ANNA UNIVERSITY EXAMINATIONS DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING AY : 2018-2019 (Regulation 2017)

Subject Code Subject Name Degree/Branch Year/ Sem / Sec Faculty In charge : EC 8252 : Electronic Devices : BE/ECE : I / II / A, B & C : Dr. K. Murugesan, Dr. D. C. Diana, Ms. S. Caroline Jebakumari

QUESTION BANK

UNIT I - SEMICONDUCTOR DIODE

PART A

- 1. State the relationship between diffusion capacitance and diode current in a N diode. [APR/MAY 2018]
- 2. Write down the diode current equation. [APR/MAY 2018]
- 3. Define the term 'Electronics'.
- 4. List the major areas of applications of electronics.
- 5. How conventional current direction and electron flow differs? State why each is important.
- 6. Define conduction band, valence band and forbidden gap and explain their origin.
- 7. What is an intrinsic semiconductor? Give examples.
- 8. What is an extrinsic semiconductor? Give examples.
- 9. How can extrinsic material be made intrinsic?
- 10. Define doping?
- 11. What are the two types of extrinsic semiconductors?
- 12. Give the conductivity equation for an intrinsic semiconductor.
- 13. Give the conductivity equation for an extrinsic semiconductor.
- 14. State mass action law.
- 15. Why depletion region is called so?
- 16. Draw a sketch to show the process of current flow by hole movement. Which have greater mobility, electrons and holes? Explain why?
- 17. Define barrier potential.
- 18. What is the value of barrier potential for Si and Ge?
- 19. What is biasing?
- 20. What happens in a forward biased mode of PN diode?
- 21. What happens in a reverse biased mode of PN diode?
- 22. Define reverse saturation current.

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- 23. What is the value of reverse saturation current for Si and Ge?
- 24. Why is reverse saturation current smaller for Si than that of germanium?
- 25. Define transition capacitance.
- 26. Give the expression for transition capacitance
- 27. Define diffusion capacitance.
- 28. Give the expression for diffusion capacitance
- 29. Define recovery time.
- 30. What are the types of recovery time?
- 31. What is storage time?
- 32. What is transition time?
- 33. Differentiate between zener and PN junction diode?
- 34. What is zener effect or zener breakdown?
- 35. List the applications of zener diode?
- 36. Define drift current.
- 37. Write about the mechanisms of breakdown in PN diode
- 38. Why does a contact difference of potential exist across an open circuited PN junction?
- 39. Determine the germanium PN junction diode current for the forward bias voltage of 0.22V at room temperature of 25°C with reverse saturation current equal to 1mA.
- 40. The reverse saturation current of silicon PN junction diode is 10 μ A. Calculate the diode current for the forward bias voltage of 0.6V at 25°C.
- 41. What is the thickness of depletion region of PN junction?
- 42. Sketch the piece wise linear characteristics of a diode.
- 43. The reverse bias saturation current of a reverse bias PN diode is $1\mu A$ at 300K. Determine its AC resistance at 150m forward bias.
- 44. An AC voltage of peak value 20V is connected in series with silicon diode and load resistance of 1 K Ω . If the forward resistance of the diode is 15 Ω find the peak current through the diode.
- 45. Differentiate between static and dynamic resistance of a diode.
- 46. What is cut in voltage in a diode and write its value for Si and Ge diodes?
- 47. What is meant by avalanche breakdown in a diode?
- 48. Define peak inverse voltage in a diode.
- 49. Define diffusion capacitance of PN junction diode.
- 50. Write the diffusion current expression and state how this current is formed
- 51. What is a diode?
- 52. Define forward resistance of diode.
- 53. Write about the mechanisms of breakdown in PN diode.
- 54. How does the diode voltage at constant current vary with temperature?
- 55. What do you mean by maximum power rating of a diode?
- 56. What are the components of the reverse recovery time of PN diode?
- 57. Compare the Si and Ge diodes with respect to cut in voltage and reverse saturation current
- 58. Define potential barrier in forward bias PN junction diode and what is the value for Si and Ge diode.

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- 59. How does the barrier width vary with applied reverse bias voltage in a step graded PN and a normal PN junction? Which type of diode uses this property?
- 60. Write about the mechanisms of breakdown in PN diode.
- 61. What is the problem posed by diffusion capacitance?
- 62. Define depletion layer capacitance in a PN junction.
- 63. What is Avalanche breakdown?
- 64. Draw the equivalent circuit of a zener diode under proper biased conditions.
- 65. What is the charge carrier found in P type materials?
- 66. Calculate the barrier capacitance of Germanium PN diode junction whose area is 1 X 1 mm, space charge thickness is 2 X 10⁻⁴ cm and the dielectric constant of Germanium is 16.
- 67. A silicon diode has a saturation current of 7.5 μA at room temperature. Calculate the saturation current at 400 K.
- 68. Calculate the diode current for the forward bias voltage of 0.6 V at 25 °C, if the reverse saturation current is 10 μ A.
- 69. Write the temperature dependence equation of a diode.
- 70. What are the major differences between switching diode and a rectifier diode?

PART -B

- 1. Demonstrate the working mechanism of a PN junction diode in both forward and reverse bias conditions. (13) [APR/MAY 2018]
- 2. Analyze the impact of temperature on V-I characteristics of PN diode. (13) [APR/MAY 2018]
- 3. i) Explain the theory of PN junction diode along with its V-I characteristic.ii) Discuss the effect of temperature upon the characteristics of PN junction diode.
- 4. i) State continuity equation and prove that concentration of charges is independent of time with zero electric field

ii) With neat diagram explain the formation of PN junction and derive its depletion width, Explain with relevant sketches for charge density, electric field intensity and potential energy barriers at the junction.

5. i) What is the breakdown mechanism found in Zener diode? Explain with neat diagram.

ii) Write detailed notes on space charge and diffusion capacitance.

- 6. Draw the Zener regulation circuit and explain its function for input and output regulation.
- 7. Derive the PN diode current equation from the quantitative theory of diode currents.
- 8. i) With a neat circuit diagram explain the operation of zener voltage regulator.ii) Define and derive the drift and diffusion currents.
- 9. Explain the effect of temperature on PN junction diodes.
- 10. Discuss the V-I characteristics of P-N junction diode and Zener diode.

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- 11. Derive an expression for the total current under forward bias and reverse bias.
- 12. The Diode current is 0.6 mA, when the applied voltage is 400 mV and 20 mA when the applied voltage is 500 mV. Determinen. Assume (KT/q) = 25 mV.
- 13. Discuss the VI characteristics of PN diode and Zener diode with their construction and principle of operation.
- 14. Discuss about the Space charge capacitance and diffusion capacitance of a PN diode.
- 15. Draw the band diagram of PN junction under forward bias and reverse bias.
- 16. (i) Write a detailed note on diffusion capacitance of a diode.

(ii) Draw the Zener diode characteristics and explain its nature. 15. Explain the behavior of PN junction, both when forward biased and reverse biased. Give suitable diagrams wherever necessary.

16. A sample of Ge is doped to the extent of 10^{14} donor atom/cm³ and 5X 10 ¹³ acceptor atoms/cm³. At room temperature the resistivity of pure Ge is 80 Ω -cm. If the applied electric field is 5V/cm, find the total current density.

17. Draw and explain the energy band diagram for conductors, insulators and semiconductors.

18. Sketch the energy band diagram for PN junction under open circuit condition and obtain the expression for contact difference of potential E_{o} .

19. Explain the mechanism of electrical conduction in a typical semiconductor. How the conductivity of semiconductors is affected by adding impurities.

20.Explain the terms: i) knee voltage ii) Reverse saturation current iii) Dynamic resistance iv) Junction breakdown.

21. Explain the effect of temperature on diode. An ideal Ge diode at room temperature has static resistance of 4.57Ω at a point where I= 45.6 mA. Find the dynamic resistance at a feedback of 0.2V.

UNIT II - BIPOLAR JUNCTION TRANSISTORS

<u>PART – A</u>

- 1. Define Early Effect. [APR/MAY 2018]
- 2. Why BJT is called as current controlled device? [APR/MAY 2018]
- 3. Giving the biasing arrangement for an NPN transistor to operate in the active region.
- 4. Define Base width modulation and bring out its consequences
- 5. What is "Early Effect" in CB Configuration and give its consequences?
- 6. What is large signal current gain?
- 7. What is rise time and delay time of transistor?
- 8. List the consequences of Early effect.
- 9. What is thermal runaway?
- 10. Why CE configuration considered being the most versatile one.
- 11. What are the biasing conditions for a transistor to operate in active region?
- 12. What happens to a transistor if both the junctions are reverse biased?

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- 13. In a transistor operating in active region although the collector junction is reverse biased, the collector current is quite large. Explain.
- 14. Derive the expression for common base current gain in terms common Emitter current gain.
- 15. What is the reason for early effect in BJT? What is the other name for it?
- 16. Derive the expression for common base current gain in terms of common emitter current gain.
- 17. Draw the basic Eber Moll equivalent circuit.
- 18. Draw the high frequency equivalent circuit of BJT.
- 19. For a transistor with α $_{\rm dc}$ =0.97, $I_{\rm CB0}$ =10 micro A and $I_{\rm b}$ =50 μ A. Find values of $I_{\rm c}$ and $I_{\rm e}$
- 20. Define line and load regulation.
- 21. What is the advantage of using emitter resistance in the context of biasing?
- 22. What is the need for biasing?
- 23. Give the circuit that offers stabilization of operating point by means of selfbiasing and diode compensation technique.
- 24. What are the advantages and disadvantages of fixed bias circuit?
- 25. What is an emitter Gummel number in the Gummel-Poon model?
- 24. Why a bipolar junction transistor is called so?
- 25. Define base width modulation
- 26. Define punch through.
- 27. What are the three ways of biasing transistor?
- 28. What is base spreading résistance?
- 29. What is the purpose of heat sink?
- 30. Explain avalanche breakdown in transistors?
- 31. Why is BJT a current controlled device?
- 32. Sketch the cross section of an npn transistor for the hybrid-pi model

<u>PART – B</u>

- Construct and demonstrate the working mechanism of CE configuration of BJT. (13) [APR/MAY 2018]
- 2. Construct and demonstrate the working mechanism of CB configuration of BJT. (13) [APR/MAY 2018]
- 3. Design and analyze a NPN bipolar junction transistor using Eber Moll transistor model. (15) [APR/MAY 2018]
- 4. Draw and explain the characteristics of PNP transistor in CB configuration.
- 5. Compare CB, CE, and CC transistor configurations.
- 6. Explain input and output characteristics of a common emitter configuration with neat sketch
- 7. (i) Explain the CE configuration of BJT in detail with required diagrams. (ii) Define and compare α , β , γ .
- 8. Explain the construction, operation and characteristics of NPN transistor with CB configuration.
- 9. Discuss in detail the input and output characteristics of

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- a. Common base
- b. Common Emitter
- c. Common collector configuration.

Also, derive expressions for h_i , h_o , h_f and h_r .

- 10. Draw and explain the IO characteristics of CE transistor.
- 11. What are the different current components in a PNP transistor? Prove the current relation I $_{C} = \alpha I_{E} + I_{CEO}$ and I $_{C} = \beta I_{B} + (1 + \beta) I_{CEO}$. In what way I $_{CBO}$ and I $_{CEO}$ depend on temperature.
- 12. Draw the input and output characteristics of common base configuration and explain the nature with the help of equations and equivalent circuits.
- 13. Derive the current gain, voltage gain, input and output resistance from CE model of a transistor.
- 14. Prove that collector to base bias is better than fixed bias.
- 15. Design a collector to base bias circuit to have operating point of 10 V,4 mA. The circuit is supplied with 20 V and uses silicon transistor of h_{fe} 250.
- 16. Derive an expression for stability factor.
- 17. Describe the stability in fixed bias and self bias and compare their performance.
- 18. Describe how AC and DC load lines are drawn.
- 19. Derive the conditions for transistor to operate as switch.
- 20. Explain Early Base Width in a transistor. How does it affect the input and output characteristics?
- 21. Derive an expression for the pinch off voltage in a JFET from first principles and explain the transfer and gain characteristics.
- 22. What is meant by bias stability? What factors affect BJT biasing?
- 23. Define the 3 stability factors. Derive and explain the condition to avoid thermal run away.

UNIT III – FIELD EFFECT TRANSISTORS

<u>PART – A</u>

- 1. What is pinch off voltage? [APR/MAY 2018]
- 2. State the application and difference between BJT and FET. [APR/MAY 2018]
- 3. Write the equation for drain current of JFET.
- 4. Define Base width modulation and bring out its consequences
- 5. Mention the advantages of MOSFET and JFET
- 6. Distinguish clearly the differences between N and P channel FETs
- 7. What is large signal current gain?
- 8. Compare any 4 salient features of BJT with JFET.
- 9. List the applications of JFET.
- 10. Draw the symbols of enhancement and depletion type MOSFET.
- 11. What is rise time and delay time of transistor.
- 12. List the consequences of Early effect.
- 13. Compare N channel FET with P channel FET.

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- 14. Why do we choose Q point at the center of the loadline?
- 15. Define current amplification factor.
- 16. How does the MOSFET have high input impedance?
- 17. A MOSFET can be operated with positive or negative gate voltage. Why?
- 18. Determine the Transconductance of a JFET if its amplification factor is 96 and drain resistance is 32 K Ω .
- 19. Mention two disadvantages of JFET over BJT.
- 20. Mention two disadvantages of JFET over BJT.
- 21. Derive the expression for common base current gain in terms of common emitter current gain.
- 22. Write the analytic Expression for ON drain resistance of JFET during ohmic region
- 23. Can depletion MOSFET be operated with positive and negative voltage? Justify.
- 24. Draw the output of NMOS depletion transistor.
- 25. Differentiate between BJT and FET
- 26. Draw a small signal model for a JFET and write down the equations, which help, in deriving the circuit.
- 27. For a transistor α_{dc} =0.97, I_{CBO} =10 micro A and I_{b} =50 μ A. Find values of I_{c} and I_{e}
- 28. Depletion MOSFET is commonly known as Normally On MOSFET. Why?
- 29. What is internal capacitance in MOSFET?
- 30. What is the advantage of using emitter resistance in the context of biasing?
- 31. Write the analytical expression for on drain resistance of JFET during the ohmic region.

PART – B

- 1. Illustrate the working mechanism of JFET with necessary diagram. (13) [APR/MAY 2018]
- 2. Discuss your understanding on MOSFET detailing the types, construction and characteristics. (13) [APR/MAY 2018]
- 3. Describe the construction, operation and characteristics of N-channel JFET.
- 4. Draw the structure of N-channel depletion type MOSFET and explain its operation and characteristics.
- 5. Explain the construction and working principle of JFET and obtain its characteristic parameters
- 6. Explain the operation of depletion mode MOSFET and its comparison over enhancement MOSFET with neat diagrams
- 7. What is a MOSFET? Explain the construction and working principle of enhancement mode and depletion mode MOSFET with a neat diagram
- 8. Explain how the construction and operation does and also the characteristics of enhancement MOSFET differ from depletion MOSFET.
- 9. Discuss the construction and working principle of E-MOSFET with its V-I Characteristics.
- 10. Sketch the transfer curve for a p-channel JFET with I_{DSS} = 4mA and V_p = 3V.
- 11. Explain the construction and operation of n-channel depletion type MOSFET

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- 12. Derive an expression for voltage gain for an FET amplifier with CS and CD configuration.
- 13. Why NMOS devices are preferred over PMOS devices. What are the handling precautions for MOSFET? Draw the circuit symbols for N channel and D MOSFETS.
- 14. Draw and explain the drain and transfer characteristics of JFET.
- 15. Draw and explain the constructional features of E MOSFET and D MOSFET. Explain the drain characteristics.
- 16. Explain the principle of operation of MOSFET, VI characteristics and characteristic parameters, limitations and in detail.
- 17. Discuss the VI characteristics of any two types of MOSFET.
- 18. Draw the schematic view of enhancement MOS and depletion enhancement MOS and explain the differences between the two by way of explanation.
- 19. How are POWER MOSFETS different from conventional NMOS and PMOS circuits? Explain.
- 20. What is the difference between JFET and BJT?
- 21. Describe the stability in fixed bias and self bias and compare their performance.
- 22. Explain in detail the biasing of MOSFET.
- 23. Derive the conditions for transistor to operate as switch.
- 24. Derive an expression for the pinch off voltage in a JFET from first principles and explain the transfer and gain characteristics.
- 25. With the help of a neat diagram, explain the voltage divider biasing method for JFET.
- 26. Draw a small signal low frequency model for a FET and explain.
- 27. Draw a small signal low frequency model for a FET and explain.

UNIT IV- SPECIAL SEMICONDUCTOR DEVICES

- 1. What is a FinFET? [APR/MAY 2018]
- 2. What is referred as CNTFET? [APR/MAY 2018]
- 3. What are the two types of metal semiconductor contact?
- 4. Give the symbol and structure of schottky diode
- 5. Give the applications of schottky diode.
- 6. Compare between schottky diode and conventional diode.
- 7. Why zener diode is often preferred than PN diode
- 8. Draw the V-I characteristics curve for zener diode.
- 9. What is zener breakdown?
- 10. Give the advantages and disadvantages of tunnel diode Advantages.
- 11. What is varactor diode?
- 12. Define contact potential in metal semiconductor contact.
- 13. Give the symbol and structure of schottky diode.
- 14. Draw the equivalent circuit of Tunnel Diode
- 15. Draw the characteristics Of tunnel diode and mark the various terms.
- 16. Write the applications of tunnel diode.
- 17. Define tunneling phenomena.
- 18. Draw the energy band diagram of metal and semiconductor before and after condution is made.

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17. What are the other names of schottky diode?

18. What is a Ohmic contact?

PART B

- 1. Illustrate with necessary diagram, the working mechanism of a LASER diode. (13)[APR/MAY 2018]
- 2. Discuss in detail about Zener and Tunnel diode. (13) [APR/MAY 2018]
- 3. Explain about the ohmic contact of metal semiconductor junction (8)
- 4. Explain the operation of zener diode and how it is used as a voltage regulator(12)
- 5. Explain the operation of tunnel diode and draw its equivalent circuit. (12)
- 6. With neat diagram give the working principle of LASER diode.(8)
- 7. Explain the operation of varactor diode (8)
- 8. With neat diagram explain about varactor diode. (8)
- 9. Discuss the construction and operation of Tunnel diode with neat energy band Diagram.
- 10. Explain the tunnel diagram of a tunnel diode.
- 11. Explain the operation of Tunnel diode with emphasis to symbolic representation, VI characteristics, energy band diagram, merits and demerits.
- 12. Explain the operation of MESFET.
- 13. Explain the following in detail (a) LDR

(b) Gallium Arsenide device.

14. Draw the VI characteristics of zener diode and explain its operation.

UNIT V- POWER DEVICES AND DISPLAY DEVICES

<u>PART - A</u>

- 1. What is the effect of temperature in Solar Cell? [APR/MAY 2018]
- 2. Draw the symbol and equivalent circuit of TRIAC. [APR/MAY 2018]
- 3. Draw the two transistor equivalent circuit of SCR.
- 4. Compare LED and LCD.
- 5. Draw the two transistor model of an SCR with its characteristic curve
- 6. Under what principle does a photo voltaic cell work? Give its diagram
- 7. Give some applications of Tunnel diode
- 8. What is meant by photovoltaic cell?
- 9. What is intrinsic standoff ratio?
- 10. Draw the symbol, construction diagram and characteristic of TRIAC .
- 11. Name any two material used to manufacture LEDs
- 12. Compare LED and LCD.
- 13. Give the structure of a DIAC.
- 14. What are the advantages of TRIAC over SCR?
- 15. What is the principle involved in LCD?
- 16. What is the reason for the nonexistence of Germanium Controlled Rectifier?
- 17. How are LCD classified based on construction. What is the power consumed by them?
- 18. Define intrinsic stand off ratio of UJT. What is its range?
- 19. Draw the VI characteristics of TRIAC and indicate its uniqueness.

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- 20. Draw the two-transistor analogy of SCR.
- 21. What is inter base resistance of UJT?
- 22. Why does a UJT show negative resistance characteristics?
- 23. Draw the VI characteristics of SCR.
- 24. Write down the significance of Opto coupler.

<u>PART – B</u>

- 1. Explain the working and characteristics of SCR and its applications. (13) [APR/MAY 2018]
- 2. Enumerate the construction and operation of LED. (13) [APR/MAY 2018]
- 3. Explain the working and characteristics of DIAC and its applications. (15) [APR/MAY 2018]
- 4. With energy diagram, explain the theory and characteristics of UJT.
- 5. Describe the construction, operation and characteristics of UJT.
- 6. Discuss the operation and characteristics of photodiode. Mention the applications of photodiodes and phototransistors.
- 7. Write detailed notes on

a.DIAC and TRIAC

- b. Photodiode and Phototransistor
- c.LED and LCD
- 8. Explain the negative resistance characteristics of Unijunction transistor With neat sketch.
- 9. Explain the construction and operation of LCD.
- 10. i)Draw and explain the two transistor equivalent model of SCR.ii) Draw and explain the V-I characteristics of TRIAC.
- 11. Discuss the V-I Characteristics of SCR. Also explain how it acts as a controlled rectifier.
- 12. With neat diagrams explain the operation of LCD.
- 13. (i) Explain the construction, operation and characteristics of SCR.(ii) Explain the construction of UJT.
- 14. With a neat diagram discuss in detail the structure, characteristics and two transistor version of SCR.
- 15. Define Latching current, Holding current, Gate current and Voltage safety factor.
- 16. Discuss in detail the Construction and Characteristics of UJT.
- 17. Give the important application of UJT as relaxation oscillator.
- 18. Discuss the methods of turning ON SCR and turning OFF SCR.
- 19. Write about the characteristics of on i) DIAC ii) TRIAC with aid of neat sketches
- 20. Explain with the equivalent circuit of a UJT, the characteristics and define standoff ratio. How UJT used as a Relaxation Oscillator.
- 21. Explain the operation of Tunnel diode with emphasis to symbolic representation, VI characteristics, energy band diagram, merits and demerits.
- 22. Draw the equivalent circuit of UJT and Explain about its characteristics in detail.

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- 23. Draw the two-transistor model of SCR. Explain the construction, operation and characteristics for different gate currents and indicate there upon holding current, latching current and break over voltage. What are the applications of SCR?24. Describe with the help of neat diagram, the construction of LED and explain the
- 24. Describe with the help of neat diagram, the construction of LED and explain the working.
- 25. Describe with neat diagram the principal of operation of a dynamic scattering of LCD.
- 26. Discuss the basic characteristics of LED and explain characteristics of power transistor.
- 27. Write short notes on(i) Solar Cell and (ii) CCD



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