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## Third Semester B.E. Degree Examination, June/July 2023 Analog Electronic Circuits

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. Explain the classical biasing for BJTs using a single power supply with circuit and relevant equations. How is bias current stabilized? (08 Marks)
- b. Design collector-to-base feedback resistor circuit to obtain a dc emitter current of 1mA and to ensure  $V_{CE} = 2.3V$ . Let  $V_{CC} = 10V$  and  $\beta = 100$ . (04 Marks)
- c. Considering the conceptual circuit of common emitter amplifier, derive the expression for small-signal input resistance between base and emitter resistance. Mention the relation between  $r_{\pi}$  and  $r_e$ . (08 Marks)

### OR

- 2 a. Why biasing by fixing  $V_{GS}$  is not a good approach? Explain biasing by fixing  $V_G$  and connecting a resistance in the source. (10 Marks)
- b. Design Drain-to-Gate feedback resistor biasing circuit to operate at a dc drain current of 0.5mA. Assume  $V_{DD} = 5V$ ,  $K'_n W/L = 1mA/V^2$ ,  $V_t = 1V$  and  $\lambda = 0$ . Use standard value for  $R_D$  and give actual values obtained for  $I_D$  and  $V_D$ . (06 Marks)
- c. A BJT having  $\beta = 100$  is biased at a dc collector current of 1mA. Find the value of  $g_m$ ,  $r_c$  and  $r_{\pi}$ . Assume  $V_T = 25mV$ . (04 Marks)

### Module-2

- 3 a. Obtain the expression for characteristic parameters of the CS amplifier with circuit diagram and its equivalent circuit. (08 Marks)
- b. A CS amplifier utilizes a MOSFET biased at  $I_D = 0.25mA$  with  $V_{OV} = 0.25V$  and  $R_D = 20K\Omega$ . The device has  $V_A = 50V$ . The amplifier is fed with a source having  $R_{sig} = 100K\Omega$  and a 20-K $\Omega$  load is connected to the output. Find  $R_{in}$ ,  $A_{vo}$ ,  $R_o$ ,  $A_v$  and  $G_v$ . (05 Marks)
- c. Explain the internal capacitances of a MOSFET and hence draw the high frequency small signal model of MOSFET. (07 Marks)

### OR

- 4 a. Find the mid band gain  $A_M$  and the upper 3-dB frequency  $f_H$  of a CS amplifier fed with a signal source having an internal resistance  $R_{sig} = 100K\Omega$ . The amplifier has  $R_G = 4.7M\Omega$ ,  $R_D = R_L = 15K\Omega$ ,  $g_m = 1mA/V$ ,  $r_0 = 150K\Omega$ ,  $C_{gs} = 1pF$  and  $C_{gd} = 0.4pF$ . (06 Marks)
- b. Explain the working of FET – based RC phase shift oscillator with circuit diagram. In an RC phase shift oscillator,  $R = 200K\Omega$  and  $C = 200pF$ . Find the frequency of the BJT-based oscillator. (08 Marks)
- c. Explain the working of clapp oscillator with a circuit diagram. (06 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42+8 = 50, will be treated as malpractice.

**Module-3**

- 5 a. Explain general feedback structure of the feedback amplifier with a signal flow diagram and mathematical expressions. (08 Marks)
- b. Explain noise reduction with the application of negative feedback in amplifiers. (08 Marks)
- c. A class B push-pull amplifier is supplied with  $V_{CC} = 50V$ . The signal brings the collector voltage down to  $V_{min} = 5V$ . The total dissipation from both transistors is 40W. Find the total power and conversion efficiency. (04 Marks)

**OR**

- 6 a. Explain transconductance amplifier with a neat block diagram. (06 Marks)
- b. Explain class-B transformer-coupled amplifier. Prove that the maximum conversion efficiency of a class B transformer coupled amplifier is 78.5%. (08 Marks)
- c. Explain class C output stage with a neat diagram. (06 Marks)

**Module-4**

- 7 a. Explain inverting amplifier with external offset null circuit and relevant expressions for output voltage and closed loop gain. (07 Marks)
- b. Explain successive-approximation type A/D converter with a neat diagram. (07 Marks)
- c. Explain positive small-signal half-wave rectifier circuit with waveforms. (06 Marks)

**OR**

- 8 a. Explain the working of a second order high pass Butterworth filter with a neat circuit diagram and frequency response. Write the relevant design equations. (08 Marks)
- b. Design second order low-pass filter at a high cutoff frequency of 1kHz. Choose capacitance value  $0.0047\mu F$ . (05 Marks)
- c. Explain the operation of 555 timer as astable multivibrator with relevant expressions. (07 Marks)

**Module-5**

- 9 a. Explain the classification of power electronic convertors. (06 Marks)
- b. With the help of elementary circuit and static V-I characteristics, explain the three regions of operation of the SCR. (08 Marks)
- c. Explain class-A commutation with necessary circuit diagram and waveforms. (06 Marks)

**OR**

- 10 a. Write a note on basic requirements for the successful firing of a thyristor. (04 Marks)
- b. Explain RC firing circuit with necessary circuit diagram and waveform. Write the relevant design equations. (08 Marks)
- c. Explain UJT relaxation oscillator with a neat circuit diagram. Derive the expression for frequency of oscillation. (08 Marks)

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