Document No : UniKL MFI_SD_AC41
Revision No: 02
Effective Date: 01 December 2008

CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

SEPTEMBER 2013 SESSION

SUBJECT CODE	:	**FED 10203**
SUBJECT TITLE	:	**ELECTRICAL TECHNOLOGY**
LEVEL	:	**DIPLOMA**
TIME / DURATION	:	**2.5 HOURS**
DATE	:	

INSTRUCTIONS TO CANDIDATES

1. **Please read the instructions given in the question paper CAREFULLY.**
2. **This question paper is printed on both sides of the paper.**
3. **Please write your answers on the answer booklet provided.**
4. **Answers should be written in blue or black ink except for sketching, graphic and illustration.**
5. **This question paper consists of TWO (2) sections. Section A and B. Answer all questions in Section A. For Section B, answer two (2) question only.**
6. **Answer all questions in English.**

THERE ARE 6 PAGES OF QUESTIONS AND 1 PAGE OF FORMULAE, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL question.
Please use the answer booklet provided.

Question 1

(a) **Draw** and **explain** a phase relationship between the sinusoidal waveforms of the following set.

i = 15 sin (ωt + 60°) A

v = 10 sin (ωt - 20°) V

(6 marks)

(b) The voltage in an AC circuit at any time t is given by $v(t) = 50 \sin(500\pi t + 45^{\circ})\ V$.
Find :

(i) The peak value (V_P), the peak to peak value (V_{PP}), the periodic time (T), the frequency (f), phase angle (θ) relative to 50 sin (500π t) and draw the signal waveform.

(8 marks)

(ii) The value of the voltage when t = 3ms.

(3 marks)

(iii) The time when the voltage first reaches maximum.

(4 marks)

(iv) The value of current $i_C(t)$ when the above value of voltage across 5 μF capacitor.

(3 marks)

(c) A coil takes a current of 5 A from a 20 V DC supply. When connected to a 200 V, 50Hz AC supply the current measured was 25 A. Calculate the;

(i) resistance

(2 marks)

(ii) impedance

(2 marks)

(iii) inductance of the coil.

(2 marks)

Question 2

(a) Calculate total impedance Z_T in the network in **Figure 1.**

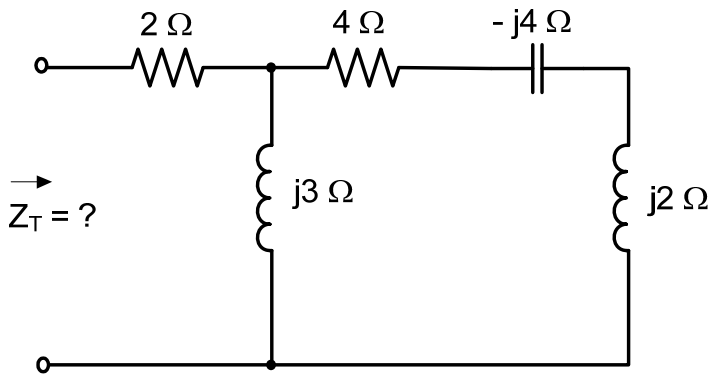

Figure 1

(10 marks)

(b) Three (3) loads are connected in parallel to a 6 kV_{RMS} ac line, as shown in **Figure 2**. Given ;

P_1 = 10 kW, PF_1 = 1

P_2 = 20 kW, PF_2 = 0.5 lagging

P_3 = 15 kW, PF_3 = 0.6 lagging

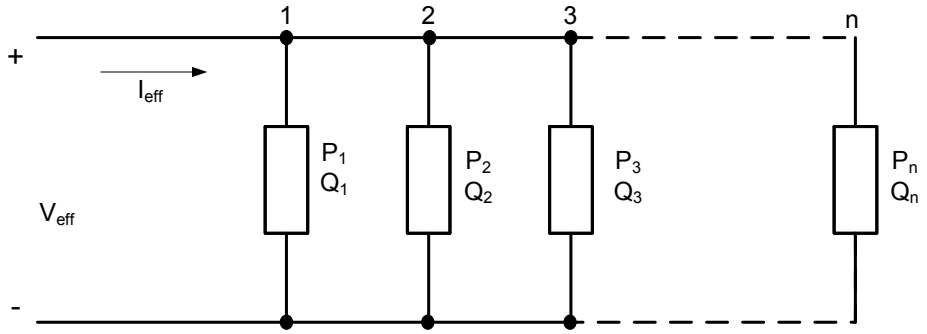

Figure 2

Find;

(i) Active power total (P_T)

(3 marks)

(ii) Reactive power total (Q_T)

(3 marks)

(iii) Apparent power total (S_T)

(3 marks)

(iv) Power factor total ($\cos \theta$)

(3 marks)

(v) Current (I_{RMS})

(3 marks)

(vi) A fourth load Q_4 is added in parallel to the three parallel loads as in **Figure 2**, such that the total power factor becomes 0.8 lagging while the total power remains the same. Find Q_4 and the resulting S (New Apparent power)

(5 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer TWO (2) questions only.
Please use the answer booklet provided.

Question 3

(a) Calculate the value of voltage V_0 in the circuit shown in **Figure 3**, by using **superposition** theorem.

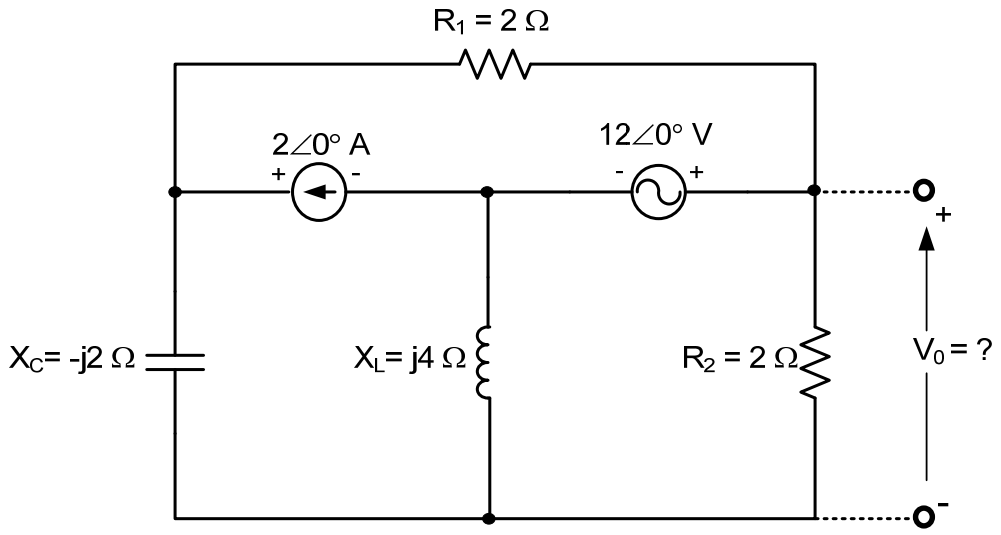

Figure 3

(14 marks)

(b) A coil of resistance 25 Ω and inductance 100 mH is connected in series with a capacitance of 0.12 μF across a 200 V, variable frequency. Calculate ;

(i) The resonant frequency

(2 marks)

(ii) The current at resonance

(2 marks)

(iii) The factor by which the voltage across the reactance is greater than the supply voltage.

(2 marks)

Question 4

(a) Refer to **Figure 4** and determine the voltage V_0 across the load X_L = j40 Ω using **nodal** analysis.

(8 marks)

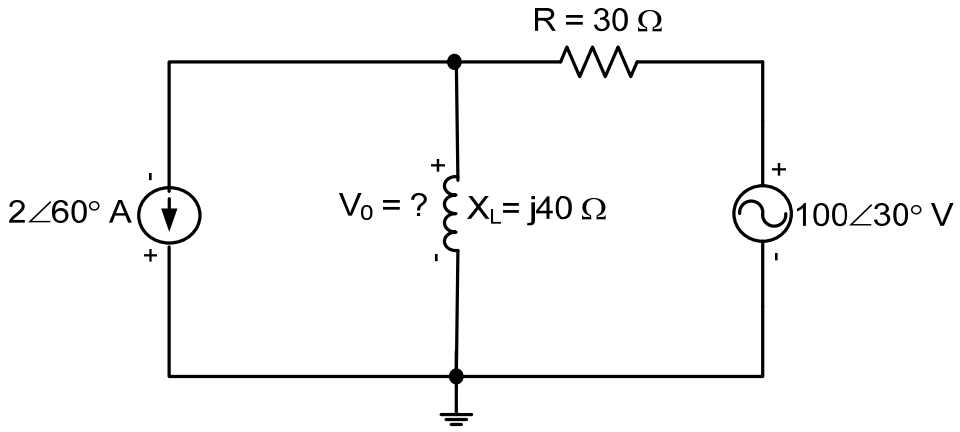

Figure 4

(b) An industrial load as in **Figure 5** requires 40 kW at power factor 0.84 lagging. The load voltage is 220 ∠0° V_{RMS} at 60 Hz. The transmission line impedance is 0.1 + j0.25 Ω. Determine :

(i) The active (P) and reactive (Q) power losses in the line.

(6 marks)

(ii) The active (P) and reactive (Q) power required at the input to the transmission line.

(6 marks)

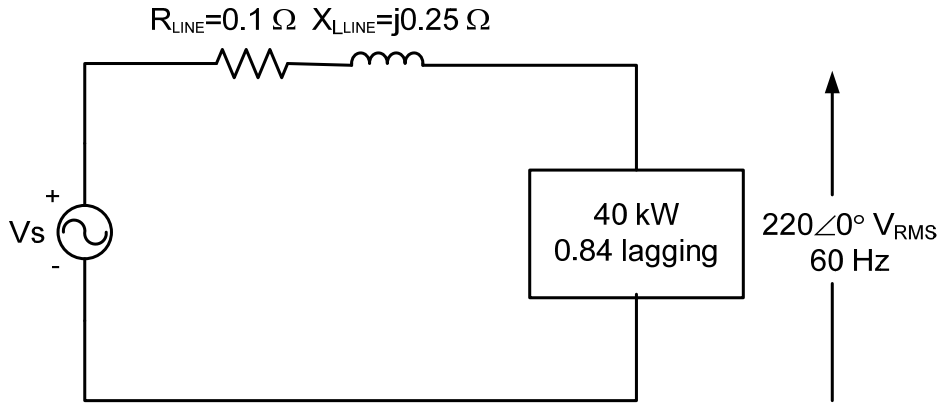

Figure 5

Question 5

(a) The three phase average power rating of the central processing unit (CPU) on a mainframe digital computer is 22659 W. The three phase line supplying the computer has a line voltage rating of 208 V_{RMS} . The line current is 73.8 A_{RMS}. The computer absorbs magnetizing reactive power (VARs).

(i) Calculate the power factor of the system.

(2 marks)

(ii) Calculate the total magnetizing reactive power absorbed by the CPU.

(3 marks)

(b) Calculate a three phase Star – Delta system as shown in **Figure 6**.

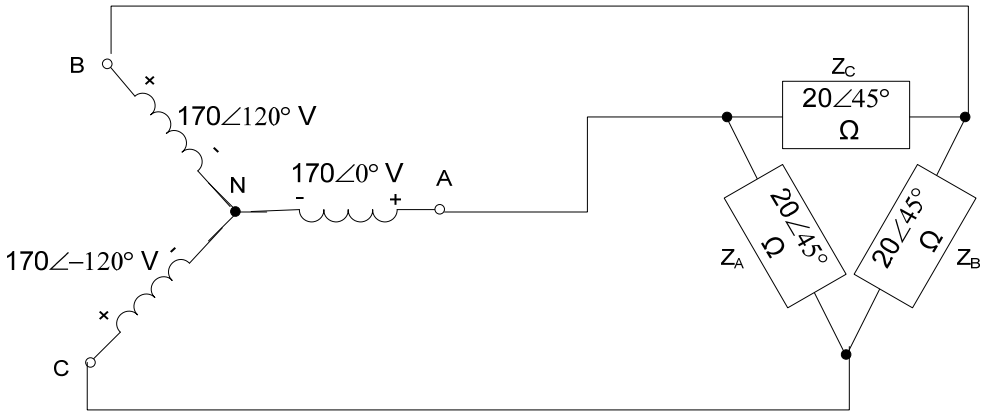

Figure 6

(i) Find the line voltages.

(3 marks)

(ii) Find the load currents.

(3 marks)

(iii) Find the line currents.

(3 marks)

(iv) Draw a phasor diagram showing line voltages, load currents, and line currents.

(3 marks)

(v) Determine the phase angle between a **line voltage** and a **line current.**

(3 marks)

END OF QUESTION PAPER

FORMULAE

$f = \frac{1}{T}$ Hz

$\omega = 2\pi f$ rad/sec

$Z_R = R\angle 0° \ \Omega$

$Z_L = jX_L = jL\omega = L\omega \angle 90° \ \Omega$

$Z_C = -jX_C = \frac{1}{jC\omega} = \frac{1}{C\omega}\angle -90° \ \Omega$

Series circuit : $Z_T = Z_1 + Z_2 + Z_3 + \ldots\ldots + Z_N \ \Omega$

Parallel circuit : $\frac{1}{Z_T} = \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3} + \ldots\ldots + \frac{1}{Z_N} \ \Omega$