EGERTON UNIVERSITY

UNIVERSITY EXAMINATIONS

NJORO CAMPUS

FIRST SEMESTER 2012/2013

FOURTH YEAR EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN AGRICULTURAL ENGINEERING

AGEN 441: BUILDING MATERIALS AND TECHNOLOGY

STREAM: 2009 (Y4) B. SC. AGEN   **TIME:** 2 hours

DAY/TIME: Friday, 12.00 – 02.00 pm   **DATE:** 11-01-2013

INSTRUCTIONS:

1. The paper contains questions in **FIVE (5)** in **SECTIONS A** and **B**

2. Attempt **ALL** in **SECTION A** and any **TWO (2)** in **SECTION B**

3. Shown in parenthesis are marks for each question.

4. **EACH QUESTION SHOULD BE STARTED ON A NEW PAGE**

5. **Observe instructions 2, 3, and 6 on the examination answer book.**

SECTION A – ATTEMPT ALL QUESTIONS

QUESTION ONE (25 marks)

(a) Concrete is a common construction material and its quality should be ensured. Using:

   (i) Neat sketch(es), briefly outline the procedure for testing the consistency of fresh concrete

                                                     (3 marks)

   (ii) Table, give a summary of the concrete test results in terms of consistency, slump and likely areas of use   **(5 marks)**

(b) A client requests for a 16.0 m by 5.0 m substructure for a set of 4 classrooms on the ground floor and the same number on the first floor. The structural design recommends a 0.25 m deep/thick by 0.75 m strip made of a 1:3:3 RC using 3Y12 and Y8 rings spaced at 250 mm; a 1.2 m deep 255 mm by 225 mm cut-stone foundation wall, a 150 mm hardcore (density 1.3 tm^{-3}) and 150 mm BRC 1:3:3 concrete slab. The work will take 2 skilled and 6 helps 14 days; 7 kg

binding wire and 1:3 mortar for walling will be equivalent to 30% of slab concrete. The general material losses (including shrinkage) and contingencies are 30% and 15%, respectively.

(i) With neat, proportionate and dimensioned sketches show all the components of the substructure **(3 marks)**

(ii) Calculate the volume of soil excavated for the foundation trench **(1 mark)**

(iii) The prices of cement (per bag), water (/m^3), sand (/tonne), ballast (/t), Y12 (per 12 m-length), Y8(/12 m), binding wire (/kg), cut-stone (/Running metre), hardcore (/t), BRC (each piece measuring 2.4 m by 1.2 m), skilled & unskilled labour (/day) are KES. 800, 150, 1500, 2500, 850, 550, 220, 100, 900, 750, 850 and 400, respectively. Prepare a bill of quantities stating other pertinent assumptions. **(13 marks)**

QUESTION TWO (15 marks)

(a) List any **four (4)** broad classes of building materials used in the construction industry giving an example in each class. **(2 marks)**

(b) Outline any **two (2)** opportunities and/or challenges of the following building materials:

(i) Glass

(ii) Plastics

(iii) Paints **(3 marks)**

(c) Briefly describe the **two (2)** procedures used to:

(i) Determine the suitability of a given soil for the earthen structures. **(7 marks)**

(ii) Preserve timber for building purposes **(3 marks)**

SECTION B – ATTEMPT ANY TWO (2) QUESTIONS

QUESTION THREE (15 marks)

(d) Outlining **any two (2)** roles (using a table), differentiate between the following pairs of personnel involved in the building industry:

(i) Supervisor and Contractor

(ii) Resident and Municipal/County Engineers

(iii) Architect and Draughtsman

(iv) Structural Engineer and Quantity Surveyor **(4 marks)**

(b) Outline **any four (4):**

(i) Safety guidelines that should be observed in handling building materials at a construction site **(4 marks)**

(ii) Types and uses of nails used in the building industry **(4 marks)**

(iii) Advantages of composite building materials **(3 marks)**

QUESTION FOUR (15 marks)

The selection of a building material will depend on the loading conditions. An engineer chose a mahogany timber framework for a 5 m by 3 m by 1.5 m water tank. The permanent (timber self loads) were taken to be 2% of the water (live) load. The properties of mahogany are: Modulus of elasticity (E) is 8400 Nmm^{-2}; allowable bending stress (F_w) is 8 Nmm^{-2}, shear stress (τ_w) is 0.7 Nmm^{-2}; allowable deflection (L_w) = L/240.

(a) State the factors that will affect the factor of safety in such a design and the selection of the building material

(b) Stating all pertinent assumptions, determine the dimensions of a rectangular 3 m span simple beam that will carry the structure with a safety margin of 3. The beams will be spaced at 0.25 m from each other. **(15 marks)**

QUESTION FIVE (15 marks)

(a) The building industry is evolving fast and so are the required materials. List any two (2) innovative techniques and/or uses of the following materials in the building industry:

    (i)   Hollow concrete blocks

    (ii)   Terrazzo

    (iii) Ceramics

    (iv) Natural fibres

    (v)   Reinforced concrete **(5 marks)**

(b) Building materials must be acquired after careful thought and assembled into a structure. Using a table, outline **any ten (10)** activities showing the persons involved and time taken in this building production process. **(10 marks)**

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