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(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2021/2021 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL AND COMMUNICATIONS ENGINEERING

COURSE CODE: ECE 226

COURSE TITLE: ELECTRIC CIRCUIT THEORY AND ANALYSIS II

DATE: MONDAY, APRIL, 25TH, 2022 **TIME:** 3:00 – 5:00 PM

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.
QUESTION ONE CARRIES 30 MARKS AND ALL OTHERS 20 MARKS EACH.

Question 1 **[30marks]**

(a) A sinusoidal voltage $v = 50 \sin \omega t$ is applied to a series RL circuit. The current in the circuit is given by $i = 15 \sin(\omega t - 53°)$. Determine;

(i) Apparent power [2marks]

(ii) Power factor, [1mark]

(iii) Active power [1mark]

(b) An R–L–C series circuit has resistance, R = 10 Ω, inductance, L = 0.1 H, and capacitance, C = 8 μf. Determine;

(i) resonant frequency; [2marks]

(ii) Q-factor of the circuit at resonance; [2marks]

(iii) half-power frequencies and bandwidth [2marks]

(c) A coil of 20Ω resistance has an inductance of 0.2 H and is connected in parallel with a condenser of $100\mu F$ capacitance. Determine;

(i) the resonant frequency [2marks]

(ii) the dynamic resistance. [2marks]

(d) Three equal impedances, each of (8 + j10) ohms, are connected in star. This is further connected to a 440 V, 50 Hz, three-phase supply. Determine;

(i) phase voltage [2marks]

(ii) active power, [4marks]

(iii) reactive power [2marks]

(e) An 8μF capacitor is connected in series with a 0.5MΩ resistor across a 200V d.c supply. Determine;

(i) the time taken for the p.d across the capacitor to grow to 160V [2marks]

(ii) the current and p.d across the capacitor 4 seconds after it is connected to the supply. [2marks]

(f) Determine the phasor currents $\mathbf{I}_1$ and $\mathbf{I}_2$ in the circuit of Figure Q1(f) [4marks]

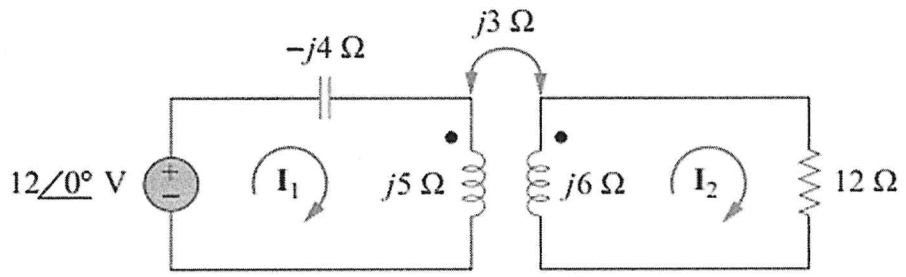


Figure Q1(f)

Question 2 **[20marks]**

(a) Three coils, each having a resistance and an inductance of 8Ω and 0.02H respectively, are connected in star across a three-phase, 230 V, 50 Hz supply. Determine the;

(i) line current, [4marks]

(ii) Active power and power factor [3marks]

(iii) reactive volt-amperes, and total volt-amperes. [3marks]

(b) Three similar coils A, B, and C are available. Each coil has a 9Ω resistance and a 12Ω inductive reactance. They are connected in delta to a three-phase, 440V, 50Hz supply. Calculate for this load,

(i) line current [3marks]
(ii) total kVA, [2marks]
(v) active power, and [2marks]
(vi) reactive power [2marks]
(c) A 415 V, 50 Hz, three-phase voltage is applied to three star-connected identical impedances. Each impedance consists of a resistance of 15Ω, a capacitance of 177μF and an inductance of 0.1 henry in series. Determine the power absorbed.
[4marks]
Excess marks (22mks)

Question 3 **[20marks]**

(a) An RLC series circuit with a resistance of 10, inductance of 0.2H and a capacitance of 40 μF is supplied with a 100 V supply at variable frequency. Determine;
(i) frequency of which resonance takes place [2marks]
(ii) current [2marks]
(iii) power dissipated [2marks]
(iv)quality factor [2marks]
(v) half power points [2marks]
(b) An inductive coil has a resistance of 10Ω and inductance of 100 mH. This coil is connected in parallel with a capacitor of 20μF. A variable frequency power at 100 V is applied across this parallel circuit. Determine;
(i) the frequency at which the circuit will reasonate [2marks]
(ii) the Q-factor, [2marks]
(iii) dynamic impedance of the circuit, and [2marks]
(iv) resonant current. [2marks]
(c) A coil of inductance 50mH and resistance 5Ω is connected to 110V d.c supply. Determine the value of current after 4ms. [2maks]

Question 4 **[20marks]**

(a) Consider the circuit shown in Figure Q4(a). Use it to determine;
(i)the coupling coefficient. [2marks]
(ii) the energy stored in the coupled inductors at time t=1s if $v = 60\cos(4t + 30°)$V. [5marks]

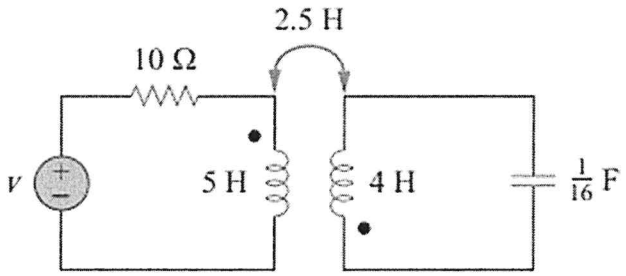


Figure Q4(a)

(b) In the circuit of Figure Q4(b), calculate the input impedance and current **I**1. Take $\mathbf{Z}_1 = 60 - j100\ \Omega$, $\mathbf{Z}_2 = 30 + j40\ \Omega$, and $\mathbf{Z}_L = 80 + j60\ \Omega$. [4marks]

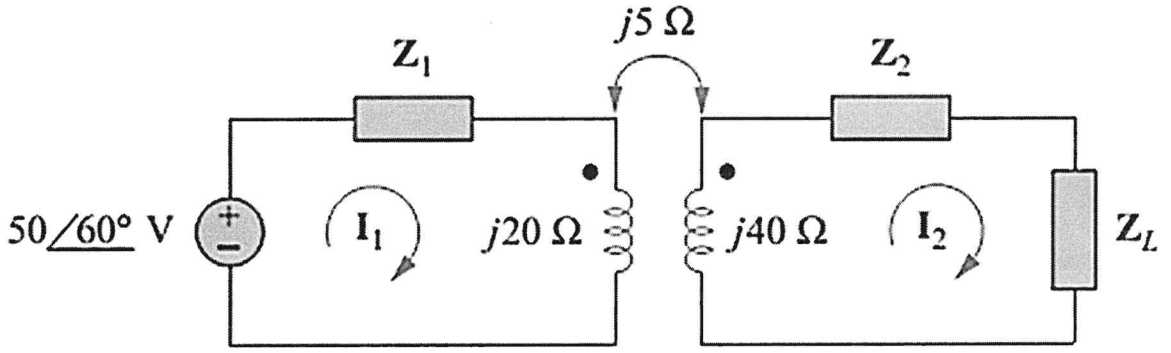


Figure Q4(b)

(c) An ideal transformer is rated at 2400/120 V, 9.6 kVA, and has 50 turns on the secondary side. Determine;

(i) the turns ratio, [2marks]

(ii) the number of turns on the primary side, and [2marks]

(iii) the current ratings for the primary and secondary windings. [2marks]

(d) For the ideal transformer circuit of Figure Q4(d), determine the complex power supplied by the source. [3marks]

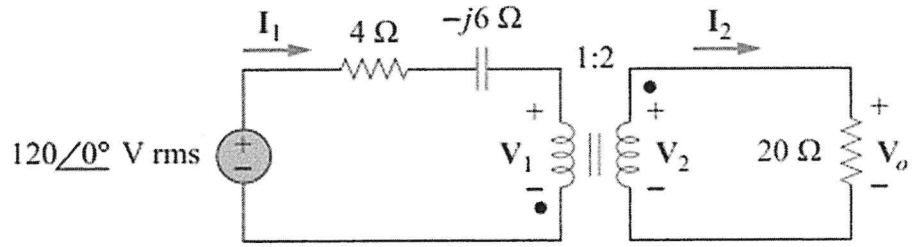


Figure Q4(d)

Question 5 **[20marks]**

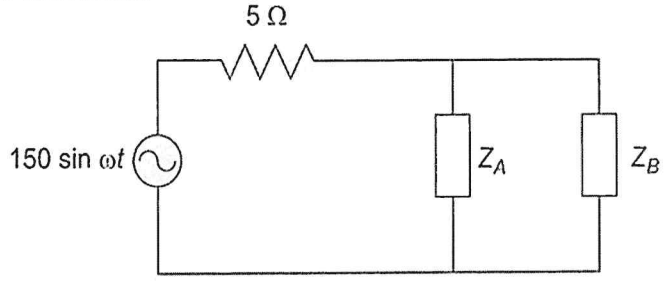
(a) A voltage source v(t)=150 sin ωt in series with 5Ω resistance is supplying two loads in parallel, $Z_A = 60\angle 30$ and $Z_B = 50\angle -25$. Determine;

(i) the average power delivered to Z_A, [3marks]

(ii) average power delivered to Z_B [3marks]

(iii) the average power dissipated in the circuit, and [2marks]

(iv) the power factor of the circuit [2marks]



(b) Each phase of a delta-connected load consists of a 50 mH inductor in series with a parallel combination of a 50Ω resistor and a 50 μF capacitor. The load is connected to a three-phase, 550V, 800 rad/s ac supply. Determine;

(i) phase current, [2marks]
(ii) the line current, [2marks]
(iii) power drawn, [2marks]
(iv) reactive power, and [2marks]
(v) kVA rating of the load [2marks]