NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRONIC ENGINEERING

ELECTRICAL ENGINEERING PRINCIPLES

TEE 2292 / EEE 2292

Examination Paper

October 2024

This examination paper consists of 3 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: N/A

Examiner's Name: Mr B. Dlodlo

INSTRUCTIONS

1. Answer ALL five (5) questions
2. Each question carries 20 marks
3. Use of calculators is permissible
4. Begin each answer to a full question on a fresh page.

MARK ALLOCATION

QUESTION	MARKS
1.	**20**
2.	**20**
3.	**20**
4.	**20**
5.	**20**
TOTAL	**100**

QUESTION 1

a) Explain the importance of conductors and insulators in electricity generation, distribution and utilisation. [4]

b) Considering that households use single phase AC mains, why is a three phase power system used to distribute electricity to the same households? [4]

c) An ideal 24V, 100AH battery can supply 100A current for an hour or 1A over 100hours according to its AH (capacity) rating.
i. Find the maximum constant power that the battery can supply over a period of two days without charging. [4]
ii. List two home appliances, connected through an inverter one at a time, which the battery can power over that same period. [2]

d) The reactance of an inductor and a capacitor is 100 Ω at a frequency of 850 Hz. Determine the reactance of each of them at a frequency of 125 Hz. [6]

QUESTION 2

a) The magnetic flux in the core of an electromagnet is 10 mWb, the flux density in the core is 1.2T. If the core has a square cross-section, determine the length of each side of the section. [4]

b) Explain the terms: self-induction and induction by motion. [8]

c) An alternating current waveform has a periodic time of 1 ms, calculate the frequency of the current. What is the periodic time of an alternating voltage of frequency 100 kHz? [4]

d) Give reasons why it is important to engage an electrical engineer or electrician to design a PV solar power system rather than just buying what is available and affordable in the shops or market stalls. [4]

QUESTION 3

a) i. What is meant by: inductive reactance and capacitive reactance? [4]
ii. Circuit A contains an inductance of reactance 150 Ω and circuit B contains a capacitance of reactance 80 Ω. If the supply voltage is 100V, calculate for each circuit: the current in the circuit and the phase angle of the circuit. [4]

b) Distinguish between magnetic flux and magnetic flux density. [4]

c) Explain the unsuitability of car-type lead-acid battery use in air force fighter jets. [4]

d) A Zimbabwean consortium once attempted to establish a diesel power station in Dema village; unfortunately, this effort ended in humiliating failure, much to the amusement of the Dema people. Given that you lack prior knowledge about this project, postulate possible reasons for the project's failure and why its collapse might have been viewed positively by the people of Dema. [4]

QUESTION 4

a) A series RLC circuit contains of 100 Ω resistor, a 0.5 H inductor and a 10μF capacitor. If the supply frequency is 200 Hz and the supply voltage is 10V r.m.s.
   i. Calculate the current in the circuit and the voltage across each element in the circuit. [6]
   ii. Calculate the power consumed and the power factor of the circuit. [6]

b) An armature conductor carries a current of 90 A. If the length of the conductor is 0.25 m and the force on the conductor is 10N, calculate the flux density in the machine. [3]

c) Define the term 'clean energy' and give three methods, which can be used to generate clean energy. [5]

QUESTION 5

a) Under what circumstances are the following used: a three phase 4 wire system and a three phase 3 wire system? [4]

b) If the alternator has four poles and its speed of rotation is 6000 revs/min calculate the frequency of the AC supply and the speed of rotation in radians per second. [8]

c) Distinguish between an induction motor and a synchronous motor. [4]

d) Why is power load shedding unavoidable in Zimbabwe and how can people in cities cushion themselves from prolonged periods of load shedding? [4]

END OF THE PAPER