Subject Name: EDC

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Unit-1: DIODE AND APPLICATIONS

Important Points /Definitions:

1. A PN junction diode is a two terminal device consisting of a PN junction formed either of Germanium or Silicon crystal. A PN junction is formed by diffusing P type material to one half side and N type material to other half side..
2. In an n-type material the electron is called the majority carrier and the hole is the minority carrier.
3. In a p-type material the hole is the majority carrier and the electron is the minority carrier.
4. The region near the junction of a diode that has very few carriers is called the depletion region.
5. In the absence of any externally applied bias, the diode current is zero.
6. In the forward-bias region the diode current increases exponentially with increase in voltage across the diode.
7. In the reverse-bias region the diode current is the very small called reverse saturation current.
8. Expression for current through a PN junction Diode is
$$I=Io[eV/\eta VT - 1]$$
9. Static resistance of a diode is defined as the ratio of the DC voltage applied across the diode to the DC current flowing through the diode.
10. Dynamic resistance of a diode is defined as the ratio of change in voltage to the change in current.
11. Reverse resistance is defined as the resistance offered by the p-n junction diode when it is reverse biased.
12. When a diode is reverse biased, the holes in the p- side and the electrons in the n-side drift away from the junction thereby uncovering more immobile charges. As a result the thickness of depletion increases, this leads to capacitance effect across the region called transition capacitance. It is given by
$$CT= \varepsilon A/W$$
13. The diffusion capacitance effect is found when the diode is forward biased and it is defined as the rate of change of injected charge with voltage and is given by
$$CD= \tau I/\eta VT$$
14. The transition capacitance is the predominant capacitive effect in the reverse-bias region whereas the diffusion capacitance is the predominant capacitive effect in the forward-bias region.

15. A Rectifier is defined as an electronic device used for converting A.C voltage or Current into Unidirectional (D.C) voltage or current.
16. A Half wave rectifier circuit is one which conducts current only during the positive half cycles of input A.C supply.
17. In Full wave Rectifier circuit current flows through the load in the same direction for both half cycle of input A.C supply
18. Bridge Rectifier circuit uses 4 diodes arranged in the form of bridge to provide full wave rectification.
19. The maximum value of Reverse voltage that a PN junction diode can withstand without damaging it, is called Peak Inverse Voltage (P.I.V)
20. The Ratio of R.M.S value of the A.C component to the D.C component in the Rectifier output is called Ripple Factor.
21. The rectifier efficiency is defined as the ratio of Dc power delivered to the load by AC input from transformer secondary
22. The transformer utilization factor TUF is defined as the Ratio of DC power delivered to the load to the AC power rating of the Transformer
23. The voltage Regulation is the factor which tells about the change in the D.C output voltage as load changes from no load to full load condition.
24. Clippers are networks that employ diodes to "clip" away a portion of an input signal without distorting the remaining part of the applied waveform.
25. A clamper is a network constructed of a diode, a resistor, and a capacitor that shifts a waveform to a different dc level without changing the appearance of the applied signal.
26. In two level clipper the signal clipped from above and below reference levels and transmitted the signal between two reference level.
27. The clamping circuit theorem states that for any input wave form under steady state conditions, the ratio of the area A_f under the output voltage curve in the forward direction to that area under the output curve in the reverse direction A_r is equal to the ratio R_f/R

$$A_f / A_r = R_f / R$$

Short Questions: (As per previous JNTUH papers)

1. What is PIV in case of half wave and full wave rectifier? (3M,Jan2015)
2. Write diode current equation (2M,Jan2015)
3. Give the ripple factor and efficiency for full wave rectifier with capacitive filter. (3M,Jan2015)
4. Explain the difference between transition and diffusion capacitances of P-N diode.(3M.May/June2017)
5. Why filter circuit is necessary with rectifiers.(3M.May/June2018)
6. Define Transformer utilization factor.(4M,June2015)
7. Define Depletion region and explain how the pn junction formed? (4M,June2015)
8. What are the advantages and disadvantages of full wave rectifier?(4M,June2015)
9. Derive expression for the efficiency of a Half wave rectifier circuit.(4M,Oct/Nov2016)
10. Draw the Bridge rectifier circuit with input and output waveforms.(4M,Oct/Nov2016)

11. Draw the V-I Characteristics of diode and explain.(3M,Dec2015)
12. Derive an expression for TUF in Bridge rectifier? (4M,Dec2015)
13. Define i) Ripple factor ii) % Regulation.(4M,June2015)

Long Questions: (As per previous JNTUH papers)

1. Derive the expression for Ripple factor for Full Wave Rectifier with L-section filter(March – 2017)
2. Define Rectification efficiency and derive expression for it for the following (i) Half wave rectifier (ii) Full wave rectifier (iii) Bridge rectifier.(June – 2015)
3. Define diffusion capacitance in a P-N junction diode and discuss its dependence on diode biasing (May – 2018)
4. Define diffusion and transition capacitance of p-n junction diode. Prove that diffusion capacitance is proportional to current I.(March – 2017)
5. Derive an expression for transition capacitance of a diode. (November/December – 2016)
6. Draw the Bridge rectifier with relevant input and output waveforms and derive expression for its efficiency(Oct/Nov – 2016)
7. Why filter circuit is necessary with rectifiers? Give the list of different filters used in rectifier. (May – 2019)
8. How a PN junction diode works? Draw and explain V-I characteristics of PN diode wit neat diagram.(May – 2018)
9. Derive the relation between α and β. (April/May – 2018)
10. With suitable expressions explain transition capacitance. (April/May – 2018)

Fill in the blanks/ Choose the best:

1. The semiconductor diode current equation is given by [c]

   (a) $I=(1-e^{V/\eta Vt})$ (b) $I=I_o(e^{1/\eta Vt}-1)$ (c) $I=I_o(e^{V/\eta Vt}-1)$ (d) $I=I_o(1-e^{1/\eta Vt})$

2. The depletion region within a PN junction is reduced when the junction has: [b]
   (a) Zero bias (b) Forward bias (c) Reverse bias (d) All of these
3. The cut in voltage (or knee voltage) of a silicon diode is [b]
   (a) 0.2V (b) 0.6V (c) 0.8 V (d) 1.0V
4. The ripple factor of a bridge rectifier is [a]

   (a) 0.482 (b) 0.812 (c) 1.11 (d) 1.21
5. The capacitance of a reverse biased PN junction [c]
   (a) Increases as reverse bias is increased (b) Decreases as reverse bias is increased
   (c) increases as reverse bias is decrease (d) Is insignificantly low
6. The PIV of a half-wave rectifier circuit with a shunt capacitor filter is [a]

   (a) $2V_m$ (b) V_m (c) $\frac{V_m}{2}$ (d) $3V_m$
7. For a PN junction diode, the current in reverse bias may be [d]
   (a) Few miliamperes (b) Between 0.2 A and 15 A
   (c) Few amperes (d) Few micro or nano amperes

8. In a PN junction when the applied voltage overcomes the ..... potential, the diode current is large, which is known as ..... [d]
(a) Depletion, negative bias (b) Reverse, reverse bias
(c) Resistance, reverse bias (d) Barrier, forward bias

9. The negative Clamper is also called [a]
(a) Positive peak clamper (b)Negative peak clamper
(c) Positive peak clipper (d) Negative peak clipper

10. Which of the following is not the name of clamping circuit [c]
a) DC restorer b) DC inserter c) DC limiter d) Both a & b

Unit-2: BIPOLAR JUNCTION TRANSISTOR

Important Points /Definitions:

1. A Transistor consists of two PN junctions formed by sandwiching either P-type or N-type semiconductor between a pair of opposite types.
2. A Bipolar Junction Transistor is a three terminal device and is called Current Controlled Device. Since , the output current is controlled by input current i.e., the current at output terminal depends on current at input terminal.
3. When emitter junction is forward biased and collector junction is reversed biased, then BJT is said to be in Active region.
4. When both emitter junction and collector junction are forward biased, then BJT is said to be in Saturation region.
5. When both emitter junction and collector junction are reverse biased, then BJT is said to be in Cutoff region.
6. A Transistor is connected in three configurations:
   i) Common Base configuration
   ii) Common Emitter configuration
   iii) Common Collector configuration
7. The Emitter current (I_E) is the sum of the collector current (Ic) and the base current (I_B), is called transistor current. I_B is very small compared to I_E or Ic.
   $$I_E = I_C + I_B$$
8. The ratio of the Collector current I_C resulting from carrier injection to the total Emitter current I_E at constant Collector-Base voltage is called Current Amplification factor (α).
   $$\alpha = I_C / I_E$$
9. The ratio of Collector current I_C to Base current I_B at constant Emitter-Collector Voltage is called Common Emitter Amplification factor or Current Gain (β)
   $$\beta = I_C / I_B$$
10. The ratio of Emitter current I_E to Base current I_B at constant Emitter-Collector Voltage is called Common Collector Amplification factor or Current Gain (γ)
    $$\gamma = I_E / I_B$$
11. DC load line is the line on the output characteristics of a transistor circuit which gives the values of Ic & Vce corresponding to zero signal (or) DC Conditions.
12. AC load line is the line on the output characteristics of a transistor circuit which gives the values of Ic & Vce when signal is applied.
13. The zero signal values of Ic & Vce are known as operating point. It is also called so because the variations of Ic and Vce take place about this point, when the signal is applied.
14. The stability factor is defined as the rate of change of collector current Ic with respect to the reverse saturation collector current Ico, keeping 'Vbe'and 'β ' constant.
15. When reverse bias voltage VCB increases,the width of depletion region also increases, which reduces the electrical base width. This effect is called as 'Early effect' or 'Base width modulation'.

Short Questions: (As per previous JNTUH papers)

1. What is quiescent point?(2M,Jan2015)
2. Define stability factor? (2M,Jan2015)
3. Define Thermal runaway. (2M,Jan2015)
4. Which is the most commonly used transistor configuration. Why? (3M,Jan2015)
5. Define the stability factors S' ,S'' and what is the need for of this in BJT circuits. (3M,May2019)
6. Define the relation among α, β and γ. (3M,May/June2017)
7. What are the advantages of fixed bias circuit?(2M, May/June2017)
8. Why we call BJT as a current controlled device.(3M,May2018)
9. Describe the basic structure of the BJT.(4M,June2015)
10. What is the effect of change in temperature on the stability of operating point? (4M,June2015)
11. What is meant by Amplification and in what region of the characteristics the transistor is operated as amplifier? (4M,June2015)
12. Define the stability factor and write the expression for it(4M,June2015)
13. Transistor works as an amplifier, justify? (4M,Oct/Nov2016)
14. Draw the self bias circuit for BJT and derive for the stability factor 'S'(4M,Oct/Nov2016)
15. Explain the Break down in transistor. (3M,Oct/Nov2017)

Long Questions: (As per previous JNTUH papers)

1. Draw the circuit diagram of a voltage divider bias and derive expression for Stability factor. (March – 2017)
2. Explain input and output characteristics of transistor in CB configuration with neat diagram. (March – 2017)
3. Explain input and output characteristics of common emitter configuration. (Jan – 2015)
4. Draw the circuit diagram for finding the CC characteristics of a Transistor.(June – 2015)
5. What is Biasing? Explain the need of it. List out different types of biasing methods.(June – 2015)
6. What is the need to fix the operating point of a transistor and illustrate the complete AC load line analysis of BJT(Oct/Nov – 2016)
7. Obtain S and S" factors. (May/June – 2017)
8. Write the differences between CB, CE, and CC Amplifier Configurations. (April/May – 2018)
9. Derive the equation for stability factor for fixed bias(April/May – 2018)
10. Draw and explain the circuit for bias compensation using diode. (April/May – 2018)

Fill in the blanks/ Choose the best:

1. The transistor is said to be in saturation region when [a]

(a) both collector and emitter junctions are forward biased
(b) both collector and emitter junctions are reversed biased ·
(c) emitter junction is forward biased, but the collector junction is reverse biased
(d) emitter junction is reverse biased, but the collector junction is forward biased

2. A transistor connected in common base configuration has [b]
(a) a high input resistance and a low output resistance
(b) a low input resistance and high output resistance
(c) a low input resistance and a low output resistance
(d) a high input resistance and a high output resistance

3. Which of the following is not a time varying quantity? [b]
(a) v_{ce} (b) V_{CE} (c) v_{CE} (d) V_{ce}

4. The d.c. load line of a transistor circuit [a]
(a) is a graph between I_C and V_{CE} (b) is a graph between I_C and I_B
(c) does not contain the locating point (d) is a curved line

5. Transistor biasing represents ……. Conditions [b]
(a) a.c. (b) d.c. (c) both a.c. and d.c. (d) none of the above

6. If biasing is not done in an amplifier circuit, it results in …… [b]
(a) Decrease in the base current (b) Unfaithful amplification
(c) Excessive collector bias (d) None of the above

7. For proper operation of the transistor, its collector should have …… [b]
(a) Proper forward bias (b) Proper reverse bias
(c) Very small size (d)None of the above

8. The circuit that provides the best stabilization of operating point is …… [c]
(a) Base resistor bias (b) Collector feedback bias
(c) Potential divider bias (d) None of the above

9. The point of intersection of d.c. and a.c. load lines represents …….. [a]
(a) Operating point (b) Current gain
(c) Voltage gain (d) None of the above

10. An ideal value of stability factor is …….. [d]
(a) 100 (b) 200 (c) More than 200 (d) 1

Unit-3: JUNCTION FIELD EFFECT TRANSISTOR (JFET) & SPECIAL PURPOSE DEVICES

Important Points /Definitions:

1. In FET current is carried by only one type of charge particles, either electrons or holes. Hence FET is called unipolar device.
2. FET is a semiconductor device in which the current is controlled by an electric field generated by the input Gate voltage. Hence FET is called as " Voltage controlled device"
3. FET is classified into two types
   i) Junction field effect transistor (JFET)
   ii) Metal oxide semiconductor field effect transistor (MOSFET)
4. A JFET is a 3- terminal device in which current conduction is by one type of charge carriers i.e., electrons or holes.
5. The three terminals of JFET are
   i) Source (S)
   ii) Drain (D)
   iii)Gate (G)
6. In the region before pinch off, where V_{DS} is small, the drain to source resistance rd can be controlled by the bias voltage V_{GS}. Therefore FET is useful as voltage variable resistor (VVR) or Voltage dependent Resistor (VDR)
7. The reverse bias characteristic of zener diode is useful in voltage regulation. Since in the reverse biased condition, at the breakdown voltage Vz, its reverse voltage remains constant for a large variation of the reverse current.
8. Zener diode is a specially designed PN junction diode. A reverse biased heavily doped PN junction diode which is operated in the breakdown region is known as Zener diode. It is also called as voltage regulator diode or breakdown diode
9. An electron device , which keeps the output voltage constant irrespective of the variation in load current, line voltage and temperature is known as electronic voltage regulator.
10. When the reverse voltage across the PN junction is increased rapidly at a voltage the junction breaks down leading to a current flow across the device. This phenomenon is called as break down and the voltage is break down voltage.
    The types of break down are
    i)zener break down
    ii)Avalanche breakdown
11. UJT stands for unijunction transistor. The UJT is a three terminal semiconductor device having two doped regions. It has one emitter terminal (E) and two base terminals ($B_1$and B_2). It has only one junction, moreover from the outlook, it resembles to a transistor hence the name unijunction transistor
12. The region on the UJT characteristic wave where the device does not obeys ohm law. That means the voltage is inversely proportional to current , is called Negative Resistance Region.
13. A silicon controller rectifier (SCR) is a three terminal, three junction semiconductor device that acts as a true electronic switch. It is a unidirectional device. It converts alternating current into direct current and controls the amount of power fed to the load.

14. The maximum current for any JFET is labeled I_{DSS} and occurs when V_{GS}= 0 V and the minimum current for a JFET occurs at pinch-off defined by $V_{GS} = V_P$.
15. I_{DSS} is the maximum drain current for a JFET and is defined by the conditions V_{GS} = 0 V and $V_{DS} > V_P$.
16. The value of Drain current is defined by Shockley's equation and is given by
$$I_D = I_{DSS}(1- V_{GS}/ V_P)^2$$
17. Tunnel diode is a Negative Resistance Device and is used as High Frequency Oscillator and Fast switching device.
18. Varactor Diode is a variable capacitor type device , whose junction capacitance varies significantly with biasing voltage. It is also called as Varicaps, Voltcaps or Varactors.
19. The impurity concentration in Tunnel diode is of the order of $1:10^3$ atoms.

Short Questions: (As per previous JNTUH papers)

1. List the applications of Varactor diode(2M,Oct/Nov2017)
2. How the Zener diode act as voltage regulator(3M,Jan2015)
3. Draw the symbol for SCR.
4. List the applications of UJT(3M,Jan2015)
5. What is avalanche break down mechanism in Zener diode? (3M,Jan2015)
6. What are the differences between BJT and FET?(4M,May2019)
7. Define pinch- off- voltage of JFET.(2M,Jan2015)
8. List out different types of biasing methods(4M,May2018)
9. Describe Tunneling phenomenon?(4M,June2015)
10. What is Avalanche breakdown? (4M,June2015)
11. Draw the Construction diagram and characteristics of the SCR(4M,Oct/Nov2016)
12. Why FET is called a voltage operative device? Explain(2M,Oct/Nov2017)
13. Explain the terms Peak voltage and Valley current in UJT. (2M,Oct/Nov2017)
14. How FET acts as Voltage Variable Resistor?(3M,Mar2017)

Long Questions: (As per previous JNTUH papers)

1. Sketch and explain the volt-ampere characteristics of a tunnel diode. Indicate the negative resistance portion. (Jan – 2015)
2. With a neat construction diagram explain the principle of operation of a JFET. Give its characteristics. (Jan – 2015)
3. Explain the construction and working of Zener diode.(June – 2015)
4. Explain in detail the break down mechanisms in a diode.(June – 2015)
5. Explain the Voltage regulation using Zener Diode.(March – 2017)
6. Draw the Construction diagram, operation and characteristics of SCR (Oct/Nov – 2016)
7. What is a Tunnel diode? Explain the construction and working with neat band diagrams? Draw its characteristics(Oct/Nov – 2016)
8. Draw the equivalent circuit and V-I Characteristics of UJT and explain it (Dec – 2015)
9. Describe the working principle of an SCR with V-I Characteristics. (May – 2018)

10. Explain in detail the working of JFET .Draw its drain and transfer characteristics (May/June – 2017)

Fill in the blanks/ Choose the best:

1. A FET has, [a]
(a) Very high input impedance (b) Very low input impedance
(c) Very low Gain (d) All the above

2. A field effect transistor (FET) operates on [a]
(a) Majority carriers only (b) Minority carriers only
(c) Positively charged ions only

3. In JFET operating above pinch-off voltage, the [a]
(a) Drain current remains practically constant (b) Drain current starts decreasing
(c) Drain current increases rapidly (d) Depletion region becomes smaller

4. Thermal runway is not possible in FET because as the temperature of the FET increases[b]
(a) the mobility decreases (b) the trans-conductance increases
(c) the drain current increases (d) the mobility increases

5. An FET is a better chopper than a BJT because it has [e]
(a) lower offset voltage (b) higher series ON resistance
(c) lower input current (d) higher input impedance. (e) both (c) and (d)

6. The JFET is a [b]
(a) current controlled device with high input resistance
(b) voltage controlled device with high input resistance
(c) voltage controlled device with low input resistance
(d) current controlled device with low input resistance

7. The best location for setting a Q-point on d.c. load line of an FET amplifier is at [c]
(a) Saturation point (b) cut-off point
(c) Mid-point (d) none of these

8. Zener diodes with breakdown voltages less than 5 V operate predominantly in what type of breakdown? [b]
(a) Avalanche (b) Zener (c) varactor (d) Schottky

9.The normal operating region for a zener diode is the [d]
(a) forward-bias region. (b) reverse-bias region
(c) zero-crossing region. (d) reverse-breakdown region

10. Back-to-back varactor diodes are used for what reason? [c]

(a) over-voltage protection (b) a wider tuning range

(c) to eliminate harmonic distortion (d) no reason; only zeners are used in a back-to-back configuration

11. A tunnel diode is used [b]

(a) in high-power circuits. (b) in circuits requiring negative resistance.

(c) in very fast-switching circuits. (d) in power supply rectifiers.

12. What type of diode is commonly used in electronic tuners in TVs? [a]

(a) varactor (b) Schottky (c) LED (d) Gunn

13. A Varactor is a PN junction diode that always operates in _____-bias and is doped to _____ the inherent capacitance of the depletion region. [b]

(a) forward, maximize (b) reverse, maximize
(c) reverse, minimize (d) forward, minimize

14. A UJT has ……. [b]

(a) Two pn junctions (b) One PN junction (c) Three PN junctions (d) None of the above

15. A UJT is sometimes called ……. Diode [d]

(a) Low resistance (b) High resistance (c) Single-base (d) Double-base

16. When the temperature increases, the inter-base resistance (R_{BB}) of a UJT …… [a]

(a) Increases (b) Decreases (c) Remains the same (d) None of the above

17. An SCR has …….. PN junctions [b]

(a) Two (b) Three (c) Four (d) None of the above

18. An SCR is sometimes called …… [d]

(a) Triac (b) Diac (c) Unijunction transistor (d) Thyristor