CBCS SCHEME

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18EC42

Fourth Semester B.E. Degree Examination, July/August 2021
Analog Circuits

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Explain the voltage divider biasing for BJTs using single power supply. How does R_E provides a negative feedback action to stabilize the bias current with necessary supporting mathematical equations. **(08 Marks)**

b. For the circuit shown in Fig.Q1(b), derive the expression of voltage gain.

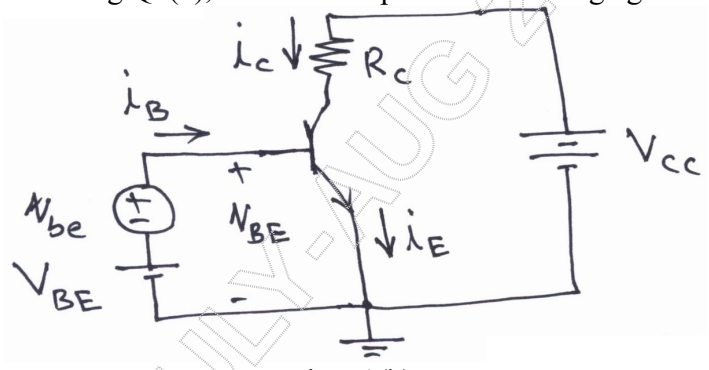

Fig.Q1(b) **(06 Marks)**

c. A BJT having $\beta = 100$ is biased at a dc collector current of 1 mA. Find the value of g_m, r_e and r_π at the bias point. Assume $V_T = \frac{1}{40}V$ **(06 Marks)**

2 a. For the circuit shown in Fig.Q2(a), find the required value of V_{GS} to establish a dc bias current $I_D = 0.5$ mA. Device parameters are $V_t = 1$ V, $K_n' \frac{W}{L} = 1$ mA/V^2 and $\lambda = 0$. What is the percentage change in I_D obtained when the transistor is replaced with another having $V_t = 1.5$ V.

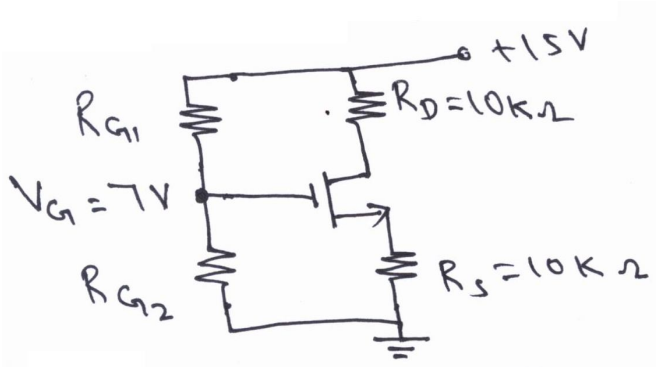

Fig.Q2(a) **(08 Marks)**

b. What is trans-conductance of a MOSFET and mention the three different expression used to calculate the trans-conductance. **(06 Marks)**

c. Explain biasing of MOSFET by fixing V_{GS}. **(06 Marks)**

3 a. For the circuit shown in Fig.Q3(a), derive the expression of R_{in}, R_o, A_{V_o} and A_V using T-model.

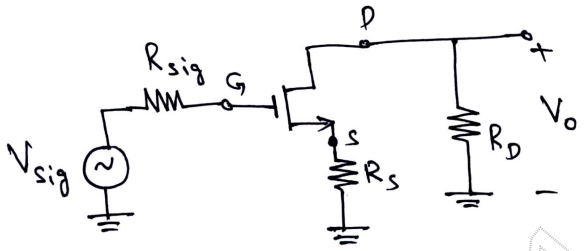

Fig.Q3(a) **(10 Marks)**

b. With mathematical equations, explain the different internal capacitances in the MOSFET. **(10 Marks)**

4 a. Explain the high frequency response of a CS amplifier using MOSFET and derive its upper cutoff frequency. **(10 Marks)**

b. Explain the working principles of Colpitts oscillator and also discuss the drawback of this oscillator are over come using Clapp oscillator. **(10 Marks)**

5 a. In a particular circuit represented by the block diagram shown in Fig.Q5(a), a signal of 1V from the source results in a difference signal of 10 mV being provided to the amplifier (A) and 10V applied to the load. For this arrangement identify the value of A and β that apply.

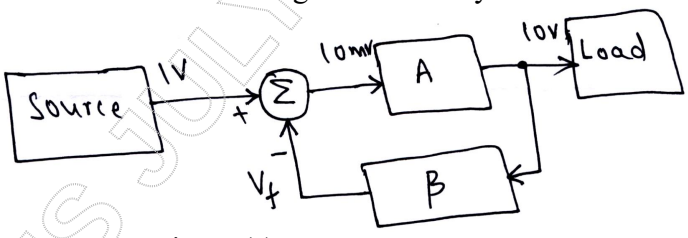

Fig.Q5(a) **(06 Marks)**

b. Draw the general feedback structure and explain with necessary expressions. **(06 Marks)**

c. What are the properties of negative feedback and explain it. **(08 Marks)**

6 a. What is output stage and discuss the classification of output stages based on the collector current? **(06 Marks)**

b. A transformer coupled class A power amplifier drawn a current of 200 mA from the collector supply of 10 V, when no signal is applied it. Determine:
(i) Maximum output power
(ii) Maximum collector efficiency
(iii) Power rating of the transistor
If the load connected across the transformer secondary is 2 Ω and transformer turn ratio is 5:1. **(06 Marks)**

c. Explain the working of class A output stage amplifier and also prove that power conversion efficiency is 25%. **(08 Marks)**

7 a. Derive the expression of exact voltage gain and ideal voltage gain of a voltage shunt feedback amplifier using OP-AMP. **(08 Marks)**

b. The 741 OP-AMP having the following parameter is connected as a non-inverting amplifier with R_1 = 1 KΩ and R_F = 10 KΩ. Given A = 200000, R_i = 2 MΩ, R_0 = 75 Ω, f_0 = 5 Hz and supply voltage = ±15V. Compute the value of A_F, R_{iF}, R_{OF} and f_F. **(06 Marks)**

c. With the circuit and waveforms, explain the working of non-inverting comparator. **(06 Marks)**

8 a. Explain the working of instrumentation amplifier using transducer bridge and derive the expression of output voltage. **(10 Marks)**

b. Explain the operation of a inverting Schmitt Trigger. **(06 Marks)**

c. The circuit shown in Fig.Q8(c) is to be used as averaging amplifier with the following specifications: $V_a = V_b = 1.5$ V, $V_c = 3$V, $R_1 = R = 1.5$ K and $V_0 = 5.2$ V. Determine the required value of R_F.

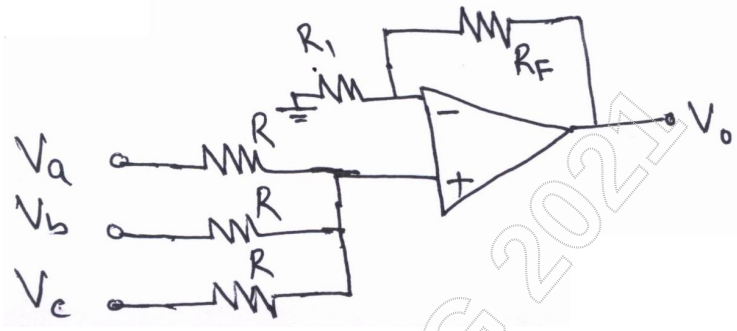

Fig.Q8(c) **(04 Marks)**

9 a. Derive the expression of output voltage of a binary weighted resistor type DAC. **(08 Marks)**

b. For the DAC using an R-2R network with R = 10 KΩ, R_F = 27 KΩ and V_R = 5V.

(i) Determine the size of each step

(ii) Calculate the output voltage when $b_0 = b_1 = b_2 = b_3 = 5$V. **(06 Marks)**

c. Explain the working of a first order active low pass filter with circuit and frequency response. **(06 Marks)**

10 a. Explain the operation of a successive approximation DAC and mention its advantages. **(08 Marks)**

b. Mention the applications of 555 IC Timer. **(04 Marks)**

c. Design an Astable Multivibrator using 555 IC Timer with

(i) $f_0 = 1$ kHz and D = 40%

(ii) $f_0 = 2$ kHz and D = 50%

(iii) $f_0 = 1$ kHz and D = 70%

Assume c = 0.01 μF for all cases. **(08 Marks)**

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