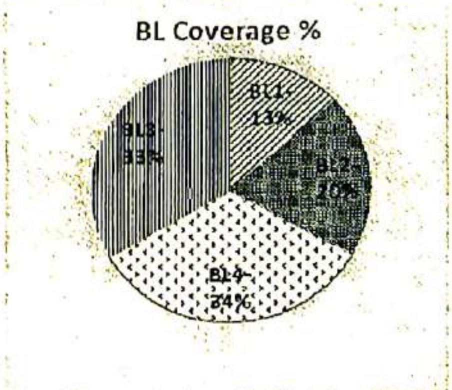
Q. No.	Question	Marks	BL	CO	PO	PI Code
6	Fit a Poisson distribution for the following distribution and hence find the theoretical frequencies.	10	3	2	1	1.2.2

x	0	1	2	3	4	5
f	142	156	69	27	58	1

7	In a normal distribution 15% of the items are under 30 and 9% are over 60. Find the mean and S.D of the distribution.	10	3	2	1	1.2.2
8	A machine produces 16 defective bolts in a batch of 500 bolts. After the machine is overhauled, it produces 3 defective bolts in a batch of 100 bolts. Has the machine improved?	10	4	3	2	2.8.1
9	Two independent samples of sizes 5 and 6 contain the following values Sample 1: 11, 13, 15, 13, 17, - Sample 2: 12, 14, 12, 16, 11, 10 Is the difference between the means significant?	10	4	3	2	2.8.1

Course Outcome (CO) and Bloom's level (BL) Coverage In Questions





Evaluation Sheet

Name of the Student:

Register No. R A

Part - A (5x4=20 Marks)			
Q. No	**CO**	**Marks Obtained**	**Total**
1	2		
2	2		
3	3		
4	3		
5 (i)	2		
5 (ii)	3		
Part- B (3x 10= 30 Marks)			
6	2		
7	2		
8	3		
9	3		

Consolidated Marks:

CO	Marks Scored
CO2	
CO3	
Total	

Signature of the Course Teacher

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DEPARTMENT OF MATHEMATICS
SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

SLOT A2
ODD

Academic Year: 2021-2022

Test: CLAT-2
Course Code & Title: 18MAB204T / Probability and Queueing Theory
Year & Sem: II & IV

Date: 24/05/2022
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CO3	Infer results by using hypothesis testing on large and small samples	4	3	3										
CO4	Examine F test, Chi Square test in sampling techniques and analyse the performance measures of queuing models.	4	3	3										
CO5	Determine the transition probabilities and classify the states of Markov chain.	4	3	3										
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Q. No.	Question	Marks	BL	CO	PO	PI Code
	Part – A (5 x 4 = 20 Marks) **Answer all the questions**					
1	The mean and variance of a Binomial distribution are 2 and $\frac{2}{3}$ respectively. Find $P(X=2)$	4	1	2	1	1.2.2
2	The length of the shower on a tropical island during rainy season has an exponential distribution with parameter 2, (time measured in minutes). If a shower has already lasted for 2 minutes, what is the probability it will last two more minutes?	4	2	2	1	1.2.2
3	A coin is thrown 400 times and is found to result in head 245 times. Test whether the coin is a fair one?	4	2	3	2	2.8.1
4	The 9 items of a sample have the following values: Sample mean 49 and S. D 2.58. Does the mean of these values differ significantly from the assumed mean 47.5?	4	2	3	2	2.8.1
5 (i)	In a busy time, the probability of getting telephone connection is 0.05. What is the probability of one getting connection in the 5[th] attempt?	2	1	2	1	1.2.2
(ii)	The mean value of a random sample of 10 items was found to be 165 with S.D. of 7.6. Find the 95% confidence limits of μ.	2	1	3	1	1.2.2
	Part-B (3 x 10 = 30 Marks) **Answer Any THREE Questions**					
6	Fit a Poisson distribution for the following distribution and hence find the theoretical frequencies x: 0, 1, 2, 3, 4 f: 123, 59, 14, 3, 1	10	3	2	1	1.2.2
7	In a normal distribution 25% of the items are under 40 and 6% are over 70. Find the mean and S.D of the distribution.	10	3	2	1	1.2.2

<table>
<tr><td>8</td><td>A random sample of 600 men chosen from a certain city contained 400 smokers. In another sample of 900 men chosen from another city, there were 450 smokers. Do the data indicate that the first city contains more smokers than the second?</td><td>10</td><td>4</td><td>3</td><td>2</td><td>2.8.1</td></tr>
<tr><td>9</td><td>Two independent samples of sizes 5 and 6 contain the following values.
<table>
<tr><td>Sample 1</td><td>9</td><td>11</td><td>13</td><td>11</td><td>15</td><td>-</td></tr>
<tr><td>Sample 2</td><td>10</td><td>12</td><td>10</td><td>14</td><td>9</td><td>8</td></tr>
</table>
Is the difference between the means significant?</td><td>10</td><td>4</td><td>3</td><td>2</td><td>2.8.1</td></tr>
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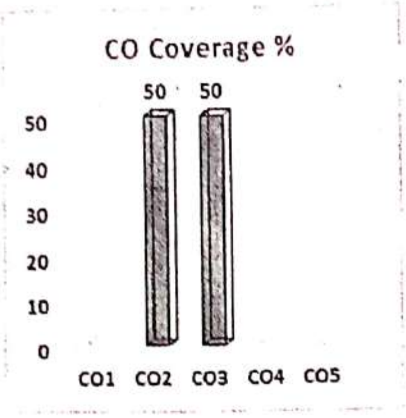
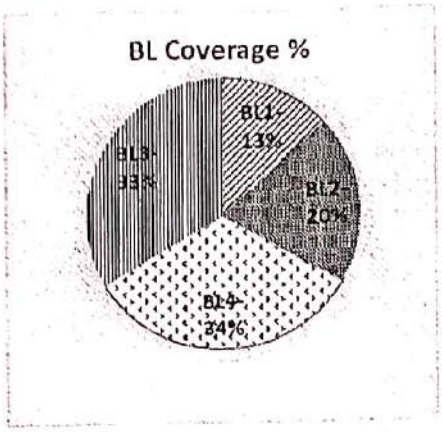
Course Outcome (CO) and Bloom's level (BL) Coverage In Questions





Evaluation Sheet

Name of the Student:

Register No.

R	A													

Part - A (5x4=20 Marks)			
Q. No	CO	Marks Obtained	Total
1	2		
2	2		
3	3		
4	3		
5 (i)	2		
5 (ii)	3		
Part- B (3x 10= 30 Marks)			
6	2		
7	2		
8	3		
9	3		

Consolidated Marks:

CO	Marks Scored
CO2	
CO3	
Total	

Signature of the Course Teacher

SRM

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DEPARTMENT OF MATHEMATICS
SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

SLOT-A2
EVEN

Academic Year: 2021-2022

Test: CLAT-2 | **Date: 24/05/22**
Course Code & Title: 18MAB204T & Probability and Queueing Theory | **Duration: 100 min**
Year & Sem: II & IV / (CSE) | **Max. Marks: 50**

Course Articulation Matrix:

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CO5	Determine the transition probabilities and classify the states of Markov chain.	4	3	3										
CO6	Apply probability techniques and implement them in the study on sampling distributions, queueing models and Markov chain	4	3	3										

Part – A (5 x 4 = 20 Marks)
Answer all the questions.

Q. No.	Question	Marks	BL	CO	PO	PI Code
1	If X is a Poisson variate such that $P(X = 1) = P(X = 2)$ find $P(X = 4)$.	4	1	2	1	1.2.2
2	The probability that a person hits a target on any given trial is 0.6, Find the probability that he will hit the target before the 4^{th} trial?	4	2	2	1	1.2.2
3	The average marks in Mathematics of a sample of 100 students was 51 with a S.D of 6 marks. Could this have been a random sample from a population with average marks 50?	4	2	3	2	2.8.1
4	A random sample of 13 students gave a mean weight of 58 kg with a S.D of 4 kg. Test the hypothesis that the mean weight in the population is 60 kg.	4	2	3	2	2.8.1
5 (i)	The mileage which car owners get with a certain kind of radial tyre is a RV having an exponential distribution with mean 4,000 km. Find the probabilities that one of these tyres will last at least 2000 km.	2	1	2	1	1.2.2
(ii)	A random sample of 500 toys was taken from a large consignment and 65 were found to be defective. Find the 95% confidence limits of the defective toys in the consignment.	2	1	3	1	1.2.2

Part-B (3 x 10= 30 Marks)
Answer any THREE questions.

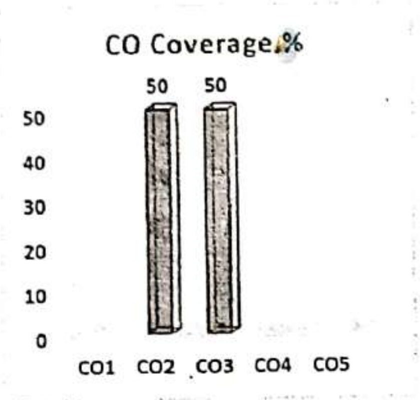
Q. No.	Question	Marks	BL	CO	PO	PI Code
6	Fit a Binomial distribution for the following distribution and hence find the theoretical frequencies	10	3	2	1	1.2.2

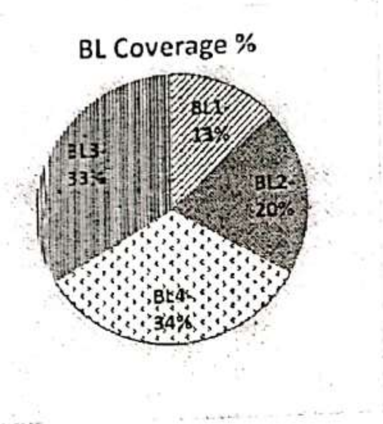
x	0	1	2	3	4
f	7	27	34	27	5

7	If X is normally distributed with mean 30 and S.D 5, find (i) $P(26 \le X \le 40)$ (ii) $P(X \le 25)$ and (iii) $P(X \ge 42)$.	10	3	2	1	1.2.2
8	A simple sample of heights of 6400 English men has a mean of 170 cm and an S.D of 6.4 cm, while a simple sample of heights of 1600 Americans has a mean of 172 cm and an S.D of 6.3 cm. Do the data indicate that Americans are, on the average, taller than the Englishmen?	10	4	3	2	2.8.1
9	Memory capacity of 9 students was tested before and after a course of meditation for a month. State whether the course was effective or not from the data below.	10	4	3	2	2.8.1

Before	10	15	9	3	7	12	16	17	4
After	33	35	35	11	34	29	21	28	32

Course Outcome (CO) and Bloom's level (BL) Coverage in Questions





Evaluation Sheet

Name of the Student:

Register No. | R | A | | | | | | | | | | | | | |

Part- A (5x 4= 20 Marks)			
Q. No	**CO**	**Marks Obtained**	**Total**
1	2		
2	2		
3	3		
4	3		
5 (i)	2		
(ii)	3		
Part- B (3x 10= 30 Marks)			
6	2		
7	2		
8	3		
9	3		

Consolidated Marks:

CO	Marks Scored
CO2	
CO3	
Total	

Signature of the course teacher

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SRM Institute of Science and Technology
College of Engineering and Technology
DEPARTMENT OF MATHEMATICS
SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

Academic Year: 2021-2022

SLOT-A1
ODD

Test: CLAT-3
Course Code & Title: 18MAB204T / Probability ang Queueing Theory
Year & Sem: II & IV

Date: 20/06/2022
Duration: 100 min
Max. Marks: 50

Course Articulation Matrix:

At the end of this course, learners will be able to:			Program Outcomes (PO)											
Course Outcomes (CO)		Learning Bloom's Level	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Apply the concepts of probability and random variables in engineering problems.	4	3	3										
CO2	Identify random variables and model them using various distributions.	4	3	3										
CO3	Infer results by using hypothesis testing on large and small samples	4	3	3										
CO4	Examine F test, Chi Square test in sampling techniques and analyse the performance measures of queuing models.	4	3	3										
CO5	Determine the transition probabilities and classify the states of Markov chain.	4	3	3										
CO6	Apply probability techniques and implement them in the study on sampling distributions, queueing models and Markov chain	4	3	3										

Part – A (4 x 5 = 20 Marks)
Answer Any Four questions

Q. No.	Questions	Marks	BL	CO	PO	PI Code
1	The following data are collected on two attributes. | | Cine-goers | Non-Cine-goers | Literate: 83, 57 Illiterate: 45, 68 Based on this, can you conclude that the two habits of literacy and cine-going are independent? Given χ^2 value at 5% for 1d.f = 3.841	5	2	4	2	2.8.1
2	Weavers in a textile mill arrive at a department store room to obtain spare parts needed for keeping the room running. The store is manned by one attendant, The average arrival rate of weavers is 10 per hr. and the service rate is 12 per hr. Both follow Poisson process. Determine (a) Probability that the number in the system exceeds 10. (b) Probability that the waiting time in the system exceeds 5 hrs.	5	1	4	1	1.2.1

Table for Question 1:

	Cine-goers	Non-Cine-goers
Literate	83	57
Illiterate	45	68

<table>
<tr><td>3</td><td>If the initial state probability distribution of a Markov chain is $p(0) = [5/6 \quad 1/6]$ and the tpm of the chain is $\begin{bmatrix} 0 & 1 \\ 1/2 & 1/2 \end{bmatrix}$, find the distribution of the chain after 3 steps.</td><td>5</td><td>2</td><td>5</td><td>1</td><td>1.2.1</td></tr>
<tr><td>4</td><td>A gambler's luck follows a pattern. If he wins a game, the probability of his winning the next game is 0.6. However, if he loses a game, the probability of his losing the next game is 0.7. There is an even chance that the gambler wins the first game.

(a) Write the state space and the initial probability distribution $p^{(1)}$

(b) Find the tpm.</td><td>5</td><td>2</td><td>5</td><td>1</td><td>1.2.1</td></tr>
<tr><td>5 (i)</td><td>Explain the symbolic representation of the Queueing model due to Kendal and give an example.</td><td>2.5</td><td>1</td><td>4</td><td>1</td><td>1.2.1</td></tr>
<tr><td>(ii)</td><td>Three boys A, B and C are throwing a ball to each other. A always throws the ball to B and B always throws the ball to C, but C is just as likely to throw the ball to B as to A. Find the tpm.</td><td>2.5</td><td>1</td><td>5</td><td>1</td><td>1.2.1</td></tr>
<tr><td colspan="7">Part-B (3 x 10 = 30 Marks)
Answer Any THREE Questions</td></tr>
<tr><td>6</td><td>Two random samples gave the following data:
<table><tr><td></td><td>Size</td><td>Mean</td><td>Variance</td></tr><tr><td>1</td><td>8</td><td>9.6</td><td>1.2</td></tr><tr><td>2</td><td>11</td><td>16.5</td><td>2.5</td></tr></table>Can we conclude that the two samples have been drawn from the same normal population?</td><td>10</td><td>3</td><td>4</td><td>2</td><td>2.8.1</td></tr>
<tr><td>7</td><td>Patients arrive at a clinic according to Poisson distribution at a rate of 30 patients per hr. The waiting room does not accommodate more than 14 patients. (14+1 in the system). Examination time per patient is exponential with mean rate of 20 per hr.
(a) What is the probability that an arriving patient will not wait?
(b) What is the expected no. of customers waiting in the queue?
(c) What is the expected waiting time until a patient is discharged from the clinic?</td><td>10</td><td>3</td><td>4</td><td>1</td><td>1.2.1</td></tr>
<tr><td>8</td><td>Find the nature of states of the Markov chain with the tpm
$$P = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 2/3 & 1/3 \end{bmatrix}$$</td><td>10</td><td>4</td><td>5</td><td>1</td><td>1.2.1</td></tr>
<tr><td>9</td><td>A fair die is tossed repeatedly. If X_n denotes the maximum of the numbers occurring in the first n tosses, find the transition probability matrix P of the Markov chain $\{X_n\}$. Find also P^2 and $P(X_2 = 6)$.</td><td>10</td><td>4</td><td>5</td><td>2</td><td>2.8.1</td></tr>
</table>

SRM Institute of Science and Technology
College of Engineering and Technology
DEPARTMENT OF MATHEMATICS
SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

Academic Year: 2021-2022

SLOT-A1
EVEN

Test: CLAT-3
Course Code & Title: 18MAB204T / Probability ang Queueing Theory
Year & Sem: II & IV

Date: 20/06/2022
Duration: 100 min
Max. Marks: 50

Course Articulation Matrix:

At the end of this course, learners will be able to:			Program Outcomes (PO)											
Course Outcomes (CO)		Learning Bloom's Level	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Apply the concepts of probability and random variables in engineering problems.	4	3	3										
CO2	Identify random variables and model them using various distributions.	4	3	3										
CO3	Infer results by using hypothesis testing on large and small samples	4	3	3										
CO4	Examine F test, Chi Square test in sampling techniques and analyse the performance measures of queuing models.	4	3	3										
CO5	Determine the transition probabilities and classify the states of Markov chain.	4	3	3										
CO6	Apply probability techniques and implement them in the study on sampling distributions, queueing models and Markov chain	4	3	3										

Part – A (4 x 5 = 20 Marks)
Answer Any FOUR Questions

Q. No.	Questions	Marks	BL	CO	PO	PI Code
1	The following data give the no. of aircraft accidents that occurred during the various days of a week. Day: Mon, Tue, Wed, Thu, Fri, Sat No. of accidents: 15, 19, 13, 12, 16, 15 Test whether the accidents are uniformly distributed over the week.	5	2	4	2	2.8.1
2	Two random samples drawn from two normal populations gave the following results. Sample no. 1: Size 5, Mean 24.6, Variance 4.24 Sample no. 2: Size 6, Mean 29, Variance 18 Test whether the two populations have the same variance.	5	1	4	1	1.2.1
3	If the tpm of a Markov chain is $\begin{pmatrix} 0 & 1 \\ 1/3 & 2/3 \end{pmatrix}$ find the steady state distribution of the chain.	5	2	5	1	1.2.1

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4	A house wife buys 3 kinds of cereals, A, B and C. She never buys the same cereal in successive weeks. If she buys cereal A, the next week she buys cereal B. However, if she buys B or C, the next week she is 3 times as likely to buy A as the other cereal. Find the tpm.	5	2	5	1	1.2.1
5 (i)	If $\lambda = 4/hr$ and $\mu = 12/hr$ in an (M/M/1) : (4/FIFO) queueing system, find the probability that there is no customer in the system.	2.5	1	4	1	1.2.1
(ii)	Suppose that the probability of a dry day (state 0) following a rainy day (state 1) is 1/3 and that the probability of a rainy day following a dry day is 1/2. Find the transition probability matrix.	2.5	1	5	1	1.2.1
	Part-B (3 x 10 = 30 Marks) **Answer Any THREE Questions**					
6	A certain drug is claimed to be effective in curing cold. In an experiment on 500 persons with cold, half of them were given the drug and half of them were given the sugar pills. The patient's reaction to the treatment are recorded in the following table: Drug: 150, 30, 70 Sugar Pills: 130, 40, 80 On the basis of this data, can it be concluded that the drug and sugar pills differ significantly in curing cold?	10	3	4	2	2.8.1
7	Customers arrive at a one-man barber shop according to a Poisson process with a mean inter arrival time of 12 min. Customers spend an average of 10 min. in the barber's chair. (a) What is the expected no. of customers in the barber shop and in the queue? (b) Calculate the percentage of time an arrival can walk straight into the barber's chair without having to wait. (c) How much time can a customer expect to spend in the barber's shop? (d) Management will provide another chair and hire another barber, when a customer's waiting time in the shop exceeds 1.25 hours. How much must the average rate of arrivals increases to warrant a second barber?	10	3	4	1	1.2.1
8	The transition probability matrix of a Markov chain $\{X_n\}$, n = 1, 2, 3, ... having 3 states 1, 2 and 3 is $P = \begin{bmatrix} 0.1 & 0.5 & 0.4 \\ 0.6 & 0.2 & 0.2 \\ 0.3 & 0.4 & 0.3 \end{bmatrix}$ and the initial distribution is $p^{(0)} = (0.6, 0.3, 0.1)$. Find (i) $P(X_2 = 3)$ and (ii) $P(X_3 = 2, X_2 = 3, X_1 = 3, X_0 = 2)$.	10	4	5	1	1.2.1
9	A gambler has Rs. 2/-. He bets Re. 1 at a time and wins Re. 1 with probability 1/2. He stops playing if he loses Rs. 2 or wins Rs. 4 (a) What is the tpm of the related Markov chain? (b) What is the probability that he has lost his money at the end of 2 plays?	10	4	5	2	2.8.1

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DEPARTMENT OF MATHEMATICS
SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

SLOT-A2
ODD

Academic Year: 2021-2022

Test: CLAT-3
Course Code & Title: 18MAB204T / Probability ang Queueing Theory
Year & Sem: II & IV
Date: 20/06/2022
Duration: 100 min
Max. Marks: 50

Course Articulation Matrix:

At the end of this course, learners will be able to:			Program Outcomes (PO)											
Course Outcomes (CO)		Learning Bloom's Level	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Apply the concepts of probability and random variables in engineering problems.	4	3	3										
CO2	Identify random variables and model them using various distributions.	4	3	3										
CO3	Infer results by using hypothesis testing on large and small samples	4	3	3										
CO4	Examine F test, Chi Square test in sampling techniques and analyse the performance measures of queuing models.	4	3	3										
CO5	Determine the transition probabilities and classify the states of Markov chain.	4	3	3										
CO6	Apply probability techniques and implement them in the study on sampling distributions, queueing models and Markov chain	4	3	3										

Part – A (4 x 5 = 20 Marks)
Answer Any Four Questions

Q. No.	Questions	Marks	BL	CO	PO	PI Code
1	The following table gives the number of fatal road accidents that occurred during the 7 days of the week. Find whether the accidents are uniformly distributed over the week. Day: Sun, Mon, Tue, Wed, Thu, Fri, Sat Number: 8, 14, 16, 12, 11, 14, 9	5	2	4	2	2.8.1
2	Two random samples drawn from two normal populations gave the following results. Sample no. 1: Size 8, Mean 1234, Variance 6 Sample no. 2: Size 7, Mean 1036, Variance 6.32 Test whether the two populations have the same variance.	5	1	4	1	1.2.1
3	If the tpm of a Markov chain is $\begin{bmatrix} 1/4 & 3/4 \\ 1 & 0 \end{bmatrix}$ find the steady state distribution of the chain.	5	2	5	1	1.2.1

<table>
<tr><td>4</td><td>A gambler has Rs. 2/-. He bets Re. 1 at a time and wins Re. 1 with probability 1/2. He stops playing if he loses Rs. 2 or wins Rs. 4. (a) Find the state space and $p^{(0)}$ of the Markov chain. (b) What is the tpm of the related Markov chain?</td><td>5</td><td>2</td><td>5</td><td>1</td><td>1.2.1</td></tr>
<tr><td>5 (i)</td><td>If $\lambda = 3$ per hr. and $\mu = 4$ per hr. and maximum capacity $k = 7$ in a finite source queueing model, find the probability that there is no customer in the system.</td><td>2.5</td><td>1</td><td>4</td><td>1</td><td>1.2.1</td></tr>
<tr><td>(ii)</td><td>A gambler's luck follows a pattern. If he wins a game, the probability of his winning the next game is 0.6. However, if he loses a game, the probability of his losing the next game is 0.7. Find the tpm.</td><td>2.5</td><td>1</td><td>5</td><td>1</td><td>1.2.1</td></tr>
<tr><td colspan="7">Part-B (3 x 10 = 30 Marks)
Answer Any THREE Questions</td></tr>
<tr><td>6</td><td>In an investigation into the health and nutrition of two groups of children of different social status, the following results are got.
<table><tr><td></td><td>Poor</td><td>Rich</td></tr><tr><td>Below normal</td><td>130</td><td>20</td></tr><tr><td>Normal</td><td>102</td><td>108</td></tr><tr><td>Above normal</td><td>24</td><td>96</td></tr></table>
Discuss the relation between the health and their social status.</td><td>10</td><td>3</td><td>4</td><td>2</td><td>2.8.1</td></tr>
<tr><td>7</td><td>Arrivals at a telephone booth are considered to be Poisson with an average time of 10 min. between one arrival and the next. The length of the phone call is assumed to be distributed exponentially with mean 3 min.
(a) Find the average number of persons waiting in the system.
(b) What is the probability that a person arriving at the booth will have to wait in the queue?
(c) What is the probability that it will take him more than 10 min. altogether to wait for phone and complete his call?
(d) The telephone department will install a second booth when convinced that an arrival has to wait on the average for at least 3 min. for phone. By how much the flow of arrivals should increase in order to justify a second booth?</td><td>10</td><td>3</td><td>4</td><td>1</td><td>1.2.1</td></tr>
<tr><td>8</td><td>The transition probability matrix of a Markov chain $\{X_n\}$, n = 1, 2, 3, ... having 3 states 1, 2 and 3 is $P = \begin{bmatrix} 0.5 & 0.3 & 0.2 \\ 0.4 & 0.2 & 0.4 \\ 0.3 & 0.3 & 0.4 \end{bmatrix}$ and the initial distribution is $p^{(0)} = (0.3, 0.3, 0.4)$. Find (i) $P(X_2 = 3)$ and
(ii) $P(X_3 = 2, X_2 = 3, X_1 = 3, X_0 = 2)$.</td><td>10</td><td>4</td><td>5</td><td>1</td><td>1.2.1</td></tr>
<tr><td>9</td><td>A salesman's territory consists of 3 cities A, B and C. He never sells in the same city on successive days. If he sells in city A, then the next day he sells in B. However, if he sells either in B or C, then the next day he is twice as likely to sell in city A as in the other city. How often does he sell in each of the cities in the steady state?</td><td>10</td><td>4</td><td>5</td><td>2</td><td>2.8.1</td></tr>
</table>

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SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

SLOT-A2
EVEN

Academic Year: 2021-2022

Test: CLAT-3 Date: 20/06/2022
Course Code & Title: 18MAB204T / Probability ang Queueing Theory Duration: 100 min
Year & Sem: II & IV Max. Marks: 50

Course Articulation Matrix:

At the end of this course, learners will be able to:			Program Outcomes (PO)											
Course Outcomes (CO)		Learning Bloom's Level	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Apply the concepts of probability and random variables in engineering problems.	4	3	3										
CO2	Identify random variables and model them using various distributions.	4	3	3										
CO3	Infer results by using hypothesis testing on large and small samples	4	3	3										
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CO5	Determine the transition probabilities and classify the states of Markov chain.	4	3	3										
CO6	Apply probability techniques and implement them in the study on sampling distributions, queueing models and Markov chain	4	3	3										

Part – A (4 x 5 = 20 Marks)
Answer Any FOUR Questions

Q. No.	Questions	Marks	BL	CO	PO	PI Code
1	The following table gives a classification of a sample of 160 plants of their flower color and flatness of leaf. | | Flat leaves | Curled Leaves | | White flower | 99 | 36 | | Real flower | 15 | 10 | Test whether the flower colors is independent of the flatness of leaf. Given χ^2 value at 5% for 1d.f = 3.841	5	2	4	2	2.8.1
2	Arrivals at a telephone booth are considered to be Poisson with an average time of 12 min. between one arrival and the next. The length of a phone call is assumed to be distributed exponentially with mean 4 min. (a) What is the average length of the queue that forms from time to time? (b) What is the probability that more than 3 customers are in the system?	5	1	4	1	1.2.1

3	Suppose that the probability of a dry day (state 0) following a rainy day (state 1) is 1/3 and that the probability of a rainy day following a dry day is 1/2. Given that May 1 is a dry day, find the probability that May 3 is a dry day.	5	2	5	1	1.2.1
4	Two boys B_1 and B_2 and two girls G_1 and G_2 are throwing a ball from one to the other. Each boys throws the ball to the other boy with probability 1/2 and to each girl with probability 1/4. On the other hand each girl throws the ball to each boy with probability 1/2 and never to the other girl. Find the tpm.	5	2	5	1	1.2.1
5 (i)	Write the formula to find average number L_w of customers in non-empty queues in a single server Poisson Queue model with infinite capacity.	2.5	1	4	1	1.2.1
(ii)	A student's study habits are as follows: If he studies one night, he is 70% sure not to study the next night. On the other hand, if he does not study one night, he is 60% sure not to study the next night as well. Find the tpm.	2.5	1	5	1	1.2.1
	Part-B (3 x 10 = 30 Marks) **Answer Any THREE Questions**					
6	Theory predicts that the proportion of beans in 4 groups A, B, C, D should be 9:3:3:1. In an experiment among 1600 beans, the numbers in the 4 groups were 882, 313, 287 and 118. Does the experiment support the theory?	10	3	4	2	2.8.1
7	The local one-person barber shop can accommodate a maximum of 5 people at a time (4 waiting and 1 getting hair cut). Customers arrive according to a Poisson distribution with mean 5 per hour. The barber cuts hair at an average rate of 4 per hour. (a) What percentage of time is the barber idle? (b) What is the expected number of customers waiting for a hair-cut? (c) How much time can a customer expect to spend in the barber shop?	10	3	4	1	1.2.1
8	Three boys A, B and C are throwing a ball to each other. A always throws the ball to B and B always throws the ball to C, but C is just as likely to throw the ball to B as to A. Show that the process is Markovian. Find the transition matrix and classify the states	10	4	5	1	1.2.1
9	A man either drives a car or catches a train to go to office each day. He never goes 2 days in a row by train but if he drives one day, then the next day he is just as likely to drive again as he is to travel by train. Now suppose that on the first day of the week, the man tossed a fair dice and drove to work if and only if a 6 appeared. Find (i) the probability that he takes a train on the third day, and (ii) the probability that he drives to work in the long run.	10	4	5	2	2.8.1