UGANDA INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

RECESS PROGRAMME END OF SEMESTER TWO EXAMINATIONS

ACADEMIC YEAR 2023/2024

DEPARTMENT: ICT

SEMESTER: ONE

PROGRAMME(S): DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINERING (DEEE)

YEAR OF STUDY: ONE

COURSE: PRINCIPALS OF ELECTRICAL TECHNOLOGY AND MAGNETIC CIRCUITS

COURSE CODE : ELT1101

DATE:

TIME:

DURATION: 3 HOURS

INSTRUCTIONS:

(i) This paper contains two Sections: A (40 marks) & B (60 marks).

(ii) Attempt ALL questions in Section A, and ONLY THREE questions in Section B.

(iii) All questions in Section B carry equal marks.

(iv) Credit will be given for use of relevant examples and illustrations.

(v) Begin each number in Section B on a new page of the answer sheet.

(vi) DO NOT write on this question paper.

SECTION A (40 MARKS)

Attempt **ALL** the Questions in this Section.

1. a) Define the following terms and state the SI unit of each

i. Conductance (**1mk**)
ii. Resistance (**1mk**)

b) If a current of 4mA flows for 2.5 minutes, find the quantity of electricity transferred. (**2mk**)

2 .Convert the following as indicated:

a) 5000 kHz= ..... MHz (**1mk**)
b) 1000 pF= ..... nF (**1mk)**

3. An electromagnet exerts a force of 15N and moves a soft iron armature through a distance of 12mm in 50 ms. Determine the power consumed. (**2mk**)

4. A 12V battery is connected in a circuit having three series-connected resistors having resistances of 4Ω, 9Ωand 11Ω. Determine the current flowing through and the p.d. across the 9Ω *resistor*. Find also the power dissipated in the 11Ω resistor. **(3mks)**

5. A capacitor has a capacitive reactance of 400 Ω when connected to a 100V, 25 Hz supply. Determine its capacitance and the current taken from the supply. (**2mks**)

6. An alternating voltage is given by v=282.8 sin 314 t volts. Find

(a) the rms voltage (**1mk**)
(b) the frequency (**1mk**)
(c) the instantaneous value of voltage when t = 4 ms. (1**mks)**

7. State kirchoff's current and voltage laws. Illustrate your answers by use of circuit diagrams. (**4mks**)

8. As regards to three-phase systems;

i) when may the neutral conductor of a star connected system be omitted. (**1mk**)
ii) State the national standard phase sequence for a three-phase supply. (**1 mk**)
iii) state the condition for maximum power transfer? (**1mk**)

9. A 60W electric light bulb is connected to a 240 V supply. Determine

(a) the current flowing in the bulb (**1mk**)

(b) the resistance of the bulb. (**1mk**)

10. State the instrument used to measure;

(a) current. (**1mk**)

(b) Potential difference. (**1mk**)

11. State the unit of electrical power and give two formulae used to calculate power. (3**mks**)

12. What is the function of a fuse in an electrical circuit? (**1mk**)

13. state two advantages of delta connection over star connection. (**2mks**)

14. define the term resonance as applied to single phase ac power and state its condition. (**2mks**)

15. What is the angle separation of 3phase voltages? (**1mk**)

16. State the phase sequence of three phase voltage (**1mk**)

17.Between series and parallel connection, what is the best method of connection if we want to maintain voltage across different loads? (**1mk**)

18. Why does the voltage lag behind in a purely capacitive circuit? (**1 mk**)

19. Why does the current lag behind in a purely inductive circuit? (**1mk**)

SECTION B [60 MARKS]

Attempt **ONLY THREE** questions in this Section.

Question 1

(a) By use of a power triangle, explain what you understand by the term
Power factor, real power, reactive power and apparent power. State and explain any two effects of low power factor. (**8mks**)

a) A 250V, 50 Hz single-phase supply feeds the following loads (i) incandescent lamps taking a current of 10A at unity power factor, (ii) fluorescent lamps taking 8A at a power factor of 0.7 lagging, (iii) a 3 kVA motor operating at full load and at a power factor of 0.8 lagging and (iv) a static capacitor. Determine, for the lamps and motor,
(a) the total current, (**4mks)**
(b) the overall power factor. (**2mks)**
(c) the total power. (**2mks)**
(d) Find the value of the static capacitor to improve the overall power factor to 0.975 lagging. (**4mks**)

Question 2

(a) State Thevenin's and Norton's Theorems for linear electric circuits.
Illustrate your answers with simple circuits. **(4 marks)**

(b) Two batteries *A* and *B* are connected in parallel and a load of 10Ω is connected across their terminals. Battery A has e.m.f. 12 V and an internal resistance of 2Ω; and battery *B* has e.m.f. 8 V and internal resistance of 1Ω. Use Kirchhoff's laws to determine the values and directions of

the currents flowing in each of the batteries and in the external resistance. Determine the p.d. across the external resistance. **(6 marks)**

(c) In the network of Figure 1 below, use nodal analysis to determine;

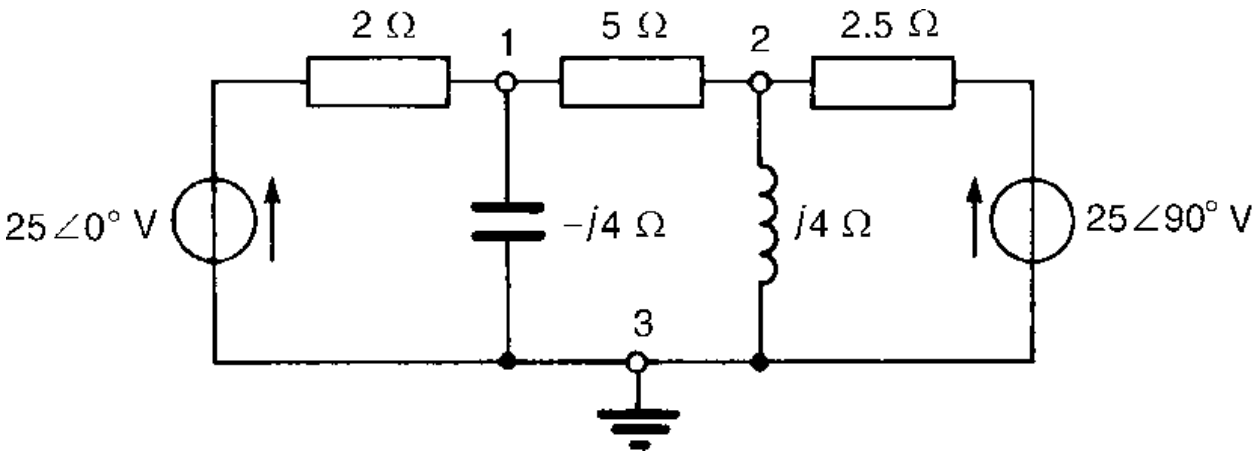


Figure 1

(i) the voltage at nodes 1 and 2. **(4mks)**

(ii) the current in the *j*4Ω inductance. **(2mk)**

(iii) the current in the 5Ω resistance. **2mks**

(iv) the magnitude of the active power dissipated in the 2.5Ω resistance. **(2mks)**

Question 3

a) Explain the operation of a single phase generator and illustrate your answer with a wave function of the emf generated. **(6 marks)**

b) The instantaneous value of current in an a.c. circuit at any time *t* seconds is given by:

$i = 50 \sin(100\pi t - 0.45)$ mA. Determine;

i) the peak to peak current, the frequency, the periodic time, and the phase angle (in degrees and minutes). **(6mks)**

ii) the current when t =0 **(2mks)**

iii) the current when t =8ms (**2mks)**

iv) the first time when the current is a maximum. (**2mks)**

v) Sketch the current for one cycle showing relevant points.**(2 mks)**

Question 4:

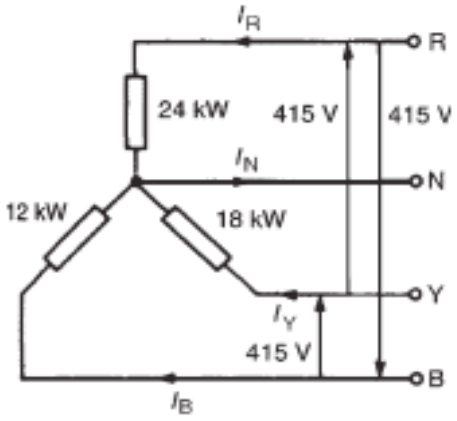
a) In relation to three phase circuits explain and illustrate how the following connections are obtained;

i) star connection. (**2mks**)

ii) delta connection. (**2mks**)

b) State four advantages of three phase power system compared to single phase power system. (4mks).

c) A 415 V, three-phase, four-wire, star connected system supplies three resistive loads as shown in below



Determine

i) Phase voltage and current in each line. **(8mks**)

ii) the current in the neutral conductor. (**4mks**)

Question 5

(a) Explain the relationship between current and voltage in purely resistive ac series single phase circuit. Use circuit diagram, phasor diagram and wave functions to illustrate your answer. (**4mks)**

(b) A coil of inductance 636.6mH and negligible resistance is connected in series with a 100Ω resistor to a 250V, 50 Hz supply. Calculate

i) the inductive reactance of the coil. **(2mks)**

ii) the impedance of the circuit. **(2mks)**

iii) the current in the circuit. **(2mks)**

iv) the p.d. across each component. **(2mks)**

v) the circuit phase angle. (**2mks)**

c) A pure inductance of 150mH is connected in parallel with a 40μF capacitor across a 50V, variable frequency supply. Determine;

i) the resonant frequency of the circuit. (4**mks)**

ii) the current circulating in the capacitor and inductance at resonance. **(2mks)**

END