1. Figure 1 shows the circuit with two impedances Z_s and Z_L.

   (a) Derive the necessary condition of Z_s and Z_L(Load) to fulfill the Maximum Power Transfer Theorem, from which load Z_L will receive maximum power delivery from power source $V_c(t)$.

   (b) Under direct current (d.c.) condition, what is the necessary condition of maximum power delivery.

   Note: R_s and R_L are the only parts of concern from Z_s and Z_L.

   (15%)

2. Find a Thevenin Equivalent Circuit from Figure 2 across terminals a and b with 80 Ohms load.

   (10%)

3. Following Figure 3, use any small signal transistor equivalent circuit model to process the problems:

   (a) Calculate C_E for resistor R_{E2}= 560 Ohms, if the operating frequency is 1000 Hz to 200 KHz.

   (b) Draw the a.c. equivalent circuit of Fig. 3.

   (c) Derive the overall voltage gain V_L/V_S.

   (15%)

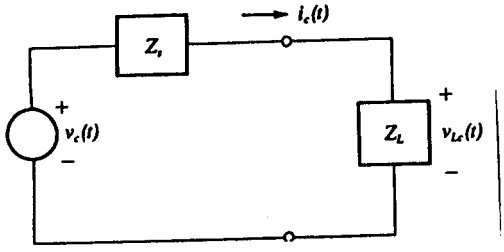

Figure 1.

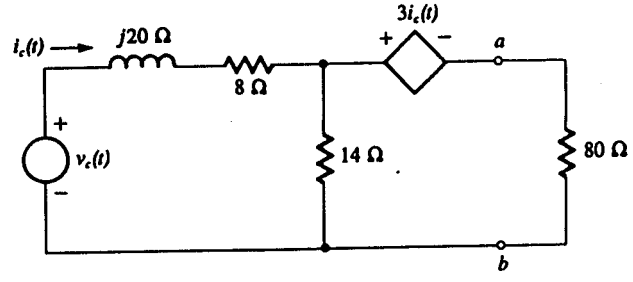

Figure 2.

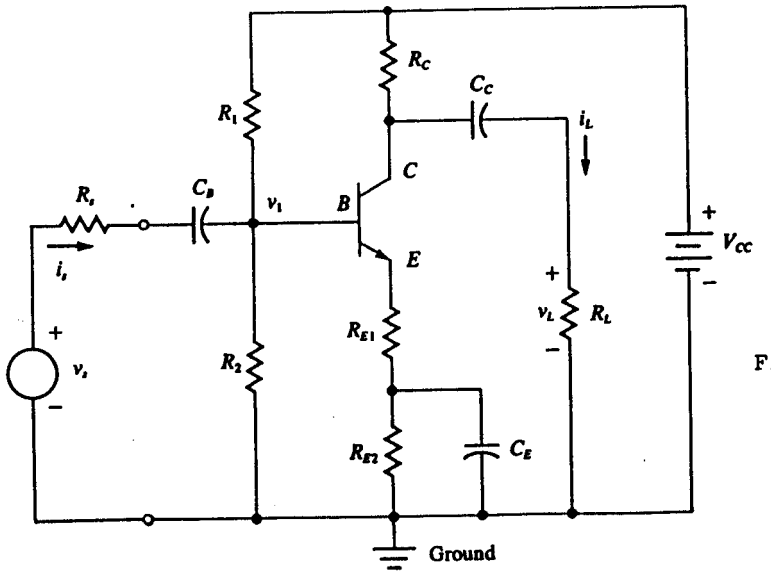

Figure 3.

4. An adaptor is designed using Figure 4. If the design conditions are determined as:

(1) transformer secondary is 12V a.c. at 60Hz,
(2) use silicon rectifier 1N4001,
(3) use 2500 μf capacitor for C,
(4) load current is 0.15 A maximum when load resistance is varying.

Process the following problems:

(a) Calculate the average voltage of V_o,

(b) Calculate the Maximum voltage of V_o.

(10%)

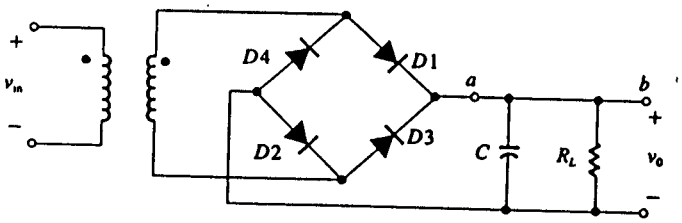

Figure 4.

5. Short answers to the following questions:

(a) Draw a Non-inverting summer OPA circuit.

(b) Draw a logic circuit to carry out:

$$F = \overline{A} \cdot B + B \cdot C$$

(10%)

6. A 10-Kg wheel as shown in Figure 6 has a moment of inertia of $I_G = 0.156\ Kg{\cdot}m^2$. Assuming that the wheel does not slip or rebound, determine the minimum velocity v_G to roll over the obstruction at A.

(10%)

7. Block D in Figure 7 moves with a speed 3 m/sec. Determine the angular velocity of its link BD and AB, and the velocity of point B at the instant shown on figure.

(10%)

8. Write the necessary equations to describe the motion of two masses between three springs as shown in Figure 8.

(20%)

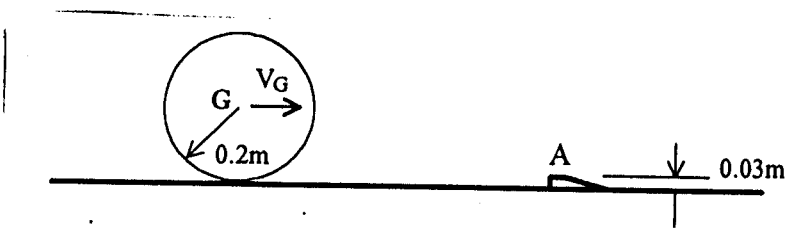

Figure 6.

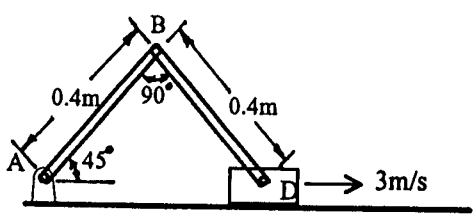

Figure 7.

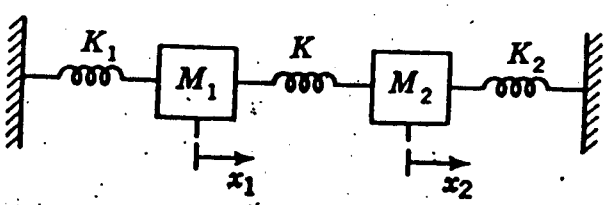

Figure 8.