TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

Exam.		Back	
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BAG	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Probability and Statistics (SH 602)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ __Necessary tables are attached herewith.__
✓ Assume suitable data if necessary.

1. What is disparsion? Explain what do you understand by absolute and relative measures of dipersion. The marks distribution of 100 students of a college is as follows: [6]

Marks	10-20	20-40	40-70	70-90	90-100
No of students	15	20	30	20	15

Find the mean, median and standard deviation on of given distribution.

2. By examining the chest x-ray, the probability that T.B is detected when a person is actually suffering from it is 0.99. The probability that the doctor diagnoses incorrectly that a person has TB, on the basis of the x-ray is 0.001. In a certain city, 1 in 10000 persons suffer from TB. A person selected at random is diagnosed to have TB. What is the probability that person has actually TB? [6]

3. Define hypergeometric distribution with an example. Describe the conditions for the binomial approximation to hypergeometric distribution. [2+3]

4. An instructor of a statistics class is planning to interview a sample of n = 10 students who are randomly selected from the class. The class has a total 30 students, consisting of 20 male and female students. [5]

   i) Determine the probability mass function of the number of female students in the sample.
   ii) Find the probability that at least students is in sample.
   iii) Find mean and variance for female students.

5. Define standard normal distribution. Give the condition for normal approximation to binomial distribution. [2+3]

6. Time taken to boot a computer is a continuous random variable x having pdf: [5]

   $$f(x) \begin{array}{l} = k\,x(1-x), 0 < x\,1 \\ = 0, \text{otherwise} \end{array}$$

   Find i) $E(x)$
   ii) $P(0.25 < x < 0.5)$

7. Define parameter and statistic with examples. Explain the central limit theorem. [5]

8. A population consists of the four numbers 5, 6, 9, 12. [5]

   i) Write down all possible sample size of two without replacement.
   ii) Verify that the population mean is equal to the mean of the sample mean.
   iii) Calculate the standard error of the sampling distribution of the sample mean.

9. What assumptions are of paired t-test? Write the process of paired t-test. [5]

10. Four brands of flashlight batteries are to be compared by testing each brand in five flashlights. Twenty flashlights are randomly selected and divided randomly into four groups of five flashlights each. Then each group of flashlights uses a different brand of battery. The lifetimes of the batteries, to the nearest hour, are as follows; [5]

Brand A	Brand B	Brand C
42	36	28
28	36	38
24	32	28
20	39	32
30	31	28

At the 5% significance level, does there appear to be a significance difference in mean lifetime among the four brands of batteries.

11. Define type I and II error. A manufacturer claimed that at least 95% of the pumps supplied to the ABC Company confirmed to specifications. However, the production manager at ABC Company wasn't satisfied with the claim of the manufacturer. Hence, to test the claim, the manager examined a sample of 250 pumps supplied last month and found that 228 pumps as per the specifications. Can you conclude that the production manager is right to doubt on the claim of the manufacturer? ($\alpha = 0.01$) [5]

12. Describe the hypothesis testing procedure of Chi-square test of independent for 2×2 table. [5]

13. A computer operator is interested to know data rate of internet users dependents upon the band width, the following result were gathered by the operator: [5]

Band Width	17	35	41	19	25	20	10	15
Data rate	47	64	68	50	60	55	30	33

i) Is there any association between band width and data rate?
ii) Fit the regression model to describe the given data and also interpret the estimated regression coefficient.
iii) Compute the band width when data rate is 62.

14. Define correlation and regression with examples. Write down the properties of correlation coefficient. [5]

15. Randomly sampled 60 TU graduated BEs, half of whom majored in civil Engineering and half in Computer Engineering. From each, the highest salary offer (including benefits) is stated in following table:

Salary of Civil Engineering		Salary of Computer Engineering Graduates	
61,228	86,792	68,421	73,361
51,836	75,155	56,276	36,956
20,620	65,948	47,510	63,627
73,356	29,392	58,925	71,069
84,186	96,382	78,704	40,203
79,782	80,644	62,553	97,097
29,523	51,389	81,931	49,442
80,645	61,955	30,867	75,188
76,125	63,573	49,091	59,854
62,531	56,276	48,843	79,816
77,073	47,510	79,782	51,943
86,705	58,925	29,523	35,272
70,286	78,704	80,645	60,631
63,196	62,553	76,125	63,567
64,358	36,956	62,531	69,423

i) Which of these groups shows consistency on the basis of salary offer?
ii) Find standard deviation of difference of average salaries of two groups. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

Exam.		Back	
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BAG	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Probability and Statistics *(SH 602)*

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1. An investor buys Rs. 12000 worth of shares in a company each month. During the 1st five months he bought the shares at a price of Rs.100, 120, 150, 200, 240 per share. After five months, what is average price paid for the shares by him? [6]

2. Define conditional probability. Two sets of candidates are competing for the positions on the Board of Directors of a company. The probability that the first and second sets will win are 0.6 and 0.4 respectively. If the first set wins the probability of introducing a new product is 0.8 and the corresponding probability if the second set win is 0.3. What is the probability that the product will be introduced? [6]

3. What is the difference between Binomial distribution and Poisson distribution? Explain under what condition Poisson distribution approximate to binomial distribution. [5]

4. An office switchboard receives telephone calls at a rate of 3 calls per minute on an average. Find the probability of receiving (a) no calls in one minute interval;
   (b) at least 3 calls in a one minute interval;
   (c) at most 2 calls in a five minute interval [5]

5. A continuous random variable X has following probability density function

$$f(x) = \begin{cases} \dfrac{3}{4}(1+x^2), & 0 \le x \le 1 \\ 0, & \text{otherwise} \end{cases}$$

   a) Find mean and standard deviation of X
   b) Find $P(-\sigma < X < \sigma)$ [5]

6. Define Normal distribution. Highlight the important properties of Normal Distribution. [5]

7. A population consists of five numbers: 2, 4, 6, 8 and 10. [5]

   a) Write down all possible samples of size two with SWOR.
   b) Calculate mean and the variance of population.
   c) Prove that sample mean is unbiased estimator of population mean.

8. The heights of hilly people of Nepal are normally distributed with a mean of 64 inches and a standard deviation of 2 inches, what is the probability that the mean height of a random sample of 100 hilly people is greater than 66 inches? [5]

9. The mean of a 200 samples of observations from a normal population with a standard deviation 5 cm is 25 cm.

   a) Estimate the population mean with 95% confidence
   b) Estimate the population mean with 95% confidence, changing the population standard deviation to 2.5 cm. [5]

10. Shyam and Co. produces three varieties of products: Deluxe, Fine and Ordinary. A recent market survey is conducted for preference of products. The preference was found as follow:

Product	Preference			
Deluxe	15	14	19	18
Fine	17	12	20	16
Ordinary	16	18	16	17

Is there a significant difference in the preference of products? Use ANOVA test, and $\alpha = 5\%$. [5]

11. Define chi-square distribution. From the following data can you conclude that there is association between the purchase of brand and geographical region? (Use 5% level of significance) [5]

	Region		
	Central	Eastern	Western
Purchase brand	40	55	45
Do not purchase brand	60	45	55

12. Define confidence level. The developer has claimed that at least 98% of the software which he supplied to a company conformed to specifications an examination of samples of 500 software revealed that 30 were defective. Test the claim at a significance level of 0.01. [5]

13. Describe about the correlation coefficients and their properties. Define coefficient of determination and state its use in analysis of data. [5]

14. The following data gives the experience of machine operators in years and their performance as given by the number of good parts turned out per 100 pieces.

Experience (X)	16	12	18	4	3	10	5	12
Performance (Y)	87	88	89	68	78	80	75	83

a) Fit the regression equation of performance ratings on experience and estimate the probable performance if an operator has 8 years experience.

b) Calculate the coefficient of determination and interpret it. [5]

15. As part of a study monitoring acid rain, measurements of sulfate deposits (kg/hectare) are recorded for different locations on the Eastern Terai of Nepal. The results are listed in the following table for 15 recent and consecutive years: [8]

Acid Rain: Sulfate Deposited (kg/hectare)

Year	Location 1 (x)	Location 2 (y)	Location 3 (z)
1	11.94	13.09	7.96
2	11.28	10.88	12.84
3	10.38	12.19	7.38
4	8.00	10.75	7.26
5	12.12	17.21	10.12
6	10.27	10.26	8.89
7	14.80	15.49	11.60
8	13.52	11.61	9.02
9	10.55	10.53	7.78
10	9.81	12.50	8.70
11	11.27	9.94	10.50
12	12.12	11.21	9.95
13	11.68	9.71	15.59
14	11.77	9.37	10.54
15	17.29	13.87	13.64

a) Find sample mean, sample standard deviation and coefficient of variation for Sulfate deposits of each location.

b) Give your conclusion about variability and uniformity from the analysis.

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2078 Bhadra

Exam.		Regular	
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Year / Part	III / I	Time	3 hrs.

Subject: - Probability and Statistics *(SH 602)*

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1. The number of minutes that a person had to wait for the bus to work on 13 working days are: 1, 10, 13, 12, 8, 2, 6, 9, 17, 30, 5, 4 and 15
   a) Find the values constituting the 5 – number summary. [6]
   b) Construct a box plot.

2. Worldlink, an internet service provider of Nepal buys, signal routers from three countries. It buys 22% of routers from America, 38% from India and 40% from China. It is found that 3% of routers from America, 4% of routers from India and 5% of routers from China are defective. If a customer buys one of these routers, what is the probability that
   a) It is defective [6]
   b) If the router is defective, it is from China. [5]

3. Compare Binomial and Negative Binomial Distributions. [5]

4. In a busy road of Kathmandu there were 500 vehicles passing from 8 AM to 6 PM. It was found that 2 in 1000 vehicle wrongly entered in a one way. Find the probability that at a particular day from 8 AM to 6 PM, there will be [5]
   a) No vehicle enter in one way
   b) One vehicle enter in one way
   c) At least one vehicle enter in one way
   d) At most 2 vehicle enter in one way

5. Define continuous random variable. Write the importance of Normal distribution with its area property. [5]

6. A random variable X has the probability density function f(x) as

$$f(x) = \begin{cases} kx\, e^{-\frac{x^2}{12}}, & x \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

   a) Find the value of k if f(x) is a probability density function. [5]
   b) Find the mean and variance of random variable X.

7. Explain the following terms with suitable example
   a) Parameters [5]
   b) Statistics
   c) Standard error of statistics

8. To illustrate that the mean of a random sample is an unbiased estimate of the mean of the population, consider five slips of paper numbered 3, 6, 9, 12, 15.
   a) List all possible samples of size 3 that can be taken without replacement from this finite population.
   b) Calculate the mean of each of the samples listed in
   c) Verify that the sample mean is an unbiased estimate of the population mean [5]

9. The response time in milliseconds was determined for three different types of circuits in an electronic calculator. The results are shown in the following table.

Circuit Type	Response				
A	19	22	20	18	25
B	20	21	33	27	40
C	16	15	18	26	17

Using $\alpha = 0.01$, test the hypothesis that the three circuit types have the same response time. ($F_{0.01, 2, 12} = 6.93$ $F_{0.01, 3, 12} = 6.70$) [5]

10. Define Hypothesis and Write down the steps involve in the test of significance of difference of mean of large population. [5]

11. Four hundred employees of Nepal Telecom are classified according to their level and decisions. Do you agree with the statement that decisions vary according to level of employee? Test at 5% level of significance. [5]

Decisions	Sr. Officer	Officer	Jr. Officer	Total
Quick	60	80	70	210
Slow	40	60	90	190
Total	100	140	160	400

12. Consider the case of Pharmaceutical Manufacturing Company testing two new compounds intended to reduce blood-pressure level. The compounds are administered two different sets of laboratory animals. In groups A, 71 out of 100 animal tested response to drug first with lower blood-pressure levels. In group B, 58 out of 90 animals tested respond to drug second with lower blood pressure level. The company wants to test at 0.05 levels whether there is a difference between the efficiencies of these two drugs. [5]

13. A sample of 10 values of the variables X1, X2 and X3 were obtained as

$\sum X_1 = 10$	$\sum X_2 = 20$	$\sum X_3 = 30$
$\sum X_1^2 = 20$	$\sum X_2^2 = 68$	$\sum X_3^2 = 170$
$\sum X_1 X_2 = 10$	$\sum X_1 X_3 = 15$	$\sum X_2 X_3 = 64$

Find Partial correlation between X2 and X3 eliminating the effect of X1 also interpret coefficient of partial determination. [5]

14. Fires and Acres Burned. Find the best predicted value of number of acres burned given that there were 80 fires [5]

Fires	73	69	58	48	84	62	57	45
Acres burned	6.2	7.2	1.9	2.7	5.0	1.6	3.0	1.6

15. A semiconductor manufacturer produces devices used as central processing units in personal computers. The speed of the device (in megahertz) is important because it determines the price that the manufacturer can charge for the devices. The following table contains measurements on 48 devices. [8]

717	727	653	637	660	693	679	682	724	642	704	695
704	652	664	702	661	720	695	670	656	718	660	648
683	723	710	680	684	705	681	748	697	703	660	722
662	709	683	705	678	674	656	667	683	691	750	685

Find the

a) Sample mean of the distribution.
b) Sample standard deviation and coefficient of variation.
c) Standard error of sample mean.
d) What percentage of the devices has a speed exceeding 700 megahertz?

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1. A professor of statistics, in his class with 20 students, had conducted a survey about time spent by students on social media, during college hours, and found average time of 20 minutes and standard deviation of 5 minutes. In subsequent verification, it was found that observation 30 was entered as 13. Then find corrected mean and standard deviation of time spent by the students on social media during college hours. [6]

2. Define mutually exclusive and independent events. An insurance company insured 2000 Civil engineers, 4000 Electrical engineers and 6000 Mechanical engineers. The probability of an accident involving Civil engineer, Electrical engineer and Mechanical engineer during their jobs is 0.01, 0.03 and 0.15 respectively. One of the insured engineers meets with an accident. What is the probability that he is civil Engineer? [6]

3. What are the characteristics of Binomial Distribution and how does it differ from Hypergeometric Distribution? [5]

4. If the probability that an individual suffers a bad reaction from a certain injection is 0.001, determine the probability that out of 2000 individuals
   a) Exactly 3, individuals will suffer bad reaction
   b) More than 2, individuals will suffer bad reaction [5]

5. If inner diameter of a rod follow Normal Distribution. If 7% of the rod has inner diameter less than 35 mm and 89% of rod has inner diameter fewer than 63 mm. Find the mean and the standard deviation of diameter of rods. [5]

6. Find the mean and variance of the probability density function given by
$$f(x) = \begin{cases} 12x^2(1-x); & 0 \le x \le 1 \\ 0 \; ; & \text{otherwise} \end{cases}$$
[5]

7. Define Standard error and explain its importance in inferential statistics and write down the formula of standard error of sample mean and sample proportion. [5]

8. A population consists of live numbers 4, 8, 12, 16 and 20. If a random sample of size 2 is drawn without replacement. [5]
   a) Find the population mean and population standard deviation.
   b) List the all possible sample and find their sample mean.
   c) Show the mean of sample mean is equal to the population mean.
   d) Find the standard error of sample mean.

9. Write the process of test of significance of difference of two means for large samples. [5]

10. The sales figure of an item in six shops before and after and advertisement is given as:

Before	53	28	31	48	50	52
After	58	29	30	55	56	45

Test whether the advertisement was effective at 5% level of significance?
(t-value for 5 degree of freedom = 2.571) [5]

11. Dyson Company in Berlin plans to produce a new hair product known as Dyson Supersonic. The suppliers for the company are company A and Company B found that 1% and 2% defective of 200 and 300 items respectively. Arrange appropriate hypothesis testing to investigate whether Company B is better by using a 0.05 level of significance. [5]

12. In a recent survey 1650 Engineers were classified according to their intelligence (GPA in Bachelor) and economic conditions after graduation. Test whether there is any association between intelligence and economic condition. [χ^2 value for 9 degree of freedom=16.919] [5]

Economic Condition after graduation	Intelligence in BE			
	Excellent	Good	Mediocre	Dull
Good	48	199	181	82
Average	80	73	65	89
Below average	86	51	51	84
Not good	81	185	190	105

13. What are the two regression coefficients and what do they present? Write the properties of regression coefficients. [5]

14. Listed below are circumference (in feet) and height (in feet) of trees in Marshall. Minnesota (base on data from "Tree Measurement" by Stenley Rice, American Biology Teacher Vol 61. No 9) [5]

X(circ)	1.8	1.9	1.8	2.4	5.1	3.1	5.5	5.1	8.3
Y (ht)	21.0	33.5	24.6	40.7	73.2	24.4	40.4	45.3	53.5

a) Is there a correlation exist?
b) Explain this correlation.

15. The scores of randomly selected 32 students of two groups on Probability and Statistics are:

Group 'A'				Group 'B'			
50	37	13	37	56	74	50	43
45	9	11	34	39	24	55	35
24	6	13	24	72	32	45	59
32	32	24	40	47	36	34	32
33	45	37	38	40	53	55	18
33	32	46	32	32	42	49	32
46	21	32	4	41	33	14	60
45	16	43	32	60	34	38	48

a) Which group is best?
b) Which group is more consistent?
c) Find standard error of difference of their means. [3+3+2]

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1. Describe the strong and weak points of various measures of Central tendency. From the following frequency distribution find the range of income of middle 70% of the employees and the median income. Also find mean deviation from mean. [6]

Income in Rs.	500-600	600-700	700-800	800-900	900-1000
No. of employees	150	300	500	200	50

2. Distinguish between absolute and relative measures of dispersion. The running capacity of two horses is given below, state which is more consistent and why? [5]

Horse A	250	255	280	290	295	300
Horse B	280	282	290	295	298	295

3. If we the following probability density function.

$$f(x) = \begin{cases} k(5+2x), & 2 \le x \le 4 \\ 0, & \text{otherwise} \end{cases}$$

Find the value of K and mean and variance of random variable X. [5]

4. A random variable X has following probability function.

X	-2	-1	0	1	2	3
P(X)	K	0.1	0.2	2k	3k	0.1

i) Find the value of K. [6]
ii) Find Mean and Variance.

5. During one stage in the manufacture of integrated circuit chips, a coating must be applied. If 70% of chips receive a thick enough coating, find the probability that among 15 chips (i) at least 12 will have thick enough coatings; (ii) at most 3 will have thick enough coatings; (iii) exactly 10 will have thick enough coatings. [5]

6. In a normal distribution 31% of the items are under 45 and 8% are over 64. Find the mean and standard deviation of distribution. (Given, $Z_{0.42}=1.4$, $Z_{0.19}=0.5$) [5]

7. Describe the advantages of sample surveys over complete enumeration? [6]

Nepal Electricity Authority wishes to estimate the average electric bills for the month of October for single family homes in Kathmandu. Based on similar studies in other cities the standard deviation is assumed to be Rs. 150. The NEA wants to estimate the average bill for October such that error will not deviate by Rs. 15 with 90% confidence. What sample size is needed?

8. What are the assumptions for the t-test? Describe the procedure of test of significance between two means for small sample. [5]

9. A research company has designed three different systems to clean up oil spills. The following table contains the results, measured by how much surface area in square meters is cleared in one hour. The data were found by testing each method in several trials. Are the three systems equally effective? Use the 0.05 level of significance. [5]

System A	55	60	63	56	59	55
System B	57	53	64	49	62	-
System C	66	52	61	57	-	-

10. Test of the fidelity and selectivity of 190 digital radio receivers produced the results shown in the following table.

		Fidelity		
		Low	Average	High
Selectivity	Low	6	12	32
	Average	33	61	18
	High	13	15	0

Use $\alpha=0.05$ and $x^2 = 5.991$ to test whether there is relationship between fidelity and selectivity. [6]

11. Define Hypothesis, and write down the steps involve in the test of significance of difference of proportion. [5]

12. In 1990, 5.8% job applicants who were tested for drugs failed the test. At the 0.05 significant level, the test claim that the failure rate is now lower if a simple random sample of 1520 current job applicants results in 58 failure. Does the result suggest that fewer job applicants now use drugs? [5]

13. Fit the regression line of yield of crop ('000 tones) on amount of rainfall (mm) and amount of fertilizers used (kg). Also estimate the yield of crop for the year in which rainfall is 13 mm and fertilizer used is 9 kg. [5]

Yield	4	6	7	9	13	15
Rainfall	3	4	6	8	12	15
Fertilizer	4	10	14	20	24	30

14. The following data gives the experience of machine operators in years and their performance as given by the number of good parts turned out per 100 pieces.

Experience (X)	16	12	18	4	3	10	5	12
Performance (Y)	87	88	89	68	78	80	75	83

a) Fit the regression equation of performance rating on experience and estimate the probable performance of an operator had 8 years experience.

b) Determine coefficient of determination and interpret it. [5]

15. List Five Number summary and prepare the box plot for numbers of guest registered each of 60 randomly selected days. [6]

108	94	188	116	165	181	106	133	176	110
169	134	129	109	85	124	119	165	153	135
105	180	105	91	117	148	83	96	101	123
128	143	136	99	169	133	89	90	174	144
151	168	103	116	106	107	179	113	172	120
179	183	99	94	87	120	154	159	103	139

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Mutually exclusive
if they cannot occur at the same time.

Subject: - Probability and Statistics *(SH 602)*

Mutually inclusive
the events cannot occur independently

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1. Write down the significance of statistics in engineering. An experiment shows the height of 51 plants given below. If average heights of all the 51 plants are 40 cm find the missing frequencies corresponding to the height 30 and 50cm. [6]

Height (cm)	10	20	30	40	50	60
No. of plant	2	3	-	21	-	5

2. What do you mean by mutually exclusive, exhaustive and complementary events? Explain with examples. In a particular city, airport A handles 50% of all airlines traffic, airport B handles 30% and airport C handles 20%. The detection rates for weapons at the three airports are 0.9, 0.5 and 0.4 respectively. A passenger is randomly selected at one of the airports. Then (i) what is the probability that he/she carrying a weapon? (ii) If he/she is found to be carrying a weapon, what is the probability that airport A is being used? [5]

3. Define probability density function? A continuous probability distribution of a variable x is defined as f(x)=KX(1-X) for all $0 \leq X \leq 1$. Compute (i) $P(X \geq 0.4)$ (ii) $P(\frac{1}{4} \leq X \leq \frac{3}{4})$ [5]

   Or,

   A fair dice was rolled until one gets a Six; find the expected number of toss required?

4. Define Negative Binomial distribution and explain characteristics. How does it differ from binomial distribution? [6]

5. A typist made 2.6 mistakes per page on average, find the probability that in the page typed by him, i) there is no mistake ii) at least two mistakes iii) at most 3 mistakes. [5]

6. Define Gamma distribution, chief characteristics and write its applications. [5]

   Or,

   The breakdown voltage X of randomly chosen diode of a particular type is known to be normally distributed with mean 40 and s.d. 1.5 volts. What is the probability that the breakdown voltage will be (a) between 39 and 42 volts; (b) at most 43 volts; (c) at least 39 volts.

7. Define estimation? Write characteristics of a good estimator? A sample of 400 students taking Entrance for BE revealed an average score of 56. Construct a 95% as well as 99% confidence interval for population mean score if standard deviation of score of all students in known to be10. [6]

8. A whole sale dealer wanted to buy a large quantity of light bulbs from two brands label A and B. He bought 100 bulbs from each bulbs brand and found by testing that brand A had mean life time 1120 hours and standard deviation 75 hours and brand B had mean life

time 1062 hours and standard deviation 82 hours. Find the 95% and 99% confidence limits for the difference in the average life of bulbs from the two brands. [5]

9. The following are the breaking strength of three different brands of cables.

Brand	Breaking Strength					
A	40	30	50	60	30	-
B	60	40	55	65	-	-
C	60	50	70	65	75	40

Construct ANOVA table and test for the equality of the average breaking strength of cables at $\alpha=5\%$. [5]

10. In a recent survey 1,072 Engineers were classified according to their intelligence (GPA in Bachelor) and economic conditions after graduation. Test whether there is any association between intelligence and economic condition. [6]

Economic Condition after graduation	Intelligence in BE			
	Excellent	Good	Mediocre	Dull
Good	48	199	181	82
Not good	81	185	190	106

x^2 value for 2 d.f.=5.991

11. What is testing of hypothesis? Explain the procedure followed in testing of Significance difference between two population proportion large sample? [5]

12. A simple random sample of Household with TV set in use. Show that 1024 of them were tuned to 60 minute while 3836 were tuned to some other show. Use 0.05 significant level to test the claim of CBS executive that "60 minute get more than a 20 shave", which mean that more than 20% of set in use are tuned to 60 minute. [5]

13. A sample of 10 values of three variables X1, X2 and X3 were obtained as

$\Sigma X_1=10$	$\Sigma X_2=20$	$\Sigma X_3=30$
$\Sigma X_1^2=20$	$\Sigma X_2^2=68$	$\Sigma X_3^2=170$
$\Sigma X_1 X_2=10$	$\Sigma X_1 X_3=15$	$\Sigma X_2 X_3=64$

Find (i) Partial correlation between X_1 and X_2 eliminating the effect of X_3 (ii) Multiple correlation between X_1, X_2 and X_3 assuming X_1 as dependent variable. [5]

14. Differentiate between correlation and regression? From following data find the Karl Pearsons coefficient correlation and interpret the result? [5]

Marks in Statistics	39	65	62	90	82	75	25	98	36	78
Marks in Mathematics	47	53	58	86	62	68	60	91	51	84

15. Following data reveals the sample of 22 pairs of observation (X,Y) drawn from large population.

X	46	61	56	68	58	45	50	59	45	66	57
Y	49	46	43	32	26	27	29	47	37	30	43
X	59	66	62	57	57	45	50	61	55	47	51
Y	32	27	37	24	43	49	48	29	37	32	26

i) Find the sample mean for each variable X and Y.
ii) Which series is more consistent and why?
iii) Find the standard error of the difference of mean.
iv) Find the coefficient of Karl Pearson correlation. [6]

***

Exam.		Regular	
Level	BE	**Full Marks**	80
Programme	BEL, BEX, BCT, B.Agri.	**Pass Marks**	32
Year / Part	III / I	**Time**	3 hrs.

Subject: - Probability and Statistics *(SH602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ *Necessary tables are attached herewith.*
- ✓ Assume suitable data if necessary.

1. What are measures of central tendencies? Write favorable points of each of them. Calculate approximate measures of central tendency from following data;   [1+2+3]

Wages in Rs/ week	Less than 35	35-37	38-40	41-43	Over 43
No. of wage earned	14	82	99	18	7

2. From a group of 4 Engineers, 3 Doctors and 2 Statistician a sub-group of 3 has to be made, what is the probability that sub-group consists of

   a) One from each profession
   b) Atleast one engineer   [4]

3. Define discrete probability distribution with suitable example. Compare Negative Binomial and Binomial probability distributions.   [3+3]

4. A quality control engineers inspects a random sample of 3 batteries from each lot of 24 car batteries that is ready to shipment. If such a lot contain six batteries with slight defects, what is the probabilities that the inspector's sample will contain

   a) None of the batteries with defect
   b) Only one of the batteries with defect
   c) At least two of the batteries with defect   [6]

5. Write major characteristics of normal distribution. Discuss relation between Normal distribution and Standard Normal distribution.   [2+3]

OR

What are Gamma and Chi-squared distributions? Specify relationship between them.

6. The life of an electric light bulbs follows Normal distribution with mean 800 hours and a standard deviation of 50 hours. Find the probability that a bulb burns

   a) Between 750 and 825 hours
   b) More than 900 hours   [5]

OR

Define exponential distribution. Suppose that the service life of a semiconductor is exponentially distributed with an average of 60 hours. Find the probability that a semi-conductor will a) still working after 90 hours
                b) fail within 120 hours

7. A population consists of five numbers 2, 4, 6 and 8

   a) Enumerate all possible sample of size two without replacement
   b) Show that the mean of the sampling distribution of sample mean is equal to population mean   [4]

8. State central limit theorem. A random sample of size 100 is taken from an infinite population with mean 75 and variance 256. Assert the chances of sample mean between 67 and 83. [6]

9. What is type Ist error? Describe the procedure of the for difference of two Mean for large sample. [6]

10. Define chi-square distribution. A book containing 500 pages, was thoroughly checked. The distribution of number of error page was given below as

Number of errors:	0	1	2	3	4	5
Number of pages:	275	138	75	7	4	1

Using chi-square test of goodness of fit, verify whether the arrivals follow a poison distribution at 5% level of significance. [6]

11. Define hypothesis. Describe the procedure of testing of hypothesis of significant difference between two population means for large samples.

OR

Describe the types of error in Hypothesis Testing. Write the procedure testing of Hypothesis of single proportion. [6]

12. Write the Decision criteria in test of Hypothesis with diagram. [4]

13. In trying to evaluate the effectiveness of antibiotics in killing bacteria, a research institute compiled the following information

Antibiotics (mg)	12	15	14	16	17	10
Bacteria	5	7	5.6	7.2	8.6	6.2

Find strength and direction of relationship between them. [4]

14. Differentiate between Correlation and regression analysis. [4]

15. Following data revels the scores of sixty candidates of IOE entrance examination

51.43	40	78.57	46.43	51.43	50.71
42.14	50.71	42.86	55	71.43	64.29
52.86	42.14	57.14	45.71	43.57	40
44.29	55.71	40	48.57	48.57	49.29
51.43	47.14	54.29	45	53.57	50
49.29	60	48.57	50.71	50	49.29
47.14	53.57	58.57	43.57	47.14	53.57
47.86	47.14	40	43.57	52.86	47.86
49.29	49.29	42.86	47.14	48.57	50
47.14	50.71	52.86	47.86	47.14	70

a) Estimate average score of candidates
b) Find unbiased estimator of true standard deviation and standard error of average score
c) Also test for consistency of score [8]

***

Subject: - Probability and Statistics *(SH602)*

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- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
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1. In two companies A and B engaged in similar type of industry, the average weekly wage and standard deviation are given below: [6]

	Company A	Company B
Average weekly wage (Rs)	460	490
Standard deviation	50	40
No. of wage earners	100	80

   i) Which company pays larger amount as weekly wags?
   ii) Which company show greater variability in the distribution weekly wages?
   iii) What is the mean and standard deviation of all the workers in two companies taken together?

2. State the law multiplication of probability. An Electronics company has an engineering position open. The Probability that an applicant is capable is 0.7. Each applicant is given written test and oral examination. A capable applicant passes with Probability 0.9 while an incapable applicant passes with Probability of 0.4. Find (a) the probability that an applicant passes the test (b) the probability that the applicant is capable given he/she passes the test. [6]

3. Define negative Binominal Distribution. If a boy is throwing stone at a target what is the probability that his 10th throw is his 5th hit, if the probability of hitting the target at any trial is 0.6. Also find the mean and variance of random variable. [5]

4. Define hypergeometric probability distribution with an example. Describe the conditions for the binomial approximation to hypergeometric distribution? [5]

5. Let X denote the amount of time for which a book on two hour reserve at a college library is checked out by a randomly selected student and suppose that X has density function, [5]

   $f(x) = 1/2x,$ $0 \le x \le 2$
   $= 0$ otherwise

   Calculate $P(X \le 1)$ and $P(0.5 \le X \le 1.5)$

6. Define continuous random variable with suitable example. Describe the properties of probability density function and distribution function. [5]

7. State Central limit theorem with an example. Explain why it is important in engineering field? [5]

8. A population consists of the four number 2,8,14,20 [5]

   i) Write down all possible sample size of two without replacement
   ii) Verify that the population mean is equal to the mean of the sample mean
   iii) Calculate the standard error of the sampling distribution of the sample mean

9. Define Karl Person coefficient of Correlation and coefficient of determination. What it is input in analysis. [5]

10. A house survey on monthly expenditure on food yield following data: [5]

Monthly expenditure (100 Rs.)	10	15	20	25	30	35	40
Monthly income (1000 Rs.)	2	4	5	7	6	6	5
Size of the family	4	5	7	10	8	11	4

Obtain the multiple correlation coefficient.

11. There was a research on voltage supply by Ba Hries supplied by two companies. Both company claims that same. But researcher suspects that there is significance difference between mean voltages between two companies. To test this, she selected independent samples from both company and in lab test the result were as follows: [5]

		Mean	Sample Standard deviation
Company A	13	3.59V	0.3V
Company B	10	3.15V	0.4V

Test the researcher suspect was correct at 5% level of significance.

12. Shyam and Co. produces three varieties of certain product: deluxe, find and ordinary. A recent market survey is conducted for preference of products. The preference was found as follow: [5]

Product	Production			
Deluxe	15	14	19	18
Fine	17	12	20	16
Ordinary	16	18	16	17

Is there a significant difference in the preference of products test it using ANOVA test. Use $\alpha = 5\%$

OR

The following are the average weekly losses of worker hours due to accidents in 10 industrial plan before and after a certain safety program was put into operation:

Before	45	73	46	124	33	57	83	34	26	17
After	36	60	44	119	35	51	77	29	24	11

Use the 0.05 level of significance to test whether the safety program is effective.

13. Define critical value. A manufacturer claimed that at least 95% of the water pumps supplied to the ABC Company confirmed to specification. However, the product manager at ABC Company wasn't satisfied with the claim of the manufacturer. Hence, to test the claim, the manager examined a sample of 250 water pumps supplied last month and found that 228 water pumps as per the specification. Can you conclude that the production manager is right to doubt on the claim of the manufactures? (α=0.01) [5]

14. Describe the Hypothesis testing procedure of Chi-square test of independence for 2×2 table. [5]

15. The following table shows the number of hours 45 hospital patients slept following the administration of a certain anesthetic. [8]

7	10	12	4	8	7	3	8	5
12	11	3	8	1	1	13	10	4
4	5	5	8	7	7	3	2	3
8	13	1	7	17	3	4	5	5
3	1	17	10	4	7	7	11	8

a) Find sample mean, sample variance and sample standard deviation
b) Compare a value that measures the amount of variability relative to the value of mean

***

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, B. Agri.	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Probability and Statistics *(SH602)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ *Necessary tables are attached herewith.*
✓ Assume suitable data if necessary.

1. What are the differences between measures of central tendency and measures of dispersion? The mean and standard deviation of 20 items is found to be 10 and 2 respectively. At the time of checking it was found that one item 8 was incorrect. Calculate the mean and standard deviation if: (i) the wrong item is omitted (ii) it is replaced by 12.   [6]

2. Define conditional probability. An assembly plant receives its voltage regulators from these three different suppliers, 60% from supplier A, 30% from supplier B, and 10% form supplier C. It is also known that 95% of voltage regulators from A, 80% of these from B, and 65% these from C perform according to specifications. What is the probability that   [6]

   i) Anyone voltage regulator received by the plant will perform according to specifications
   ii) A voltage regulator that perform according to specification came from B

3. Write the differences and similarities between Binomial and Negative Binomial Distribution.   [2+3]

4. In certain factory turning out optical lenses, there is a small change, 1/500 for any lens to be defective. The lenses are supplied in packets of 10 each. What is the probability that a packet will contain   [5]

   i) No defective lens
   ii) At least one defective lenses
   iii) At most two defective lenses

OR

Define mathematical expectation of a discrete random vasriable. A probability distribution is given.

X = x	0	1	2	3	4	5
p(X=x)	0.26	0.25	0.11	0.02	0.25	0.11

Find (a) $P(X \geq 4)$; (b) $p(0 < X < 4)$; (c) mean and variance of X

5. Define standard normal distribution. Give the condition for normal approximation of Poisson distribution.   [5]

6. The mean inside diameter of a sample of 200 washers produced by a machine is 0.502 cm and the standard deviation as 0.005 cm. The purpose for these washers are interned allows a maximum tolerance in the diameter of 0.496 to 0.508 cm, otherwise the washers are considered defective. Determine the percentage of defective washers produced by the machine. Assume the diameter is normally distributed.   [5]

7. What do you mean by sampling distribution of a sample mean and its Standard Error? Explains with example. What would be the variance of sampling distribution of mean, if sample is taken from finite population?   [5]

8. Define the Central Limit Theorem. A sample of 100 mobile battery cells tested to find the length of life produced the following results as mean 13 months and standard deviation of 3 months. Assuming the data to be normally distributed by using Central Limit Theorem what percentage of battery cells expected to have Average life? [5]

   i) More than 15 months (ii) Less than 9 months

9. Define partial and multiple correlations with examples. Write down the properties of partial and multiple correlation. [5]

10. An article in wear (Vol.152, 1992, pp. 171-181) presents data on the fretting wear of mild steel and oil viscosity. Representative data follow, with x = oil viscosity and y = wear volume (10^{-4} cubic millimeters). [5]

y	240	181	193	155	172	110	113	75	94
x	1.6	9.4	15.5	20.0	22.0	35.5	43.0	40.5	33.0

   i) Fit the sample linear regression model using least
   ii) Predict fretting wear when viscosity x = 30

11. Describe the procedure of the test of significance for difference of two population mean for large sample. [5]

12. Ten objects were chosen at random from the large population and their weights were found to be in grams 63, 63, 64, 65, 66, 69, 65, 66.1, 64.5. In the light of above data, discuss the suggestion that the mean weight in the population is 65 gm. Use $\alpha = 0.05$. [5]

13. Define chi-square distribution. From the following data can you conclude that there is association between the purchase of brand and geographical region? (Use 5% level of significance). [5]

	Region		
	Central	Eastern	Western
Purchase brand	40	55	45
Do not purchase brand	60	45	55

14. In a postal survey of 500 households, 330 said that they thought they were being overcharged for the public services within their area. [5]

   i) Calculate an approximate 99% confidence interval for the population proportion, p, of households who thought they were being overcharged for public services within their area.
   ii) Estimate the size of sample required to estimate the value of p to be within 99% confidence limits of ±0.025.

15. Following data gives the sample records of number of passenger take ticket at the counter of Bus during one hour period. [8]

22	58	32	36	62	57	25	45	23	37
64	56	46	60	29	49	63	36	26	58
60	26	58	58	29	43	53	36	45	22
52	43	45	31	45	39	35	38	30	60
58	42	54	62	52	42	65	58	51	60
53	45	31	53	22	53	51	52	47	59

   Find the
   i.   Sample mean of Number of passenger
   ii.   Sample Standard deviation and Coefficient of variation.
   iii. Standard error of the sample mean.
   iv.   Find the 95% and 99% confidence limit of sample mean

***

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, B.Agri.	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Probability and Statistic (SH602)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt _All_ questions.
✓ The figures in the margin indicate _Full Marks_.
✓ _Necessary tables are attached herewith._
✓ _Assume suitable data if necessary._

1. What is absolute and relative Measure of Dispersion? Construct a Box plot from the following data of marks of students as: [1+5]

Marks	10-20	20-30	30-40	40-50	50-60
No. of students	2	6	22	13	7

2. State the law of addition of probability. In a training, the 70% of persons achieved a rating of Satisfactory. Of those as rated as Satisfactory, 80% had Acceptable Scores on the personality test. Of those rated as Unsatisfactory, 35% had Acceptable Scores. Find the probability that an applicant would be a Satisfactory trainee given the Acceptable scores on personality test. [2+4]

3. Define Negative binomial distribution with its important characteristics. [5]

4. A particularly long traffic light on your morning commute is green 20% of the time that you approach it. Assume that each morning represents as independent trial. [5]

   i) Over five mornings, what is the probability that the light is green on exactly one day?
   ii) Over 20 mornings, what is the probability that the light is green on exactly four days?

5. The distribution function for a random variable X is [5]

   $F(x) = 1 - e^{-2x}$ for $x \geq 0$

   $\qquad = 0 \qquad$ for $x < 0$

   i) Find $P(X > 2)$
   ii) Find mean and variance of the variable X.

6. Define Standard Normal Distribution with their respective probability density function and describe its properties. [5]

7. An article in Wear (Vol.152, 1992, pp.171-181) presents data on the fretting wear of mild steel and oil viscosity. Representative data follow, with x = oil viscosity and y = wear volume (10⁻⁴ cubic millimeters). [5]

y	240	181	193	155	172	110	113	75	94
x	1.6	9.4	15.5	20.0	22.0	35.5	43.0	40.5	33.0

   i) Fit the simple linear regression model using least
   ii) Predict fretting wear when viscosity x = 30

8. What are the two regression coefficients and what do they represent? Write the properties of regression coefficient. [5]

9. Define Central Limit Theorem. An electronics company manufactures resistors that have a mean resistance of 100 ohms and a standard deviation of 10 ohms. The distribution of resistance is normal. Find the probability that a random sample of 25 resistors will have an average resistance less than 95 ohms. [5]

10. Define standard error of sample mean. A population consist of the four numbers 12, 19, 13, 16. [5]

    i) Write down all possible sample size of two without replacement.
    ii) Find standard error of the sample mean.

11. Describe the procedure of the test of significance for difference of two population mean for large sample. [5]

12. In the investigation of a citizens' committee complaint about the availability of fire protection within the country, the distance in miles to the nearest fire station was measured for each of five randomly selected residences in each of four areas. [5]

Area 1	7	5	5	6	8
Area 2	1	4	3	4	5
Area 3	7	9	8	7	8
Area 4	4	6	3	7	5

Do these data provide sufficient evidence to indicate a difference in mean distance for the four areas at the = 0.05 level of significance?

OR

The diameter of steel rods manufactured on two different extrusion machines is being investigated. Two random samples of sizes $n_1 = 15$ and $n_2 = 17$ are selected, and the sample means and sample variances are $\bar{x}_1 = 8.73, s_1^2 = 0.35, \bar{x}_2 = 8.68,$ and $s_2^2 = 0.40,$ respectively. Assume that $\sigma_1^2 = \sigma_2^2$ and that the data are drawn from a normal distribution. Is there evidence to support the claim that the two machines produce rods with different mean diameters? Use $\alpha = 0.05$ in arriving at this conclusion.

13. A random sample of 500 adult residents of Maricopa County found that 385 were in favor of increasing the highway speed limit to 75 mph, while another sample of 400 adult residents of Pima County found that 267 were in favor of the increased speed limit. Construct 95% confidence interval on the difference in the two proportions. [5]

14. Define chi-square distribution. From the following data can you conclude that there is association between the purchase of brand and geographical region? [5]

	Region		
	Central	Eastern	Western
Purchase brand	40	55	45
Do not purchase brand	60	45	55

Use 5% level of significance.

15. The following table shows the number of hours 45 hospital patients sleep following the administration of a certain anesthetic. [8]

7	10	12	4	8	7	3	8	5
12	11	3	8	1	1	13	10	4
4	5	5	8	7	7	3	2	3
8	13	1	7	17	3	4	5	5
3	1	17	10	4	7	7	11	8

    i) Find sample mean, sample variance and sample standard deviation.
    ii) Compute a value that measures the amount of variability relative to t value of mean.

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, B.Agri.	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: -Probability and Statistics (SH602)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt _All_ questions.
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✓ _Necessary tables are attached herewith._
✓ Assume suitable data if necessary.

1. Write difference between measure of central tendency and measure of dispersion and their importance. The following table represents the marks of 100 students. [6]

Marks	0-20	20-40	40-60	60-80	80-100
No. of Students	14	?	27	?	15

If the mode value is 58, find the missing frequencies and the mean of all 100 students.

2. Define multiplication law of probability for dependent and independent events with suitable examples. The independent probabilities that the three sections of a costing department will encounter a computer error 0.2, 0.3 and 0.1 per week respectively. What is the probability that there would be: [6]
   i)   At least one computer error per week?
   ii) One and only one computer error per week?

3. Define Negative binomial distribution with an example. How does the negative binomial distribution differ from binomial distribution? [2+3]

4. A heavy machinery manufacturer has 3840 large generators in the field that are under warranty. If the probability is 1/1200 that any one will fail during the given year, find the probability: [5]
   i)   That exactly 3 generators will fail during the given year?
   ii) That between 2 and 6 are fail during the given year?

5. Define the standard normal distribution. Give the condition for normal approximation of Poisson distribution. [2+3]

6. The breakdown voltage X of a randomly chosen diode of a particular type is known to be normally distributed with mean 40 volts and variance 2.25 volts. What is the probability that the breakdown voltage will be: [5]
   i)   Between 39 and 42 volts
   ii) Between 40 and 43 volts
   iii) Less than 44 volts

OR

A probability density function is given by $f(x)=Ax(6-x)^2$ for $0 < x < 6$
   i)   Find the value of A
   ii) Find the mean and variance of this distribution

7. Define sampling distribution of proportion with example. [4]

8. The monthly income of a particular group of retailer's follows a normal distribution with mean Rs.21,000.00 and standard deviation of Rs.9,487.00. A random sample of size 10 retailers was taken and the mean income is calculated. Find the probability that this sample lies between Rs.18,000.00 and Rs.27,000.00. [6]

9. Define partial correlation and multiple correlations with suitable examples. Write down properties of partial and multiple correlations. [5]

10. The following data gives the number of twists required to break a certain kind of forced alloy bar and percentage of alloying element A present in the metal. [5]

Number of twists	41	49	69	65	40	50	58	57	31	36
Percentage of element A	10	12	14	15	13	12	13	14	13	12

   i)   Fit the regression equation of number of twists on percentage of element A. Determine the predicted number of twist required to break an alloy when percentage of element is 20.

11. The mean weight loss of n = 16 grinding balls after a certain length of time in mill slurry is 3.42 grams with a standard deviation of 0.68 gram. Construct a 99% confidence interval for the true mean weight loss of such grinding balls under the stated conditions. [4]

12. Four trained operators works on production of new product. The productivity of the operators are recorded as below: [6]

Operators	Production			
1	10	12	14	16
2	12	11	13	16
3	14	15	12	11
4	16	10	17	17

Using ANOVA, test whether the difference in average productivity due to the difference in operators are significant. Use $\alpha = 5\%$

OR

The following are the average weekly losses of worker hours due to accidents in 10 industrial plants before and after a certain safety program was put into operation:

Before	45	73	46	124	33	57	83	34	26	17
After	36	60	44	119	35	51	77	29	24	11

Use the 0.05 level of significance to test whether the safety program is effective.

13. Define confidence level and significance level. A manufacturer claimed that at least 95% of the cables supplied to the ABC Company confirmed to specifications. However, the production manager at ABC Company wasn't satisfied with the claim of the manufacturer. Hence, to test the claim, the manager examined a sample of 250 cables supplied last month and found that 228 cables as per the specifications. Can you conclude that the production manager is right to doubt on the claim of the manufacturer? ($\alpha=0.01$) [5]

14. Define chi-square distribution. A book containing 500 pages was thoroughly checked. The distribution of number of error page was given below as: [5]

Number of errors	0	1	2	3	4	5
Number of pages	275	138	75	7	4	1

Using chi-square test of goodness of fit, verify whether the arrivals follow a Poisson distribution at 5% level of significance.

15. The sample of length of life of bulbs from two companies are given below: [8]

Length of Life (hours)	Company	
	A	B
500-600	10	3
600-700	7	8
700-800	6	15
800-900	8	12
900-1000	21	4
1000-1100	10	5
1100-1200	2	15
1200-1300	12	13
1300-1400	19	7
1400-1500	9	7
1500-1600	3	4
1600-1700	7	6
1700-1800	5	3
1800-1900	4	2
1900-2000	1	3

i) Calculate mean length of life of bulbs for Company A and Company B.
ii) Calculate sample standard deviation and sample variance for given data.
iii) Which Company's bulbs are more uniform?

22 TRIBHUVAN UNIVERSITY	**Exam.**	**Regular**	
INSTITUTE OF ENGINEERING	Level	BE	Full Marks	80
Examination Control Division	Programme	BEL, BEX, BCT, B.Agri	Pass Marks	32
2071 Chaitra	Year / Part	III / I	Time	3 hrs.

Subject: - Probability and Statistic (SH602)

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✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ **Necessary tables are attached herewith.**
✓ Assume suitable data if necessary.

1. Two different sections of a statistics class take the same quiz and the scores are recorded below: [6]

   a) Find the range and standard deviation for each section
   b) What do the range values lead you to conclude about the variation in the two sections?
   c) Why is the range misleading in this case?
   d) What do the standard deviation values lead you to conclude about the variation in two sections?

Section 1	1	20	20	20	20	20	20	20	20	20	20
Section 2	2	3	4	5	6	14	15	16	17	18	19

2. Define dependent and independent events with suitable examples. The independent probabilities that the three sections of a costing department will encounter a computer error are 0.2, 0.3 and 0.1 per week respectively. What is the probability that there would be: [6]

   i) At least one computer error per week
   ii) One and only one computer error per week

3. Write the differences and similarities between Binominal and Negative Binominal Distribution. [2+3]

4. A quality control engineer inspects a random sample of 4 batteries from each lot of 24 car batteries that is ready to shipment. If such a lot contain six batteries with slight defects. What are the probabilities that the inspector's sample will contain: [5]

   i) None of the batteries with defect?
   ii) At least two of the batteries with defects?
   iii) At most three of the batteries with defect?

5. A random variable X has the following probability density function as: [5]

   $$f(x) = \begin{cases} kx^3(4-x)^2, & 0 < x < 1 \\ 0, & \text{otherwise} \end{cases}$$

   Find the value of k, using this value of k find mean and variance of distribution.

6. The breakdown voltage X of a randomly chosen diode of a particular type is known to be normally distributed with mean 40 volts and variance 2.25 volts. What is the probability that the breakdown voltage will be: [5]

   i) Between 39 and 42 volts
   ii) Less than 44 volts
   iii) More than 43 volts

   ### OR

   The daily consumption of electric power in a certain city follow a gamma distribution with $\alpha = 2$ and $\beta = 3$. If the power plant of this city has daily capacity of 12 million kilowatt hours, what is the probability that this power supply will be inadequate on any given day?

7. State central limit theorem. An electrical firm manufactures light bulbs that have a length of life that is approximately normally distributed with mean equal to 800 hours and standard deviation of 4 hours. Find the probability that a random sample of 16 bulbs will have an average life of less than 12775 hours. [5]

8. What do you mean by sampling distribution of a sample mean and its standard Error? What would be the variance of sampling distribution of mean if sample is taken from finite population? [3+1]

9. Define partial and multiple correlation with suitable examples. Write down the properties of partial and multiple correlation. [5]

10. The following data gives the number of twists required to break a certain kind of forged alloy bar and percentage of alloying element A present in the metal. [5]

Number of twists	41	49	69	65	40	50	58	57	31	36
Percentage of element A	10	12	14	15	13	12	13	14	13	12

i) Fit the regression equation of number of twists on percentage of element A. Determine the predicted number of twists required to break an alloy when percentage of element is 20.

ii) Find 99% confidence interval for the regression coefficient (i.e.slope)

11. In a certain factory, there are two independent processes manufacturing the same item. The average weight in a sample of 250 items produced from one process is found to be 120 gram with a standard deviation of 12 gram, while the corresponding figures in a sample of 400 items from the other process are 124 and 14 respectively. Test whether the two mean weights differ significantly or not at 5 percent level of significance. [5]

12. Three trained operators work on production of new product. The productivity of the operators are recorded as below: [5]

Operators	Production			
1	10	12	14	16
2	12	11	13	16
3	14	15	12	11

Using ANOVA test whether the difference in average productivity due to the difference in operators are significant. Use $\alpha = 5\%$

OR

Define confidence level and significance level. A company claims that its light bulbs are superior to those of its main competitor. If a study showed that a sample of 40 of its bulbs has mean lifetime of 647 hours of continuous use with standard deviation of 27 hour. While a sample of 40 bulbs made by its main competitor had mean lifetime of 638 hours of continuous use with standard deviation of 31 hours. Does this substantiate claim at 1% level of significance?

13. Write down the steps for testing hypothesis on difference between two population proportions for the large sample size. [5]

14. 1072 students were classified according to their intelligence and economic conditions. Test whether there is any association between intelligence and economic condition. [6]

Economic Condition	Intelligence			
	Excellent	Good	Mediocre	Dull
Good	48	199	181	82
Not good	81	185	190	106

15. The sample of length of life of bulbs from two companies are given below: [8]

Length of life (hours)	Company	
	A	B
500-600	10	3
600-700	21	8
700-800	6	15
800-900	8	12
900-1000	21	4
1000-1100	10	5
1100-1200	2	15
1200-1300	12	13
1300-1400	19	7
1400-1500	9	7
1500-1600	3	4
1600-1700	7	6
1700-1800	5	3
1800-1900	4	2
1900-2000	1	3

i) Calculate mean length of life of bulbs for company A and company B.
ii) Calculate sample standard deviation and sample variance for given data.
iii) Which company's bulbs are more uniform?

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, B.Agri.	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Probability and Statistics (SH602)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ **Necessary tables are attached herewith.**
✓ Assume suitable data if necessary.

1. The following are data on the breaking strength (in pounds) of 3 kinds of material: [2×3]

Material 1	144	181	200	187	169	171
Material 2	186	194	176	182	133	183
Material 3	197	165	180	198	175	164

   i) Calculate the average breaking strength and the median breaking strength for each material.
   ii) Calculate standard deviation and variance for each material.

2. Define independent and mutually exclusive events with an example. An assembly plant receives its voltage regulators from these three different suppliers, 60% from supplier A, 30% from supplier B and 10% from supplier C. It is also known that 95% of voltage regulators from A, 80% of these from B and 65% these from C perform according to specifications. What is the probability that: [2×3]

   i) Anyone voltage regulator received by the plant will perform according to specifications.
   ii) A voltage regulator that perform according to specification came from B and C.

3. Write difference between binominal distribution and negative binomial distribution with suitable examples. [2+2]

4. Among the 12 solar collectors on display at a trade show, 9 are flat-plate collectors and the others are concentrating collectors. If a person visiting the show randomly selects 6 of the solar collectors to check out, what is the probability that [2+2+2]

   i) Non of them will be flat-plate collectors.
   ii) At least 3 of them will be flat-plate collectors.
   iii) At most 2 of them will be concentrating collectors.

5. Define standard normal distribution. Write down its importance in engineering field. [4]

6. The breakdown voltage X of randomly chosen diode of a particular type is known to be normally distributed with mean 40 and standard deviation 1.5 volts. What is the probability that the breakdown voltage will be [6]

   i) Between 39 and 42 volts
   ii) At most 43 volts
   iii) At least 3.9 volts

OR

If a random variable X has a function
$$f(x) = 2e^{-2x} \quad \text{for } x > 0$$
$$0 \quad \text{for } x \leq 0$$

Find (i) Verify that the function is probability density function
  (ii) $P(1 < x < 3)$
  (iii) Find mean and variance

7. What do you mean by the sampling distribution of sample proportion? [4]

8. A population consists of 5,6,9,12. Consider all possible samples of size two which can be drawn without replacement from this population. Find [2×3]

   i) Population mean and population standard deviation.
   ii) Mean of sampling distribution of mean.
   iii) Standard error of sampling distribution of mean.

9. The simple correlation coefficient between fertilizer (X_1), seeds (X_2) and productivity (X_3) are $r_{12}=0.69$, $r_{13}=0.64$ and $r_{23}=0.85$. Calculate the partial correlation $r_{12.3}$ and multiple correlations $R_{1.23}$. [4]

10. An article in Concrete Research presented data on compressive strength X and intrinsic permeability Y of various concrete mixes and cures. Summary quantities are n = 14, $\Sigma y = 572$, $\Sigma y^2 = 23,530$, $\Sigma x = 43$, $\Sigma x^2 = 157.42$ and $\Sigma xy = 1697.80$. Assume that the two variables are related according to the simple linear regression model. [6]

    i) Calculate the least squares estimates of the slope and intercept
    ii) Use the equation of the fitted line to predict what permeability would be observed when the compressive strength is x = 4.3.

11. The following are the breaking strength of three different brands of cables. [6]

Brand	Breaking strength					
A	40	30	50	60	30	-
B	60	40	55	65	-	-
C	60	50	70	65	75	40

Construction ANOVA table and test for the equality of the average breaking strength of cables at α=5%

OR

In a manufacturing company the new modern manager is in a belief that music enhances the productivity of workers. He made observations on 6 workers for a week and recorded the production before and after the music was installed. From the data given below, can you conclude that the productivity has indeed changed due to music? (α=1%)

Week without music	219	205	226	198	209	216
Week with music	235	186	240	203	221	205

12. A random sample of size 16 showed a mean of 52 with a standard deviation 4. Obtain 99% and 95% confidence limits population mean. [4]

13. From the following data can you conclude that there association between the purchase of brand and geographical region using Chi-square test at α=1%? [5]

	Region		
	Central	Eastern	Western
Purchase brand	40	55	45
Do not purchase brand	60	45	55

14. What are the steps in hypothesis testing? A study shows that 16 of 200 computers produced on one assembly need readjustment before shipping while same happens on 14 out of 300 produced. Test at 1% level of significance that the second assembly is superior than first one? [5]

15. Entrance scores of three engineering institutes is as follows: [1+2+2+3]

Institutes									
A	740	800	830	840	860	890	830	930	1070
B	655	775	825	978	989	1025	950	980	1100
C	850	825	749	870	565	978	925	950	1000

Calculate mean, standard deviation, coefficient of variation and answer the following

    i) Which institute is good?
    ii) Which institute is consistent/reliable?

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Exam.	Regular		
Level	BE	**Full Marks**	80
Programme	BEL, BEX, BCT, B.Agri.	**Pass Marks**	32
Year / Part	III / I	**Time**	3 hrs.

Subject: - Probability and Statistics *(SH 602)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ __Necessary tables are attached herewith.__
✓ Assume suitable data if necessary.

1. Write any four characteristics of ideal measure of central tendency. For a group of 16 candidates, the mean and standard deviation were found be 20 and 5 respectively. Later it is discovered that the score 32 was measured as 23. Find the correct mean and correct standard deviation. [2+4]

2. Define dependent and independent events with examples. In a bolt factory, machines A, B and C manufacture 25%, 35% and 40% of the total respectively. Of their output 5, 4 and 2 percent are defective bolts. A bolt is drawn at random from the product and is found to be defective. What is the probability that it was manufactured from the machine B? [2+4]

3. Write any two conditions that a function is a probability mass function. It is found that 10% of the items produced by a company are defective. Out of 8 items chosen, using binomial distribution, find the probability of: (i) no defective item (ii) at least one defective item. [2+2+2]

4. Define Poisson distribution. Write the limiting case of Poisson distribution as a Binomial distribution. [2+2]

5. In a continuous distribution, whose probability density function $f(x)=Kx(2-x)$, $0 \leq x \leq 2 = 0$ otherwise. Find: [2+2+2]

   a) The value of K
   b) Mean of the distribution
   c) Variance of the distribution

6. State the importance of normal distribution in engineering field with an example. [4]

7. What do you mean by the sampling distribution of sample proportion? Distinguish between parameter and statistics. [1+3]

8. State the central limit theorem. A random sample of size 100 is taken from an infinite population having the mean 76 and variance 256. What is the probability that the sample mean will be between 75 and 78? [6]

9. The following table gives the age of the cars of a certain company and annual maintenance costs : [5]

   Age of cars (Years):   2   4   6   8   10
   Maintenance costs (Rs.000) : 10 15 22 32 46
   Obtain the regression equation for cost related to age and also estimate the cost of maintenance for 10 yrs old car.

10. The simple correlation coefficient between temperature (X_1), corn yield (X_2) and rainfall (X_3) are $r_{12} = 0.59$, $r_{13} = 0.46$ and $r_{23} = 0.77$. Calculate the partial correlation coefficient $r_{12.3}$ and multiple correlation $R_{1.23}$. [5]

11. The sample of 900 members has a mean of 3.4cms and standard deviation 2.61cms. If the population is normal and its mean is unknown, find 95% and 98% fidcial limits of true mean. [5]

12. A potential buyer of light bulbs bought 50 bulbs each of two brands. Upon testing these bulbs, he found that brand A had a mean life of 1282 hours with S.D. of 80 hours whereas the brand B had a mean life of 1208 hours with S.D. of 94 hours. Can the buyer be quite certain that the two brands do differ in quality? $\alpha = 10\%$. [5]

13. Describe the procedure of the test of significance of mean for sample. [4]

14. A soft drink is being bottled using two different filling machines. The standard deviation of the process for machine A and B was 0.010 and 0.015L respectively. 30 bottles were randomly sampled from each machine and the means were 2.04 and 2.07 L respectively. Can one conclude that both machines are filling the same volume of soft-drink? Test the hypothesis at $\alpha = 0.01$ level of significance. [6]

OR

Eight pots growing barley plants each were exposed to a high tension discharge, while nine similar pots were enclosed in an earthed wire cage. The number of tillers in each pot were an follows:

Caged	17	27	18	25	27	29	27	23	17
Electrified	16	16	20	16	20	17	15	21	

Test the hypothesis whether electrification exercises have any real effect on the fillering at $\alpha = 0.05$ level of significance.

15. The admission staff of a university, concerned with the success of the students it selects for admission wishes to compare the students' college performances with high school grades and test scores. The high school and college grade-point average (GPA) and student's average test (SAT) scores of 20 sampled students are follows: [2×4]

H.S. GPA	College GPA	SAT score	H.S. GPA	College GPA	SAT score
3.6	2.5	1100	3.4	3.6	1180
2.6	2.7	940	2.9	3.0	1010
2.7	2.2	950	3.9	4.0	1330
3.7	3.2	1160	3.2	3.5	1150
4.0	3.8	1340	2.1	2.5	940
3.5	3.6	1180	2.2	2.8	960
3.5	3.8	1250	3.4	3.4	1170
2.2	3.5	1040	3.6	3.0	1100
3.9	3.7	1310	2.6	1.9	860
4.0	3.9	1330	2.4	3.2	1070

a) Find, for each of the HS GPA, college GPA and SAT scores; The mean and standard deviation.

b) What is your conclusion about variability and uniformity from the analysis?

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Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Probability and Statistics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Seven** questions selecting **Four** from **Group A** and **Three** from **Group B**.
✓ The figures in the margin indicate **Full Marks**.
✓ **Necessary figures are attached herewith.**
✓ Assume suitable data if necessary.

Group A

1. a) Find the median, the lower and upper quartiles and the inter-quartile range for the following data: 4, 0, 5, 3, 6, 2, 5, 9, 5, 3. [6]

   b) Discuss the importance and limitation of graphical representation of data. [5]

2. a) An engineering system has two components, Let us define the following events: [6]

   A: First component is good; $\overline{A}$: First component is defective.

   B: Second component is good; $\overline{B}$: Second component is defective.

   Describe the following events in terms of A, $\overline{A}$, B and $\overline{B}$ if at least one of the components is good one is good and one is defective

   The test has produced the following result: P(A) = 0.8, P(B/A = 0.85, P(B/$\overline{A}$) = 0.75 Determine the probability that

   i) The second component is good.
   ii) At least one of component is good.
   iii) Are they independent? Verify your answer.

   b) Define sample space, event and outcome with suitable example. [5]

3. a) Define the probability density function and it probability distribution. Give three engineering examples of discrete case. [5]

   b) Test for impurities commonly found in drinking water from private wells showed that 30% of all wells in a particular area have impurity A. If a random sample of 5 wells is selected from the large number of wells in the area, what is the probability that: [6]

   i) Exactly 3 will have impurity A?
   ii) At least 3?
   iii) Fewer than 3?

4. a) Define the hyper geometric distribution. Describe the conditions for Hyper geometric distribution. [5]

   b) From the DVDs manufactured by Sony, batches of DVDs are randomly selected and the number of defects x is found for each batch as given below. [6]

x	0	1	2	3	4
P(x)	0.502	0.385	0.089	0.011	0.001

   i) Identify the random variable x (discrete or continuous).
   ii) If in a batch it contains 5000CD, find the average number of defective DVDs

5. a) Define the normal distribution and standard normal distribution and its application in engineering field. [5]

b) The Precision Scientific Instrument Company manufactures thermometers that are supposed to give reading of 0°C at the freezing point of water. Tests on a large sample of these instruments reveal that at the freezing point of water, some thermometers give readings below 0° (denoted by negative numbers) and some give readings above 0° (denoted by positive numbers). Assume that the mean reading is 0°C and the standard deviation of the readings is 1.00°C. Also assume that the reading are normally distributed. If one thermometer is randomly selected, find the probability of randomly selecting one thermometer that reads (at the freezing point of water) [6]

   i) The reading is less than 1.58°   ii) Above – 1.23°.

6. a) Define the joint probability mass distribution, marginal probability mass function and conditional joint probability mass function. [5]

  b) The given joint probability density function is $f_{xy}(x, y) = a(x + y)$, for $0 < x < 1$ and $1 < y < 2 = 0$ elsewhere [6]

   i) Find the marginal function of X and Y.
   ii) Find the probability for ($0.5 < x < 0.8$ and $Y > 1.5$)

Group B

7. a) What are estimator and estimates? Describe the criteria for a good estimator. [6]

  b) A commission on crime is interested in the estimation of the proportion of crimes to firearms in an area with one of the highest crime rates in a country. The commission selects a random sample of 300 files of recently committed crimes in the area and determine that a firearm was reportedly used in 180 of them. Estimate 95% and 99% confidence of the true proportion p of all crimes committed in the area in which some type of firearm was reportedly used. [6]

8. a) What are assumptions for z- test? Describe the procedures of testing proportion? [6]

  b) The Edison Electric Institute has published figures on the annual value of kilowatt hours consumed by various home appliances. It is claimed that a vacuum cleaner consumed an average of 46 kilowatt hours per year. If a random sample of 12 homes included in a planned study indicates that vacuum cleaner consumes an average of 42 kilowatt hours per year with a standard deviation of 11.9 kilowatt hours, does this suggest at the 0.05 level of significance that vacuum cleaners consumes, on the average, less than 46 kilowatt hours annually? Assume the population of kilowatt hours to be normal. [6]

9. a) Describe the errors of hypothesis. Explain the procedure for test of significance of pair data. [6]

  b) According to Chemical Engineering an important property of fiber is its water absorbency. The average percent absorbency of 25 randomly selected pieces of cotton fiber was found to be 20 with a standard deviation of 1.25. A random sample of 25 pieces of acetate yielded an average percent of 12 with a standard deviation of 1.25. Is there strong evidence that the population mean percent absorbency for cotton fiber is significantly higher than the mean for acetate? Assume that the percent absorbency is approximately normally distributed and that the population variances in percent absorbency for the two fibers are the same. Use a significance level of 0.05. [6]

10. a) Write the properties of correlation coefficient and describe under what condition there exist only one regression line. [6]

  b) On 13 April 1994, the following concentrations of pollutants were recorded at eight stations of the monitoring system for air pollution control located in the downtown area of Milan, Italy: [6]

	Station							
	Aquileia	Cenisio	Juvara	Liguria	Marche	Senato	Verziere	Zavattari
NO_2 mg $/m^3$	130	130	115	120	135	142	90	116
CO_2 mg/m^3	2.9	-4.4	3.6	4.1	3.3	5.7	4.8	7.3

   i) Show the relationship between NO_2 and CO_2 by graphical method
   ii) Compute the correlation coefficient between NO_2 and CO_2
   iii) Explain the relationship between NO_2 and CO_2

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