Strathmore
UNIVERSITY

SCHOOL OF COMPUTING AND ENGINEERING SCIENCES (SCES)
BACHELOR OF ELECTRICAL AND ELECTRONICS ENGINEERING
END OF SEMESTER EXAMINATION
BEE 4202 : SYSTEMS ENGINEERING
DATE: Thursday, 19th March 2026. Time: 16.00 - 18.00 Hours

Instructions
1. This examination consists of **FIVE** questions.
2. Answer Question **ONE (COMPULSORY)** and any other **TWO** questions.

QUESTION ONE [30 MARKS]

a) Write a paragraph explaining what is meant by the statement "Systems engineering is focused on the system as a whole. " State what characteristics of a system you think this statement implies and how they apply to systems engineering. (4 marks)

b) Discuss the difference between engineered complex systems and complex systems that are not engineered.
   i. Give one example of both. (2 marks)
   ii. Can systems engineering be applied to non-engineered complex systems? (2marks)

c) A systems engineering team is struggling with communication and task allocation. The project manager decides to use the Myers-Briggs Type Indicator (MBTI) to better understand team member preferences and improve collaboration.

   Required
   i. Define the MBTI and explain its purpose in understanding personality differences. (2 marks)

   ii. List and describe the **four MBTI dichotomies**, including an example of how each might influence behavior in a team environment. (4 marks)

iii. A team member scores as **INTJ** on the MBTI. Explain what each letter represents and describe two potential strengths and one potential challenge this person might have in a team setting. (2 marks)

d) Strathmore finance department has decided to develop a multipurpose ATM to deliver cash, accept cash. Pay bills, and print pass book. For each of the operational phase of this machine:
   i. Identify at least two operational scenarios and explain them in detail. (2 marks)
   ii. Develop an input/ouput trace for two scenarios and identify I/O requirement. (4 marks)
   iii. Develop an external system diagram (2 marks)
   iv. Develop a set of originating requirements and prepare the ORD for the operational phase (3 marks)

e) Many systems are planned, designed, produced, and operated with little initial concern for affordability and the total cost of the system over its intended lifecycle. The technical aspects are usually considered first, with the economic aspects deferred until later.

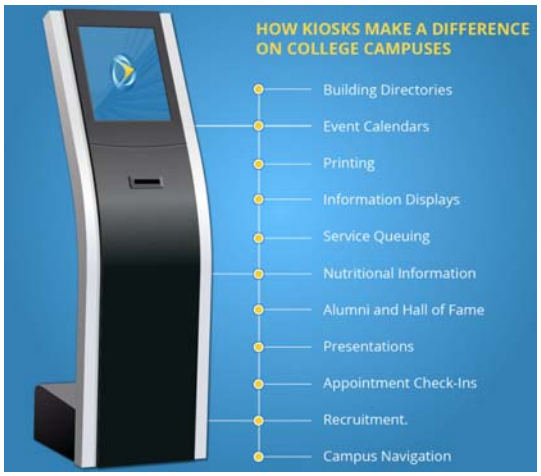
Required

Define the following terms in relation to systems engineering (3 marks)
   i. Affordability
   ii. Life-Cycle Cost (LCC)
   iii. Cost-effectiveness

QUESTION TWO [15 MARKS]

a) From the history of industrial disasters, identify one case study for system failure. Make a presentation of the case by highlinghting the following factors. (9 marks)
   1. System details
   2. Failure mode
   3. Failure analysis
   4. Root cause
   5. Proposed solution(s)

b) A local university wants to develop a service kiosk shown below.



Required

i. Using the Hatley–Pirbhai template to perform the functional decomposition of the campus navigation system (3 marks)
ii. Draw the functional hierarchy showing lower-level functions (3 marks)

QUESTION THREE [15 MARKS]

a) A systems engineer is developing an autonomous delivery drone system. The system must meet the following high-level requirements:
   1. Maximum payload: 5 kg
   2. Range: 20 km per battery charge
   3. Obstacle detection and avoidance
   4. Communication with central control system

   The engineer decides to use **Model-Based Systems Engineering (MBSE)** to manage requirements, architecture, and verification.

   Required

   i. Define MBSE and explain its main benefits over document-based systems engineering. (2 marks)
   ii. Identify three common MBSE modeling languages or tools that could be used in this project and briefly explain their purpose. (3 marks)
   iii. Draw or describe a simple **high-level SysML block definition diagram (BDD)** for the drone system, including at least three subsystems. (5marks)
   iv. Explain how MBSE can assist with **requirements traceability, verification, and validation** in this drone project. (5 marks)

QUESTION FOUR [15 MARKS]

a) Select one of the household appliances listed below:
    1. automatic dishwasher
    2. washing machine
    3. television set

Required

i. State the *functions* that it performs during its operating cycle. Indicate the primary medium (signals, data, material, or energy) involved in each step and the basic function that is performed on this medium. (3 marks)

ii. For the selected appliance, describe the physical elements involved in the implementation of each of the above functions. (2 marks)

b) Describe the relationship among implementation, integration, verification, validation, and transition in the V-model of systems engineering. (10 marks)

QUESTION FIVE [15 MARKS]

a) Using the Systems Engineering Life Cycle perspective, explain how feedback from the Operations & Maintenance phase improves future system designs. (6 marks)

b) **A defense agency is evaluating two radar systems using a cost-effectiveness ratio (CER).** The measure of effectiveness (MOE) is "Detection Probability × Coverage Area."

System	Cost (M$)	Detection Probability	Coverage Area (sq km)
A	18	0.92	250
B	25	0.95	300

Required:

i. Compute the MOE for each system. (3 marks)

ii. Compute the cost-effectiveness ratio for each system. (3 marks)

iii. Recommend the best option and justify using CER and operational value. (3 marks)