410704/410804

Roll No. _____ Total No. of Pages: 4

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B. Tech. IV - Sem. (Main / Back) Exam., (Academic Session 2021- 2022)

Electronics & Communication Engineering

4EC4 – 04/4EI4 – 04 Analog Circuits

Common to ECE & EIC

Time: 2½ Hours Maximum Marks: 120

Min. Passing Marks:

Instructions to Candidates:

Part – A: Short answer questions (up to 25 words) 6 × 3 marks = 18 marks. Candidates have to answer six questions out of ten.

Part – B: Analytical/Problem solving questions 3 × 10 marks = 30 marks. Candidates have to answer three questions out of seven.

Part – C: Descriptive/Analytical/Problem Solving questions 3 ×24 marks = 72 marks. Candidates have to answer three questions out of five.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

Q.1 Define thermal runaway in bipolar junction transistors.

Q.2 What is the role of biasing in transistors?

Q.3 Discuss the condition of validity for high frequency Hybrid – π model of BJT.

Q.4 Define gain and phase margin for any amplifier.

Q.5 State the Barkhausen criterion for sinusoidal oscillator.

Q.6 Classify various types of oscillator as per the frequency range.

Q.7 Calculate the voltage gain of non-inverting amplifier using op – amp 741.

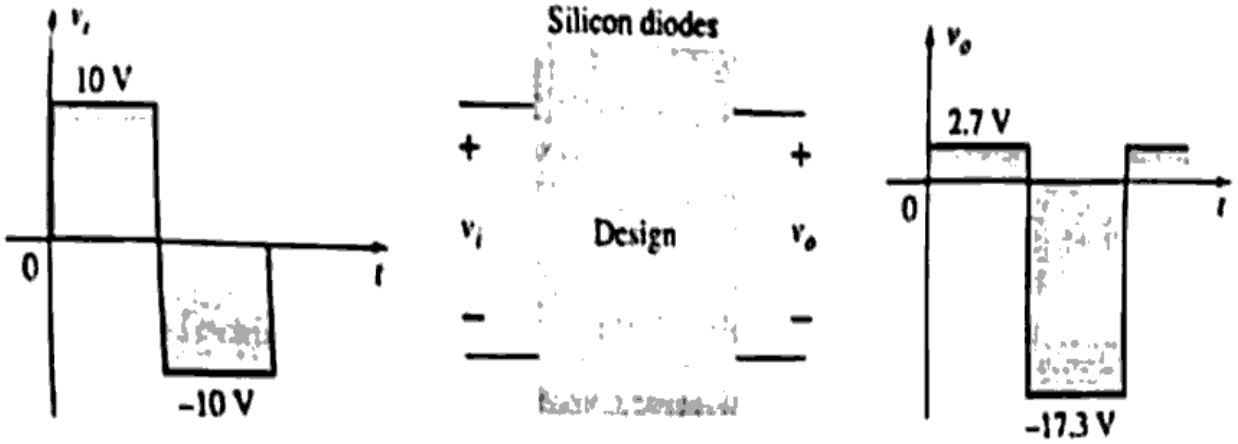
Q.8 Define the CMRR of operational amplifier.

Q.9 What are applications of digital-to-analog converters?

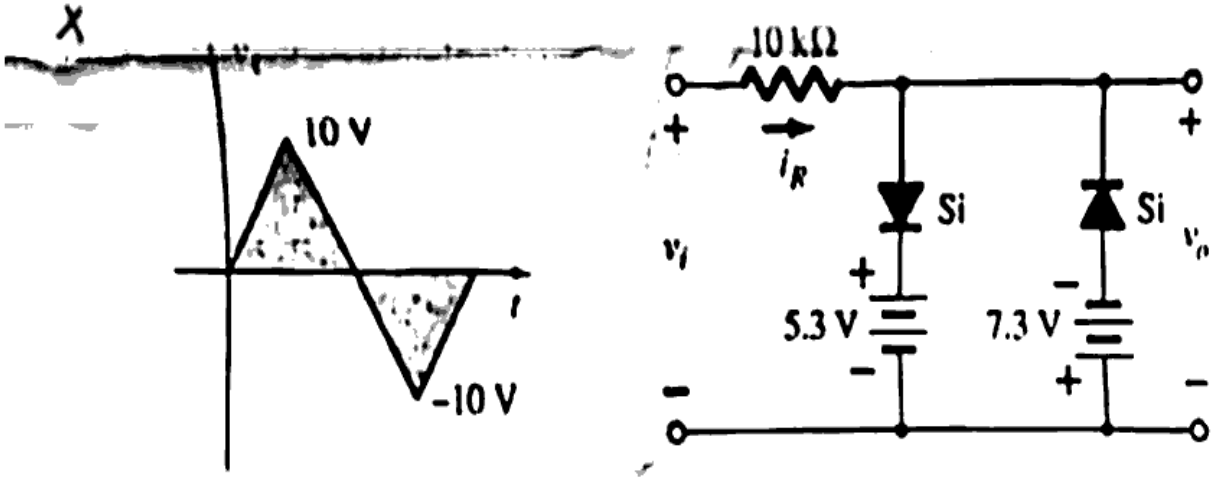
Q.10 What are the characteristics of negative feedback?

PART – B

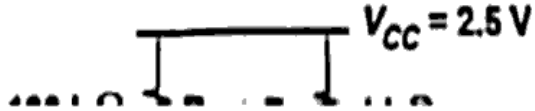
Q.1 (a) *Design a clamper to perform* following operation and draw the transfer curve for the *same:*



(b) Sketch v_0 and i_R for the circuit shown below –

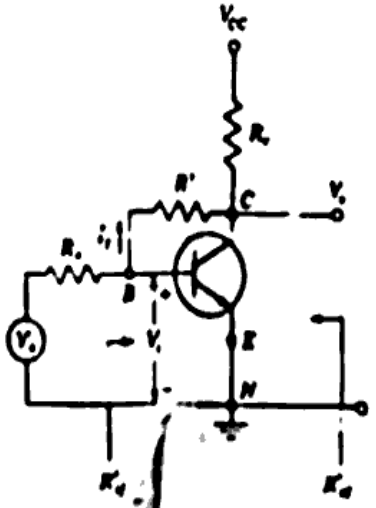


Q.2 Determine the DC bias voltage VCE and the current IC for the voltage divider configuration of shown below. Also, calculate the stability factor of the circuit if β of transistor is 99.



Q.3 How the small signal model of BJT is derived at high frequency. Discuss the origin of each resistance and capacitance of the high frequency small signal model with the relevant device physics. Derive the hybrid – π conductance in terms of h – parameters.

Q.4 For the circuit shown below, $R_C = 5K\Omega$, $R' = 50\Omega$, $R_S = 10K\Omega$, $h_{ie} = 1.1K\Omega$ and $h_{fe} = 100$. Identify the topology and calculate the voltage gain, input and output resistance with and without feedback.



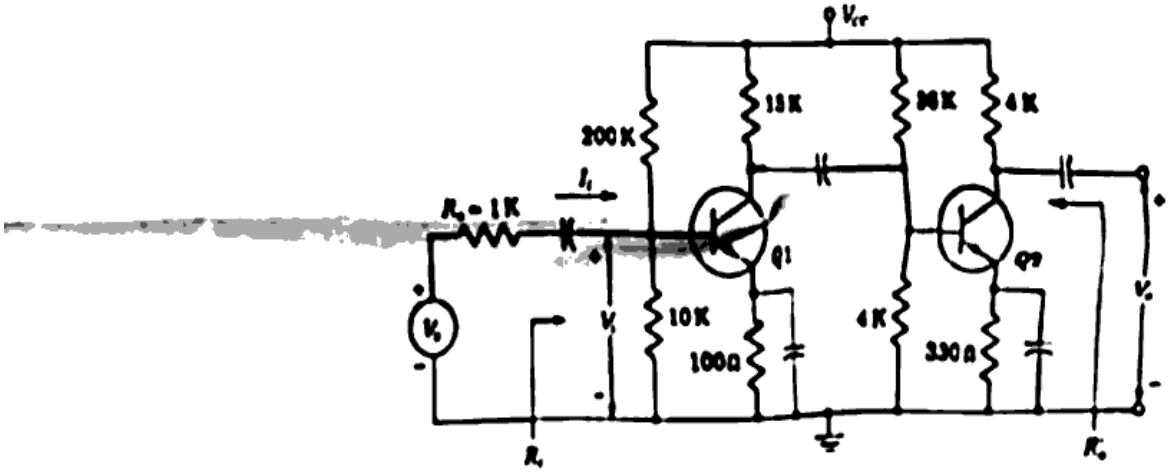
Q.5 In a BJT based Hartley oscillator circuit, the inductor (L) of tank circuit has a series resistance (r). Calculate the frequency of oscillation and condition of oscillation for this circuit. What happens if this series resistance is made equal to zero?

Q.6 Discuss the characteristics of operational amplifier. Also, design a precision half and full wave rectifier using op – amp 741.

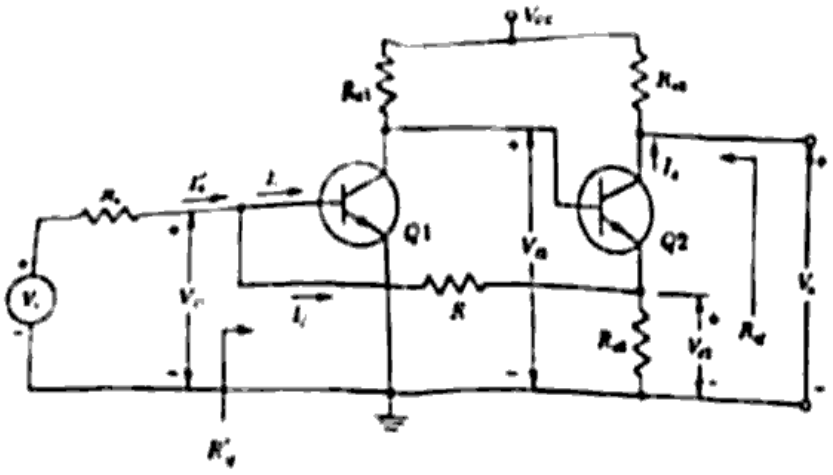
Q.7 Discuss the concept of switched capacitor circuits with suitable example.

PART – C

Q.1 Using approximate/simplified small signal mode calculate the voltage gain A_v of the circuit shown below by consider $\beta = 49$, $I_{CQ} \approx I_{EQ} = 1.16$ mA. Also, assume both the transistors to be identical and capacitors to be lager enough.



Q.2 Analyze the following circuit and derive A_v, A_d, A_{vf}, R_i, R_{if}, R_o and R_{of} for the same using the concept of negative feedback.



Q.3 Explain the current mirror circuit using BJT. How single stage CE amplifier can be converted into a differential pair? For a differential amplifier, prove that the transfer characteristics is represented by following equation:

$$V_o = I_o R_c \left[\frac{e^{\frac{V_{id}}{2V_T}} - e^{-\frac{V_{id}}{2V_T}}}{e^{\frac{V_{id}}{2V_T}} + e^{-\frac{V_{id}}{2V_T}}} \right]$$

Here V_{id} is the differential input voltage, V_o is differential output voltage and I_o is total current through emitter resistance and R_C is the collector resistance and V_T is thermal equivalent of voltage.

Q.4 Discuss the working and operation of Schmitt trigger use op–amp and draw output characteristics and hysteresis curve under zero and non - zero values of reference voltage V_R.

Q.5 *Design and analyze the Bandpass filter using op-amp. Also, design a low pass filter using op-amp for the voltage gain of 10 and cutoff frequency of 16 kHz.*