Indian Institute of Technology Patna
End-Semester Examination, Autumn Semester 2012-2013
Electrical Sciences (EE101)

Full Marks: 70 **Time: 3 hours**

Answer all questions

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1. (a) Which of the elements in the following is not bilateral?
(i) resistor (ii) inductor (iii) capacitor, (iv) transistor.

(b) When a sinusoidal voltage is applied to a purely inductive circuit, the current in the circuit
(i) is in phase with the applied voltage, (ii) leads the voltage by 90^0, (iii) lags the voltage by 90^0, (iv) none of these.

(c) The static resistance of a diode is
(i) its opposition to the DC current flow, (ii) its opposition to the AC current flow, (iii) resistance of diode when forward-biased, (iv) none of these.

(d) A sinusoidal current wave is represented by $e = 311\ sin(377t)$. The frequency of current is
(i) 50 cps, (ii) 60 cps, (iii) 70 cps, (iv) 80 cps.

(e) The current gain of a BJT is
(i) $g_m r_0$, (ii) g_m / r_0, (iii) $g_m r_\pi$, (iv) g_m / r_π

(f) The terminal voltage of an npn transistor is as follows: $V_E = 0$ V, $V_B = 0$ V and $V_C = 5.0$ V. Identify the mode of operation of the transistor.

(g) Subtract the following unsigned binary numbers 11010 – 10101 using (i) 2's complement and (ii) 1's complement.

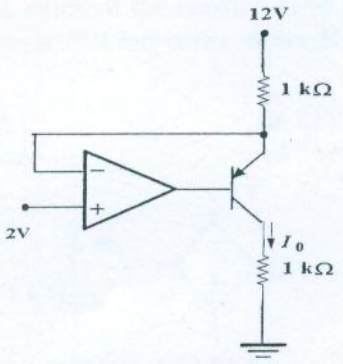
(h) Express the following function as a product of maxterms: F (x, y, z) = xy + z

(i) In reference to digital circuits, state the difference between combinational and sequential circuits?

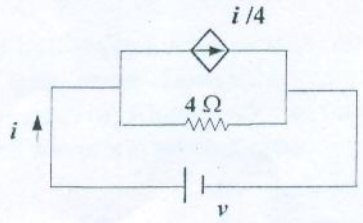
(j) A BJT has a base current of 200μA and emitter current of 20mA. Determine collector current, α and β.

(k) Draw Input and Output characteristic curve for a pnp transistor connected in Common Emitter mode.

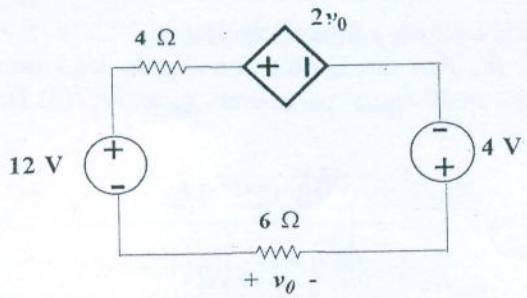
(l) The Op-Amp in the following figure is ideal. Find current I_0.



(m) In the network shown in the figure, find the effective resistance faced by the voltage source.

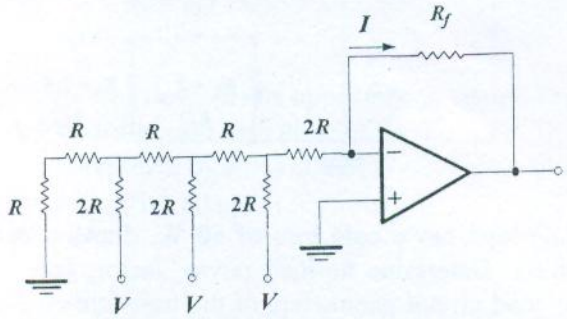


(n) Determine v_0 in the following circuit.

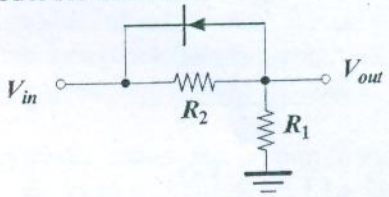


(o) State DeMorgan's law with three Binary variables.

(p) Find the current I through resistance R_f in the following circuit.

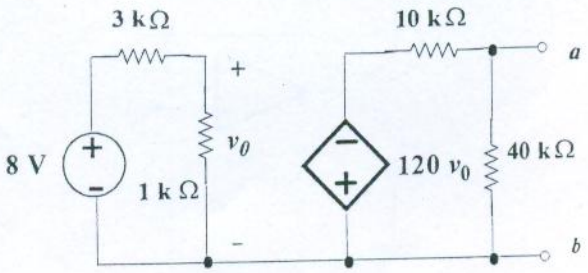


(q) Plot the transfer (input vs. output) characteristic for the circuit shown in the following figure. In the characteristic curve clearly show the slopes and coordinates of the point from which slope changes. Assume a constant-voltage model for the diode.



[1×6+2×9+2×3=30]

2. (a) For the given circuit what is the value of the resistor to be connected across terminals a-b that will absorb highest power from the circuit? What is the value of that power (i.e., the highest power absorbed by the resistor)?



(b) How Op-Amp can be used as non-inverting amplifier? [5+3=8]

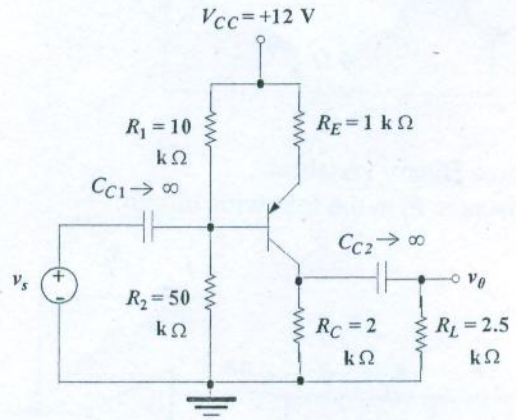
3. (a) Explain the operation of Full-wave Bridge rectifier circuit when a sinusoidal input is applied at the primary winding of transformer. Derive the expressions for (i) DC value of load current, (ii) rms value of load current, (iii) Ripple factor of load current, (iv) PIV of Diode.

(b) Show the output voltage waveform when a capacitor is connected in parallel with the load resistance. [7 + 1 = 8]

4. For the following function, use Karnaugh map method to obtain the (a) minimized SOP expression and (b) minimized POS expression: $F(A, B, C, D) = \sum (0, 3, 6, 7, 8, 9, 13, 15)$

[4+4=8]

5. Assume that the transistor in the following figure has $V_{BE}(on) = 0.7V$, $\beta = 100$, thermal voltage $V_T = 0.026V$. Neglect Early effect. (a) Plot the Q-point on the dc load line. (b) state the mode of operation of transistor. (c) Find the small-signal parameters g_m and r_π. (d) Determine the small signal voltage gain. [2+1+2+3=8]



6. (a) A transformer on no-load has a core loss of 50 W, draws a current of 2 A (r.m.s.) and has induced emf 230 V (r.m.s.). Determine no-load power factor, core loss current and magnetizing current. Also calculate no-load circuit parameters of the transformer. Neglect winding resistance and leakage flux.

(b) For the following circuit, calculate (i) the average power delivered by the source, (ii) the reactive power delivered by the source, (iii) the apparent power delivered by the source, (iv) the complex power delivered by the source. [5+3=8]