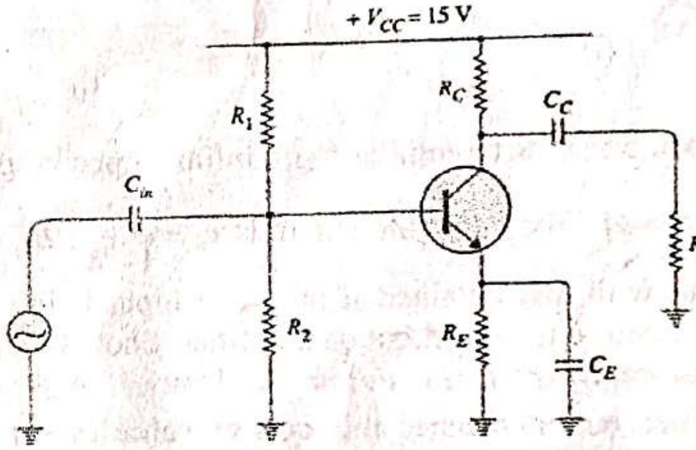
NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA
THEORY EXAMINATION
Question Paper

Month and Year of Examination : **MAY 2024**
Programme : **B.Tech** Semester: 4th
Subject: **Analog Electronics**
Course No: **ECPC-209** Maximum Marks: **50**
Number of Questions to be Attempted: **5** Time Allowed: **3 Hrs.**
Total No. of Questions: **5** Total No. of Pages Used: **3**

Unless stated otherwise, the Symbols have their usual meanings in context with the Subject. Assume suitably and state, additional data required, if any.

The Candidates, before starting to write the solutions, should please check the Question Paper for any discrepancy, and also ensure that they have been delivered the question paper of **right course no.** and right subject title.

Note: Attempt all the questions with equal marks.

1a.	What is difference in an amplifier, both internally and end-to-end working, when MOS is used instead of a BJT? Illustrate with the help of suitable mathematics and illustrations.	5
1b.	For the transistor amplifier shown in the Fig. below, $R_1 = 10\,k\Omega$, $R_2 = 5\ k\Omega$, $R_C = 1\,k\Omega$, $R_E = 2\,k\Omega$ and $R_L = 1\,k\Omega$. Assume $V_{BE} = 0.7\,V$. (i) Draw DC. load line (ii) Determine the operating point (iii) Draw a.c. load line 	5
2a.	Describe the classification of amplifiers based on different criterion with justification and applications. Consider a voltage amplifier having a frequency response of the low pass single time constant type with a dc gain of 60 dB and a 3-dB frequency of 1000 Hz. Find the gain in dB at $f = 10$ Hz, 10 kHz, 100 kHz and 1 MHz.	5
2b.	The input resistance R_{in} of each stage is 1kΩ in a two-stage RC coupled amplifier shown in the Fig. below. Find (i) voltage gain of first stage (ii) voltage gain of second stage (iii) total voltage gain.	

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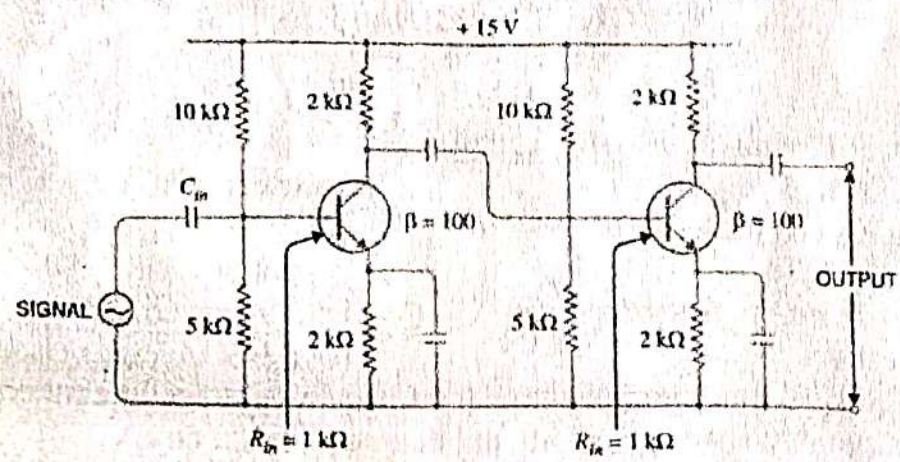

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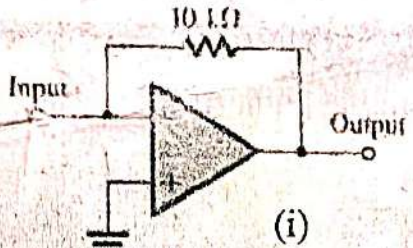
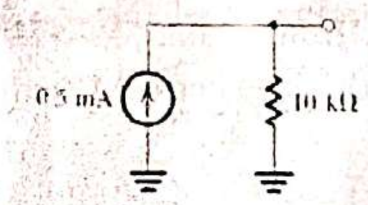
3. Describe the features and working of an ideal OP-AMP. Describe its differential and common modes in both inverting and non-inverting configurations.
The circuit shown in Fig. (i) below can be used to implement a trans-resistance amplifier. Find the value of the input resistance R_i, the trans-resistance R_m and the output resistance R_o of the trans-resistance amplifier. If the signal source shown in Fig. (ii) below is connected to the input of this amplifier, find its output voltage



(i)



(ii)

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4. The input to an operational differentiator (with infinite open loop gain $A_V \equiv A$) is a ramp voltage $v = \alpha t$. Show that the output is $v_o = \frac{A}{1-A}\alpha RC\left(1-e^{-t(1-A)/RC}\right)$
Compare the result with that obtained if the same input is impressed upon a simple RC differentiator circuit without an amplifier. Show that approximately the same final constant output $RC\, dv/dt$ is obtained. Also show that the operational amplifier output reaches this correct value of the differentiated input much more quickly than does the simple RC circuit. 10

OR

4a. Enumerate various linear and nonlinear applications of an OPAMP. Describe any two of them in detail citing its circuit diagrams, working, mathematics and illustrations of both input and output. 6

4b. Design a second-order bandpass filter with midband voltage gain $A_0 = 50$ (30 dB), a center frequency $f_0 = 160\ Hz$, and a 3-dB bandwidth $B = 16$ Hz. 4

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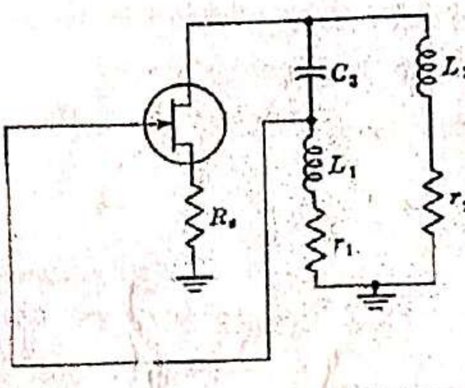
5a.	Consider an N-bit ADC whose analog input varies between 0 and V_{FS} (FS indicates full scale) i) show that the LSB corresponds to a change in the analog signal of $V_{FS}/(2^N - 1)$ indicating resolution of the converter ii) prove that the maximum error is half the resolution iii) how many bits are required to obtain a resolution of 5 mV or better for $V_{FS} = 10$ V. What is the actual resolution and quantization error obtained.	4
5b.	Describe Barkhausen criterion? Explain its usage in the working of a sinusoidal oscillator. Consider the Hartley oscillator shown in the Fig. below. If the resistances of the inductors are r_1 and r_2, respectively, find the frequency of oscillation. 	6

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