MACHAKOS UNIVERSITY

University Examinations 2021/2022

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD/FOURTH YEAR SECOND SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE (ANALYTICAL CHEMISTRY

BACHELOR OF EDUCATION (SCIENCE)

SAN 306/SCH 405: INDUSTRIAL UNIT OPERATIONS AND INDUSTRIAL CHEMISTRY

DATE: **TIME:**

INSTRUCTIONS:

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

SECTION A

QUESTION ONE (compulsory) (30 MARKS)

a) The selection of a specific material for a particular use is a very complex process. However, one can simplify the choice if the four parameters listed below are considered:

i. Operating parameters

ii. Manufacturing processes

iii. Functional requirements

iv. Cost considerations

List four factors affecting each of the above in selection of materials. **(8 marks)**

b) Define the following mechanical properties that affect the selection of a materials. **(5 marks)**

i. Tensile Strength
ii. Hardness
iii. Ductility
iv. Impact Strength
v. Wear Resistance

c) Distinguish between Sintered Metals and Clad Metals (4 marks)

d) The two important classes of organic polymers are: Thermoplastics and Thermosetting plastics. Define the above plastics giving two examples in each case. (4 marks)

e) Write the mathematical expression of the mass balance for a system without a chemical reaction. (2 marks)

f) Discuss the following types of materials: (3 marks)

i. Nanomaterials
ii. Spintronics
iii. Macrostructure

g) Heat exchangers are used in industries. Provide two examples of the most common types. (4 marks)

SECTION B

QUESTION TWO (20 MARKS)

a) Provide the raw materials for production of:

i. Sulphuric acid (2 marks)
ii. Aspirin (2 marks)
iii. Ammonia (2 marks)
iv. Di-ammonium phosphate (2 marks)

b) Using an equation where possible, explain the steps involved in the conversion of:

i. Starch to dextrose with the help of acid catalyst (4 marks)
ii. Production of sugar (4 marks)

iii. Production of pharmaceutical tablets (4 marks)

QUESTION THREE (20 MARKS)

a) Determine if distillation is a unit operation or a unit process Explain your answer. (3 marks)

b) List four application of the following unit operations. **(4 marks)**

i. solid movement

ii. movement of fluid

c) List three factors that a process designer considers in designing a chemical process. (3 marks)

d) A chemical production plant consists of a combination of chemical reactions. List four of such reactions. (4 marks)

e) Explain using a chemical reaction equation the production of PET used to make plastic bottles. (6 marks)

QUESTION FOUR (20 MARKS)

a) Discuss the principle behind the following productions:

i. Borosilicate grass production (1 mark)

ii. Muriate of Potash (KCl) (2 marks)

b) Loop reactors are used, for example, in the manufacture of poly(ethene) and the manufacture of poly(propene). Draw a flow chart for this production process. (5 marks)

c) Provide two synthetic and one natural examples of polymers formed by chain growth. (2 marks)

d) Provide 3 major raw materials for glass production. (3 marks)

e) Explain the role of analytical chemist in glass production. (2 marks)

f) Explain how Calcium Ammonium Nitrate fertilizer is produced using equations. (5 marks)

QUESTION FIVE (20 MARKS)

a) List three applications of mass transfer unit operation. (**3 marks)**

b) Compare laboratory preparation to industrial processing. **(5 marks)**

c) Using a flow chat diagram, explain the unit processes in the following:

i. Urea Manufacture **(3 marks)**

ii. NaCl Manufacture **(4 marks)**

d) Define a monomer and draw the structures of the following typical cationic monomers: isobutene, vinyl ethers, styrene, tetrahydrofuran (THF). (**5 marks)**