THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. DEGREE PROGRAMME 2008/2009

FINAL EXAMINATION 2008

PHU 2143 / PHE 4143 CIRCUIT THEORY AND ELECTRONICS

DURATION : TWO & HALF HOURS (2 1/2 HR)

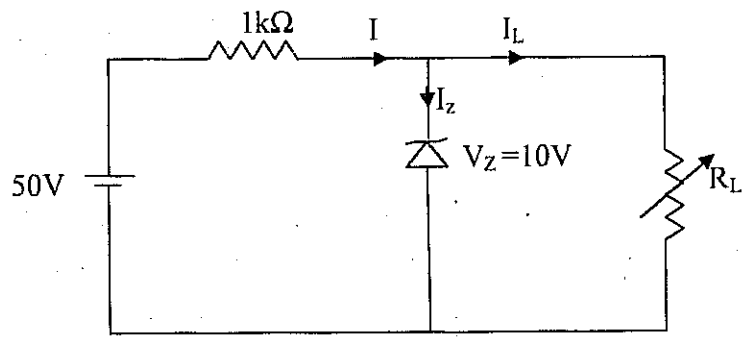
Date : 13 – 01 – 2009 **Time : 1.00 – 3.30 pm**

Answer **FOUR** Questions

1. Derive expressions for the efficiency of a half-wave rectifier circuit and full-wave bridge rectifier circuit.

(a) A full-wave rectifier circuit uses two diodes. The internal resistance of each diode may be assumed constant at 20Ω. The circuit is powered by a center tap transformer which is providing ac voltage of 50 V (rms) from center tap to each end of secondary. If the load resistance of the circuit is 980Ω find the mean load current and rms value of load current.

(b)



In the above circuit determine the range of R_L that will result in a constant voltage of 10 V across R_L.

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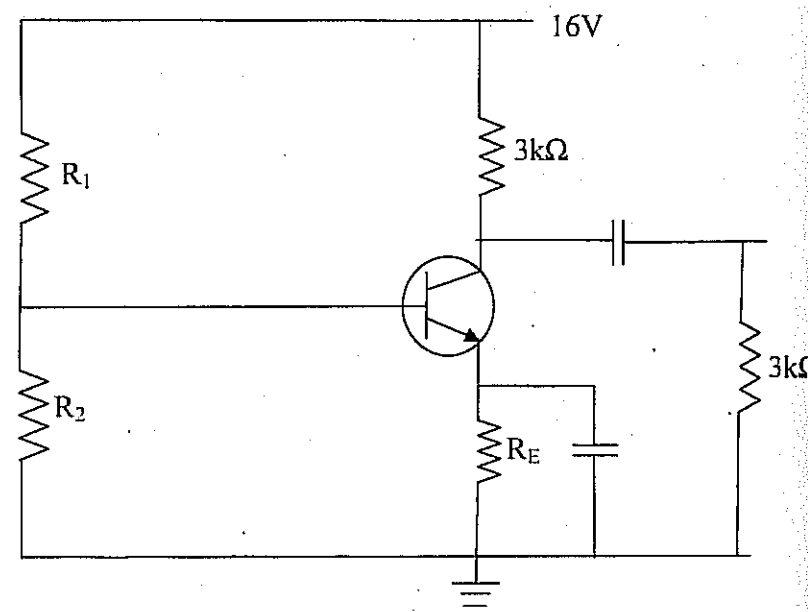


Establish the relation $\beta = \frac{\alpha}{1-\alpha}$ for a bipolar junction transistor.

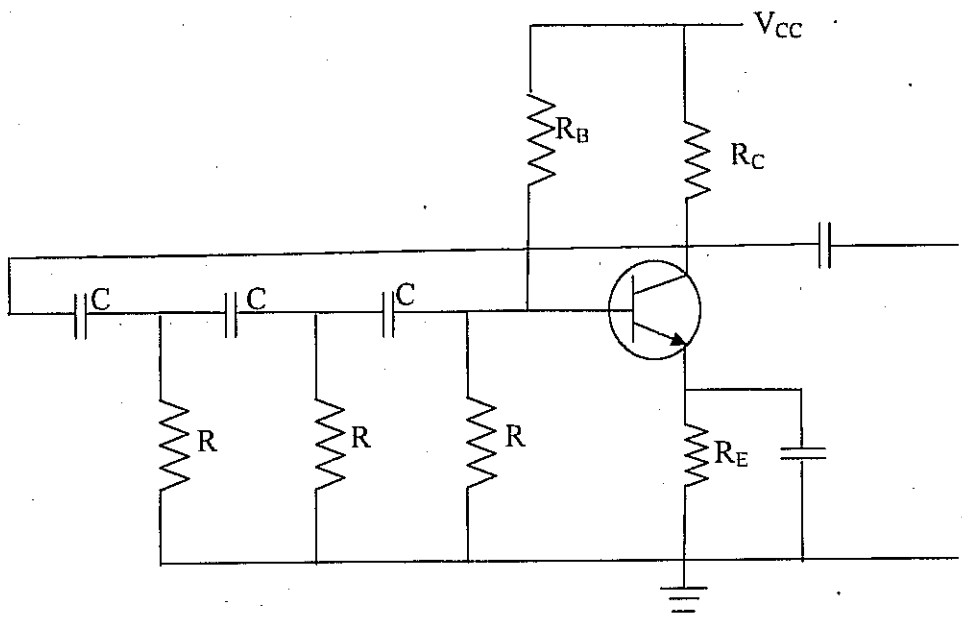
In the above circuit npn transistor has $\alpha = 0.985$ and $V_{BE} = 0.3V$. Calculate R_1, R_2 and R_E to place the Q-point at $I_C = 2mA$ and $V_{CE} = 6V$.

Draw the dc and ac load lines of the circuit.

3. A common emitter transistor circuit is driven by an ac source of internal resistance 600Ω. The load resistance of the circuit is 1 kΩ. The transistor has the following h-parameters: $h_{ie} = 1.1k\Omega$, $h_{fe} = 100$, $h_{re} = 2.0 \times 10^{-4}$ and $h_{oe} = 20 \times 10^{-6}$ mho. Calculate the current gain, voltage gain, input resistance and output resistance of the circuit.

4. Consider the phase shift oscillator circuit given below. Show that the frequency of oscillations in the circuit is $f = \frac{1}{2\pi RC\sqrt{6}}$

If $R = 1$ MΩ and $f = 954$ Hz calculate a suitable C to give the oscillations.



5. With relevant circuit diagrams explain the working of three types of multivibrator circuits. What is the basic difference among them?
An astable multivibrator circuit has two equal biasing resistances of each 10 kΩ and two equal coupling capacitors of capacitance 0.01 μF. Determine the time period and frequency of the square wave produced by the multivibrator. Prove any formula you may use.

6. (a) Prove the following Boolean expressions:
   (i) $A\bar{B}D + A\bar{B}\bar{D} = A$
   (ii) $AB + A(B + C)\ B(B + C) = B + AC$
   (iii) $AB + \bar{A}C + BC = AB + \bar{A}C$
   (iv) $(\bar{A} + B)(A + B) = B$
   (v) $ABC + BC + \bar{A}B = B(C + \bar{A})$

   (b) State the limitations of SR flip-flop. Show that an SR flip-flop can be converted into a JK flip-flop using NAND gates and obtain the truth table
   Using timing diagrams explain the action of a mod-16 ripple counter and a decade counter. State the counting sequence for both counters.
   A certain counter is being pulsed by a 256 kHz clock signal. The output frequency from the last flip-flop is 2 kHz. Determine the mod number and the counting range of the counter.

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