UNIVOTEC

UNIVERSITY OF VOCATIONAL TECHNOLOGY

Faculty of Industrial & Vocational Technology

Bachelor of Technology in Building Services Technology - 2015 / 2016(B1)

Bachelor of Technology in Mechatronics Technology - 2015 / 2016 (B1)

Bachelor of Technology in Manufacturing Technology -2015 / 2016 (B1)

Year I – Semester - I Examination - September - 2015

Theory of Electricity EE10401

Instructions:

- Write your INDEX NUMBER, MODULE CODE and the TITLE of the paper in the answer book. Also write your index number on each additional sheet or book attached.
- Read all questions first before attempting to answer.
- Answer **5** questions only. All questions carry equal marks.

Duration : 03 hours

Resistivity of Copper is 1.78 x 10^{-8} Ωm, Resistivity of Aluminium is 2.84 x 10^{-8} Ωm , Permeability of free space is 4π x 10^{-7} Hm^{-1} and permittivity of free space is 8.85 x 10^{-12} F/m.

(1). (i) Why is the electric potential at a point is unique? (*03 marks*)

(ii) Describe briefly the term "Voltage divider" and state three applications of this principle. (*05 marks*)

(iii) A 100 V, 60 watt bulb is to be operated from a 230 V DC supply. Find the value of the resistance to be connected in series with the bulb to glow normally. (*06 marks*)

(iv) Two bulbs of 100 W, 230 V each are connected in parallel across a 200V supply. Calculate the total power drawn from the supply. (*06 marks*)

(2) (i) Describe two types of non-linear resistors and their applications. (*08 marks*)

(ii) (a) Calculate the voltage drop produced in 100m length of copper cable 16 mm^2 in cross sectional area when it carries 25A. (*04 marks*)

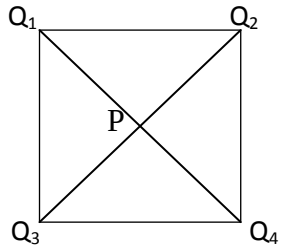
(b) What would be the voltage drop if the same size of aluminium cable were used. (*04 marks*)

(iii) A DC load of current 25A is to be supplied from a point 30m away. Determine a suitable cross sectional area for the copper cable in order that the total voltage drop (go and return) may be limited to 6V. (*04 marks*)

(3) (i) Sketch the pattern of electric field and equipotential lines around two similar charges. *(04 marks)*

(ii) Four charges (Q_1, Q_2, Q_3 and Q_4) are kept at the corners of a square as given in the figure below. The length of a side of the square is 2m. Find the potential at the centre of the square (P) if Q_1 = +1μC, Q_2 = -2 μC , Q_3 = +3 μC and Q_4 = +2 μC

(Consider the medium as air or free space.)



(06 marks)

(iii) (a) Calculate the capacitance of a parallel plate capacitor with a plate area of 20cm x 20cm and a gap of 1.5mm between the metal plates, when the dielectric is air. (*04 Marks)*

(b) If this capacitor is charged to 40 volts, determine the charge on the capacitor and the stored energy. (*04 marks)*

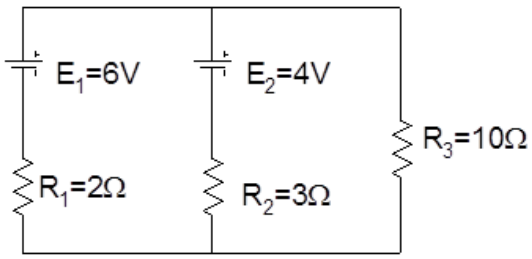
(c) What will be the value of capacitance, if it is built with paper as dielectric having a relative permittivity (ε_r) of 3. *(02 marks)*

(4) (i) Explain briefly the categorisation of the materials according to their magnetic properties with examples for each type and describe which category is most suitable for the electrical applications such as relays and transformers. (*10 marks)*

(ii) Differentiate the magnetism and the electromagnetism. (*04 marks*)

(iii) A rectangular shaped core is made of mild steel bar of 10mm x 20mm cross section. The mean length of the magnetic path is 18 cm. The exciting coil has 300 turns. If the current flowing through the coil is 2A, Calculate the Magneto Motive Force and the flux density. (Assume the relative permeability of the mild steel as 900) (*06 marks*)

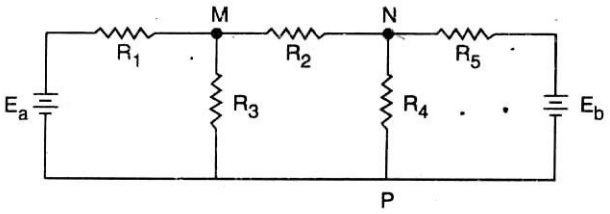
(5) (i) Find the current through R_3 in the figure below by using Thevenin's theorem. (*16 marks)*



(ii) Does this circuit deliver the maximum power through R_3 as a 10Ω resistor? Justify your answer. (*04 marks*)

(6) (i) What is "an independent node" according to Electrical Network Topology. *(02 marks)*

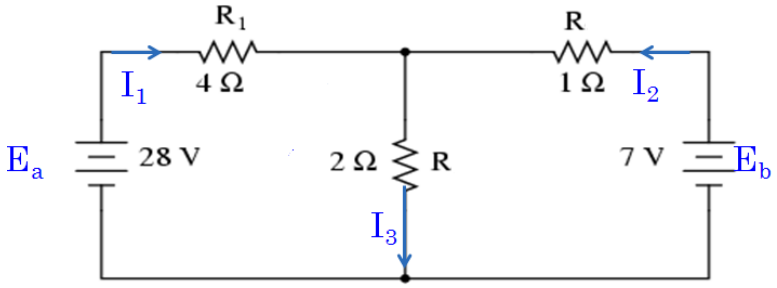
(ii) For the Circuit shown below, find the voltages across R_3 and R_4 resistors by using Nodal Voltage analysis and calculate the currents through all the resistors. *(18 marks)*



$R_1 = 5$, $R_2 = 10$, $R_3 = 12$, $R_4 = 15$, $R_5 = 8$ ohms , $E_a = 4V$ and $E_b = 6V$

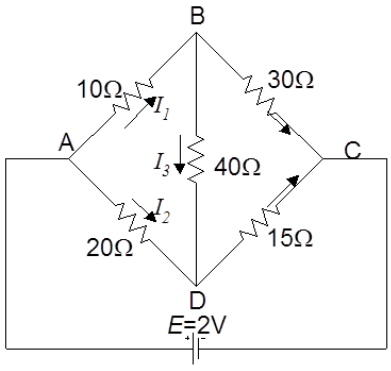
(7) (i) State the usefulness of Superposition theorem. (*02 marks*)

(ii) In the circuit given below, find the currents I_1, I_2 and I_3 by applying Superposition Theorem (*18 marks*)



(8) (i) What are the active and passive elements in an electrical network? (*04 marks*)

(ii) Calculate the currents I_1, I_2 and I_3 in the circuit given below. (*16 marks*)



Note: Use the following equations where applicable.

To convert a Delta (Δ) to a Wye (Y)

$$R_A = \frac{R_{AB}R_{AC}}{R_{AB}+R_{AC}+R_{BC}}$$

$$R_B = \frac{R_{AB}R_{BC}}{R_{AB}+R_{AC}+R_{BC}}$$

$$R_C = \frac{R_{AC}R_{BC}}{R_{AB}+R_{AC}+R_{BC}}$$

To convert a Wye (Y) to a Delta (Δ)

$$R_{AB} = \frac{R_AR_B + R_AR_C + R_BR_C}{R_C}$$

$$R_{BC} = \frac{R_AR_B + R_AR_C + R_BR_C}{R_A}$$

$$R_{AC} = \frac{R_AR_B + R_AR_C + R_BR_C}{R_B}$$