Assimilating (Theorist)

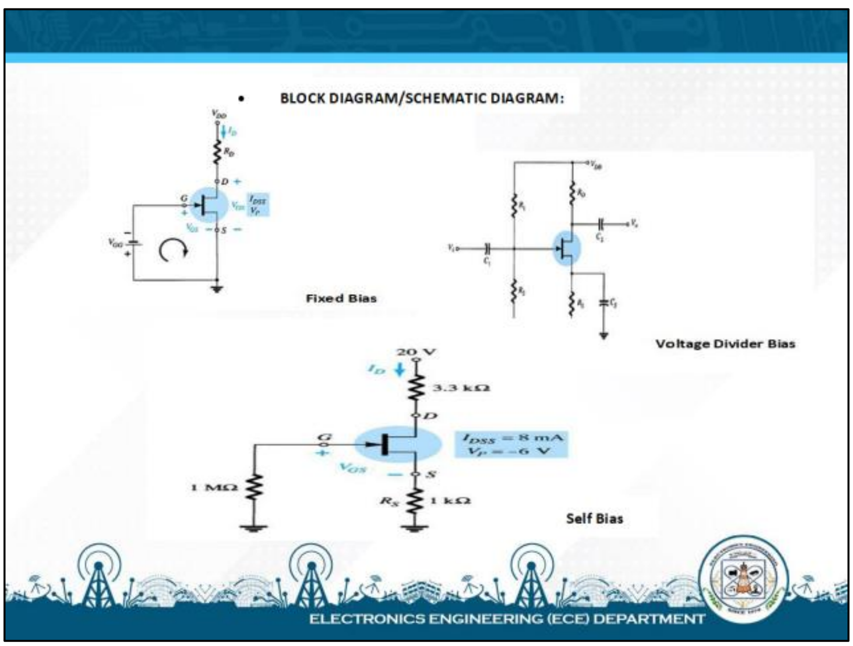
EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

BEGINNER

I. **Main Objective:** To understand the basic concepts and principles behind FET biasing through guided explanation and logical reasoning before hands-on application.

II. **Procedure:**

1. Enter the virtual lab and watch the presentation. Try to understand the main ideas about FET bias circuits, what VDD is, and how to pick the right resistor and capacitor values.
2. Based on what you learned, choose the resistor and capacitor values you think will work well in the simulation.
3. Build the FET bias circuit in the VR lab using the parts provided (breadboard, FET, resistors, capacitors).
4. Use virtual tools (voltmeter and ammeter) to check the voltage and current at the input and output of your circuit.
5. Write down all your readings in a worksheet outside the VR environment so you can look at them later.
6. Use the simple formulas from the presentation to calculate voltage and current values yourself. Write your answers in the same worksheet and compare them with the values you measured.
7. Make a simple diagram showing how you connect the voltmeter and ammeter in the circuit during your simulation. This will help you clearly see how the tools were used.



EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

1. OBJECTIVES	
A. Content Standards	• Learners demonstrate understanding of the basic operation of a FET bias circuit by assembling a given circuit correctly in a VR laboratory. • Learners apply safe handling practices of virtual instruments (breadboard, voltmeter, ammeter) for basic measurement tasks.
B. Performance Standards	• Learners accurately follow a guided procedure to assemble a simple FET bias circuit in VR. • Learners take basic voltage and current readings at specified points with minimal error. • Learners record and compute basic voltage and current values using straightforward formulas.
C. Learning Competencies/Objectives	• Assemble the given FET bias circuit in VR following basic guided instructions. • Perform simple voltage and current measurements using VR instruments. • Record measurements in a basic table and apply simple formulas to compute voltage and current values. • Create a basic block diagram showing instrument connections.
2. CONTENT	Experiment 5: Field Effect Transistor Biasing
3. LEARNING RESOURCES	
A. References	• ECEN 30034 Experiments Material Module 9 • ECEN 30034 Instructional Material • Electronics Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky 10 ed.
4. PROCEDURES	
A. Pre-Activity Preparation	**NAVIGATION OF VIRTUAL LABORATORY** • Students enter the VR laboratory environment and are given 5 minutes to practice basic navigation • Teachers will facilitate the activity by giving instructions, answering questions, and ensuring students are familiar with the VR setup while they explore. **LEARNING STYLE IDENTIFICATION** • Students are given 5 minutes to complete a quick Learning Style Questionnaire to determine if they are Pragmatist, Theorist, Reflector, or Activist.

EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

	KNOWLEDGE LEVEL ASSESSMENT • Students are given 10 minutes to take a pre-test assessing their understanding of FET bias circuits. This will classify them into Beginner, Intermediate, or Advanced levels. **ASSIGNMENT OF TRACKS** • Based on learning style and knowledge level results, students are assigned the appropriate version of the VR presentation and activity procedure.
B. Discussion of Concepts	**INTRODUCTION** A pleasant morning everyone! I'm excited to see you here in our virtual classroom today! Welcome to the Electrosphere! Today, we will explore how to assemble and measure a basic FET bias circuit. We'll work step-by-step, applying only what's practical and needed to complete the task. Don't worry about complex theories right now. We'll focus on doing the circuit using tools properly, reading voltages, and understanding how a circuit works through real actions. Are you ready to get started? Let's jump into our virtual world and bring these circuits to life! **PART 1: WHY FET BIAS CIRCUIT?** FET bias circuits are important because they help set the correct working condition for a transistor. If we don't set this properly, the transistor might not work at all or work in the wrong way. In real-life electronics—like in amplifiers or radios—bad biasing can cause the entire circuit to fail. **What You'll See in the VR Presentation:** • A simple diagram of a basic FET circuit • Clear markings showing where resistors and capacitors are placed • Where the power supply (VDD) should be connected

EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

What You'll Do Today:
You'll build this circuit in the virtual lab to help the FET work the way it should. You'll also measure voltages and currents to see if they match what we expect based on the theory.

PART 2: WHAT IS VDD AND WHY DOES IT MATTER?

VDD is the voltage we connect to the drain of the FET. It gives power to the whole circuit. Choosing the right VDD is important—if it's too high or too low, the FET might not work properly. It could cause problems like distortion, overheating, or the transistor not turning on at all.

Common VDD Values:

- **5V to 9V** – Used in low-power circuits like sensors or small amplifiers. These are often battery-powered or part of digital systems.
- **12V to 15V** – Common in lab experiments and standard amplifier circuits. It gives more room for signals to move and works well for most biasing setups.
- **18V to 24V** – Used in high-power or radio frequency (RF) circuits. These setups usually need extra heat control and protection parts.

Helpful Tip:
In the virtual lab, try using 12V as your starting VDD. It works well for most basic biasing circuits like self-bias or voltage divider bias, and helps you get good voltage and current readings.

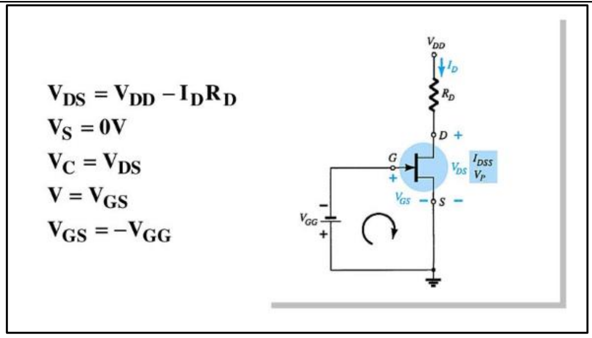
PART 3: COMPONENTS' PREVIEW

Here are the main components you'll use:

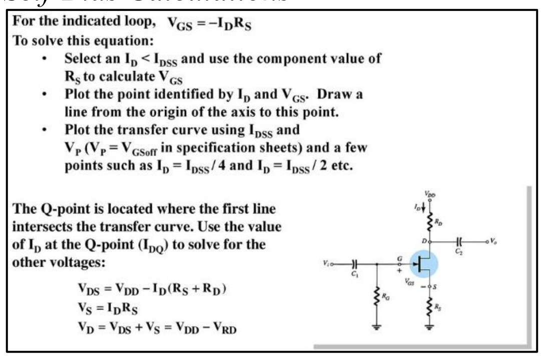
- ***Resistors (pre-selected values)***
- ***Capacitors (pre-selected values)***
- ***Breadboard***

	• ***Multimeter (to measure voltage and current)*** ***Quick Tip for Pragmatists:*** Always double-check connections. A simple wrong plug can cause wrong readings. **PART 4: DIFFERENT WAYS TO BIAS A FET** Just like BJTs, FETs need biasing to make sure they work in the right region where they amplify signals properly. Biasing helps set this “sweet spot.” Here are four common ways to bias a FET: 1. Fixed Bias - The simplest method. A resistor connects the gate directly to the power supply. It’s easy to build but not very stable, especially if the temperature changes. 2. Self-Bias - This uses a resistor on the source side (RS). It creates a negative feedback, which helps the circuit stay more stable. Great for practice and early designs. 3. Voltage Divider Bias - Two resistors are used as a voltage divider to set a stable voltage at the gate. This is one of the most commonly used methods. To understand or solve this circuit easily, we often use Thevenin’s Theorem. 4. Feedback Bias - Mostly used in enhancement-type MOSFETs. A resistor connects the output back to the gate, feeding part of the signal back to help keep the operation steady. **PART 5: BASIC FORMULAS** We’ll use only simple formulas today to help pick resistor values. **Key Formulas Presented:** • *Ohm’s Law: $V = IR$ (to find correct resistor values for gate, drain, and source)* • *Fixed-Bias Calculations*

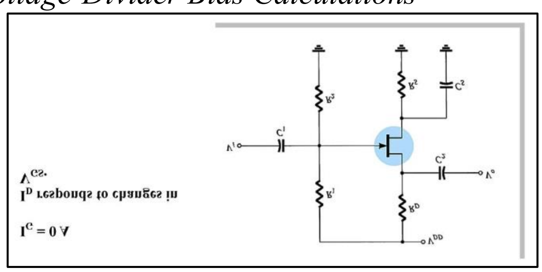
EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

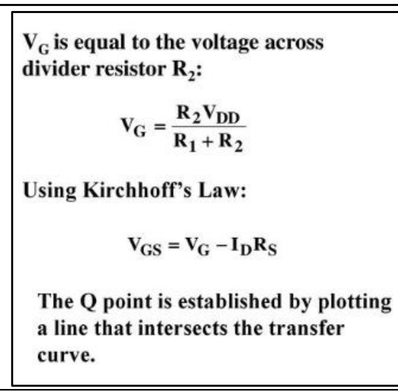


- *Self-Bias Calculations*



- *Voltage-Divider Bias Calculations*





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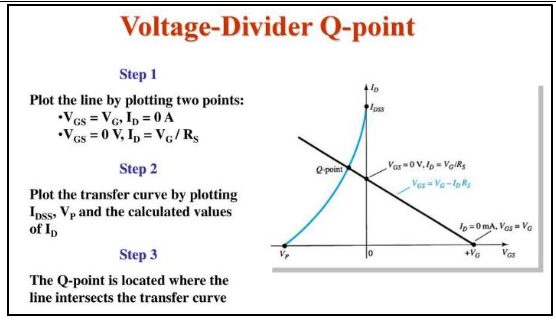

Using the value of I_D at the Q-point, solve for the other variables in the voltage-divider bias circuit:

$$V_{DS} = V_{DD} - I_D(R_D + R_S)$$
$$V_D = V_{DD} - I_D R_D$$
$$V_S = I_D R_S$$
$$I_{R1} = I_{R2} = \frac{V_{DD}}{R_1 + R_2}$$

- *Reminder that capacitors help smooth out voltages*

PART 6: BASIC SETUP

Watch First – VR Demo by the Teacher (with voice guide):

- *Place the FET on the breadboard*
- *Add the resistors and capacitors in the right spots*
- *Connect the VDD (power supply) carefully*
- *See exactly where to place the multimeter probes to take correct readings*

At this point, don’t worry about memorizing all the theory. Just follow along and try to match the setup exactly. Once the circuit is built correctly, understanding how it works will come easier.

PART 7: WHAT TO MEASURE

Once your circuit is ready, you’ll use the multimeter to measure:

- *VGS — Gate-to-Source Voltage*
- *VDS — Drain-to-Source Voltage*

	• *ID — Drain Current* We'll record these values in our worksheet. After measuring, you'll apply very basic formulas to double-check if your circuit behaves properly. **PART 8: CONCLUSION** You now have everything you need to start building your first FET bias circuit. Today, you learned the essentials: what a bias circuit does, how VDD powers the circuit, how to use simple formulas and how to choose the right resistors and capacitors. Now, it's your turn to make your FET bias circuit!
C. Presentation of the Experiment and Establishing a Purpose	**EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING** **Materials:** VR headset and controller, worksheet **Main Objective:** To understand the basic concepts and principles behind FET biasing through guided explanation and logical reasoning before hands-on application. **Procedure:** **I.** Enter the virtual lab and watch the presentation. Try to understand the main ideas about FET bias circuits, what VDD is, and how to pick the right resistor and capacitor values. **II.** Based on what you learned, choose the resistor and capacitor values you think will work well in the simulation. **III.** Build the FET bias circuit in the VR lab using the parts provided (breadboard, FET, resistors, capacitors). **IV.** Use virtual tools (voltmeter and ammeter) to check the voltage and current at the input and output of your circuit. **V.** Write down all your readings in a worksheet outside the VR environment so you can look at them later. **VI.** Use the simple formulas from the presentation to calculate voltage and current values yourself. Write your answers in the same worksheet and compare them with the values you measured.

EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

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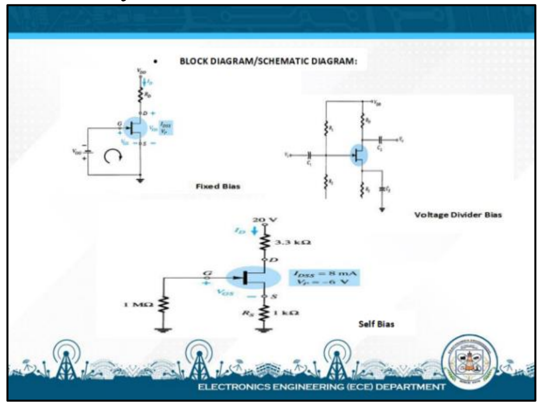
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<tr><td>E. Experiment Conclusion</td><td>The teacher summarizes key learnings, discusses results, and addresses common challenges observed during the VR activities.</td></tr>
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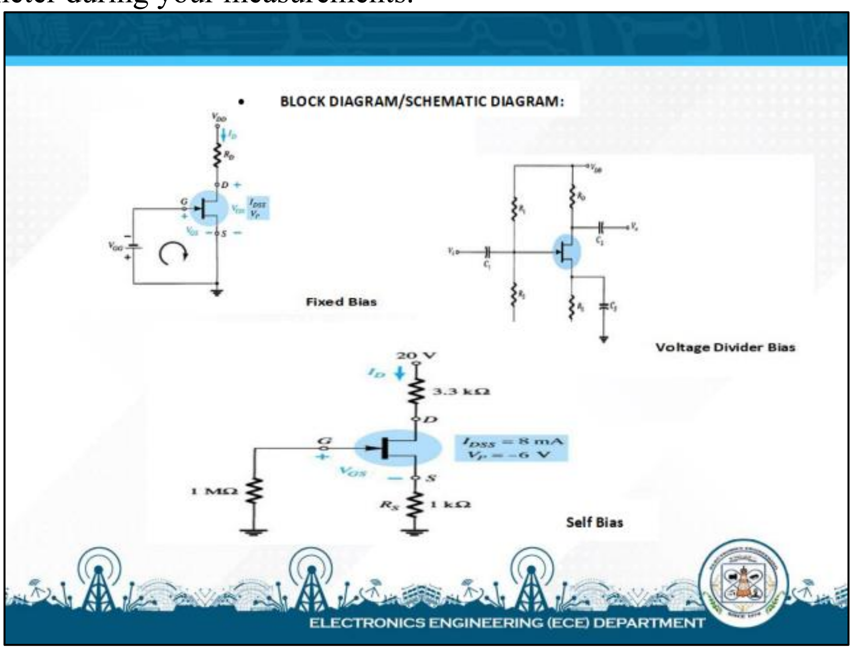
EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

INTERMEDIATE

I. Main Objective: Build and test a FET bias circuit in the virtual lab. Use formulas to calculate expected values and compare them with your measurements to see how the circuit really works.

II. Procedure:

1. Enter the virtual lab and watch the presentation to review how FET bias circuits work and learn the basic formulas you'll need.
2. Calculate the resistor and capacitor values using the formulas shown in the presentation.
3. Build the FET bias circuit in the VR environment using those values.
4. Use the virtual voltmeter and ammeter to carefully measure voltage and current at different parts of your circuit.
5. Write down all your measurement results on a worksheet outside the VR lab.
6. Use the formulas to calculate what the voltage and current should be, then compare these with your measurements. Record these comparisons in your worksheet.
7. Draw a simple block diagram that shows how you connected the voltmeter and ammeter during your measurements.



EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

I. OBJECTIVES	
A. Content Standards	• Learners demonstrate understanding of FET bias circuit behavior through independent assembly and theoretical validation using measurement results. • Learners apply analytical thinking to recognize and explain minor discrepancies between theoretical and practical measurements.
B. Performance Standards	• Learners independently assemble the given FET bias circuit in VR, selecting appropriate resistor and capacitor values based on calculations. • Learners perform accurate multi-point measurements and organize data for analysis. • Learners compare theoretical and measured results and explain possible causes of deviations.
C. Learning Competencies/Objectives	• Assemble the given FET bias circuit in VR independently with minimal guidance. • Select suitable resistor and capacitor values based on theoretical calculations. • Accurately measure voltages and currents across multiple circuit points. • Organize data systematically, compare theoretical and measured values, and reflect on minor discrepancies. • Create a functional block diagram of the actual VR measurement setup.
II. CONTENT	Experiment 5: Field Effect Transistor Biasing
III. LEARNING RESOURCES	
A. References	• ECEN 30034 Experiments Material Module 9 • ECEN 30034 Instructional Material • Electronics Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky 10 ed.
IV. PROCEDURES	
A. Pre-Activity Preparation	**NAVIGATION OF VIRTUAL LABORATORY** • Students enter the VR laboratory environment and are given 5 minutes to practice basic navigation • Teachers will facilitate the activity by giving instructions, answering questions, and ensuring students are familiar with the VR setup while they explore. **LEARNING STYLE IDENTIFICATION** • Students are given 5 minutes to complete a quick Learning Style Questionnaire to determine if they are Pragmatist, Theorist, Reflector, or Activist.

EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

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Students are given 10 minutes to take a pre-test assessing their understanding of FET bias circuits. This will classify them into Beginner, Intermediate, or Advanced levels.
ASSIGNMENT OF TRACKS
Based on learning style and knowledge level results, students are assigned the appropriate version of the VR presentation and activity procedure.</td></tr>
<tr><td>B. Discussion of Concepts</td><td>INTRODUCTION

Good day. Welcome to the Electrosphere! Today, we're diving deeper into the practical side of FET biasing, not just wiring up components but understanding why we choose certain values and how each part affects the transistor’s operation.

In this session, we’ll revisit and apply key concepts like typical VDD, resistor, and capacitor values, biasing methods, and formulas. This goes beyond basic connection because we’ll talk about setting the correct operating point, avoiding distortion, and ensuring your FET performs reliably. Let’s start!

PART 1. REVIEW OF FET BIASING METHODS

In this part, we’ll go over the main ways to bias FETs that you’ll see in real circuits. In the VR lab, you’ll notice how each method changes component choices—especially how VDD, resistors, and capacitors affect the circuit’s behavior.

Since you already know basic transistor operation, we’ll focus on what makes each bias method different and when to use them:
Fixed Bias
The gate connects to VDD through a resistor.
It’s simple but not very stable when the temperature changes.
Best for basic switching circuits or controlled lab tests.</td></tr>
</table>

2. **Self-Bias**

- Adds a resistor (RS) on the source side, creating negative feedback.
- This makes the circuit more stable than fixed bias.
- The gate voltage depends on the voltage drop across RS.
- In VR, watch how the source voltage affects the gate bias.

3. **Voltage Divider Bias**

- Uses two resistors (R1 and R2) to set a steady gate voltage.
- Gives better control of the gate voltage (VGS) and a steady operating point (Q-point).
- In VR, you'll see how Thevenin's Theorem helps simplify the circuit analysis.

4. **Feedback Bias**

- A resistor connects from the drain back to the gate.
- Helps stabilize the circuit, especially for enhancement-mode MOSFETs.
- The circuit adjusts automatically based on changes in drain current.

During the VR session, pay attention to how VDD (usually between 9V and 15V) and the RC time constants (from resistor-capacitor pairs) affect the signal and bias stability. You'll practice adjusting or checking these values to fit each bias method.

PART 2. REVIEW OF BASIC FORMULAS

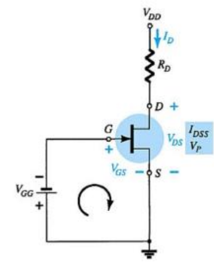
We'll use only simple formulas today to help pick resistor values.

Key Formulas Presented:

- *Ohm's Law: V = IR (to find correct resistor values for gate, drain, and source)*
- *Fixed-Bias Calculations*

EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

$$V_{DS} = V_{DD} - I_D R_D$$
$$V_S = 0V$$
$$V_C = V_{DS}$$
$$V = V_{GS}$$
$$V_{GS} = -V_{GG}$$



- *Self-Bias Calculations*

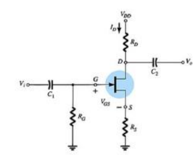
For the indicated loop, $V_{GS} = -I_D R_S$

To solve this equation:

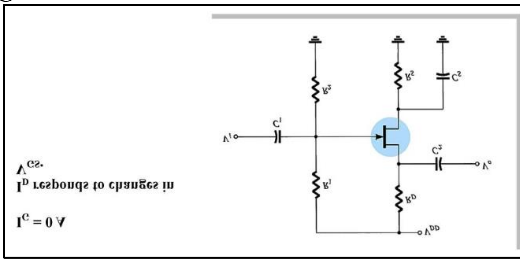
- **Select an $I_D < I_{DSS}$ and use the component value of R_S to calculate V_{GS}**
- **Plot the point identified by I_D and V_{GS}. Draw a line from the origin of the axis to this point.**
- **Plot the transfer curve using I_{DSS} and V_P ($V_P = V_{GSoff}$ in specification sheets) and a few points such as $I_D = I_{DSS} / 4$ and $I_D = I_{DSS} / 2$ etc.**

The Q-point is located where the first line intersects the transfer curve. Use the value of I_D at the Q-point (I_{DQ}) to solve for the other voltages:

$$V_{DS} = V_{DD} - I_D(R_S + R_D)$$
$$V_S = I_D R_S$$
$$V_D = V_{DS} + V_S = V_{DD} - V_{RD}$$



- *Voltage-Divider Bias Calculations*



V_G is equal to the voltage across divider resistor R_2:

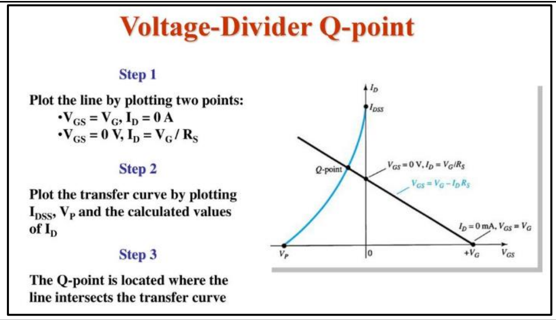
$$V_G = \frac{R_2 V_{DD}}{R_1 + R_2}$$

Using Kirchhoff's Law:

$$V_{GS} = V_G - I_D R_S$$

The Q point is established by plotting a line that intersects the transfer curve.

EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING



Using the value of I_D at the Q-point, solve for the other variables in the voltage-divider bias circuit:

$$V_{DS} = V_{DD} - I_D(R_D + R_S)$$
$$V_D = V_{DD} - I_D R_D$$
$$V_S = I_D R_S$$
$$I_{R1} = I_{R2} = \frac{V_{DD}}{R_1 + R_2}$$

- *Reminder that capacitors help smooth out voltages*

PART 3: CONCLUSION

Great job following through the discussion! You've now reviewed the key principles behind FET biasing, including how to set VDD correctly, and how resistor-capacitor combinations shape the transistor's performance.

It's now your turn to put these concepts into action. Begin your virtual lab activity by assembling the bias circuit, measuring VGS, VDS, and ID, and analyzing whether your design aligns with expected values.

C. Presentation of the Experiment and Establishing a Purpose

EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

Materials: VR headset and controller, worksheet

Main Objective: Build and test a FET bias circuit in the virtual lab. Use formulas to calculate expected values and compare them with your measurements to see how the circuit really works.

Procedure:

1. Enter the virtual lab and watch the presentation to review how FET bias circuits work and learn the basic formulas you'll need.
2. Calculate the resistor and capacitor values using the formulas shown in the presentation.
3. Build the FET bias circuit in the VR environment using those values.

	4. Use the virtual voltmeter and ammeter to carefully measure voltage and current at different parts of your circuit. **5.** Write down all your measurement results on a worksheet outside the VR lab. **6.** Use the formulas to calculate what the voltage and current should be, then compare these with your measurements. Record these comparisons in your worksheet. **7.** Draw a simple block diagram that shows how you connected the voltmeter and ammeter during your measurements.
D. Post-Assessment (Knowledge Check)	Students are given 10 minutes to take a post-test inside VR to measure knowledge improvement by comparing pre-test and post-test results.
E. Experiment Conclusion	The teacher summarizes key learnings, discusses results, and addresses common challenges observed during the VR activities.

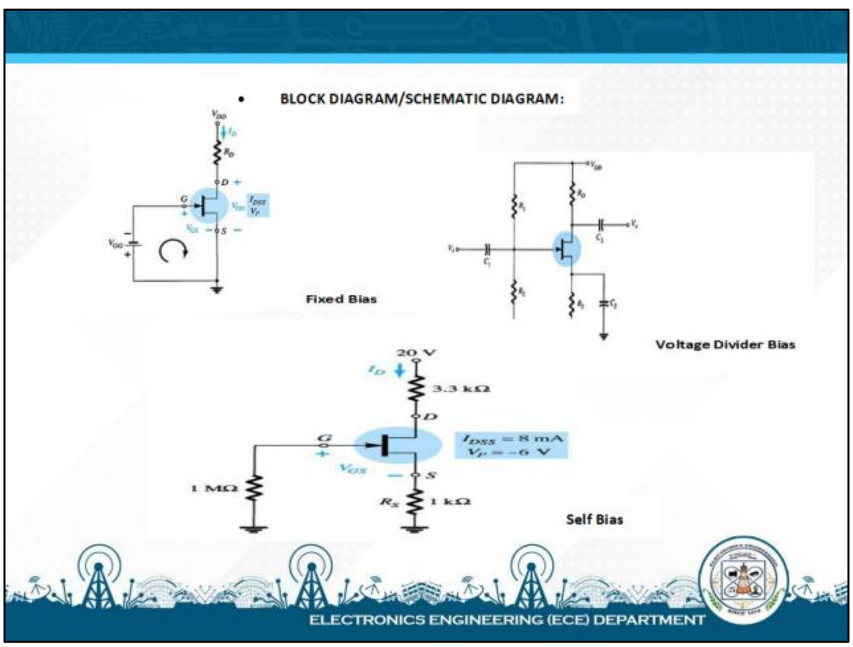
EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

DIFFICULT

I. Main Objective: To design, optimize, and troubleshoot FET bias circuits by conducting practical measurements in a virtual laboratory environment, performing manual calculations, and critically evaluating circuit performance.

II. Procedure:

1. Enter the virtual lab and watch the presentation about how to optimize and adjust the bias circuit.
2. Choose resistor and capacitor values following the design instructions provided.
3. Build the given FET bias circuit in the virtual lab using the breadboard and parts with the values you selected.
4. Use the virtual voltmeter and ammeter to measure voltages and currents at the correct points in the circuit.
5. Write down your measurements on a worksheet outside the virtual lab.
6. Calculate the expected voltages and currents using the formulas, then compare these results with your measurements.
7. Organize and record your results carefully, noting any problems or unusual behavior.
8. Draw a clear block diagram that shows the signal flow and how the measuring instruments were connected.



EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

1. OBJECTIVES	
A. Content Standards	• Learners demonstrate advanced understanding of FET bias circuit performance, identifying causes of real-world measurement deviations and proposing optimizations. • Learners apply troubleshooting strategies and critical analysis to enhance circuit reliability and performance.
B. Performance Standards	• Learners optimize resistor and capacitor values based on theoretical understanding and practical VR results. • Learners troubleshoot and refine the assembled FET bias circuit to achieve closer alignment between measured and expected values. • Learners develop a detailed block diagram showing refined signal and measurement flows based on their analysis.
C. Learning Competencies/Objectives	• Independently select optimized resistor and capacitor values for improved FET bias performance. • Assemble, measure, and troubleshoot the given FET bias circuit in VR with minimal supervision. • Analyze significant deviations between expected and measured results, diagnose causes, and propose refined solutions. • Develop a detailed block diagram illustrating instrument signal flow and finalized circuit setup.
2. CONTENT	Experiment 5: Field Effect Transistor Biasing
3. LEARNING RESOURCES	
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Students are given 5 minutes to complete a quick Learning Style Questionnaire to determine if they are Pragmatist, Theorist, Reflector, or Activist.
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Students are given 10 minutes to take a pre-test assessing their understanding of FET bias circuits. This will classify them into Beginner, Intermediate, or Advanced levels.
ASSIGNMENT OF TRACKS
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<tr><td>B. Discussion of Concepts</td><td>INTRODUCTION

A pleasant morning everyone! It’s great to welcome you here to the Electrosphere!
Today, we’re leveling up! This session is crafted for those who already have a strong grasp of basic biasing.

We’ll focus not just on building circuits, but on optimizing bias circuits for the best performance.
You’ll learn practical strategies to fine-tune circuit behavior, balancing parameters like gain, linearity, power efficiency, and stability.

Ready to elevate your circuit design skills? Let’s dive into advanced biasing optimization in our virtual world!

PART 1: WHY OPTIMIZE BIAS CIRCUITS?

Even if a transistor works with basic biasing, it might not perform optimally. Poor optimization can cause:
Non-linearity (distortion in amplifiers)
Thermal runaway (increased current leading to overheating)
Reduced gain or wrong operating region
Poor noise performance (especially in low-noise applications)
Optimization ensures:</td></tr>
</table>

	• Stable Q-point (Operating point) • Maximum symmetrical signal swing (avoid clipping) • Minimum distortion • Controlled power dissipation ***Key Points Shown in VR Presentation:*** • *Importance of setting the Q-point in the middle of the load line* • *How device parameters (like β for BJTs, or Vth for FETs) shift with temperature* • *Real-world factors: load variations, temperature drift, and manufacturing tolerances* **PART 2: STRATEGIES FOR BIAS OPTIMIZATION** In this section, you will analyze and understand several practical methods to improve bias circuit performance. Use this to build a strong conceptual foundation and apply these methods thoughtfully during your VR lab work. **1. Emitter/Source Degeneration** • Adding a resistor in the emitter (BJT) or source (FET) creates negative feedback. • This feedback helps the circuit stay stable when temperatures change and makes the signal more linear. • Think of it as a self-correcting mechanism that keeps the transistor working properly. **2. Fine Adjustment of Base/Gate Voltage** • Instead of fixed resistors, use a voltage divider with an adjustable trimmer potentiometer. • This lets you precisely set the base (BJT) or gate (FET) voltage to get the exact operating point you want. • It's like fine-tuning a machine to run at peak performance.

	3. Temperature Compensation • Use components that react to temperature changes, like thermistors or diode junctions. • These parts automatically adjust biasing as the temperature shifts, preventing problems like thermal runaway. • For example, a silicon diode's voltage drop changes with temperature to balance the transistor's behavior. **4. Load Line Shifting** • After setting up the bias, revisit your load line by considering how real parts behave, not just ideal ones. • Adjust the collector or drain resistor to allow the transistor to handle the largest possible clean signal swing. • Aim for the operating point (Q-point) to be in the middle of the voltage range for best performance. **5. Bypass Capacitor Optimization** • Bypass capacitors placed across emitter/source resistors help restore AC gain without affecting DC bias. • Changing the capacitor value changes the amplifier's low-frequency cutoff: bigger capacitors lower the cutoff frequency, smaller ones raise it. • This controls how your amplifier handles different signal frequencies. **Formula:** $$f_L = \frac{1}{2\pi R_E C}$$ *Larger C → Lower cutoff frequency* *Smaller C → Higher cutoff frequency* **PART 3: WHAT TO MEASURE AND FINE-TUNE**

EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

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After you’ve made optimization changes, carefully check the following measurements to see if your circuit works as expected:

VCE / VDS (Collector-to-Emitter / Drain-to-Source voltage): Confirm the Q-point is roughly in the middle of the operating range. This means the transistor is properly biased and ready for linear operation.
IC / ID (Collector / Drain current): Verify the current remains stable even if the temperature changes. Stable current means your bias circuit handles real-world conditions well.
Gain (Av): Measure the amplifier gain and compare it to your design goals. The gain should match or come close to the expected value.
Distortion: Look at the output waveform. It should be symmetrical and free of clipping or distortion, showing clean amplification.
Power Dissipation: Make sure the power the transistor uses stays within safe limits to avoid damage.

Tip:
Test your circuit’s stability by slightly changing resistor values or VDD voltage by about ±10%. If these small changes cause large shifts in bias or performance, your circuit needs better stabilization.
PART 4: CONCLUSION
Today, you explored how bias circuit optimization is not just about making circuits “work,” but making them perform reliably and efficiently.
You learned practical fine-tuning strategies. Now, it’s your turn! Do the experiment and apply these techniques. Let’s start!
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<td>C. Presentation of the Experiment and Establishing a Purpose</td>
<td>
EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING
Materials: VR headset and controller, worksheet
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EXPERIMENT 5: FIELD EFFECT TRANSISTOR BIASING

	Main Objective: To design, optimize, and troubleshoot FET bias circuits by conducting practical measurements in a virtual laboratory environment, performing manual calculations, and critically evaluating circuit performance. **Procedure:** **1.** Enter the virtual lab and watch the presentation about how to optimize and adjust the bias circuit. **2.** Choose resistor and capacitor values following the design instructions provided. **3.** Build the given FET bias circuit in the virtual lab using the breadboard and parts with the values you selected. **4.** Use the virtual voltmeter and ammeter to measure voltages and currents at the correct points in the circuit. **5.** Write down your measurements on a worksheet outside the virtual lab. **6.** Calculate the expected voltages and currents using the formulas, then compare these results with your measurements. **7.** Organize and record your results carefully, noting any problems or unusual behavior. **8.** Draw a clear block diagram that shows the signal flow and how the measuring instruments were connected.
D. Post-Assessment (Knowledge Check)	Students are given 10 minutes to take a post-test inside VR to measure knowledge improvement by comparing pre-test and post-test results.
E. Experiment Conclusion	The teacher summarizes key learnings, discusses results, and addresses common challenges observed during the VR activities.