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The Open University of Sri Lanka
Department of Electrical and Computer Engineering

ECX3234 – Electrical Technology

Final Examination 2015/2016 **Closed Book Test**

Date: 25th November 2016 Time: 09.30-12.30

This Question paper consists of two parts: **A** *and* **B.** *Part A consist of 5 questions and Part B consist of 3 questions. Answer any three questions from Part A and any two questions from Part B. All questions carry equal marks.*

Part A

Q1

a. Explain why the efficiency of an auto-transformer is higher than that of a two-winding transformer with same rating.
b. Describe the difference between auto-transformer and two-winding transformer.
c. A load of 100 kVA is to be supplied at 460 V from 2300 V supply mains by an auto-transformer. Determine the current and voltage rating for each of the windings of auto-transformer. If the auto-transformer is replaced by a two winding transformer what would be the rating of the transformer?

Q2

a. With the help of power triangle define the terms 'active power', 'reactive power', 'apparent power' and 'power factor'.
b. What are the causes of poor power factor? Explain the disadvantage of having poor power factor both from consumer and utility point of view.
c. Write four methods of power factor improvement.
d. A three-phase 8kW induction motor operates full load at 0.75 power factor lagging. Determine the kVAR rating of the capacitor that is to be connected in parallel with the motor to improve the power factor to 0.95.

Q3

a. State the transformer losses obtained from the open circuit test and short circuit test respectively. Also explain variations of these losses with respect to load current.

b. A 10 kVA, 500/250 V, 50 Hz single-phase distribution transformer gave following test results when it was subjected to open circuit (O/C) and short circuit (S/C) tests.

O/C Test: 250V, 3.0 A, 200 W

S/C Test: 15 V, 30 A, 300 W

Calculate the efficiency of the transformer and voltage regulation at full load at 0.8 power factor lagging.

Q4

a. Briefly explain three types of DC distribution system.

b. Compare DC distribution system with AC distribution system considering relative merits and demerits.

c. An industrial factory has DC distribution system with copper cable as shown in figure Q4. The details of the distribution system is given in the table below.

Line	Length (m)	Cross section (cm^2)
OA	200	0.6
AB	50	0.3
AC	120	0.15

The load at point B takes 50 A while at point C a motor is connected. The motor runs at full-load. The voltage at motor terminal is 230 V and the voltage at point B is 235 V. Determine the current taken by the motor and the supply end voltage. The copper cable resistivity is 2μΩ.cm.

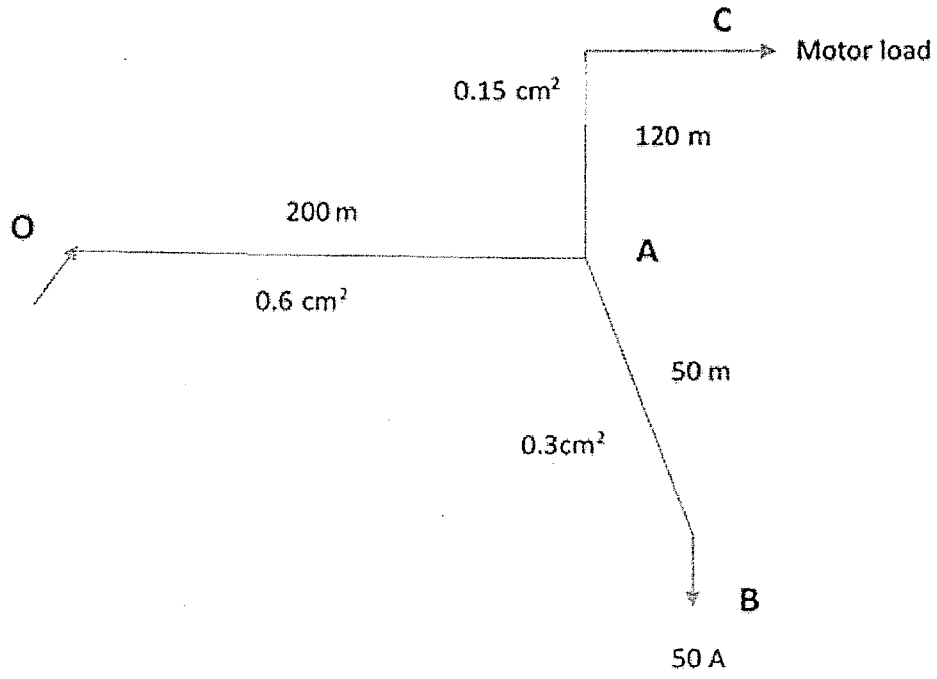


Figure Q4

Q5

a. Briefly explain electricity distribution system in Sri Lanka by providing comparison of its network topologies

b. A 50 Hz, single phase transmission line has several loads 5 km away from the substation as shown in figure Q5. The transmission line has impedance of 1+ j 5 Ω per km. In order to maintain 230 V at the load end, Calculate

i. Current flowing in the transmission line
ii. Substation voltage
iii. Active and reactive power dissipated in the line

iv. Active and reactive power delivered by substation

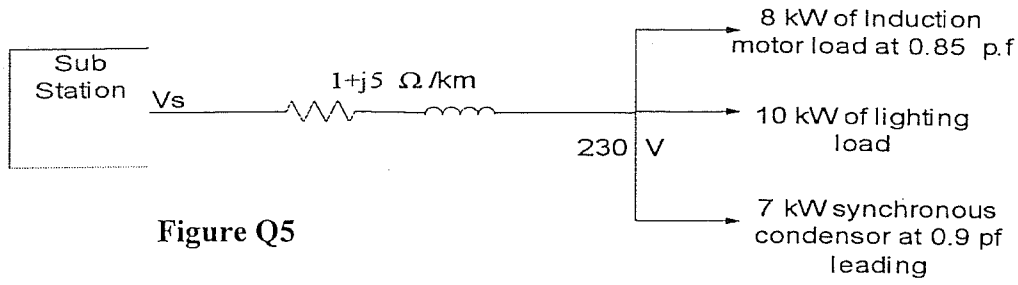


Figure Q5

Part B

Q6. Solve the following. *Write all relevant intermediate steps.*

a) Convert 11011011011001_2 to a hexadecimal value.

b) Convert 105.625_{10} to a binary value.

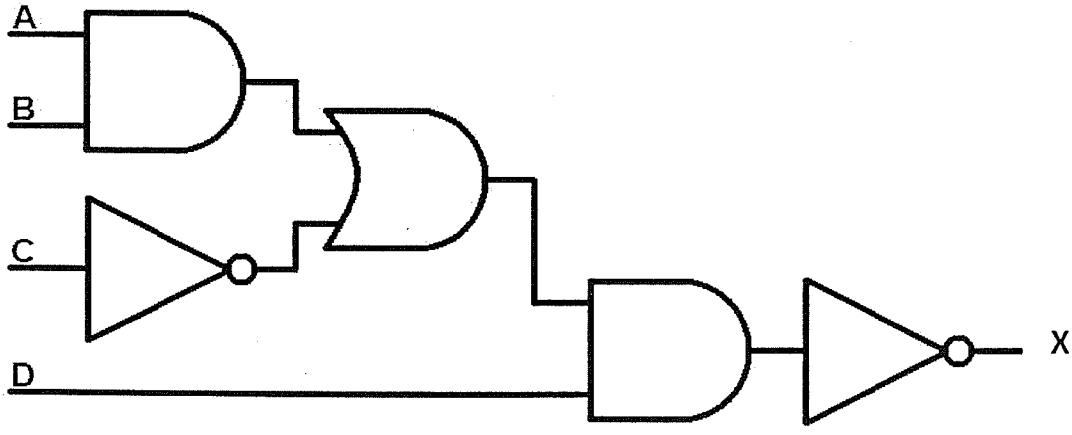
c) Perform the following **binary** operations.

i) $1011101_2 \times 1111_2$ ii) $1100011_2 \div 1100_2$

d) Find the value of m if $249_m = 295_{10}$

e) Subtract 6 from 3, using two's complement representation. [3 – 6]

f)



Schematic diagram of a combinational logic circuit is presented in the figure above.

I. Determine the truth table for this circuit.
II. Represent the logic output X in canonical sum-of-product form.
III. Minimise the output function using a Karnaugh map.

Q7.

a) Describe the Zener breakdown of a pn-junction, and compare this to the avalanche breakdown.

b) Describe how the zener stabiliser circuit reacts when:

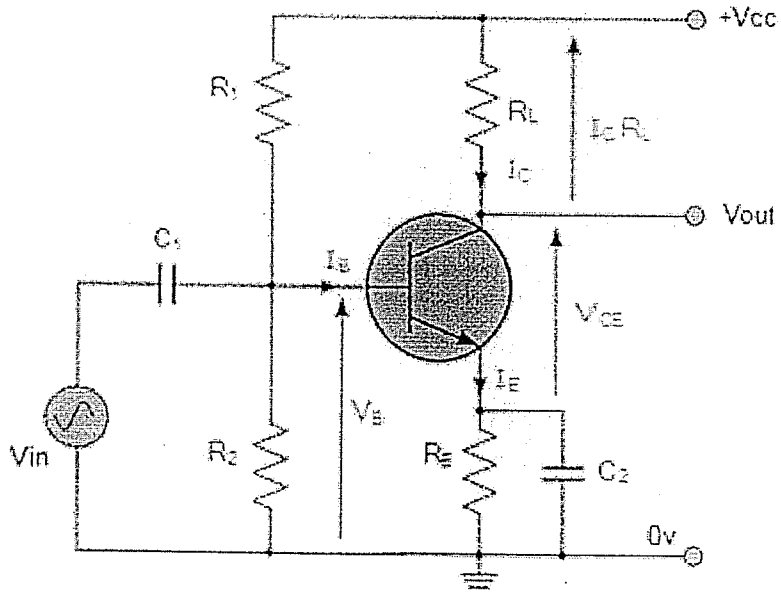
I. there is a fluctuation of the source (input) voltage.
II. there is a fluctuation of the output resistance (load)

c) Zener diode of a stabiliser circuit is given as 8 V/½ W. I_{zmin} is given as 250 μA. What is a suitable series resistor value, for this resistor to stabilise a fluctuation of the load between the values 12 kΩ - 20kΩ? The source voltage is fixed at 18 V.

Q8.

a) Compare the characteristics of FETs and BJTs, and explain briefly why FETs are more popular in ICs.

b) In the diagram below a common type of BJT Amplifire. Describe its stabilistion property.



c) Assuming the use of a silicone transistor, with R_1 = 27 kΩ, R_2 = 14.7 kΩ, R_E = 680 kΩ, R_L = 1 kΩ, V_{CC} = 10 V and β = 100, calculate the currents I_B, I_C and voltage V_{CE}.