Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	ELECTRICAL TECHNOLOGY
COURSE CODE	:	BEE 10403
PROGRAMME CODE	:	BEJ / BEV
EXAMINATION DATE	:	JUNE / JULY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 Analyze the following based on the Resistor (R), Inductor (L), Capacitor (C) circuit as in **Figure Q1.**

(a) Phase difference between current flows at L series with C_2 branch, at R branch and at C_1.

(13 marks)

(b) Phase difference between complex power of C_1, L series with C_2 branch and R branch.

(7 marks)

Q2 A balanced 120 V_{rms} wye connected three-phase source with positive phase sequence is connected to two balanced three-phase loads connected in parallel. Load #1 is wye connected with $Z_Y = (30 + j40)\Omega$ and Load #2 is delta connected with $Z_\Delta = (60 - j45)\Omega$. The line impedance per phase is $Z_{line} = (2 + j4)\Omega$. (Please refer to **Figure Q2**).

(a) Draw the per phase equivalent circuit.

(4 marks)

(b) Analyze the value of the total complex power supplied by the three-phase source.

(6 marks)

(c) Analyze the value of the total three-phase power delivered to each load.

(10 marks)

Q3 The magnetic circuit as shown in **Figure Q3** has the following dimensions: A_c= 16 cm^2, l = 40cm, l_g= 0.5mm and N = 350 turns. The core is made of a material with the B-H relationship given in **Table Q3**. For B = 1.0 T in the core.

(a) Draw the electric equivalent circuit that represents the magnetic circuit from **Figure Q3**.

(3 marks)

(b) Determine the flux φ and the total flux linkage λ, where λ=N φ.

(4 marks)

(c) Determine the required current to set this flux if there is no air gap.

(7 marks)

(d) Identify the required current related to the presence of an air gap.

(6 marks)

Q4 (a) Sketch the approximate transformer model that is (please label your sketch appropriately):

(i) Referred to the primary.

(1 mark)

(ii) Referred to the secondary.

(1 mark)

(iii) With no excitation branch, referred to the primary.

(1 mark)

(iv) With no excitation branch, referred to the secondary.

(1 mark)

(b) The results of open circuit and short circuit test on a 25 kVA 440/220V 60 Hz transformer are as follow:

Open circuit test
Primary open circuited with instrumentation on the low voltage side $V_{oc} = 220V$, $I_{oc} = 9.6A$ and $P_{oc} = 710W$.
Short circuit test
Secondary short circuited $V_{sc} = 42V$, $I_{sc} = 57A$ and $P_{sc} = 1030W$.
Evaluate the parameters of the exact equivalent circuit referred to the high voltage side. (Assume $X_p = a^2X_s$ and $R_p = a^2R_s$).

(6 marks)

(c) (i) Define voltage regulation (VR) of a transformer.

(2 marks)

(ii) Considering the simplified transformer equivalent circuit where the effect of excitation branch to voltage regulation is ignored, demonstrate with phasor diagrams, the effect of various power factors of the load to the VR of a transformer.

(2 marks)

(iii) A 1ϕ, 10 kVA, 2200/220 V, 60 Hz transformer with approximate equivalent circuit referred to the high side, has the following parameters:
$R_{eq,p} = 10.4\Omega$, $R_c = 48.4k\Omega$, $X_{eq,p} = 31.3\Omega, X_m = 8.94k\Omega$
where all the symbols carry their usual standard meanings. Determine the voltage regulation for 75% full load, 0.6 power factor lagging. Assume the load voltage to be at rated value.
[Hint: due to the approximation of the equivalent circuit, $V_p = E_1$, where V_p and E_1 are the voltages at the input and across the parallel magnetizing branch ($R_c||X_m$) respectively]

(6 marks)

Q5 (a) (i) Name various power losses in a DC motor.

(2 marks)

(ii) Sketch with power flow diagram for a DC generator and a DC motor (please label your diagrams appropriately).

(3 marks)

(iii) A four pole, 40 kW, DC motor operating at 1500 rpm has a generated emf of 124 V. If the speed is reduced to 80 % of its original value, and the pole flux is doubled. Develop the induced emf and frequency of the rectangular wave in the armature winding.

(5 marks)

(b) (i) Diagram equivalent circuits (with appropriate labelling) for separately excited DC motor and shunt DC motor.

(5 marks)

(ii) A 250 V shunt DC motor has an armature resistance of 0.25 Ω and a field resistance of 125 Ω. At no load, the motor takes a line current of 5.0 A while running at 1200 rpm. If the line current at full load is 52 A, calculate the full load speed.

(5 marks)

-END OF QUESTIONS –

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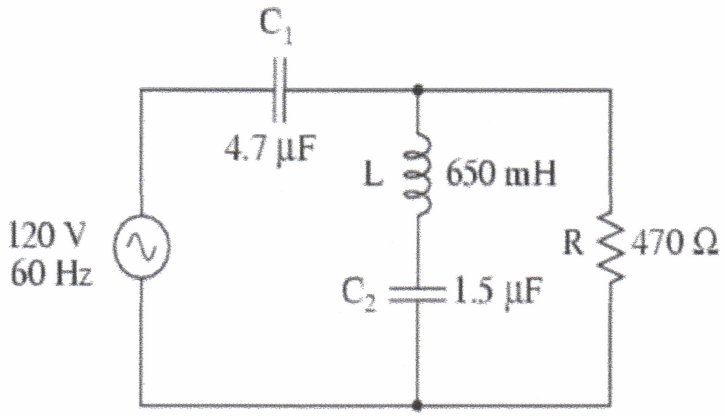

Figure Q1

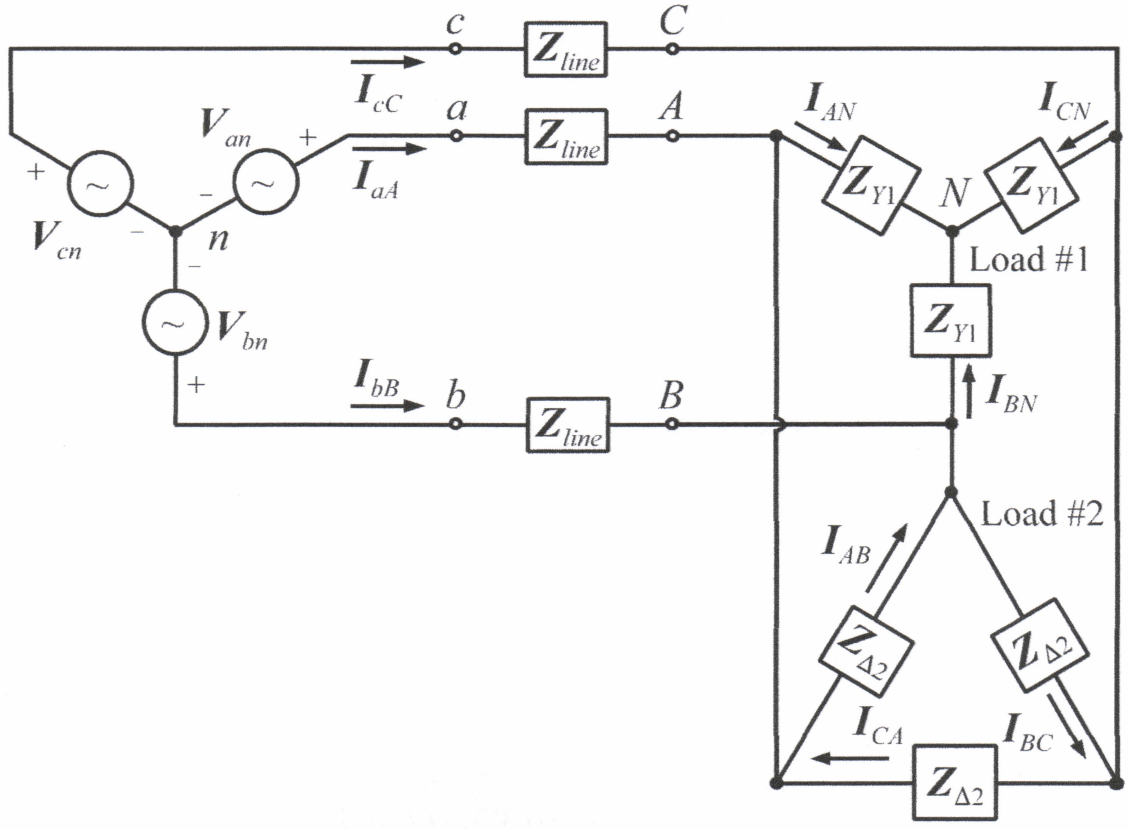

Figure Q2

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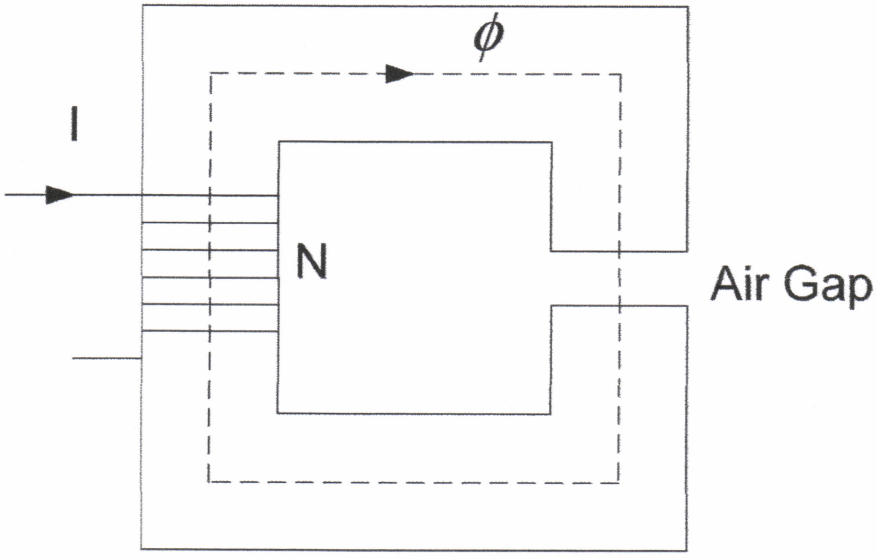

Figure Q3

Table Q3

B (Tesla)	H (A.T)
0.6	12.5
0.8	15.0
1.0	20.0
1.2	31.0
1.4	55.0