TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR DEGREE OF:

BACHELOR OF SCIENCE IN ELECTRICAL & ELECTRONIC ENGINEERING
BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING
BACHELOR OF SCIENCE IN CIVIL ENGINEERING
BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY
(BSEE/BSME/BSCE/BSIT)

SMA 2272/AMA 4203: STATISTICS

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2014
TIME ALLOWED: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Mathematical tables*
- *Scientific Calculator*

This paper consist of **FIVE** questions
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **FOUR** printed pages

Question One (Compulsory)

a) Define the following terms as used in Statistics:

(i) Mutually exclusive events **(1 mark)**

(ii) Sample space **(1 mark)**

b) The heat evolved in calories per gram of a cement mixture is approximately normally distributed. The mean is thought to be 100 and the standard deviation is 2. We wish to test Ho:μ=100 against Hi: μ≠100 with a sample of size n = 5 specimens. If the acceptance region is defined as $98.5 \le \bar{x} \le 101.5$, find the type 1 error **(3 marks)**

c) An article in the Journal of Heat Transfer described a new method of measuring the thermal conductivity of Armco iron. Using a temperature of 100°F and a power input of 550 wats, the following 10 measurements of thermal conductivity were obtained:

41.6, 41., 42.3, 419, 41.9, 42.2, 417, 42.3, 41.8, and 42.0

Using the above data, calculate:

- **(i)** Point estimate of the mean thermal conductivity **(2 marks)**
- **(ii)** Standard deviation of the mean thermal conductivity **(3 marks)**
- **(iii)** The standard error of the point estimate obtained in part (i) above **(2 marks)**

d) The time until a chemical reaction is complete (in milliseconds) is a approximated by the cumulative distribution function:

$$F(x) = \begin{cases} 0 & x < 0 \\ 1 - e^{-0.01x} & x \geq 0 \end{cases}$$

- **(i)** Determine the probability density function of x **(2 marks)**
- **(ii)** What proportion of reactions is complete within 200 milliseconds? **(2 marks)**

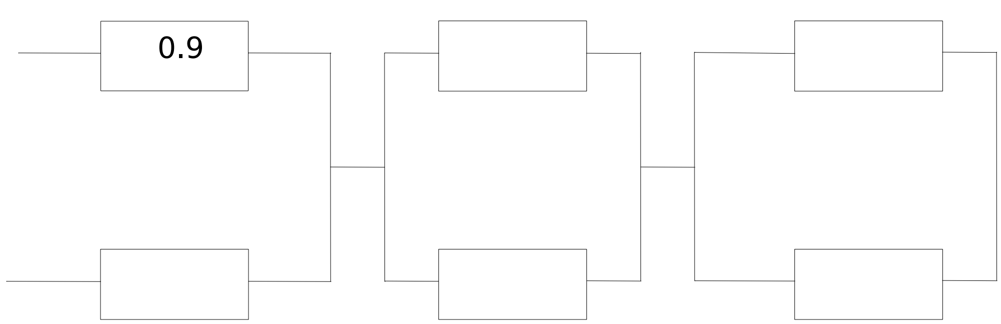
e) An optical inspection system is to distinguish among different part types. The probability of a correct classification of any part is 0.98. Suppose that three parts are inspected and that the classifications are independent. Let the random variable X denote the number of parts that are correctly classified. Determine the:

- (i) Probability distribution of X **(3 marks)**
- (ii) The variance of X **(4 marks)**

f) Suppose that $P(A|B) = 0.45$ 5 and $P(B) = 0.5$ determine the following:

- (i) $P(A \cap B)$ **(1 mark)**
- (ii) $P(A^1 \cap B)$ **(2 marks)**

g) The following circuit operates if and only if there is a path of functional devices from left to right. The probability that each device functions is as shown. Assume that the probability that a device is functional does not depends on whether or not other devices are functional. What is the probability that the circuit operates? **(4 marks)**



Question Two

The following table shows green liquor Na_2S concentration (in gl) and paper machine production (in tones per day)

Paper production (tons)	Liquor concentration
X	Y
7	18
12	32
8	28
12	24
14	22
9	32
18	36
14	26
8	26
12	28
17	28

a) Draw a scatter plot and explain your plot **(3 marks)**

b) Calculate the Pearson correlation coefficient between x and y. (Interpret your answer) **(6 marks)**

c) Determine the coefficient of determination and interpret your answer. **(3 marks)**

d) Construct a linear regression model between X and Y **(6 marks)**

e) Estimate the value of Y given that X = 6 **(2 marks)**

Question Three

a) Describe the properties of a good estimator. **(8 marks)**

b) The life in hours of a 75-watt bulb is known to be normally distributed with $\delta = 25 hours$ A random sample of 20 bulbs has a mean life of $\bar{x} = 1014$ hours. Construct a 95% confidence interval on the mean life **(4 marks)**

c) A melting point test of 10 samples of a binder used in manufacturing a rock propellant resulted in $\bar{x} = 154.2^o F$

Assume that the melting point is normally distributed with d^2 = 1.5 Test H; μ = 155 verses Ho; μ≠155 at 0.01 level of significance **(8 marks)**

Question Four

The following table shows the number of voltages at some sub stations:

Voltage	No of Observation
120-123	1
124-127	4
128-131	2
132-135	7
136-139	21
140-143	41
144-147	19
148-151	12
152-155	2
156-159	1

Using the above data, calculate:

a) The mean **(4 marks)**
b) Mode **(3 marks)**
c) Median **(3 marks)**
d) Standard deviation **(4 marks)**
e) Quartile range **(4 marks)**
f) 35^{th} percentile **(2 marks)**

Question Five

a) The following table summarizes the analysis of samples of galvanized steel for coating weight and surface roughness.

		Coating Weight	
		High	Low
Surface	High	12	16
Roughnes s	Low	88	34

(i) If the coating weight of a sample is high, what is the probability that the surface roughness is high? **(3 marks)**
(ii) If the surface roughness of a sample is high, what is the probability that the coating weight is high? **(3 marks)**
(iii) Are the events surface roughness and coating weight independent **(4 marks)**

b) An electronic product contains 40 integrated circuits. The probability that any integrated circuit is defective is 0.01, and the integrated circuits are independent. The product operates only if there are no defective integrated circuits. What is the probability that the product operates. **(3 marks)**

c) The number of failures for cytogenics machine from contamination in biological samples is a Poisson random variable with a mean of 0.01 per 100 samples. What is the probability that the machine will not fail during a study that includes 500 participants? **(3 marks)**

d) The line width of a semi conductor is assumed to be normally distributed with a mean of 0.5 micrometer and a standard deviation of 0.5 micrometer and a standard deviation of 0.05 micrometer. What is the probability that a line width is greater than 0.62 micrometer? **(4 marks)**