

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION
(MINISTRY OF HIGHER EDUCATION)

MECHANICAL ENGINEERING DEPARTMENT

FINAL EXAMINATION
DECEMBER 2011 SESSION

JJ102 : ELECTRICAL TECHNOLOGY

DATE : 26 APRIL 2012 (THURSDAY)
DURATION : 2 HOURS (11.15 AM - 1.15 PM)

This paper consists of **TWELVE (12)** pages including the front page.
Section A: Objective (25 questions – answer all)
Section B: Structured (4 questions – answer 3 questions)

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DO NOT OPEN THIS QUESTION PAPER UNTIL INSTRUCTED BY
THE CHIEF INVIGILATOR

(CLO stated at the end of each question is referring to the learning outcome of the topic assessed. The CLO stated is only for lectures' references.)

SECTION A

OBJECTIVES (25 Marks)

INSTRUCTION:

This section consists of **TWENTY FIVE (25)** objective questions. Answer **ALL** questions in the answer booklet.

1. What is the unit for electromotive force? [CLO 1]
A. Ohm
B. Volt
C. Watt
D. Ampere
2. The door bell has a resistance of 8Ω and requires a $1.5A$ current to operate. Calculate the voltage required to ring the bell? [CLO 1]
A. 12 v
B. 53 v
C. 1.2 v
D. 5.3 v

3.

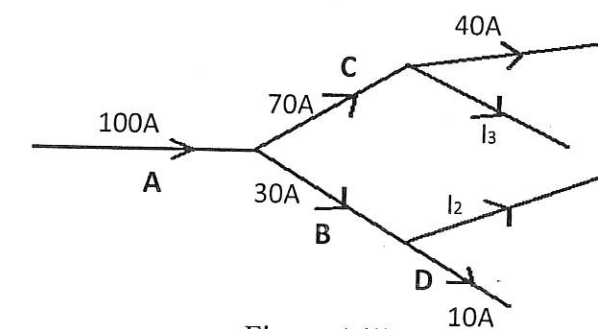


Figure A(1)

By referring to Figure A(1), if the equation for Kirchoff's Current Law is $A - B - C = 0$ then calculate the current of I_2 and I_3 . [CLO 1]

- A. 30A, 40A
- B. 20A, 30A
- C. 40A, 30A
- D. 30A, 20A

4. Which of the following would affect the electrical conductivity of a circuit?
[CLO 1]

- i. Thickness of the wire
- ii. Length of the wire
- iii. Temperature of the wire
- iv. Voltage of the wire

- A. i, ii and iv
- B. i, ii and iii
- C. ii, iii and iv
- D. i, iii and iv

5. A resistance of 10Ω is placed across 9V battery. What is the current flow through the battery? [CLO 1]

- A. 0.9 A
- B. 9.0 A
- C. 0.09 A
- D. 9×10^{-3} A

6. Calculate the total current that passes through all resistors if the voltage supply is 120V as shown in Figure A(2): [CLO 1]

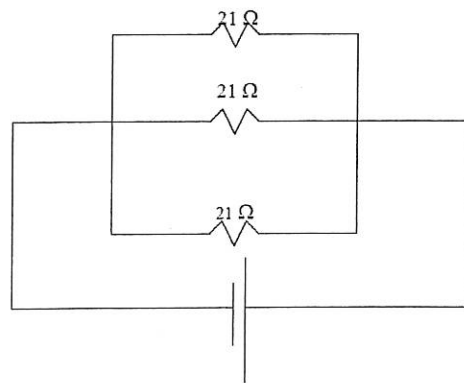


Figure A(2)

- A. 1.714 A
- B. 1.9 A
- C. 17.14 A
- D. 19 A

7.

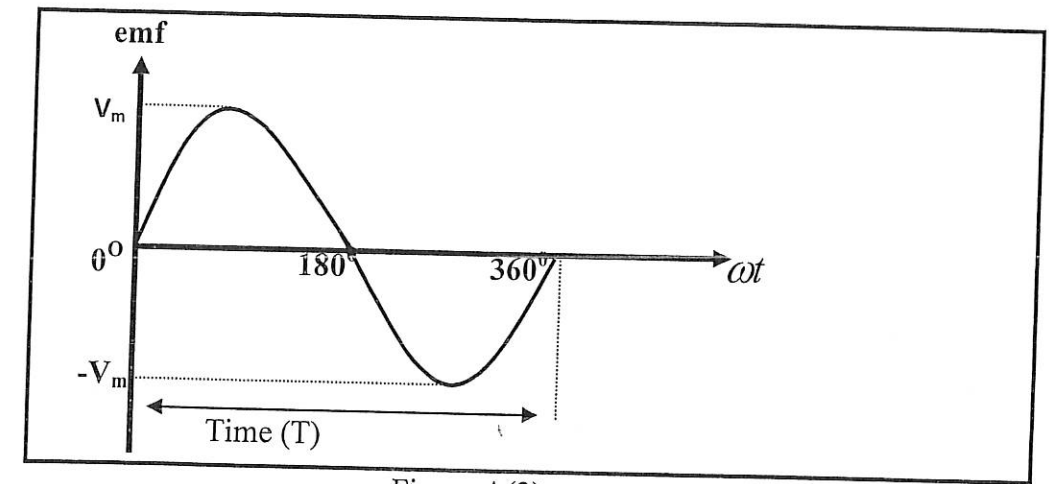


Figure A(3)

Based on Figure A(3), what is the equation for the waveform? [CLO1]

- A. $V(t) = V_m \cos \omega t$
- B. $V(t) = V_m \tan \omega t$
- C. $V(t) = V_m \sin \omega t$
- D. $V(t) = V_m \sinh \omega t$

8.

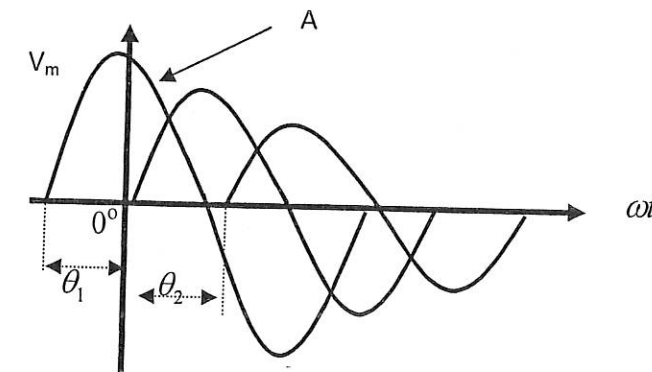


Figure A(4)

Refer to Figure A(4). State the equation for the waveform A.

- A. $V = V_m \sin(\omega t - \theta_1)$
- B. $V = V_m \sin(\omega t + \theta_2)$
- C. $V = V_m \sin(\omega t - \theta_2)$
- D. $V = V_m \sin(\omega t + \theta_1)$

9. Which is the equation that is used to determine reactive power in Alternating Current circuit? [CLO2]
- VI
 - $VI \cos \theta$
 - $VI \sin \theta$
 - I^2R
10. State the unit for apparent power. [CLO1]
- VA
 - Watt
 - VAR
 - V
11. Below are the effects of capacitor in a circuit of the electrical device **EXCEPT** [CLO2]
- Store electrical charges
 - Strengthen the electrical current
 - Reduce the signal in radio circuit
 - Increase circuit power factor

12. Which statement is the best to suit the vector diagram in Figure A(5) below? [CLO2]

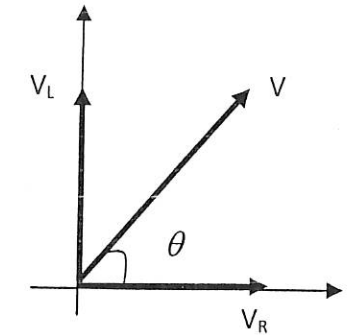


Figure A(5)

- RL circuit with the value of R is equal to zero
 - RL circuit with the value of L is equal to zero
 - RLC circuit with the value of X_L is smaller than X_C
 - RLC circuit with the value of X_L is greater than X_C
13. Which statement best describes a three phase system? [CLO1]
- Three system that has 240 voltage phase of the same magnitude produced by the three separate coil conductor which space 180° apart
 - Three system that has 415 voltage line of the same magnitude produced by the three separate coil conductor which space 120° apart
 - Three system that has 240 voltage line of the same magnitude produced by the three separate coil conductor which space 60° apart
 - Three system that has 415 voltage phase of the same magnitude produced by the three separate coil conductor which space 30° apart
14. Which is the advantage of the three phase system compared to single phase system?
- Higher efficiency and power factor
 - Conductor used is bigger
 - Bigger structure supported for conductor
 - Less power losses

15. In a three- phase system, when the loads are perfectly balanced, the neutral current is
- Zero
 - One-third of maximum
 - Two-third of maximum
 - At maximum
16. Three phase generators produce simultaneous multiple sinusoidal voltage that are separated by
- certain constant frequencies
 - certain constant voltages
 - certain constant currents
 - certain constant phase angles
17. Determine the characteristic of the magnetic flux around the conductor if two closed current-carrying conductors flow in the same direction.
- Repulsion to each other
 - Attraction to each other
 - Combination to each other
 - Opposition to each other
18. Below are the factors that affect electromagnetic strength **EXCEPT**
- Types of the conductor
 - Length of the conductor
 - Thickness of the conductor
 - Resistivity of the conductor
19. A 100mm long wire, moves with uniform speed 4 ms^{-1} at right angles to its length and to a uniform magnetic field. Calculate flux density if the induced electromagnetic field generated in the wire is 0.15 V.

- 60 T
 - 0.06 T
 - 0.375 T
 - $375 \mu\text{T}$
20. Which component is **NOT** included in a DC generator?
- Commutator
 - Slip rings
 - Brush
 - Stator
21. Identify two types of motor starter. [CLO1]
- Inductor Start Motor
 - Capacitor Start Motor
 - Coil Start Motor
 - Resistance Start Motor
- i and iii
 - i and iv
 - ii and iii
 - ii and iv
22. The function of secondary winding in transformer is to _____.
[CLO1]
- deliver the energy
 - transfer the energy
 - dividing the energy
 - receives the energy
23. How many windings can be found in an auto transformer? [CLO1]
- 1

- B. 2
- C. 3
- D. 4

24. Which of the following is a type of single-phase double-wound transformer construction?

- i. Core type
- ii. Close type
- iii. Open type
- iv. Shell type

- A. i and ii
- B. i and iii
- C. ii and iii
- D. i and iv

25. Below are the types of transformer **EXCEPT**

- i. Double-phase shell
- ii. Helix and disc coils on single-phase
- iii. Core and windings of double-phase
- iv. Core and windings of single-phase

- A. i, ii, iii
- B. i, ii, iv
- C. i, iii, iv
- D. ii, iii, iv

SECTION B:

STRUCTURED (75 Marks)

INSTRUCTION:

This section consists of **FOUR (4)** essay questions. Answer any **THREE (3)** questions in the answer booklet.

QUESTION 1

- a) i. Define Ohm's Law and state the equation. [CLO 1] (4 Marks)
- ii. Explain the use of voltmeter and draw its symbol. [CLO 1] (4 Marks)
- iii. Based on equation $P = IV$, prove that $P = I^2R$ and $P = V^2/R$. [CLO 1] (6 Marks)
- b) Madam Norsiah switches on 14 lights from 8pm to 11pm every night. If 8 lights are 100W each and others are 75 W each, calculate:- [CLO 1]
- i. The energy used for one night (6 Marks)
- ii. The cost of electricity for January (31 days) if the cost of electricity is 12 cents per unit. (5 Marks)

QUESTION 2

- a) A $6\mu\text{F}$ and $10\mu\text{F}$ capacitor are connected in series to 200V, 50Hz supply voltage. [CLO 2]
- i. Draw and label the circuit
- ii. Calculate total capacitance
- iii. Determine the charge for every capacitor (10 Marks)
- b) An Alternating Current circuit has $50 \angle 30^\circ \Omega$ impedance, assuming the frequency is 50 Hz. [CLO 2]

- i. Determine the AC circuit whether it is RL or RC. State the value of resistance, R.
(6 Marks)
- ii. Draw and label the AC circuit and impedance triangle.
(9 Marks)

QUESTION 3

- a)
 - i. State the direction of magnetic field of a magnet bar.
 - ii. List **TWO (2)** methods used to determine the direction of magnetic field when current flows through a conductor.
(4 Marks)
- b) Explain **TWO (2)** methods used to produce induced emf.
(10 Marks)
- c) A mild steel ring has a radius of 50mm and across section area of 400mm². A current of 0.5A flow in a coil wound uniformly around the ring and the flux produced is 0.1 Wb. If the relative permeability at this value of current is 200, calculate:
 - i. Reluctance of the mild steel
(6 Marks)
 - ii. Number of turns on the coil
(5 Marks)

QUESTION 4

- a) The number of windings for a transformer is $N_p = 1500$ turns and $N_s = 5000$ turns.
 - i. Calculate the ratio of K.
 - ii. Determine the type of transformer and
 - iii. Draw the symbol of transformer to differentiate the number of windings.
 - iv. If the ratio, $K = 1.5$ and total primary winding is 2000 turns, find the number of turns in secondary winding.
(10 Marks)
- b) Given 3 advantages to using three phase system (3 Φ) compared to single phase system (1 Φ).
(6 marks)
- c) A balanced, three wire, 3 phase maximum load has a voltage of 415V.
 - i. Draw the three phase sinusoidal waveform
(3 marks)
 - ii. Find the voltage for three wire when the angle is $\theta = 250^\circ$
(6 marks)