UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	PHYSICS III
COURSE CODE	:	DAS 24603
PROGRAMME CODE	:	DAU
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTIONS	:	ANSWER **FIVE (5) QUESTIONS ONLY**

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) A dielectric materials is placed between the two parallel plates, called capacitor. State **two (2)** advantages of using dielectrics in capacitor.

(2 marks)

(b) **Figure Q1 (b)** shows capacitors connected to a voltage source of 36 V. Calculate:

(i) the capacitance of the equivalent capacitor.

(10 marks)

(ii) the charge stored on capacitor C_4.

(8 marks)

Q2 (a) Two type of resistor, R_1: coded with Yellow, Violet, Brown, Gold and R_2: coded with Yellow, Violet, Brown, Silver are considered to be used as part of an electrical components in a circuit.

(i) State the resistance and tolerance of each resistor.

(3 marks)

(ii) Out of the two resistors, suggest the most preferable resistor to be use in the circuit. State the reason.

(2 marks)

(b) **Figure Q2 (b)** shows seven resistors connected to a 12 V battery in a closed circuit. The resistance of the resistor is 7 Ω each. Calculate:

(i) the resistance of the equivalent resistance.

(8 marks)

(ii) the current drawn from the battery.

(2 marks)

(c) A copper wire has a length of 150 m and a diameter of 1.0 mm. If the wire is connected to a 3.5 V battery, calculate the current flows through the wire. Given the resistivity of copper, $\rho_{cu} = 1.72 \times 10^{-8}\ \Omega \cdot m$)

(5 marks)

Q3 (a) By referring to **Figure Q3 (a)**, calculate the amount of current I_1 , I_2 , and I_3 by using Kirchhoff's Law (re-draw and label your circuit accordingly).

(13 marks)

(b) An emf source of 20 V with internal resistance r = 0.5 Ω is connected in the circuit shown in **Figure Q3 (b)**. Calculate:

(i) the equivalent resistance for external loaded.

(5 marks)

(ii) the current drawn from the battery.

(2 marks)

Q4 A series connection of resistor, inductor, and capacitor are connected to an alternating emf device that operates at $\mathcal{E} = (130\ \text{V})\ \sin(30\pi t)$. Given the value of resistor, inductor, and capacitor are 150 Ω, 530 mH, and 76 μF respectively. Calculate:

(a) the impedance of the circuit.

(7 marks)

(b) the power factor and the phase difference.

(4 marks)

(c) the average power at which energy is dissipated in the resistance.

(6 marks)

(d) the new capacitance needed to maximize the average power if the other parameters of the circuit remain the same.

(3 marks)

Q5 (a) State the difference between intrinsic and extrinsic semiconductor. Give an example for each type of semiconductor.

(4 marks)

(b) Sketch and discuss the energy level diagram for insulator and semiconductor material.

(8 marks)

(c) (i) Describe how forward-bias of pn junction diode occurs.

(6 marks)

(ii) Sketch the V-I characteristics curve of forward-bias pn junction diode.

(2 marks)

Q6 (a) Without using a calculator, convert the following number system into decimal number.

(i) $1EE7_{16}$

(2 marks)

(ii) 10001111_2

(2 marks)

(iii) 217_8

(2 marks)

(b) Boolean expression of an output variable is given below:

$$(A\overline{B}(C + BD) + \overline{A}\overline{B})C$$

(i) Draw the logic circuit diagram from the Boolean expression given.

(7 marks)

(ii) Simplified the given Boolean expression.

(6 marks)

(iii) According to your answer in **Q6 (b)(ii)**, draw the simplified logic circuit.

(1 mark)

Q7 (a) Show the difference between half-wave rectifier and full-wave rectifier by sketching an output voltage waveform without capacitor filter for each type of rectifier.
(4 marks)

(b) Define the following:

(i) Peak Inverse Voltage (PIV).
(1 mark)

(ii) Root-mean-square Voltage (V_{rms})
(1 mark)

(c) A 70 Ω load resistance is connected across a half wave rectifier. A 2.5 mF filter capacitor is added across the load resistor. The input supply voltage (rms) is 250 V at 100 Hz. Calculate:

(i) the average voltage.
(3 marks)

(ii) the load current across the resistor.
(2 marks)

(iii) the peak-to-peak voltage (V_{p-p}).
(2 marks)

(iv) the ripple percentage.
(3 marks)

(v) Sketch the output voltage waveform of the half-wave rectifier with capacitor filter.
(4 marks)

- END OF QUESTION-

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LIST OF FIGURE

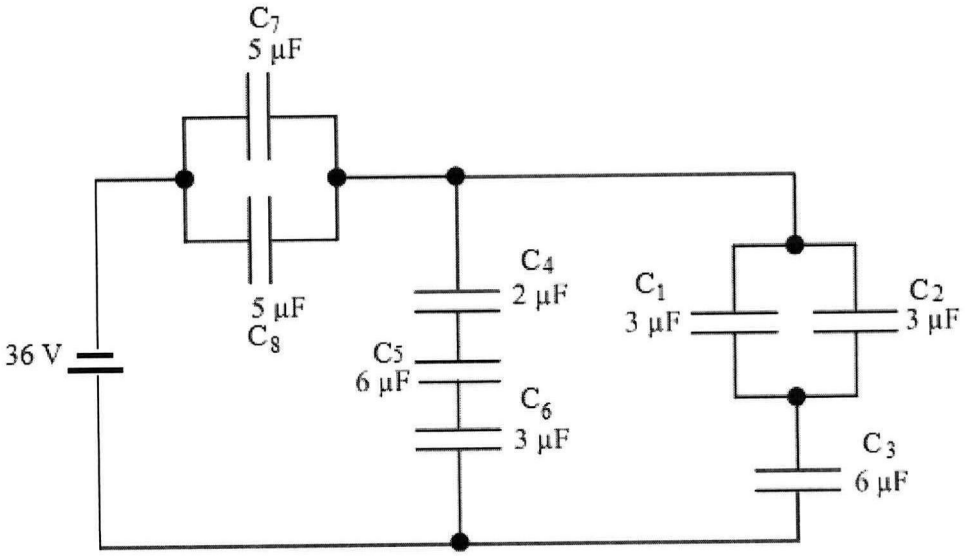

Figure Q1 (b)

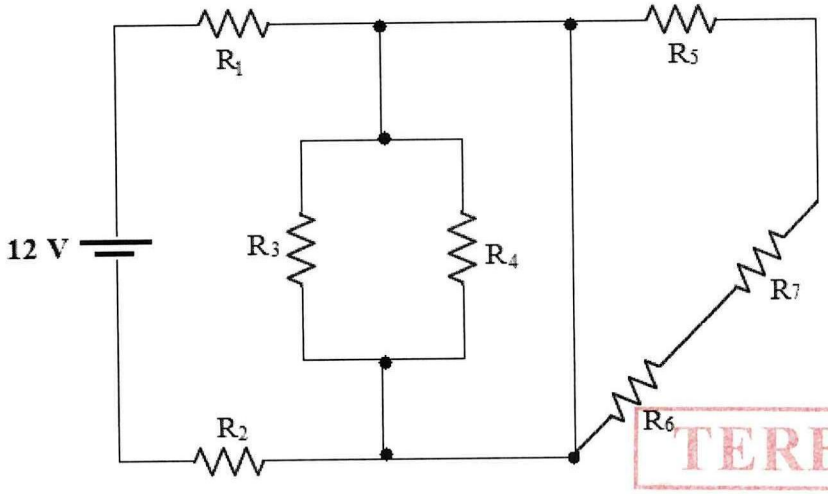

Figure Q2 (b)

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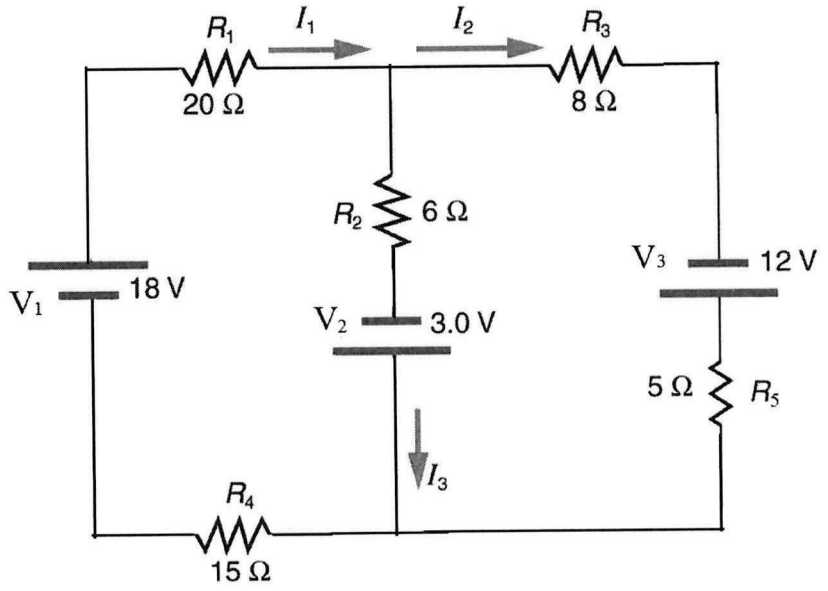

Figure Q3 (a)

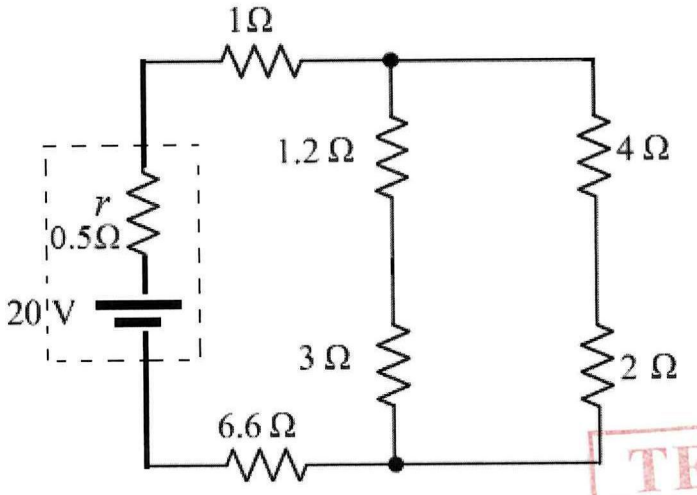

Figure Q3 (b)

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LIST OF FORMULA

$q = \pm ne$	P: $C_{eq} = C_1 + C_2$	S: $R_{eq} = R_1 + R_2$
$C = \frac{\kappa \varepsilon_o A}{d}$	S: $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$	P: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$
$C = \frac{Q}{V}$	$V = IR$	$J = \frac{I}{A} = nve$
$R = \frac{\rho L}{A}$	$V_{ab} = \varepsilon - Ir$	$V_n = \frac{R_n}{R_T} V_T$
$\sigma = \frac{1}{\rho}$	$P = I^2 R = IV$	$I_n = \frac{I_T}{R_n} R_T$
$U = CV^2 = \frac{1}{2} QV$	$E = Pt$	$A_{\text{p-p}} = 2A_m$
$X_C = \frac{1}{2\pi f C}$	$\omega = 2\pi f$	$A_{rms} = \frac{A_m}{\sqrt{2}}$
$X_L = 2\pi f L$	$Z = \sqrt{(X_L - X_C)^2 + R^2}$	$V_{rms} = \frac{V}{\sqrt{2}}$
$\tan \emptyset = -\frac{X_C}{R}$	$\tan \emptyset = \frac{X_L - X_C}{R}$	$\cos \emptyset = \frac{R}{Z}$
$\tan \emptyset = \frac{X_L}{R}$	$V_C = I_C X_C$	$P_{avg} = {I_{rms}}^2 R$
$Z = \sqrt{R^2 + {X_L}^2}$	$V_L = I_L X_L$	$P_{avg} = I_{rms} V_{rms} \cos \emptyset$
$Z = \sqrt{R^2 + {X_C}^2}$	$I_{rms} = \frac{V_{rms}}{Z}$	$I_L = \frac{V_{avg}}{R_L}$
$N_e = 2n^2$	$V_{p-p} = \frac{I_L}{2f\text{C}}$	$V_{avg} = \frac{2V_m}{\pi}$
$V_s = V_m \sin \omega t$	$V_{p-p} = \frac{I_L}{f\text{C}}$	$V_{avg} = \frac{V_m}{\pi}$

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TABLE OF REFERENCE

Table 1: Resistor Colour Coded.

Colour	Digit	Multiplier	Tolerance (%)
Black	0	1	
Brown	1	10^1	1
Red	2	10^2	2
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	0.5
Blue	6	10^6	0.25
Violet	7	10^7	0.1
Grey	8	10^8	
White	9	10^9	
Gold		10^{-1}	5
Silver		10^{-2}	10
(none)			20

Table 2: Boolean Algebra Laws

Commutative		$A + B = B + A$ $A \cdot B = B \cdot A$
Associative		$A + (B + C) = (A + B) + C$ $A \cdot (B \cdot C) = (A \cdot B) \cdot C$
Distributive		$A \cdot (B + C) = A \cdot B + A \cdot C$ $A(B + C) = AB + AC$
AND	1 2 3 4	$A \cdot 0 = 0$ $A \cdot 1 = A$ $A \cdot A = A$ $A \cdot \bar{A} = 0$
OR	5 6 7 8	$A + 0 = A$ $A + 1 = 1$ $A + A = A$ $A + \bar{A} = 1$
Miscellaneous	9 10 11	$A + AB = A$ $A + \bar{A}B = A + B$ $(A + B)(A + C) = A + BC$