# MACHAKOS UNIVERSITY

**University Examinations for 2021/2022**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

**SECOND YEAR SECOND SEMESTER EXAMINATION FOR**

**BACHELOR OF SCIENCE IN ELECTRICAL & ELECTRONICS ENGINEERING**

**EEE 204: CIRCUIT THEORY II**

**DATE:** **TIME:**

***INSTRUCTIONS TO STUDENTS***

1. *This paper contains 5 questions.*
2. *Attempt **Question One** and **Any Other Two questions***
3. *Show calculations where applicable*

**QUESTION ONE (COMPULSORY)(30 MARKS)**

a) Briefly explain **Three** advantages of three-phase circuit over single-phase circuit. (6 marks)

b) In the parallel RLC circuit shown in Fig.Q1 b)

(i) Calculate the values of $\omega_0$, Q-factor, and Bandwidth (3 marks)

(ii) Find half-power frequencies, $\omega_1$ and $\omega_2$ (3 marks)

(iii)Determine the power dissipated at $\omega_0$, $\omega_1$ and $\omega_2$. (4 marks)

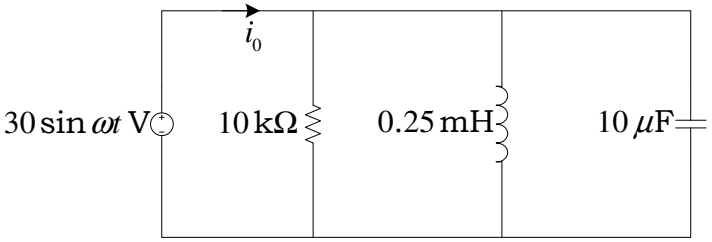


Fig. Q1b)

c) Find $i(t)$ for the circuit of Fig. (b) when $i_1(t) = 7e^{-6t}$ A for $t \geq 0$ and $i(0) = 0$ using Laplace transforms. (6 marks)

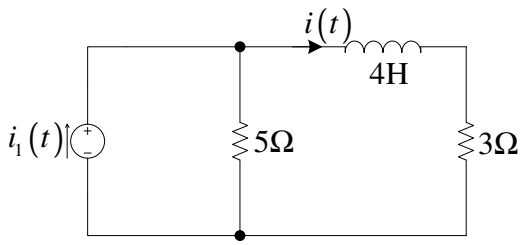

Fig. Q1 c)

d) Find the natural response of $i_n(t)$ for $t > 0$ for the circuit shown in Fig.Q1 d) given that $i(0) = 2\,\text{A}$. (8 marks)

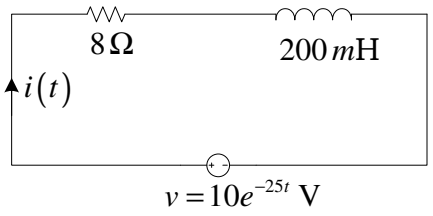

Fig.Q1d)

**QUESTION TWO (20 MARKS)**

a) A star connected three phase load has a resistance of $10\,\Omega$ and a capacitive reactance of $20\,\Omega$ in each phase. It is fed from a $400\,\text{V}$ 3 phase balanced supply. Find

(i) The magnitude of phase voltage (1 mark)
(ii) the line current (1 mark)
(iii)apparent power (1 mark)
(iv)active power (1 mark)
(v) reactive power (1 mark)
(vi)Draw phasor diagram showing phase voltages, line voltages and line currents. (9 marks)

b) Determine the forced response for the circuit current, $i_f$, for the circuit of Fig. Q2 b). (7 marks)

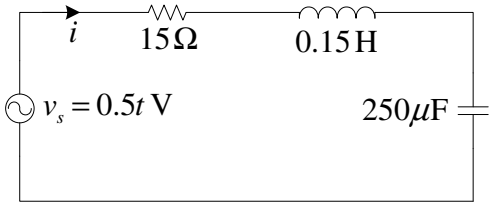

Fig. Q2 b)

**QUESTION THREE (20 MARKS)**

a) In the circuit shown in Fig. Q3 a), find
   (i) The total circuit resistance (5 marks)
   (ii) The supply current $I$ (1 mark)
   (iii) The voltage across $20\,\Omega$ resistor (2 marks)

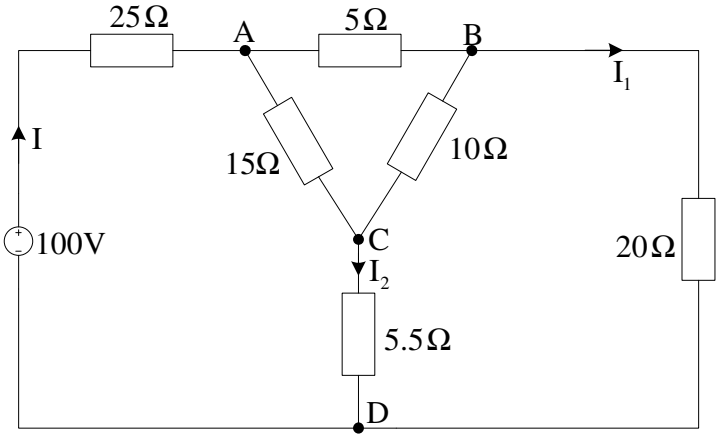


Fig.Q3a)

b) Find the complete response of the circuit of Fig. Q3 b), given that $i(0) = 0$.

(12 marks)

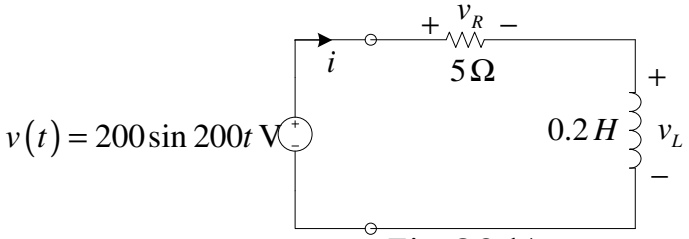


Fig. Q3 b)

**QUESTION FOUR (20 MARKS)**

a) A series RLC circuit has $R = 25\,\Omega$, $L = 0.05\,H$ and $C = 4\,\mu F$. The applied voltage is 80 V. Find
   i) Resonant frequency in Hertz (2 marks)
   ii) Q-factor (1 mark)
   iii) Upper and lower half power frequencies (3 marks)
   iv) Band width in Hertz (1 mark)
   v) Current at resonance (1 mark)
   vi) Current at half power points (1 mark)
   vii) Voltage across inductance at resonance (1 mark)

b) Using Fourier transform method, determine, the response $V_0(\omega)$ of the circuit of Fig. Q4b) when $v(t) = 10e^{-5t}u(t)\,\text{V}$ and plot the poles and zeros on the s-plane.

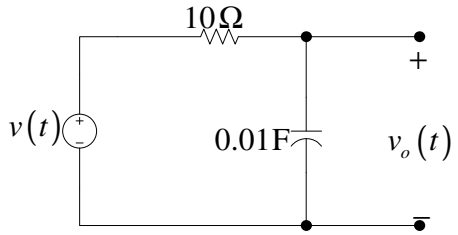


Fig. Q4 b)

(6 marks)

c) Briefly explain the following terms as used in circuit analysis:

i) Resonance (1 mark)
ii) Phase Sequence (1 mark)
iii) Natural Response (1 mark)
iv) Frequency response (1 mark)

**QUESTION FIVE (20 MARKS)**

a) Construct the Bode plots of the function below for $0.1 < \omega < 100\,\text{rad/s}$. $H(s) = \dfrac{10(s+100)}{s+1}$

(7 marks)

b) A delta-connected 3 phase load has an impedance of $(10 + j15)\,\Omega$ in each phase. It is fed from a 200 V, 3-phase balanced supply. Find

(i) The phase current (3 marks)
(ii) The line current (1 mark)
(iii) The apparent power (1 mark)
(iv) The active power (1 mark)
(v) The Reactive power (1 mark)
(vi) Draw phasor diagram showing phase voltages, line currents and phase currents. (6 marks)