Reg. No:

SRM Institute of Science and Technology

Tiruchirappalli Campus, Trichy – 621 105

Faculty of Engineering and Technology

Continuous Learning Assessment - I, First Semester, October -2022.

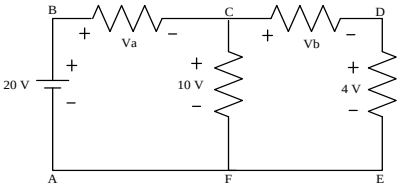
Department of Electronics and Communication Engineering

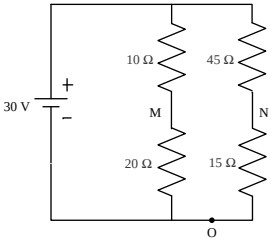
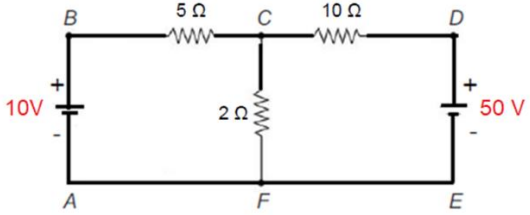
21EES101T: Electrical and Electronics Engineering

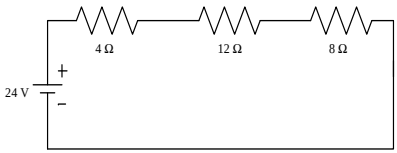
(Regulations 2021)

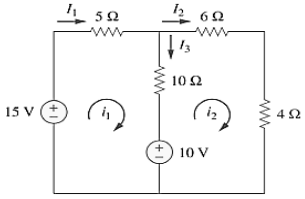
Date: 28.10.2022

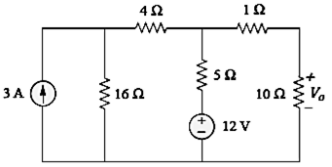
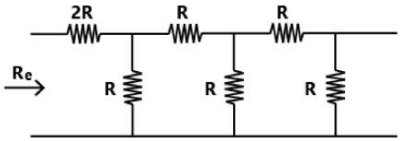
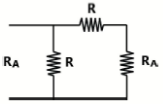
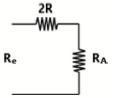
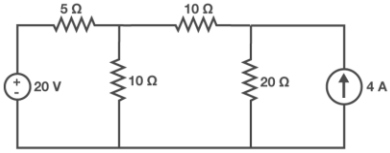
Time: 90 Minutes **Max. Marks**: 50

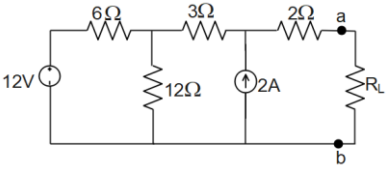
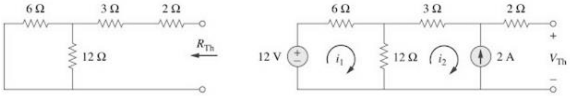
	Answer ALL Questions.		
	PART A – (10 x 1 = 10 marks)		
1.	A circuit containing resistor and a capacitor in series connection has an impedance of 25 Ω and the resistance of 10 Ω. Obtain the power factor. **A. 0.4 leading** B. 0.4 lagging C. 0.866 leading D. 0.866 lagging	CO 1	K 1
2.	By applying KVL, determine the voltages V_a and V_b in the given circuit  A. 2 V, 4 V B. 6 V, 5 V **C. 10V, 6 V** D. 9 V, 12 V	CO 1	K 1
3.	A wire is carrying a direct current of 20A and a sinusoidal alternating current of peak value 20 A. 24A B. 25A	CO 1	K 1

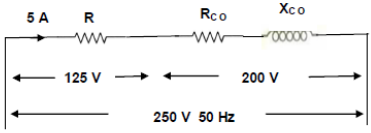
	C. 26A **D. 24.5A**		
4.	A circuit consists of three identical resistors connected in series. When one resistor is removed the circuit current will A. Decrease B. Increase by one third C. Decrease by one third **D. Remains the same**	CO 1	K 1
5.	Find out the voltage V_{MN}  A. 10.5 V B. 8.5V C. 16.5 V **D. 12.5 V**	CO 1	K 1
6.	Consider the following circuit. Find the current across 5Ω .resistor  A. 0.1 A B. 0.3 A C. 0.5 A D. **0.25 A**	CO1	K 1
7.	Determine the average value of voltage v(t)= 300 sin wt A. 85.5 V **B. 191.08 V** C. 90 V D. 125.08 V	CO1	K 1
8.	If the value of the resistors are doubled in a circuit which consists of an ideal voltage source and linear resistors, the voltage appeared across each resistor is	CO1	K 1

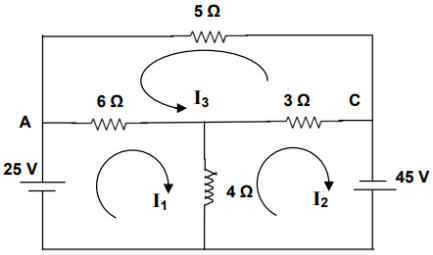
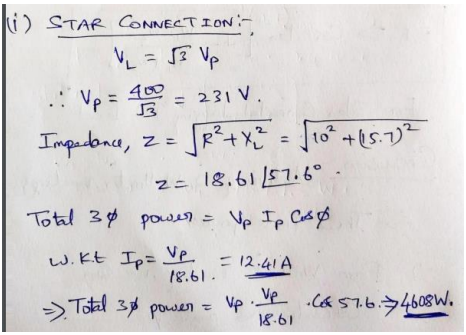
	A. Not changed B. Doubled C. Halved D. Increased by three times		
9.	Voltage of a coil when it has di/dt= 20 mA/s and L=8 H is **A. 16 mV** B. 1.6 mV C. 160 mV D. 0.16 MV	CO1	K 1
10.	Find the voltage present in the 12 Ω of the circuit shown  A. 10.5V B. 8.6V C. 16.2V **D. 12.0V**	CO1	K 1

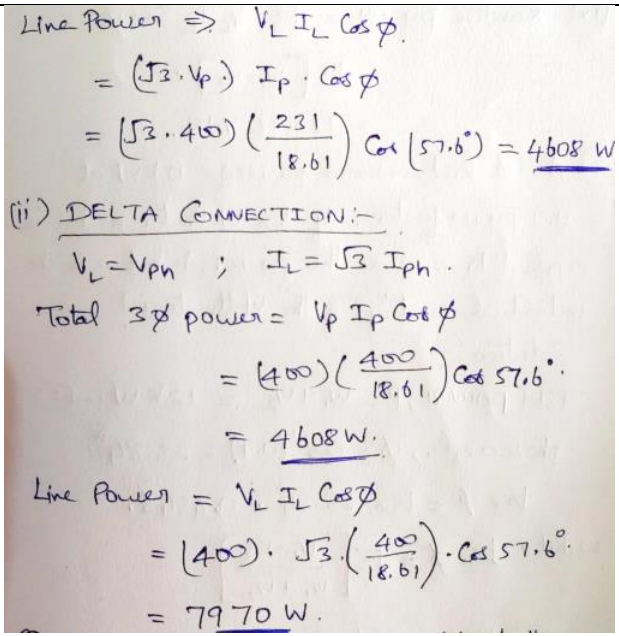
	Answer Any Five Questions.		
	PART B – (5 x 5 = 25 Marks)		
11.	For the shown circuit, find the branch currents by using mesh analysis  $-15 + 5i_1 + 10(i_1 - i_2) + 10 = 0$ $3i_1 - 2i_2 = 1$ (1) For mesh 2 $6i_2 + 4i_2 + 10(i_2 - i_1) - 10 = 0$ $i_1 - 2i_2 = -1$ (2) Solve equations 1 and 2 to get i_1 and i_2 $3i_1 - 2i_2 = 1$ (1) $i_1 - 2i_2 = -1$ (2) $2i_1 = 2$ $i_1 = 1A$ $3 \times 1 - 2i_2 = 1$ $-2i_2 = 1 - 3 = -2$ $i_2 = 1A$ $I_1 = i_1 = 1A$ $I_2 = i_2 = 1A$ $I_1 = i_1 - i_2 = 1 - 1 = 0A$	CO 1	K 2

12.	Find the value of current across 10Ω resistor, using Thevenin's theorem in the circuit shown.  R_{th}=5Ω and V_{th}=10V	CO 1	K 2
13.	The ladder network shown in the figure, find the equivalent resistance of R_e.  To find R_e we need to find equivalent resistance of remaining network $R_A = \frac{R \times (R + R_A)}{2R + R_A}$ $2RR_A + R_A^2 = R^2 + RR_A$  $R_A^2 + RR_A - R^2 = 0$ $R_A = \frac{-R \pm \sqrt{R^2 + 4R^2}}{2} = \frac{-R + \sqrt{5}R}{2}$ $R_A = 0.62\ R$ $R_e = 2 + 0.62\ R$ $\frac{R_e}{R} = 2.62$  	CO 1	K 2
14.	For a given circuit, find the current across 20Ω resistor by using super position theorem.  $I = I_1 + I_2$ Substituting the values of I_1 and I_2 in the above equation, we get I = 0.4+1.6 = 2 A Therefore, the current flowing through the resistor is 2 A.	CO 1	K 2

15.	Find the value of R_L by the principle of maximum power transfer theorem for the circuit shown.  $R_{\text{Th}} = 2 + 3 + 6 \| 12 = 5 + \frac{6 \times 12}{18} = 9\ \Omega$  $-12 + 18i_1 - 12i_2 = 0, \quad i_2 = -2\ \text{A}$ Solving for i_1, we get i_1 = -2/3. Applying KVL around the outer loop to get V_{Th} across terminals *a-b*, we obtain $-12 + 6i_1 + 3i_2 + 2(0) + V_{\text{Th}} = 0 \quad \Rightarrow \quad V_{\text{Th}} = 22\ \text{V}$ For maximum power transfer, $R_L = R_{\text{Th}} = 9\ \Omega$ and the maximum power is $p_{\max} = \frac{V_{\text{Th}}^2}{4R_L} = \frac{22^2}{4 \times 9} = 13.44\ \text{W}$	CO 1	K 2
16.	Derive the expression of average and RMS value of full wave rectifier. $V_{\text{avg}} = \frac{1}{T/2}\int_0^{T/2} V(t)\,\text{d}t = \frac{2V_m}{T}\int_0^{T/2}\sin(\omega t)\,\text{d}t = \frac{2V_m}{T}\left[-\frac{\cos(\omega t)}{\omega}\right]_0^{T/2} = \frac{2V_m}{\omega T}\{-\cos(\omega T/2)+\cos 0\} = \frac{2V_m}{2\pi}\{-\cos(\pi)+\cos 0\} = \frac{V_m}{\pi}(+1+1) = \frac{2}{\pi}V_m \approx 0.637\,V_m.$ $V_{\text{rms}}^2 = \frac{V_m^2}{T}\int_0^T \sin^2(\omega t)\,\text{d}t = \frac{V_m^2}{2T}\int_0^T 2\sin^2(\omega t)\,\text{d}t = \frac{V_m^2}{2T}\int_0^T \{1-\cos(2\omega t)\}\,\text{d}t = \frac{V_m^2}{2T}\int_0^T \text{d}t - \frac{V_m^2}{T}\int_0^T \cos(2\omega t)\,\text{d}t = \frac{V_m^2}{2T}\left[T\right]_0^T - \frac{V_m^2}{2T}\left[\frac{\sin(2\omega t)}{2\omega}\right]_0^T = \frac{V_m^2}{2} - \frac{V_m^2}{4\omega T}\left\{\sin(2\omega T)-\sin(0)\right\} = \frac{V_m^2}{2} - \frac{V_m^2}{4\omega T}\left\{\sin(4\pi)-\sin(0)\right\} = \frac{V_m^2}{2} - \frac{V_m^2}{4\omega T}(0-0) = \frac{V_m^2}{2}.$	CO 1	K 2

17.	A resistance is connected in series with a coil. With a supply of 250 V, 50 Hz, the circuit takes a current of 5 A. If the voltages across the resistance and the coil are 125 V and 200 V respectively, calculate (i) impedance, resistance and reactance of the coil (ii) power absorbed by the coil and the total power. diagram.  Fig. 21 Example 7 Resistance $R = \frac{125}{5} = 25\ \Omega$ $\lvert Z_{co} \rvert = \frac{200}{5} = 40\ \Omega$; $\lvert Z_T \rvert = \frac{250}{5} = 50\ \Omega$ Since $\lvert Z_{co} \rvert = 40\ \Omega$, $\lvert R_{CO} + jX_{co} \rvert = 40$; $R_{co}^2 + X_{co}^2 = 1600$ Since $\lvert Z_T \rvert = 50\ \Omega$; $\lvert (25+R_{CO}) + jX_{co} \rvert = 50$ $625 + 50\,R_{CO} + R_{co}^2 + X_{co}^2 = 2500$ i.e. $50\,R_{CO} = 2500 - 625 - 1600 = 275$ Resistance of the coil $R_{CO} = 5.5\ \Omega$ Also $X_{co}^2 = 1600 - 5.5^2 = 1569.75$ Reactance of the coil $X_C = 39.62\ \Omega$ Impedance of the coil $Z_{CO} = (5.5 + j\,39.62) = 40 \angle 82.1^0\ \Omega$ Power absorbed by the coil $P_{CO} = 5^2 \times 5.5 = 137.5$ W Total power $P_T = (5^2 \times 25) + 137.5 = 762.5$ W Total impedance $Z_T = (30.5 + j\,39.62) = 50 \angle 52.41^0\ \Omega$ $\lvert I \rvert R_{CO} = 5 \times 5.5 = 27.5$ V; $\lvert I \rvert X_{CO} = 5 \times 39.62 = 198.1$ V	CO 1	K 2
18.	A series RLC circuit with R =10Ω, L=10mH and C=1μF is connected to 200 V variable frequency supply. Find the resonance frequency, current, voltages Quality factor and Bandwidth. $\omega_0^2 = \frac{1}{L\,C} = \frac{10^6}{0.01 \times 1} = 10^8$; Therefore $\omega_0 = 10^4$ rad. / sec. Resonant frequency $f_0 = \frac{\omega_0}{2\pi} = 1591.55$ Hz.; At resonance $X_L = X_C = \omega_0 L = 100\ \Omega$ Circuit current at resonance $I_0 = \frac{200}{10} = 20$ A Voltage across resistor $V_R = 10 \times 20 = 200$ V Voltage across L and C: $\lvert V_L \rvert = \lvert V_C \rvert = X_L\, I_0 = 100 \times 20 = 2000$ V Quality factor $Q = \frac{X_L}{R} = \frac{100}{10} = 10$ Bandwidth $\omega_{BW} = \frac{R}{L} = \frac{10}{0.01} = 1000$ rad. / sec. = 159.155 Hz	CO 1	K 2

Answer ALL Questions.			
PART C – (01 x 15 = 15 marks)			
20.	For a given circuit, find the current and voltage drop across each resistor.  **Three loops equations are:** $-25 + 6(I_1 + I_3) + 4(I_1 - I_2) = 0$ $-45 + 4(I_2 - I_1) + 3(I_2 + I_3) = 0$ $5I_3 + 6(I_3 + I_1) + 3(I_2 + I_3) = 0$ $\begin{bmatrix} 10 & -4 & 6 \\ -4 & 7 & 3 \\ 6 & 3 & 14 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 25 \\ 45 \\ 0 \end{bmatrix}$: On solving $I_3 = -14$ A Current in 5 Ω resistor = 14 A from A to C	CO 1	K 2
OR			
21.	Three similar coils each of resistance 10 Ω and an inductance of 0.05H are connected in star and delta to three phase 400V,50Hz symmetrical system. Find the phase current, line current, total phase power & total line power?  (i) STAR CONNECTION:- $V_L = \sqrt{3}\, V_p$ $\therefore V_p = \frac{400}{\sqrt{3}} = 231$ V. Impedance, $Z = \sqrt{R^2 + X_L^2} = \sqrt{10^2 + (15.7)^2}$ $Z = 18.61 \angle 57.6°$ Total 3φ power = $V_p I_p \cos\phi$ w.kt $I_p = \frac{V_p}{18.61} = 12.41$ A $\Rightarrow$ Total 3φ power = $V_p \cdot \frac{V_p}{18.61} \cdot \cos 57.6 \Rightarrow 4608$ W.	CO 1	K 2



Line Power $\Rightarrow V_L I_L \cos\phi$.

$= (\sqrt{3} \cdot V_p) I_p \cdot \cos\phi$

$= (\sqrt{3} \cdot 400)\left(\frac{231}{18.61}\right) \cos(57.6^\circ) = 4608\ W$

(ii) DELTA CONNECTION:-

$V_L = V_{ph}$; $I_L = \sqrt{3}\, I_{ph}$.

Total 3ϕ power $= V_p I_p \cos\phi$

$= (400)\left(\frac{400}{18.61}\right) \cos 57.6^\circ$.

$= 4608\ W$.

Line Power $= V_L I_L \cos\phi$

$= (400) \cdot \sqrt{3} \cdot \left(\frac{400}{18.61}\right) \cdot \cos 57.6^\circ$.

$= 7970\ W$.