MACHAKOS UNIVERSITY

University Examinations for 2019/2020Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 204: CIRCUIT THEORY II

DATE: 14/12/2020 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS

Answer Question One and Any Other Two Questions
Show calculations where applicable

QUESTION ONE (COMPULSORY)(30 MARKS)

a) In an RLC series circuit shown in Fig. Q1 a) determine

i. Maximum power dissipated in the circuit

ii. The bandwidth of the resonant circuit

iii. The half-power frequencies ω_1 and ω_2

iv. The circuit current at half-power frequency

v. The power dissipated at the lower half-power frequency, ω_1 (14 marks)

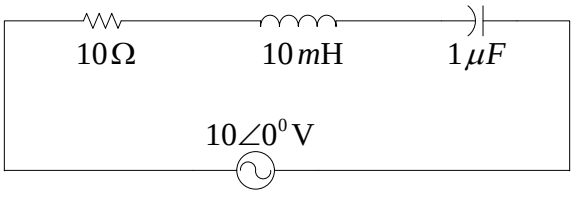

Fig. Q1 a)

b) Find the forced response for the voltage in Fig. Q1 b). when $R = 2.5\ k\Omega$, $C = 100\ \mu F$ and $i = 6t$ mA. (7 marks)

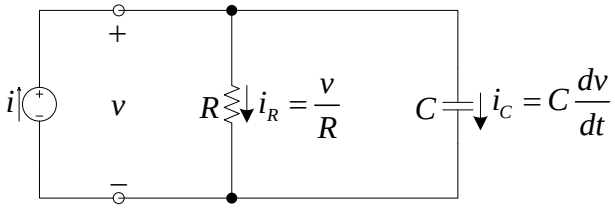

Fig. Q1 b)

c) Explain the following terms as used in circuits:

i. Quality factor, Q

ii. Resonance (3 marks)

d) Find $f(t)$ of the following function (6 marks)

$$F(s) = \frac{15s^2 - 16s - 7}{(s+2)(s^2 + 6s + 25)}$$

QUESTION TWO (20 MARKS)

a) For the circuit of Fig.Q1 a), obtain the gain $I_0(\omega)/I_i(\omega)$ and its poles and zeros. (6 marks)

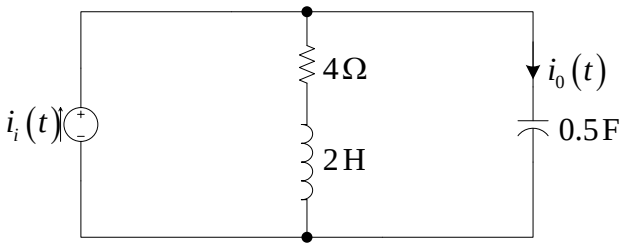

Fig. Q1 a)

b) A balanced delta connected load of $(12 + j5)\Omega$ is fed from a 3 phase 3 wire 130 V system. Find

i. The magnitude of phase and line currents and

ii. Total active power (8 marks)

c) Briefly explain three advantages of three-phase circuit over single-phase circuit. (6 marks)

QUESTION THREE (20 MARKS)

a) In the parallel RLC circuit shown in Fig. Q 3 a)

i. Calculate the values of ω_0, Q-factor, and Bandwidth

ii. Find half-power frequencies, ω_1 and ω_2

iii. Determine the power dissipated at ω_0, ω_1 and ω_2. (9 marks)

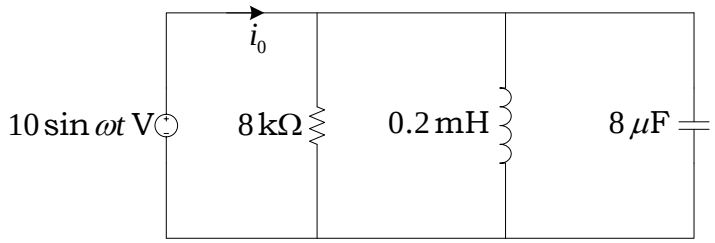

Fig. Q3 a)

b) Construct the Bode plots for the following transfer function

$$H(s) = \frac{20(s+2)}{s(s^2+4s+16)}$$ (6 marks)

c) A 3-H inductor and a 20μF capacitor are in series with an unknown inductor. If the voltage across the capacitor is $v_c = 5\sin 100t$ and the total voltage across the network is equals zero, then what is the value of the unknown inductance L_x? (5 marks)

QUESTION FOUR (20 MARKS)

a) Find $v_2(t)$ for $t > 0$ using state variable method for the circuit shown in Fig. Q4 a), assume there is no initial stored energy. (10 marks)

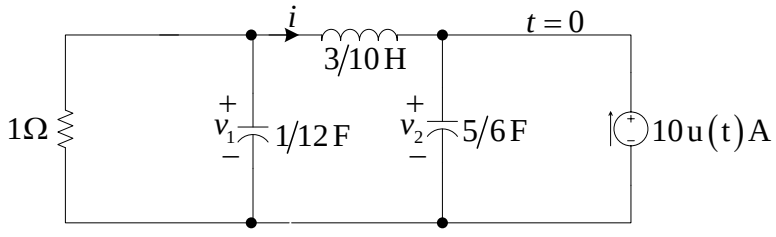

Fig. Q4 a)

b) Find $i(t)$ for the circuit shown in Fig. Q4 b) using Laplace transform method when $v_c(0) = 10\text{V}$ and $i(0) = 0$. The input source is $v_1(t) = 15u(t)\text{V}$. (10 marks)

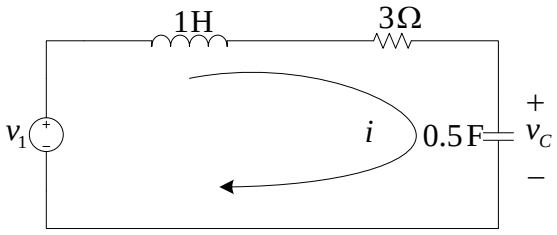

Fig. Q4 b)

QUESTION FIVE (20 MARKS)

a) Find the response, $v_0(t)$ of the RL circuit of Fig. Q5 a) when $v(t) = 4e^{-2t}u(t)\text{V}$. The initial condition is zero. (5 marks)

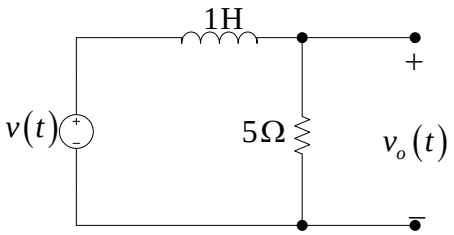

Fig. Q5 a)

b) A star connected three phase load has a resistance of 8Ω and a capacitive reactance of 10Ω in each phase. It is fed from a $400\,\text{V}$ 3 phase balanced supply. Find

i. The line current

ii. Total amperes

iii. Active power

iv. reactive power

v. Draw phasor diagram showing phase voltages, line voltages and currents. (15 marks)