Indian Institute of Technology Patna
Mid-Semester Examination, Autumn Semester 2011-2012
Electrical Sciences (EE101)

**Full Marks: 40**   **Time: 2 hours**

Answer All Questions

1. In the given circuit, the variable resistor (R_0) is adjusted until it dissipates maximum power from the circuit.
(a) Find the value of R_0 when it dissipates maximum power.
(b) Find the corresponding value of power dissipated through R_0.
(c) Find the corresponding value of the percentage of total power dissipated through R_0.
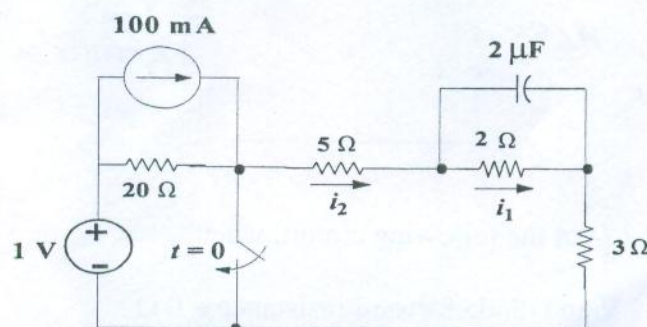
$$[5+1+1 = 7]$$
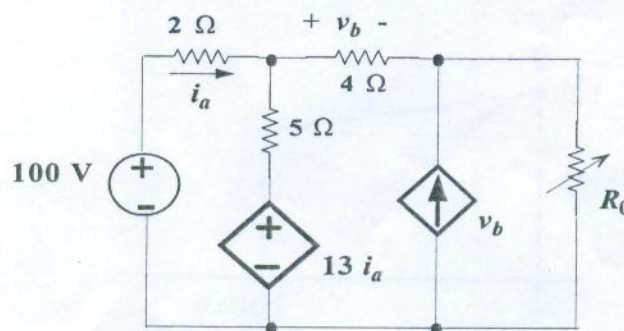
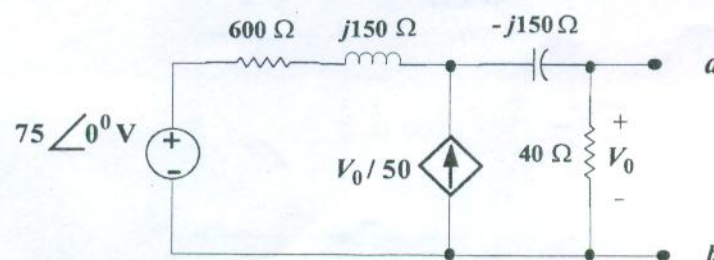2. The switch in the given circuit is closed at $t = 0$ after being open for a long time.
(a) Find $i_1(0^-)$ and $i_2(0^-)$.
(b) Find $i_1(0^+)$ and $i_2(0^+)$.
(c) Find $i_1(t)$ for $t \geq 0$.
(d) Find $i_2(t)$ for $t \geq 0$. $$[1+1+2+2 = 6]$$

3. Find Thevenin equivalent circuit with respect to the terminals a, b of the circuit shown in the following figure.   [6]

4. Define quiescent point in reference to ac-analysis of diode. Derive expression for diode small-signal resistance, which shows that diode small-signal resistance depends on quiescent point. [2+4 = 6]

5. For a Half-wave rectifier circuit, when a sinusoidal input is applied at the primary winding of transformer, derive expressions for (i) rms value of load current, (ii) Percentage voltage regulation (iii) Ripple factor of load current. [2+2+2 = 6]

6. (a) In a series RLC circuit R = 2kΩ, L = 1/40 H and C = 1/400 µF. Find the resonant frequency.

(b) A function is given by: $f(t) = \sin^2 t + \cos 2t$. Find the frequency components of $f(t)$.

(c) A fully charged mobile phone with a 12V battery is good for a 10minute talktime. Assume that, during the talk-time, the battery delivers a constant current of 2A and its voltage drops linearly from 12 V to 10V as shown in the figure. How much energy does the battery deliver during this talk-time?
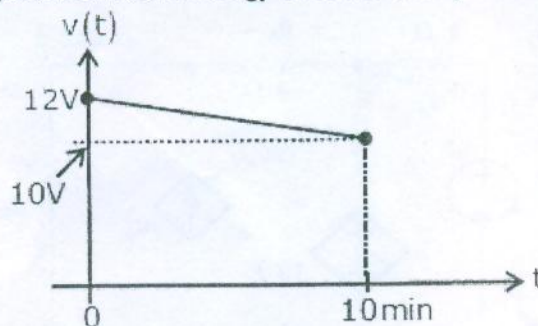
(d) An AC source with peak voltage 20V and internal impedance $Z_s = 1 + 2j$ Ω feeds a load of impedance $Z_L = 7 + 4j$ Ω in the figure below. Find the real power, reactive power supplied to the load. Also find the power factor for the load.
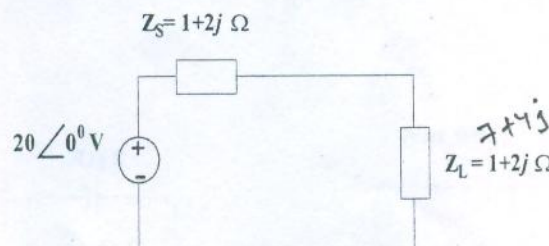
(e) Find the diode current I_D in the following circuit, when
   i) Diode is ideal
   ii) Cut-in voltage = 0.7 V and diode forward resistance = 0 Ω
   iii) Cut-in voltage = 0.7 V and diode forward resistance = 30 Ω   [1+1+2+2+3 = 9]

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