Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

THIRD SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION
NOV/DEC 2015
SUBJECT: ANALOG ELECTRONIC CIRCUITS (ECE - 201)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. For the transistor circuit in Fig. Q1(A), V_{CC}=22.5V, R_C=5.6kΩ, R_e=1kΩ, R_1=90kΩ, R_2=1kΩ, V_{BE} = 0.6V, and β=55, determine the Q-point.

1B. Given that R_b=9kΩ, R_e=1kΩ, β=55 and $V_{BE} = V+(R_b+R_e)[(1+\beta)/\beta]I_{CO}-[(R_b+R_e(1+\beta))/\beta]I_C$. Assuming I_{CO} and β to be constant, determine the stability factor $S'=\partial I_C/\partial V_{BE}$.

1C. Explain to how to obtain h_{fe} from the transistor output characteristics. In the Fig. Q1(C), if i_{C2}=2mA, i_{C1}=1mA, i_{B2}=20μA and i_{B1}=10μA, determine the value of h_{fe}.

(5+3+2)

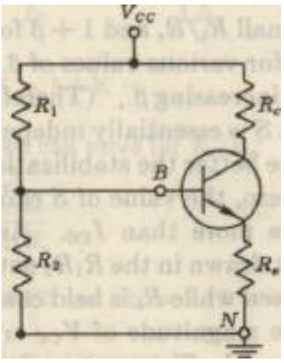

Fig. Q1(A)

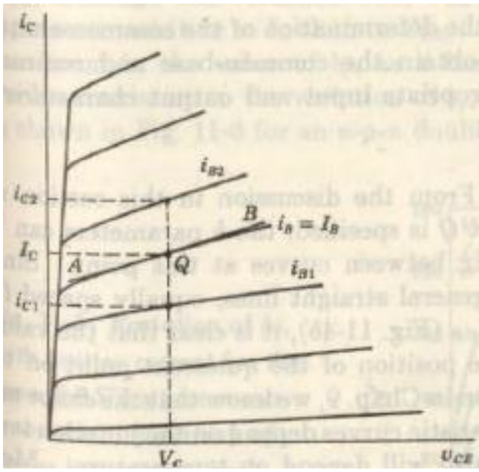

Fig. Q1(C)

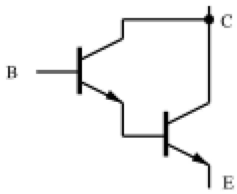

Fig. Q2(A)

2A. For the transistor circuit in Fig. Q2(A), two transistors are identical with h_{ie}=1kΩ and h_{fe}=100 and other parameters are neglected. If terminal C is connected to V_{CC}, a 1kΩ resistor is connected from E to ground, determine the small signal resistance seen at the terminal B.

2B. For the circuit drawn in Fig. Q2(B), obtain an expression for $A_I=-I_L/I_1$, $Z_I=V_1/I_1$ and $A_V=V_2/V_1$.

2C. For a transistor I_C=2mA, V_T=26mV and h_{fe}=100. Verify if the following statements are true.

(i) For the transistor, $g_m = I_C/V_T$ = 76.9mA/V.

(ii) For the transistor, $r_{b'e} = h_{fe}/g_m$ = 1.3kΩ.

(5+3+2)

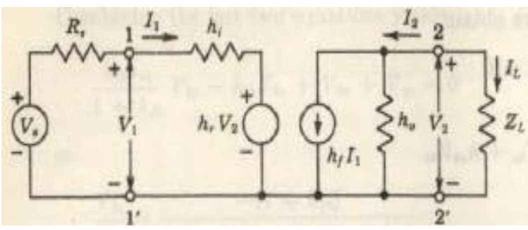

Fig. Q2(B)

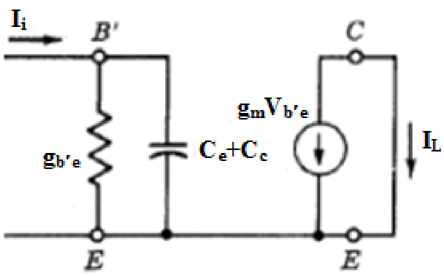

Fig. Q3(A)

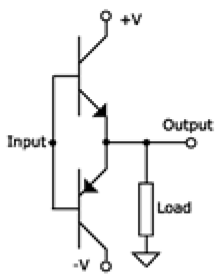

Fig. Q3(B)

3A. In the circuit of Fig. Q3(A), given that h_{fe}=50, g_m = 50mA/V, $r_{b'e}$=1kΩ, C_c=3pF, C_e=100pF. i) Obtain an expression for $A_i=I_L/I_i$. ii) Calculate the Cut-off frequency of A_i, when it is written in the form $|A_i|=h_{fe}/[1+(f/f_\beta)^2]^{1/2}$.

3B. Assuming ideal transistor, show that the amplifier circuit in Fig. Q3(B), has a maximum efficiency of 78.5%.

3C. i) A single stage amplifier has a upper cut-off frequency of 2MHz. Three such stages are connected in cascade are non-interacting. The overall cut-off frequency will be ____.

ii) In a device input current i_b and output current i_c are related by $i_c=i_b+i_b^2$. If the input current $i_b=\cos(2\pi 100t)+\cos(2\pi 200t)$, output current will be ____.

(5+3+2)

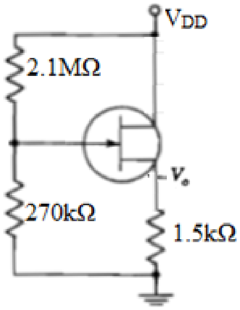

Fig. Q4(A)

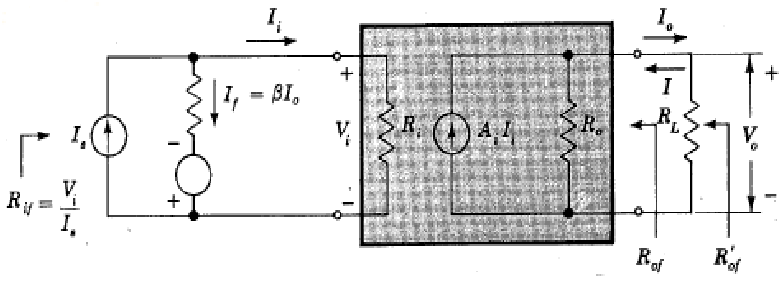

Fig. Q5(A)

4A. In the FET circuit of Fig. Q4(A), the device has g_m=25mA/V, r_d=50kΩ. If the input signal (V_i) is at the gate terminal, Calculate the value of voltage gain (V_o/V_i), resistance seen by the input source and the resistance seen at the output terminal.

4B. With necessary diagrams and I-V characteristics, explain the functioning of an n-channel MOSFET.

4C. Define μ of an FET. Determine the value of μ if an FET has g_m=25mA/V, r_d=50kΩ.

(5+3+2)

5A. By analyzing the amplifier block in Fig. Q5(A), show that,

$$A_I \equiv \frac{I_o}{I_i} = \frac{A_i R_o}{R_o + R_L}, \quad R_{if} = \frac{V_i}{(1+\beta A_I)I_i} = \frac{R_i}{1+\beta A_I}, \quad R_{of} = \frac{V}{I} = R_o(1+\beta A_i), \quad R'_{of} = R'_o \frac{1+\beta A_i}{1+\beta A_I}$$

5B. Verify if the following statements made with respect to the circuit in Fig. Q5(B) are true or false.

(i) Is an example of a Current Shunt feedback

(ii) In the network drawn without feedback, on the input side 15kΩ and 100Ω resistors appear in series.

(iii) In the network drawn without feedback, on the output side 15kΩ and 100Ω resistors appear in parallel.

(iv) For small signal analysis, 4.7kΩ, 91kΩ and 10kΩ appear from collector of Q1 to ground.

(v) The 1kΩ resistor present at the emitter of Q1 will not appear in the small signal analysis due to large capacitance connected across it.

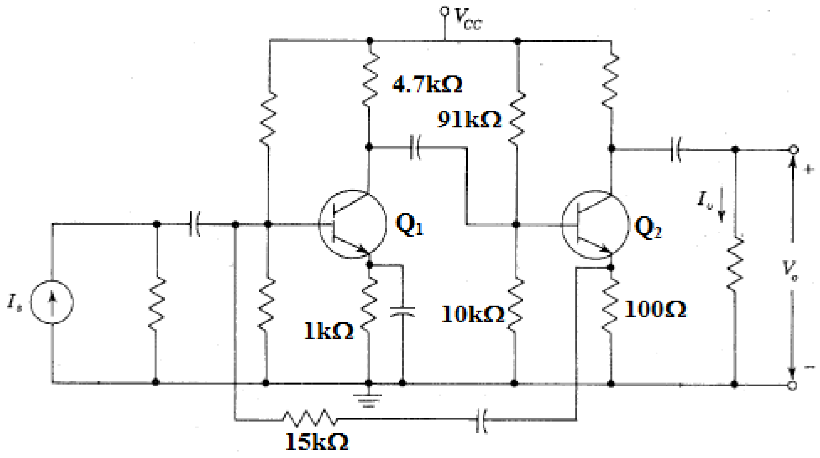

Fig. Q5(B)

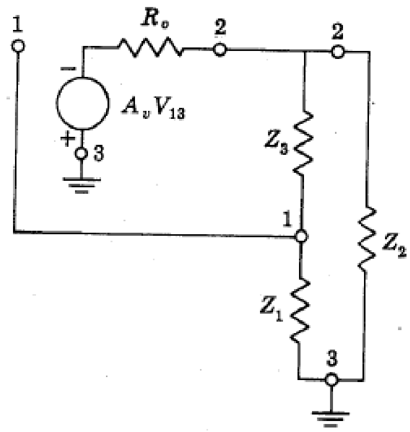

Fig. Q6(A)

6A. In the circuit of Fig. Q6(A), obtain an expression for loop gain -Aβ. If all 'Z' are reactive elements, for -Aβ to be unity and positive, show that Z_1 and Z_2 must have the same sign.

6B. Verify if the following statements are true or false.

1. In a Wien bridge oscillator, if R=1kΩ, required to C to get a 10kHz oscillation is 0.016μF.
2. A crystal can be used as an inductor or as a capacitor depending on the frequency of operation.
3. It is possible to build an oscillator circuit using an Opamp, 2 resistors and 2 capacitors.
4. Sweep circuits are commonly used in CRTs.
5. To get stable frequency of oscillation, crystal oscillators are preferred.

(5+5)