SRI RAMAKRISHNA INSTITUTE OF TECHNOLOGY

PACHAPALAYAM, COIMBATORE-10

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ELECTRIC CIRCUITS AND ELECTRON DEVICES
2 MARKS

Regulation 2008

For Second Semester B.E / B.Tech Students

SRI RAMAKRISHNA INSTITUTE OF TECHNOLOGY

Department of Electrical and Electronics Engineering

Subject: Electric Circuit and Electron Devices

UNIT -1(CIRCUIT ANALYSIS TECHNIQUES)

1. Define Electric current.

Electric current is defined as the rate of flow of electric charge.

$I=(dq / dt)$ amperes

q = charge in coulombs.

The unit of current is ampere.

2. Define electrical Potential or Voltage.

This is generally measured between two points and its unit is the volt. If the work done in moving a charge of one coulomb between any two points is 1 joule, then we say that the potential of one point with reference to the second point is 1 volt.

$V = dW / dQ$

W is the work done in joules.

3. What is meant by resistance?

(i)The resistance of a circuit is the property by which it oppose the flow of current.

(ii) It is measured in Ohms.

4. Define Conductance.

The reciprocal of resistance is called conductance. its unit is siemen and its symbol is G.

$G=1/R$

5. State Ohm's law.

When the temperature remains constant, current flowing through a circuit is directly proportional to potential difference across the conductor.

Mathematically we write

$$V = IR$$

6. Define Electric power.

The rate at which the work is done is power and its unit is joule per second or watt.

` $P = V.I$ Watts. (Or) $P = I^2R$

7. State Kirchhoff's Current Law.

The sum of the currents flowing towards a junction is equal to the sum of the current flowing away from it.

8. Define Kirchoff's Voltage Law.

Around a closed circuit, the sum of potential rises is equal to the sum of potential drops

9. What are the results of resistance in series?

Equivalent resistance Rs of two resister connected in series is given by:

$$Rs= R1+R2$$

10. What is the Result of resistance in parallel?

Equivalent resistance Rp of two resistors connected in parallel is given by:

$$1/Rp=1/R1+1/R2$$

11. Define active and passive network.

Active Network:

A circuit which contains a source of energy is called active network. Voltage and current sources are energy sources.

Passive Network:

A circuit which contains no energy source is called passive network. The passive network contains resistor, capacitor and inductor.

12 Three resister (10 ohm, 6 ohm, 4 ohm) are connected in series . Find the equivalent resistance?

Equivalent resistance Rs =R1 +R2 +R3

Rs= 10+6+4

Rs= 20 ohm

13. Three resister (20 ohm, 10 ohm, 30 ohm) are connected in parallel. Find the equivalent resistance?

Equivalent resistance 1/ Rp = 1/R1 + 1/R2 + 1/R3

1 / Rp = 1/20 + 1/10 + 1/30

1 / Rp = 0.1833

Rp = 5.454 ohm

14. Types of dependent sources?

The dependent sources are classified into 4 types

1. voltage dependent voltage source (VDVS)
2. voltage dependent current source (VDCS)
3. current dependent voltage source (CDVS)
4. current dependent current source (CDCS)

15. State Superposition theorem.

In a linear network containing several sources (including dependent sources), the overall response (branch current or voltage)in any branch in the network equals the algebraic sum of responses of each individual sources considered separately with all other sources made in operative .i.e replaced by internal resistances or impedances.

16. State thevenin's theorem?

Any linear, two terminal ,bilateral active network can be replaced by a voltage source of thevenin's volage VTH which is in series with thevenin's resistance RTH . VTH is the open circuit voltage across the terminals and RTH is the effective resistance looking back from the terminals

17. State norton's theorem?

Any linear, two terminal, active network can be replaced by a current source Isc in parallel with thevenin's resistance RTH . Isc is the short circuit current in output terminal and RTH is the effective resistance looking back from the terminals.

18. State maximum power transfer theorem?

Maximum power transfer theorem for DC circuits : Maximum power will be delivered from a source to the load resistance is equal to the resistance of the network looking back at it from the load terminals, all sources being replaced by their respective internal resistances.

Maximum power transfer theorem for AC circuits: Maximum power transfer to a load occurs when the load impedance is equal to complex conjugate of the impedance of the network looking back at it from the load terminals, all sources being replaced by their respective internal resistances.

19. What is the condition for maximum power transfer?

The power delivered is maximum if the load resistance is equal to the source resistance.

20. Write some applications of maximum power transfer theorem.

1.Power amplifiers.

2.Communication systems

3.Microwave transmissions.

21.What is the limitation of Superposition theorem?

This theorem is valid only for linear systems.This theorem can be applied for calculating the current through or voltage across any particular element.But this Superposition theorem is not applicable for calculation of power.

22. What are the limitations of Maximum power transfer theorem?

The maximum efficiency which can be obtained by using this theorem is only 50%.Its because 50% of the power is unnecessarily wasted in Rth

23. What is Duality?

Two electrical networks which are governed by the same types of equations are called dual networks or duality is said to exist between them.

UNIT –II (TRANSIENT RESONANCE IN RLC CIRCUITS)

1. What is meant by alternating quantity?

Alternating quantity is one in which the magnitude and direction change with respect to time.

2. What is meant by cycle?

One complete set of positive and negative values of an alternating quantity is called as cycle.

3. Define time period.

The time taken to complete one cycle is called the time period of the quantity (T).

4. Define Frequency.

The number of cycles occurring per second is called frequency

$$F = 1 / T \text{ Hz.}$$

5. Define amplitude.

The maximum value ,either positive or negative ,of an alternating quantity is called amplitude.

6. Define RMS value.

The effective value of an alternating current is that value of steady direct current which produces the same heat as that produced by the alternating current when passed through the same resistor for the same interval of time.

7. What is transient?

If the network contains energy storage elements ,with change in excitation,the current and voltage change from one state to other state.the behavior of the voltage or current when it is changed from one state to another is called the transient state.

8. Define transient time.

The time taken for the circuit to change from one steady state to another steadty state is called as transient time.

9.Define natural response.

When we consider a circuit containing storage elements which are independent of sources ,the response depends upon the nature of the circuit is called the natural response.

10.Define transient response.

Energy storing elements like inductor and capacitor deliver their energy to the resistances.Hence the response changes with time,gets saturated after sometime,and is referred to as the transient response.

11.What is the time constant for series RL and RC circuit? (AU /CBE –May 2008)

Time constant for RL series circuit = L / R

Time constant for RC series circuit = RC

12.Write the expression for transient current for series RL and RC circuits. (AU /CBE – May 2008)

For RL circuit

$$i(t) = I\,(1 - e^{-t/\tau})$$

Where $I = V / R$; τ = time constant = L / R

For RC circuit

$$i(t) = (V / R)\,(e^{-t/RC})$$

13. Define time constant for RC circuit.(AU / ECE –Dec 2007)

The time constant for RC series circuit is defined as the period during which the current rise to 36.8% of its final value.

14.Define resonance.

An A.C circuit is said to be in resonance if it behaves as a purely resistive circuit.The total current drawn by the circuit is then in phase with the applied voltage ,and the power factor will then be unity. Thus at resonance ,the equivalent complex impedance of the circuit has no j component.

15.What is resonant frequency?

The frequency at which resonance occurs is called the resonant frequency.

At resonant frequency XL = XC

16.Define series resonance.

A resonance occurring in RLC series circuit is called series resonance.Under resonance condition the input current is in phase with applied voltage.

17.Define quality factor Q of a coil.

Quality factor of a coil is defined as the ratio of the reactance of the coil to its resistance at resonance.

$$Q = XL / R = XC / R$$

18. What are coupled circuits?

If the transfer of energy occurs from one circuit to another circuit through mutual induction, then the two circuits are said to be coupled.

19.What is meant by single tuned coupled circuits.

The coupled circuit is said to be single tuned when the secondary coil contains an adjustable capacitor which can be tuned to resonance.

20.What is meant by double tuned coupled circuits.?

A double tuned coupled circuits is a one in which the capacitor is present in both primary and secondary.

21. Give the applications of tuned circuits.

1.Used in radio receivers.

2.In amplifier circuits

3.In communication circuits.

22. Give two difference of single and double tuned circuits?

1. A capacitor is introduced either primary or secondary side for single tuned circuits . but in double tuned circuits , two capacitors , one in primary and another in secondary are introduced.

2. Single tuned circuits are used to select lower frequencies . but double tuned circuits, are used to select particular band of frequencies .

UNIT -III(SEMICONDUCTOR DIODES)

1.What do u meant by extrinsic semiconductor?

The electrical conductivity of pure semiconductor can be increased by adding impurity to it.the resulting semiconductor is called extrinsic semiconductor or impure semiconductor.

2.How do you increase the conductivity of the intrinsic semiconductor?

The conductivity of intrinsic semiconductor can be increased by adding the impurity through the process known as doping.

3.What is forbidden energy gap?

The energy gap between the valence band and conduction band is known as forbidden energy gap.

4.What are the charge carriers found in P type material?

Majority carriers = Holes

Miniority carriers = Electrons

5.What are called P and N type semiconductor ?

P- Type semiconductor:

When a small amount of trivalent impurity (e.g. gallium,Indium) is added to a pure semiconductor crystal the resulting extrinsic semiconductor is known as P-type semiconductor.

N-Type semiconductor:

When a small amount of pentavalent impurity (e.g. Antimony,Arsenic) is added to a pure semiconductor crystal the resulting extrinsic semiconductor is known as N-type semiconductor.

6.What is meant by doping in a semiconductor?

The process of adding impurity to pure semiconductor to increase the electrical characteristics of semiconductor is known as doping.

7.Define a semiconductor.

The materials ,whose electrical properties lie between that of conductors and insulators are known as semiconductors.

8.What is a covalent bond?

Sharing of valence band electrons with neighbouring atom is known as covalent band.

9.How is a hole formed in a semiconductor?

At room temperature ,some of the covalent bonds are broken due to the thermal energy supplied to the semiconductor crystal .Once the covalent bond is broken the electrons become free and are shifted to conduction band.the vacancy created in the valence band is called a hole.Whenever an electron is jumped up to the conduction band,a hole is created in the valence band.

11. Define cut in voltage of a diode.

The forward voltage at which the current through the PN junction starts increasing rapidly is known as knee voltage.It is also called as cut- in voltage or threshold voltage.

12. Define Diffusion current.

The charge concentration is greater in one region of a semiconductor as compared to the rest of the region.Thus,it has a tendency to move from region of higher concentration to the region of lower concentration. This process is called diffusion and the electric current produced due to this process is known as diffusion current.

13. Define drift current.

When an electric field is applied across the semiconductor;the holes move towards the negative terminalof the battery and electrons move towards the positive terminal of the battery.This combined effect causes a current flow in the circuit and is called as drift current.

14.What is depletion region.?

The region around the junction from which the charge carriers are completely depleted is known as depletion region.Since this region has immobile ions,which are electrically charged.this depletion region is known as space charge region.

15. What is diffusion capacitance?

The diffusion capacitance of forward biased diode is defined as the rate of change of injected charge with voltage.

$$CD = dq / dv$$

14.What is hall effect?

When a semiconductor material carrying a current ‘I ‘ is placed in a transverse magnetic field (B) then the emf is induced in a direction perpendicular to both current and magnetic field.This phenomenon is called as hall effect and the induced voltage is known as hall voltage. (EH)

15. Define Zener diode?

When reverse voltage is reaches breakdown voltage on normal PN junction diode, the current through the junction and the power dissipated at the junction with adequate power dissipation capabilities to operate in the break down region . One such a diode is known as zener diode. Zener diode is heavily doped than the ordinary diode.

16 Define zener breakdown voltage.

The reverse voltage applied across the zener diode,which cause the breakdown is known as zener breakdown voltage.

17 List the uses of zener diode.

i) It can be used as voltage regulator.

ii)It can be used as limiter in wave shaping circuits.

iii)It can be used in protection circuit against damage from accidental over voltage.

iv)It can be used as a fixed reference voltage in a network for calibrating voltmeters.

18 What is a PN junction diode?

A PN junction diode is a two terminal semiconductor device consisting of a PN junction formed either in germanium or silicon crystal.It is formed from a piece of semiconductor by diffusing P type material to one half side and N type material to other half side . The plane dividing two zones is known as a junction.

19. Explain the term Knee voltage and breakdown voltage with respect to diodes.

Knee voltage:

The forward voltage at which the current through the PN junction starts increasing rapidly is known as knee voltage.It is also called as cut-in –voltage or threshold voltage.

Breakdown voltage:

The reverse voltage at which the PN junction breakdown occurs is called as breakdown voltage.

20. Give the diode current equation.

$$I = I0[ev/ŋVt - 1]$$

Where

I = Forward (or reverse) diode current.

I 0 = Reverse saturation current at temperature T.

V = Diode voltage.

V T = Threshold voltage

T = Temperature of diode junction.

21. Define peak inverse voltage in a diode.

Peak inverse voltage is the maximum voltage applied across the diode when ireverse biased without destroying it.

22. Define barrier potential at the junction.

Potential barrier is defined as the potential difference built up across the PN junction which restricts further movement of charge carriers across the junction .

23. Distinguish junction diode from Zener diode.

Junction diode	Zener diode.
It is never intentionally operated in the breakdown region because it may damage.	It is operated in the breakdown region.
It have thick junction	It have thin junction
Power dissipation is less	Power dissipation is HIGH.
Dynamic resistance is very small in reverse bias	Dynamic resistance is very high in reverse Bias
Used as rectifiers, voltage multipliers, clippers and clampers.	Used as voltage regulators, limiters etc.,

UNIT IV

TRANSISTORS

1. What is a transistor (BJT)?
Transistor is a three terminal device whose output current, voltage and /or power is controlled by input current.

2. What are the terminals present in a transistor?
Three terminals: emitter, base, collector.

3. What is FET?
FET is abbreviated for field effect transistor. It is a three terminal device with its output characteristics controlled by input voltage.

4. Why FET is called voltage controlled device?
The output characteristics of FET is controlled by its input voltage thus it is voltage controlled.

5. What are the two main types of FET?
1. JFET 2. MOSFET.

6. What are the terminals available in FET?
1). Drain, 2).Source and 3). Gate

7. What is JFET?
JFET- Junction Field Effect Transistor.

8. What are the types of JFET?
N- Channel JFET and P- Channel JFET

9. What are the two important characteristics of JFET?
1. Drain characteristics 2. Transfer characteristics.

10. What is transconductance in JFET?
It is the ratio of small change in drain current to the corresponding change in drain to source voltage.

11. What is amplification factor in JFET?
It is the ratio of small change in drain to source voltage to the corresponding change in Gate to source voltage.

12. Why do we choose q point at the center of the load line?
The operating point of a transistor is kept fixed usually at the center of the active region in order that the input signal is well amplified. If the point is fixed in the saturation region or the cut off region the positive and negative half cycle gets clipped off respectively.

13. List out the different types of biasing. ._
Voltage divider bias, Base bias, Emitter feed back bias, Collector feedback bias, Emitter bias.

14. What do you meant by thermal runway?
Due to the self heating at the collector junction, the collector current rises. This causes damage to the device. This phenomenon is called thermal runway.

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

16. Define current amplification factor?
It is defined as the ratio of change in output current to the change in input current at constant.

17. What are the requirements for biasing circuits?
• The q point must be taken at the Centre of the active region of the output characteristics.
• Stabilize the collector current against the temperature variations.
• Make the q point independent of the transistor parameters.
• When the transistor is replaced, it must be of same type.

18. When does a transistor act as a switch?
The transistor acts as a switch when it is operated at either cutoff region or saturation region

19. What is biasing?
To use the transistor in any application it is necessary to provide sufficient voltage and current to operate the transistor. This is called biasing.

20. What is stability factor?
Stability factor is defined as the rate of change of collector current with respect to the rate of change of reverse saturation current.

21. Explain about the various regions in a transistor?
The three regions are active region, saturation region and cutoff region.

22. Explain about the characteristics of a transistor?
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.

UNIT -V(SPECIAL SEMICONDUCTOR DEVICES)

1.What is tunnel diode ?

The tunnel diode is a high conductive two terminal PN junction diode,doped heavily about 1000 times higher than a conventional PN junction diode.

2.Define Negative resistance of tunnel diode .

It is defined as the property of a tunnel diode ,during its forward biased voltage increases current decreasing as a result of its dynamic resistance is negative ,hence it is called as negative resistance of the device.

3.Define Tunneling phenomenon. (or) How does tunnel diode works ?

The width of the depletion region in a tunnel diode varies as the square root impurity concentration .i.e. if the concentration of impurity atom is greatly increased ,the barrier width 'W ' reduces. In this condition ,instead of crossing over the junction barrier,the electron penetrate through the barrier .this behavior of a diode is known as tunneling phenomenon.

4. Explain the advantages of tunnel diode?

a. environmental immunity.
b. Low cost
c. Simplicity
d. Low noise
e. High speed
f. Low power consumption

5. Explain the disadvantages of tunnel diode?

Only disadvantage of tunnel diode are its low output voltage swing and it is a two terminal device . hence there is no isolation between input and output . hence transistor is used along with a tunnel diode for frequencies below 1 GHz.

6. Explain the applications of tunnel diode?

(i) . As a high speed switch .

(ii). in pulse and digital circuits .

(iii). in negative resistance and high frequency (micro wave) oscillator .

(iv) in switch networks

(v).in timing and computer logic circuitry .

(vi). design of pulse generators and amplifiers

7.Explain the Advantages of photodiode?

a. can be used as variable resistance device.

b. Highly sensitive to the light.

c. The speed of the operation is very high . the switching of current and hence the resistance value from high to low or other wise is very fast .

8. Explain the Disadvantages of photodiode?

(i) The dark current is temperature dependent .

(ii) The overall photo diode characteristics are temperature dependent Hence have poor temperature stability

(iii) The current and change in current is in the range of A which may not be sufficient to drive other circuits. Hence amplification is necessary

9.What is Pin diode ?

Pin diode is a high speed switching device, because its highly improved switching time in comparison with a PN diode.Inthis diode high resistivity intrinsic layer is sandwiched between the heavily doped P and N regions thus it is named as PIN diode.

10. What is a varactor diode ?

The varactor diode is a semiconductor, voltage dependent variable capacitor diode. This special diode which is made for the application utilization of voltage variable properly hence it is called varactor diode or Varicaps (or) voltage cap.It is operated under reverse biased conditions so as to yield a variable junction capacitance.

11. What is the significance of varactor diode ?

The varactor diode is a semiconductor ,voltage deprndent ,variable capacitors diode.Their mode of operation depends on the capacitance that exists at the PN junction when it is reverse biased.

12. Why germanium instead of silicon is used for construction of SCr ?

For the construction of SCR germanium is preferred than silicon because ,more silicon per ampere current is required. Hence the current rating is increased ,it require more silicon.

13.What are the methods used to turn on SCR ?

(i) Voltage trigerring

(ii) dV / dt trigerring

(iii) Gate trigerring

14.What is SCR ?

A Silicon Controlled Rectifier (SCR)is a three terminal ,three junction semiconductor device .It is unidirectional device. It converts alternating current into direct current and control the amount of power fed to the load .

15. Write an two different characteristics of SCR ?

1. Forward characteristics

2. Reverse characteristics

16. Mention the application of SCR.

(i) It can be used as a speed control element in DC and Ac motors.

(ii)It can be used as an inverter.

(iii) It can be used as an Converter.

17. Define breakdown voltage of SCR.

It can be defined as the minimum forward voltage at which the SCR starts conducting heavily.

18.Define latching current.

It can be defined as the maximum anode current that an SCr capable of passing without destruction.

19. Define holding current of an SCR .

It can be defined as the minimum value of anode current required to keep the SCR in ON position.

20.What is DIAC ?

Diac is a two terminal ,bi-directional semiconductor switching depending upon the polarity of the voltage applied across its main terminals .In operation ,diac is equivalent to two 4 layer diodes connected in antiparallel.

21.List out the applications of DIAC.

(i) It is used as a trigger device in TRIAC power control systems.

(ii) It is used in lamp dimmer circuits

(iii) It is used in heater control circuits

(iv) It is used for speed control of universal motor.

22.A triac is considered as two SCRs connected in reverse parallel.Why?

The TRIAC is a bidirectional device.,i.e it conducts in both direction ,In order to achieve this characteristics two SCRs are connected in reverse and parallel.

23.Compare SCR with TRIAC.

S.No	SCR	TRIAC
1	It is a unidirectional device	It is a bidirectional device
2	It is triggered by a narrow positive pulse applied at the gate.	It is triggered by a narrow pulse of the either polarity to the gate.
3	SCR are available only with large current rating.	Triac are available for both lower current and large current rating.
4	It has fast turn off	The turn off time is less than SCR
5	UJT is used for triggering	Diac is used for triggering
6	Applications: Phase control, Protection of power suppliers	Applications: Phase control, light dimmer

24.What is TRIAC ?

TRIAC is a three terminal bi-directional semiconductor switching device. It can conduct in both the directions for any desired period.In operation it is equivalent to two SCRs connected in antiparallel .

25.Give the applications of UJT.

(i) It is used in timing circuits

(ii)It is used in switching circuits.

(iii) It is used in phase control circuits.

(iv) It is used in saw –tooth generators.

(v)It is used in pulse generation.

26.Define dark current of a photo diode .

When there is no light ,the reverse biased photodiode carriers a current which is very small and is called as dark current.

27.What is photodiode ?

It is a light sensitive device used to convert light signal into electrical signal.

28.What is mean by solar cell ?

A solar cell is basically a PN junction diode which converts solar energy into electric energy.it is also called a solar energy converter.

29.What is Photo voltaic effect?

When the light is incident on the photodiode ,an internal voltage is generated,it causes the current flow through internal circuit even though no external source is applied.this generated emf is proportional to the frequency and the intensity of the incident light.This phenomenon is called photo voltaic effect.

30.What is known as photo conductive effect?

This is the absorption of incident light by an semiconductor resulting in increase in conductivity.

31.What is an LCD ?

LCD is a passive type display devices used for display of numeric and alphanumeric character in dotmatrix and seven segment display.The main advantage of LCDis the low power consumption because no light generation is required .

32.On what factor does the color of the light emitted by a LED depend ?

(i) Energy gap of the material

(ii) The colour of the emitted light depends on the type of the material used.

33. Explain the Advantages of LED?

The various advantages of LED are.

(i) LED are small in size , and hence can be regarded as point source of light . because of their small size , several thousand of LEDs can be packed in one sq . metre area
(ii)The brightness of light emitted by LED depends on the current flowing through LED.hence the brightness of light can be smoothly controlled by varying the current. This makes possible to operate LED displays under different ambient lighting conditions .
(iii)LED s are faster operating devices . they can be turned on and off in less than 1 micro second.
(iv)The LEDs are light in weight.
(v)The LEds are available in various colours.
(vi)LEDs have long life.
(vii)The LEDs are cheap and readialy available .
(viii)The LEds are easy to interface with various other electronic circuits .

34. Explain the Disadvantages of LED ?

a. It draws considerable current requiring frequent replacement of battery in low power battery operated devices.
b. Luminous efficiency of LEDs is low which is about 1.5 lumen/watt.
c. The characteristics are affected by temperature
d. Need large power for the operation compared to normal p-n junction.

35. Write an application of LED?

a. All kind of visual display. In seven segment displays and alpha numeric displays. Such displays are commonly used in watches and calculators.
b. In the optical devices such as optocouplers .
c. As ON-OFF indicator in various types of electronic circuits.
d. LEDs useful in remote controls.