Indian Institute of Technology Patna
Mid-Semester Examination
Electrical Sciences (EE101)

2009 - 2010

Full Marks: 40 **Time: 2 Hours**

Answer all questions

1. Find the Thevenin equivalent at terminals *a*-*b* in the circuit of Figure 1.

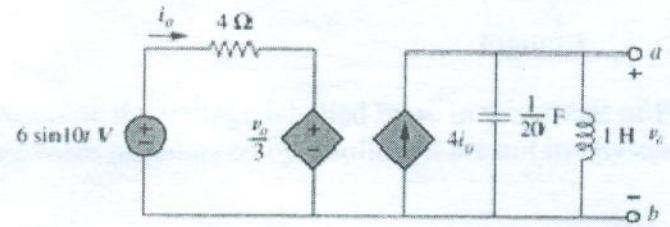

Figure 1 (7)

2. (a) Derive the expressions for natural response for a series *RLC* circuit for different possible values of *R*, *L* and *C*.

(b) The switch in the circuit of Fig. 2 is moved from position *a* to *b* at $t = 0$. Determine $i(t)$ for $t > 0$.

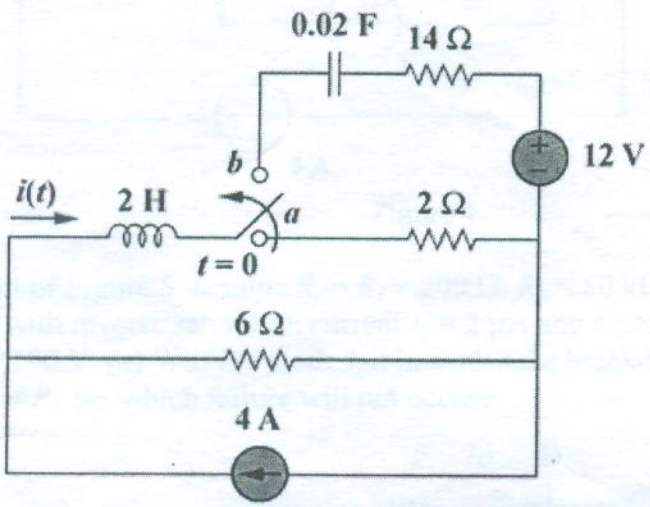

Figure 2 (3+5=8)

3. Find the frequency at which the phase shift between the input and output signals in a Wien Bridge network (given in Figure 3) is zero. Here, V_i and V_0 represent phasors for input and output sinusoids. Find the corresponding gain $A_v = \frac{V_0}{V_i}$.

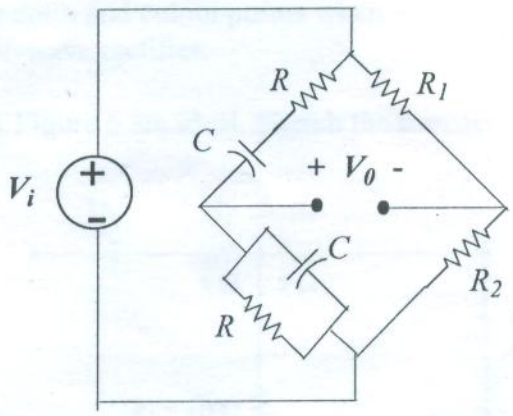

Figure 3 (5)

4. Determine the voltage labelled by v_a in the circuit of Figure 4 using supernode concept. Crossed wires not marked by a solid dot are not in physical contact.

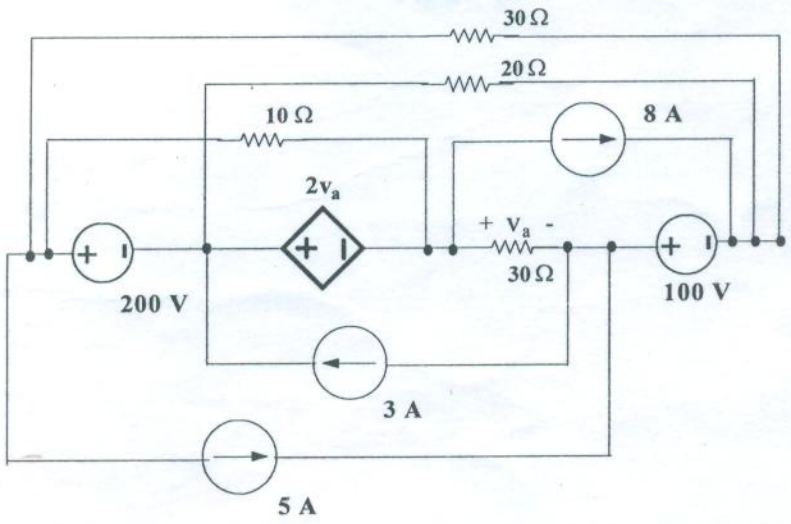

Figure 4 (5)

5. In the circuit of Figure 5, assume $R_s = R_1 = 200\ \Omega$, $R_L = 50\ \text{k}\Omega$ and $v_s = 400 \sin \omega t$ V. The diode is ideal with reverse saturation current $I_0 = 2\ \mu\text{A}$ and a peak inverse voltage (PIV) rating of $V_R = 100$ V. (a) Will the diode fail in avalanche breakdown? (b) If diode will fail, is there a value of R_L for which failure will not occur?

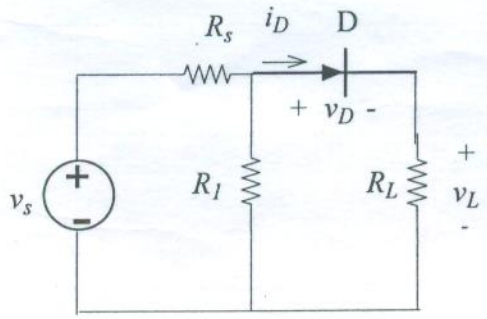

Figure 5 (5)

6. Derive the expressions for cutin and cutout points when a capacitor is connected in parallel with the load of a half-wave rectifier. (5)

7. The diodes in the circuit of Figure 6 are ideal. Sketch the transfer characteristic for -20 V $\leq$ $V_1 \leq 20$ V.

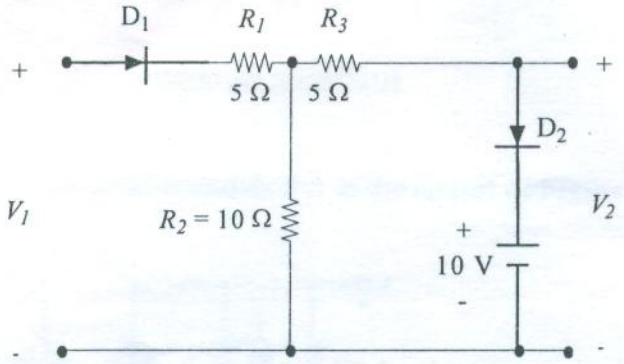

Figure 6 (5)