Ref. No. : Ex/IEBE/T/212/2019

B.E. INSTRUMENTATION AND ELECTRONICS ENGINEERING SECOND YEAR
FIRST SEMESTER – 2019

SUBJECT: Circuit Theory **Time: Three hours** **Full Marks 100**

Module:1: 25 marks

1. A) Determine the current labeled i in the circuit shown in Fig.Q1A. 5

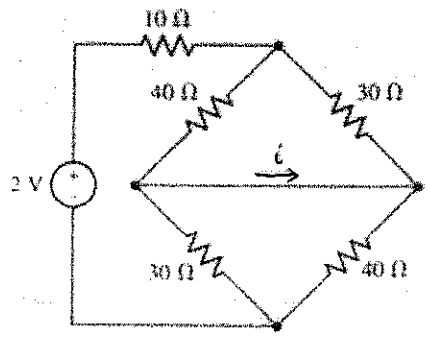

Fig. Q1A

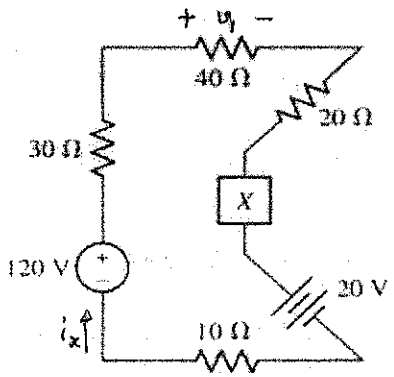

Fig.Q1B

OR

B) Find the power being absorbed by element X in Fig.Q1B if it is a a) 100Ω resistor, b) 40V independent voltage source, + reference on top, c) dependent voltage source labeled $25i_x$, +reference on top. 5

Any two from Question 2, 3 & 4

2. Find the Thevenin equivalent of the network shown in Fig.Q2. 10

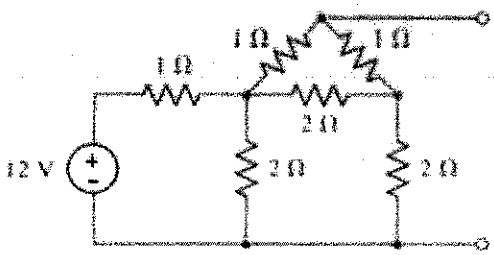

Fig.Q2

3. a) Determine the voltage across 17kΩ resistor in the circuit shown Fig.Q3.
   b) If the maximum power rating of the resistor is 250mW, what is the maximum positive voltage to which the 5V source can be increased before the resistor overheats? 10

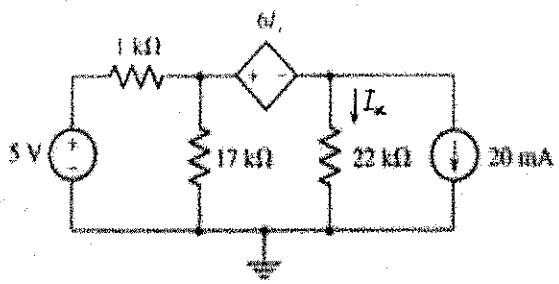

Fig.Q3

4. For the circuit shown in Fig.Q4 find ix , iy and power dissipated by the resistor 3Ω. 10

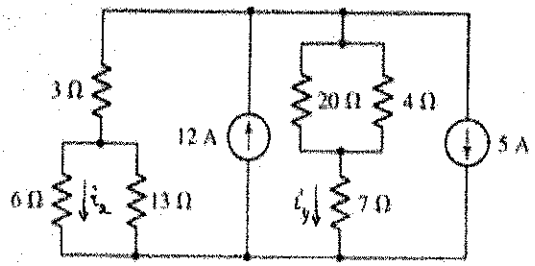

Fig.Q4

Module:2 : 25 marks

Answer any two from Question 5, 6, 7 & 8

5. Let $v_s=400t^2V$ for t>0 and $i_L(0)=0.5A$ in the circuit of Fig.Q5. At t=0.4s, find the values of energy: a) stored in the capacitor, b) stored in the inductor, c) dissipated by the resistor since t=0. 10

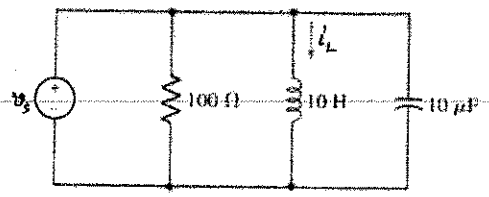

Fig.Q5

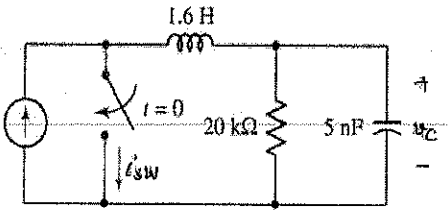

Fig.Q6

6. After being open for a long time, the switch in the circuit shown in Fig.Q6 is closed at t=0. For t>0, find a) $v_C(t)$, b) $i_{SW}(t)$. 10

7. Determine i(t) for all values of time in the circuit shown in Fig.Q7. 10

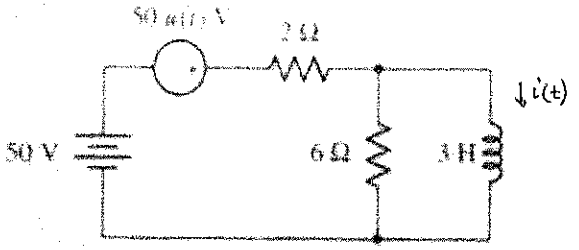

Fig.Q7

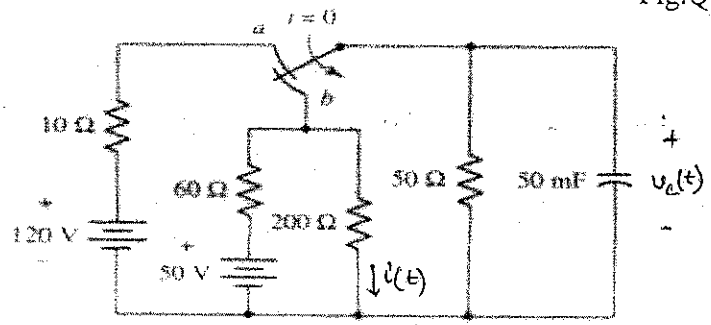

Fig.Q8

8. Find the capacitor voltage of circuit shown in Fig.Q8. 10

9. A) A parallel RLC circuit contains a 6Ωand resistor, a 7H inductor and a (1/42)F capacitor. Find the value of resonant frequency and exponential damping co-efficient. What will be the response of this circuit: under damped or over damped or critically damped? What new values of resistance should be used to achieve two other damping response? 5

OR

B) Find the current when the voltage applied to an inductor of 2H is 5

$$v(t) = \begin{cases} 5t\ for\ 0 \le t < 1 \\ 5\ for\ 1 \le t < 5 \\ 5 - 5(t-5) for\ 5 \le t < 6 \\ 0\ for\ t \ge 6 \end{cases}$$

Module:3:: 25 marks

Answer any two from Question 10, 11 & 12

10. a) Find the input admittance of the Y_{in} of the network shown in the Fig.Q10 and draw it as the parallel combination of resistance R and inductance L. Giving values for R and L if ω =1rad/s.

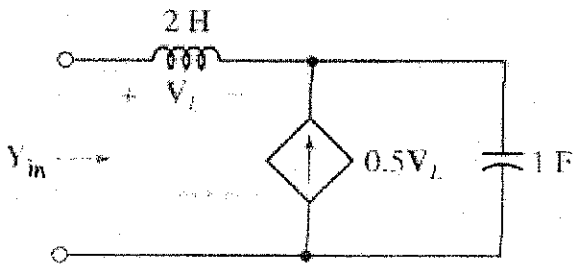

Fig.Q10

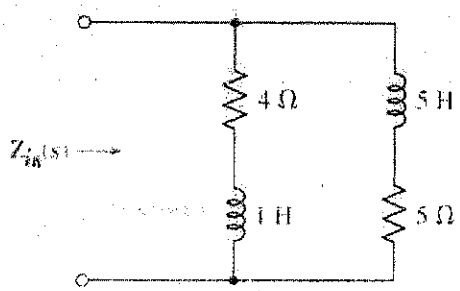

Fig.Q11

b) Find $Z_{in}(s)$ for the network shown in the Fig.Q11 and find all the critical frequencies of $Z_{in}(s)$. 10

11. Two impedances Z_1=6+j8Ω and Z_2=8-j6Ω are in parallel and the whole combination is in series with a third impedance Z_3=5+j5Ω. The circuit is driven by a sinusoidal voltage $v_s(t)$=50sin100πt. Find all the currents and voltages using phasor representation. 10

12. i) Let H(s)=100(s+2)/(s^2+2s+5). a) Find the pole and zero for H(s), b) find H(jω), c) find |H(jω)|, d) find the frequency, ω_{max} at which |H(jω)| is maximum.
ii) The pole of H(s) are at -1±j4 and zero is at -2. Let H(0)=1. a) find H(s), find $|H(j\omega)|_{max}$. 10

13. A) Find $v_x(t)$ in the circuit in Fig.Q13A if v_{s1}=20cos1000t V and v_{s2}=20sin1000t V.

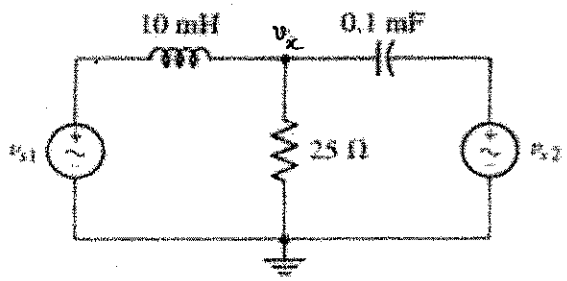

Fig.Q13A 5

OR

B) A two element network has an input impedance of 200+j80 at the frequency ω=1200rad/s. What capacitance C should be placed in parallel with the network to provide an input impedance with a) zero reactance? b) a magnitude of 100 Ω? 5

Module:4: 25 marks

14. A) A parallel resonance circuit is composed of the element R=8kΩ, L=50mH, and C=80nF. Find i) ω_0, ii) ω_d, iii) Q_0, iv) α, v) ζ. Symbols have their usual meaning. 5

OR

B) For the circuit shown in Fig.Q14B, write appropriate mesh equations for the left mesh and the right mesh if $v_s(t)=20e^{-1000t}$ V. 5

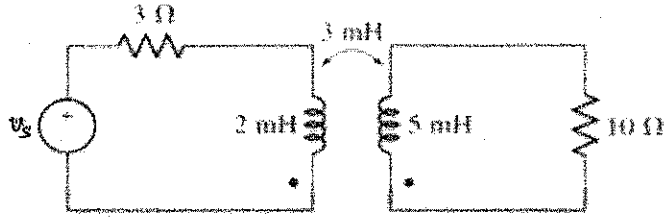

Fig.Q14B

Answer any two from Question 15, 16 & 17

15. In the circuit shown in the Fig.Q15, let I=4ang(35°) find the average power being supplied a) by the source, b) to the 20Ω resistor, and find the apparent power being supplied c) to the 20Ω resistor , d) to the load. What is the PF of the load? 10

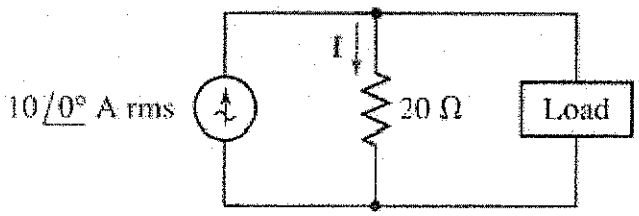

Fig.Q15

16. Construct a Bode magnitude plot for

$$H(s)=\frac{10s}{(1+s)[1+2(0.1)\left(\frac{s}{100}\right)+\left(\frac{s}{100}\right)^2]}$$

10

17. Construct a Bode phase plot for

$$H(s)=\frac{-2s}{(1+\frac{s}{10})(1+\frac{s}{20000})}$$

10