



MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL & ELECTRONIC

SPH304: AC CIRCUIT THEORY

DATE:

TIME:

INSTRUCTIONS; ANSWER QUESTION ONE AND ANY OTHER TWO

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) i) Explain the terms reactive and active power in A.C. circuits (2 marks)
ii) A coil of resistance 8Ω and inductance 150mH in series with a $300\mu\text{F}$ capacitor is connected in series v to a 400V , 50Hz supply
Calculate i) Current flowing in the circuit
ii) Phase difference (5 marks)
- b) i) Define the following terms with reference to magnetic circuits.
ii) Reluctance
ii) Absolute permeability (4 marks)
- c) A magnetic circuit has a cross-sectional area of 0.5cm^2 with one part 3cm long and relative permeability of 1500 and a second part 4cm long with relative permeability 800 . It has 200 turns coil carrying current of 20A , determine the flux in the circuit. (4 marks)
- d) i) With aid of characteristic curves explain the operation of the following filters
ii) low pass
iii) All pass filter
- e) State 3 merits and 2 demerits of the Maxwell -wien bridge (5 marks)

- d) The secondary of a transformer connected across a bridge rectifier to provide a no load dc voltage of 9 V. If the secondary winding resistance is $3\ \Omega$ and dynamic resistance of each diode is $1\ \Omega$, determine the Determine the
- peak and rms voltages on
 - dc output across a load resistance of $100\ \Omega$ and $1\ \text{K}\ \Omega$. (10 marks)

QUESTION TWO (20 MARKS)

- a)
 - Explain the reason why electrical equipments are rated in VA or KVA. (2 marks)
 - Define the terms conductance and susceptance in A.C. circuits (4 marks)
 - A coil of inductance 200mH and resistance $60\ \Omega$ is connected in parallel with a $80\ \mu\text{F}$ capacitor across 300v , 50Hz supply
Determine the:
 - Current in the coil and its phase angle
 - Supply current and phase angle
 - Apparent power (6 marks)
- b)
 - Define Transformer impedance matching
 - State Two applications of impedance matching in telecommunication systems. (3 marks)
- c) A transformer has 1000 and 400 primary and secondary turns, the primary and secondary turns, the primary and secondary resistances are $0.6\ \Omega$ and $0.08\ \Omega$ respectively, with corresponding resistances of $6\ \Omega$ respectively.
Determine the;
 - Equivalent resistance referred to primary winding.
 - Equivalent impedance referred to primary
 - Phase angle (5 marks)

QUESTION THREE (20 MARKS)

- a)
 - Define the terms primary and secondary filters. (4 marks)
 - Explain Aliasing in filters
- b) Figure 1 shows a circuit of low-pass filter with $V_{in} = 12\text{V}$.

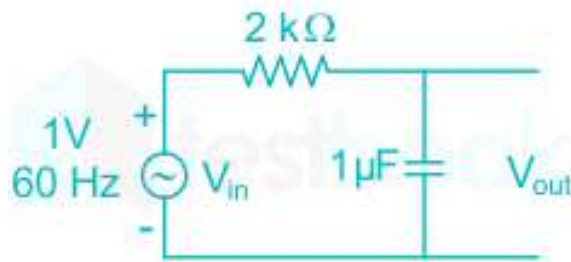


Fig 1

Determine the;

- i) Reactance of capacitor at 1KHZ
- ii) Output voltage at 1KHZ.
- iii) The break frequency of the circuit
- iv) Output voltage at the break frequency

(8 marks)

c) i) State the:

ii) Lenz's law

iii) Fleming's left hand rule

(4 marks)

d) Highlight the factors which affect the inductance of an inductor in electromagnetism

(2 marks)

QUESTION FOUR (20 MARKS)

a) i) Explain the importance of A.C bridges in circuit analysis

ii) State the three types of instruments used as detectors in A.C bridges.

(6 marks)

b) i) Four impedances of an a.c bridge are

$$Z_1 = 600 \angle 40^\circ \Omega$$

$$Z_2 = 200 \angle 90^\circ \Omega$$

$$Z_3 = 50 \angle 20^\circ \Omega$$

$$Z_4 = 40 \angle 30^\circ \Omega$$

Determine whether the bridge is balanced or not

(4 marks)

c) i) With the aid of a circuit diagram, show that for Maxwell's inductance bridge. The value of unknown inductance L_1 is given by the expression

$$L_1 = \frac{L_2 R_3}{R_4}$$

$$R_4$$

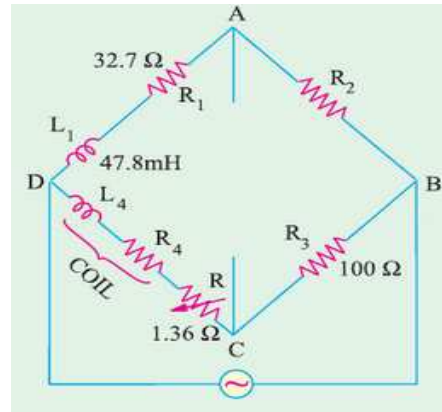
Where R_3 and R_4 are known Resistances

L_2 standard inductance.

- ii) The arms of an a.c. Maxwell bridge are arranged as follows: AB and BC are non-reactive resistors of $100\ \Omega$ each, DA is a standard variable reactor L_1 of resistance $32.7\ \Omega$ and CD comprises a standard variable resistor R in series with a coil of unknown impedance. Balance was obtained with $L_1 = 47.8\ \text{mH}$ and $R = 1.36\ \Omega$. Find the resistance and

inductance of the coil

(10 marks)



QUESTION FIVE (20 MARKS)

- a) i) State any Three disadvantages of half wave are rectifier
 ii) With the aid of a block diagram, explain the parts of a rectifier circuit. (7 marks)
- b) With the aid of circuit diagram and waveform, explain the operation of a centre tap bridge rectifier (5 marks)
- c) A 220 V, 60 Hz voltage is applied to a centre tapped step-down transformer of 22: 1 with a load of $1\ \text{K}\ \Omega$ connected across the output of two-diode full-wave rectifier. Assume diodes to be ideal. If the resistance of half-secondary winding is $0.5\ \Omega$, determine the
- (i) peak, rms and dc voltages,
 (ii) peak, rms and dc currents, (8 marks)