MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

EXAMINATION FOR DIPLOMA IN BUILDING AND CIVIL ENGINEERING

2705/302: MATHEMATICS III

Date: 4/8/2016   **Time: 8:30 – 10:30 AM**

INSTRUCTIONS TO THE CANDIDATE:

1. *Answer Question 1 and any other two questions.*

2. *You must have the following items for this paper:*
   - *Statistical tables;*
   - *Scientific Calculator.*

1. (a) It is known that 10% of the articles coming out of a manufacturing process are defective and must therefore be discarded. Determine the probability of obtaining:

   (i)   at least one defective article if two articles are drawn at random;

   (ii)   at least two defective articles if three articles are drawn at random;

   (iii) at least one defective articles if three articles are drawn at random.   (9 marks)

   (b) An educational survey conducted by the Ministry of Education among a random sample of 420 candidates from Nairobi County in the performance in science subjects in KCSE 2012 result, found out the following information about the candidates:

   - 244 passed in Biology
   - 218 passed in Chemistry
   - 178 passed in Physics
   - 108 passed in Biology and Chemistry
   - 88 passed in Biology and Physics
   - 84 passed in Chemistry and Physics
   - 24 did not pass in any of the three subjects

   (i)   Present this information in a Venn diagram.   (7 marks)

(ii) Determine the number of candidates in the study who passed in:

- Chemistry or Physics but not Biology.
- Chemistry and Physics but not Biology. (4 marks)

2. (a) In a certain machine, the following actions are possible; the top can blow or not; the spiggots can go up or go down or remain still; and the cum-lever can wriggle or thump. The top blows with a probability of $\frac{1}{5}$. The spiggots go up with a probability of $\frac{1}{2}$ if the top blows; otherwise they go up or go down or remain still with equal probabilities. The cum-lever wriggles if the spiggots go up; otherwise it wriggles with a probability of $\frac{1}{6}$. The machine is robust and works provided the cum-lever is thumping.

(i) Present this information in a tree diagram;

(ii) Determine the probability that the machine works;

(iii) Determine the probability that the top blows and the cum lever wriggles;

(iv) If the machine breaks down, determine the probability that the top is blowing. (11 marks)

(b) An architect claims that only 40% of the multi-storey buildings in Masaku Town were approved by a registered engineer. Assuming that this claim is true, determine the probability that among 8 such buildings randomly selected from Masaku Town, the following were approved by a registered engineer:

(i) exactly 4 buildings;

(ii) between 4 and 6 inclusive;

(iii) at least 3 buildings. (9 marks)

3. (a) It is known that 4% of the items coming out of a production process are defective. Determine the probability that among 250 items randomly selected from the production process:

(i) exactly 5 are defective;

(ii) between 6 and 8 inclusive are defective;

(iii) at least 3 are defective. (9 marks)

(b) The operational life span of a given brand of desktop computers has been found to be normally distributed with a mean of 4.8 years and a standard deviation of 1.6 years.

(i) Determine the proportion of the desktop computers that will have a lifespan of between 3.8 years and 6.6 years; (5 marks)

(ii) If these desktop computers have a warranty period of 2 years, determine the percentage of original sales which will require replacement through this warranty;

(3 *marks*)

(iii) If the manufacturer of these desktop computers wants only 5% of the computers to be replaced through this warranty, determine the warranty period that should be set to achieve this. (3 *marks*)

SECTION B – SURVEYING III

ANSWER AT LEAST TWO QUESTIONS FROM THIS SECTION.

4. a) Explain the following terms

    i.   Formation level
    ii.   Formation line
    iii. Road profile (6 marks)

    b) A new road of side widths, *w1* and *w2* from its centerline is to be constructed at a height, *h* below ground level on a gentle negative slope of *1: s*. If the formation level is to be *bm* wide with side slopes of *1: m*, calculate;

    i.   Side widths *w1* and *w2* in *m*
    ii.   The area of a section of the road in m^2 (14 marks)

5. a) With an aid of elaborate sketches describe three types of cross-sections. (6 marks)

    b) The table below shows staff readings taken from a level set up for setting out sight rails for a sewer. The sewer is to rise from K to M at a gradient of 1:100.

STATION	STAFF READINGS (m)	REMARKS
Bench Mark	1.515	R. L = 1250.00 m
Ground level at K	2.680	-
Invert level at K	3.045	-
Ground level at L	2.135	-
Ground level at M	1.004	-

    If the distances KL and LM are 50 m and 65 m respectively, calculate;

    i.   The reduced levels of inverts at K, L and M
    ii.   The heights of sight rails at K, L and M for use with a 2.25 m boning rod
    (14 marks)

6. a) Explain the general stages of setting out in surveying (6 marks)

    b) An embankment is made on a ground having a transverse slope of 1 in 10. The width of the bank at the formation level is 10m. The side slope of the embankment is 2:1. The heights of the bank at the centre-line of the formation level are 3 m, 3.5 m, and 4m respectively. The consecutive cross-sections are spaced at 25 m apart. Find;
    i)   The side widths

ii) The cross-sectional areas

iii) The volume of earthwork assuming the centerline to be straight using the prismoidal rule (14 marks)

7. (a) Define the following terms as used in Mass Haul Diagrams.

   i) Haul

   ii) Free haul distance

   iii) Over haul volume

   iv) Overhaul (4 marks)

   (b) The formation width of two cross-sections of a road 50*m* apart is 10*m*, and the side slope for cutting is 1:1 and for filling is 2:1. The transverse slope of the ground is 1 in 5. The depths of excavations at the centerline of the two cross-sections are 0.50*m* and 0.70*m* respectively. Find the volume of cutting and filling using the end areas formula. Apply prismoidal corrections for the computed areas (16 marks)