



Solid State Electronics

Course Structure – Modules 1, 2, & 3

Module 1

Topic Unit 1: Semiconductor Introduction (timeline)

- A. Atomic Structure
- B. Semiconductors, Conductors, and Insulators
- C. Covalent Bonds
- D. Conduction
- E. N-Type or P-Type Material

Topic Unit 2: The Diode (timeline)

- A. pn Junction
- B. Depletion Region
- C. Barrier Potential
- D. Diode Biasing
 - 1. Forward
 - a. voltage
 - b. current
 - 2. Reverse
 - a. voltage
 - b. current
- E. V-I Characteristic Curve
- F. Temperature Effects
- G. Diode Packages
- H. Diode Testing
- I. Diode Lab

Topic Unit 3: Zener Diode (timeline)

- A. Zener Diode symbol.
- B. Characteristic Curve
- C. Operation in the reverse breakdown region
- D. Forward bias operation same as rectifier diode.
- E. Zener diode specs.
 - 1. *Voltage* V_z : The Zener voltage
 - 2. I_{ZMax} the maximum current that can flow through a Zener diode at V_Z .
 - 3. I_{ZMin} the minimum current that can flow through a Zener diode at V_Z .
 - 4. R_z zener resistance
 - 5. Power rating





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6. Voltage tolerance
7. Temperature stability
8. Junction temperature
9. Package

Topic Unit 4: UJT (timeline)

- A. Basic operation
- B. UJT Lab

Topic Unit 5: SCR (timeline)

- A. Basic operation
- B. SCR Lab

Lab/Test/Project:

Final Exam:





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Module 2

Topic Unit 6: Power Supplies (timeline)

- A. Transformer
 - 1. Peak-to-Peak
 - 2. Peak
 - 3. RMS
 - 4. Average
 - 5. Center Tap
- B. Half Wave Rectifier
 - 1. Pulsating DC Voltage
 - a. Positive Output
 - b. Negative Output
 - 2. V_{max}
 - a. $= V_{\text{Peak of secondary}} - V_{\text{diode}}$
 - 3. Average DC Voltage Output
 - a. $= V_{max} / \pi$
 - 4. Diode PIV rating
- C. Full Wave Rectifier
 - 1. Pulsating DC Voltage
 - a. Positive Output
 - b. Negative Output
 - 2. V_{max}
 - a. $= (V_{\text{Peak of secondary}} / 2) - V_{\text{diode}}$
 - 3. Average DC Voltage Output
 - a. $= (2 (V_{max})) / \pi$
 - 4. Diode PIV rating
 - a. $= ((2)(V_{\text{Peak of secondary}}) + .7v)$
- D. Full Wave Bridge Rectifier
 - 1. Pulsating DC Voltage
 - a. Positive Output
 - b. Negative Output
 - 2. V_{max}
 - a. $= V_{\text{Peak of secondary}} - 2(V_{\text{diode}})$
 - 3. Average DC Voltage Output
 - a. $= (2 (V_{max})) / \pi$
 - 4. Diode PIV rating
 - a. $= V_{\text{Peak of secondary}} + .7v$





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E. Filtering

1. Capacitor Filter
2. RLC Time Constant
3. Frequency Of Half Wave, Full Wave and Full Wave Bridge Voltages Compared
4. Ripple Voltage p-p
5. Ripple Compared
6. Filtered Average DC Voltage Output (All 3 types of power supplies)
7. Effectiveness of the Filter or % Ripple
8. Surge Current
 - a. Diode Forward Surge Current Rating
 - 1) IFSM on Spec Sheet
 - b. Surge Resistor

Lab/Project/Test:

Topic Unit 7: Voltage Regulation (timeline)

A. Line Regulation

1. If there is a change in input voltage, the regulator must maintain a constant output voltage.
2. Line regulation
3. Expressed as a percentage change per volt:

B. Load Regulation

1. If a change in load resistance causes a change in current draw, the regulator must maintain a constant output voltage.
2. Load regulation
3. Expressed as a percentage change per milliamp.
4. Load regulation

C. Basic Zener shunt regulator

1. Circuit
2. Basic components
 - a. Load (RL)
 - b. Series resistor (Rs)
 - c. DC Supply voltage
 - d. Zener diode





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The following regulators must be completed after transistor theory.

- D. Series transistor regulator
- E. Transistor shunt regulator
- F. Three terminal regulators (linear)
 - 1. fixed positive regulators
 - 2. fixed negative regulators
 - 3. variable positive regulators
 - 4. variable negative regulators

Lab/Project/Test:

Final Exam:





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Module 3

Topic Unit 8: Bipolar Junction Transistor Characteristics (timeline)

- A. Two pn junctions
 - 1. Emitter
 - 2. Base
 - 3. Collector
 - 4. Base-Emitter junction
 - 5. Base-Collector junction
- B. Type
 - 1. NPN
 - 2. PNP
- C. Symbols
- D. Biasing
- E. Operation
- F. Currents
- G. Basic formulas
 - 1. $I_E = I_C + I_B$
- H. Transistor parameters and characteristic curves
- I. Voltage and current measurements
 - 1. Voltages with respect to ground
 - 2. Voltages not with respect to ground
 - 3. Currents
- J. Transistor characteristic curves
 - 1. Circuit used to determine the characteristic curves.
 - 2. Other methods to determine the curves.
 - 3. Linear region
 - 4. Saturation region
 - 5. Breakdown region
 - 6. Cutoff region
- K. DC load line
 - 1. Two points determine a line
 - 2. Calculating the two points
 - 3. Maximum transistor ratings
 - a. Maximum power rating
 - 4. Transistor data sheets





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5. Transistor testing
6. Packages
7. Transistors as switches
 - a. Switch off = transistor condition biased in cutoff
 - b. Switch on = transistor condition biased in saturation
 - c. Application
8. Transistor as an amplifier
 - a. V_{in}
 - b. V_{out}
 - c. Voltage gain
 - d. DC operating point and DC bias
 - 1) Q point
 - 2) Operation in the linear region
 - 3) Operation out of the linear region
 - e. Common emitter amplifier
 - 1) Amplifier calculations fixed bias
 - 2) Amplifier calculations self bias
 - 3) Amplifier calculations voltage divider bias
 - 4) Phase inversion of the common emitter amplifier
 - 5) Input and output impedance
 - f. Common collector amplifier

Lab/Test/Project

Final Exam:





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