INTI
INTERNATIONAL COLLEGE PENANG (507232-U)
LAUREATE INTERNATIONAL UNIVERSITIES

FINAL
Examination Paper

(COVER PAGE)

Session : APRIL 2013

Programme : DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING

Course : EEE1104: ELECTRICAL MEASUREMENTS AND TRANSMISSION

Date of Examination : 1 August 2013

Time : 5p.m. – 7p.m. Reading Time : Nil

Duration : 2 Hours

Special Instructions :

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Materials permitted :

Non-Programmable Scientific Calculator

Materials provided :
Nil

Examiner(s) : **Shalyn Lim Sheue Hui**

Moderator : **Alan Wong**

*This paper consists of _9_ printed pages, including the cover page.*

INTI INTERNATIONAL COLLEGE PENANG
DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMME (DEEI)

EEE1104: ELECTRICAL MEASUREMENTS AND TRANSMISSION
FINAL EXAMINATION: APRIL 2013 SESSION

Instructions: This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

**Question 1**

(a) Identify the type of instrument shows in Figure Q1 (a). Describe how "A" and "B" work in the system with relevant torques.

(8 marks)

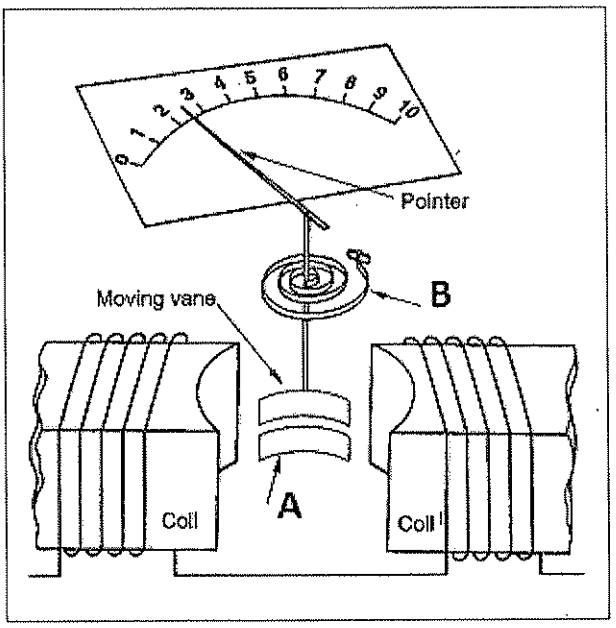


Figure Q1(a)

(b) A voltmeter and an ammeter are used to measure resistance with the full scale of 10V and 10A. The readings are 7.20V and 9.05A respectively. The scale of each instrument has 100 division and can be read with certainty to ± 0.5 division and the instrument themselves have an error of ± 1%. Consider the loading effect of both meters is negligible; compute the value of the resistance and the possible absolute error.

(5 marks)

(c) The coil of a moving coil voltmeter is 4cm x 3cm wide and has 100 turns around it. The control spring exerts a torque of $2.4 \times 10^{-4}$ Nm when the deflection is 100 divisions on full scale. If the flux density of the magnetic field in the gap is 1 Tesla, estimate the resistance that must put in series with the coil to give one volt/division. The resistance of the voltmeter coil may be neglected.

(5 marks)

**(d)** A 250V moving iron voltmeter shows correct measurement at FSD when connects to a DC supply. This instrument coil has a resistance of 300 Ω and placed in series with internal resistance of 2200Ω. When the supply change to AC source with 50Hz, the measurement of FSD becomes 248V. Calculate the inductance of the meter. Suggest one way to reduce the measurement error and justify quantitatively.

(7 marks)

**Question 2**

(a) An ammeter that has an internal resistance of 78Ω is used to measure the current through resistor $R_c$ in Figure Q2 (a). Determine the percentage of error of the reading due to ammeter insertion.

(6 marks)

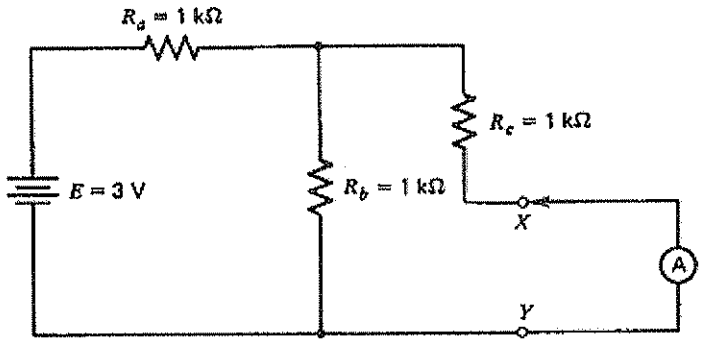


Figure Q2 (a)

(b) An Aryton shunt ammeter with current range of $I_1$,$I_2$ and $I_3$ is shown in Figure Q2(b). The meter coil resistance, $R_m$ and Shunt, $R_{sh}$ are indicated.

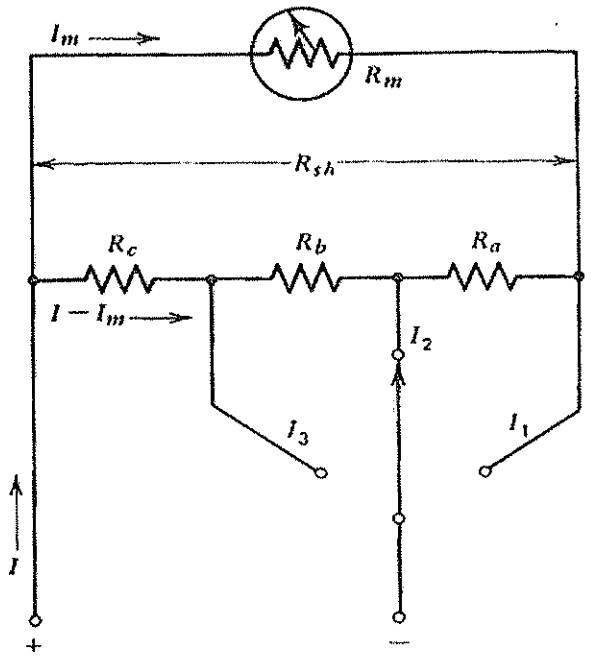


Figure Q2(b)

(i) If the switching done at $I_2$, prove that (detail step) the equation is given as below.

(4 marks)

$$R_b + R_c = \frac{I_m(R_{sh} + R_m)}{I_2} \ (\Omega)$$

(ii) Given the following specification :

$I_1 = 10\text{mA}$ ; $I_2 = 100\text{mA}$ ; $I_3 = 1\text{A}$ ; $I_m = 100\mu\text{A}$ , $R_m = 1\text{k}\Omega$

Calculate the value of $R_a$, $R_b$ and $R_c$.

(9 marks)

(c) A 1-mA full scale deflection current meter is inserted to an ohmmeter. The meter movement has an internal resistance, $R_m$=100Ω and 3V battery will be used in the circuit. Determine the unknown resistor required in order to produce 20% of full scale deflection. Sketch the basic circuit of series ohmmeter with proper labeling.

(6 marks)

**Question 3**

(a) For the circuit of Figure Q3(a), the magnitude of the line voltage at the generator is 208 volts. Calculate

(i) the line voltage $V_{ab}$ at the load.

(5 marks)

(ii) the load phase current, $I_{ab}$.

(2 marks)

(iii) the total active power

(4 marks)

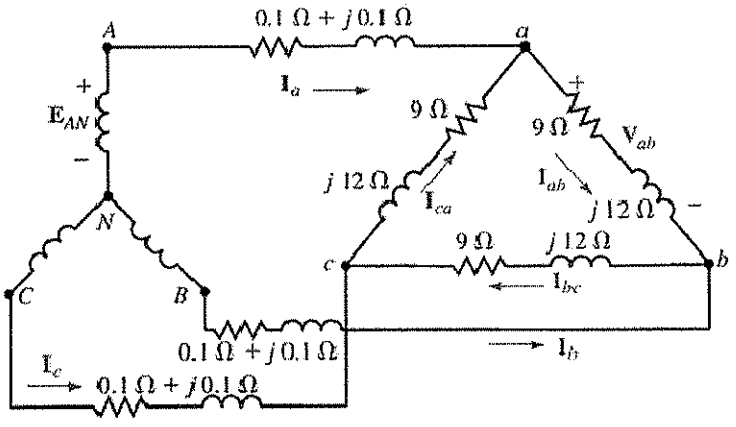


Figure Q3(a)

(b) The two-wattmeter method produces wattmeter readings with 1560W and 2100 W when connected to a delta connected load. If the line voltage is 220 V, calculate

(i) the per-phase average power

(2 marks)

(ii) the power factor

(4 marks)

(iii) the phase impedance

(3 marks)

(c) A balanced delta three-phase source serves three delta loads, as follows:

Load 1: 24 kW at 0.6 lagging power factor
Load 2: 10 kW at unity power factor
Load 3: 12 k at 0.8 leading power factor

If the line voltage at the loads is 208 V rms at 60 Hz, determine the line current and the combined power factor of the loads

(5 marks)

**Question 4**

(a) Calculate impedance parameter of the networks shown in
( hints: use s-domain for reactance network)

(i) Figure Q4(a)(i)

(5 marks)

(ii) Figure Q4(a)(ii)

(8 marks)

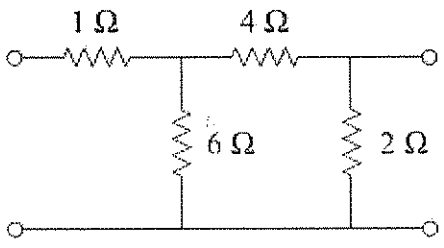


Figure Q4(a)(i)

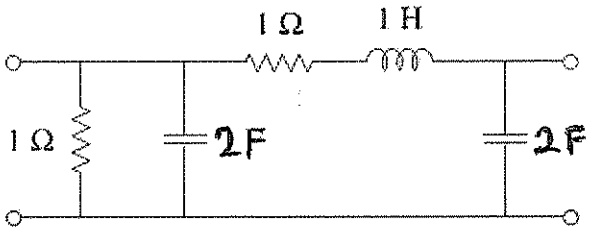


Figure Q4(a)(ii)

(b) A T network has series impedance $Z_1$ =5+j20 Ω and $Z_3$ =5+j16 Ω, and a shunt impedance $Z_2$=2-j15 Ω. Calculate

(i) Image impedance

(5 marks)

(ii) Image transfer coefficient

(5 marks)

(iii) Image attenuation coefficient and phase change coefficient.

(2 marks)

**Question 5**

(a) What are the purposes to design an impedance matching network? Next, design a π matching network to have characteristic impedance of 600 Ω and attenuation of 20 dB. What is the new overall attenuation if the three π networks are cascaded?

(7 marks)

(b) A correctly terminated transmission line is 10km long and has the following primary coefficients:

R=20 Ω/km, L=16 mH/km, C= 0.045 μF/km and G = 0 S/km

Given ω= 5000 rad/s, calculate

(i) the characteristic impedance (polar form)

(3 marks)

(ii) the propagation coefficient (polar form)

(3 marks)

(iii) the attenuation coefficient (dB/km) and phase-change coefficient (degree/km)

(4 marks)

(c) A correctly terminated line has a characteristic impedance of 800 Ω, an attenuation coefficient of 0.3 Np/km and it is 4km in length. Calculate the current in the load when the voltage applied across the sending terminals of the line is 2V. What happen if the characteristic impedance is short circuit? why?

(8 marks)

**Question 6**

(a) Differentiate between low-loss line and loss-free line.

(4 marks)

(b) A loss-free line has a characteristic impedance of 1000Ω and a load impedance of (800-j100)Ω. Calculate the voltage reflection coefficient and the v.s.w.r.

(5 marks)

(c) A 320 km long three-phase line delivers 10MW power at lagging power factor of 0.8 and 120kV to a load. The ABCD parameters of the line are A=D=0.94+j0.039, B=86.3+j135.1 Ω, C= (-1.48+j8.62)x$10^{-5}$ S. calculate sending-end voltage and current.

(9 marks)

(d) A radio frequency transmission line has an inductance of 263.2 nH/m and capacitance of 46.8 pF /m. Calculate

(i) its characteristic impedance.

(2 marks)

(ii) its phase change coefficient at 30 MHz.

(3 marks)

(iii) its phase velocity of propagation.

(2 marks)

**--THE END—**