SRM Institute of Science and Technology
Ramapuram campus

Department of Mathematics
18MAB204T- Probability and Queueing Theory

Year/Sem: II/IV **Branch: CSE, IT**

Unit I - PROBABILITY AND RANDOM VARIABLES

1.	The amount of time, in hours, that a computer functions before breaking down is a random variable of thetype (a) Continuous (b)Discrete (c) Neither discrete norcontinuous (d) Continuous as well as discrete	**Ans: (a)**	**(CLO-1, Remember)**
2.	The rth moment of a random variable about mean is called (a) Moment generating function (b) arbitrary moment (c) central moment (d) neutral moment	**Ans: (c)**	**(CLO-1, Apply)**
3.	A random variable X has the following probabilityfunction: x: 0 | 1 | 2 | 3 | 4 P(x): K | 2k | 5k | 7k | 9k Then the value of k= --------- (a)1/24(b) 1/12 (c)1 (d) 24/21	**Ans: (a)**	**(CLO-1, Apply)**
4.	The probability function of a random variable X is given by $p(x)=\begin{cases}\frac{1}{4}, & for\ x=-2\\ \frac{1}{4}, & for\ x=0\\ \frac{1}{2}, & for\ x=10\\ 0, & elsewhere\end{cases}$ Find P (X ≤ 0) (a)1/4(b) 1/12 (c)1/2 (d) 1/20	**Ans: (c)**	**(CLO-1, Apply)**
5.	The p.d.f. of X is defined as $f(x)=\begin{cases}k, & for\ 0<x\le 4\\ 0, & otherwise\end{cases}$ then the value of k is (a)1/4(b) 1/2 (c)3/4 (d) 1/20	**Ans: (a)**	**(CLO-1, Apply)**

6.	Consider a random variable X with p.d.f $f(x)=\begin{cases}3x^2, \text{ if } 0<x<1\\ 0, \text{otherwise}\end{cases}$ Find E (X) (a)1/4(b) 1/2 (c)1/8 (d) 3/4	**Ans: (d)**	**(CLO-1, Apply)**
7.	If X is a continuous R.V, then $\frac{d}{dx}F(x)=f(x)$ at all points here F(x) is -------- (a) integrable (b) Constant (c) 1 (d) Differentiable	**Ans: (d)**	**(CLO-1, Apply)**
8.	The value of 'k' from the following table is------ (a) 1 (b) $\frac{1}{10}$ (c) $\frac{1}{15}$ (d) $\frac{2}{3}$	**Ans:(c)**	**(CLO-1, Apply)**
9.	A commuter train arrives punctually at a station every 25 minutes. Each morning, a commuter leaves his house and casually walks to the train station. Let X denote the amount of time, in minutes, that commuter waits for the train from the time he reaches the train station. It is known that the probability density function of X is $f(x)=\begin{cases}\frac{1}{25}, \text{ for } 0<x<25\\ 0, \text{ otherwise.}\end{cases}$ What is the expected value of the random variable X. (a) 1/5 (b) 25/2 (c)1/25 (d)3/25	**Ans: (b)**	**(CLO-1, Apply)**
10.	The value of $P(1/2<X<2/3)$ from the (a) 0.5 (b) ∞ (c) undefined (d) 1	**Ans: (c)**	**(CLO-1, Apply)**
11.	The Relation between Variance and Standard deviation is ------ (a) var $= S.D^2$ (b) var $=\sqrt{S.D}$ (c) var$-S.D=0$ (d) var $=\sqrt[2]{S.D}$	**Ans: (a)**	**(CLO-1, Apply)**
12.	The Relation between Covariance and Mean is ------ (a)$\text{cov}(X,Y)=E(XY)-E(X)E(Y)$ (b) $\text{cov}(X,Y)=E(XY)+E(X)E(Y)$ (c) $\text{cov}(X,Y)=E(XY)-(E(X)E(Y))^2$ (d) $\text{cov}(X,Y)=E(XY)^2-(E(X)E(Y))^2$	**Ans: (a)**	**(CLO-1, Remember)**

x	-2	-1	0	1	2	3
p(x)	0.1	k	0.2	2k	0.3	3k

x	-2	-1	0	1	2	3
p(x)	0.1	1/15	0.2	2/15	0.3	3/15

13.	The value of k if the pdf $f(x) = kx^2e^{-x}$, $x \geq 0$ is -------- (a) 0.5 (b) ∞ (c) 0 (d) 1	**Ans: (a)**	**(CLO-1, Apply)**
14.	Given E(X) = 5 and E(Y) = -2, then E(X – Y) is (a) 3 (b) 5 (c) 7 (d) –2	**Ans:(c)**	**(CLO-1, Apply)**
15.	A variable that can assume any possible value between two points is called (a) discrete random variable(b) continuous random variable (c) discrete sample space(d) random variable	**Ans: (b)**	**(CLO-1, Remember)**
16.	The generalized form of Tchebycheff's inequality is ---------- (a) $P[\lvert X-\mu\rvert \geq k\sigma] \leq \frac{1}{k^2}$ (b) $P[\lvert X-\mu\rvert > k\sigma] = 1-\frac{1}{k^2}$ (c) $P[\lvert X-\mu\rvert < k\sigma] = \frac{1}{k^2}$ (d) $P[\lvert X-\mu\rvert > k\sigma] = \frac{1}{k^2}$	**Ans: (a)**	**(CLO-1, Remember)**
17.	The conditions satisfied by the pmf is …… (a) $p(x) \geq 0 \,\&\, \sum p(x) = 1$ (b) $f(x) \geq 0 \,\&\, \int_{-\infty}^{\infty} f(x)dx = 1$ (c) $p(x) \leq 0 \,\&\, \sum p(x) = 0$ (d) $f(x) \leq 0 \,\&\, \int_{-\infty}^{\infty} f(x)dx = 1$	**Ans: (a)**	**(CLO-1, Remember)**
18.	If Var(X) = 4, then Var(4X+5) is (a)89 (b) 69 (c) 64 (d) 9	**Ans: (c)**	**(CLO-1, Remember)**
19.	If X and Y are independent random variables with Var 2 and 3 respectively, thenVar(3X+4Y) is (a) 66 (b) 7 (c) 25 (d) 18	**Ans: (a)**	**(CLO-1, Remember)**
20.	If X and Y are independent random variables with Var 2 and var 3 respectively, thenVar(2X - Y) is (a) 66 (b) 11 (c) 25 (d) 18	**Ans: (b)**	**(CLO-1, Remember)**
21.	If E(X) =3 ,then E(3X+4) is (a) 15 (b) 13 (c) 9 (d) 10	**Ans: (b)**	**(CLO-1, Remember)**
22.	If E(X+3) =6 ,then E(3X+4) is (a) 15 (b) 13 (c) 9 (d) 10	**Ans: (b)**	**(CLO-1, Remember)** ,

23.	Var(6X+4) is (a)6Var(X) (b) 36Var(X) (c)Var(X) (d)0	**Ans: (b)**	**(CLO-1, Remember)**
24.	Var (aX+b) = (a)aVar(X)+b (b) a^2 Var(X) (c)aVar(X) (d)Var(X)	**Ans: (b)**	**(CLO-1, Remember)**
25.	If c is a constant in a continuous probability distribution, then p(x = c) is always equal to (a) zero(b) one(c) negative(d) does not exist	**Ans: (a)**	**(CLO-1, Remember)**
26.	If X is a discrete random variable with probability distribution P(X=x)=kx, x=1,2,3,4, Find P(2<x<4). (a) 3/10 (b) 1/15 (c) 1/2 (d) 1/30	**Ans: (a)**	**(CLO-1, Apply)**
27.	The value of F(-∞) is (a) 0.5 (b)0.05 (c)0 (d) 1	**Ans: (c)**	**(CLO-1, Remember)**
28.	A set of numerical values assigned to a sample space is called (a) random sample(b) random variable (c) random numbers(d) random experiment	**Ans: (b)**	**(CLO-1, Remember)**
29.	If a random variable has the moment generating function Mx(t)= 2/(2-t), determine the mean of X. (a) 1/4 (b)1/3 (c)1/2 (d) 2	**Ans: (c)**	**(CLO-1, Apply)**
30.	If the probability density function of X is given by f(x) =2(1-x), 0<x<1, Find mean (a) 1/4 (b)1/3 (c)1/2 (d) 2	**Ans: (b)**	**(CLO-1, Apply)**
31.	The distribution function F(x) is equal to (a) P (X = x)(b) P (X ≤ x) (c) P (X ≥ x)(d) P (X > x)	**Ans: (b)**	**(CLO-1, Remember)**

32.	Let X be a random variable and $Y = 2X + 1$. What is the variance of Y if variance of X is 5 ? (a)10 (b) 20 (c) 5 (d) 1	**Ans:(b)**	**(CLO-1, Remember)**
33.	If the range of X is {0,1,2,3,4} and P(X=x)=0.2. Determine the mean (a) 3/4 (b)1/15 (c) 1/2 (d) 2	**Ans: (d)**	**(CLO-1, Apply)**
34.	A discrete probability function p(x) is always non-negative and always lies between (a) 0 and ∞(b) 0 and 1(c) –1 and +1(d) –∞ and +∞	**Ans: (b)**	**(CLO-1, Remember)**
35.	E [X − E (X)] is equal to (a) E(X)(b)V(X)(c) 0(d) E(X) − X	**Ans: (c)**	**(CLO-1, Apply)**
36.	If X and Y are independent random variables , then the MGF of their sum is equal to…….of their MGFs. (a) Product (b)sum (c) Difference (d)symmetric difference	**Ans: (a)**	**(CLO-1, Remember)**

Unit II-PROBABILITY DISTRIBUTIONS

1	A discrete R.V X has moment generating function $M_x(t) = (\frac{1}{4} + \frac{3}{4}e^t)^5$. Then E(X) and Var(X) is a) $\frac{15}{4}, \frac{15}{4}$ b) $\frac{15}{4}, \frac{15}{16}$ c) $\frac{1}{4}, \frac{5}{4}$ d) $\frac{1}{4}, \frac{3}{4}$	**Ans: (b)**	**(CLO-2, Apply)**
2	Mean and Variance of Binomial Distribution is a)np, npq b)nq, n/q c) pq , p+q =1, d) p+q,p-q	**Ans: (a)**	**(CLO-2, Remember)**
3	If X and Y are independent Poisson variates with parameters λ_1 and λ_2, then X+Y is also a Poisson variate with parameter a) $\lambda_1 + \lambda_2$ b) $\lambda_1 - \lambda_2$ c) λ_1 / λ_2 d) $\lambda_1 . \lambda_2$	**Ans: (a)**	**(CLO-2, Remember)**
4	If on an average, 9 ships out of 10 arrive safely to a port then the variance of the number of ships returning safely out of 150 ships is a) 135 b) 13.5 c) 1.35 d) 12	**Ans: (b)**	**(CLO-2, Apply)**
5	Let X be a random variable following Poisson distribution such that P(X=2) = 9P(X=4) + 90P(X=6), then the mean of X is a)1 b) 2 c)0 d)5	**Ans: (a)**	**(CLO-2, Remember)**
6	If X is a random variable with geometric distribution, then P[X >s+t / X > s] = a) P[X > s] b) P[X > t] c) P[X < t] d) P[X < s]	**Ans: (b)**	**(CLO-2, Remember)**
7	If the probability of success on each trial is 1/3 , then the expected number of trials required for the first success is a) 2/3 b) 3 c) 2 d)1/3	**Ans: (b)**	**(CLO-2, Apply)**
8	8. A typist types 2 letters errorneously for every 100 letters. Then the probability that the tenth letter typed is the first letter with error is a) 0.0167 b) 2.335 c) .0001 d) 0.1	**Ans: (a)**	**(CLO-2, Apply)**
9	Four coins are tossed simultaneously the probability of getting 2 heads is a) 3/4 b)11/16 c)3/8 d)3	**Ans: (c)**	**(CLO-2, Remember)**
10	Poisson distribution is a limiting case of a)Binomial distribution b) uniform distribution c) Geometric distribution d) Normal distribution.	**Ans: (a)**	**(CLO-2, Remember)**

11	The mean and variance of poisson distribution is a)λ b) λ^2 c) λ^3 d) pq	**Ans: (a)**	**(CLO-2, Apply)**
12	If the moment generating function of the random variable is $e^{4(e^t-1)}$, Find P(X = μ + σ)where μ and σ^2 are the mean and variance of poisson a)$\frac{e^4 4^6}{6!}$ (b)$\frac{e^{-4}4^6}{6!}$ c)$\frac{e^{-6}6^4}{4!}$ d)$\frac{e^6 6^4}{4!}$	**Ans: (b)**	**(CLO-2, Apply)**
13	Variance of Exponential distribution is a)$\frac{1}{\lambda}$b) $\frac{1}{\lambda^2}$ c)$\frac{1}{\sqrt{\lambda}}$ d)λ	**Ans: (b)**	**(CLO-2, Apply)**
14	Which of the following cannot generate a Poisson distribution? (a) The number of telephone calls received in a ten-minute interval (b) The number of customers arriving at a petrol station (c) The number of bacteria found in a cubic feet of soil (d) The number of misprints per page	**Ans: (b)**	**(CLO-2, Remember)**
15	The mean of standard Normal distribution is a) Zero b) one c) infinity d) uniform	**Ans: (a)**	**(CLO-2, Remember)**
16	If X is uniformly distributed over (-α,α), α< 0, find α so that P(X>1) = 1/3 a)0 b) 1/2 c)3 d)∞	**Ans: (c)**	**(CLO-2, Apply)**
17	If for a poissonvariate, $E(X^2) = 6$, what is E(X) a)1 b) 2 c) 6 d)3	**Ans: (b)**	**(CLO-2, Remember)**
18	If X ~N(9,81) the standard normal variate Z will be (a) Z = [X – 81] / 9(b) Z = [X − 9] / 81 (c) Z = [X − 9] / 9(d) Z = [9 − X] / 9	**Ans: (c)**	**(CLO-2, Apply)**
19	The mean of rectangular distribution is (a) np(b) 1/λ (c) (a+b)/2(d) λ	**Ans: (c)**	**(CLO-2, Remember)**
20	If X is a Poisson variate such that P(X=0)=0.5, then var(X) is *(a)* e^2 (b)log2 (c) 0.5 (d)log4	**Ans: (b)**	**(CLO-2, Remember)**

21	If f(x)=$Ae^{-x/5}$, x> 0, then the value of A is a)1/5 b) 2 c)1/6 d)1	**Ans: (a)**	**(CLO-2, Apply)**
22	The mean and Standard deviation of a Binomial distribution are 2 and 5, what is the probability of success? a) 1/5 b)1 c)1/2 d)2	**Ans: (a)**	**(CLO-2, Apply)**
23	If the probability of success on each trial is 1/2. What is the expected number of trials required for the first success? (a)3 (b) 2 (c) 4 (d)5	**Ans: (b)**	**(CLO-2, Apply)**
24	Normal distribution is the limiting form of ---------- distribution under suitable statistical conditions a)Exponential distribution b) Uniform distribution c) Normal distribution d) Binomial distribution	**Ans: (d)**	**(CLO-2, Remember)**
25	25. For a binomial distribution ,if mean = 4 and variance = 3 ,the value of n is a)0 b)16 c)10 d)4	**Ans: (b)**	**(CLO-2, Apply)**
26	Which of the following distribution satisfies Memoryless Property? a) Binomial distribution b) Poisson distribution c) Geometric distribution d) Normal distribution.	**Ans: (c)**	**(CLO-2, Remember)**
27	If X is uniformly distributed with mean 1 and variance 4/3 then find P(X<0). a)1/4 b)1/16 c)1/10 d)4	**Ans: (a)**	**(CLO-2, Apply)**
28	The time (in hours) required to repair a machine is exponentially distributed with parameter $\lambda = \frac{1}{2}$. What is the probability that the repair time exceeds 2hrs ? a)0.2679 b)0.3679 c)0.4679 d)0.5679	**Ans: (b)**	**(CLO-2, Apply)**
29	If X is uniformly distributed in (-a,a),then its probability density function is (a) 1/2a (b) 1/a (c)2/a (d)3/a	**Ans: (a)**	**(CLO-2, Apply)**
30	In a binomial distribution, the probability of success is twice as that of failure. Then out of 4 trials, the probability of no success is (a) 16/81 (b) 1/16 (c) 2/27 (d) 1/81	**Ans: (d)**	**(CLO-2, Apply)**

31	The mean and variance of a binomial distribution are 4 & 4/3 respectively. Find P (X ≥1) ,if n = 6. (a) 721/729 (b)724/729 (c)727/729 (d)728/729	**Ans: (d)**	**(CLO-2, Apply)**
32	An urn contains four balls of red, black, green and blue colours. There is an equal probability of getting any coloured ball. What is the expected value of getting a blue ball out of 30 experiments with replacement? a)1.5 b)30 (c)7.5 d)15	**Ans: (c)**	**(CLO-2, Apply)**
33	The MGF of standard normal distribution is a) $e^{\frac{t^2}{2}}$ b) $e^{\frac{-t^2}{2}}$ c) $te^{\frac{t^2}{2}}$ d) $2e^{\frac{t^2}{2}}$	**Ans: (a)**	**(CLO-2, Apply)**
34	If the mean and variance of binomial variate are 8 and 6 then the values of p, q and n are (a)q=1/4 , p=3/4, n =34 (b) q=1/2 , p=1/2, n =32 (c)q=3/4 , p=1/4, n =32 (d)q=1/3 , p=2/3, n =32	**Ans: (c)**	**(CLO-2, Apply)**
35	A manufacturer produces switches and experiences that 2 per cent switches are defective. The probability that in a box of 50 switches, there are zero defective is : (a) 2.5 e^{-1}(b) e^{-1}(c) 2 e^{-1}(d) 1-e	**Ans: (b)**	**(CLO-2, Remember)**
36	The parameters of the normal distribution f(x)=$\left(\frac{1}{\sqrt{72\pi}}\right)\frac{e^{-(x-10)^2}}{72}$ - $\infty < x < \infty$ (a) (10,6)(b) (10,36)(c) (6,10) (d) (36,10)	**Ans: (b)**	**(CLO-2, Remember)**

UNIT III - TESTING OF HYPOTHESES

1	If θ_0 is a population parameter and θ is the corresponding sample statistic and if we set up the Nullhypotheses $H_0: \theta = \theta_0$ then the right-tailed alternative hypotheses is (a) $H_1: \theta = \theta_0$ (b) $H_1: \theta > \theta_0$ (c) $H_1: \theta < \theta_0$ (d) $H_1: \theta \neq \theta_0$	**Ans: (b)**	**(CLO-3, Remember)**
2	The size of large sample is : (a)Exact (b) Less than 30 (c) Greater than 30 (d) Equal to 30	**Ans: (c)**	**(CLO-3, Remember)**
3	The statistic to test the significance difference between sample proportion and populationproportion is (a) $\frac{p-P}{\sqrt{\frac{p}{n}}}$ (b) $\frac{p+P}{\sqrt{\frac{pQ}{n}}}$ (c) $\frac{p-P}{\sqrt{\frac{PQ}{n}}}$ (d) $\frac{p-P}{\sqrt{\frac{Q}{n}}}$	**Ans: (c)**	**(CLO-3, Remember)**
4	The statistic to test the significance difference between the sample mean and population mean is (a) $Z = \frac{\bar{X}-\mu}{\frac{\sigma}{\sqrt{n}}}$ (b) $Z = \frac{\bar{X}+\mu}{\frac{\sigma}{\sqrt{n}}}$ (c) $Z = \frac{\bar{X}}{\frac{\sigma}{\sqrt{n}}}$ (d) $Z = \frac{\bar{X}-\mu}{\frac{\sigma}{n}}$	**Ans: (a)**	**(CLO-3, Remember)**
5	If σ_1 and σ_2 are equal and not known then the test statistic is (a) $Z = \frac{\bar{X}_1-\bar{X}_2}{\sqrt{\frac{s_1^2}{n_2}+\frac{s_2^2}{n_1}}}$ (b) $Z = \frac{\bar{X}_1+\bar{X}_2}{\sqrt{\frac{s_1^2}{n_2}+\frac{s_2^2}{n_1}}}$ (c) $Z = \frac{\bar{X}_1-\bar{X}_2}{\sqrt{\frac{s_1^2}{n_2}-\frac{s_2^2}{n_1}}}$ (d) $Z = \frac{\bar{X}_1-\bar{X}_2}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}}$	**Ans: (a)**	**(CLO-3, Remember)**
6	The sample is said to be small if (a) n> 30 (b) n > 100 (c) n < 60 (d) n < 30	**Ans: (d)**	**(CLO-3, Remember)**
7	The t – distribution is used to test the significance of the difference between (a)Mean of two small samples b) Variance of two small samples (c) Mean of two large samples (d) Variance of two large samples	**Ans: (a)**	**(CLO-3, Remember)**

8	If $n_1 = n_2 = n$, then the degrees of freedom to test mean of the two small samples is (a) $n_1 + n_2 - 2$ (b) $n_1 + n_2 + 2$ (c) $2n - 2$ (d) $2n + 2$	**Ans: (c)**	**(CLO-3, Remember)**
9	The statistics to test the significance difference between means of two small samples is (a) $\frac{\overline{x_1} - \overline{x_2}}{\sqrt{\left(\frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2 - 2}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$ (b) $\frac{\overline{x_1} + \overline{x_2}}{\sqrt{\left(\frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2 - 2}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$ (c) $\frac{\overline{x_1} - \overline{x_2}}{\sqrt{\left(\frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2 - 2}\right)\left(\frac{1}{n_1} - \frac{1}{n_2}\right)}}$ (d) $\frac{\overline{x_1 x_2}}{\sqrt{\left(\frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2 - 2}\right)}}$	**Ans: (a)**	**(CLO-3, Remember)**
10	A _____ is a subset of a population (a) sample (b) proportion (c) parameter (d) statistic	**Ans: (a)**	**(CLO-3, Remember)**
11	Area of the rejection region depends on (a) significant level (b) proportion (c) parameter (d) statistic	**Ans: (a)**	**(CLO-3, Remember)**
12	The hypothesis that an analyst is trying to prove is called the (a) Null hypothesis (b) alternative hypothesis (c) parameter (d) test statistic	**Ans: (b)**	**(CLO-3, Remember)**
13	Type I error is (a) accept H_0, when it is false (b) accept H_0, when it is true (c) reject H_0, when it is true (d) reject H_0, when it is false	**Ans:(c)**	**(CLO-3, Remember)**
14	The standard deviation of a sampling distribution is called as (a) Sampling error (b) Standard error (c) simple error (d) sample error	**Ans:(b)**	**(CLO-3, Remember)**
15	The degrees of freedom for testing a sample mean of a sample of size ' n' is (a) n (b) n-1 (c) n+1 (d) 2n	**Ans:(b)**	**(CLO-3, Remember)**
16	The size of small sample is (a)Minimum 30 (b) Less than 30 (c) Greater than 30 (d) Equal to 25	**Ans: (b)**	**(CLO-3, Remember)**
17	Type II error is (a) accept H_0, when it is false (b) accept H_0, when it is true (c) reject H_0, when it is true (d) reject H_0, when it is false	**Ans:(a)**	**(CLO-3, Remember)**

18	The standard error of sample proportion is (a)$\sqrt{\frac{PQ}{n}}$ (b) $n\frac{PQ}{n}$ (c) $\frac{P}{Q}$ (d) $\frac{P}{n}$	**Ans:(a)**	**(CLO-3, Remember)**
19	A ------- is a numerical characteristic of a sample and a ---------is a numerical characteristic of apopulation. (a)Sample,population(b)Population, sample (c)Statistic,parameter(d)Parameter,statistic	**Ans:(c)**	**(CLO-3, Remember)**
20	A failing student is passed by an examiner, it is an exampleof (a) Type I error (b) Type II error (c) Unbiased decision (d) Difficult to tell	**Ans:(b)**	**(CLO-3, Remember)**
21	A passing student is failed by an examiner, it is an exampleof (a) Type I error (b) Type II error (c) Best decision(d) Unbiased decision	**Ans: (a)**	**(CLO-3, Remember)**
22	Area of the critical region depends on (a) Size of α (b) Size of β (c) Test-statistic (d) Number of values	**Ans: (a)**	**(CLO-3, Remember)**
23	Which hypothesis is called as research hypothesis? (a) Null hypothesis (b) Alternative hypothesis (c)Simplehypothesis(d) Composite hypothesis	**Ans:(b)**	**(CLO-3, Remember)**
24	Student's t-distribution has (n-1) degrees of freedom when all the n observations in the sampleare (a) Dependent (b) Independent (c) Maximum (d) Minimumvalues	**Ans:(b)**	**(CLO-3, Remember)**
25	The number of independent values in a set of values iscalled (a)Test-statistic (b) Degree of freedom (c) Level of significance(d)Levelofconfidencevalues	**Ans: (b)**	**(CLO-3, Remember)**
26	A region corresponding to a statistic't' in the sample space S which lead to the rejection of H_0 is called ---------- region (a) critical (b) acceptance(c) centre (d) parametric	**Ans:(a)**	**(CLO-3, Remember)**
27	Find the standard error of population proportion p for sampling with replacement. The population proportion is 0.5 and size of sample is 4. (a) 0.5(b) 0.25(c) 0.225(d) 0.375	**Ans:(b)**	**(CLO-3, Apply)**

28	Find the value of standard error $\dot{X}$ in a sampling distribution without replacement. Given that the standard deviation of the population of 100 items is 25. (a)2.5(b)0.25(c)0.22(d) 7.5	**Ans:(a)**	**(CLO-3, Apply)**
29	The sampling error is defined as? (a) difference between population and parameter (b) difference between sample and parameter (c) difference between population and sample (d) difference between parameter and sample	**Ans:(c)**	**(CLO-3, Remember)**
30	A manufacturer of ball pens claims that a certain pen he manufactures has a mean writing life of 400 pages with a standard deviation of 20 pages. A purchasing agent selects a sample of 100 pens and puts them for test. The mean writing life for the sample was 390 pages. Find the test statistic. (a) 3 (b) 5 (c) 1 (d) 2	**Ans:(b)**	**(CLO-3, Apply)**
31	Confidence limits are used to estimate a ---------- of a population (a) parameter (b)statistic(c) mean(d) mode	**Ans:(a)**	**(CLO-3, Remember)**
32	Rejecting null hypothesis when calculated test statistic value is ……tabulated value (a)less than (b)greater than (c) equal (d) unequal	**Ans:(b)**	**(CLO-3, Remember)**
33	The value of the test statistic which separates the critical region from the acceptance region is called the----------value (a) parameter (b)critical(c) mean (d) mode	**Ans:(b)**	**(CLO-3, Remember)**
34	The sample observations are ----------in t-distribution. (a) dependent (b) equal (c) independent(d) infinite	**Ans:(c)**	**(CLO-3, Remember)**
35	A server channel monitored for an hour was found to have an estimated mean of 20 transactions transmitted per minute. The variance is known to be 4. Find the standard error. (a) 0.398 (b) 0.598 (c) 0.198 (d) 0.258	**Ans:(d)**	**(CLO-3, Apply)**
36	The probability curve of the 't' distribution is similar to the ---------- curve (a) parametric (b)standard normal (c) markov(d) stochastic	**Ans:(b)**	**(CLO-3, Remember)**

Unit-IV-QUEUEING THEORY

1	The use of F-distribution is to test the (a) Mean of two small samples (b) Variance of two small samples (c) Mean of two large samples (d) Variance of two large samples	**Ans: (b)**	**(CLO-4, Remember)**
2	The value of test statistic F is (a) F > 1 (b) F< 1 (c) F = 1 (d) F = 0	**Ans: (a)**	**(CLO-4, Remember)**
3	Chi square distribution is used to (a) To test the mean of two small samples (b) To test the mean of two large samples (c) To test the goodness of fit (d) To test the variance of two populations	**Ans:(c)**	**(CLO-4, Remember)**
4	In Chi square test , the number of observations in the sample is (a) ≥ 50 (b) ≤ 50 (c) 10 (d) 100	**Ans: (a)**	**(CLO-4, Remember)**
5	In Chi square test , the condition to choose n is (a) $4 \leq n$ (b) $4 \leq n \leq 16$ (c) $n \geq 16$ (d) $n \leq 4$	**Ans: (b)**	**(CLO-4, Remember)**
6	The statistic of chi square test is (a) $\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$ (b) $\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i^2}$ (c) $\chi^2 = \sum (O_i - E_i)$ (d) $\chi^2 = \sum \frac{(O_i - E_i)^2}{2}$	**Ans: (a)**	**(CLO-4, Remember)**
7	The number of degrees of freedom of Chi square test is (a) n-2 (b) n-3 (c)n-4 (d) n-1	**Ans: (d)**	**(CLO-4, Remember)**
8	The number of degrees of freedom of Chi square test in poisson distribution is (a) n-2 (b) n-3 (c)n-4 (d) n-1	**Ans: (a)**	**(CLO-4, Remember)**
9	The number of degrees of freedom of Chi square test in normaldistribution is (a) n-2 (b) n-3 (c)n-4 (d) n-1	**Ans: (b)**	**(CLO-4, Remember)**
10	Test used for independence of attributes (a) t-test (b) z-test (c)F-test (d) chi-square test	**Ans: (d)**	**(CLO-4, Remember)**

11	The value of χ^2 for 2 x 2 contingency table is (a) $\chi^2 = \frac{N(ad-bc)}{(a+b)(c+d)(a+c)(b+d)}$ (b) $\chi^2 = \frac{N(ad+bc)^2}{(a+b)(c+d)(a+c)(b+d)}$ (c) $\chi^2 = \frac{N(ad-bc)^2}{(a+b)(c+d)(a+c)(b+d)}$ (d) $\chi^2 = \frac{N(ad+bc)^2}{(a-b)(c+d)(a+c)(b+d)}$	**Ans: (c)**	**(CLO-4, Remember)**
12	In Queueingsystem,the number of arrivals per unit time always follows ---------- distribution. (a) poisson (b) exponential (c) Binomial d)Normal	**Ans: (a)**	**(CLO-4, Remember)**
13	In the model M/M/1 , the first M represents--------- a) server b) arrival c) no. of servers d)departure	**Ans: (b)**	**(CLO-4, Remember)**
14	In the model M/M/1 , then 1 represents ---------- a)single server b) multiple server c) single arrival d) multiple arrival	**Ans: (a)**	**(CLO-4, Remember)**
15	The average waiting time of acustomer in the (M/M/1):$(\infty/FIFO)$system is a) $\frac{1}{\mu-\lambda}$ b) $\frac{\lambda}{\mu-\lambda}$ c) $\frac{\mu}{\mu-\lambda}$ d) $\frac{\mu}{\mu+\lambda}$	**Ans: (a)**	**(CLO-4, Remember)**
16	If the arrival and departure rates in a public telephone booth with a single phone are1/12 and1 /14 respectively, find the probability that the phone is busy. a) 1/3 b)1/2 c)1/5 d)1/6	**Ans: (a)**	**(CLO-4, Remember)**
17	The number of arrivals per unit time has a poisson distribution with mean _____ a) $\frac{1}{\lambda}$ b)λ c)μ d) $\frac{1}{\mu}$	**Ans: (b)**	**(CLO-4, Remember)**
18	The average number of customers in the system in M/M/1 model is a) $\frac{1}{\mu-\lambda}$ b) $\frac{\lambda}{\mu-\lambda}$ c) $\frac{\mu}{\mu-\lambda}$ d) $\frac{\mu}{\mu+\lambda}$	**Ans: (b)**	**(CLO-4, Remember)**
19	The probability that the arrival enter the service without wait is a)1 + P(arrival has to wait) b)P(arrival has to wait) – 1 c)1 - P(arrival has to wait) d)zero	**Ans: (c)**	**(CLO-4, Remember)**
20	If the inter-arrival time and service time in a public telephone booth with a single-phone follow exponential distributions with means of 10 and 8 minutes respectively, Find the average number of callers in the booth at any time. a) 4 b)2 c) 5 d)6	**Ans: (a)**	**(CLO-4, Apply)**

21	The number of customer in the system are always _____ a) mutually exclusive b) mutually exhaustive c) mutually exclusive and exhaustive d) unique	**Ans: (c)**	**(CLO-4, Remember)**
22	The relation between $E(N_s)$ and $E(N_q)$ is a) $E(N_s) = E(N_q) + \frac{\lambda}{\mu}$ b) $E(N_s) = E(N_q) - \frac{\lambda}{\mu}$ c) $E(N_s) = E(N_q) + \frac{1}{\mu}$ d) $E(N_s) = E(N_q) + \lambda\mu$	**Ans: (a)**	**(CLO-4, Remember)**
23	In which basis the service is provided in queueing theory (a)LCFO (b)LIFO (c) FCFS (d)FCLS	**Ans: (c)**	**(CLO-4, Remember)**
24	What stands for 'd' in the queue model (a/b/c :d/e) (a)queue discipline (b)system capacity (c)servicetime(d) number of servers	**Ans:(b)**	**(CLO-4, Remember)**
25	The traffic intensity is (a) λ/μ^2 (b) λ^2/μ (c) λ/μ (d) $1/\mu$	**Ans:(c)**	**(CLO-4, Remember)**
26	The arrivals in queuing system follows ---------- (a) poisson (b) exponential (c) Binomial d)Normal	**Ans: (a)**	**(CLO-4, Remember)**
27	Consider an M|M|1 queuing system. If $\lambda = 6$ and $\mu = 8$, Find the probability of atleast 10 customers in the system. a) 0.0563 b)0.0989 c) 0.0878 d)0.0675	**Ans:(a)**	**(CLO-4, Apply)**
28	If $\lambda=1/13$ and $\mu=1/4$ in (M/M/1)(∞/FCFS) then the expected number of customers in the system is (a)0.3324 (b)0.4444 (c) 0.3434 (d) 0.7454	**Ans: (b)**	**(CLO-4, Apply)**
29	If $\lambda=1/13$ and $\mu=1/4$ in (M/M/1)(∞/FCFS) then the traffic intensity is (a)0.3077(b)0.3770 (c) 0.3434 (d) 0.7377	**Ans:(a)**	**(CLO-4, Apply)**
30	Prob. Of queue length being greater than on equal to n (a) $\frac{\lambda}{\mu}$ (b) 2 $\frac{\lambda}{\mu}$ c) $\left(\frac{\lambda}{\mu}\right)^n$ (d) $\left(\frac{\lambda}{\mu}\right)\left(\frac{\lambda}{\mu}\right)^n$	**Ans:(c)**	**(CLO-4, Apply)**
31	Suppose that customers arrive at a Poisson rate of one per every 12 minutes and that the service time is exponential at a rate of one service per 8 minutes. What is the average number ofcustomer in the system?	**Ans:(d)**	**(CLO-4, Apply)**

	(a)4 (b)5 (c) 3 (d) 2		
32	If the arrival and departure rates in a public telephone booth with a single phone are1/12 and1 /14 respectively, find the probability that the phone is busy. (a)1/4 (b)1/5 (c) 1/2 (d) 1/3	**Ans:(d)**	**(CLO-4,Apply)**
33	If the inter-arrival time and service time in a public telephone booth with a single-phone follow exponential distributions with means of 10 and 8 minutes respectively, Find the average number of callers in the booth at any time. (a) 4 (b)5 (c) 3 (d) 2	**Ans:(a)**	**(CLO-4, Apply)**
34	If the arrival and departure rates in a M/M/I queue are 1/2 per minute and 2/3 per minute respectively, find the average waiting time of a customer in the queue. (a)4 min (b)5 min (c) 3.5 min (d) 4.5 min	**Ans:(d)**	**(CLO-4, Apply)**
35	What is the probability that a customer has to wait more than 15 minutes to get his service completed in (M/M/I) : (∞ / FIFO) queue systme if λ = 6 per hour and μ = 10 per hour ? (a)0.3679(b)0.5989 (c) 0.4999 (d) 0.6379	**Ans:(a)**	**(CLO-4, Apply)**
36	A super market has a single cashier. During the peak hours, customers arrive at a rate of 20 customers per hour. The average no of customers that can be processed by the cashier is 24 per hour. Find the probability that the cashier is idle (a)0.369 (b)0.567 (c) 0.167 (d) 0.6379	**Ans:(c)**	**(CLO-4, Apply)**
37	Customers arrive at a one-man barber shop according to a Poisson process with mean inter-arrival time of 12 minute, Customers spend an average of 10 min in the barber's chair. What is the expected number of customers in the barber shop and in the queue ? (a)4 (b)5 (c) 3 (d) 2	**Ans:(b)**	**(CLO-4, Apply)**
38	The nature of the customer who leaves the queue because of lengthy queue is (a)Reneging (b)Balking (c) Jockeying (d) leaving	**Ans:(b)**	**(CLO-3, Remember)**
39	In a given (M/M/I) : (k / FIFO) queue, λ = 3 per hour and μ = 4 per hour and effective mean arrival rate is 2.88 per hour, then what is P_n? (a)0.38 (b)0.48 (c) 0.18 (d) 0.28	**Ans:(d)**	**(CLO-4, Apply)**
40	If λ= 3, per hour, μ =4 per hour and maximum capacity k=7 in a (M/M/1) : (k /FIFO) system, then the average number of customers in the system. (a) 1 (b) 2 (c) 4 (d)6	**Ans:(b)**	**(CLO-4, Apply)**

41	What is the probability that a customer has to wait more than 15 min to get his service completed in a in a (M/M/1) : (/FIFO) , if λ = 6 per hour and μ =10 per hour. (a) 0.459 (b) 0.369 (c) 0.269 (d)0.169	**Ans:(b)**	**(CLO-4, Apply)**
42	If a customer has to wait in a (M/M/1) : (∞/FIFO) queue system, what is his average waiting time in the queue, if λ= 8 per hour and m = 12 per hour? (a) 1 (b) 2 (c) 5 (d)6	**Ans:(c)**	**(CLO-4, Apply)**

UNIT V- MARKOV PROCESS

1	A discrete parametermarkov process is called a (a)Markov process (b) stationary process (c) random process (d) Markov chain	Ans: (d)	(CLO-5, Remember)
2	A square matrix , in which the sum of all the elements of each row is one is called a (a)unitary matrix (b) diagonal matrix (c) stochastic matrix (d) skew matrix	Ans: (c)	(CLO-5, Remember)
3	A stochastic matrix P is said to be regular if all the entries of P^m are (a)negative (b) positive (c) semi positive (d) either positive or negative	Ans: (b)	(CLO-5, Remember)
4	If $\pi = (\pi_1, \pi_{2,\ldots,} \pi_n)$ is the steady state distribution of the chain whose tpm is the n^{th} order square matrix P, then (a) πP = π(b) $\pi\mu = \pi$(c) $\pi A = n$ (d) πP = P.	Ans: (a)	(CLO-5, Remember)
5	The conditional probability $P[X_n = a_j/X_{n-1} = a_i]$ is called (a) secondtpm(b)one-step transition probability (c) homogeneous (d) n-step tpm	Ans:(b)	(CLO-5, Remember)
6	If the one-step tpm does not depend on the step ie. $p_{ij}(n-1,n) = p_{ij}(m-1,m)$ the markov chain is called (a)stationary chain (b) discrete chain (c) homogeneous markov chain (d) regular markov chain	Ans: (c)	(CLO-5, Remember)
7	The conditional probability $P[X_n = a_j/X_0 = a_i]$ is called (a) secondtpm(b)one-step tpm (c) homogeneous (d) n-step transition probability	Ans:(d)	(CLO-5, Remember)
8	If P is the tpm of a homogeneous Markov chain , then the n-step tpm $P^{(n)} = P^n$ is known as (a) probability theorem (b) Chapman- Kolmogorov Theorem (c) Markov theorem (d) Chapman theorem	Ans: (b)	(CLO-5, Remember)
9	State i of a Markov chain is said to be ----- with period d_i if $d_i>1$ (a) periodic (b) not periodic (c) aperiodic (d) biperiodic	Ans: (a)	(CLO-5, Remember)
10	State i of a Markov chain is said to be ----- with period d_i if $d_i =1$ (a) periodic (b) not periodic (c) aperiodic (d) biperiodic	Ans: (c)	(CLO-5, Remember)

11	Every state can be reached from every other state , the Markov chain is said to be (a) homogeneous (b) reducible (c) irreducible (d) recurrent	**Ans: (c)**	**(CLO-5, Remember)**
12	Anon null persistent and aperiodic state is called (a) markov (b) irreducible (c) recurrence (d) ergodic	**Ans: (d)**	**(CLO-5, Remember)**
13	A state i is said to be ------ if the return to state i is certain. (a) persistent (b) non persistent (c) ergodic (d) periodic	**Ans:(a)**	**(CLO-5, Remember)**
14	A state i is said to be ------ if the return to state i is uncertain. (a) persistent (b) non persistent (c) transient (d) periodic	**Ans: (c)**	**(CLO-3, Remember)**
15	A state i is said to be ------ if the mean recurrence time μ_{ii} is finite. (a) persistent (b) non persistent (c) transient (d) non null persistent	**Ans:(d)**	**(CLO-5, Remember)**
16	A state i is said to be ------ if the mean recurrence time $\mu_{ii} = \infty$. (a) persistent (b) non persistent (c) null persistent (d) non null persistent	**Ans:(c)**	**(CLO-5, Remember)**
17	If a markov chain is finite and irreducible , all its states are (a) persistent (b) null persistent (c) non null persistent (d) recurrent	**Ans: (c)**	**(CLO-3, Remember)**
18	A Markov chain is completely specified when…… .(is/are) given. (a) initial probability distribution and tpm (b) tpm alone (c) absorbing state alone (d) probability distribution	**Ans:(a)**	**(CLO-5, Remember)**
19	If $\pi P = \pi$, where P = $\begin{pmatrix} 0 & 1 \\ 1/2 & 1/2 \end{pmatrix}$ then values of (π_1, π_2) is (a) (1/3,2/3) (b) (1/2,1/2) (c) (2/3,1/3) (d) (0,1)	**Ans:(a)**	**(CLO-5, Apply)**
20	If the tpm of a markovchain is $P = \begin{pmatrix} 0.1 & 0.5 & 0.4 \\ 0.6 & 0.2 & 0.2 \\ 0.3 & 0.4 & 0.3 \end{pmatrix}$ find $P[X_1 = 3/X_0 = 2]$. (a) 0.1 (b) 0.2 (c) 0.4 (d) 0.6	**Ans:(b)**	**(CLO-5, Apply)**
21	If the transition probability matrix of the Markov chain is $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ then the period of the chain is (a) 4 (b) 1 (c) 2 (d)not periodic	**Ans:(c)**	**(CLO-5, Apply)**
22	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 trains but if he drives one day, then the next day he is just as likely to drive again he is to travel by train. Now suppose that on the first day of the week, the man tossed a fair die and drove to work if and only if a '6' appeared. Find the probability that he takes a train on the second day. (a) 1/14 (b) 1/12 (c) 1/4 (d) 1/6	**Ans:(b)**	**(CLO-5, Apply)**

23	A State i of a Markov chain is said to be an absorbing state if P_{ii} = (a) ∞ (b) 2 (c) 0 (d) 1	**Ans:(d)**	**(CLO-5, Remember)**
24	The limiting probability $\lim_{n\to\infty} P^n$ = (a) 1 (b) P (c) ∞ (d) -1	**Ans:(b)**	**(CLO-5, Remember)**
25	If thereexists a stationary distribution, in ……..chain, then it is unique. (a) persistent (b) transient (c) null persistent (d) Irreducible	**Ans:(d)**	**(CLO-5, Remember)**
26	In an absorbing Markov chain, a state which is not absorbing is (a) persistent (b) transient (c) null persistent (d) Irreducible	**Ans:(b)**	**(CLO-3, Remember)**
27	If the transition probability matrix of the Markov chain is $\begin{pmatrix} 0.75 & 0.25 \\ 0.5 & 0.5 \end{pmatrix}$ then the steady state distribution of the chain is (a)[1/2,1/2] (b) [2/3, 1/3] (c) [1/4, 3/4] (d)[2/5, 3/5]	**Ans:(a)**	**(CLO-5, Apply)**
28	Suppose that the probability of a dry day following a rainy day 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 also a dry day. (a) 1/14 (b) 1/12 (c) 5/12 (d) 1/6	**Ans:(c)**	**(CLO-5, Apply)**
29	If the transition probability matrix of the Markov chain is $\begin{pmatrix} 0 & 1 \\ 0.5 & 0.5 \end{pmatrix}$, then the steady state distribution of the chain is (a)[1/2,1/2] (b) [1/3, 2/3] (c) [1/4, 3/4] (d)[2/5, 3/5]	**Ans:(b)**	**(CLO-5, Apply)**
30	A Student's study habit 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, then the TPM of the Markov Chain is (a) $\begin{pmatrix} 0.75 & 0.25 \\ 0.5 & 0.5 \end{pmatrix}$ (b) $\begin{pmatrix} 0.3 & 0.7 \\ 0.4 & 0.6 \end{pmatrix}$ (c) $\begin{pmatrix} 0.5 & 0.5 \\ 0.5 & 0.5 \end{pmatrix}$ (d) $\begin{pmatrix} 0.7 & 0.3 \\ 0.5 & 0.5 \end{pmatrix}$	**Ans:(b)**	**(CLO-5, Apply)**

31	The tpm of a Markov chain $\{X_n\}$ with three states 1,2,3 is P = $\begin{pmatrix} 0.1 & 0.50 & 0.4 \\ 0.6 & 0.2 & 0.2 \\ 0.3 & 0.4 & 0.3 \end{pmatrix}$ & the intial distribution is $P^{(0)}$ = (0.7, 0.2 0.1). Find $P(X_3 = 2, X_2 = 3, X_1 = 3, X_0 = 1)$ (a) 0.289 (b) 0.0336 (c) 0.269 (d)0.169	**Ans:(b)**	**(CLO-5, Apply)**
32	If the transition probability matrix of the Markov chain is $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ then the nature of the chain is (a) aperiodic (b) reducible(c) irreducible (d)ergodic	**Ans:(c)**	**(CLO-5, Remember)**
33	Three boys A, B, C are throwing a ball 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. This process is (a) Non markov (b) Markov (c) Binomial (d) Normal	**Ans:(b)**	**(CLO-5, Apply)**
34	If the transition probability matrix of the Markov chain is $\begin{pmatrix} 1/2 & 1/2 \\ 1/3 & 2/3 \end{pmatrix}$ then the invariant probability is (a)[1/2,1/2] (b) [2/3, 1/3] (c) [1/4, 3/4] (d)[2/5, 3/5]	**Ans:(d)**	**(CLO-5, Apply)**
35	If a homogenous Markov chain is regular, then every sequence of state probability distributions approaches a unique fixed probability distribution called ---------- distribution of Markov chain. (a) Variant (b) steady state (c) Binomial (d) Normal	**Ans:(b)**	**(CLO-5, Remember)**
36	---------- process is a markov process. a) Poisson (b) Standard normal (c) Binomial (d) Normal	**Ans:(a)**	**(CLO-5, Remember)**