MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

SECOND SEMESTER SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF ELECTRICAL AND ELECTRONICS ENGINEERING
BACHELOR OF CIVIL AND BIULDING ENGINEERING

BACHELOR MECHANICAL ENGINEERING

ECU 201: ENGINEERING MATHEMATICS VI

DATE: **TIME: 2 HOURS**

Attempt **Question one (compulsory)** and any ***other two questions***.

QUESTION ONE (30 MARKS)

(a) Differentiate between the following terms

(i) A statistic and a parameter (2 marks)

(ii) Independent and mutually exclusive events (2 marks)

(iii) Discrete and continuous variables (2 marks)

(b) The sample weekly output in units of a manufacturing company has been recorded over 30 weeks. The data is shown below

19	22	20	16	24	24	16	20	24	23
25	20	19	20	19	17	18	21	23	21
19	20	19	22	23	26	20	25	24	21

Group the data above into class intervals starting with 16-<18, 18-<20, 20-<22.. (2 marks)

Hence from the grouped data determine

(i) Mean (2 marks)

(ii) Mode (2 marks)

(iii)Inter-quartile range (3 marks)

(c) The probability density function $f(x)$ of a continuous random variable X is

$$f(x) = \begin{cases} \frac{3}{8}x^2 & , \quad 1 \leq x \leq 2 \\ 0, & Otherwise \end{cases}$$

Obtain the mean and variance of X. (4 marks)

(d) Suppose that X a discrete random variable with probability distribution function

$$f(x) = \begin{cases} \frac{kx}{2}, x = 0, 1, 2, 3, 4 \\ 0, \quad Otherwise \end{cases}$$

Find the value of k. Hence calculate the $p(X > 2)$ (4 marks)

(e) A random variable X has a moment generating function given by

$$M_X(t) = \frac{1}{1-t}$$

Compute mean and variance of X (4 marks)

(f) In an attempt to separate 4 white beads and 6 black beads in a container, a ball is picked at random. Whenever a white bead is picked, it is returned into the container before the next draw but if a black bead is picked, it is not returned. If three attempts are made and in each attempt only one ball is picked, what is the probability that at most two white bead are picked (3 marks)

QUESTION TWO (20 MARKS)

(a) It is believed that there is a relationship between the costs of maintaining machines and its age. In order to establish the truth, a Construction firm manager collected the data on weekly maintenance cost (Y) in $ and age (X) in months for six similar machines. The data is summarized in a table below

Months (X)	17	14	12	21	35	33
Cost (Y) in $	500	430	480	355	510	655

(i) Obtain the product moment correlation coefficient between weekly maintenance cost (Y) and age (X) in months. Comment on the results (6 marks)

(ii) Determine the linear regression model relating weekly maintenance cost (Y) to age (X) in months (5 marks)

(iii) If the maintenance cost for a machine is $570, how old is the machine? (2 marks)

(iv) What percentage of maintenance cost of a machine is determined by its age? (2 marks)

(b) Obtain the spearman's rank correlation coefficient for the following data

X	47	44	42	51	65
Y	50	43	48	35	51

(5 marks)

QUESTION THREE (20 MARKS)

(a) (i) What is sampling? (1 mark)

(ii) Differentiate probability sampling and non-probability sampling (2 marks)

(b) Briefly discuss the following sampling schemes

(i) Simple random sampling (2 marks)

(ii) Stratified sampling (2 marks)

(iii) Two stage sampling (2 marks)

(iv) Quota sampling (2 marks)

(c) There are three in a thousand chances that people contract a malnutrition disease in Makueni County. If the person contracts the disease, he/she is 98% likely to test positive for the disease. But if a person does not contract the disease, he/she is 2% likely to test positive for the disease. If a person contracts the disease, what is the probability that he/she will test positive? (4 marks)

(d) The number of accidents happening (X) between Mlolongo and Machakos Junction in a day as a poison distribution with parameter λ=3. The distribution is given below

$$P(X = x) = \begin{cases} \frac{3^x e^{-3}}{x!}, & x = 0, 1, 2, \dots \\ 0\ , & otherwise \end{cases}$$

What is the probability that

(i) at least two accidents happened in a day (2 marks)

(ii) three accidents that happened in a particular day (2 marks)

QUESTION FOUR (20 MARKS)

(a) A discrete random variable X has a probability mass function given by

$$f(x) = \begin{cases} \frac{1}{2^x}, & x = 0, 1, 2, \dots \\ 0, & otherwise \end{cases}$$

Obtain the moment generating function of X. Hence calculate the mean and variance of X (8 marks)

(b) Let x be a continuous random variable with a probability density function given by

$$f(x) = \begin{cases} \frac{3}{8}x^2, & 0 \leq x \leq 2 \\ 0, & otherwise \end{cases}$$

Find the cumulative distribution function of a random variable $Y = X^2$. Hence find the p.d.f of Y. (5 marks)

(c) If the height of 3000 students in a certain university is normally distributed with mean 68 inches and standard deviation 2 inches. Determine

(i) Probability that the height of a student is between 60 and 70 inches inclusive (3 marks)

(ii) Probability that is a student height is above 70 inches (2 mark)

(iii)The number of students number of students whose height is above 60 inches (2 marks)

QUESTION FIVE (20 MARKS)

(a) The table below shows the distribution of height to the nearest cm of 40 students.

Height (cm)	145-149	150-154	155-159	160-164	165-169	170-174	175-179
Frequency	2	5	16	9	5	2	1

Calculate:

(i) Median height (3 marks)

(ii) Inter-quartile range (5 marks)

(iii)80th percentile (2 marks)

(iv)9th decile (2 marks)

(b) The following table show the number of casual workers, mean and variance of daily wages in (Ksh) paid to the casual workers by three road construction firms

Name of the Firm	No. of employees	Mean	Variance
Wang	100	850	225
Xui	180	600	625
Jong	120	900	729

(i) Obtain the overall mean daily earnings for all casual workers in the three companies (3 marks)

(ii) Among the three companies, which one has an even wage distribution? (5 marks)