



GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY
Faculty of Engineering
Department of Electrical, Electronic and Telecommunication Engineering

BSc Engineering Degree
1st Semester Examination – July 2022
(Intake 39-2 - ENG)

EE 1102 – FUNDAMENTALS OF ELECTRICAL ENGINEERING

Time allowed: 3 hours

18 July 2022

ADDITIONAL MATERIAL PROVIDED

None

INSTRUCTIONS TO CANDIDATES

This paper contains 5 questions on 3 pages

Answer all Questions.

This is a closed book examination

This examination accounts for 70% of the module assessment. A total maximum mark obtainable is 100. The marks assigned for each question and parts thereof are indicated in square brackets.

If you have any doubt as to the interpretation of the wordings of a question, make your own decision, but clearly state it on the script.

Assume reasonable values for any data not given in or provided with the question paper, clearly make such assumptions made in the script.

All examinations are conducted under the rules and regulations of the KDU.

1.

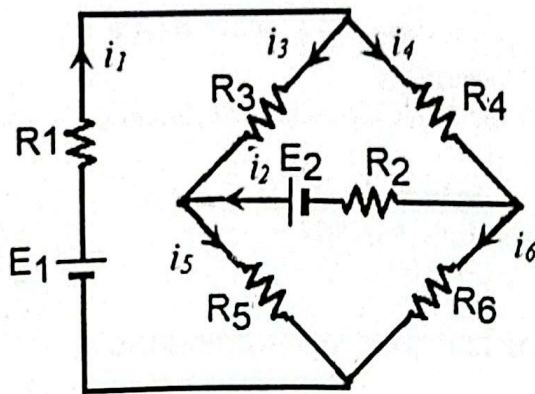


Figure Q1

$$\begin{aligned} E_1 &= (10 + N_1) \text{ V} \\ E_2 &= (20 - N_2) \text{ V} \\ R_1 &= 2 \Omega \\ R_2 &= 2 \Omega \\ R_3 &= 4 \Omega \\ R_4 &= 4 \Omega \\ R_5 &= 4 \Omega \\ R_6 &= 4 \Omega \end{aligned}$$

For the circuit shown in the figure, write down

- Three independent Kirchhoff's Current Law equations [02 marks]
- Three independent Kirchhoff's Voltage Law/Ohm's Law equations [06 marks]
- Determine the currents in all the branches by solving the above equations. [12 marks]

2.

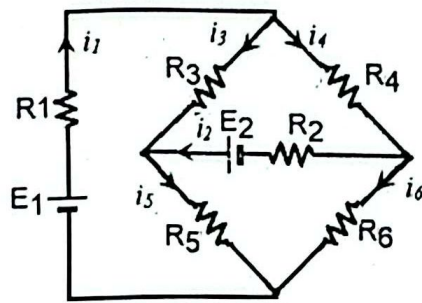


Figure Q2

$$\begin{aligned} E_1 &= (10 + N_1) \text{ V} \\ E_2 &= (20 - N_2) \text{ V} \\ R_1 &= 2 \Omega \\ R_2 &= 2 \Omega \\ R_3 &= 4 \Omega \\ R_4 &= 4 \Omega \\ R_5 &= 4 \Omega \\ R_6 &= 4 \Omega \end{aligned}$$

- For the circuit shown in figure Q2, sketch the two circuits used to determine the current in the branch R_6 , using Superposition Theorem. Briefly explain the steps. [06 marks]
 - For the circuit in figure Q2, determine the Thevenin's equivalent circuit across R_6 , with resistance R_6 removed, giving also the values of i_1 , i_2 and i_3 with R_6 removed. [12 marks]
 - Using this circuit, determine the current i_6 in branch R_6 . [02 marks]
3. (a) Describe briefly 4 sources of bulk power generation currently used in Sri Lanka. [4 marks]
WIND, HYDRO, THERMAL, SOLAR
- (b) A 3 phase, 400 V, 50 Hz supply feeds a balanced star connected load of 5kVA at a power factor of 0.8 lag. Determine the line current in magnitude and phase, the active and reactive power of the load. Determine also the resistance and inductance of each phase of the load. [10 marks]
- (c) If the power factor of the three phase load is to be improved to 0.95lag, determine the rating of each of 3 capacitors necessary to be connected in delta. [6 marks]

4.

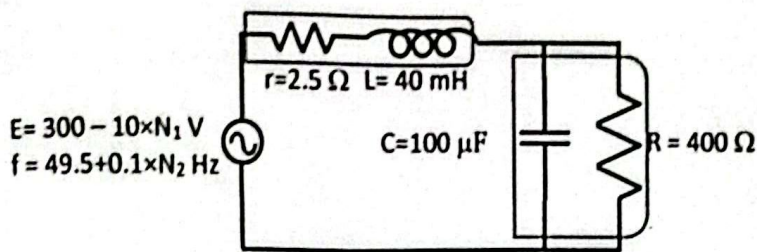


Figure Q4

Figure Q4 shows the connection of a practical inductor (inductance L and series resistance r) and a practical capacitor (capacitance C and parallel resistance R). Determine the

- complex impedance value of the inductor L with series resistance r , [02 marks]
 - complex impedance value of the capacitor C with parallel resistance R , [03 marks]
 - total impedance of the circuit, [02 marks]
 - current supplied by the source in magnitude and phase relative to supply voltage, [01 mark]
 - voltage across the practical inductor and the practical capacitor, [04 marks]
 - power factor at supply terminals, [01 mark]
 - active and reactive power delivered from supply terminals, [02 marks]
 - phasor diagram showing the phasor relations of the supply voltage, the supply current and the voltage across the inductor and the capacitor relative to the supply voltage. [05 marks]
5. (a) A parallel plate capacitor, shown in figure Q5(a) has electrodes of width 25mm, separated by 3 materials, A (thickness 2mm, length 15mm, relative permittivity $\epsilon_r = 5.0$) and B (thickness 1mm, length 10mm, relative permittivity $\epsilon_r = 3.0$) and C (thickness 1mm, length 15mm, relative permittivity $\epsilon_r = 4$). Determine the capacitance of the arrangement ($\epsilon_0 = 8.854 \times 10^{-12}$ F/m). [3 marks]
- If a voltage of 250V is applied across the overall capacitor, determine the voltage appearing across each section. [2 marks]
- (b) Figure 5(b) shows a magnetic core with mean height of core $h = 100$ mm, mean core length $l = 200$ mm, with a cut of height 1mm in the centre limb. If the width and thickness of each limb and yoke are 25mm \times 25mm, with relative permeability $\mu_r = 2000$ and $N = 150$ turns uniformly wound on the middle limb, determine the flux in the middle limb when a current of 10A passes through the coil. [$\mu_0 = 4\pi \times 10^{-7}$ H/m]. [7 marks]
- (c) Sketch a suitable diagram to show how 13A socket outlets may be connected in a ring circuit. [2 marks]
- (d) Sketch a typical diagram showing the connections for the TT system of earthing for both a single-phase consumer and a three phase consumer. [1 mark]
- (e) Sketch a typical diagram showing the basic circuit of a residual current protection device. [1 mark]
- (f) Explain with the aid of suitable diagrams, why two principles of operation are involved in the miniature circuit breaker and not in fuses. Explain these two principles $M.O.B./THEORY$ [3 marks]
- (g) Sketch a diagram to illustrate the wiring of a lamp controlled by two switches at the top and bottom of a staircase. [1 mark]

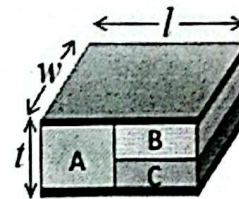


Figure Q5(a)

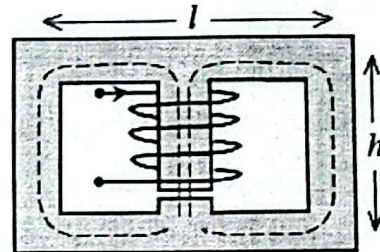


Figure 5(b)

[END OF QUESTION PAPER]