FIJI NATIONAL UNIVERSITY
College of Engineering, Science & Technology

SCHOOL OF ELECTRICAL & ELECTRONICSENGINEERING

TRADE DIPLOMA IN ENGINEERING (ELECTRICAL & ELECTRONICS MAJOR)

EEE466 – CIRCUIT ANALYSIS

FINAL EXAMINATION – TRIMESTER 3, 2017

DAY/DATE: 29/11/2017 TIME : 9.00 - 12.10pm DURATION: 3HRS.10min

ROOM: SAMABULA CAMPUS/ BA CAMPUS

INSTRUCTION TO STUDENT

1. You are allowed 10 minutes extra reading time during which you are NOT to write.
2. **Begin each answer(each Question)** on a fresh page and use both sides of the sheet.
3. Write your candidate number at the top of each answer & attached sheet.
4. Insert all written foolscaps, MC Answer Sheet, graph paper in their correct sequence and secure with a string.
5. For all sheets of paper on which rough/draft work has been done, cross it through and you must attach all of them to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. Multiple Choice Answer Sheet, Tables & formula on the Appendix.
8. **SECTION A. – Short Answer & Multiple Choice - 30 marks**
   SECTION B. – Answer ALL question - 50 marks
   SECTION C. – Select any two (2) questions. - 20 marks

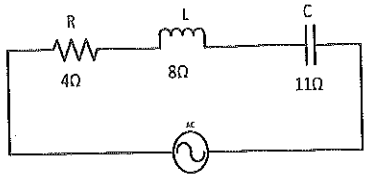
Section – A: [30 marks]

(i) Short Answer (10 marks)

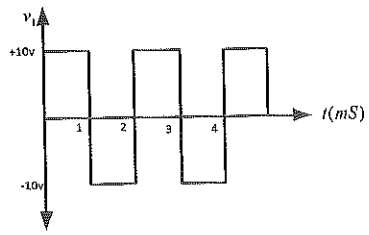
In this section, read the question properly/ carefully and determine your answer by correctly writing it in the answer sheet provided.

1. Differentiate the term "*Conductance*" and "*Susceptance*" in terms of electrical engineering. **[2 marks]**

2. Express the impedance of the circuit as a complex number in polar form. **[2 marks]**



3. Calculate the Average Values of the square waveform in graph below:- **[2 marks]**

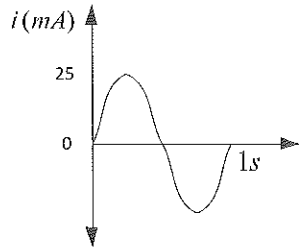


4. Determine the average power delivered to networks having the following input voltage and current as described below: - **[2 marks]**

$$v = 150\sin(\omega t - 70^0)$$
$$i = 25\sin(\omega t - 45^0)$$

5. Find the Effective Values(RMS) of the sinusoidal waveform in graph below:-

[2 marks]



(ii) Multiple Choice (20 marks)

In this section, read the question properly/ carefully and select your best answer by putting a circle around the alphabet of your choice along the question number in the answer sheet provided in the Appendix-2.

(1 mark each)

1. The value of natural logarithm e is approximately……..?

   (a) 3.142
   (b) 2.728
   (c) 2.718.
   (d) 2.782.

2. In RC Timing circuits, during the 1st time constant, the capacitor is charged to about ---- of the source voltage.

   (a) 63.2%
   (b) 62.5%
   (c) 86.5%.
   (d) 82.7%.

3. Referring to the question above, the Timing circuits, during the 3rd time constant, the capacitor is charged to about ---- of the source voltage.

   (a) 74.3%
   (b) 94.5%
   (c) 63.2%.
   (d) 82.7%.

4. Determine the *frequency* component of the following voltage equation $v = 240\sin 377t + 75^0$.

   (a) 497
   (b) 70
   (c) 377t + 80
   (d) 377t

5. Specify the *phase shift* component of the following voltage equation, $v = 240\sin 377t + 75^0$.

   (a) 80
   (b) 377t + 75
   (c) 377
   (d) 75

6. Determine what *frequency* will an inductor of 9uH have the same reactance with a capacitor of 0.10uF?

   (a) 14.7 GHz
   (b) 167.8 KHz
   (c) 16.43 KHz
   (d) 6.43 MHz

7. In a RCL series circuit of a resistor of 4.7kΩ, capacitor of 83μF and inductor of 0.22H connected with a 240v supply with 50 Hz. Determine the <u>*inductive*</u> reactance?

   (a) 78.53kΩ
   (b) 78.53Ω
   (c) 69.12Ω
   (d) 69.12kΩ.

8. In the same RCL series circuit above of a 4.7kΩ resistor, 83μF capacitor and inductor of 0.22H connected with a 240v supply with 50 Hz. Calculate the <u>*capacitive*</u> reactance.

   (a) 38.79Ω
   (b 38.79kΩ
   (c) 38.35MΩ
   (d) 38.35Ω.

9. In a RCL series circuit, a 240v supply with 50 Hz connected with a resistor of 4.7 kΩ, capacitor of 83μF and inductor of 0.22H. The *impedance* of the circuit will be:-?

(a) 4.7kΩ
(b) 46.60Ω
(c) 47.6kΩ
(d) 42.6kΩ.

10. Covert the following voltage $v_a = 50\ sin(377t + 30^0)$ from *time domain* into *phasor domain* and re-write the voltage into phasor format.

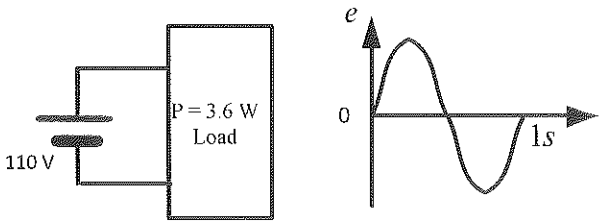
(a) $v_a = 70.71v\ \angle 30^0$ (b) $v_a = 35.35v\ \angle 21^0$

(c) $v_a = 70.71v\ \angle 21^0$ (d) $v_a = 35.35v\ \angle 30^0$.

11. Which of the following dependent sources is not appropriate?

(a) voltage controlled voltage source
(b) current controlled voltage source
(c) voltage controlled current scourge
(d) current controlled current source

12. A system of 110V dc delivers 3.6W to the load as per diagram below. Find the *peak value* of the applied *voltage* (E_m) if the source to be delivered same power to the same load.



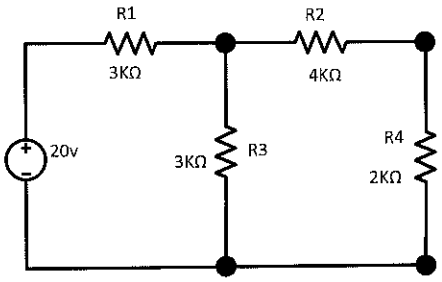
(a) $E_m = 149.24v$,
(b) $E_m = 159.86v$
(c) $E_m = 77.77v$
(d) $E_m = 155.56v$

13. Refer to the system above in Question no. 12, determine the *peak value* of the *current* (I_m) if the source to delivered same power to the same load.

(a) $I_m = 46.28mA$
(b) $I_m = 42.28mA$

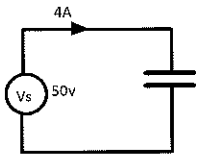
(c) $I_m = 46.42mA$
(d) $I_m = 56.22mA$

14. In a series-parallel network below, determine the total resistance.



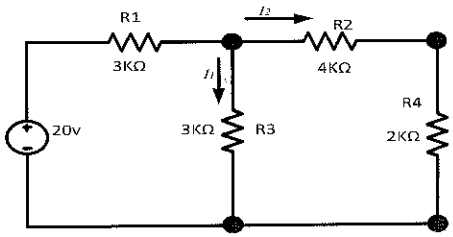
(a) $R_T = 6k\Omega$
(b) $R_T = 5.6k\Omega$
(c) $R_T = 5k\Omega$
(d) $R_T = 6.6k\Omega$

15. In a purely capacitive circuit, current (*i*) leads voltage (*v*) by 90°, determine the average power in the capacitor.



(a) $P_{av} = 0w$
(b) $P_{av} = 10w$
(c) $P_{av} = 100w$
(d) $P_{av} = 1Kw$

16. In the series-parallel network below, determine the current flowing into R3 resistor.



(a) $I_1 = 4mA$
(b) $I_1 = 2.7mA$

(c) $I_1 = 1.3mA$
(d) $I_1 = 4.3mA$

17. In the series-parallel network above, determine the voltage drop across R_1 resistor.

(a) $V_{R1} = 10v$
(b) $V_{R1} = 8v$
(c) $V_{R1} = 14v$
(d) $V_{R1} = 12v$

18. In the series-parallel network above, determine the voltage drop across R_3 resistor.

(a) $V_{R3} = 8.1v$
(b) $V_{R3} = 3.9v$
(c) $V_{R3} = 7.4v$
(d) $V_{R3} = 8.5v$

19. In complex algebra, determine the complex conjugate of the following complex number:- z = 2 + j3.

(a) $z = -2 + j3$
(b) $z = 2 - j3$
(c) $z = 2 + j3$
(d) $z = 2 * j3$

20. Convert this complex number, z = 5 - j6 into polar form.

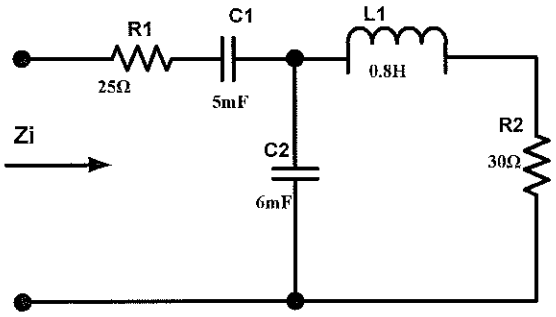
(a) $z = 8.7 \angle -50.2^0$
(b) $z = 8.9 \angle 50.2^0$
(c) $z = 7.8 \angle -50.2^0$
(d) $z = 7.8 \angle 50.2^0$

Section – B: - Answer all question in this section [50 marks]

Question 1

Use complex algebra [j-notation] application to:- **(10 marks)**

i. Determine the input impedance of the circuit shown below. [7 marks]
ii. Plot its phasor diagram [3 marks]

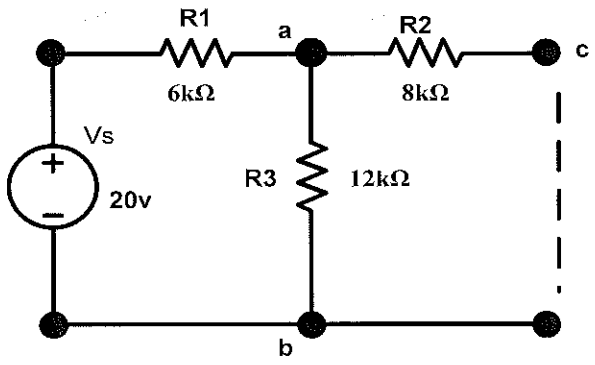


(use ω =10 rad/s)

Question 2

(10 marks)

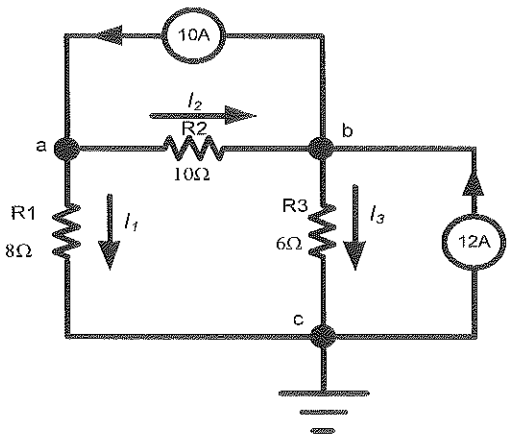
For the Series/Parallel Resistive network circuit below, determine the following:-



i) The voltage across each resistor. *(4marks)*
ii) The current through the circuit. *(1mark)*
iii) If there is a short between points **c-b**, work out the current through the parallel branch *(3marks)*
iv) The current through the circuit if points **a-b** is shorted. *(2marks)*

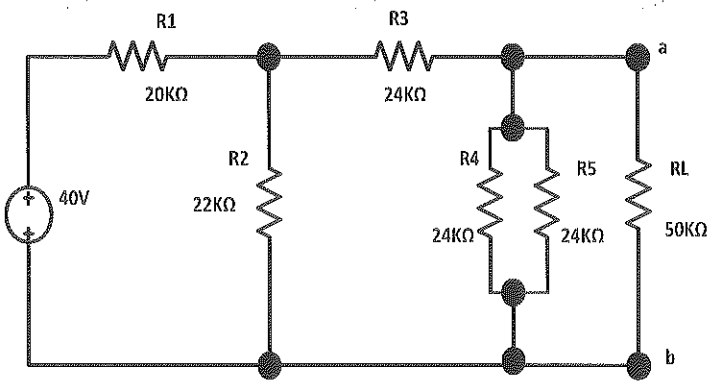
Question 3

(a). Using Nodal Analysis method, find the voltage at node "a" & node "b" in the circuit given below. **(10 marks)**



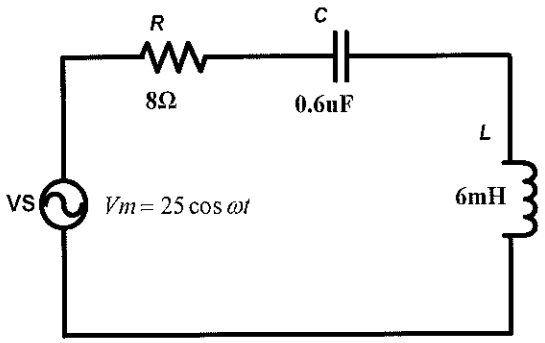
Question 4

From the circuit given below, determine Thévenin's equivalent circuit and calculate the current through the load resistor. **(10 marks)**



Question - 5

For the RLC circuit below, resistor = 8Ω, capacitor = 0.6uF and inductor = 6mH, show all the necessary calculation to determine the following:- **(10 marks)**



(use $\pi = 3.14$)

a) The resonant frequency (2 marks)
b) Half power frequencies (4 marks)
c) Quality Factor (2 marks)
d) Bandwidth (2 marks)

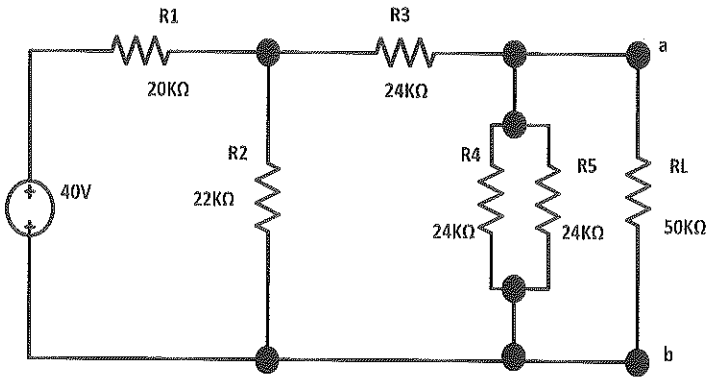
Section – C: [20 marks]

Select any TWO (2) questions from the five (5) questions given below.

Question - 1

For the circuit shown below, calculate and determine the Norton's equivalent circuit.

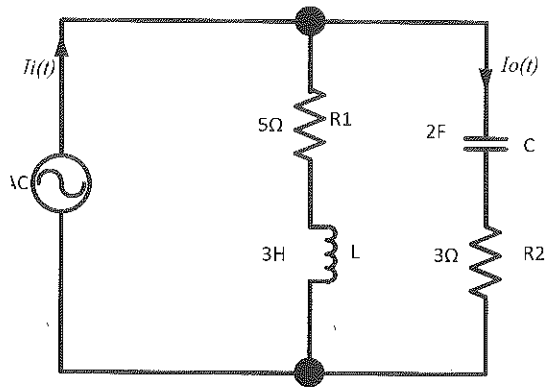
(10 marks)



Question - 2

For the circuit below, *show the full calculation* of the **Gain** = $\mathbf{I_O}$ **(w) /** $\mathbf{I_I}$**(w)** and determine the **poles** and **zeroes** of the circuit below using the RL and RC responses.

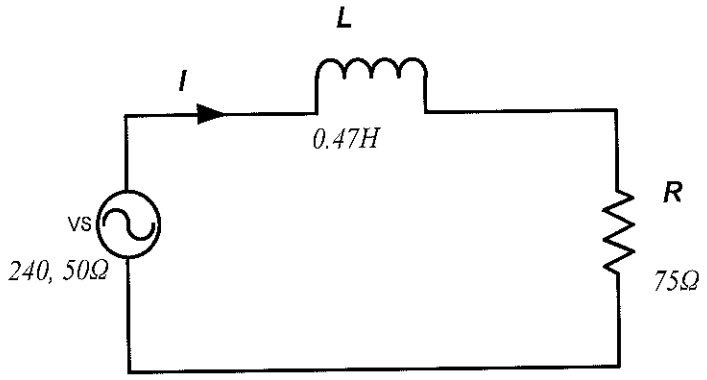
(10 marks)



Question - 3.

(a). The RL circuit shown below, determine the impedance of the circuit, and its phase angle?

(6 marks)

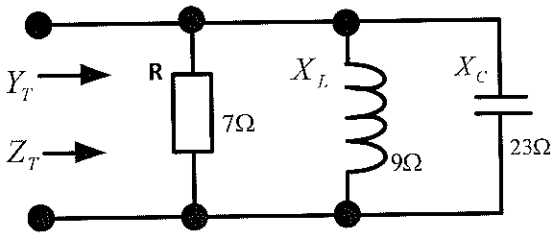


(b). The voltage across a 3uF Capacitor is given as $v = 30 \sin 377t$. What is the sinusoidal expression for the current and Sketch the *voltage* and *current* curves.

(4 marks)

Question 4

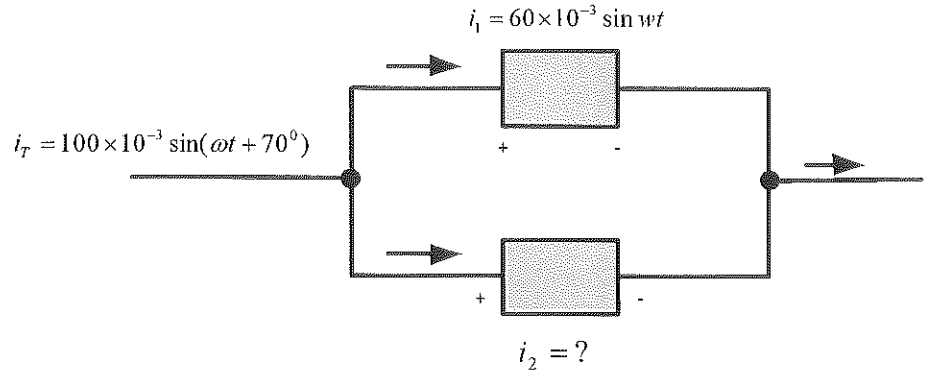
For the parallel RCL network below. **(10 marks)**



i. Find the admittance of each parallel circuit. (3 marks)
ii. Determine the input admittance. (2 marks)
iii. Calculate the input impedance (2 marks)
iv. Draw the input impedance diagram. (1½ marks)
v. Draw the admittance diagram. (1½ marks)

Question 5

Determine the current i_2 for the network in the circuit below. **(10 marks)**



---------- END OF PAPER----------

Appendix 1

Formulas

1. $\omega_1 = R/2L + \sqrt{(R/2L)^2 + 1/LC}$

2. $\omega_2 = -R/2L + \sqrt{(R/2L)^2 + 1/LC}$

3. $f_0 = 1/2\pi\sqrt{LC} \qquad \omega_0 = 2\pi f_0 \qquad \omega_0 = \frac{1}{\sqrt{LC}} \qquad \omega_0 = \sqrt{\omega_1 \omega_2}$

4. $Q = \frac{\omega_0 L}{R} = \frac{1}{\omega_0 CR} = \frac{X_L}{R} = \frac{X_C}{R} = \frac{1}{R}\sqrt{\frac{L}{C}}$

5. $B = \omega_0^{\,2} CR \qquad B = \omega_2 - \omega_1 \qquad B = \frac{\omega_0}{Q} \qquad P(\omega_0) = \frac{Vm^2}{2R}$

6. $X_L = 2\pi fL \qquad P = \frac{V_m I_m \cos\theta}{2} \qquad P(\omega_{1\&2}) = \frac{Vm^2}{4R} \qquad P = \frac{V^2{}_{eff}}{R} = I^2{}_{eff} R$

7. $X_C = \frac{1}{2\pi fC} \qquad \sin A \sin B = \frac{\cos(A-B) - \cos(A+B)}{2}$

9. $I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2, \qquad \beta_1\left[(V_{DD} - 2V_T)V_{ON} - 0.5^2{}_{ON}\right]$

10. $f_H = \pm\frac{8\,fo}{Vc}, \qquad V_{DS} = V_{DD} - I_D R_D$

Appendix 2 – Section A Answer Sheet.

Use this answer sheet to answer Section A by putting a circle around the letter or the alphabet of your choice.- Remove this Answer Sheet and insert it with rest of your Sheet

Q1		A	B	C	D
Q2		A	B	C	D
Q3		A	B	C	D
Q4		A	B	C	D
Q5		A	B	C	D
Q6		A	B	C	D
Q7		A	B	C	D
Q8		A	B	C	D
Q9		A	B	C	D
Q10		A	B	C	D
Q11		A	B	C	D
Q12		A	B	C	D
Q13		A	B	C	D
Q14		A	B	C	D
Q15		A	B	C	D
Q16		A	B	C	D
Q17		A	B	C	D
Q18		A	B	C	D
Q19		A	B	C	D
Q20		A	B	C	D