SNS COLLEGE OF TECHNOLOGY

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COIMBATORE-641 035, TAMIL NADU

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Name: 23ECT203 LINEAR INTEGRATED CIRCUITS

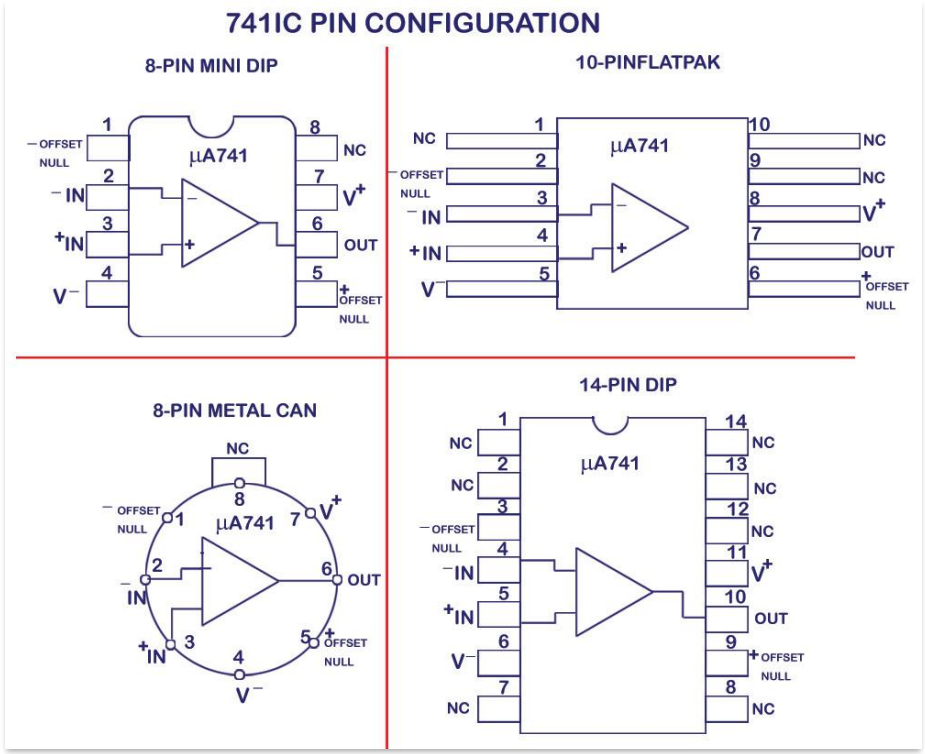
II YEAR/VI SEMESTER

UNIT I –BASICS OF OPERATIONAL AMPLIFIERS

Topic : Internal Circuit of IC 741

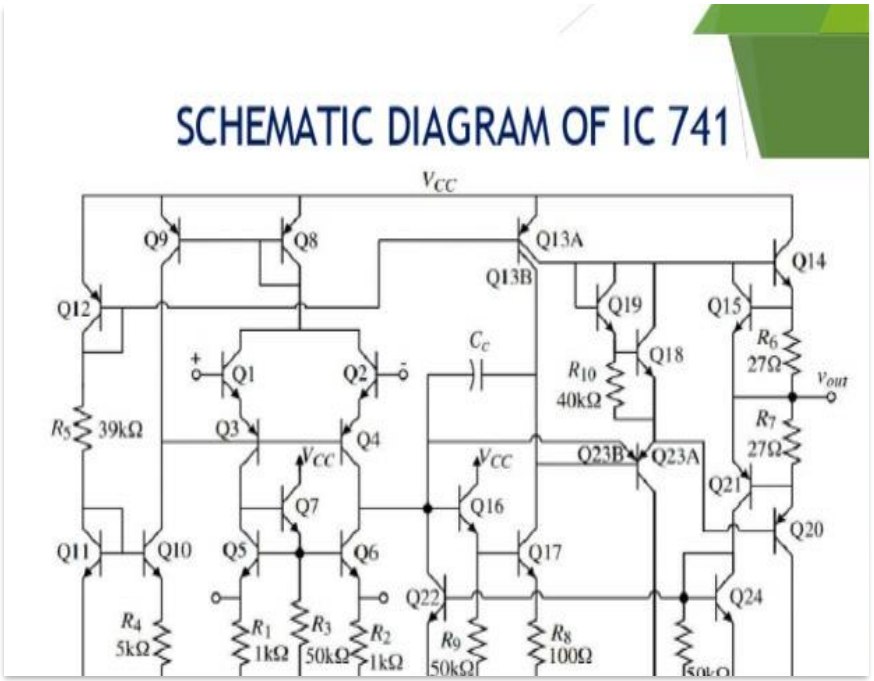
Introduction to IC 741

- The 741 is a classic operational amplifier IC introduced in 1968
- Widely used in analog circuits due to its stability and versatility
- Understanding internal circuit helps in troubleshooting and design optimization
- Consists of three main stages: input, intermediate, and output stage



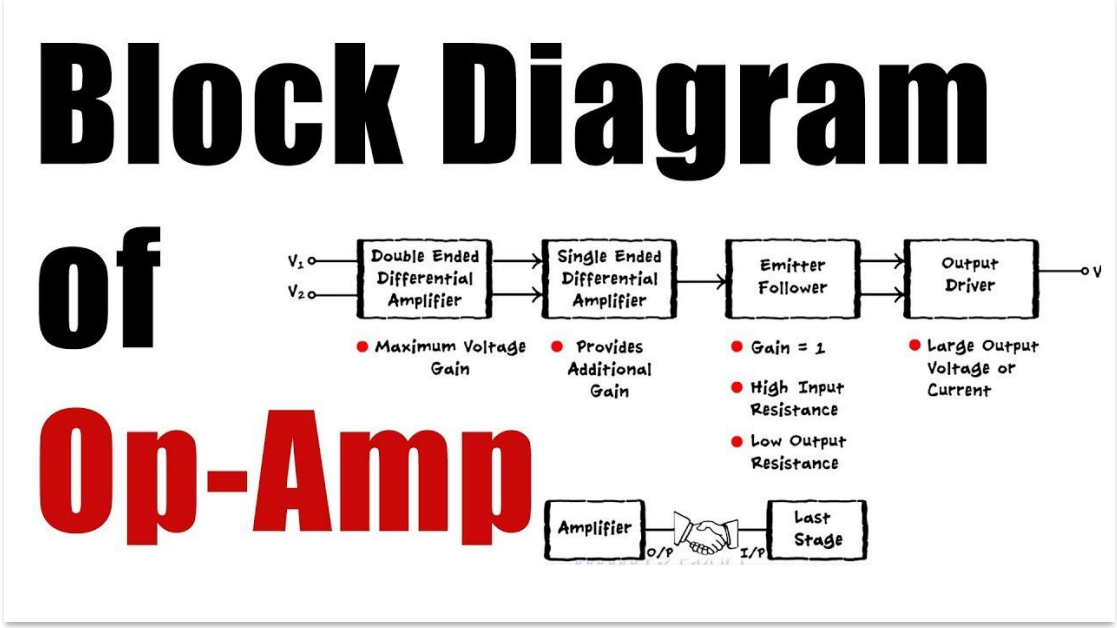
Stage 1: Empathize - Understanding IC 741 Challenges

- Complex internal circuit with 20 transistors makes analysis difficult
- Temperature variations affect circuit performance
- Understanding internal stages crucial for troubleshooting
- Students struggle with connecting theory to practical implementation



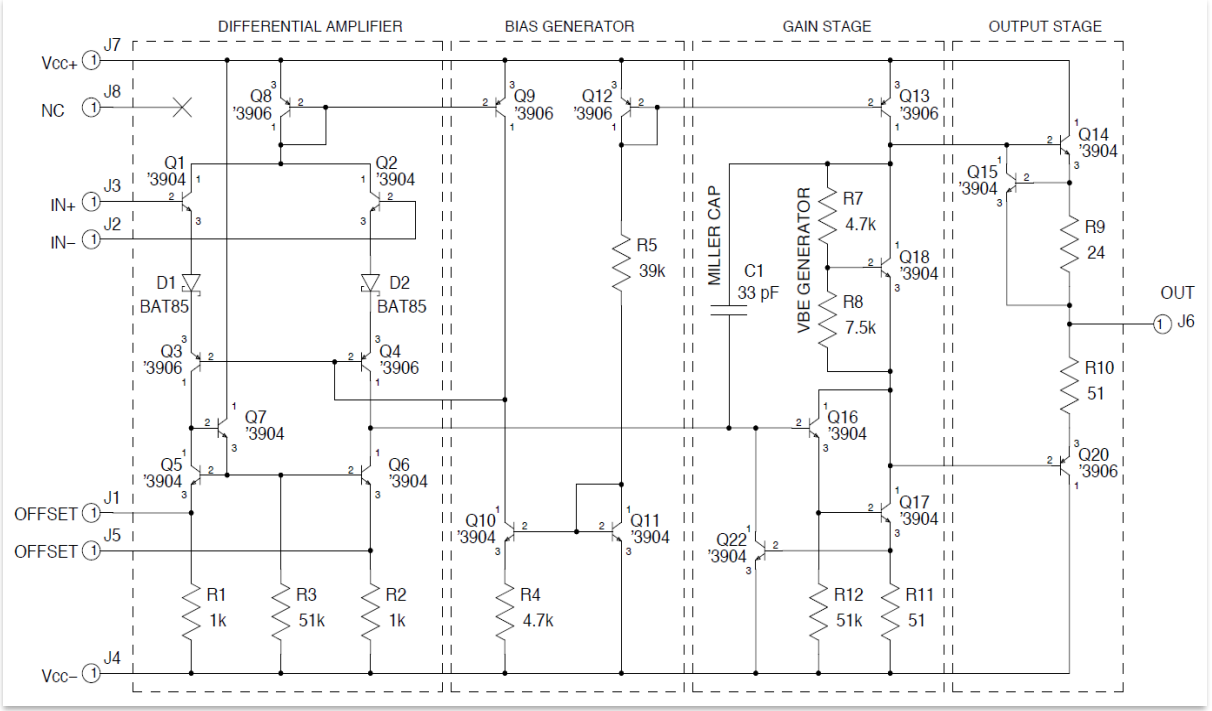
Stage 2: Define - IC 741 Circuit Requirements

- Input Stage: Differential amplifier with high input impedance
- Intermediate Stage: High voltage gain with frequency compensation
- Output Stage: Low output impedance with current limiting
- Bias Network: Provides stable reference voltages for all stages



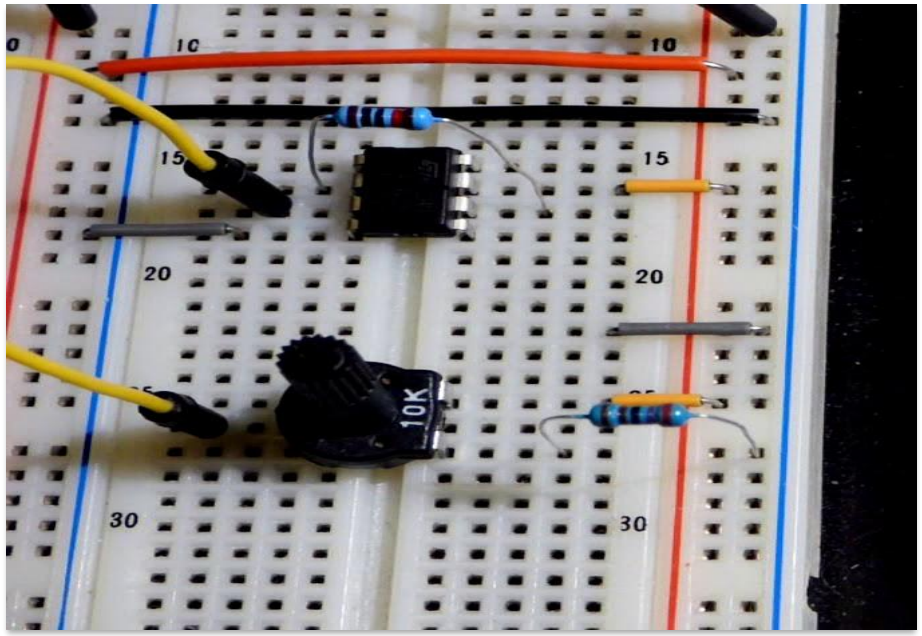
Stage 3: Ideate - IC 741 Circuit Solutions

- Simplify analysis by breaking circuit into functional blocks
- Use equivalent circuits to understand each stage's behavior
- Apply mathematical models for quantitative analysis
- Design experiments to verify theoretical predictions



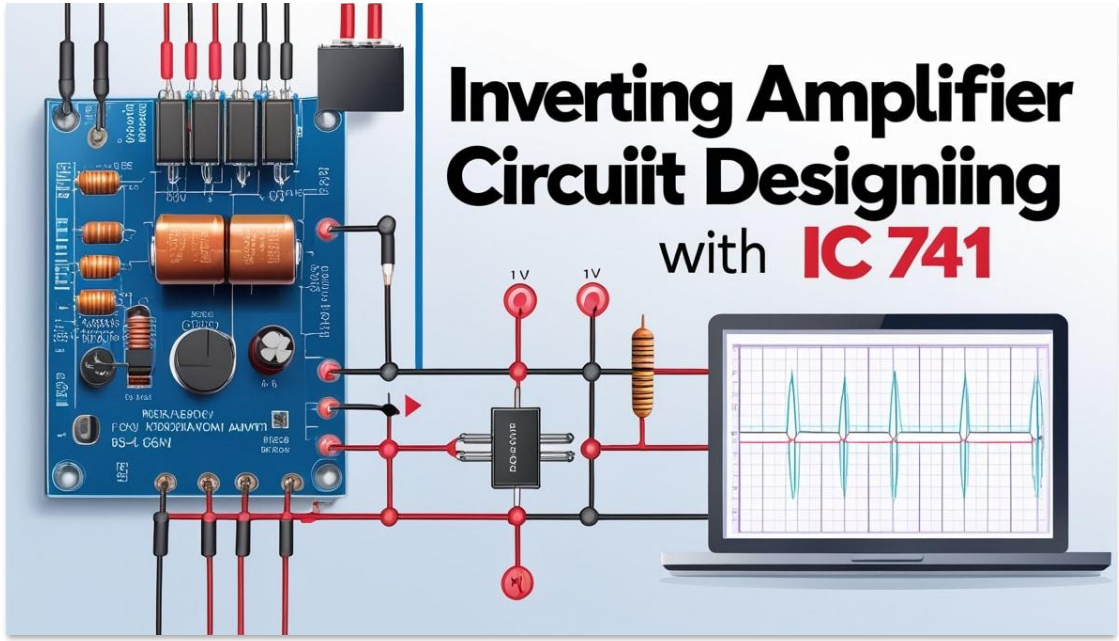
Stage 4: Prototype - Building IC 741 Circuits

- Create simplified models of each internal stage
- Build test circuits on breadboards to verify functionality
- Use simulation software to predict circuit behavior
- Document all connections and measurements for analysis



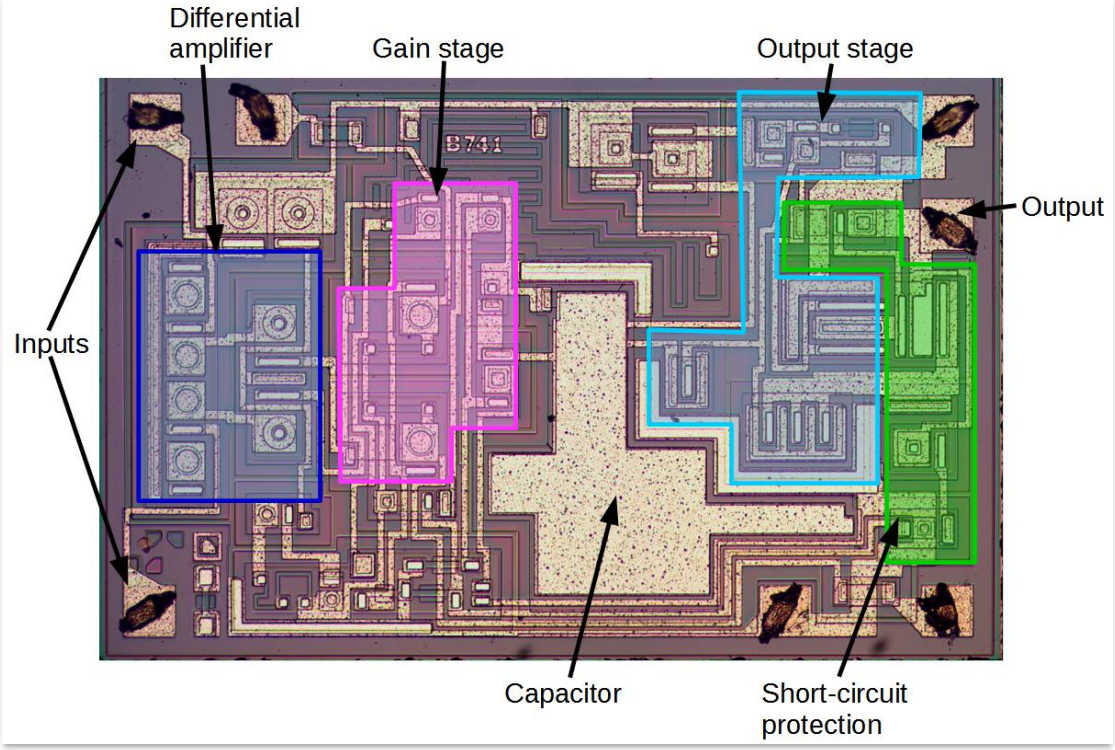
Stage 5: Test - Evaluating IC 741 Performance

- Measure input/output characteristics of each stage
- Compare measured values with theoretical predictions
- Test circuit behavior under different conditions
- Document performance limitations and improvement strategies



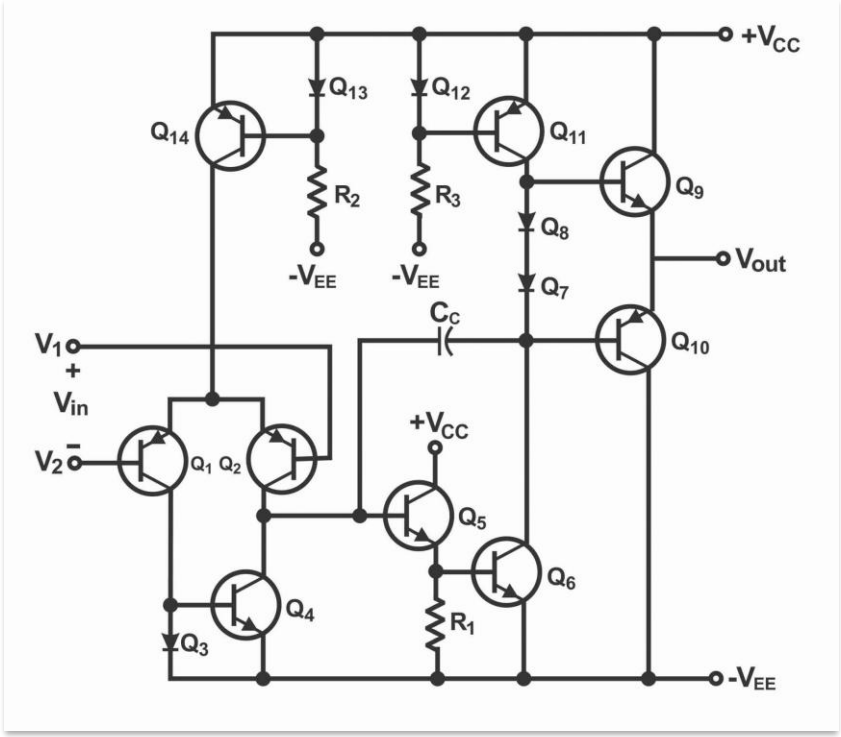
Input Stage of IC 741

- Differential amplifier configuration (Q1-Q4)
- Provides high input impedance and common-mode rejection
- Current mirror (Q5-Q6) improves linearity
- Input bias current compensation network (Q7-Q8)



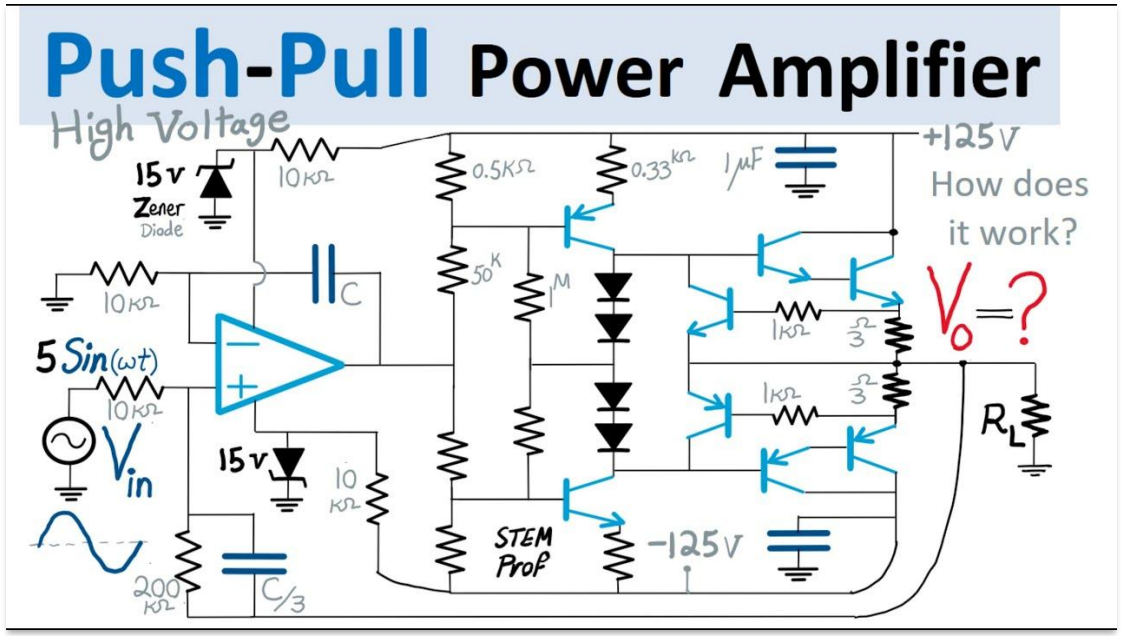
Intermediate Stage of IC 741

- Darlington pair (Q16-Q17) provides high voltage gain
- Frequency compensation capacitor (C1) prevents oscillation
- Current source (Q13) provides stable biasing
- Buffer transistor (Q20) isolates input from output



Output Stage of IC 741

- Class AB push-pull configuration (Q14-Q20)
- Provides low output impedance and high current capability
- Short circuit protection (Q15, Q21, Q22)
- Thermal compensation prevents thermal runaway



Activity: THINK PAIR SHARE

THINK (2 minutes)

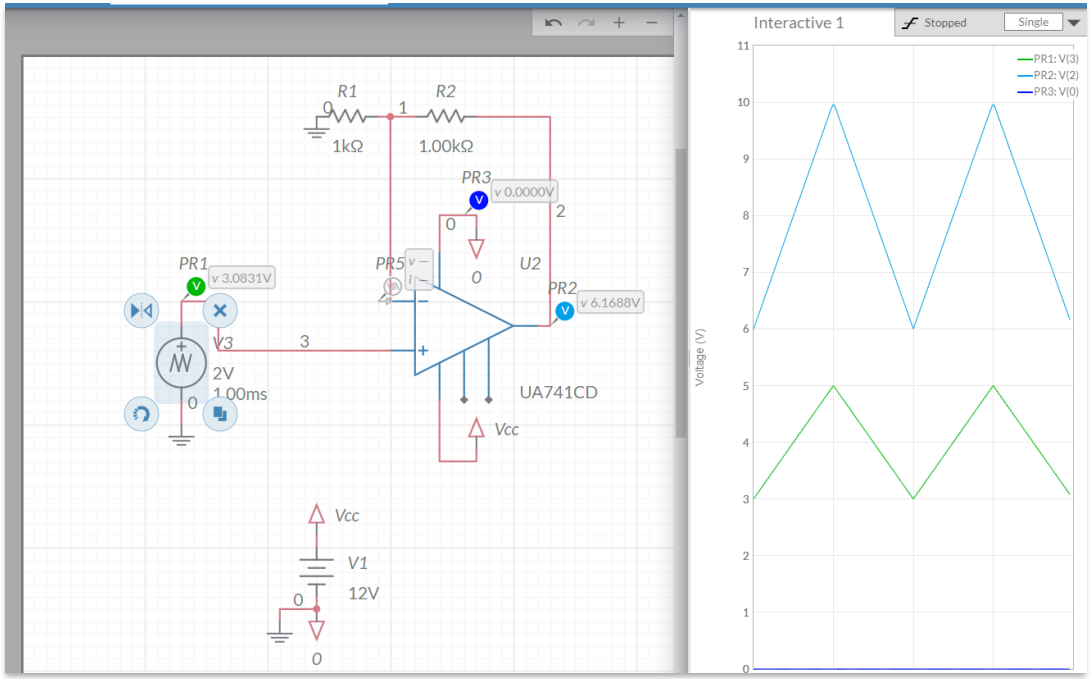
Analyze the given IC 741 circuit and identify its internal stages

PAIR (2 minutes)

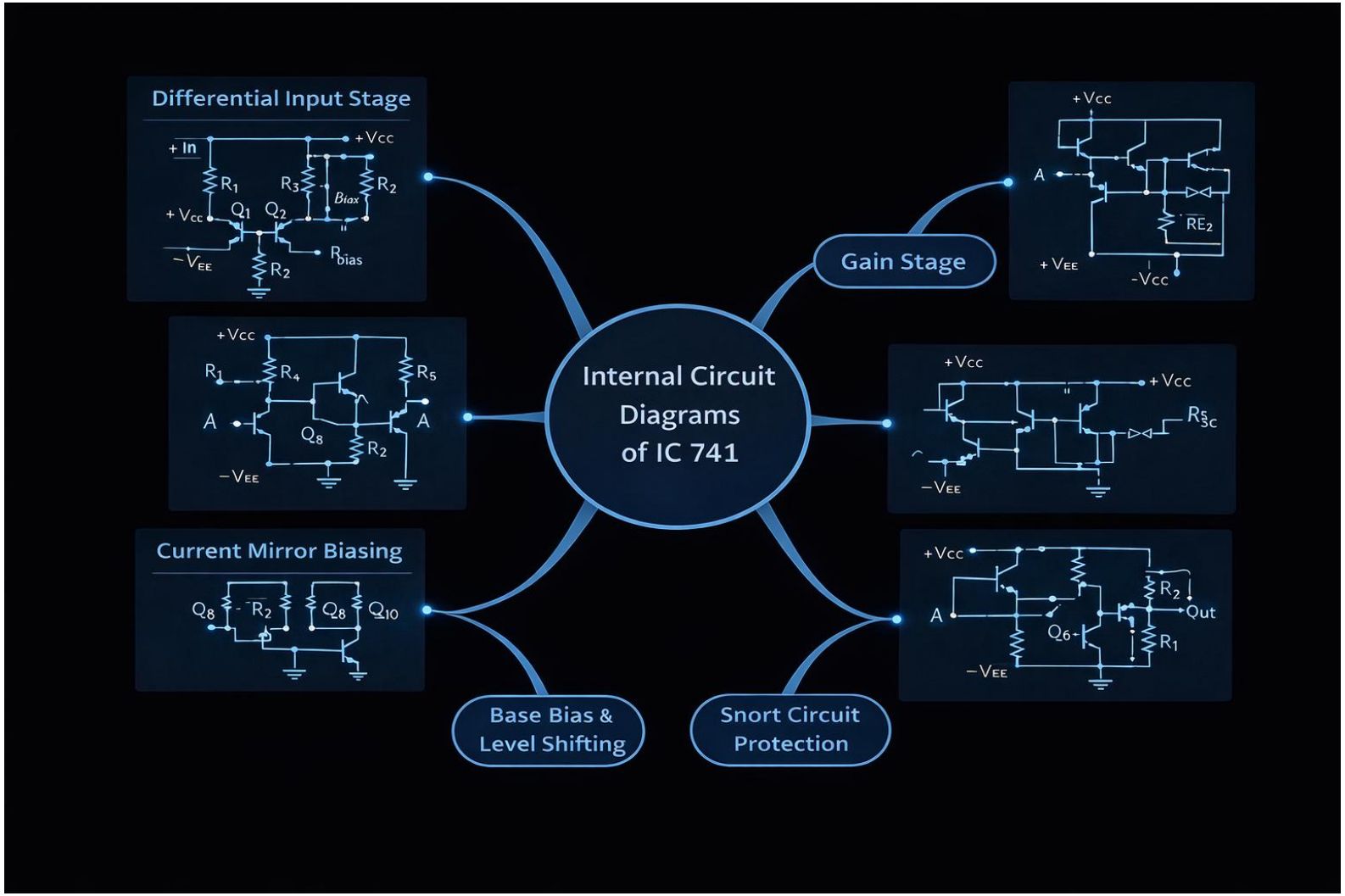
Discuss your findings with a partner and compare notes

SHARE (1 minute)

Present your analysis to the class



Mind Map: IC 741 Internal Circuits



Assessment: IC 741 Internal Circuits

Short Answer

Explain the function of each internal stage

Problem Solving

Calculate voltage gain of the intermediate stage

Application

Design a simple circuit using IC 741

Critical Thinking

Compare ideal vs. real IC 741 characteristics

1). Op-Amp is abbreviated as _____.

Operational Amplifier
Operand amplitude
Operational amplitude
None of the above

2). Op-Amp is a _____ type of amplifier.

CurrentVoltagePowerResistance

3). Op-Amp is _____ coupled voltage type of amplifier.

ACDCADCDAC

4). Op-Amp has _____ gain.

HighLowZeroMedium

5). A device with direct current coupled, high gain electronic voltage type amplifier with one output and differential input is called _____.

RectifierAmplifierTransformerOp-amp

6). Op-Amp has _____ inputs.

SingleSimilarZeroDifferential

7). Op-Amp has _____ outputs.

SingleSimilarMultipleDifferential

References

Linear Integrated Circuits D. Roy Choudhry, Shail Jain New Age International Pvt. Ltd., Fifth edition 2018

Design with Operational Amplifiers and Analog Integrated Circuits Sergio Franco Fourth Edition, Tata Mc Graw-Hill, 2014

OP-AMP and Linear ICs Ramakant A. Gayakwad 4th Edition, Prentice Hall / Pearson Education, 2001

uA741 Datasheet Texas Instruments Available online at ti.com

Thank You