MACHAKOS UNIVERSITY COLLEGE

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

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION (SCIENCE)

SPH471: PLASTICS AND RUBBER TECHNOLOGY

DATE: 5/8/2016 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS:

Answer question **ONE** which is compulsory and any other **TWO**

SECTION A

QUESTION 1 (COMPULSORY)

a) Distinguish between (i) Plastics and polymers (2 marks)

(ii) Saturated and unsaturated hydrocarbons (2 marks)

b) i) Explain why polymer moduli are said to be dependent on material test speed (3 marks)

ii) Describe temperature dependence of partially crystalline polymers (5 marks)

c) Describe the properties of cross-linked rubber (7 marks)

d) Compare the properties of thermoplastics and thermoset polymers (6 marks)

e) Describe i) Addition polymerization (3 marks)

ii) Condensation polymerization (3 marks)

SECTION B

QUESTION TWO

There are several models used to represent the visco-elastic properties of polymers.

a) With suitable illustrations, derive the rheological equations (equations for the rate of strain, $\frac{de}{dt}$) for : - (i) The Maxwell's model (5 marks)

(ii) The Voigt model (5 marks)

b) Using the standard model, show that its creep analysis is in agreement with the observed behavior of polymers (10 marks)

QUESTION THREE

One method of reinforcing polymers is by making composites.

a) Explain the advantages of composites over the constituent materials (6 marks)

b) Show that the critical length L_c , of fibers in composites is given by $L_c = \frac{R\sigma_f}{\tau}$, where R is the radius of the fibers, σ_f is the tensile stress of the fiber, and τ the shear stress.(4 marks)

c) A composite has the following constituents by weight

20 % of glass fiber of density 2560 kgm^{-3} and tensile strength 2050 GPa

55 % of polyester resin of density 1200 kgm^{-3} and tensile strength 55 MPa

25 % of calcium carbonate filler of density 2700 kgm^{-3} and tensile strength 25 MPa

i) Calculate the volume ratio of each constituent in the composite (7 marks)

ii) Determine the tensile strength of the composite (3 marks)

QUESTION FOUR

Polymers have been associated with many environmental effects. Discuss : -

a) How polymers have been a problem to the environment (12 marks)

b) Ways to control the negative effects associated with polymers (8 marks)

QUESTION FIVE

Polymers are very useful in the modern society. Discuss the advantages of plastics and polymers over conventional materials in modern daily life. (20 marks)