

B.Tech. DEGREE EXAMINATION, DECEMBER 2023
OPEN BOOK EXAMINATION
 Fourth Semester

18ECC201J – ANALOG ELECTRONIC CIRCUITS

(For the candidates admitted from the academic year 2020-2021 to 2021-2022)

- Specific approved THREE text books (Printed or photocopy) recommended for the course
- Handwritten class notes (certified by the faculty handling the course / head of the department)

Time: 3 Hours

Max. Marks: 100

Answer **FIVE** questions

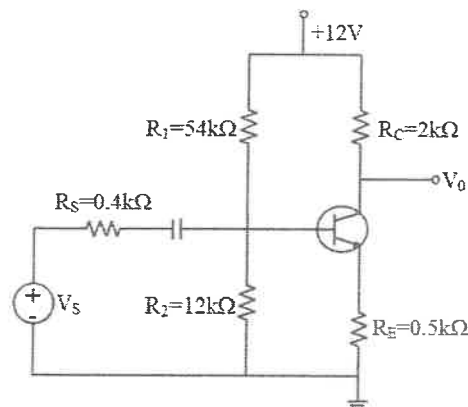
(Question No 1 is compulsory)

Marks	BL	CO	PO
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- 1.a.i. Determine the small signal voltage gain, input resistance of a common emitter BJT circuit with emitter resistor shown below.

The transistor parameters are:

$$\beta = 80, V_{BE(ON)} = 0.7V \text{ and } V_A = \infty.$$

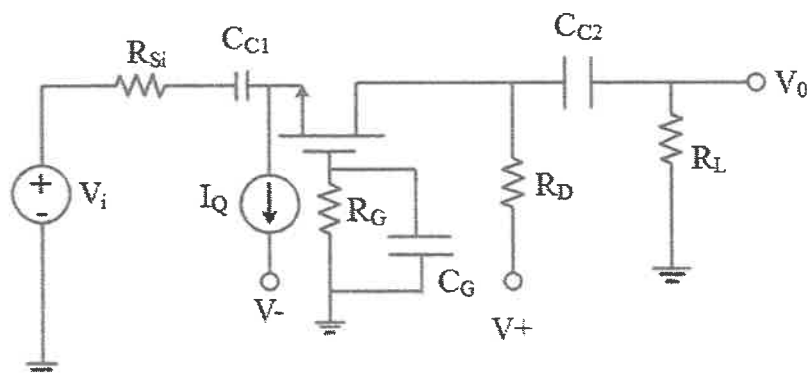


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|--|---|---|---|---|
| ii. For a common emitter BJT amplifier consisting of both coupling and load capacitors derive the corner frequencies, time constants and the mid band gain. | 6 | 3 | 1 | 3 |
| b. In the small signal hybrid - π equivalent circuit of BJT the diffusion resistance is represented as | 1 | 2 | 1 | 2 |
| (A) $\frac{\beta V_T}{I_{CQ}}$ | | | | |
| (B) $\frac{\beta I_{CQ}}{V_T}$ | | | | |
| (C) $\frac{I_{CQ}}{V_T}$ | | | | |
| (D) $\frac{V_T}{I_{CQ}}$ | | | | |
| c. Which of the following BJT amplifier is referred to as an impedance transformer? | 1 | 2 | 1 | 2 |
| (A) Common emitter | | | | |
| (B) Common base | | | | |
| (C) Emitter follower | | | | |
| (D) Cascade | | | | |
| 2.a.i. In applications including sensors and audio amplifiers it is desirable to have a BJT transistor with high current gain. Is it suitable to use a Darlington configuration to provide high current gain? Justify using necessary diagrams and equations. Also, prove that the Darlington pair has | 8 | 3 | 1 | 3 |

high input resistance.

- ii. What is the value of current gain A_i in a Darlington pair if the current amplification factors of the individual transistors is 99 and 100? (With and without approximation). 4 3 1
- iii. State briefly the need for a BJT multistage configuration amplifier circuit where in the input is given into a common emitter (CE) amplifier and it drives a common base amplifier. Derive the voltage gain for the above stated BJT multistage amplifier. 6 2 1 2
- b. The input impedance of a common base BJT amplifier is 1 1 1 1
 (A) Low (B) High
 (C) Moderate (D) Infinity
- c. In the design of a good audio amplifier the lower cut off frequency f should be less than 1 2 1 2
 (A) 1 kHz (B) 20 kHz
 (C) 20 Hz (D) 100 Hz
- 3.a.i. Analyze the common gate amplifier circuit and derive its voltage gain, current gain, input and output impedances. 8 2 2 2

- ii. For the circuit shown below determine the output voltage for a given input current. The circuit parameters are 4 3 2 3
 $I_Q = 2\text{mA}$, $V_T = 5\text{V}$, $V^- = -5\text{V}$, $R_G = 120\text{K}\Omega$, $R_D = 3\text{K}\Omega$, $R_L = 12\text{K}\Omega$, $V_{TN} = 1\text{V}$, $K_n = 1\text{mA/V}^2$, $\lambda = 0$, $R_{Si} = 40\text{k}\Omega$ and the input current is $120\sin\omega t\mu\text{A}$.



- iii. Elaborate with necessary equations and diagrams the effect of output coupling capacitor on the voltage gain of the common source amplifier circuit. State the significance of time constant and corner frequency. 6 2 2 2
- b. In MOSFET, the transconductance is a transfer coefficient relating output current to 1 2 2 2
 (A) Input current (B) Input voltage
 (C) Output voltage (D) Output power
- c. The output resistance in a source followers circuit is 1 1 2 1
 (A) High (B) Low
 (C) Moderate (D) Infinity

- 4.a.i. A Wein bridge oscillator uses RC bridge circuit for generating oscillations. How is Barkhausen criteria satisfied in a Wein Bridge oscillator? With suitable diagrams and equations elaborate the working principle of Wein bridge oscillator and state its frequency of oscillation. 8 2 3 1
- ii. In a Wein bridge oscillator, the values of resistors and capacitors are given by $R_1 = R_2 = 220K\Omega$, $C_1 = C_2 = 250PF$. determine the frequency of oscillations. 4 3 3 3
- iii. Write short notes on the LC tuned oscillator that has its basic resonant circuit containing 2 inductive elements and 1 capacitive element and find its frequency of oscillation if $L_1 = 1000\mu H$, $L_2 = 100\mu H$, $M = 20\mu H$ and $C = 20pF$. 6 3 3 3
- b. An oscillator differs from an amplifier because it 1 1 3 1
- (A) Has more gain (B) Requires no input signal
(C) Requires no DC supply (D) Always has the same input
- c. In a phase shift oscillator, the frequency determining elements are _____ 1 1 3 1
- (A) L and C (B) R, L and C
(C) R and C (D) C only
- 5.a.i. Derive and determine the input resistance of a shunt input connection and output resistance of a series output connection, for a feedback current amplifier. Consider a shunt-series feedback amplifier in which the open loop gain is $A_f = 10^4$ and the closed loop gain is $A_{if} = 40$. Assume the input and output resistances of the basic amplifier are $R_i = 8k\Omega$ and $R_o = 18k\Omega$ respectively. From the values obtain write the inference. 12 3 3 3
- ii. Critically examine the reasons for the need of negative feedback. Why is negative feedback required? Does it have any disadvantages? Elaborate. 6 2 3 1
- b. The shunt-shunt configuration of negative feedback amplifier is also known as 1 1 3 1
- (A) Transconductance amplifier (B) Trans resistance amplifier
(C) Voltage amplifier (D) Current amplifier
- c. Common base amplifier is an example of which of the following feedback topologies? 1 2 3 1
- (A) Series-series (B) Series-shunt
(C) Shunt-series (D) Series-series
- 6.a.i. Explain the need for push-pull connection in class-B power amplifier and derive its efficiency. Prove that the maximum efficiency provided by class-B power amplifier is 78.5%. 8 2 4 2
- ii. For a class B power amplifier providing a 20 V peak signal to a 15Ω load (speaker) with a power supply of $V_{CC} = 25V$, determine the input power, output power, and circuit efficiency. 4 3 4 3

- iii. Identify the class of power amplifier that is designed to operate with pulse type signals and explain its operations with necessary diagrams. 6 2 4 2
- b. The cross over distortion is a behaviour characteristic of 1 1 4 1
 (A) Class A output stage (B) Common base output stage
 (C) Class AB output stage (D) Class B output stage
- c. The transistor amplifier with more than 85% efficiency is likely to be 1 2 4 1
 (A) Class A (B) Class B
 (C) Class AB (D) Class C
- 7.a.i. Analyze the basic bipolar differential amplifier using its small signal equivalent circuit and derive its differential and common mode gain. 10 2 5 2
- ii. For the above bipolar differential amplifier, circuit determine the Common Mode Rejection Ratio (CMRR) if the A_d and A_c are respectively 95.2 and -0.3266. 2 3 5 3
- iii. For a BJT common emitter amplifier circuit with active load, derive the small signal voltage gain with suitable equations and diagrams. 6 2 5 2
- b. In a 3-transistor BJT current source the reference and output currents are related as .1 2 5 2
 (A) $I_o = \frac{I_{ref}}{\left[1 + \frac{2}{\beta(1+\beta^3)}\right]}$ (B) $I_o = \frac{I_{ref}}{\frac{2}{\beta(1+\beta^3)}}$
 (C) $I_o = \frac{I_{ref}}{\frac{2}{\beta(1-\beta^3)}}$ (D) $I_o = 1 - \frac{I_{ref}}{1+2\beta}$
- c. In a differential amplifier if $V_1 = +5V$ and $V_2 = -5V$, the common mode voltage V_{cm} is 1 2 5 2
 (A) 5 (B) 10
 (C) 0 (D) 1

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