CHUKA UNIVERSITY

FACULTY OF SCIENCE, ENGINEERING & TECHNOLOGY

DEPARTMENT OF PHYSICAL SCIENCES

BSc – FOOD SCIENCE & NTECHNOLOGY

Year 2 semester 2 Exam –April/June 2021

ICEN 206 – ELECTRICAL ENGINEERING PRINCIPLES

Time 2 hours

Instructions

*Answer question **ONE** and any other **TWO** questions.*

Clearly show your working.

Question One.

a. Distinguish between intrinsic and extrinsic semiconductors and also between P and N type of semiconductors. (4 marks)

b. What is the difference between single phase and three phase ac source? (4 marks)

c. Differentiate between self and mutual electromagnetic induction. Hence outline the working of a transformer. (6 marks)

d. State the three configuration modes of transistors and give one feature of each. (3 marks)

e. State the two Kirchhoff's laws and give the justification of each of them. (4 marks)

f. Distinguish between core-type and shell types of transformers.. (4 marks)

g. The maximum flux density in the core of a 250/3000 V, 50Hz single phase transformer is $1.2Wbm^{-2}$. If the emf per turn is 8V, determine;

   (i) primary and secondary coils,

   (ii) area of the coil. (5 marks)

Question two.

a. Explain using circuit diagrams what is meant by half-wave and full wave rectification. (6 marks)

b. What is a PN junction? Explain the effects of temperature on the internal barrier voltage of a PN junction. (4 marks)

c. With the help of energy bands explain how conduction takes place in conductors, semiconductors and insulators. (5 marks)

d. Explain the difference of a PNP and NPN transistors using a circuit diagram for each. (5 marks)

Question three.

a. A circuit consists of an uncharged capacitor connected in series with a 50 kΩ resistor and has a time constant of 15 ms. Determine by calculation
   (i) the capacitance of the capacitor and
   (ii) the voltage drop across the resistor 5 ms after connecting the circuit to a 20 V, d.c. supply. (4 marks)
b. The field winding of a 200 V d.c. machine has a resistance of 20 Ω and an inductance of 500 mH. Calculate:
   (i) the time constant of the field winding,
   (ii) the value of current flow one time constant after being connected to the supply, and
   (iii) the current flowing 50 ms after the supply has been switched on. (8 marks)
c. A motor has an output of 6 kW, an efficiency of 75% and a power factor of 0.64 lagging when operated from a 250 V, 60 Hz supply. It is required to raise the power factor to 0.925 lagging by connecting a capacitor in parallel with the motor. Determine
   (i) the current taken by the motor,
   (ii) the supply current after power factor correction,
   (iii) the current taken by the capacitor,
   (iv) the capacitance of the capacitor and
   (v) the kvar rating of the capacitor. (8 marks)

Question four.

a. A 400 V, 3-phase, 4 wire, star-connected system supplies three resistive loads of 15 kW, 20 kW and 25 kW in the red, yellow and blue phases respectively. Determine the current flowing in each of the four conductors. 8 marks)
b. A 3-phase, star-connected alternator delivers a line current of 65 A to a balanced delta-connected load at a line voltage of 380 V. Calculate
   (i) the phase voltage of the alternator,
   (ii) the alternator phase current and
   (iii) the load phase current. (6 marks)
c. Three inductive loads, each of resistance 4Ω and reactance 9Ω are connected in delta. When connected to a 3-phase supply the loads consume 1.2 kW. Calculate
   (i) the power factor of the load,
   (ii) the phase current,
   (iii) the line current and
   (iv) the supply voltage. (6 marks)

Question five.

a. Find the emfs and in the circuit of Figure 1 below, and find the potential difference of point *b* relative to point *a*.

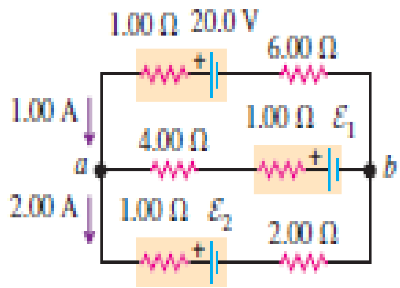

Figure 1

(8 mark)

b. Distinguish between a current and a voltage transformer (6 marks)

c. A 10 kVA, single-phase transformer has a turns ratio of 12:1 and is supplied from a 2.4 kV supply. Neglecting losses, determine

(i) the full load secondary current,

(ii) the minimum value of load resistance which can be connected across the secondary winding without the kVA rating being exceeded, and

(iii) the primary current. (8 marks)