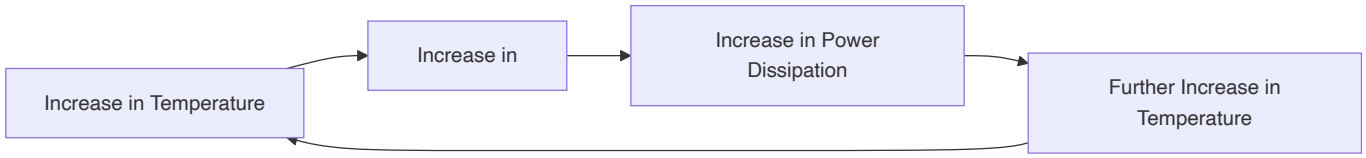
Question 1(a) [3 marks]

Explain thermal runaway in details.

Answer:
Thermal runaway is a destructive mechanism in BJT transistors where increased temperature creates a self-reinforcing cycle leading to device failure.



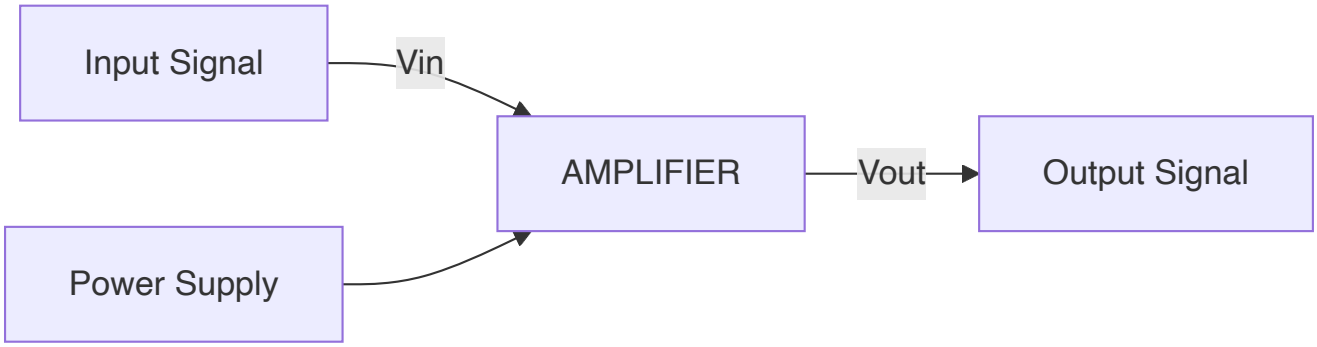
- **Heat Generation**: Temperature rises from normal operation
- **Leakage Current**: Collector current Ic increases with temperature
- **Power Dissipation**: More power = Temperature rises further
- **Destructive Cycle**: Continuous cycle until transistor destroys itself

Mnemonic: "The Higher Temperature, The Higher Current"

Question 1(b) [4 marks]

Define amplifier with simple block diagram write down amplifier parameters.

Answer:
An amplifier is an electronic device that increases the power, voltage or current of an input signal.



Amplifier Parameter	Description
Voltage Gain (Av)	Ratio of output voltage to input voltage
Current Gain (Ai)	Ratio of output current to input current
Power Gain (Ap)	Product of voltage gain and current gain
Bandwidth	Range of frequencies amplifier can handle
Input Impedance	Resistance seen by the input source
Output Impedance	Internal resistance of amplifier

Mnemonic: "VIPS-BIO" (Voltage, Input impedance, Power, Supply, Bandwidth, Impedance Output)

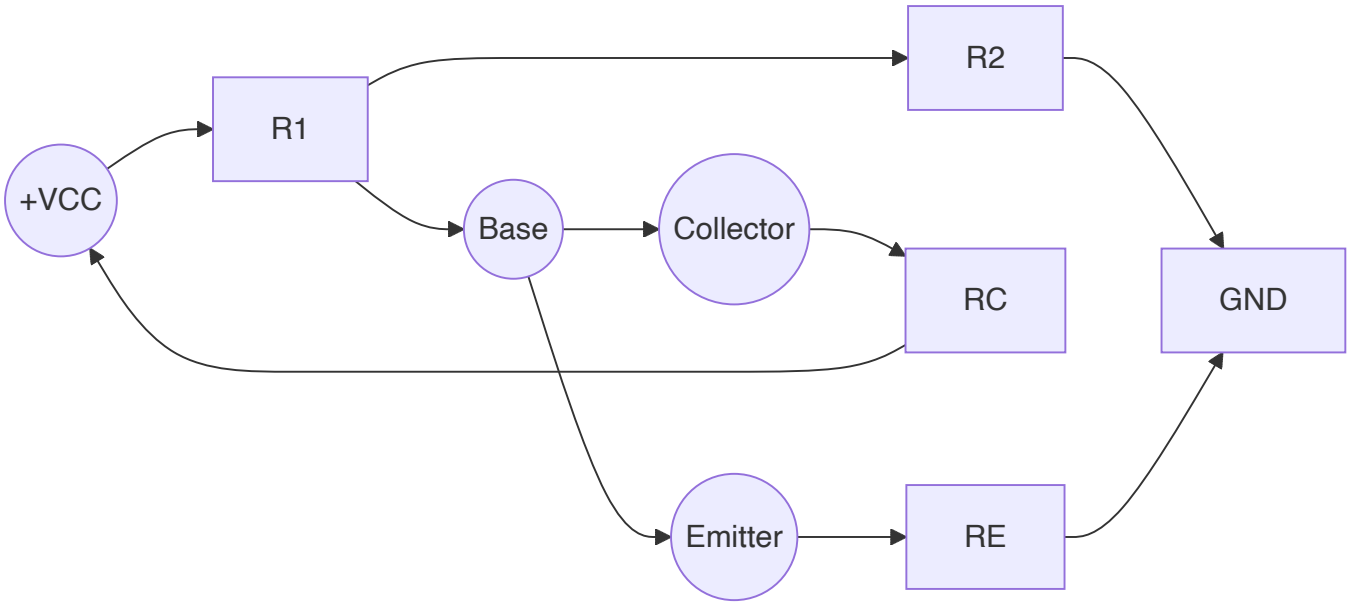
Question 1(c) [7 marks]

Define Biasing in transistor? Write down types of biasing methods. Explain the voltage divider biasing method in details.

Answer:
Biasing is the process of establishing a stable operating point (Q-point) for a transistor by applying DC voltages.

Biasing Method	Key Features
Fixed Bias	Simple, poor stability
Collector Feedback	Self-adjusting, better stability
Voltage Divider	Best stability, widely used
Emitter Bias	Good stability, negative feedback

Voltage Divider Biasing:



- **R1 & R2**: Form voltage divider to provide stable base voltage
- **RE**: Provides stabilization through negative feedback
- **RC**: Determines collector current and voltage gain
- **Stability**: Best stability against temperature variations

Mnemonic: "Divide Voltage Before Transistor Conducts"

Question 1(c) OR [7 marks]

Explain Heat sink.

Answer:
A heat sink is a passive heat exchanger that transfers heat from electronic devices to the surrounding air.

Component	Function
Base	Conducts heat from device
Fins	Increases surface area for heat dissipation
Thermal Interface Material	Improves contact between device and sink
Types	Extruded, Bonded, Folded, Die-cast

- **Thermal Resistance**: Lower is better for heat dissipation
- **Material**: Usually aluminum or copper for good conductivity
- **Surface Area**: More fins means better cooling

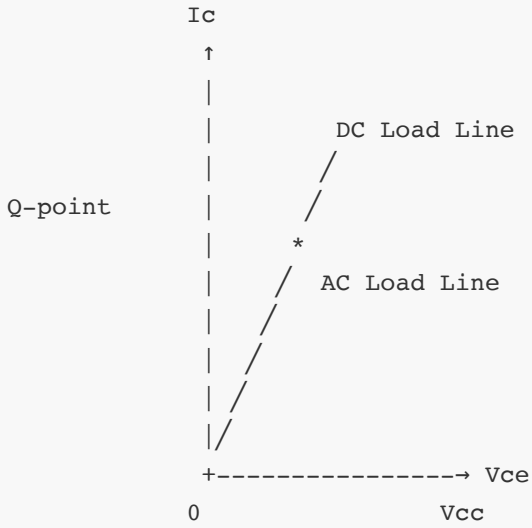
- **Air Flow**: Critical for efficient heat removal

Mnemonic: "Heat Sinks Keep Transistors Running"

Question 2(a) [3 marks]

Describe the D.C. and A.C. Load Lines.

Answer:
Load lines graphically represent possible operating points of a transistor on its characteristic curves.



- **DC Load Line**: Shows all possible operating points under DC conditions
  - **Equation**: Ic = (VCC - VCE)/RC
  - **Endpoints**: (0, VCC/RC) and (VCC, 0)
- **AC Load Line**: Shows operating points during AC signal handling
  - **Steeper Slope**: Due to AC resistance being less than DC
  - **Centered at Q-point**: The operating point established by biasing

Mnemonic: "DC Draws Completely, AC Alters Course"

Question 2(b) [4 marks]

Briefly explain bandwidth and gain-bandwidth product of an amplifier.

Answer:
Bandwidth and gain-bandwidth product are key specifications for amplifier frequency performance.

Parameter	Description
Bandwidth	Frequency range where gain drops by less than 3dB
Lower Cutoff (f_1)	Frequency where gain drops by 3dB at low end
Upper Cutoff (f_2)	Frequency where gain drops by 3dB at high end
Gain-Bandwidth Product	Product of gain and bandwidth, remains constant

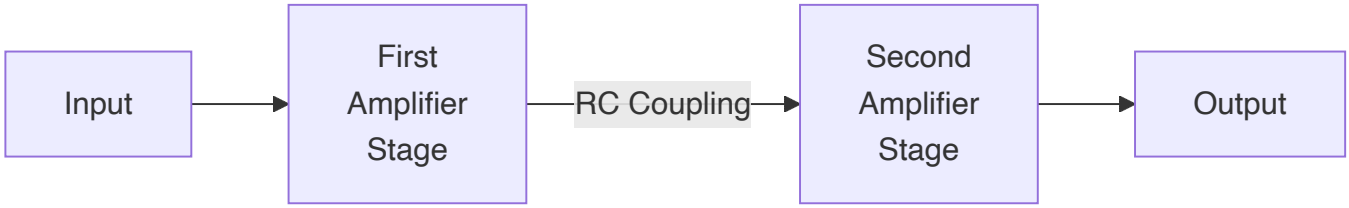
- **Bandwidth Formula**: BW = f_2 - f_1
- **Gain-Bandwidth**: Remains constant when gain changes
- **Trade-off**: Higher gain means lower bandwidth

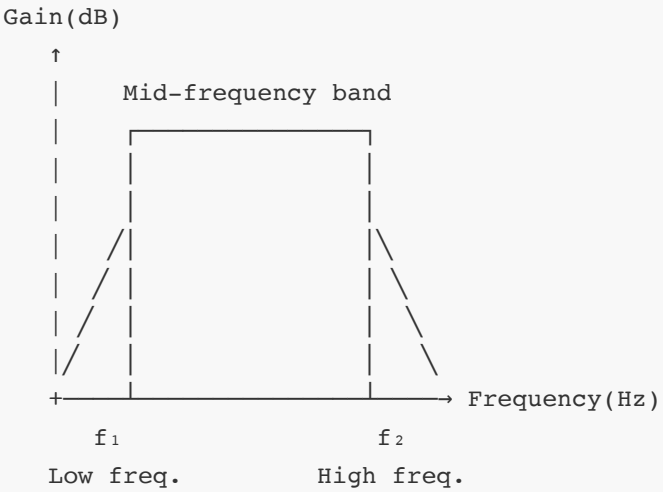
Mnemonic: "Better Bandwidth Gets Perfect Transmission"

Question 2(c) [7 marks]

Explain frequency response of two stage RC coupled amplifier.

Answer:
The frequency response of a two-stage RC coupled amplifier shows how gain varies with frequency.





- **Low Frequency Response**: Limited by coupling capacitors
  - **Roll-off Rate**: -20 dB/decade for each stage
- **Mid Frequency Response**: Maximum and flat gain region
  - **Total Gain**: Product of individual stage gains

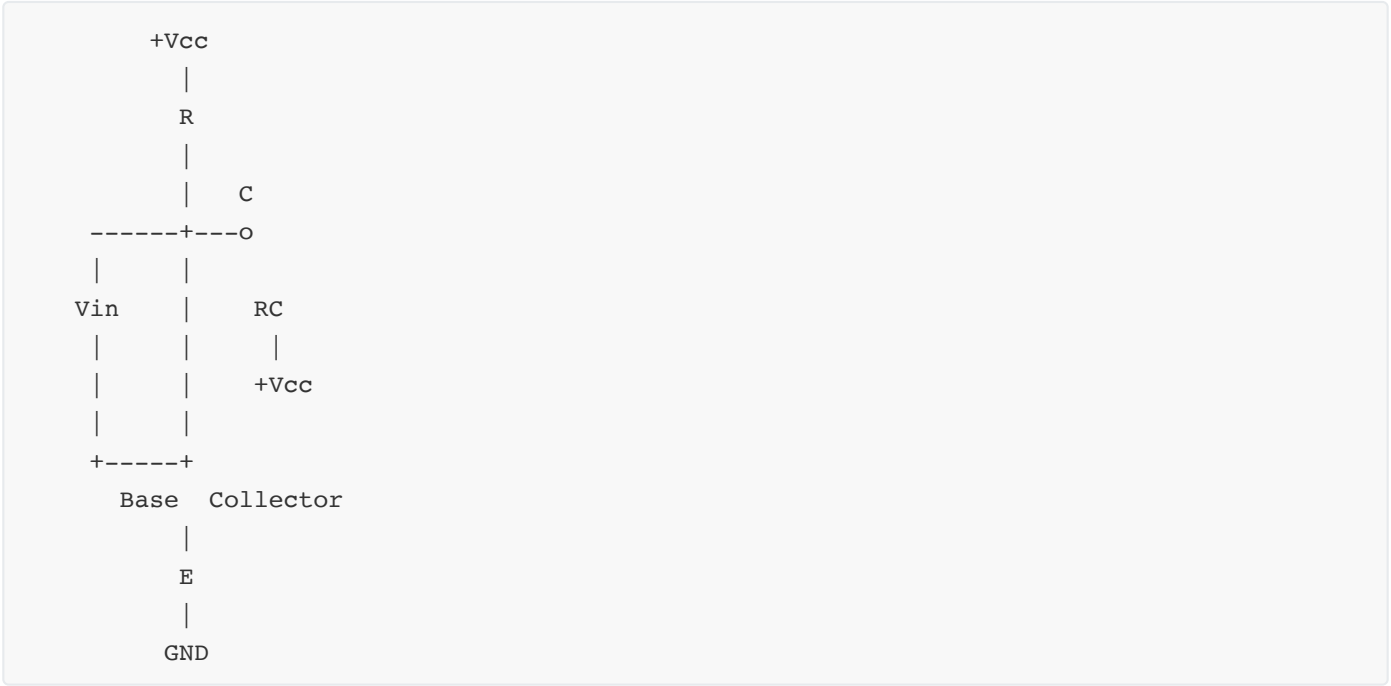
- **High Frequency Response**: Limited by transistor capacitances
    - **Roll-off Rate**: -20 dB/decade for each stage

Mnemonic: "Low Couples Weakly, High Capacitance Blocks"

Question 2(a) OR [3 marks]

Explain fixed bias circuit for transistor biasing.

Answer:
Fixed bias is the simplest biasing method for transistors, using a single resistor connected to the base.



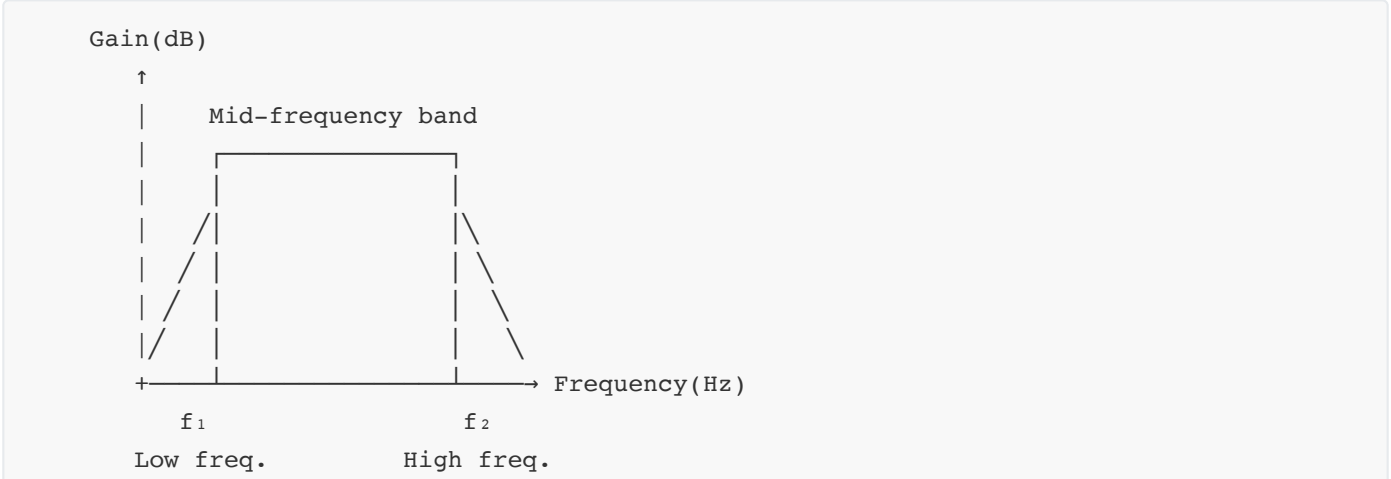
- **Circuit Elements**: Base resistor (RB) and collector resistor (RC)
- **Base Current**: IB = (VCC - VBE)/RB
- **Collector Current**: IC = β × IB
- **Drawbacks**: Poor stability, affected by temperature changes

Mnemonic: "Fix Bias, Face Burden" (of instability)

Question 2(b) OR [4 marks]

Explain frequency response of single stage amplifier.

Answer:
The frequency response of a single-stage amplifier shows gain variation across different frequencies.



Frequency Range	Characteristics
Low frequency region	Gain drops due to coupling capacitors
Mid frequency region	Maximum and constant gain
High frequency region	Gain decreases due to transistor capacitances

- **Lower cutoff frequency**: Determined by coupling capacitors
- **Upper cutoff frequency**: Limited by internal transistor capacitances
- **Bandwidth**: Range between lower and upper cutoff frequencies

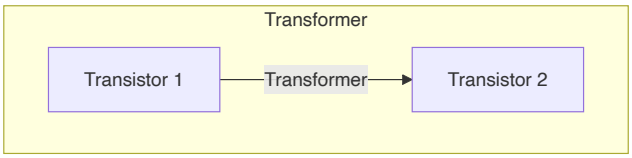
Mnemonic: "Low Middle High - Capacitors Matter Here"

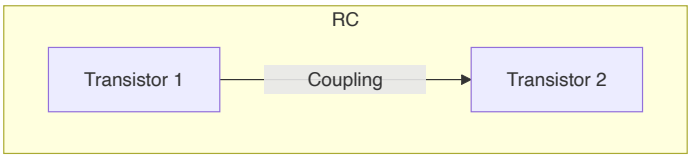
Question 2(c) OR [7 marks]

Compare transformer coupled amplifier and RC coupled amplifier

Answer:

Parameter	RC Coupled Amplifier	Transformer Coupled Amplifier
Coupling Element	Resistor and capacitor	Transformer
Frequency Response	Wide bandwidth	Limited bandwidth
Efficiency	Lower (20-25%)	Higher (50-60%)
Size & Weight	Small and lightweight	Bulky and heavy
Cost	Inexpensive	Expensive
Impedance Matching	Poor matching	Excellent matching
Distortion	Low distortion	Higher due to core saturation
DC Isolation	Good isolation	Excellent isolation
Applications	General purpose	Audio power amplifiers





Mnemonic: "RC Takes Breadth, Transformer Takes Power"

Question 3(a) [3 marks]

Explain in brief Direct coupled amplifier.

Answer:
A direct-coupled amplifier connects stages without coupling capacitors or transformers, allowing DC signal amplification.

- **DC Signal Handling**: Can amplify very low frequencies and DC
- **No Coupling Elements**: Output of first stage directly connects to input of next
- **Frequency Response**: Excellent low-frequency response
- **Drawbacks**: Thermal drift, bias stability issues

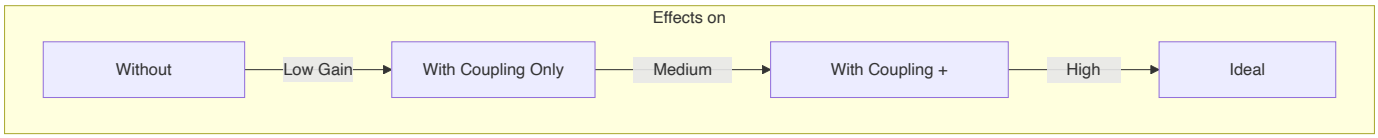
Mnemonic: "Directly Connected, Down to Complete zero frequency"

Question 3(b) [4 marks]

Explain effects of emitter bypass capacitor and coupling capacitor on frequency response of an amplifier.

Answer:

Capacitor	Function	Effect on Frequency Response
Emitter Bypass Capacitor	Bypasses AC around RE	Increases gain at mid and high frequencies
Coupling Capacitor	Blocks DC, passes AC	Determines lower cutoff frequency



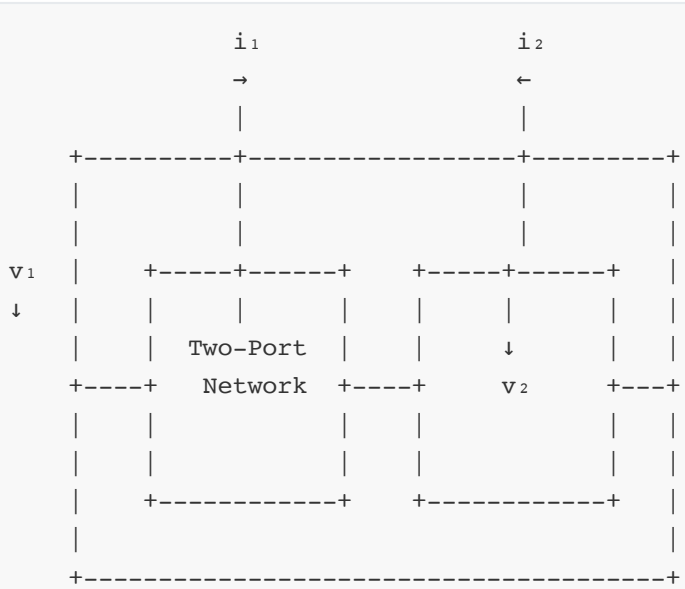
- **Emitter Bypass Capacitor**:
  - **Without**: Lower gain due to negative feedback
  - **With**: Higher gain as RE is bypassed for AC signals
- **Coupling Capacitor**:
  - **Too Small**: Poor low-frequency response
  - **Larger Value**: Better low-frequency response

Mnemonic: "Coupling Controls Lows, Bypass Boosts All"

Question 3(c) [7 marks]

Draw Transistor Two Port Network and describe h-parameters for it. Write down advantages of hybrid parameters.

Answer:
A two-port network is a model to analyze transistor behavior using h-parameters (hybrid parameters).



H-Parameter	Definition	Physical Meaning
h_{11} (h_{ie})	Input impedance with output short-circuited	Base-emitter resistance
h_{12} (h_{re})	Reverse voltage gain with input open-circuited	Feedback from output to input
h_{21} (hf_e)	Forward current gain with output short-circuited	Current gain (β)
h_{22} (ho_e)	Output admittance with input open-circuited	Output conductance

Advantages of H-Parameters:

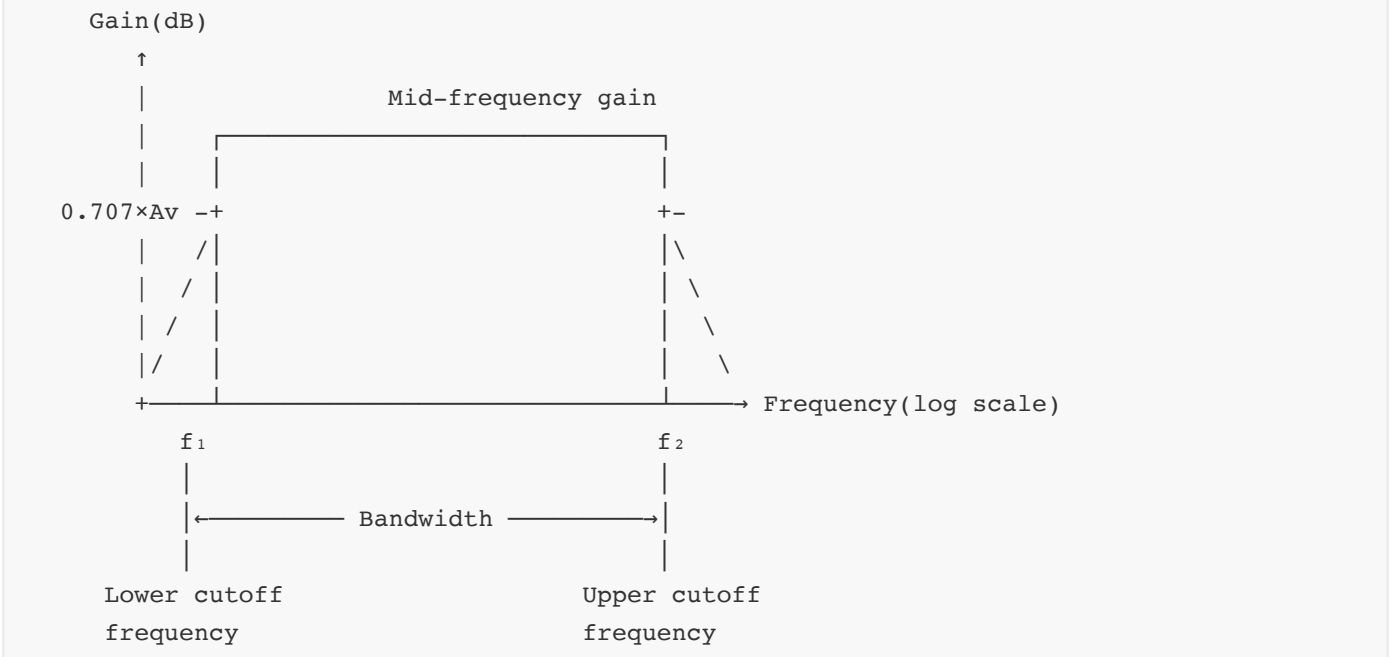
- **Easily Measured**: Direct measurement with simple circuits
- **Mixed Units**: Uses ratios of voltage and current
- **Model Accuracy**: Close approximation to transistor behavior
- **Mathematical Simplicity**: Linear equations for analysis

Mnemonic: "Input, Reverse, Forward, Output - IRFO Parameters"

Question 3(a) OR [3 marks]

Draw frequency response of an amplifier and indicate upper cut-off frequency, lower cut-off frequency, bandwidth, and mid frequency gain of the amplifier on the response.

Answer:
The frequency response graph shows how gain varies with frequency for an amplifier.



- **Mid-frequency Gain (Av)**: Maximum gain in the flat region
- **Lower Cutoff Frequency (f_1)**: Frequency where gain drops to 0.707×Av (-3dB)
- **Upper Cutoff Frequency (f_2)**: Frequency where gain drops to 0.707×Av (-3dB)

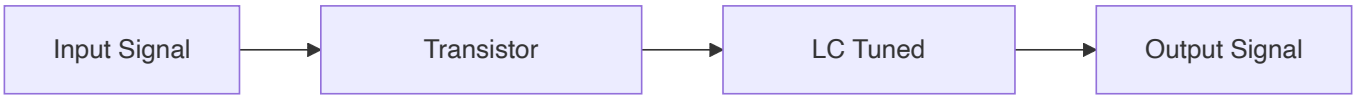
- **Bandwidth**: The difference between upper and lower cutoff frequencies (f_2 - f_1)

Mnemonic: "Lower Bandwidth Upper Makes Amplifier Response"

Question 3(b) OR [4 marks]

Describe the transistor used as a tuned amplifier.

Answer:
A tuned amplifier uses LC resonant circuits to amplify signals selectively at specific frequencies.



Component	Function
LC Tank Circuit	Resonates at specific frequency
Transistor	Provides amplification
Resonance Frequency	$f = 1/(2\pi\sqrt{LC})$
Quality Factor (Q)	Determines bandwidth

- **High Selectivity**: Amplifies signals at resonant frequency
- **Applications**: RF receivers, transmitters, communications
- **Types**: Single-tuned, double-tuned, stagger-tuned
- **Bandwidth**: Inversely proportional to Q factor

Mnemonic: "Tuning LC Selects Signals Precisely"

Question 3(c) OR [7 marks]

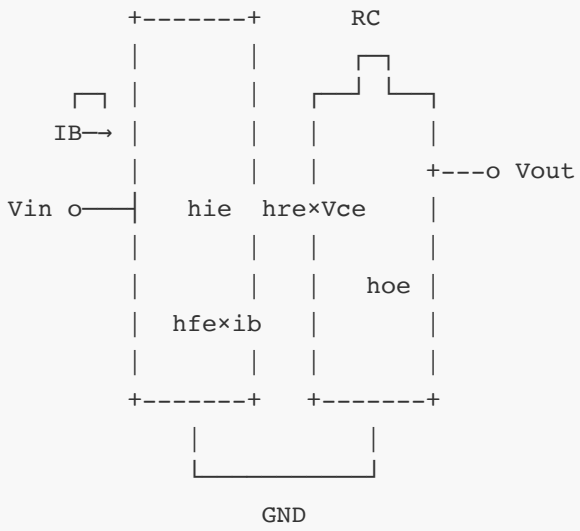
Describe the importance of h parameters in two port network. Draw h-parameters circuit for CE amplifier.

Answer:
H-parameters provide a complete mathematical model for analyzing transistor circuits as two-port networks.

Importance of h-parameters:

Aspect	Importance
Circuit Analysis	Simplified equations for complex circuits
Design Calculations	Predict gain, input/output impedance
Manufacturer Specs	Standard way to specify transistor characteristics
Stability Analysis	Determine stability conditions
Frequency Dependence	Model behavior across frequencies

CE Amplifier h-parameter equivalent circuit:



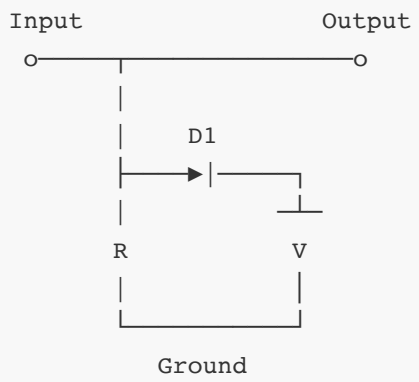
- **hie**: Input impedance (base-emitter resistance)
- **hre**: Reverse voltage feedback ratio
- **hfe**: Forward current gain (β)
- **hoe**: Output admittance

Mnemonic: "Input Resistance, Feedback Ratio, Forward gain, Output conductance"

Question 4(a) [3 marks]

Describe the diode clipper circuit with necessary diagram.

Answer:
A clipper circuit limits or clips off a portion of the input signal that exceeds a certain voltage level.



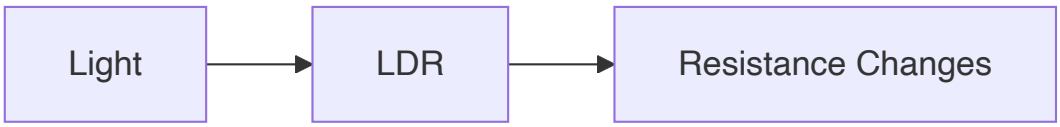
- **Operation**: Diode conducts when voltage exceeds threshold
- **Types**:
  - **Positive Clipper**: Clips positive half-cycles
  - **Negative Clipper**: Clips negative half-cycles
  - **Biased Clipper**: Clips at voltage level other than zero

Mnemonic: "Clip Portions Passing Preset Points"

Question 4(b) [4 marks]

Explain Short note on LDR.

Answer:
LDR (Light Dependent Resistor) is a photoresistor whose resistance decreases with increasing light intensity.



Property	Description
Composition	Cadmium sulfide (CdS) or cadmium selenide (CdSe)
Resistance Range	1MΩ (dark) to few KΩ (bright light)
Response Time	Typically 10-100ms
Spectral Response	Peak sensitivity in visible spectrum

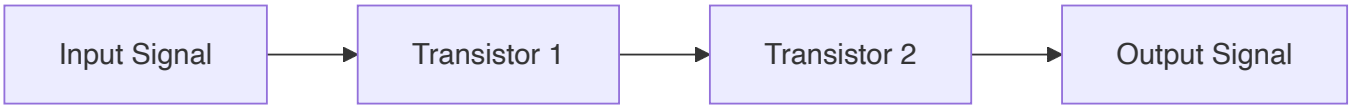
- **Light Absorption**: Generates free carriers
- **Resistance**: Inversely proportional to light intensity
- **Applications**: Light sensors, automatic lighting, camera exposure control
- **Symbol**: Variable resistor with arrow pointing inward

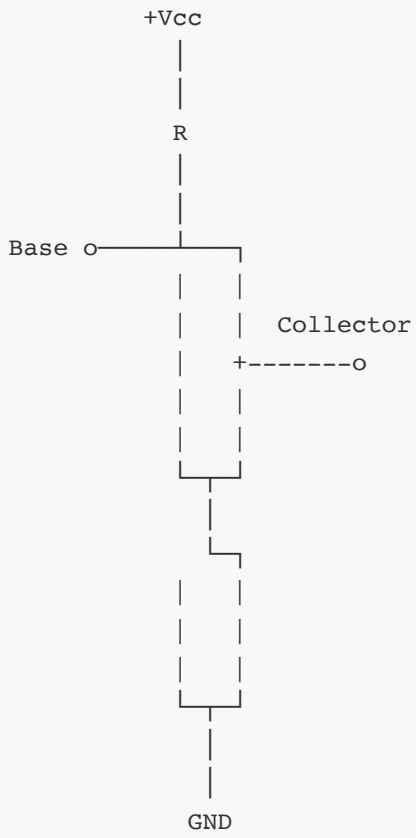
Mnemonic: "Light Decreases Resistance"

Question 4(c) [7 marks]

Explain Darlington pair and its applications.

Answer:
A Darlington pair consists of two transistors connected so that the current amplified by the first is further amplified by the second.





Characteristic	Description
Current Gain	$\beta\_total = \beta_1 \times \beta_2$ (very high)
Input Impedance	Very high ($\beta_2 \times R\_e1$)
Output Impedance	Low
Switching Speed	Slower than single transistor

Applications:

- **Power Amplifiers**: High current gain applications

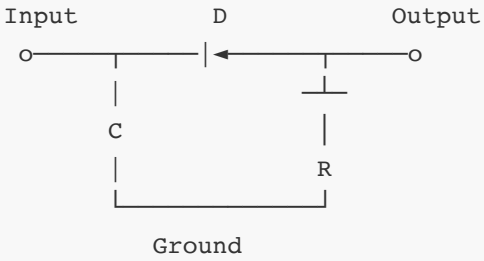
- **Audio Amplifiers**: High input impedance stages
- **Buffer Circuits**: Minimizing loading effects
- **Motor Control**: Driving high-current loads
- **Touch Sensitive Switches**: High sensitivity due to high gain

Mnemonic: "Double Transistors Amplify Really Greatly"

Question 4(a) OR [3 marks]

Describe the diode clamper circuit with necessary diagram.

Answer:
A clamper circuit shifts the entire waveform up or down by adding a DC component without changing its shape.



- **Operation**: Capacitor charges during one half-cycle, maintaining DC level
- **Types**:
  - **Positive Clamper**: Shifts waveform upward
  - **Negative Clamper**: Shifts waveform downward
  - **Biased Clamper**: Shifts to specific DC level

Mnemonic: "Clamps Peaks Down Consistently"

Question 4(b) OR [4 marks]

Explain the working and applications of OLED.

Answer:
OLED (Organic Light Emitting Diode) is a display technology using organic compounds that emit light when electric current passes through.

Layer	Function
Cathode	Injects electrons
Emissive Layer	Organic material that emits light
Conductive Layer	Conducts holes from anode
Anode	Injects holes (usually transparent)

- **Working Principle**: Electron-hole recombination creates photons
- **Self-illuminating**: No backlight required unlike LCD
- **Types**: PMOLED (Passive Matrix) and AMOLED (Active Matrix)
- **Advantages**: Thinner, lighter, wider viewing angles, better contrast

Applications:

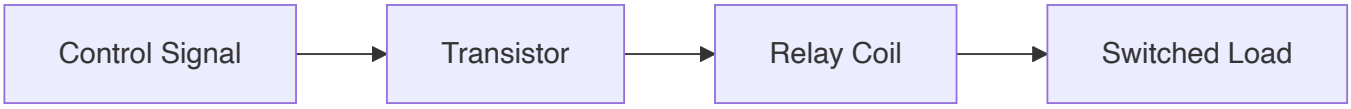
- Smartphones and tablets
- Television screens
- Digital camera displays
- Wearable devices
- Lighting panels

Mnemonic: "Organic Layers Emit Diode-light"

Question 4(c) OR [7 marks]

Describe the transistor used as a relay driver.

Answer:
A relay driver uses a transistor to control a relay, allowing a low-current control signal to switch a high-current load.

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 │
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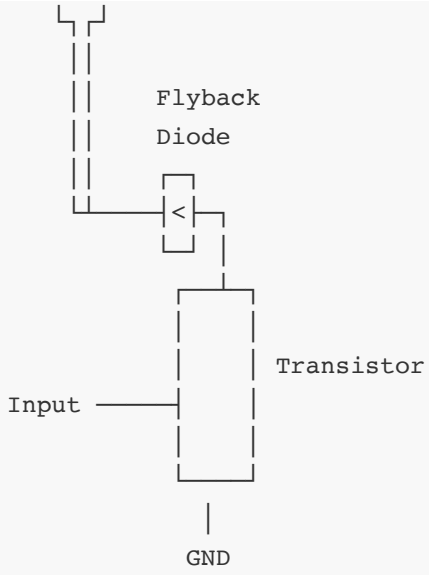


Component	Function
Transistor	Amplifies control signal to drive relay
Flyback Diode	Protects transistor from back EMF
Base Resistor	Limits base current
Relay Coil	Electromagnetic switch

Applications:

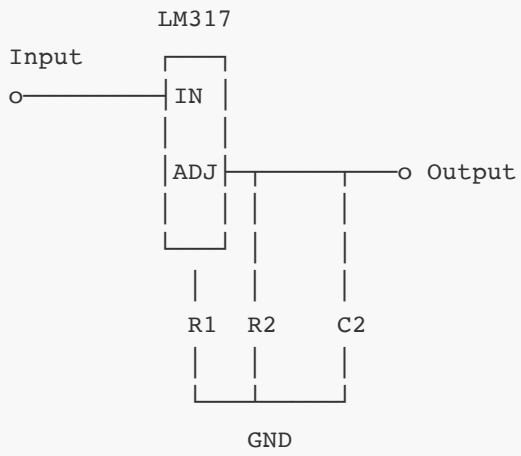
- Motor control circuits
- Industrial automation
- Automotive electronics
- Home appliance control
- Power distribution systems

Mnemonic: "Tiny Regulates Driving Relays"

Question 5(a) [3 marks]

Draw circuit diagram of a variable power supply using LM317 IC.

Answer:
LM317 is an adjustable voltage regulator that can be used to create a variable power supply.



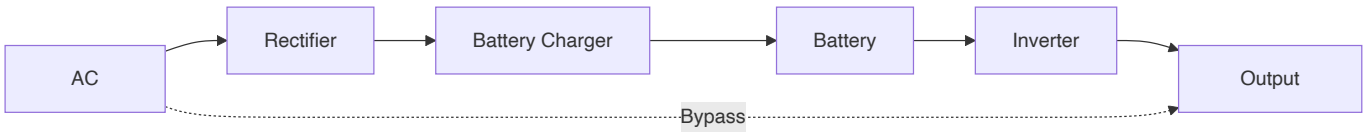
- **Components**:
  - **LM317**: Adjustable voltage regulator IC
  - **R1**: Fixed 240Ω resistor
  - **R2**: Variable resistor (potentiometer)
  - **C1, C2**: Filter capacitors
- **Output Voltage**: VOUT = 1.25 × (1 + R2/R1)

Mnemonic: "LM317 Makes Voltage Adjustable"

Question 5(b) [4 marks]

Explain working of UPS.

Answer:
UPS (Uninterruptible Power Supply) provides emergency power when main power fails.



UPS Type	Operation
Offline/Standby	Switches to battery when power fails
Line-Interactive	Regulates voltage and switches to battery
Online/Double-Conversion	Always powers from battery, continuously charged

- **Main Components**: Rectifier, battery, inverter, control circuit
- **Functions**:
  - Power conditioning
  - Voltage regulation

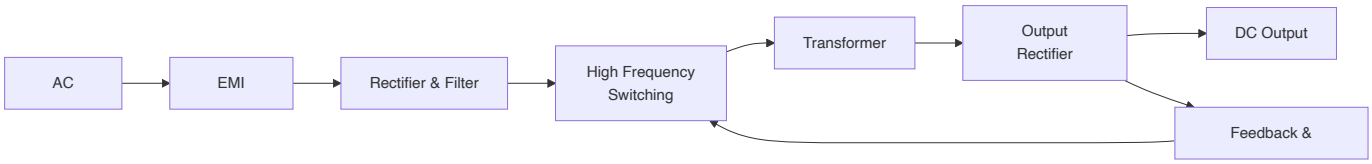
- Surge protection
- Battery backup

Mnemonic: "Uninterrupted Power Supplied During Blackouts"

Question 5(c) [7 marks]

Draw and explain SMPS block diagram.

Answer:
SMPS (Switch Mode Power Supply) uses switching regulation to convert electrical power efficiently.



Block	Function
EMI Filter	Reduces electromagnetic interference
Rectifier & Filter	Converts AC to DC and smooths it
Switching Circuit	Chops DC at high frequency
Transformer	Provides isolation and voltage conversion
Output Rectifier	Converts high-frequency AC back to DC
Feedback Circuit	Regulates output voltage

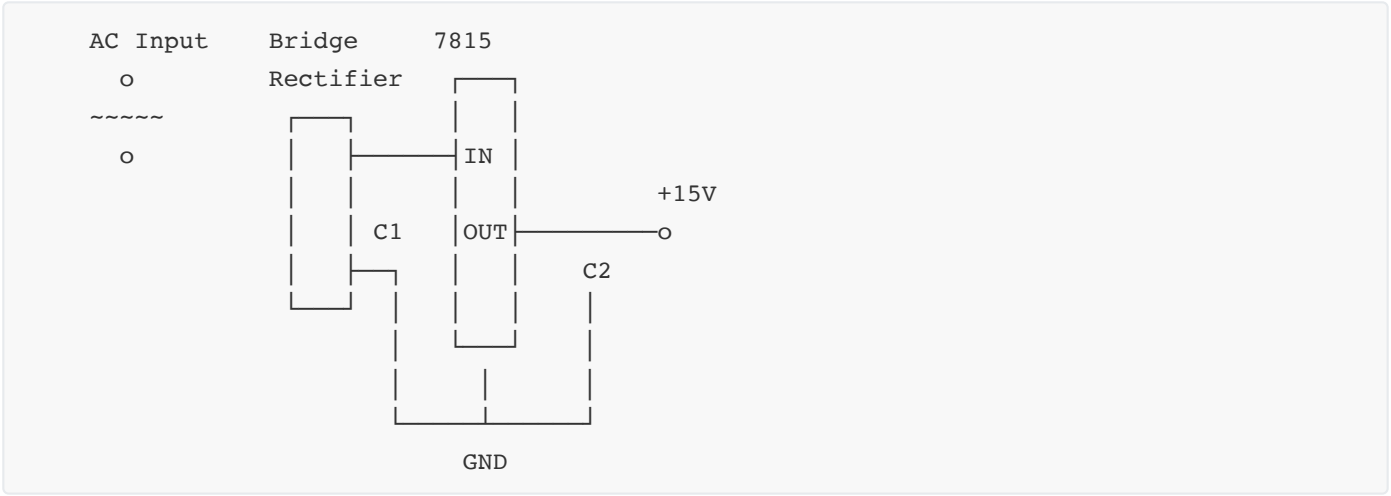
- **Advantages**: High efficiency (70-90%), smaller size, lower weight
- **Operation**: Uses PWM (Pulse Width Modulation) at 20-200 kHz
- **Types**: Forward, Flyback, Push-pull, Half bridge, Full bridge
- **Applications**: Computers, TVs, mobile chargers, LED drivers

Mnemonic: "Switch Makes Power Stable"

Question 5(a) OR [3 marks]

Draw circuit diagram for +15 v Power Supply using its IC and explain in brief

Answer:
A +15V power supply can be built using the 7815 voltage regulator IC.



- **Components**:
  - **7815**: Fixed +15V voltage regulator IC
  - **Bridge Rectifier**: Converts AC to pulsating DC
  - **C1**: Input filter capacitor (1000-2200μF)
  - **C2**: Output filter capacitor (10-100μF)
- **Working**: Rectifies AC, filters it, then regulates to stable +15V DC

Mnemonic: "7815 Fixes Voltage To Fifteen"

Question 5(b) OR [4 marks]

Explain working of solar battery charger circuits.

Answer:
Solar battery chargers convert sunlight into electrical energy to charge batteries.

Component	Function
Solar Panel	Converts sunlight to electricity
Blocking Diode	Prevents battery discharge through panel at night
Charge Controller	Regulates charging voltage and current
Battery	Stores electrical energy

- **Operating Modes**:
  - **Bulk Charging**: Maximum current until ~80% charged
  - **Absorption**: Constant voltage, decreasing current

    - **Float/Trickle**: Maintains full charge
- **Protection Features**: Overcharge, over-discharge, reverse polarity

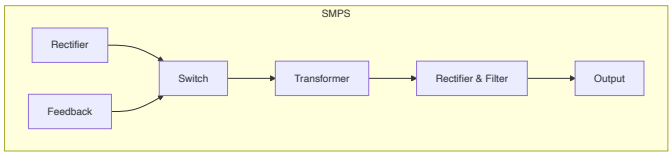
Mnemonic: "Sun Charges Batteries Safely"

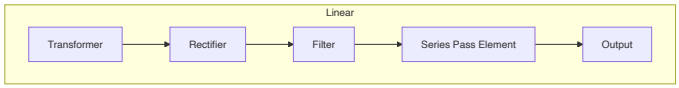
Question 5(c) OR [7 marks]

Discuss comparison of linear regulated power supply with switch mode power supply.

Answer:

Parameter	Linear Power Supply	Switch Mode Power Supply
Operating Principle	Continuous voltage regulation	High-frequency switching
Efficiency	Low (30-40%)	High (70-90%)
Size & Weight	Large and heavy	Compact and lightweight
Heat Dissipation	High	Low
Output Noise	Very low	Higher (switching noise)
Response Time	Fast	Slower
Component Count	Lower	Higher
Cost	Less for low power	Less for high power
Complexity	Simple design	Complex design
EMI	Low	Higher (requires filtering)





Applications:

- **Linear**: Audio equipment, laboratory instruments, sensitive circuits
- **SMPS**: Computers, TVs, mobile chargers, industrial power supplies

Mnemonic: "Linear Loves Low noise, Switching Saves Size"