



Vellore – 632014, Tamil Nadu, India  
**SCHOOL OF ELECTRICAL ENGINEERING**  
**Fall SEMESTER 2023-2024**  
**CAT-II**

**SLOT: G1+TG1**

Programme Name & Branch : B.Tech & CSE

Course Code: BEEE102L Course Name: Basic Electrical and Electronics Engineering

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Class Number(s): VL2023240107487, VL2023240107785, VL2023240107779,  
VL2023240107494, VL2023240107791

Date of the Examination: /10/2023

**Duration : 90 minutes**

**Max. Marks : 50**

**General instruction(s):**

**Answer all the questions**

**Assume if any data is missing**

Q.No.	Question	Marks
1	In a balanced three phase Y-Y system, the source voltage is 400 V and the frequency is 50Hz. The load comprises of a resistor of 22 $\Omega$ and inductor of 3.82 mH in series. Calculate (i) Phase voltage (ii) Line current (iii) Total real and reactive power (iv) Power factor	10
2	In a balanced three phase Y- $\Delta$ system, the per-phase load impedance $10-j5.2 \Omega$ is connected to a 400 V supply. Calculate the (i) line current (ii) active and reactive powers (iii) apparent power (iv) identify the type of load (resistive or inductive or capacitive) with necessary justification.	10

3	<p>Perform the following conversions as indicated [3+3+2+2]M</p> <p>i) <math>(108.435)_{10}</math> to base 2</p> <p>ii) <math>(328.435)_{10}</math> to base 8</p> <p>iii) <math>(100101101.0110001)_2</math> to base 16</p> <p>iv) <math>(4ADC)_{16}</math> to base 8</p>	10
4	<p>a) Using boolean laws prove that [6 M]</p> $(A + B)(\overline{A} \overline{C} + C) + \overline{(B + AC)} = \overline{A} B$ <p>b) Simplify the boolean expression [4 M]</p> $A[B + C(\overline{AB + AC})]$	10
5	<p>Using K-map method obtain the minimum sum of products form and draw the logic circuit for the following function</p> $F(A, B, C, D) = \sum(0, 2, 3, 5, 7, 8, 9, 10, 11, 13, 15)$	10

## BEEE102L Cat-2 solutions

1. In a balanced three-phase Y-Y system, the source voltage is 400 V and the frequency is 50Hz. The load comprises of a resistor of 22  $\Omega$  and inductor of 3.82 mH in series. Calculate (i) phase voltage (ii) line current (iii) Total real and reactive power (iv) power factor.

Given:

$$V_L = 400, \quad f = 50 \text{ Hz} \quad R = 22 \Omega, \quad L = 3.82 \text{ mH}$$

$$Z = R + j(\omega L) = 22 + j(2\pi f L) = 22 + j1.2 = 22.03/\underline{3.12^\circ} \Omega$$

At source side:

$$V_{Ph} = \frac{V_L}{\sqrt{3}} = \frac{400}{\sqrt{3}} = 230.94 \text{ V}$$

At load side:

Source  $V_{ph} = V_{Ph}$

a)  $V_{ph} = 230.94 \text{ V}$

$$I_{Ph} = \frac{V_{Ph}}{Z} = \frac{230/0^\circ}{22.03/3.12^\circ} = 10.43/\underline{-3.12^\circ} \text{ A}$$

b) For star connected load  $I_{Ph} = I_L = 10.43 \text{ A}$

c) Real power

$$P_{1\phi} = V_{Ph} \times I_{Ph} \times \cos(\phi) = 230.94 \times 10.43 \times \cos(3.12^\circ) = 2.40 \text{ kW}$$

Total real power

$$P_{3\phi} = 3 \times V_{Ph} \times I_{Ph} \times \cos(\phi) = 7.21 \text{ kW}$$

d) Reactive power

$$Q_{1\phi} = V_{Ph} \times I_{Ph} \times \sin(\phi) = 230.94 \times 10.93 \times \sin(3.12^\circ) = 0.13 \text{ kVAR}$$

Total reactive power

$$Q_{3\phi} = 3 \times V_{Ph} \times I_{Ph} \times \sin(\phi) = 0.41 \text{ kVAR}$$

e) power factor

$$\cos(\phi) = \cos(4.57^\circ) = 0.99(\text{lagging})$$

2. In a balanced three phase Y- $\Delta$  system, per-phase load impedance  $10-j5.2 \Omega$  is connected to a 400 V supply. Calculate the (i) line current (ii) active and reactive powers (iii) apparent power (iv) identify the type of load (resistive or inductive or capacitive) with necessary justification.

Given:

$$V_L = 400 \text{ V}, Z = 10 - j5.2 = 11.27/\underline{-27.47^\circ}$$

Source side:

$$\overline{V_L} = 400 \text{ V}$$

The line voltage from the Y connected source will be the phase voltage for a  $\Delta$ -connected load

Load side:

Phase current:

$$|I_{Ph}| = \frac{|V_{Ph}|}{|Z|} = \frac{400}{11.27} = 35.49 \text{ V}$$

a) Line current:

$$I_L = \sqrt{3}I_{Ph} = 61.47 \text{ A}$$

b) Real power

$$P_{1\phi} = V_{Ph} \times I_{Ph} \times \cos(\phi) = 400 \times 35.49 \times \cos(-27.47^\circ) = 12.59 \text{ kW}$$

$$P_{3\phi} = 3 * V_{Ph} \times I_{Ph} \times \cos(\phi) = 37.78 \text{ kW}$$

Reactive power:

$$Q_{1\phi} = V_{ph}I_{Ph} \sin(\phi) = 400 \times 35.49 \times \sin(-27.47^\circ) = -6.54 \text{ kVAR}$$

$$Q_{3\phi} = 3 * V_{Ph} \times I_{Ph} \times \sin(\phi) = -19.64 \text{ kVAR}$$

c) Apparent power

$$|S_{1\phi}| = \sqrt{P_{1\phi}^2 + Q_{1\phi}^2} = 14.18 \text{ kVA}$$

$$|S_{3\phi}| = 42.65 \text{ kVA}$$

d) As the reactive power is negative, the load is capacitive

3. Perform the following conversions as indicated [3+3+2+2]M

- (a)  $(108.435)_{10}$  to base 2
- (b)  $(328.435)_{10}$  to base 8
- (c)  $(100101101.0110001)_2$  to base 16
- (d)  $(4ADC)_{16}$  to base 8

(i)  $(108.435)_{10} = (?)_2$

2	108	$0.435 \times 2 = 0.87$	0.87 with carry 0
2	54 - 0	$0.87 \times 2 = 1.74$	0.74 with carry 1
2	27 - 0	$0.74 \times 2 = 1.48$	0.48 with carry 1
2	13 - 1	$0.48 \times 2 = 0.96$	0.96 with carry 0
2	6 - 1		
2	3 - 0		
2	1 - 1		
2	0 - 1		

$(108.435)_{10} = (1101100.0110)_2$

(ii)  $(328.435)_{10} = (?)_8$

8	328	$0.435 \times 8 = 3.48$	0.48 with carry 3
8	41 - 0	$0.48 \times 8 = 3.84$	0.84 with carry 3
8	5 - 1	$0.84 \times 8 = 6.72$	0.72 with carry 6
		$0.72 \times 8 = 5.62$	0.62 with carry 5

$(328.435)_{10} = (510.3365)_8$

(iii)  $(100101101.0110001)_2 = (?)_{16} = (12D.62)_8$

$$\frac{\underline{000100101101.01100010}}{1 \quad 2 \quad D \quad 6 \quad 2}$$

(iv)  $(4ADC)_{16} = (?)_8 = (45334)_8$

$$\frac{\underline{0100 \ 1010 \ 1101 \ 1100}}{4 \quad 5 \quad 3 \quad 3 \quad 4}$$

4. a) Using boolean laws prove that

$$(A + B)(\overline{A \overline{C}} + C)(\overline{\overline{B} + AC}) = \overline{A}B$$

Ans:

$$\begin{aligned} (A + B)(\overline{A \overline{C}} + C)(\overline{\overline{B} + AC}) &= (A \overline{A} \overline{C} + A C + B \overline{A} \overline{C} + B C)(\overline{\overline{B} \overline{AC}}) \\ &= (0 + A C + B \overline{A} \overline{C} + B C)(B(\overline{A} + \overline{C})) \quad \text{where } A \overline{A} = 0 \\ &= (A C + B \overline{A} \overline{C} + B C)(B \overline{A} + B \overline{C}) \\ &= A C B \overline{A} + A C B \overline{C} + B \overline{A} \overline{C} B \overline{A} + B \overline{A} \overline{C} B \overline{C} + B C B \overline{A} + B C B \overline{C} \\ &= \overline{A} B \overline{C} + \overline{A} B \overline{C} + \overline{A} B C \quad \text{where } A \overline{A} = 0 \text{ and } C \overline{C} = 0 \\ &= \overline{A} B \overline{C} + \overline{A} B \overline{C} + \overline{A} B C \\ &= \overline{A} B(\overline{C} + C) = \boxed{\overline{A} B} \quad \text{where } C + \overline{C} = 1 \end{aligned}$$

5. b) Simplify the boolean expression

$$A[B + C(\overline{AB + AC})]$$

Ans:

$$\begin{aligned} A[B + C(\overline{AB + AC})] &= A[B + C(\overline{AB} \overline{AC})] \quad \text{Demorgan's law} \\ &= A[B + C((\overline{A} + \overline{B})(\overline{A} + \overline{C}))] \quad \text{Demorgan's law} \\ &= A[B + C(\overline{A} \overline{A} + \overline{A} \overline{C} + \overline{B} \overline{A} + \overline{B} \overline{C})] \\ &= A[B + C(\overline{A} + \overline{A} \overline{C} + \overline{A} \overline{B} + \overline{B} \overline{C})] \quad \text{where } \overline{A} \overline{A} = \overline{A} \\ &= A[B + \overline{A} C + \overline{A} \overline{C} C + \overline{A} \overline{B} C + \overline{B} \overline{C} C] \\ &= A[B + \overline{A} C + 0 + \overline{A} \overline{B} C + 0] \quad \text{where } \overline{C} C = 0 \end{aligned}$$

$$\begin{aligned}
&= A[B + \bar{A} C + \bar{A} \bar{B} C] \\
&= AB + A \bar{A} C + A \bar{A} \bar{B} C \\
&= \boxed{AB} \quad \text{where } \bar{A} A = 0
\end{aligned}$$

6. Using K-map method obtain the minimum sum of products form and draw the logic circuit for the following function

$$F(x, y, z) = \sum(0, 2, 3, 5, 7, 8, 9, 10, 11, 13, 15)$$

$$F = \Sigma(0, 2, 3, 5, 7, 8, 9, 10, 11, 13, 15)$$

		CD			
		$\bar{C}\bar{D}$	$\bar{C}D$	$CD$	$C\bar{D}$
$\bar{A}\bar{B}$	$\bar{A}\bar{B}$	0 1	1	3 1	2 1
	$\bar{A}B$	4	5 1	7 1	6
AB	AB	12	13 1	15 1	14
	$A\bar{B}$	8 1	9 1	11 1	10 1

$$F = A \bar{B} + C D + B D + \bar{B} \bar{D}$$