DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

K.S.R. COLLEGE OF ENGINEERING: TIRUCHENGODE – 637 215.

COURSE / LESSON PLAN SCHEDULE

NAME : P.THILAGAVATHI
CLASS : II –ECE
SUBJECT CODE/NAME :18EC313/ ELECTRONIC DEVICES AND CIRCUITS

TEXT BOOKS:

1. Sedra / Smith, "Micro Electronic Circuits" Oxford University Press, 7th Edition ,2017
2. Anil K Maini.Varsha Agarwal,"Electronic Devices and Circuits",John Wiley India, Reprint 2012.

REFERENCE BOOKS:

1. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 11th Edition, PHI, 2015
2. David A. Bell, "Solid State Pulse Circuits", 4th Edition PHI, 2012.
3. Donald A.Neamen."Electronic Circuit Analysis and Design", 2nd Edition,Tata McGraw Hill, 2009.
4. Millman.J. and Halkias C.C, "Integrated Electronics", Tata McGraw Hill, 48th Reprint 2008
5. NPTEL Course Link:http://nptel.ac.in/courses/117101106/7

EXTRA REFERENCE BOOK:

1. R.S.Sedha,"Applied Elecctronics",S.Chand & Company Ltd,

LEGEND:

L - Lecture
BB - Black Board
pp - Pages
PPT - Power Point
OHP - Over Head Projector
Rx - Reference

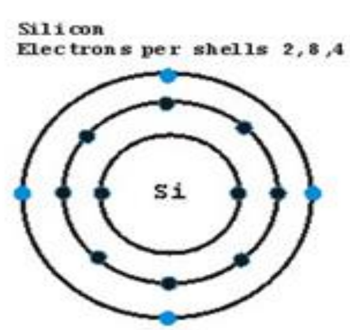
Sl. No	Lecture Hour	Topics to be covered	Teaching Aid Required	Book No./Page No
UNIT-I SEMICONDUCTOR DIODES				
1.	L1	**Types of semiconductor**: Intrinsic and extrinsic semiconductor	BB	T_{X1}/pp 53-56,R_{X1}/pp 7-8
2.	L2	P-type and N-type semiconductor	BB	T_{X1}/pp 56-59,R_{X1}/pp 8-10,
3.	L3	Carrier concentration	BB	R_{X4}/pp 27-43
4.	L4	Fermi energy level, Variation of Fermi level with temperature	BB	T_{X2}/pp 4-10
5.	L5	Electrical conductivity	BB	T_{X2}/pp 10-18
6.	L6	Drift and diffusion current	BB	T_{X1}/pp 59-65
7.	L7	PN Junction: Forward bias and reverse bias	BB	T_{X1}/pp 71-79,108-112 R_{X1}/pp 10-30
8.	L8	Diode current equation	BB	T_{X2}/pp 30-32
9.	L9	Capacitance	BB	T_{X1}/pp 79-82,R_{X1}/pp 31-33
UNIT- II TRANSISTORS				
10.	L10	NPN and PNP operations	BB	T_{X1}/pp 164-179,R_{X1}/pp 115-117
11.	L11	Configurations	BB	T_{X1}/pp 179-193,R_{X1}/pp 117-130
12.	L12	Biasing methods	BB	T_{X1}/pp 223-229,R_{X1}/pp 144-181
13.	L13	Bias compensation techniques	BB	T_{X2}/pp 144-152
14.	L14	Hybrid parameter for CE amplifier	BB	T_{X1}/pp 274-282,T_{X2}/pp 307-325,R_{X1}/pp 327-339
15.	L15	Miller's theorem	BB	T_{X2}/pp 366-369
16.	L16	Darlington amplifier and bootstrapping emitter follower		T_{X2}/pp 338-343
17.	L17	Hybrid π equivalent model		T_{X1}/pp 290-295
18.	L18	Low and high frequency response of CE amplifier		T_{X1}/pp 296-308,T_{X2}/pp 345-351, T_{X2}/pp 357-362

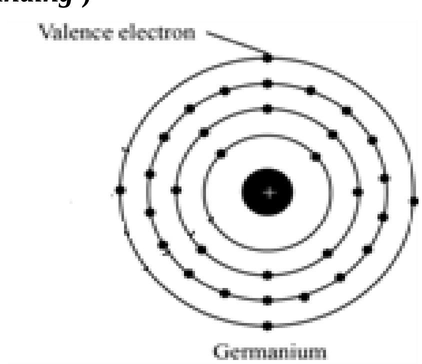
UNIT – III FET				
19.	L19	JFET types	BB	T_{X1}/pp 477-480 R_{X1}/pp 215-230
20.	L20	Operation of N-channel JFET	BB	T_{X1}/pp 485-490 R_{X1}/pp 238-243
21.	L21	Operation of P-channel JFET	BB	T_{X1}/pp 480-485 R_{X1}/pp 243-246
22.	L22	Velocity Saturation	BB	T_{X1}/pp 483-487
23.	L23	MOSFET Types	BB	T_{X1}/pp 344-346, T_{X1}/pp 369-372,473-477
24.	L24	Operation of MOSFET	BB	T_{X1}/pp 347-359
25.	L25	CMOS operation	BB	T_{X1}/pp 359-368
26.	L26, L27	CMOS Inverter, voltage transfer curve and threshold voltage, Latch up problem and prevention	OHP	T_{X1}/pp 389-392 T_{X1}/pp 453-457
UNIT - IV RECTIFIERS AND POWER SUPPLIES				
27.	L28, L29	Rectifiers – Analysis of half wave, full wave and bridge rectifiers with resistive load	BB	T_{X1}/pp 130-136 R_{X1}/pp 71-77
28.	L30, L31	Analysis for ripple voltage with C, L, LC, CLC filters	PPT	T_{X1}/pp 136-141 T_{X2}/pp 558-565
29.	L32	Voltage regulators: Zener diode regulator	BB	T_{X1}/pp 127-129
30.	L33	Transistor Series and Shunt Regulators	BB	T_{X2}/pp 565-568,571-576
31.	L34	Current limiting and over voltage protection circuits	OHP	T_{X2}/pp 568-571
32.	L35, L36	Switched Mode Power Supply (SMPS)	PPT	T_{X2}/pp582-584
UNIT V- SPECIAL SEMICONDUCTOR DEVICES				
33.	L37	Zener and Tunnel diode		T_{X1}/pp 126-130,T_{X2}/pp 51-53 Rx1/pp 35-38
34.	L38	PIN and Varactor diode		T_{X2}/pp 50-51
35.	L39	LED,LCD		T_{X2}/pp 279-290,Rx1/pp 38-42
36.	L40	LASER		E_{X1}/pp 284-286
37.	L41	Photo diode and Phototransistor		T_{X2}/pp 259-264,T_{X2}/pp 268-270, Rx1/pp 893-897
38.	L42	Photoconductive and Photovoltaic cells		T_{X2}/pp 255-258
39.	L43	SCR		T_{X2}/pp 220-229,Rx1/pp 864-874
40.	L44	DIAC and TRIAC		T_{X2}/pp 229-235,Rx1/pp 880-883
41.	L45	UJT		T_{X2}/pp 215-220,Rx1/pp 883-893

PART-A

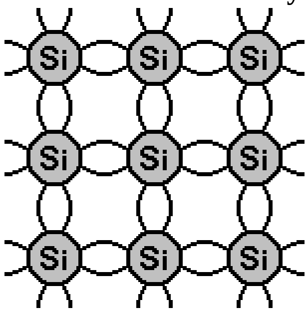
UNIT I -SEMICONDUCTOR DIODES

1. Demonstrate the structure of silicon atom. (*Understanding*) **CO1**





2. **Illustrate the silicon crystal arrangement. (*Understanding*)** **CO1**



3. **Illustrate Semiconductors with examples. (or) What are Semiconductors? (*Understanding*)** **CO1**

The materials whose electrical property lies between those of conductors and insulators are known as Semiconductors. **Ex germanium, silicon.**

4. **Differentiate between intrinsic and extrinsic semiconductor. (*Understanding*)** **CO1**

Pure form of semiconductors are said to be intrinsic semiconductor. Ex: germanium, silicon. It has poor conductivity

If certain amount of impurity atom is added to intrinsic semiconductor the resulting semiconductor is Extrinsic or impure Semiconductor. It has good conductivity

5. **Define doping. (*Remembering*)** **CO1**

Process of adding impurity to an intrinsic semiconductor atom is doping. The impurity is called dopant

6. **Justify why N - type or pentavalent impurities are called as Donor impurities?(*Evaluating*)** **CO1**

N- type impurities will donate the excess negative charge carriers (Electrons) and therefore they are referred to as donor impurities.

7. **Justify why P–type or trivalent impurities are called as acceptor impurity? (*Evaluating*)** **CO1**

P- type impurities make available positive carriers because they create holes which can accept electron, so these impurities are said to be as acceptor impurity.

8. **Recall the diode current equation.(*Remembering*)** **CO1**

The diode current equation relating the voltage V and current I is given by

$I = I_0 (e^{(V/\eta V_T)} - 1)$

Where I = Diode Current,

I_0 = Diode reverse saturation current at room temperature,

V= External voltage applied to the diode,

$V_T = kT/q = T/11600$ volt- equivalent of temperature,

k – Boltzmann's constant (1.38066×10^{-23} J/K

q = charge of the electron (1.60219×10^{-19} C)

T= temperature of the diode junction (K) = (^{o}C+273^{o}).

9. **What is storage capacitance? *(Remembering)*** **CO1**

In forward biased condition, the width of the depletion region decreases and holes from p-side get diffused in the n-side, while electrons from n-side move in to the p-side. As the applied voltage increases, concentration of injected charged particles increases. This rate of change of the injected charge with applied voltage is defined as a capacitance called diffusion capacitance or storage capacitance (C_D). CD=dQ/dV

10. **Define drift current. *(Remembering)*** **CO1**

When an electric field is applied across the semiconductor, the holes move towards the negative terminal of the battery and electron move towards the positive terminal of the battery. This drift movement of charge carriers will result in a current termed as drift current

11. **Give the expression for drift current density. *(Remembering)*** **CO1**

Drift current density due to electrons $J_n = q\, n\, \mu_n E$

Where, Jn - drift current density due to electron

q- Charge of electron μn - Mobility of electron

E - applied electric field

Drift current density due to holes. Jp = q p μp E
Where, Jn - drift current density due to holes
q - Charge of holes
μp - Mobility of holes E - applied electric field

12. Define the diffusion current. ***(Remembering)*** **CO1**

A concentration gradient exists, if the number of either electrons or holes is greater in one region of a semiconductor as compared to the rest of the region. The holes and electron tend to move from region of higher concentration to the region of lower concentration. This process in called diffusion and the current produced due this movement is diffusion current.

13. Give the expression for diffusion current density. *(Remembering)* **CO1**

Diffusion current density due to electrons Jn = q Dn dn / dx
Where Jn - diffusion current density due to electron
q - Charge of an electron
Dn – diffusion constant for electron
dn / dx – concentration gradient
Diffusion current density due to holes Jp = - q Dp dp / dx
Where Jp - diffusion current density due to holes
q - Charge of a hole
Dp – diffusion constant for hole
dn / dx – concentration gradient

14. Differentiate between drift and diffusion currents. (*Understanding*) **CO1**

Drift current
1. It is developed due to potential gradient.
2. This phenomenon is found both in metals and semiconductors
Diffusion current
1. It is developed due to charge concentration gradient.
2. This phenomenon is found only in metals

15. Define mean life time of a hole and electron. ***(Remembering)*** **CO1**

The electron hole pair created due to thermal agitation will disappear as a result of recombination. Thus an average time for which a hole or an electron exists before recombination can be said as the mean life time of a hole or electron.

16. Define transition capacitance for diode. ***(Remembering)*** **CO1**

When a PN junction is reverse biased, the depletion layer acts like a dielectric material while P and N –type regions on either side which has low resistance act as the plates. In this way a reverse biased PN junction may be regarded as parallel plate capacitor and thus the capacitance across this set up is called as the transition capacitance. CT = A / W Where CT - transition capacitance A - Cross section area of the junction W – Width of the depletion region.

17. Summarize diffusion capacitance for diode. (*Understanding*) **CO1**

The diffusion capacitance of a forward biased diode is defined as the rate of change of injected charge with voltage. $Cd = I / V_T$ Where, Cd – time constant I – current across the diode V_T – threshold voltage

18. Compare storage capacitance and transition capacitance. (*Evaluating*) **CO1**

S.No	Storage Capacitance	Transition Capacitance
1.	Reverse bias	Forward bias
2.	Majority carriers	Minority carriers
3.	Low capacitance	Large capacitance
4.	$V_T = kT/q = T/11600$	$Cd = I / V_T$

19. What is depletion region in PN junction? ***(Remembering)*** **CO1**

The region around the junction from which the mobile charge carriers (electrons and holes) are depleted is called as depletion region.since this region has immobile ions, which are electrically charged , the depletion region is also known as space charge region.

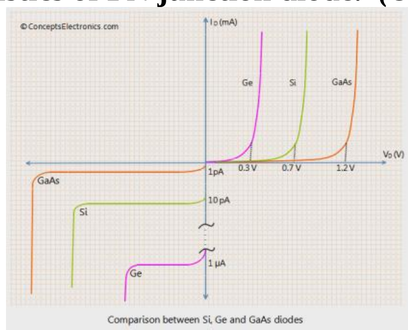
20. What is barrier potential? *(Remembering)* **CO1**

Because of the oppositely charged ions present on both sides of PN junction an electric potential is established across the junction even without any external voltage source which is termed as barrier potential.

21. What is Reverse saturation current? *(Remembering)* **CO1**

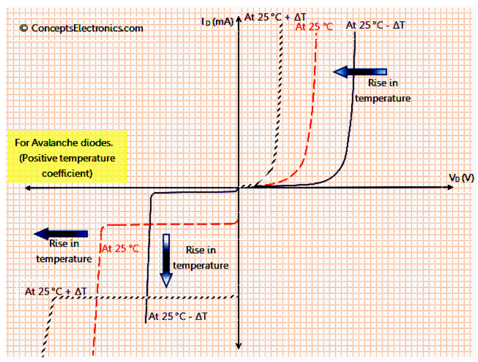
The current due to the minority carriers in reverse bias is said to be reverse saturation current. This current is independent of the value of the reverse bias voltage.

22. Demonstrate the VI characteristics of PN junction diode. *(Understanding)* **CO1**



Comparison between Si, Ge and GaAs diodes

23. Judge the VI characteristics of PN junction diode with respect to change in temperature? (*Evaluating*) **CO1**



24. Give the diode current equation. *(Remembering)* **CO1**

The diode current equation relating the voltage V and current I is given by

$$I = I_0\left(e^{\frac{qV}{\eta KT}} - 1\right)$$

where

I – diode current

Io – diode reverse saturation current at room temperature

V – external voltage applied to the diode , a constant, 1 for Ge and 2 for Si

VT = kT/q = T/11600, thermal voltage

K – Boltzmann's constant (1.38066x10^-23 J/K)

q – charge of electron (1.6x10^-19 C)

T – temperature of the diode junction

25. Write the application of PN Junction diode. *(Remembering)* **CO1**

- Can be used as rectifier in DC Power Supplies.
- In Demodulation or Detector Circuits.
- In clamping networks used as DC Restorers
- In clipping circuits used for waveform generation.
- As switches in digital logic circuits.
- In demodulation circuits.

PART-B

1. Depletion region decreases during Forward bias and increases during Reverse bias in the case of a p-n junction diode.-justify **(*Evaluating*)** **CO1**

2. Estimate drift and diffusion current for a semiconductor. (***Evaluating***) **CO1**

3. Explain Storage capacitance and transition capacitances in PN junction diode (***Analyzing***) **CO1**

4. Depletion region decreases during Forward bias and increases during Reverse bias in the case of a p-n junction diode.-justify ***(Evaluating)*** **CO1**

5. Describe the operation of the p-n junction diode with V-I characteristics. (***Understanding***) **CO1**

6. Explain the effect of temperature of a diode. (***Understanding***) **CO1**

7. Discuss drift current and diffusion current and derive equations for it***.(Analyzing)*** **CO1**

UNIT II- TRANSISTORS

1. What is a Bipolar Junction Transistor (BJT)?) *(Remembering)* **CO2**

Transistor is a three terminal device whose output current, voltage and /or power is controlled by input current.

2. Comparatively base is made thin why? (*Understanding*) **CO2**

Transistor Consists of Three portions namely emitter, base and collector. Among them base forms middle part. It is very thin and lightly doped because it allows most of the emitter current carriers towards the collector. Since base is acting as an interface it doesn't need more area.

3. Collector region of transistor is larger than emitter. Why? (*Understanding*) **CO2**

Collector is made physically larger than emitter and base because collector is to dissipate much power.

4. Why the transistor is called a current controlled device? *(Remembering)* **CO2**

The output characteristics of the transistor depend on the input current. So transistor is called a current controlled device.

5. Define current amplification factor. *(Remembering)* **CO2**

It is defined as the ratio of change in output current to the change in input current at constant

6. What are the recommended for biasing circuits? (*Evaluating*) **CO2**

i. The Q point must be taken at the Centre of the active region of the output characteristics. ii. Stabilize the collector current against the temperature variations. iii. Make the Q point independent of the transistor parameters. iv. When the transistor is replaced, it must be of same type.

7. Define Base width modulation (Early Effect). (Apr-May 2011) *(Remembering)* **CO2**

In a common base configuration, an increase in collector voltage increases the space charge width at the output junction diode. This action makes the effective base width w to decrease. This is known as early effect. Due to this effect the recombination rate reduces at base region and charge gradient is increase within the base.

8. Elaborate the characteristics of a transistor. (*Remembering)* **CO2**

Input characteristics: it is drawn between input voltage & input current while keeping output voltage as constant.

Output characteristics: It is drawn between the output voltage &output current while keeping input current as constant

9. Which device is called as bipolar device? Why? *(Remembering)* **CO2**

Bipolar Junction Transistor (BJT) is called bipolar devices because the current conduction is by both majority and minority carriers

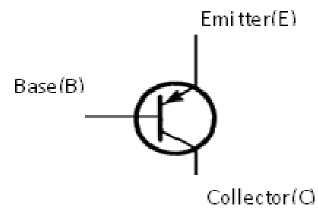
10. Develop[the Doping concentration and area of BJT.(*Applying*) **CO2**

	Doping concentration	**Area**
Emitter	Heavily doped	Moderate area
Base	Lightly doped	Thin
collector	Moderately doped	More area than emitter

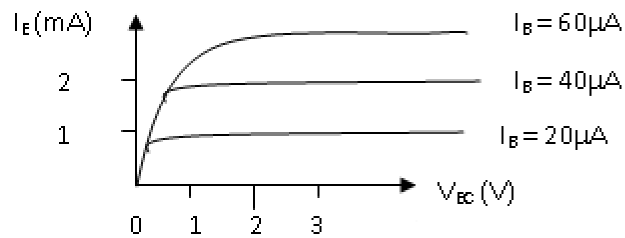
11. Design the bias condition of the base emitter and base collector junction for a transistor to operate as amplifier? (*Applying*) **CO2**

Base Emitter junction should be forward biased Collector Base junction should reversed biased

12. Model symbol of PNP transistor and mark its terminals. (Nov/Dec 2010). (*Applying*) **CO2**



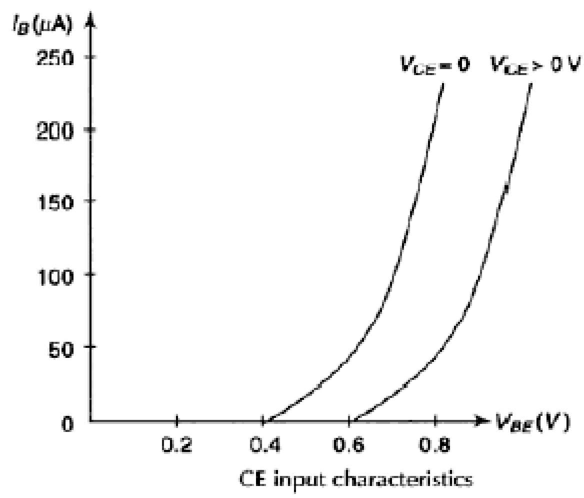
13. Label the output characteristics of a BJT in CC mode.(June/July 2010) *(Remembering)* **CO2**

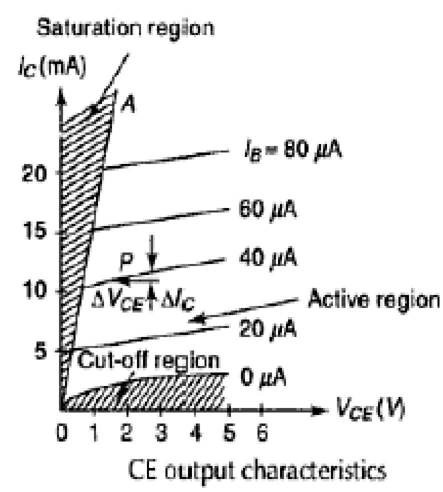


14. What are the three regions in BJT characteristics? *(Remembering)* **CO2**

Active region, saturation region and cut off region.

15. Draw the characteristics of CE configuration. *(Remembering)* **CO2**





16. Among CE, CB, CC which one is most popular. Why?(*Analyzing)* **CO2**

CE is most popular among the three because it has high gain compared to base and collector configuration. It has the gain about to 500 that finds excellent usage in audio frequency applications.

17. Compare and contrast CB, CC, and CE. *(Analyzing)* **CO2**

	CB	CE	CC
input impedance	very low (100Ω	moderate(750Ω)	very high(100Ω)
output i pedance	very high(450Ω)	moderate(45KΩ)	very low (25Ω)
current gain	1	high	hig
voltage gain	high(150)	high(150)	1
application	For High Frequency	for udio Frequency	for Impedance matching

18. Justify why CE configuration input characteristics shifts downwards.(*Evaluating*) **CO2**

Input characteristics shift downdards because of base width modulation

19. Recall the Doping concentration of transistor (*Remembering*) **CO2**

Emitter is heavily doped base is lightly doped collector is moderately doped

20. What is meant by Biasing? *(Remembering*) **CO2**

It is the process of providing sufficient voltage and current to switch ON and to operate in linear region of its transfer characteristics. Biasing keeps Base Emitter junction forward bias and Collector Base junction reverse bias.

21. Define faithful amplification ((*Remembering*) **CO2**

Faithful amplification means the transistor must increase the magnitude of the signal without changing its shape (or) amplify the signal without change its shape.

22. Relate the need for biasing? *(understanding*) **CO2**

To operate transistor in desired region, apply external DC voltage of correct polarity and magnitude to the two junctions of the transistor

23. Summarize Q point? *(understanding*) **CO2**

Proper operation of transistor whether the signal is present or not fixed amount of current and voltage are required these value of current and voltages defines the point at which the transistor operates this is called operating point or Q point or Quiescent if the level of current and voltage are fixed the operating point is also fixed

24. How to select the Q point for an amplifier? *(Remembering*) **CO2**

Q point should be located at the center of load line which ensures that the amplified signal will be an exact replica of the input signal.

25. What are the factors that affecting the Q point (*Remembering*) **CO2**

1)Changes in temperature, 2) Changes in the value of β, 3) Change of parameters from one transistor to other

26. Define Stability factor. What is its ideal value (*understanding*) **CO2**

$S = \frac{\Delta I_C}{\Delta I_{CO}}$ / constant V_{BE} & β $S' = \frac{\Delta I_C}{\Delta V_{BE}}$ / constant I_{CO} & β $S'' = \frac{\Delta I_C}{\Delta \beta}$ / constant Ico & V_{BE}

Its ideal value =1

27. Distinguish the various biasing methods? (*Analyzing*) **CO2**

Biasing method	Advantages	Disadvantage
Fixed Bias	➢ Good flexibility ➢ Require less component	➢ Poor thermal stability ➢ Q point shift due to β
Collector – Base Bias	➢ Provides better thermal stability than fixed bias ➢ Requires only one resistor	➢ stability factor is high ➢ Reduce the gain of the amplifier
Voltage divider or Self Bias	➢ Good stability ➢ Possible to avoid signal lo s	➢ Require more components ➢ stability factor depends on RB & RE

28. What is Stabilization Technique? (*Remembering*) **CO2**

It refers to the use of resistive biasing circuits which permits I_B to vary so as to keep I_C constant.

29. What is Bias Compensation? (*Remembering*) **CO2**

Compensation technique is used to stabilize the Q point instead of DC biasing circuits where the reduction of gain crosses the tolerable limit. It uses the temperature sensitive devices such as diodes, transistor, thermistors, sensistor to compensate for the variation in currents.

30. Identify how the compensation achieved in Diode compensation for V_{BE}? (*Applying*) **CO2**

Change in V_{BE} is compensated by change in voltage across diode.

31. Identify how the compensation achieved in Diode compensation for I_{CO}? (*Applying*) **CO2**

In order to compensate for I_{CO}, diode saturation current is equal to transistor leakage current which gives $I_C = \beta I_B$

32. Discover how the compensation achieved by using Thermistor? (*Analyzing*) **CO2**

Thermistor resistance **decreases** exponentially with increase in temperature. As resistance decreases, V_{BE} decreases so that I_B decreases.

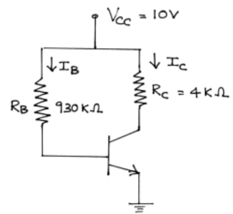
33. Criticize how the compensation achieved by using Sensistor? (*Evaluating*) **CO2**

Sensistor resistance **increases** with increase in temperature. As resistance increases, V_{R2} decreases so that forward emitter bias decreases. As a result I_C decreases.

34. Define Thermal Runaway. (*Remembering*) **CO2**

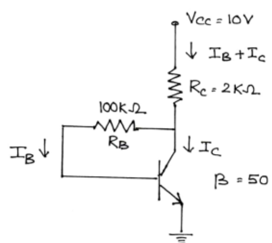
The self-destruction of an unbiased transistor is known as thermal runaway. To avoid it; the operating point is to be stabilized.

35. Determine the operating point from the figure below shows a silicon transistor with β=100 and biased by base resistor method. (*Applying*) **CO2**



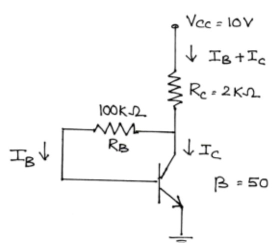
$V_{CC} - V_{BE} = I_B R_B \Rightarrow I_B = \frac{V_{CC} - V_{BE}}{R_B}$, ∴ Operating point is (6V, 1mA)

36. An N-P-N transistor with β=50 is used in a CE circuit with VCC=10V, RC=2KΩ. The bias is obtained by connecting a 100KΩ resistance from collector to base. Assume VBE=0.7V. Find i) the quiescent point and ii) Stability factor 'S' (*Applying*) **CO2**



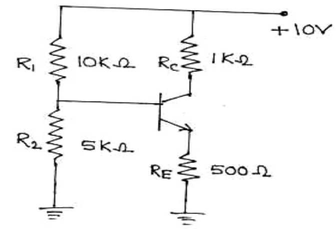
$V_{CC} - V_{BE} = I_B R_B \Rightarrow I_B = \frac{V_{CC} - V_{BE}}{R_B}$, ∴ Operating point is (6V, 1mA)

37. An N-P-N transistor with β=50 is used in a CE circuit with VCC=10V, RC=2KΩ. The bias is obtained by connecting a 100KΩ resistance from collector to base. Assume VBE=0.7V. Find i) the quiescent point and ii) Stability factor 'S' (*Applying*) **CO2**



$\therefore I_C = \frac{\beta\left(V_{CC} - V_{BE} - I_C R_C\right)}{R_C + R_B}$, ∴ The quiescent point is **(5.308V, 2.3mA)**, $S = \frac{51}{1 + 50\left(\frac{20\times10^3}{102\times10^3}\right)} = 25.75$

38. For the circuit shown in figure, determine the value of IC and VCE. Assume VBE=0.7V and β=100. (*Applying*) **CO2**



$V_B = \frac{R_1}{R_1+R_2}V_{CC} = \frac{5\times10^3}{10\times10^3+5\times10^3}\times10 = 3.33V$, $V_E = V_B - V_{BE} = 3.33-0.7 = 2.63V$ $I_E = \frac{V_E}{R_F} = \frac{2.63V}{500} = 5.26mA$

$I_B = \frac{I_E}{1+\beta} = \frac{2.63\times10^{-3}}{101} = 52.08\mu A$ $\quad V_{CC} - I_C R_C - V_{CE} - I_E R_E = 0 \quad V_{CE} = 2.162V$

39. Infer what are the effects of unbiased R_E? (U*nderstanding*) **CO2**

- Increase in the Input Impedance
- Reduction in voltage amplification
- Improved stability of voltage gain.

40. Compare CB,CE,CC amplifiers (*Analyzing*) **CO2**

	CB	CE	CC
input impedance	very low (100Ω)	moderate(750Ω)	very high(100Ω)
outpu impedance	very high(450Ω)	moderate(45KΩ)	very low (25Ω)
cu rent gain	1	high	high
voltage gain	high(150)	high(150)	1
application	For High Frequency	For Audio Frequency	for Impedance matching

41. Explain the function of bypass capacitor in an amplifier circuits. (*Remembering*) **CO2**
It offers low reactance to AC signal which increases the voltage gain of amplifier

42. Why coupling capacitor is used to connect a signal source to an amplifier. (*Remembering*) **CO2**
It blocks DC voltage but passes AC signal, because of this biasing conditions are maintained constant

43. Define the various h parameters. (*Remembering*) (May03) **CO2**
Input Impedance=h_{11}=V_i/I_i
Reverse voltage Gain=h_{12}= V_i / V_o
Forward Current Gain =h_{21}= I_o/I_i
Output Admittance =h_{22}=I_o/V_o

44. Why h parameter model is important for BJT? (*Remembering*) **CO2**
It is important because:
1. its values are used on specification sheets 2. it is one model that may be used to analyze circuit behavior 3. it may be used to form the basis of a more accurate transistor model

45. Define Voltage Amplification factor (Av). (*Remembering*) **CO2**
The ratio of the output voltage V2 to the input voltage V**i** gives the voltage gain of the transistor

$$A_V = \frac{A_I Z_L}{Z_i} , \quad A_I = \frac{-h_f}{1+h_O Z_L}$$

46. Define Miller theorem (*Remembering*) (May04), (Nov2010) **CO2**
It states that, if the gain ratio of two node is 1:K then an impedance of Z connecting the two nodes can be replaced with Z/K impedance between the first node and ground and a KZ/(K-1) impedance between the second node and ground.

47. What does Bootstrapping Mean? (*Remembering*) (May03) **CO2**
If the gain of the amplifier is 1, then if the voltage at one end of resistor changes, then there is same changes at the other end of resistor. It is as if resistor were pulling itself up by its bootstraps

48. Justify Why the Darlington connection is not possible for more number of stages. .(***Evaluating***) **CO2**

When number of stages increases, the leakage current also increases and gets multiplied by the current gain. Voltage gain will also reduce.

49. List Importance of Darlington Emitter Follower? .(***Evaluating***) **CO2**

High current gain, Low voltage gain, High input resistance, Low output resistance

50. List the advantages of h parameters. (*Remembering*) (Nov2010) **CO2**

- Easy to measure
- Real number up to RF
- Easily correctable from one configuration to other.

51. Write the equation form which the small signal LF equivalent of JFET is formed (*Applying*) (May05) **CO2**

$$I_d = g_m V_{gs} + V_{ds}/r_d$$

52. What is the need for multistage amplifier? (*Remembering*) **CO2**

In single stage amplifier, the parameters input impedance, Voltage gain; Bandwidth and Output impedance are not fulfilled. So the multistage amplifier is needed for these requirements.

53. What is cascade amplifier? (*Remembering*) **CO2**

It consists of CE and CB configurations. CB provide a good High Frequency operation

54. List the features of Cascode Amplifier? (*Remembering*) **CO2**

- Input and current gain are equal to the corresponding value of single stage CE amplifier
- Output resistance is equal to that of CB amplifier
- Bandwidth is very large

55. What is the voltage gain of cascade amplifier? (*Remembering*) **CO2**

It is the product of voltage gains of the various stages

$A_V = A_{V1}.A_{V2}.A_{V3}\ldots\ldots\ldots A_{VN}$.

56. Define CMRR.(*Remembering*) **CO2**

It is the ratio of differential gain to common mode gain **[Ad/ Ac]**

57. List the features of Differential Amplifier? (*Remembering*) **CO2**

- High input impedance
- Low output impedance
- Large Bandwidth
- High CMRR

58. Relate how does constant current can be improving CMRR? (*Understanding*) (Nov2010) **CO2**

In the circuit, RE will ideally be ∞ and Ac will be zero making CMRR ∞. R_E replaced with constant current circuit will improve CMRR.

59. Justify how does input impedances increases due to Darlington pair? (*Evaluating*) **CO2**

In Darlington pair two transistors are cascaded in CC configuration as a result of this input impedance is increased.

60. Define Bandwidth. (*Remembering*) **CO2**

It is defines as the difference between the half power frequency.**BW=** $f_2 - f_1$ **Hz**

61. Definition of Mid band gain(*Remembering*) **CO2**

The Mid band of an amplifier is the band of frequencies between 10 f_1 and 0.1 f_2.

62. How coupling capacitor effect the bandwidth of an amplifier. (*Remembering*) **CO2**

It offers a large reactance at Low Frequency, due to this, voltage drop across them increases which in turn reduce the gain of the amplifier.

63. Infer the effect of bypass capacitor?(*understanding*) (Nov 2010) **CO2**

At Low Frequency, reactance is not equal to zero, but it has finite value. The parallel combination of R_E and C_E will offer a finite impedance. So R_E is not properly bypassed and the voltage gain will reduced.

64. Infer the effect of internal transistor capacitances? ?(*understanding*) (Nov 2010) **CO2**

At high frequencies, the coupling and bypass capacitors act as short and do not affect the amplifier response. However, at high frequencies, the internal capacitances, commonly known as junction capacitances do come into play, reducing the current gain.

65. Illustrate why it is not possible to use the h parameters at High Frequency? (*Remembering*) **CO2**

At High Frequency, h parameter become complex and its values are frequency dependent

66. Define alpha cutoff frequency. (*Remembering*) **CO2**

It is the frequency at which the short circuit CB current gain of the transistor drops by 3db from its value at Low Frequency. $f_\alpha = 1 + hfe/2\pi rb'e[ce + cc]$

67. Define beta cutoff frequency. (*Remembering*) **CO2**

It is the frequency at which the short circuit CE current gain of the transistor drops by 3db from its value at Low Frequency. $f_\beta = 1 / 2\pi rb'e[ce + cc]$

68. Define f_T. (*Remembering*) **CO2**

It is the frequency at which the short circuit CE current gain becomes unity. $f_T = hfe\, f_\beta$.

69. Define rise time? (*Remembering*) **CO2**

The time difference between the t_1 and t_2 which corresponds to 10% and 90% value of the final value is called rise time. $\mathbf{t_r = 2.2\, R_2C_2}$

70. Relate the relation between bandwidth and rise time? (*Understanding*) **CO2**

$BW = f_H = 0.35 / tr$

71. List the significance of two capacitors in hybrid Π model. (*Remembering*)

Diffusion capacitance is offered by the forward biased BE junction and represents the excess minority carrier storage at the base emitter junction. Its value is 100Pf.

Transition capacitance is offered by reverse biased CB junction. Its value is 3pF.

72. Recall the expression for lower cutoff frequency of multistage amplifier. (*Understanding*) **CO2**

$\mathbf{f_L(n) = f_L/\sqrt{2^{1/n-1}}}$ $f_L(n)$ – Lower 3dB frequency of identical cascaded stages, f_L- Lower 3dB frequency of single stage, n – Number of stages

73. Recall the expression for Higher cutoff frequency of multistage amplifier.(*Understanding*) **CO2**

$\mathbf{f_H(n) = f_H.\sqrt{2^{1/n-1}}}$ $f_H(n)$ – Higher 3dB frequency of identical cascaded stages, f_H - Higher 3dB frequency of single stage, n – Number of stages.

74. Identify the role of coupling network in multistage amplifier (*Applying*) (Nov2010) **CO2**

- To transfer AC output of one stage to next stage
- To isolate the DC conditions of one stage to next stage

75. Justify why the drop in gain at the low frequency region & high frequency region (*Evaluating*) (Nov2010) **CO2**

Gain at Low Frequency is low due to **Coupling & Bypass capacitors**

Gain at High Frequency is low due to **Junction capacitance.**

76. Define gain –bandwidth product?(*Remembering*) **CO2**

It is the product of gain and bandwidth of an amplifier is always constant. It defines, if gain increases bandwidth decreases.

77. What are parameters that will influence the frequency response of FET Amplifier? (*Remembering*) **CO2**

External capacitance which decides the high frequency

Internal capacitance which decides the low frequency.

PART-B

1. Explain the operation of NPN & PNP transistor with necessary diagrams.(Dec 2009) **(*Evaluating*)** **CO2**
2. Criticize the operation, Input and Output characteristics of a transistor under CE Configuration. ***(Evaluating*)** **CO2**
3. With neat diagram explain the operation, Input and Output characteristics of a transistor under CB Configuration.(Nov-Dec 2010).(Nov-Dec 2011)**(*Understanding*)** **CO2**
4. With neat diagram explain the operation, Input and Output characteristics of a transistor under **CO2**

CC Configuration.(Nov-Dec 2010).(Nov-Dec 2011) ***Understanding*)**

5. Interpret various breakdowns in transistor. ***(Evaluating*)** **CO2**

6. Construct D.C load line? How will you select the operating point? Explain it using common emitter amplifier characteristics as an example? **(*Understanding*)** **CO2**

7. Demonstrate the circuit diagram of Fixed -bias circuit using CE configuration and Derive it stability factor.(***Understanding)*** **CO2**

8. Demonstrate the circuit diagram of Collector to Base bias circuit using CE configuration and explain how it stabilizes operating point. (***Understanding)*** **CO2**

9. Draw the circuit diagram of self-bias circuit using CE configuration and explain how it stabilizes operating point. **(*Analyzing*) (Nov 2010)** **CO2**

10. Explain the bias compensation techniques by using i)Diode ii) Themistor iii)Sensistor **(*Analyzing*)** **CO2**

11. Justify With the help of neat diagram the voltage divider biasing are stable than other biasing circuits method for FET.(***Evaluating***) **CO2**

12. Draw the biasing circuit for self bias for FET using common source configuration (***Understanding)*** **(May04)** **CO2**

13. Develop the expressions for current gain, voltage gain, input impedance and output impedance for an emitter follower circuit. **(*Applying)*** (Nov/Dec13). **CO2**

14. Explain with circuit diagram the bootstrapped Darlington emitter follower. **(*Understanding*)** (Dec12) **CO2**

15. Explain in detail with neat sketch, function of differential amplifier. Derive its Ad, Ac and CMRR **(*Applying)*** **(**Nov 2010) (Nov/Dec 2011)

16. Draw the high frequency hybrid π model for a transistor in the CE configuration and explain the significance of each component. ***(Remembering)*** **(**Nov/Dec14).

17. Explain the relation between h parameters hybrid π model. **(*Understanding*)**

18. Derive an expression for voltage and current gain, cutoff frequencies including source resistance and gain bandwidth product. **(*Understanding*)**

UNIT-III-FET

1. Why it is called field effect transistor*?(Understanding)* **CO3**

The drain current ID of the transistor is controlled by the electric field that extends into the channel due to reverse biased voltage applied to the gate, hence this device has been given the name Field Effect Transistor.

2. Identify Which device is called as Unipolar device and Why? (*Applying*) **CO3**

Since the operation of FET depends on the flow of majority carriers (either the electrons or holes) only, the FET is said to be unipolar device.

3. Why FET is called voltage controlled device?(*Remembering*) **CO3**

The output characteristics of FET are controlled by its input voltage thus it is voltage controlled device.

4. Classify FETs? Or What are the two main types of FET? (Analyzing) **CO3**

FET is abbreviated for Field Effect Transistor. It is a three terminal device with its output characteristics controlled by input voltage. <u>Types:</u> 1. JFET 2. MOSFET

5. What are the two important characteristics of JFET? (*Remembering*) **CO3**

i.Drain characteristics ii. Transfer characteristics.

6. What is Transconductance in JFET? (*Remembering*) **CO3**

It is the ratio of small change in drain current to the corresponding change in drain to source voltage.

7. Define Amplification Factor for JFET? (*Remembering*) **CO3**

It is the ratio of small change in drain to source voltage to the corresponding change in Gate to source voltage

8. What are the importances of FET?(Evaluating) **CO3**

The FET has the following advantages over BJT. i. The noise level very low in FET since there are no junctions. ii. FET has very high power gain. iii. Offers perfect isolation between input and output since it has very high input impedance. iv. FET is a negative temperature Co-efficient device hence avoids thermal runaway

9. Define pinch off voltage in FET. (*Remembering*) **CO3**

Pinch off voltage is the minimum drain to source voltage where the Drain current approach constant value (saturation value) beyond the pinch off voltage the channel width cannot be reduced

10. Justify why the noise level in FET is very small. ?(*Evaluating)* **CO3**

In FET, for current conduction no junction is involved. The conduction is either through an N-type or P-type semiconductor. Therefore, the noise level is very small.

11. With V_{GS} = 0 the drain current in saturation region of JEFT is 8mA.If the pinch off voltage is -4V, estimate the drain current at V_{GS} = -2V. (*Applying*) **CO3**

$I_D = I_{DSS} [1 - V_{GS}/V_P]^2 = 8 \times 10^{-3} [1 - (-2) / (-4)]^2 = 2$ mA.

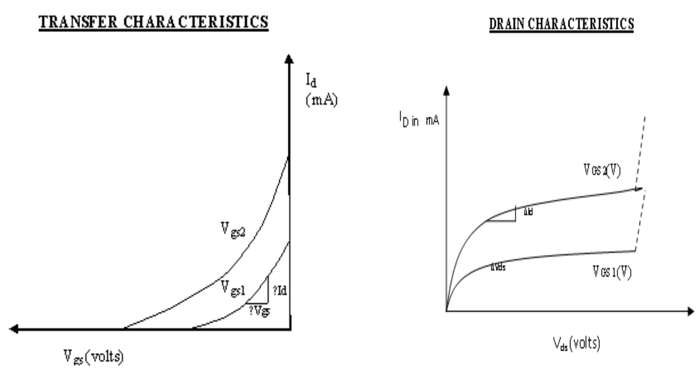
12. List the applications of MOSFET. (*Remembering*) **CO3**

1. It can be used as amplifiers in oscilloscope, electronic voltmeters.
2. It is used in computer memories.
3. It is used in logic circuits.
4. It is used as Oscillators.
5. It is used in communication

13. Justify your reason Why depletion region in a JFET is tapered? (Evaluating) **CO3**

A narrow channel exists between two p type semiconductors in n-channel type FET. When voltage is applied between the drain and source electrons flow from drain to source through the narrow channel between the depletion regions. This constitutes the drain current I_D. When gate to source voltage is also increased above zero voltage, the depletion regions are widened. This reduces the effective width of the channel which means the depletion regions are tapered.

14. Model the VI Characteristics of JFET. (*Applying*) **CO3**



15. Compare BJT and MOSFET. (Understanding) **CO3**

S.No	Parameter	BJT	FET
1.	Control element	Current controlled device. Input current controls the output current	Voltage controlled device. Input voltage controls the drain current
	Current conduction	Both majority and minority carriers	Only by majority carriers
2.	Input resistance	Less(Kilo ohms)	Very high(Mega ohms)
3.	Switching speed	Less speed	High switching speed

4.	Thermal runaway	Exists	Does not exists
5.	Thermal noise	More	Less
6.	Relation between Input and Output	Linear	Nonlinear
7.	Handling	Very easy	Need much care in handling
8.	Gain bandwidth product	High	Low

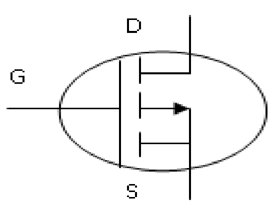
16. Differentiate JFET and MOSEFT. (Understanding) **CO3**

FET	MOSFET
1.Reverse bias for gate(operated only in depletion mode) 2.Gate is formed as a diode 3.Operated only in depletion mode 4.High input impedance 5. Gate current is high.	1.Positive or negative gate voltage(depletion MOSFET can be operated in both depletion mode and enhancement mode) 2.Gate is made as a capacitor 3. Can be operated either in depletion or enhancement mode 4.Very high input impedance due to capacitive effect 5. Gate current is low.

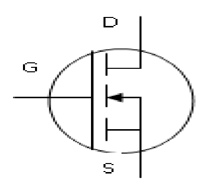
17. Differentiate Enhancement MOSEFT and Depletion MOSEFT (. Understanding) **CO3**

Enhancement MOSEFT	Depletion MOSEFT
1.Positive voltage at the gate 2.Inversion layer is made 3.Negative charges are formed	1.Negative voltage at the gate 2.Depletion of majority carriers happens 3. Positive charges are formed

18. Draw the model of an N-Channel Enhancement and P-Channel Depletion type MOSFET. (*Applying*) **CO3**



P-CHANNEL MOSFET



N-CHANNEL MOSFET

PART B

1. Formulate the working of JFET under different bias conditions.(**(*Creating*)** **CO3**
2. Explain the construction and working principle of N-Channel JFET. **(*Understanding*)** **CO3**
3. Explain the construction and working principle of P-Channel JFET. **(*Understanding*)** **CO3**
4. Explain the construction and working principle of depletion type MOSFET. Also explain its drain and transfer characteristics with neat sketch. **(*Evaluating*)** **CO3**
5. Explain the construction and working principle of Enhancement type MOSFET. (***Evaluating*)** **CO3**

UNIT IV RECTIFIERS AND POWER SUPPLIES

1. **What are various stages in linear power supply? *(Remembering)*** **CO4**
   Rectifier, filter and regulator.
2. **Define Rectifiers. *(Remembering)*** **CO4**
   A rectifier is defined as electronic device used for convert A.C voltage into Pulsating DC voltage. A rectifier utilizes unidirectional conduction device like PN junction diode.

3. Define voltage regulation. *(Remembering)* **CO4**

Voltage regulation = $(V_{NL} - V_{FL})/V_{FL}$.

4. Define ripple factor . (Nov 2010) **CO4**

Ripple factor =

$$\frac{\textbf{RMS value of AC component of output}}{\textbf{D.C. or average value of the component}}$$

5. Define-efficiency of a half-wave rectifier along with its maximum value. *(Remembering)* **CO4**

The efficiency of a half wave rectifier is defined as the ratio of D.C output power to A.C. input power.

Efficiency = DC output power/ A.C input power.

6. Define Peak Inverse Voltage (PIV). *(Remembering)* **CO4**

Peak inverse voltage is defined as the maximum reverse voltage that a diode can withstand without destroying the junction

7. Define Transformer utilization factor (TUF). *(Remembering)* **CO4**

Transformer utilization factor is defined as the ratio of DC power to that of AC rating of the transformer secondary. **TUF = Pdc / Pac (rated)**

8. List the expressions of form factor and peak factor for a half wave rectifier. *(Remembering)* **CO4**

Form factor = RMS value / average value

Peak factor = peak value / RMS Value

9. Compare the different types of rectifier circuits. (*Understanding*) **CO4**

Parameters	**HWR**	**FWR**	**Bridge rectifier**
Average value	Im / π	2Im / π	2Im / π
Rms value	Im / 2	Im / $\sqrt{2}$	Im / $\sqrt{2}$
Efficie c	40%	81.2%	81.2%
TUF	28.7%	69.3%	8 .2%
Ripple fact r	1.21	0.48	0.48
Ri ple frequency	50Hz	100Hz	100Hz
PIV	Vm	2Vm	Vm
Center tap transformer	not required	required	not required

10. List the advantages and disadvantages of different types of rectifier circuits? *(Remembering)* **CO4**

Types of rectifiers	**Advantages**	**Disadvantages**
HWR	➢ Simple circuit	➢ High ripple factor ➢ Low efficiency ➢ Low TUF
FWR	➢ Low ripple factor ➢ Better efficiency ➢ Better TUF	➢ Cost of center tap transformer high ➢ Need large size of diodes
Bridge rectifier	➢ Center tap transformer is not required ➢ Efficiency high ➢ TUF is high	➢ Four diodes are needed ➢ As two diodes conduct simultaneously, the voltage drop increases, output decreases.

11. Compare the different types of filters. (*Understanding*) **CO4**

Parameters	**Capacitor filter**	**Inductor filter**	**L Section filter**	π ***Section filter***
Ripple factor	$\frac{1}{4\sqrt{3}\,fCR}$	$\frac{R}{3\sqrt{2}\omega L}$	$\frac{R}{6\sqrt{2}\,\omega^2\,LC}$	$\frac{1}{4\sqrt{3}(\omega^2 LC_1C_2R_L)}$

Useful in	reducin ripple in load voltage	reducing ripple in load current	reducing ripple in load current	reducing ripple in load voltage
Suitable for	light load application	Heavy load application	light & heavy load application	all loads
Surge current	very high	low	low	low

12. List the pros and cons of various filters? *(Remembering)* **CO4**

Types of filters	**Advantages**	**Disadvantages**
Capacitor filter	➢ easy to design ➢ reduction in the ripple content ➢ increase in the average load voltage	➢ ripple factor is dependent on the load ➢ regulation is poor ➢ diodes have to handle large peak currents
Inductor filter	➢ low ripple factor at heavy load currents ➢ reduce ripple in output	➢ ripple factor is poor ➢ bulky and costly
L Section filter	➢ good load regulation ➢ low ripple factor and not dependent on load	➢ power loss takes place in inductor ➢ bulky and costly
π ***Section filter***	➢ low ripple factor ➢ high DC voltage	➢ power loss takes place in inductor ➢ bulky and costly ➢ high peak diode current

13. What is the need of filter circuit? *(Remembering)* **CO4**

The output of rectifier circuit consists of **DC and Ripple components**. To remove the ripples, the filter circuits are used

14. Why a simple capacitor filter is not suitable for heavy loads. *(Remembering)* **CO4**

As the load current increases, for the same d.c output voltage the load resistance decreases. This increases ripple content in the output for heavy loads. Practically for heavy loads, the d.c output voltage decreases and shows very poor regulation. Hence the simple capacitor is not suitable for heavy loads

15. Define Line & Load regulation. *(Remembering)* (Nov2010) **CO4**

Line regulation is defined as the change in output voltage for a change in regulated load voltage due to change in line voltage, keeping the load current and temperature constant.

Line regulation =V_{LH}-V_{LL}

LH=load voltage with high line voltage,

LL= load voltage with low line voltage

Load regulation is defined change in the regulated output voltage when the load current changes from min to max **.**

Load regulation=V_{NL}-V_{FL}.

16. What are the factors affecting the output voltage of a regulated power supply? *(Remembering)* **CO4**

Load current, Input voltage, Temperature.

17. List the factors that determine the stability of the voltage regulators. *(Remembering)* **CO4**

The output d.c. voltage V0 depends upon the input unregulated dc voltage Vin, load current IL and temperature T.The three factors that determine the stability of voltage regulator are

1. Input regulation factor, $S_v = \Delta V_o/\Delta V_{in}$ when $\Delta I_L=0$, $\Delta T = 0$.
2. Output resistance, $R_o = \Delta V_o/\Delta I_L$ when $\Delta V_{in} =0$, $\Delta T =0$

Temperature coefficient $S_T = \Delta V_o/\Delta T$ when $\Delta V_{in}=0$, $\Delta I_L = 0$

18. List the disadvantages of the linear voltage regulators? (*Understanding*) **CO4**

- Low efficiency
- Need large value of capacitors
- Input transformer is bulky and costly

19. What is the basic concept of SMPS? *(Remembering)* **CO4**

SMPS, series pass transistor operates as a **switch**. Pulses from generator are applied to switch, when it is ON it connects the input as it is to the input of the filter. When it is OFF, filter input is disconnected and gives rectangular waveform. Then filter converts the rectangular into smooth dc voltage by removing the ripple contents.

20. What is a voltage multiplier? *(Remembering)* (May2008) **CO4**

It produces a DC output voltage in terms of multiplication of input voltage.

21. List pros and cons of SMPS? *(Remembering)* (Nov 2010) **CO4**

Advantages	**Disadvantages**
➢ Efficiency is high due to less heat dissipation ➢ Protection against excessive output voltage ➢ Higher power handling capacity ➢ Reduced harmonic feedback into the supply main	➢ Load regulation is poor ➢ No isolation between input and output ➢ Radio frequency interference to the neighbouring circuits ➢ Transient response is slow

22. Compare Rectifier and regulator. (*Understanding*) **CO4**

Rectifier	**Regulator**
Rectifier converts pure sinusoidal input into pulsating D.C. output.	Regulator converts pulsating D.C. input into constant D.C. output.
The output contains ripples.	The output is ripple free.
Output voltage changes with respect to load current, input voltage and temperature.	Output voltage changes with respect to load current, input voltage and temperature
Not provided with over load protection, short circuit protection, thermal shutdown etc.	Provided with all sorts of protection circuits.

23. What is Bleeder resistor? *(Remembering)* **CO4**

This resistance is connected across the output of the filter, to place minimum load.

24. Compare shunt regulator and series regulator. (*Understanding*) **CO4**

Shunt regulator	Series regulator
The control element is in parallel with the load.	The control element is in series with the load.
Any change in output voltage is compensated by changing the current Ish through the control element as per the control signal	Any change in output voltage is compensated by adjusting the voltage across the control element as per the control signal.
Regulation is poor	Regulation is good

PART-B

1. Explain with circuit diagram of Half wave & Full wave **(*Understanding*) (Nov/Dec 2011)** **CO4**
2. Explain with circuit diagram of bridge rectifiers derive the expression for ripple factor and **CO4**

Efficiency.(**(*Understanding*)**

3. Explain the operation of C,L,PI Filters AND derive its ripple factor for the same**(Nov 2010) (Nov/Dec2011(*Understanding*)** **CO4**

Explain with a neat diagram; the Series transistorized voltage regulators and Shunt transistorized voltage regulators. **(*Understanding)***

Demonstrate the operation of SMPS. **(*Understanding*) (Nov/Dec 2012)**

Relate the various components of power supply and explain each block. ***(Remembering)*** **(Nov/Dec 2011)**

Explain the working of centre tapped full wave rectifier(with and without filter) with neat diagrams and derive the necessary equations.

UNIT V SPECIAL SEMICONDUCTOR DEVICES

1. **What are break down diodes? *(Remembering)*** **CO5**

Diodes which are designed with adequate power dissipation capabilities to operate in the break down region are called as break down or zener diodes.

2. **Classify break down based on its phenomenon.(*Analyzing)*** **CO5**

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

3. **Demonstrate zener breakdown? (*Understanding)*** **CO5**

Zener break down takes place when both sides of the junction are very heavily doped and consequently the depletion layer is thin and consequently the depletion layer is tin. When a small value of reverse bias voltage is applied, a very strong electric field is set up across the thin depletion layer. This electric field is enough to break the covalent bonds. Now extremely large number of free charge carriers are produced which constitute the zener current. This process is known as zener break down

4. **What is avalanche break down? (June 2009) 0r what is meant by avalanche multiplication? (Apr-May 2011) *(Remembering)*** **CO5**

When bias is applied, thermally generated carriers which are already present in the diode acquire sufficient energy from the applied potential to produce new carriers by removing valence electron from their bonds. These newly generated additional carriers acquire more energy from the potential and they strike the lattice and create more number of free electrons and holes. This process goes on as long as bias is increased and the number of free carriers gets multiplied. This process is termed as avalanche multiplication. Thus the break down which occurs in the junction resulting in heavy flow of current is termed as avalanche break down.

5. **Experiment with avalanche breakdown voltage varies with temperature?(*Applying*)** **CO5**

In lightly doped diode an increase in temperature increases the probability of collision of electrons and thus increases the depletion width. Thus the electrons and holes need a high voltage to cross the junction. Thus the avalanche voltage is increased with increased temperature

6. **Experiment with zener breakdown voltage varies with temperature? (*Applying*)** **CO5**

In heavily doped diodes, an increase in temperature increases the energies of valence electrons, and hence makes it easier for these electrons to escape from covalent bonds. Thus less voltage is sufficient to knock or pull these electrons from their position in the crystal and convert them in to conduction electrons. Thus zener break down voltage decreases with temperature.

7. **List the importance of zener diode?(*Evaluating*)** **CO5**

i.Zener diode as a voltage regulator. ii.Zener diode as a constant voltage source.

8. **List the importance of zener diode. (Nov/Dec 2010) *(Evaluating*)** **CO5**

Zener diodes are widely used as voltage references and as shunt regulators to regulate the voltage across small circuits. When connected in parallel with a variable voltage source so that it is reverse biased, a Zener diode conducts when the voltage reaches the diode's reverse breakdown voltage. From that point on, the relatively low impedance of the diode keeps the voltage across the diode at that value.

9. What is tunneling phenomenon? (*Remembering*) **CO5**

The phenomenon of penetration of the charge carriers directly though the potential barrier instead of climbing over it is called as tunneling.

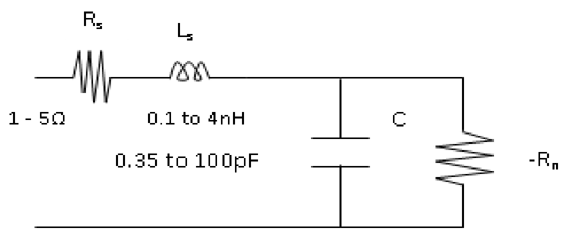
10. What is a tunnel diode? (*Remembering*) **CO5**

The tunnel diode is a pn junction diode in which the impurity concentration is greatly increased about 1000 times higher than a conventional PN junction diode thus yielding a very thin depletion layer. This diode utilizes a phenomenon called tunneling and hence the diode is referred as tunnel diode.

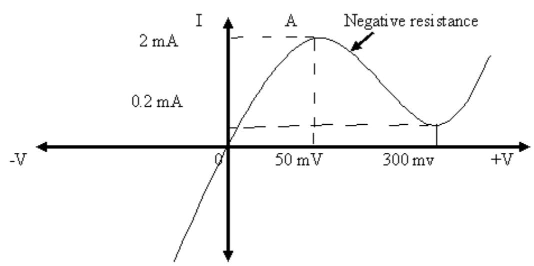
11. List the applications of tunnel diode. (*Remembering*) **CO5**

- High speed switching devices
- High speed storage devices
- Used in relaxation oscillator

12. Draw the equivalent model for tunnel diode.(*Applying*) **CO5**



13. Demonstrate V- I characteristics of tunnel diode. (*Understanding*) **CO5**



14. What is a varactor diode?((*Remembering*) **CO5**

A diode which is based on the voltage variable capacitance of the reverse biased P-N junction is said to be varactor diode. It has other names such as varicaps, voltacaps.

15. Demonstrate characteristics of varactor diode. (*Understanding*) **CO5**

16. List the applications of varactor diode? (*Remembering*) **CO5**

- The varactor diode is used in tuning circuits
- It finds use in parametric amplifiers
- It is used in automatic frequency control device.
- It finds its application in adjustable bandpass filters.

17. **Distinguish between abrupt and hyper abrupt doping. (*Analyzing*)** **CO5**

Abrupt Doping	Hyper Abrupt Doping
Uniform doping	Non Uniform doping
Capacitance variation is 4:1	Capacitance variation is 10:1
Capacitance value is 100pF to 25pF	Capacitance value is 100pF to 2pF

18. **Examine how an LED works? (*Analyzing*)** **CO5**

A PN junction diode which emits light when forward biased is known as Light Emitting Diode (LED).

19. **Why normal PN junction diode is not preferred for Light Emitting Diode (*Remembering*)** **CO5**

Normal PN junction diode emits heat whereas LED emits light radiations

20. **List the semiconductors which are used in LEDs to emit various lights. (*Remembering*)** **CO5**

Infra-Red – Gallium Arsenide
Red – Gallium Phosphide
Blue – Gallium nitrite

21. **List the importance of LED. (*Remembering*)** **CO5**

Efficiency: LEDs emit more light per watt than incandescent bulbs.[1] Their efficiency is not affected by shape and size, unlike fluorescent light bulbs or tubes.
Color: LEDs can emit light of an intended color without using any color filters as traditional lighting methods need. This is more efficient and can lower initial costs.
Size: LEDs can be very small (smaller than 2 mm^2) and are easily populated onto printed circuit boards.
Lifetime: LEDs can have a relatively long useful life.
ON/OFF time: LEDs light up very quickly. A typical red indicator LED will achieve full brightness in under a microsecond. LEDs used in communications devices can have even faster response times.

22. **Define PIN Diode (*Remembering*)** **CO5**

PIN diode is made up of three semiconductor material :2 heavily doped P& N Type Material separated by intrinsic

23. **Discuss the working of PIN Diode in various biasing. (Creating)** **CO5**

During forward bias it acts as variable resistor and during reverse bias it acts as capacitor

24. **List the applications Of PIN Diode. (*Rembering*)** **CO5**

- Attenuator because of its resistance can be controlled by current
- DC controlled microwave switch.

25. **What is dark current in photo diode and what should be the value. (*Remembering*)** **CO5**

When no light incident light the reverse current is almost negligible and this is called dark current the value is 25µA at reverse voltage of 3V.

26. **List the applications of Photo diode. (*Remembering*)** **CO5**

- Demodulator
- Logic circuits
- Optical communication systems
- Encoders
- Photo detection both visible & invisible

27. **Identify Photo resistor materials? (*Applying*)** **CO5**

Photo conductive cells are made of Cadmium sulphide(CdS) or Cadmium selenide(CdSe) whose resistance varies inversely with intensity of light .

28. **Identify various regions in the VI characteristics of UJT?(*Applying*)** **CO5**

1. Cut-off region
2. Negative resistance region.
3. Saturation region

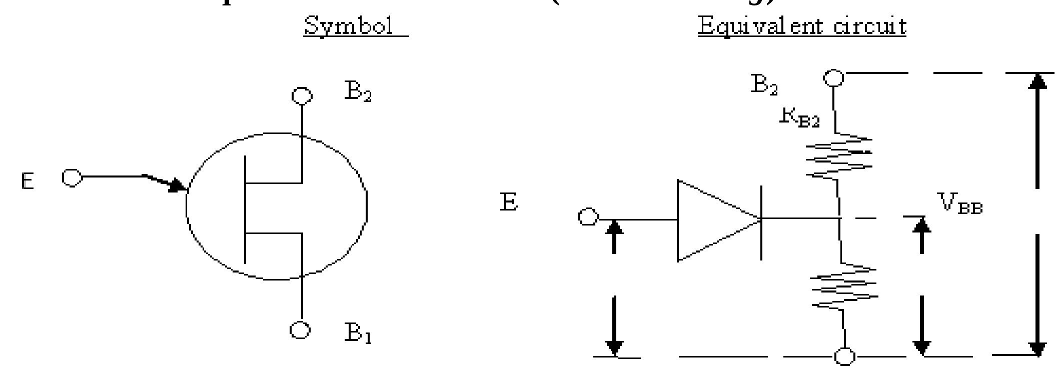
29. Conclude why negative resistance region occurs in UJT? (*Evaluating*) **CO5**

In a UJT when the emitter voltage reaches the peak point voltage, emitter current starts flowing. After the peak point any effort to increase in emitter voltage further leads to sudden increase in the emitter current with corresponding decrease in emitter voltage, exhibiting negative resistance. This takes place until the valley point is reached. This region between the peak point and valley point is called negative resistance region.

30. What is the principle behind photovoltaic cell.(*Analyzing*) **CO5**

Conversion of light energy into electrical energy .

31. Demonstrate equivalent circuit of UJT.(*Understanding*) **CO5**



32. List the applications of UJT. (*Remembering*) **CO5**

1.It is used in timing circuits
2. It is used in switching circuits
3. It is used in phase control circuits
4. It can be used as trigger device for SCR and TRIAC.
5. It is used in saw tooth generator.
6. It is used for pulse generation.

33. Why phototransistor is preferred than photodiode for practical applications. (*Remembering*) **CO5**

The gain for photo transistor is high than photo diode
Switching speed is high

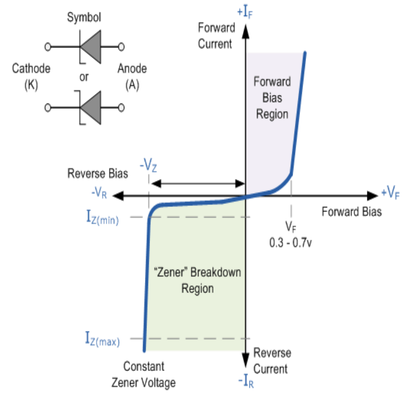
34. Differentiate between the doping concentration of PN Junction, Zener & tunnel diode. (Understanding) **CO5**

s.no	PN junction diode	Zener Diode	Tunnel diode
1.	Moderately doped	Heavily doped	Very Heavily doped
2.	Depletion region in terms of µm	Depletion region in terms of nm	Depletion region in terms of pm
3.	Avalanche break down	Zener break down	Tunneling takes place at Speed of light
4.	Reverse biased current will be in terms of µA	Reverse biased current will be In terms of mA	

35. Distinguish between PN junction diode & zener diode *(Analyzing)* **CO5**

S.NO	PN junction diode	Zener Diode
1.	Moderately doped	Heavily doped
2.	Depletion region in terms of µm	Depletion region in terms of nm
3.	Avalanche break down	Zener break down
4.	Reverse biased current will be In terms of µA	Reverse biased current will be In terms of mA

36. **Demonstrate the VI characteristics of zener diode** ***(Understanding)*** **CO5**



PART-B

1. Explain the operation of Zener diode, its principle and its VI characteristics with neat diagram. ***(Remembering)*** **CO5**

2. Explain the operation of Zener diode, its principle and its VI characteristics with neat diagram. ***(Remembering)*** **CO5**

3. **Elaborate (*Understanding*)** **CO5**
LED,photodiode ,photovoltaic cells

4. Experiment various diodes **(*Applying*)** **CO5**
PIN Diode, Varactor Diode,Tunnel diode

5. Develop the working, applications of Photo transistor ,UJT, LCD and Photoconductive. **(*Understanding*)** **CO5**

6. Explain the construction and working of Zener diode with a neat sketch. **(*Understanding*)** **CO5**

7. Explain the principle and operation of LASER diode with neat diagram. **(*Understanding*)** **CO5**

8. Explain the construction and working of LED with its characteristics. **(*Understanding*)** **CO5**

9. Explain the construction and characteristics of UJT with a neat sketch. **(*Understanding*)** **CO5**

10. With a neat sketch explain the construction and working characteristics of a SCR. **(*Understanding*)** **CO5**