(AC Circuits)
Test 2

Time allowed – Two Hours plus *10 Minutes reading time*

18 Pages in this Question Booklet

Total Marks Available

Aids to be supplied by College:

None

Aids to be supplied by Students:

SECTION	Possible Marks	Actual Marks
A	20	
B	20	
C	23	
D	23	
TOTAL	86	

Instructions to Students:

- **Electronic devices are to be turned off and removed from your person.** You cannot access an electronic device during this examination.
- All questions are to be answered in the space provided in this Question Booklet. Answers to Section A – Multi-choice Questions, are to be recorded on the Answer Sheet attached to this Question Booklet.
- You are not to use any reference book in this examination.
- The whole of this Question Booklet is to be handed to the Supervisor upon completion.

Aids permitted where indicated:

Standard Dictionaries	Bilingual Dictionaries	Technical Dictionaries	Programmable Calculators	Non-programmable Calculators	Mobile Phones	MP3 Players
No	**Yes**	**No**	**No**	**Yes**	**No**	**No**

I have received feedback on my attempt at this assessment.

Signed: Date:

Section A – (20 Marks)

Multi-choice Questions

Instructions:

Select either A, B, C or D from the options and write the letter in the numbered box provided for each question. Each question is worth one mark.

1. The ratio of the peak value of a rectified AC waveform to its average value is:

   A. 0.637
   B. 0.707
   C. 1.1
   D. 1.73

2. An oscilloscope can be used to measure:

   A. phase shift
   B. resistance
   C. rms power
   D. rms values of voltage and current

3. The oscilloscope selector switch is set to 4 volts/div and the sinewave trace shows a peak to peak value of eight divisions. The actual peak value is:

   A. 4 volts
   B. 8 volts
   C. 16 volts
   D. 32 volts

4. At low frequencies (not DC), capacitors:

   A. are like an open circuit
   B. have a high impedance value
   C. have a lower impedance value
   D. take more current

5. The unit of capacitive reactance is the:

   A. Ampere
   B. Farad
   C. Henry
   D. Ohm

6. Current in a purely inductive circuit lags the voltage by:

   A. 0 degrees
   B. 90 degrees
   C. 120 degrees
   D. 180 degrees

7. The type of voltage stamped on an appliances nameplate is

A. average voltage
B. instantaneous voltage
C. peak voltage
D. rms voltage

8. The average power consumed by a purely inductive circuit is:

A. high
B. low
C. variable
D. zero

9. The inductive reactance (X_L) of a coil is directly proportional to the:

A. circuit current
B. circuit impedance
C. frequency
D. supply voltage

10. The current in a circuit, consisting of resistance and inductance in series:

A. lags the voltage between 0^o and 90^o
B. leads the voltage between 0^o and 90^o
C. leads the voltage by 90^o
D. lags the voltage by 90^o

11. The capacitive reactance (X_C) of a capacitor is inversely proportional to the circuit:

A. current
B. frequency
C. resistance
D. voltage

12. The equivalent circuit of a practical inductor consists of:

A. inductance and capacitance
B. inductance and resistance
C. inductance only
D. resistance only

13. The ratio of the adjacent side to the hypotenuse side of a right angle triangle is the:

A. cosine of the angle
B. cotangent of the angle
C. sine of the angle
D. tangent of the angle

14. Inductors are used to control current in an AC circuit because they:

A. are cheaper than resistors
B. have a good power factor
C. have a low power loss
D. have a low value of inductance reactance

15. What would the power frequency be when a 50 Hz supply is connected to an AC circuit.

A. there is no power waveform
B. 2.5 kHz
C. 50 Hz
D. 100 Hz

16. The value of an AC waveform that has the same heating effect as the equivalent value of DC is the:

A. average value
B. peak to peak value
C. peak value
D. rms value

17. If the frequency to an inductive AC circuit was increased the phase angle between the voltage and current will:

A. Decrease
B. Go to zero degrees
C. Increase
D. Remain the same

18. AC series resonance can produce:

A. dangerous voltages
B. high frequencies
C. low current
D. low noise

19. When resonance occurs in a series RLC circuit, the impedance is equal to the:

A. capacitive reactance
B. inductive reactance
C. resistance
D. total impedance of the circuit

20. The frequency of a sinewave which has a period of 20 mS is:

A. 25 Hz
B. 50 Hz
C. 100 Hz
D. 1000 Hz

Section B – (20 Marks)

Short Answer Questions

Instructions:

Write your answer in the space provided for each question on the answer sheet. Each question is allocated 2 marks.

1. What does the term 'PERIOD' refer to on an alternating waveform?

2. When does resonance occur in an RLC series circuit?

3. What is the average real AC power drawn by a capacitor during for one full cycle of an AC supply?

4. In a series LR circuit the supply voltage is equal to the 'linear sum' of the inductor and resistor volt drops. True or false

5. What is the opposition to current referred to in a circuit with capacitive, inductive and resistive components?

6. What factors of a 'Practical Inductor' affect the phase angle between the voltage and current through the inductor?

7. Does changing the frequency on a purely resistive AC circuit have any effect on the overall impedance?

8. What is the direction of rotation of a phasor diagram?

9. What would happen to the circuit phase angle of a series RLC circuit if the resistance value was increased?

10. In what type of AC circuit does the voltage lag the current waveform?

Section C - (23 Marks)

Drawings and Diagrams

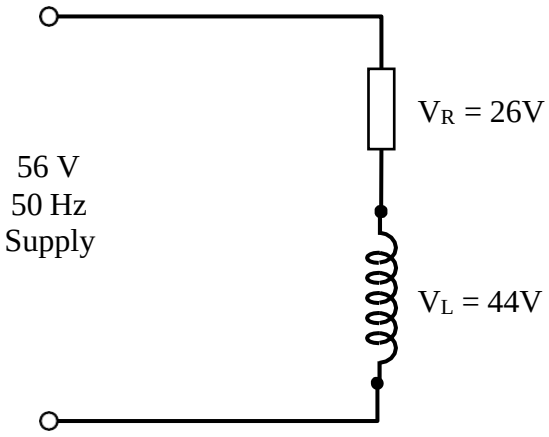
Instructions:

No calculations required. Scale, Draw & Measure

1. For the circuit below accurately draw a voltage phasor diagram to scale and *measure*.

   a. the Circuit phase angle, and
   b. the Inductor's phase angle.

   Note: (*Show your scale*).

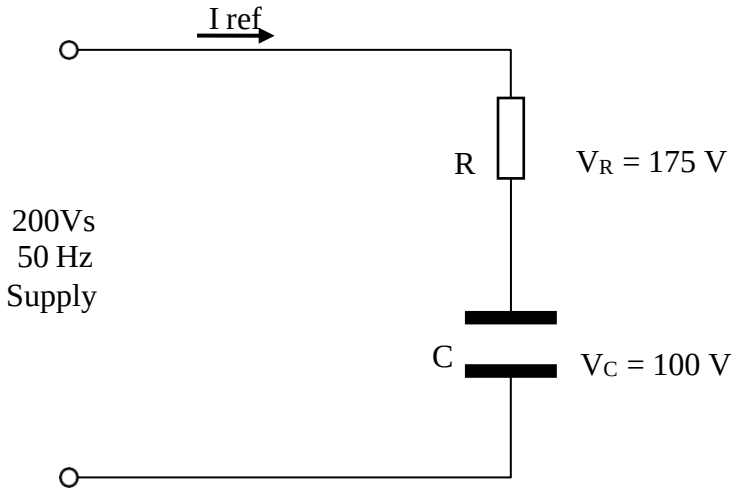


(5 Marks)

2. Draw to scale the phasor diagram for the following circuit. Include phasors for V_R, V_C, and V_S. ***Measure*** and state the circuit phase angle.

Note: (*Show your scale*).

(4 Marks)



3. The voltage drops across an RLC series circuit measure, $V_R = 50$ V, $V_C = 70$ V and $V_L = 120$ V.

a. Draw to scale the phasor diagram representing the phase relationship between the supply voltage and current (3 Marks)

b. Measure and state the supply voltage from your phasor. (1 Mark)

c. Measure the circuit phase angle (1 Mark)

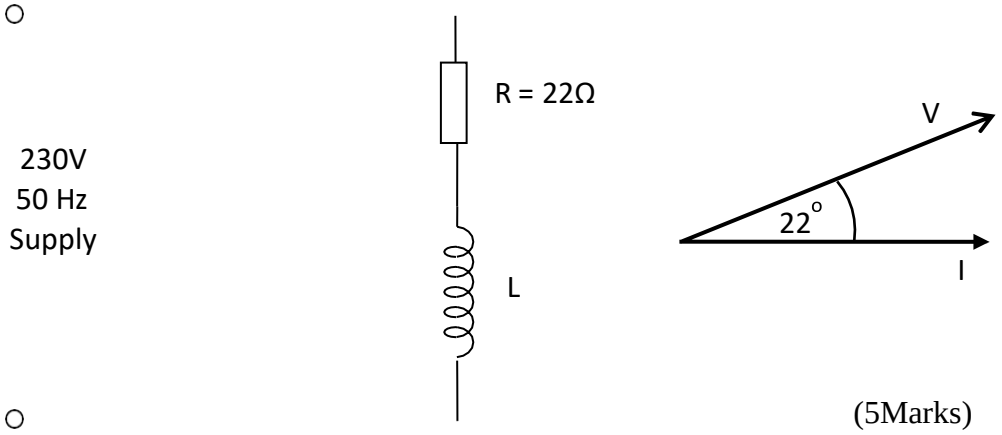
Note: *(Assume coil resistance is zero)* (*Show your scale*).

(5Marks)

4. Examine the following circuit and phasor diagram and

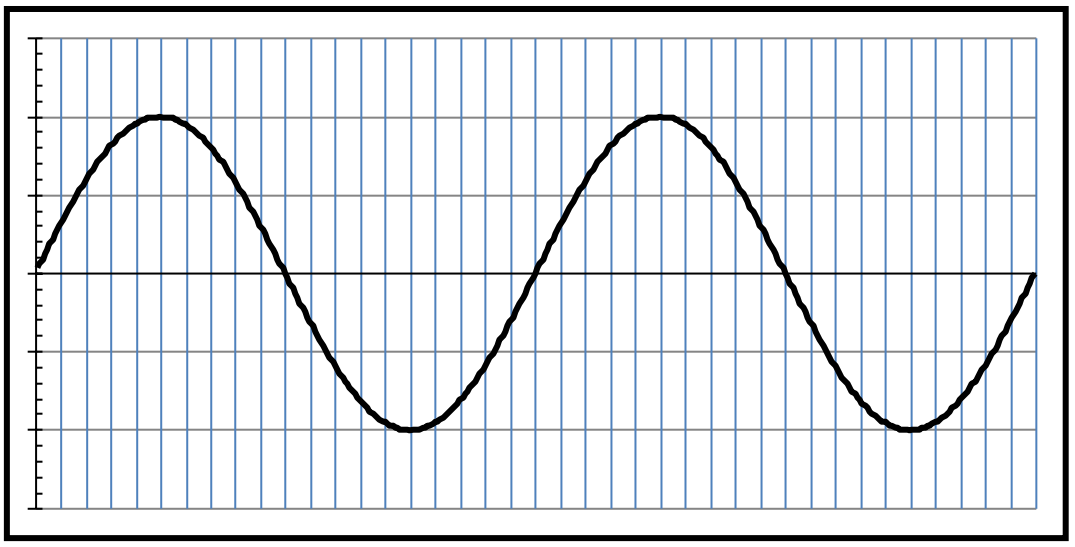
a. Draw its impedance triangle to scale and label all sides (3 Marks)
b. Measure and state the value of impedance (1 Mark)
c. Measure and state the value of reactance (1 Mark)

Note: (*Show your scale*).



(5Marks)

5. Examine the following waveform as displayed on a CRO.
If the CRO's Vertical scale is set to 50 Volts/div, and the and Horizontal scale is set to 1 mSec/div determine the signals:
(*Calculations required*)



A. Peak voltage: _____

B. Frequency: _____

C. RMS value: _____

D. Average voltage for one half cycle: _____

(4 Marks)

Section D – (23Marks)

Calculations

Instructions:

Answer the following questions showing all formulas and calculations used.
(*Marks will be **deducted** for incorrect engineering notation and units*)

1. A single phase motor winding has a measured resistance of 18 Ω an inductance of 172 mH and is connected to 230 V 50 Hz supply.
   Determine the:
   a. Inductive Reactance
   b. Circuit Impedance
   c. Supply Current
   d. Circuit phase angle

   (4 Marks)

2. A 138 μF capacitor is connected to a 230 V 50 Hz supply. Determine the:

   a. Capacitive Reactance
   b. Circuit Impedance
   c. Supply Current

   (3 Marks)

3. A capacitor with a reactance of 207 Ω and a resistor of 100 Ω are connected in series across a 230V, 50Hz supply. Calculate:

   a. The current through each component
   b. The voltage across the capacitor
   c. The voltage across the resistor

(4Marks)

4. An ideal inductor draws a current of 3A when connected to a 240V, 50Hz supply. Determine the inductance value of the coil.
   (Assume coil resistance is zero).

(2 Marks)

5. An RLC series circuit containing a 219 Ω resistor, a capacitor with a reactance of 180 Ω, and an inductor with a reactance of 260 Ω is connected to a 230V 50Hz supply. Calculate:

   a. The circuit impedance,
   b. The circuit current,
   c. The circuit phase angle, and
   d. The volt drop across each component

(6 Marks)

6. A series circuit where R=12 Ω, L = 122 mH and C = 37 μF, is connected to a 120 V, variable frequency supply. Calculate the:

a. The Resonant frequency
b. The circuit current at resonance
c. The voltage across the capacitor at resonance

(4 Marks)

Note: The symbols used on this sheet follow AS1046 pt 1. There are alternate recognised symbols in use. The list does not contain every equation used in the course. Transposition of equations will be necessary to solve problems

$$Q = It \qquad v = \frac{s}{t} \qquad a = \frac{\Delta v}{t}$$

$$F = ma \qquad W = Fs \qquad W = mgh$$

$$W = Pt \qquad \eta\% = \frac{output}{input} \times \frac{100}{1} \qquad I = \frac{V}{R}$$

$$P = VI \qquad P = I^2R \qquad P = \frac{V^2}{R}$$

$$R_2 = \frac{R_1 A_1 l_2}{A_2 l_1} \qquad R_h = R_c(1 + \alpha\Delta t) \qquad R = \frac{\rho l}{A}$$

$$R_T = R_1 + R_2 + R_3 \qquad V_T = V_1 + V_2 + V_3 \qquad \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$I_T = I_1 + I_2 + I_3 \qquad V_2 = V_T \frac{R_2}{R_1 + R_2} \qquad I_2 = I_T \frac{R_1}{R_1 + R_2}$$

$$R_x = \frac{R_A R}{R_B} \qquad C = \frac{Q}{V} \qquad \tau = RC$$

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \qquad C_T = C_1 + C_2 + C_3 \qquad C = \frac{A\varepsilon_o\varepsilon_r}{d}$$

$$F_m = IN \qquad H = \frac{F_m}{l} \qquad B = \frac{\Phi}{A}$$

$$\Phi = \frac{F_m}{S} \qquad S = \frac{l}{\mu_o\mu_r A} \qquad V = N\frac{\Delta\Phi}{\Delta t}$$

$$e = Blv \qquad L = \frac{\mu_o\mu_r AN^2}{l} \qquad L = N\frac{\Delta\Phi}{\Delta I}$$

$$V = L\frac{\Delta I}{\Delta t} \qquad \tau = \frac{L}{R} \qquad F = BIl$$

$$T = Fr \qquad E_g = \frac{\Phi ZnP}{60a} \qquad P = \frac{2\pi nT}{60}$$

$$t = \frac{1}{f} \qquad f = \frac{np}{120} \qquad V = 0.707V_{max}$$

$$I = 0.707I_{max} \qquad V_{ave} = 0.637V_{max} \qquad I_{ave} = 0.637I_{max}$$

$$v = V_{max}\sin\phi \qquad i = I_{max}\sin\phi \qquad I = \frac{V}{Z}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} \qquad X_L = 2\pi fL \qquad X_C = \frac{1}{2\pi fC}$$

$$\cos\phi = \frac{P}{S} \qquad \cos\phi = \frac{R}{Z} \qquad S = \sqrt{P^2 + Q^2}$$

$$S = VI \qquad P = VI\cos\phi \qquad Q = VI\sin\phi$$

$$f_o = \frac{1}{2\pi\sqrt{LC}} \qquad V_L = \sqrt{3}V_P \qquad I_L = \sqrt{3}I_P$$

$$S = \sqrt{3}V_L I_L \qquad P = \sqrt{3}V_L I_L\cos\phi \qquad Q = \sqrt{3}V_L I_L\sin\phi$$

$$\tan\phi = \sqrt{3}\left(\frac{W_2 - W_1}{W_2 + W_1}\right) \qquad Q = mC\Delta t$$

$$V^{`} = 4.44\Phi fN \qquad \frac{V_1}{V_2} = \frac{N_1}{N_2} \qquad \frac{I_2}{I_1} = \frac{N_1}{N_2}$$

$$N_{syn} = \frac{120f}{p} \qquad s\% = \frac{(n_{syn} - n)}{n_{syn}} \times \frac{100}{1} \qquad f_r = \frac{s\% \times f}{100}$$

$$V_{reg}\% = \frac{(V_{NL} - V_{FL})}{V_{FL}} \times \frac{100}{1} \qquad V_{reg}\% = \frac{(V_{NL} - V_{FL})}{V_{NL}} \times \frac{100}{1} \qquad T = \frac{\Phi ZIP}{2\pi n}$$

$$I_{ST} = \frac{1}{3} \times I_{DOL} \qquad T_{ST} = \frac{1}{3} \times T_{DOL} \qquad I_{ST} = \frac{V_{ST}}{V} \times I_{DOL}$$

$$T_{ST} = \left(\frac{V_{ST}}{V}\right)^2 \times T_{DOL} \qquad I_{motor\,st} = \frac{\%TAP}{100} \times I_{DOL} \qquad I_{line\,st} = \left(\frac{\%TAP}{100}\right)^2 \times I_{DOL}$$

$$E = \frac{\Phi_v}{A} \qquad E = \frac{I}{d^2} \qquad \eta_v = \frac{\Phi_v}{P}$$

$$V_L = 0.45V_{ac} \qquad V_L = 0.9V_{ac} \qquad V_L = 1.17V_{phase}$$

$$V_L = 1.35V_{line} \qquad PRV = \sqrt{2}V_{ac} \qquad PRV = 2\sqrt{2}V_{ac}$$

$$PRV = 2.45V_{ac} \qquad V_{ripple} = \sqrt{2}V_{ac} \qquad V_{ripple} = 0.707V_{phase}$$

$$V_{ripple} = 0.1895V_{line}$$

Student Name:_____

Class : _____

Date : _____

Section A - Answer Sheet

Multi-choice Questions

Instructions:

Enter your personal details in the top right hand corner of this sheet.
Place an **X** in box of your choice. If you make a mistake, circle your answer ⊗ and choose again.

Question	A.	B.	C.	D.
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Totals				

Question	A.	B.	C.	D.
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
Totals				

Total Marks Section A _____ _____