KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER
SPECIAL/SUPPLIMENTARY EXAMINATIONS

FOR THE DEGREE OF B. SC(PHYICS)

COURSE CODE: SPM 421

COURSE TITLE: POLYMERS II

DURATION: 2HRS

DATE: 17/11/2022 **TIME:** 2:00PM-4:00PM

INSTRUCTIONS TO CANDIDATES

- Answer question ONE (compulsory) and any TWO of the remaining questions.
- Attempted questions must be indicated on front cover of answer booklet.
- Every question should be started on new page and question indicated respectively.
- The symbols used bears the usual meaning.

Question One (30 Marks)

a. Define the term polymer. (2 Marks)
b. Discuss the Thermoplastic Elastomer. (4 Marks)
c. Discuss applications of reinforced polymers. (4 Marks)
d. Differentiate between elastomers and polymers. (2 Marks)
e. What are the functions of additives in polymers? (2 Marks)
f. Give any three specific applications of thermosetting elastomers. (3 Marks)
g. What is the difference between thermoplastic elastomers (TPE) and general plastic materials? (3 Marks)
h. What is Thermoset plastic and What are their common characteristics? (3 Marks)
i. What is the meaning of blooming and bleeding as used in polymer formation? (2 Marks)
j. Compare three properties of different thermosetting polymers. (3 Marks)
k. Discuss the two general structural and chemical characteristics of polymer molecules. (2 Marks)

Question Two (20 Marks)

a. Stress relaxation describes how polymers relieve stress under constant strain. Discuss any four stress relaxation processes that are applied in polymers. (8 Marks)
b. In order to prevent the degradation of polymers during processing or use, polymer stabilizers are employed in accordance with the degradation mechanism of the relevant polymer. Discuss any three polymer stabilizers. (6 Marks)
c. There are several ways of classification of polymers based on some special considerations. Discuss any four major classifications of polymers based on molecular forces. (6 Marks)

Question Three (20 Marks)

a. There are three steps in this type of polymerization: initiation, propagation, and termination. Give an account of the three steps explaining what happens at each step. (8 Marks)
b. **Polymerization** is process in which relatively small molecules, called monomers, combine chemically to produce a very large chainlike or network molecule, called a polymer. Discuss any two ways through which Polymers are formed. (6 Marks)
c. Explain why discoloration of polymer occur and discuss in details the factors responsible for discoloration. (6 Marks)

Question Four (20 Marks)

a. As an alternative to bulk polymerization, it is possible to run polymerization reactions in the presence of solvent and under several other unique conditions. Briefly discuss

polymerization hence discuss any four classification methods used to classify polymer, discussing two examples under each category. (8 marks).

b. Termination of chain growth can occur by disproportionation *or* through a variety of chain transfer reactions. Explain what is meant by chain transfer. Also, a chain transfer to initiator [I2] involves the reaction

$$P + I_2 \rightarrow PI + I$$

Write an expression for the rate of chain transfer to initiator using the initiator concentration $[I_2]$ and the concentration of propagating species [P]. At steady state [P] $\sim [I_2]^{\frac{1}{2}}$. Write an expression for the kinetic chain length, $\nu = R_p/R_t$, where R_t includes all reactions that end chain growth and explain why $1/\nu$ is a more useful function that ν. (6 marks)

c. Derive the Relaxation Modulus $E(t)$ for the Maxwell material. (6 Marks)