THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

((A Constituent College of JKUAT)

(A Centre of Excellence)

Faculty of Engineering &Technology in Conjunction with Kenya Institute of Highways and Building & Technology (KIHBT)

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

HIGHER DIPLOMA IN CONSTRUCTION

EBE 3201: MATHEMATICS IV

END OF SEMESTER EXAMINATION
SERIES: AUGUST 2012
TIME: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer Booklet*
- *Scientific Calculator*
- *Mathematical Table*

This paper consists of **FIVE** questions
Answer any **THREE** questions

All questions carry equal marks
This paper consists of **THREE** printed pages
Question One (20 Marks)

a) Given the following matrices:

$$A = \begin{pmatrix} 3 & b & 3 \\ a & 2 & d \\ -1 & c & -2 \end{pmatrix} B = \begin{pmatrix} 0 & -10 & e \\ 0 & 4 & 5 \\ f & 0 & 1 \end{pmatrix} C = \begin{pmatrix} 5g & 5 & 2 \\ 0 & 2h & 10 \\ 15 & 5 & 3i \end{pmatrix}$$

$5A + B = C^{-1}$

If   find the values for a up to i given that matrix C is orthogonal   **(7 marks)**

b) Investigation of a quarry site is to be done in three consecutive days by three different trades. 8 drillers 4 quarrymen and 5 surveyors are to be engaged in day one. In day two 6 drillers, 2 quarrymen and 4 surveyors are to work while on the third day, 5 drillers, 3 quarrymen and 2 surveyors will be sufficient. The total amount of money to paid to the traders for day one, day two and day three are kshs 34,000, kshs 24,500 and kshs 19750 respectively. Each trade is to be paid at a uniform rate. Use the inverse matrix method to determine the daily rate for each contractor.   **(8 marks)**

c) Three forces f_1, f_2, f_3 acting at a point from the following equations:

$$f_1 + f_2 + f_3 = 20$$
$$2f_2 + f_1 + 3f_3 = 38$$
$$3f_1 + 9f_3 + 4f_2 = 86$$

use Crammer's rule to determine the forces.   **(5 marks)**

Question Two (20 marks)

a) The lengths for roofing sheets supplied by a contractor are normally distributed with a mean length of 3m and standard deviation of 10mm. Determine the probability for rejecting sheets if they were to have a mean length deviation of $\pm$ 15mm   **(5 marks)**

b) Five material inspectors measured the length of a beam and obtained the following results:
    6.8, 6.9, 6.7, 6.6 and 6.5m
    i)   Form samples of size 2 and calculate the mean length for each sample.
    ii) Calculate the sampling distribution of mean for the sample means obtained in 2(c)
    iii) Determine the standard error of the sampling distribution for the mean lengths obtained in 2(b)
                                                 (5 marks)

c) A tensile test was carried out on a steel tube. The results of the extensions obtained are as shown in table 1:
    TABLE 1

Force Applied (KN)	4.5	9.0	13	18	22	27
Extension (mm)	3.8	8.9	10.4	16.1	19.6	21.3

i) Determine the equation for the regression line of extension on force applied.

ii) Comment on the results obtained in 2(c) (i)

iii) Estimate the extension expected to occur if a force of 15KN were to be applied. **(11 marks)**

Question Three (20 marks)

a) A bag contains 10 balls of same size. 2 are black, 3 white and 5 are red. Two balls are drawn at random without replacement. Using a tree diagram, find the probability that the balls have different colours. **(5 marks)**

b) 3% of bolts produced by a machine is defective 200 bolts are produced per day. Find the probability that if random sampling is done:
   i) At most 2 bolts will be found to be defective
   ii) At least 3 bolts will be found to be defective
   iii) Only 5 bolts will be found to be defective. **(6 marks)**

c) The diameter of certain rods form a normal probability distribution with mean 1.24cm and standard deviation 0.03cm, 1000 rods sampled will be rejected if diameter of the rods is less than 1.14cm or more than 1.3cm.
   i) Find the number of rods that will be accepted.
   ii) 0.4% of the rods will be rejected if diameter is larger than the one specified although have same standard deviation. Determine the mean for such rods. **(9 marks)**

Question Four (20 marks)

$$\begin{vmatrix} \lambda & 2 & 1 \\ 2 & \lambda & 1 \\ 2 & 1 & \lambda+1 \end{vmatrix} = 0$$

a) Show that $\lambda = 2$ satisfies the equation.) and hence determine the other values of λ **(8 marks)**

$$\begin{bmatrix} 2 & -1 & 0 \\ 4 & -5 & 1 \\ 1 & 2 & -1 \end{bmatrix}$$

b) Given the matrix M of the form; find M-1 and hence solve the linear equations.

$$2x - y = 3$$
$$-5y + 4x + z = 2$$
$$x + 2y - z = 3$$

(12 marks)

Question Five (20 marks)

The following data were the mean breaking strengths of 12 sections of a cable in netwons:

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1300   1450   1500   1700   1650   1400
1250   1500   1640   1350   1730   1870
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a) Compute the mean and unbiased standard deviation of the breaking strengths of the sections.

(5 marks)

b) Test at 5% level of significance whether the mean breaking strength of sections of the cable is less than 1600N. **(7 marks)**

$$\sigma = 150$$

c) Find the 95% confidence internal of the time mean breaking strength of the 12 sections if

(8 marks)