MASINDE MULIRO UNIVERSITY

OF SCIENCE AND TECHNOLOGY

UNIVERSITY EXAMINATIONS

2013/2014 ACADEMIC YEAR

FIFTHYEAREXAMINATIONS

FOR THE DEGREE OF

BACHELOR OF SCIENCE

IN

CIVIL & STRUCTURAL ENGINEERING

COURSE CODE: CSE 514E

COURSE TITLE: MECHANICS OF COMPOSITE MATERIALS

TIME: 3 HRS

INSTRUCTIONS TO CANDIDATES

- ***THIS PAPER CONTAINS SIX QUESTIONS***
- ***ANSWER QUESTIONS ONE AND TWO & ANY OTHER THREE QUESTIONS***
- ***MARKS TO QUESTIONS ARE AS SHOWN***
- ***DO NOT USE A PROGRAMMABLE CALCULATOR***
- ***NO MOBILE PHONES ALLOWED IN THE EXAMINATION ROOM***

THIS PAPER CONSISTS OF (3) PRINTED PAGES

Question One

a) Vividly describe a composite material (6mks)

b) The Euler buckling formula gives the critical load at which a long column buckles as;

$$Pcr = \frac{\pi^2 EI}{L^2}$$

Where Pcr = Critical Buckling load

E = Young's modulus of column

I = Second moment of area

L = Length of beam

If the column has a circular cross section, show that the lightest beam for specified stiffness is one with the highest value of the ratio $E^{1/2}/P$ (5mks)

c) It is known that composites have distinct advantages over metals. Explain if in your opinion you think that there could be any drawbacks or limitations resulting from their usage (8mks)

d) A Boeing 747-400ER jumbo jet is made predominantly of aluminium and has a mass of 184,000kg (assume non –aluminium components are of negligible mass). Boeing intends to replace 10% of the aluminium with carbon fibre. If the airplane burns 3,600 gallons of fuel every hour and if the fuels costs Kshs. 400 per gallon, calculate how much money the airline would save on a 16 hour flight from Washington to Nairobi. (17mks)

Assume the following:-

i) Density of carbon fibre = 0.00158g/mm3

ii) Density of aluminium = 0.0027g/mm3

iii) Mass of aircraft is directly proportional to its fuel consumption (17mks)

Question Two

a) Explain why fibre reinforcements are always of a thin diameter (9mks)

b) Explain what is meant by Ferro cement (3mks)

c) State merits and demerits of fibre-reinforced polymeric meshes (4mks)

Question Three

A continuous and aligned fibre – reinforced composite consists of 40Vol% of glass fibres having a modulus of elasticity of 696Pa and 60 Vol% of a polyster resin that, when hardened, displays a modulus of 3.4Pa

a) Compute the modulus of elasticity of this composite in the longitudinal direction (2mks)

b) If the cross-sectional area is 250mm^2 and a stress of 50MPa is applied in this longitudinal direction, compute the magnitude of the load carried by each of the fibre and matrix phases (7mks)

c) Determine the strain that is sustained by each phase when the stress in part(ii) is applied (7 mks)

Question Four

a) i) Explain, what you understand by the term 'Glulam'

ii) State the benefits of glulam (4mks)

b) Outline the fibre factors that contribute to the mechanical performance of a composite (12mks)

Question Five

A displacement field in a body is given by;

$u=10^{-5}(x^2+6y+7xz)$

$u=10^{-5}(yz)$

$w=10^{-5}(xy+yz^2)$

Find the strain at (xyz) = (1, 2, 3) (16marks)

Question Six

a) Outline the classification of composites according to the geometry of the reinforcement (12mks)

b) State strengths and limitations of phenolic laminates (4mks)