MARKING SCHEME

School:………..*SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING*

Programme:… ***CERTIFICATE IV IN ELECTRICAL ENGINEERING***

Unit code:…….***EEE344***

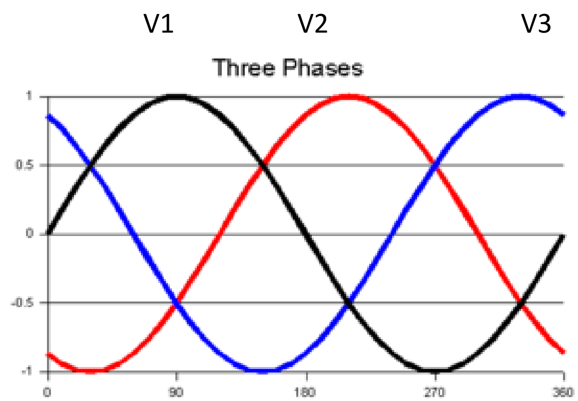
Unit Title:……*ELECTRICAL PRINCIPLES (TRADE) 3*

Date:…………AS PER TIME TABLE

Examiner:……*MR SUMENDRA KUMAR*

Section A
Three Phase Circuits

1.



(3 marks)

2. A broken neutral stops the equipment operating. Altough the equipment appears to be dead, the active is still connected and it is possible for someone to complete the circuit from the supply, through himself via earth.

Another reason why neutral should not be broken is to protect the loads applied to the supply.

(3 marks)

3. Star system

i. Similar ends connected

ii. For balanced loads and $I_L = I_P$, $V_L = \sqrt{3}\ V_P$

iii. Two volatages are available

iv. Line voltage leads phase voltage by 30º E

v. Suited for long distance power transmission

Delta System

i. Dissimilar ends are connected

ii. For balanced loads, $V_L = V_P$ and $I_L = \sqrt{3}\ I_P$

iii. One voltage available only

iv. Line current leads the phase current by 30º E

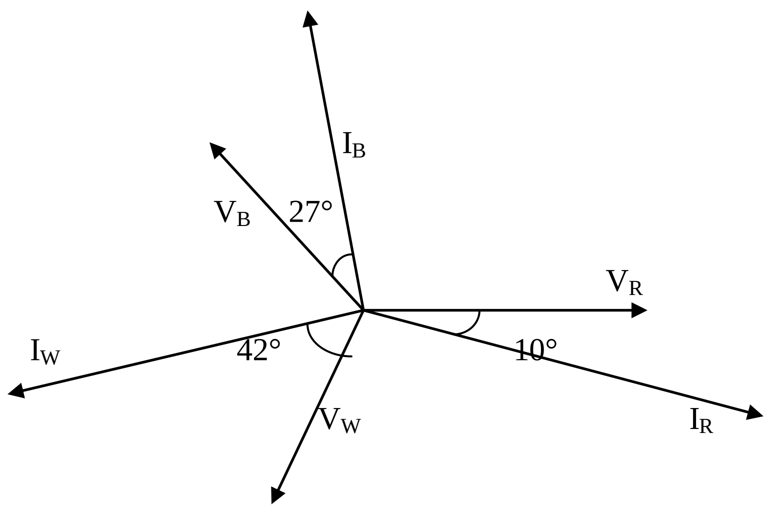
v. Suited to localized rotating machinery

(5 marks)

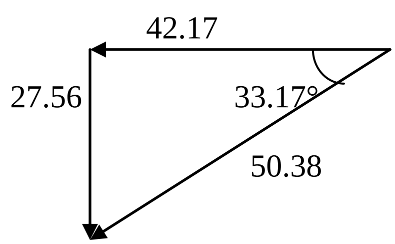
4.

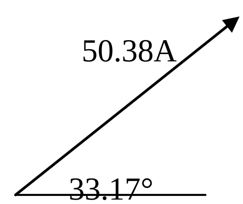
(6 marks)

5.



	X	Y
45A at 10° lagging	45 cos 10 = 44.32	-45 sin 10 = -7.81
87.5 at 42° lagging	-87.5 cos 18 = -83.22	-87.5 sin 18 = -27.04
62.5A at 27° lagging	-62.5 cos 87 = -3.27	62.5 sin 87 = 62.41
	= -42.17	= 27.56





Therefore current in the neutral will be the equilibriant, i.e

(8 marks)

6.

i. To carry any unbalanced currents in four wire system
ii. To allow for single phase loads to be connected on three phase four wire system

(4 marks)

7. $I_P = I_{L} / \sqrt{3} = 5/1.732 = 2.88A$ (2 marks)

8. I = P / V for resistive loads

$I_{R=}$ 24000/240= 100A

$I_{W=}$ 18000/240= 75A

$I_{R=}$ 12000/240= 50A (6marks)

9.

a. $X_L = 2\Pi f L$

$= 2 \times 3.142 \times 50 \times 38 \times 10^{-3}$

$= \mathbf{11.94\Omega}$

b. $Z = \sqrt{R^2 + X_L^2}$

$= \sqrt{12^2 + 11.94^2}$

$= \mathbf{16.93\Omega}$

c. $I_P = \frac{V_P}{Z_P}$

$= \frac{240}{16.93}$

$= \mathbf{14.18A}$

d. $I_P = I_L$

$= \mathbf{14.18A}$

e. $P = \sqrt{3}\ VI \cos\theta$

$= 1.732 \times 415 \times 14.18 \times 0.7$ (5 marks)

= 728.7 watts

10.

a. Total Power = W1 + W2

= 3 + - 1

= **2kW**

b. $\tan\theta = \sqrt{3}. \frac{W1 - W2}{W1 + W2}$

$= \sqrt{3}. \frac{3 - -1}{3 + -1}$

$= 1.732 \times \frac{4}{2}$

= 3.46

θ = 73.87 º therefore Cos θ = 0.28 (3 marks)

<u>**Section B**</u>

<u>**Power Factor Improvement**</u>

1. A.C machines are rated in KVA and not in KW because KVA is a constant value depending on voltage and full load current. Where as KW is a variable factor, which depends on the load power factor. As the power factor changes the KW value also changes. Therefore machines are to be rated in KVA which is constant.

(2 marks)

2.a) Active component of motor load = 40x0.8=32kW
Therefore total active load = 10+30+32=72kW

b) KVAr of the motor = 40sin Ø   *cos¯ 0.8= 36.86*
= 40 x Sin 36.86
= 24 KVAr

c) KVA = √kW□+KVAr□
= √72□+24□
= 75.9 KVA

d) P.f. = *cos Ø* = total kW / total KVA   (8 marks)
= 72/75.9 = 0.95

3.

a) $kVA = VI = \frac{400 \times 50}{1000} = 20kVA$

b) $P = kVA \cos Ø = 20 \times 0.8 = 16kW$ *(3 marks)*

4.

i. Effect on transmission line. The line has to carry more current at low P.F.
ii. Effect on transformers, the KW capacity of transformer is decreased
iii. Effect on switchgear – needs larger switchgear
iv. Effect on generator – KVA rating is lowered
v. Effect on prime mover – decreases the efficiency of prime movers

(4 marks)

5.

i. The KW capacity of prime mover is better utilized
ii. Increases the KW capacity of alternators
iii. The KW capacity of transformers and lines is increased
iv. The efficiency of every plant is increased
v. The overall cost per unit is decreased
vi. The regulation of the lines are improved

(5 marks)

6. $\cos\theta \text{ (p.f)} = \frac{\text{Power}}{\text{KVA}}$

$= \frac{2000}{2050}$

$= \mathbf{0.975}$

(2 marks)

7.

a. At 0.92 power factor:

$I_1 = \frac{1000}{230 \times 0.92} = \mathbf{4.73A}$

b. At 0.36 power factor:

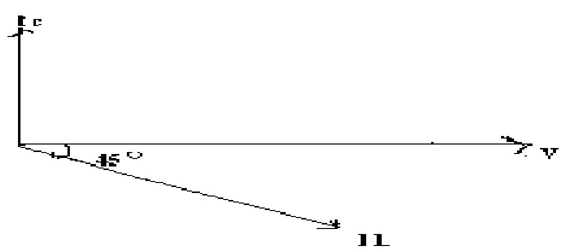
$I_2 = \frac{1000}{230 \times 0.36} = \mathbf{12.08A}$

c. At unity power factor:

$I_3 = \frac{1000}{230 \times 1} = \mathbf{4.34\ A}$

(3 marks)

8.



a. I_s when p.f is unity:

$I_s = 80 \cos 45^o$

$= \underline{\mathbf{56.56\ A}}$

b. $I_c = 80 \sin 45^o$

$= \underline{\mathbf{56.56\ A}}$

c. $X_c = \frac{V_s}{} = \frac{115}{} = \underline{\mathbf{2.03\ \Omega}}$

I_c 56.56

d. $C = \dfrac{1}{2\Pi\, f\, X_c}$

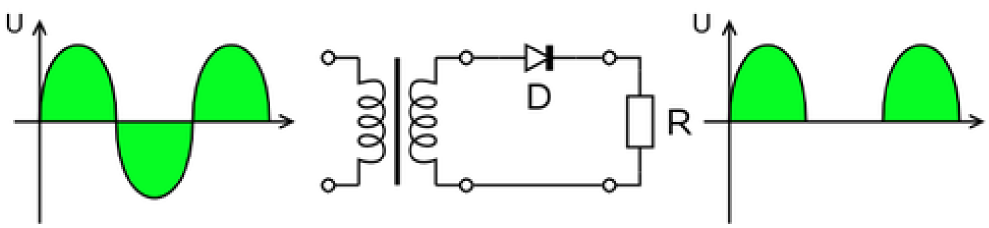
$= \dfrac{1}{2 \times 3.142 \times 60 \times 2.03} =$ **<u>1300µF</u>**

(8 marks)

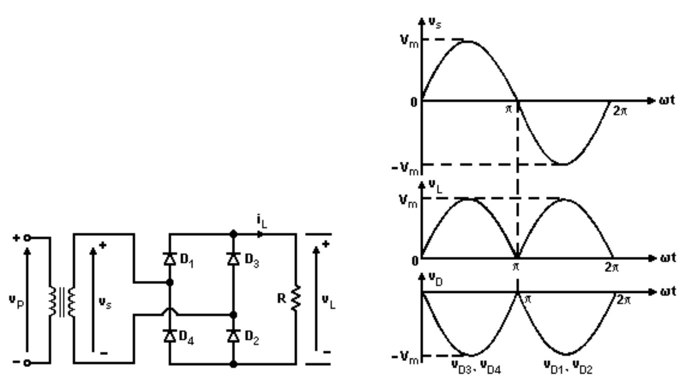
<u>Section C</u>

<u>Rectifiers</u>

1) a) single phase half wave

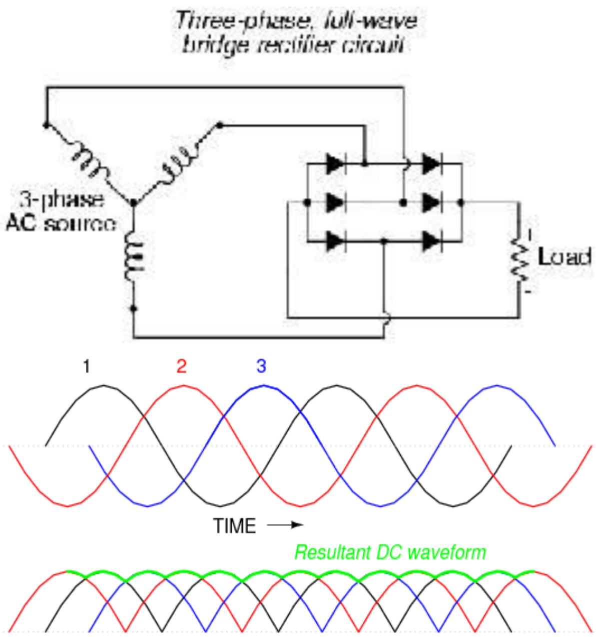


b) Single phase bridge



(a) Circuit diagram (b) Waveforms

c) Three phase full wave bridge



(12 marks)

2) a) $V_L = 0.9V_{a.c.} = 0.9 \times 46 = V_L = 41.4V$

b) $I_L = \frac{V_L}{R_L} = \frac{41.4}{7.0} = I_L = 5.91A$

c) $V_R = \sqrt{2}V_{a.c.} = \sqrt{2} \times 46 = V_R = 65.05V$

d) $f_R = 2f_{supply} = 2 \times 60 = f_R = 120Hz$

e) $PRV = 2\sqrt{2}V_{a.c.} = 2 \times \sqrt{2} \times 46 = PRV = 130.10V$

(8 marks)