National University of Computer and Emerging Sciences, Lahore Campus

	Course Name:	**Electronic Devices and Circuits**	**Course Code:**	**EE1004**
	Program:	**Electrical Engineering**	**Semester:**	**Fall 2024**
	Duration:		**Total Marks:**	**70**
	Submission Date:	**02-12-2024**	**Weight:**	**4%**
	Section:	**ALL**	**Page(s):**	**1**
	Exam Type:	**Assignment-3(CEP)**	**CLO #**	**3**

CLO	Description	Domains & Levels	PLO
CLO3	Analyze the single stage BJT amplifier	C4	2

Instructions:

- You are required to submit both hard and soft copy of the assignment.
- You can take the assumption if some information is missing but state it clearly.
- Report can be either handwritten or in typed form.

Problem Statement

1. Find the component values of a single-stage audio amplifier using a Bipolar Junction Transistor (BJT) for an audio application. You must fulfill as much of the following requirements as possible.
    - Open circuit voltage gain should be 5 times sum of all digits in your registration number e.g. your registration number is 23L-1234 then voltage gain would be $5(1+2+3+4)=50$
    - Input resistance must be greater than 40kΩ
    - The output impedance should be less than 500 Ω
    - The circuit is powered by a +15V DC supply.
    - Consider a biasing scheme that provides the thermal bias stability.
    - As a starting point take DC operating current $I_C = 1mA$ at room temperature.
    - Assume $\beta = 100$
    - Take $I_s = 10^{-14}A$ and $V_{BE} = 0.7V$ at room temperature
2. Select the standard available resistor values with 5% tolerance and Analyze your circuit. Find the input resistance, output resistance, open circuit voltage gain and signal swing to check if it fulfills the requirement.
3. Analyze how variations in temperature from -10°C to 60°C affects the performance of the amplifier.

Objectives: To help students understand the concepts related to the design and analysis of single stage BJT amplifier.

Deliverables: A complete report that should include the following

- Schematic diagram
- Detailed Calculations showing how each component value was chosen
- In depth analysis of your design. It should include the explanation about the conflicting requirements and tradeoffs. Show which one of them are met in your design.
- Temperature analysis: Clearly explain, with calculations, how changes in temperature affect the dc and ac parameters.
- Simulation Results (Bonus): Verify gain, input resistance, and output swing using a circuit simulation tool of your choice.

Complex Engineering Problem Attributes

<table>
<tr>
<td>WP1: Depth of knowledge
WP2: Range of conflicting requirements
WP3: Depth of analysis
WP4: Familiarity of issues
WP5: Extent of applicable codes
WP6: Extent of stakeholders
WP7: Interdependence</td>
<td>
Knowledge Profile WK3

• WP1: Depth of Knowledge – Finding the component values according to the specifications requires the knowledge of circuit analysis and deep understanding of BJT as an amplifier.
• WP2: Range of conflicting requirements -- Requirements are conflicting. Adjustment of specification will be required.
• WP3: Depth of analysis -- No unique solution due to conflicting requirement. Detailed analysis is required to verify the design.
<table>
<tr><th>Rubrics</th><th></th><th>CLOs</th><th>Marks</th></tr>
<tr><td>Gives the correct schematic diagram with proper labels.</td><td>WP1</td><td>CLO3</td><td>5</td></tr>
<tr><td>Finds the components values according to the requirements</td><td>WP1</td><td>CLO3</td><td>20</td></tr>
<tr><td>Selects the standard resistor values and provides an in-depth analysis to verify the design.</td><td>WP3</td><td>CLO3</td><td>20</td></tr>
<tr><td>Identifies the conflicting requirements/ tradeoffs and explains which of them are met in the final design.</td><td>WP2</td><td>CLO3</td><td>15</td></tr>
<tr><td>Finds the parameters affected by temperature change and analyzes the circuit at -10°C and 60°C</td><td>WP3</td><td>CLO3</td><td>10</td></tr>
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