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SFI GEC PALAKKAD

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Pages:4

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2019

Course Code: EST 130

Course Name: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

PART I: BASIC ELECTRICAL ENGINEERING

(2019-Scheme)

Max. Marks:50 Duration: 90 min

PART A

Answer all questions, each carries 4 marks.

1 Define the terms i) mmf ii) magnetic field strength iii) magnetic flux and iv) magnetic flux density.

2 State and explain i) Faraday's laws and ii) Lenz's law.

3 State and explain Kirchhoff's laws with examples

4 Explain the advantage of three phase system of power supply compared to single phase system of power supply.

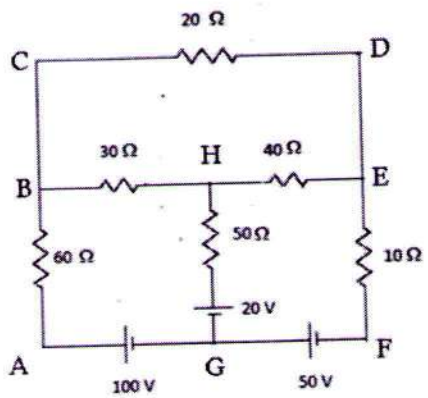
5 When an alternating voltage of (80+j60) V is applied to a circuit, the resulting current flow is (-4+j10)A. Find the impedance, power consumed and the phase angle of the circuit. (5x4=20)

PART B

Answer one full question from each module, each question carries 10 marks

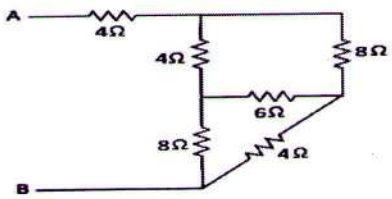
Module-I

6 Calculate the current in each branch of the following circuit using mesh analysis? (10)



OR

7 Using star-delta transformation, determine the equivalent resistance R_{AB} (10)



Module-II

8 An alternating current varying sinusoidally with a frequency of 50Hz has an rms value of 20A.

i)Write down the equation for the instantaneous current

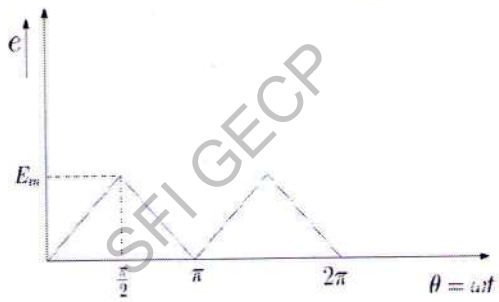
ii) Find the instantaneous value of current at 0.0025s.

iii)Find the instantaneous value of current 0.125s after passing through a positive maximum value (10)

iv) At what time, measured from a positive maximum value, will the instantaneous current be 14.14 A?

OR

9 Determine the average and rms values of the triangular voltage wave having maximum value E_m volt as shown in figure. (10)



Module-III

10 Two impedances Z_1 and Z_2 when connected separately across a 220V, 50 Hz supply, consume 300W and 150W at a power factor of 0.4 lagging and 0.7 leading respectively. When the two impedances are connected in series across the same supply, find total power consumed and overall power factor. (10)

OR

11 A balanced three phase load has per phase impedance of (30+j50) Ω. If the load is connected across 400V, 3 phase supply, find (i) phase current (ii) line current and (iii) power supplied to load when it is connected in (a) star (b) delta. (10)

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FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2019

Course Code: EST 130

Course Name: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

PART II: BASIC ELECTRONICS ENGINEERING

(2019-Scheme)

Max. Marks: 50 Duration: 90 min

PART A

Answer all questions, each carries 4 marks.

1 What are the different types of capacitors? Give any two applications of capacitors.

2 Describe the forward characteristics of a diode?

3 Draw the block diagram of a public address system and write the role of each block.

4 Explain the working of a bridge rectifier.

5 Explain the concept of cells in cellular communication. (5x4=20)

PART B

Answer one full question from each module, each question carries 10 marks

Module-IV

6 a) Explain the formation of potential barrier in a PN junction diode. (4)

b) What do you understand by Avalanche breakdown? Draw and explain the reverse V-I characteristics of a diode. (6)

OR

7 Explain the working of an NPN transistor. Describe with suitable sketches the input and output characteristics of an NPN transistor. (10)

Module-V

8 a) Draw the circuit diagram of an RC coupled amplifier and explain its frequency response. (6)

b) Narrate how capacitor filter eliminate ripples from the output of a rectifier. (4)

OR

9 a) What is the need of biasing? Draw the potential divider biasing circuit? (4)

b) Explain the working of a simple zener voltage regulator. (6)

Module-VI

10 a) What are the merits of AM compared to FM. The carrier amplitude of a given AM wave is 5V and the message signal amplitude is 3V. Find the modulation index. (5)

b) Explain the block diagram of a super heterodyne receiver. (5)

OR

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11 a) Describe the principle of an antenna. (3)

b) With necessary block diagram explain the working of a GSM system (7)

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EST 130
BASICS OF ELECTRICAL AND ELECTRONICS
(2019 - scheme) - DECEMBER, 2019.

PART - A

1. i) mmf : Magnetomotive force (mmf) is the property of a material to give rise to the magnetic field. Also defined as the work done in moving the unit magnetic pole once around the magnetic circuit.

ii) magnetic field strength : It is the part of magnetic field in a material that arises from external current and is not intrinsic to material itself. Expressed in amperes per metre

iii) Magnetic flux : It is the measurement of total magnetic field which passes through a given area.

iv) Magnetic flux density : It is defined as the force acting per unit current per unit length on a wire placed at right angles to magnetic field.

2. i) Faraday's Law :

1st law

Whenever a conductor or is placed in a varying magnetic field, an emf is induced in it and if its closed an induced current is also induced in it.

2nd law

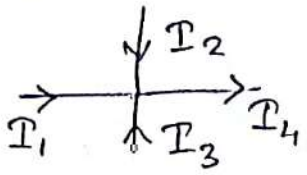
The magnitude of the induced emf in a closed circuit is directly proportional to the rate of change of magnetic flux linked with the circuit. $e = -\frac{d\phi}{dt}$

ii) Lenz's law.

It states that the direction of an induced current is always such as to oppose the change producing it.

3. Kirchoff's Current Law.

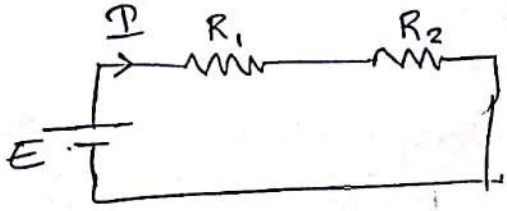
The algebraic sum of all currents entering and exiting a node must be equal to zero.



$$I_1 + I_2 + I_3 = I_4$$

Kirchoff's voltage law.

The algebraic sum of voltages around a closed loop is zero.



$$E - IR_1 - IR_2 = 0$$

$$\Sigma V = 0.$$

4. Three phase power supply advantages

- It can transmit more power compared to single phase system.
- The efficiency of three phase operated machines are higher.
- Three phase induction motors have higher power factor and efficiency than that of single phase.
- Power to weight ratio of 3ϕ alternator is high compared to 1ϕ.

5. $V = (80 + j60)\ V = 100 \angle 36.86$

$I = (-4 + j10)\ A = 10.77 \angle 111.8$.

i) Impedance, $Z = \frac{V}{I} = \frac{100 \angle 36.86}{10.77 \angle 111.8} = 9.28 \angle -74.9$

$= 2.41 - 8.96i$

ii) Power consumed, $P = I^2R = (10.77)^2 \times 2.41$

$= 280.8\ W$

iii) Phase angle b/w voltage and current $= 111.8 - 36.86$

$= 74.9$

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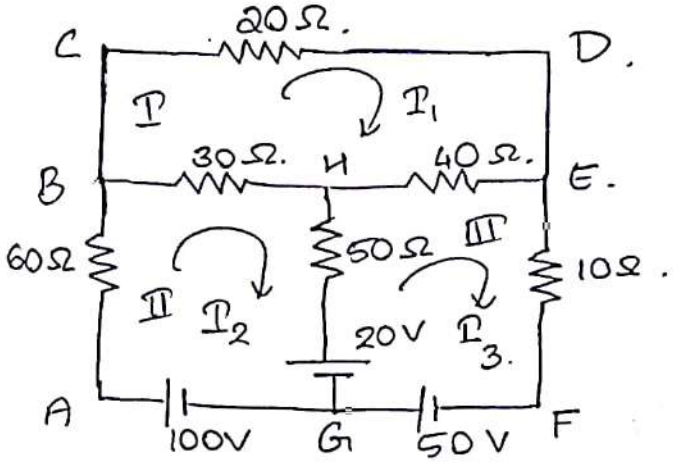


Assume currents I_1, I_2, I_3 flowing in each mesh.

Applying KVL in I mesh,

$$-20I_1 - 40(I_1 - I_3) - 30(I_1 - I_2) = 0$$

$$-90I_1 + 30I_2 + 40I_3 = 0 \quad \text{— (1)}$$

II mesh,

$$100 - 60I_2 - 30(I_2 - I_1) - 50(I_2 - I_3) - 20 = 0$$

$$30I_1 - 140I_2 + 50I_3 = -80 \quad \text{— (2)}$$

III mesh,

$$20 - 50(I_3 - I_2) - 40(I_3 - I_1) - 10I_3 + 50 = 0$$

$$40I_1 + 50I_2 - 100I_3 = -70 \quad \text{— (3)}$$

Solving (1), (2) & (3)

$I_1 = 1.49\,A \quad I_2 = 1.65\,A \quad I_3 = 2.12\,A$

Branch currents.

$CD = I_1 = 1.49\,A$.

$BH = I_2 - I_1 = 0.16\,A$.

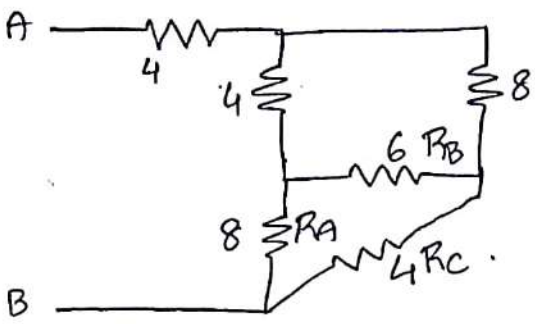
$HE = I_3 - I_1 = 0.63\,A$.

$HG = I_3 - I_2 = 0.47\,A$

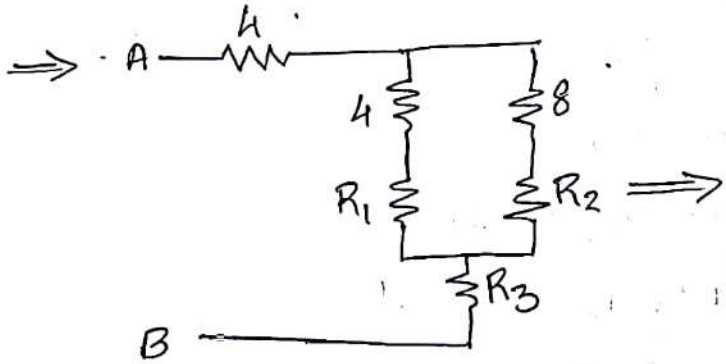
$AG = I_2 = AB = 1.65\,A$

$GF = EF = I_3 = 2.12\,A$

7.



Applying star delta transformation



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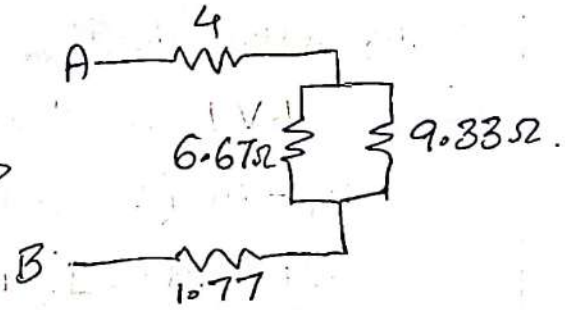

$R_1 = \frac{R_A R_B}{R_1+R_2+R_3}$ $\quad R_2 = \frac{R_B R_C}{R_1+R_2+R_3}$ $\quad R_3 = \frac{R_A R_C}{R_1+R_2+R_3}$

$= \frac{8\times6}{18} = 2.667\Omega$ $\quad = \frac{24}{18} = \frac{4}{3} = 1.33\Omega$ $\quad = \frac{32}{18} = 1.77\Omega$.

Equivalent resistance, $R_{AB} = 4 + 1.77 + \left(\frac{6.67\times9.33}{6.67+9.33}\right)$

$= 5.77 + 3.89$

$= 9.66\Omega$.

8. $I_{rms} = 20A$ $\quad 2\nu = 50Hz$.

$I_m = \sqrt{2}\times I_{rms}$ $\quad \omega = 2\pi 2\nu$.

$= 20\sqrt{2}\ A$ $\quad = 100\pi\ rad/s$

i) Instantaneous current $I_0 = I_m \sin\omega t$.

$I_0 = 20\sqrt{2}\sin 100\pi t$.

ii) Inst. current at 0.0025.

$I_0 = 20\sqrt{2}\sin 100\times180\times0.0025$ ~~degree~~ (in degree)

$= 20\ A$

iii) When $t = 0.125$ s.

$I_0 = 20\sqrt{2} \sin 100 \times 180 \times 0.125$

$= 28.28$ A (Since it has passed through a max value)

iv) When $I_0 = 14.14$.

$14.14 = 20\sqrt{2} \sin 100 \times 180 \times t$.

$\sin(100 \times 180 \times t) = \frac{10\sqrt{2}}{20\sqrt{2}}$.

$100 \times 180 \times t = \sin^{-1}\left(\frac{1}{2}\right)$

$= 30$.

$t = \frac{30}{100 \times 180} = \frac{1}{600}$ sec

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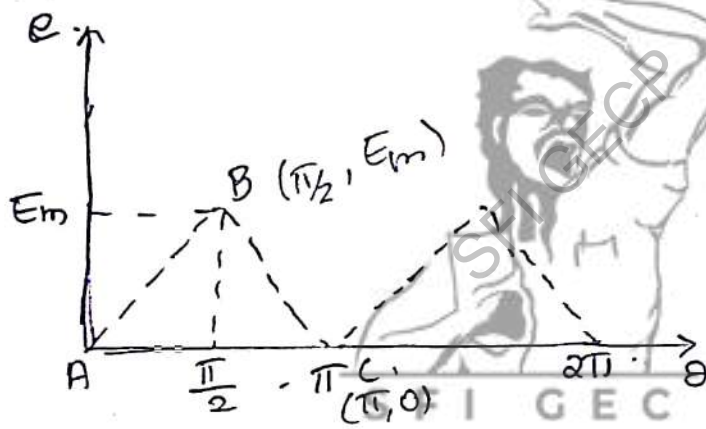
9.



$V_{avg} = \frac{\text{Area under the curve}}{\text{Time period}} = \frac{\frac{1}{2} \times \pi \times E_m}{\pi}$.

$= \frac{E_m}{2}$

$V_{rms} = \frac{1}{T} \int_0^T v(t)^2 dt$.

Eqn of AB $= \frac{y}{E_m} = \frac{x}{\pi/2}$. $\frac{\pi}{2} y = E_m$

$y = \frac{2E_m}{\pi} \cdot x$.

Eqn of BC $= \frac{y - E_m}{E_m} = \frac{x - \frac{\pi}{2}}{\pi/2}$.

10. Inductive impedance consumes 300W at 0.4 lagging p.f.

$V_1 I_1 \cos\phi_1 = 300$ . .

$220 \times I_1 \times 0.4 = 300$

$I_1 = \frac{300}{220 \times 4} = 3.26A$ 3.4 A

Power, $= 300 = I_1^2 R_1 = 3.26^2 \times R_1$

$R_1 = \frac{300}{3.26^2} = 25.95\Omega$

Impedance $= \frac{220}{3.4} = 64.7\Omega$

$X_L = \sqrt{Z_1^2 - R_1^2} = 59.26\Omega$.

Capacitive impedance consumes 150W at 0.7 leading p.f.

$V_2 I_2 \cos\phi_2 = 150$.

$220 \times I_2 \times 0.7 = 150$

$I_2 = 0.97A$

Power, $= I_1^2 R_2 = 150 = 0.97^2 \times R_2$

$R_2 = \frac{150}{0.97^2} = 159.4\Omega$.

Impedance, $= \frac{220}{0.97} = 226.804$

$X_C = \sqrt{Z_2^2 - R_2^2} = \sqrt{226.8^2 - 159.4^2} = 161.84\Omega$.

When both are connected in series,

Total impedance $= \sqrt{R^2 + X^2} = \sqrt{(25.95 + 159.4)^2 + (59.26 - 161.34)^2}$

$= 211.811$

$I = \frac{220}{211.811} = 1.03A$

i) Total power consumed $= I^2 R = (1.03)^2 \times (25.95 + 159.4)$

$= 196.63W$

ii) Power factor, $\cos\phi = \frac{X_L - X_C}{R} = 0.55$ (leading)

$\cos\phi = \frac{R}{Z} = 0.875$

11. a) Star connected

$V_L = 400\,V$. $\quad Z = \sqrt{30^2+50^2} = 58.31$

$V_{Ph} = \frac{V_L}{\sqrt{3}} = \frac{400}{\sqrt{3}} = 231\,V$

i) Phase current, $I_{Ph} = \frac{V_{Ph}}{Z} = 3.96\,A$

ii) Line current, $I_L = I_{Ph} = 3.96\,A$

iii) Power factor, $\cos\phi = \frac{R}{Z} = \frac{30}{58.31}$

$= 0.5144$

Power $= \sqrt{3}\,V_L I_L \cos\phi$

$= \sqrt{3} \times 400 \times 3.96 \times 0.5144$

$= 1.411\,KW$

b) Delta connected

$V_{Ph} = V_L = 400\,V$.

i) Phase current $= \frac{V_{Ph}}{Z} = \frac{400}{58.31} = 6.85\,A$.

ii) Line current $I_L = \sqrt{3}\,I_{Ph} = \sqrt{3} \times 6.85$

$= 11.88\,A$.

iii) Power $= \sqrt{3} \times V_L \times I_L \times \cos\phi$

$= \sqrt{3} \times 400 \times 11.88 \times 0.5144$.

$= 4.233\,KW$

BASIC ELECTRONICS ENGINEERING

1. Electrolytic capacitor - They have polarity

   Mica capacitor - Mica as dielectric medium

   Ceramic Capacitor - titanium and barium as the dielectric

   Paper capacitor - Capacitor consists of two metal foils separated by strips of paper.

Capacitors are used as storage device.

Capacitors are widely used in electronic circuits to perform various tasks such as smoothing, filtering bypassing etc.

2. When a P-N junction is forward biased, the holes which repelled from the positive terminal of the source move towards the Junction. Similarly the electrons which are repelled from the negative terminal of the battery move towards the junction. Because of the ac acquired energy from the voltage source, some of the holes and electrons penetrate the depletion region and recombine themselves. This reduce the width of depletion region as well as the barrier potential As a result more majority carriers diffuse across

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The junction and hence a large current flow through the p-n junction

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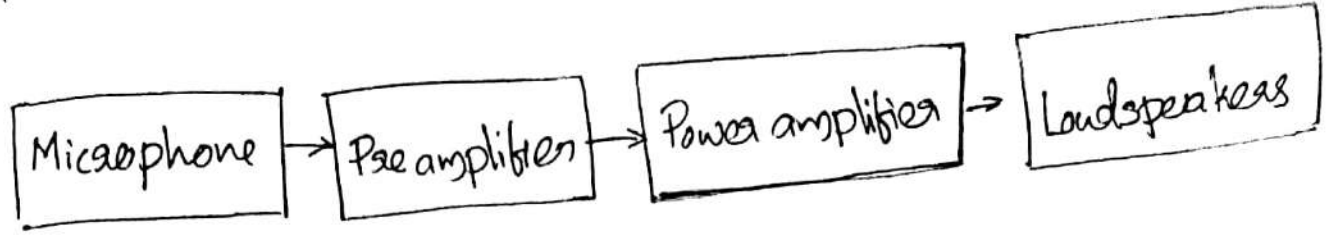


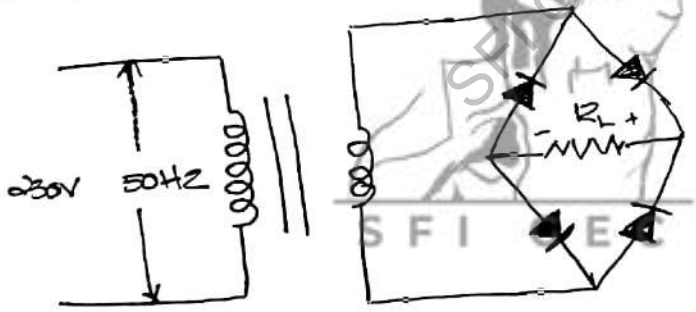
Microphone :- Sound signals convert into corresponding electrical signals.

Pre amplifier :- increase the amplitude of signal coming from microphone

Power amplifier :- power of signal is boosted by the power amplifier in order to drive the loudspeaker.

Loudspeaker :- It converts the electrical signal back into sound wave.

4)



During the positive half cycle of the input. diode D_1 and D_2 conduct and diode D_3 and D_4 do not conduct. Therefore current flows through the secondary winding. diode D_1, load resistor R_L and diode D_2 as shown in figure

During the negative half cycle diodes D_3 and D_4 conduct while D_1 and D_2 donot conduct. Hence

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current flows through the secondary winding, diode D_3, load resistor R_L and diode D_4 as indicated in figure. In both cases, current flows through the load is in the same direction. As a result, a full wave rectified voltage is developed across the load resistor R_L.

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5) The cellular concept is a system level idea which makes one use of multiple low power transmitters, each providing coverage to a small portion of the service area, thus in a cellular system an area is divided into a number of cells ~~where~~ each ~~are divided by~~ one is served by a base station.

Each cellular base station is allocated a portion of the total number of channels or frequencies available to the entire system, adjacent cells are assigned different group of channels (frequencies) to avoid interference between the base stations. cells which are sufficiently distant from each other can use the same frequency band. Each cell is represented by a hexagon. This hexagonal pattern makes adjacent antennas placed equidistant. For a cell radius R, the distance between adjacent cell centres is $d = \sqrt{3}R$

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6) Barrier Potential

When a p-material is combined ~~to form~~ with n-material to form a p-n junction holes from p-sides diffuse into n-side and electrons from n-side to p-side. They recombine with each other at the junction and the depletion region is formed across the junction. Since the depletion region contain immobile ~~region~~ ions which are electrically charged; It is also called the space-charge region. These ions create an electric field that provides a force opposing the further diffusion of charge carriers. The electric field creates potential difference across the junction which is called space charge potential or barrier potential.

(5) Avalanche Breakdown

The current through a reverse biased p-n junction is very small. If the applied reverse voltage is made too large, the increased electric field causes an increase in velocities of minority

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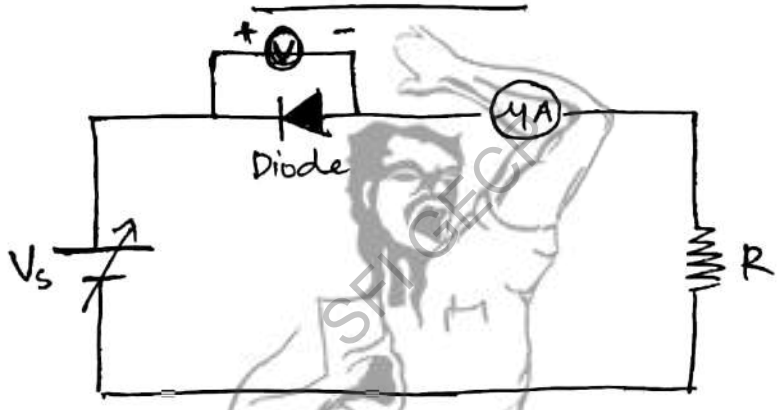
carriers. These high energy carriers break covalent bonds, thereby generating more carriers. These generated carriers are also accelerated by the electric field. They break more covalent bonds during their movement. Thus a chain reaction is established creating a large number of carriers which give rise to high reverse current. These phenomenon is called avalanche breakdown.

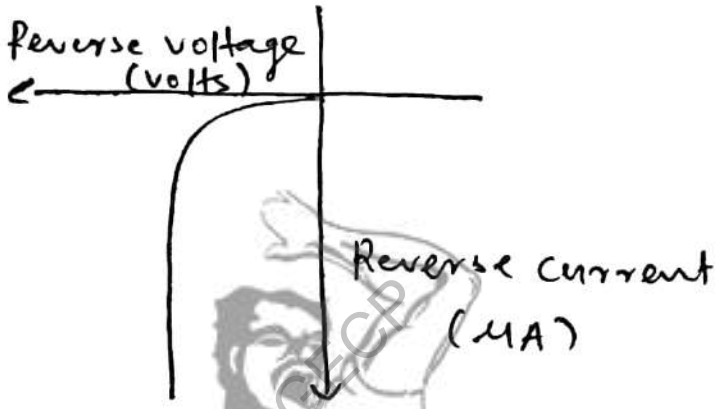
Reverse V-I characteristics



Circuit to obtain reverse Characteristics

the negative terminal of the voltage source is connected to the anode of the diode and positive terminal to the cathode to reverse bias the diode. When the reverse bias is is increased to a sufficiently large value, the diode reverse current increases rapidly as shown in the graph. The applied reverse

voltage at which sharp increase in current takes place is called break down Voltage.



Reverse characteristics of diode.

When the applied reverse voltage is below a certain voltage, the diode ~~cannot~~ current is very small and remains constant.

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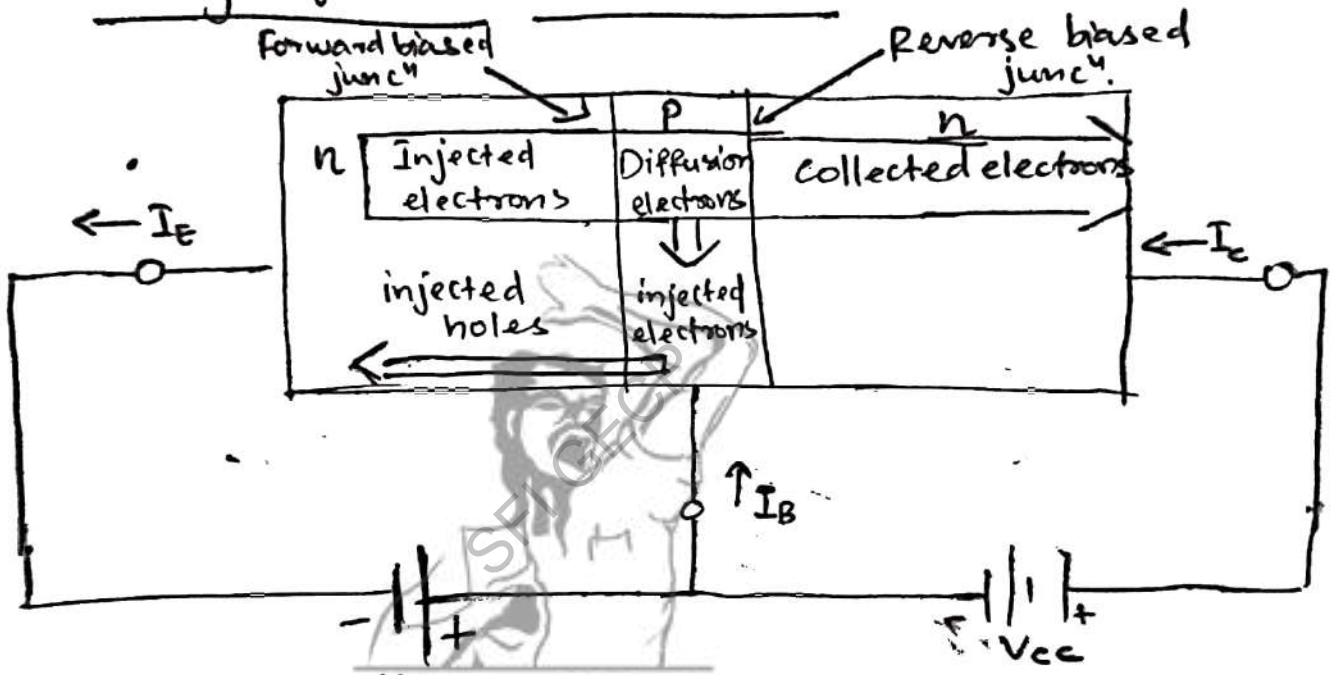
7. Working of N-P-N transistor



Bipolar junction ~~with~~ Transistor (BJT) with biasing voltage. Sources V_{EE} & V_{CC} applied. The forward

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bias on the emmitter bias junction will cause current to flow across the junction. The current consists two components, electrons injected.

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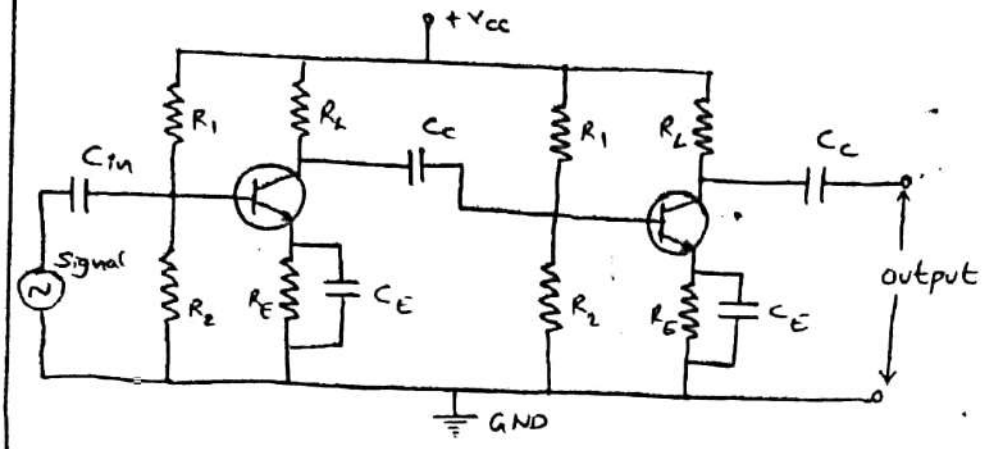
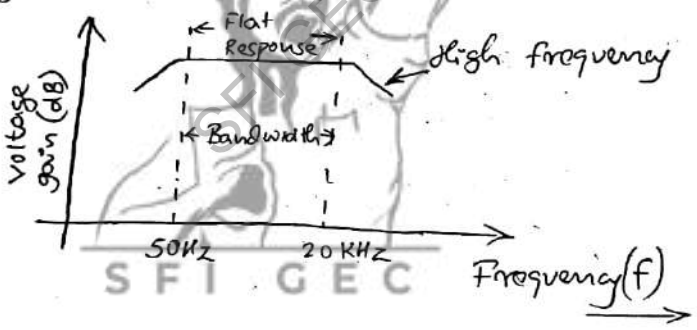
8 a) Draw the circuit diagram of RC coupled amplifier and explain its frequency response.

Soln RC coupled Amplifier.



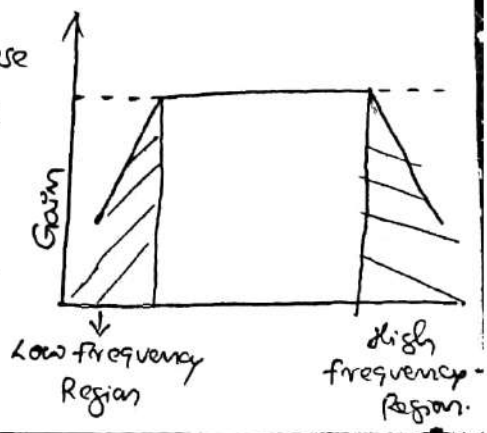
> Frequency Response of RC coupled Amplifier

Frequency response curve is a graph that indicates the relationship between voltage gain and function of frequency. The frequency response of a RC coupled amplifier is as shown in the following graph.



From the graph, it is understood that the frequency rolls off or decreases for the frequencies below 50Hz and for the frequencies above 20KHz. Whereas the voltage gain for the range of frequencies between 50Hz and 20KHz is constant.

At low frequency gain is low because the reactance of the capacitor is low at lower frequency and similarly at higher frequency the capacitor CE acts a short circuit and so again the gain is low.



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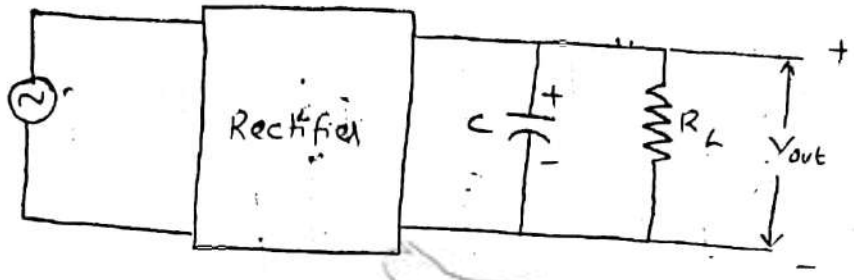
8 b) Narrate how capacitor filter eliminate ripples from the output of a rectifier.

Soln



A large value capacitor C is connected in shunt (parallel) with the load resistor R_L. The capacitor has a basic property that it opposes any change in voltage across it. When the rectifier output voltage is increasing to the maximum voltage V_m, the capacitor charges to V_m. When the rectifier output is decreased from maximum voltage V_m the capacitor starts to discharge through the load resistor R_L. Ripples can be eliminated by allowing the capacitor to discharge slowly. The value of the load resistor is taken as large as possible (according to $\tau = R_L C$). Therefore capacitor filters are suitable for light loads (load with large value of resistance)...

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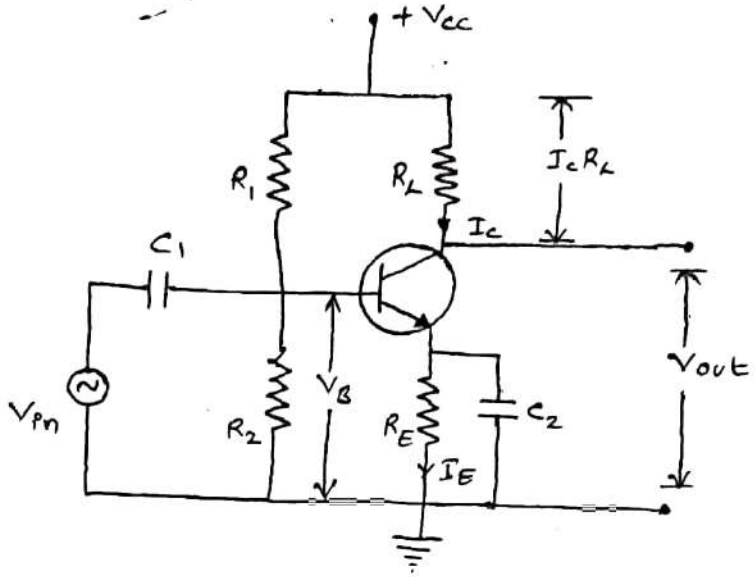
9 a) what is the need of biasing ? Draw the potential divider biasing Circuit. ?

Soln.



Need of biasing.

1.) To keep the Emitter - Base junction forward biased and Collector - Base junction reverse biased during the entire cycle of input signal.

2.) To stabilize the Q-point against the changes in temperature, variations in transistor parameters, aging of the components etc.

- First Condition will ensure the linear operation of transistor.
- Second Condition will protect the transistor from thermal runaway.

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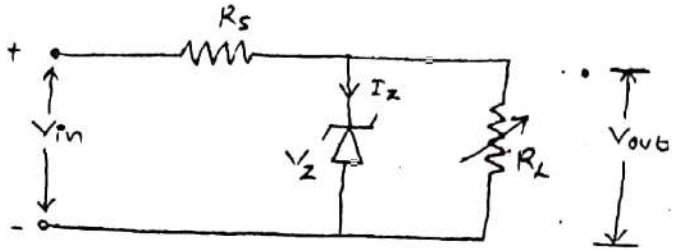
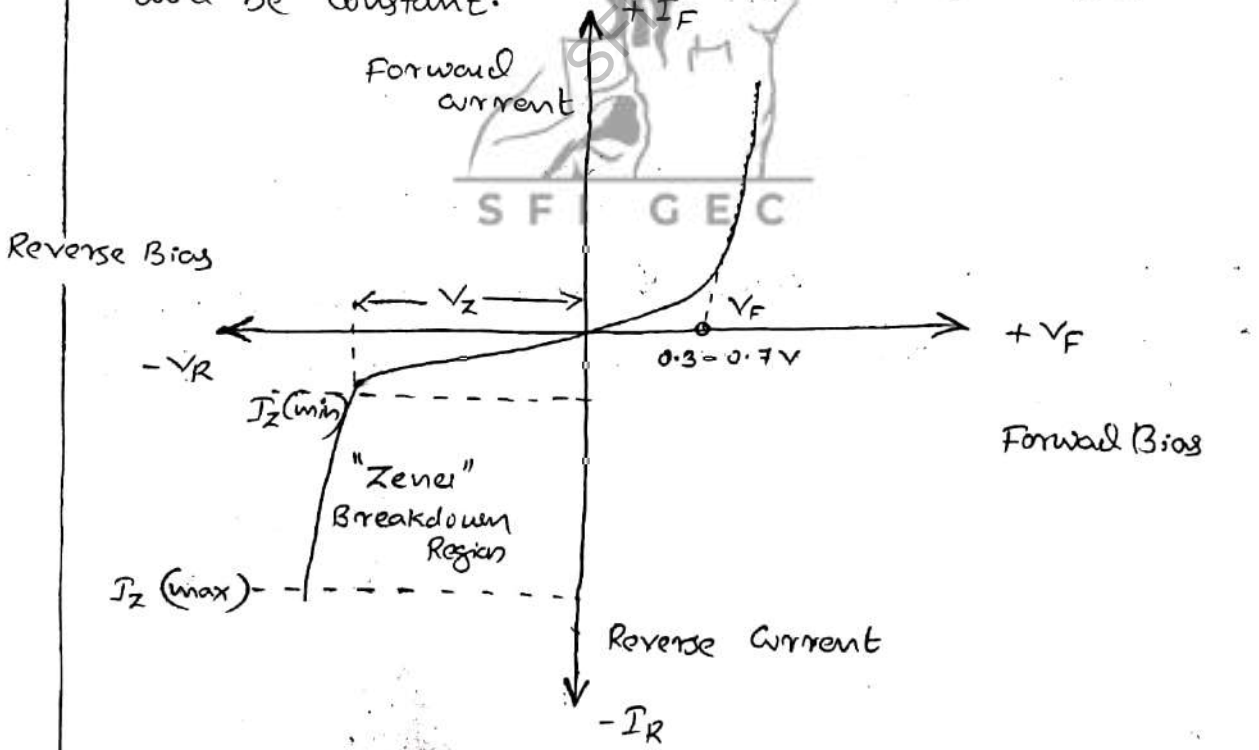
9) b) Explain the working of Simple Zener Voltage Regulator.

Soln



Zener Diodes are widely used as shunt Voltage Regulators to regulate voltage across small loads. Zener Diodes have a sharp reverse breakdown voltage and breakdown voltage will be constant for a wide range of currents. Thus we will connect a zener diode parallel to the load such that the applied voltage will reverse bias it. Thus if the b reverse bias voltage across the Zener diode exceeds the knee voltage, the voltage across the load will be constant.



Zener Diode VI - Characteristics

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10) a) What are the merits of AM compared to FM. The carrier amplitude of a given AM wave is 5V and the message signal amplitude is 3V. Find the modulation index.

b) explain the block diagram of a super heterodyne receiver.

ans) a) • AM is easy to generate and demodulate while FM is more complex transmitting and recieving equipments.

• area covered is large with less bandwidth in AM.

• AM is cheaper compared to FM.

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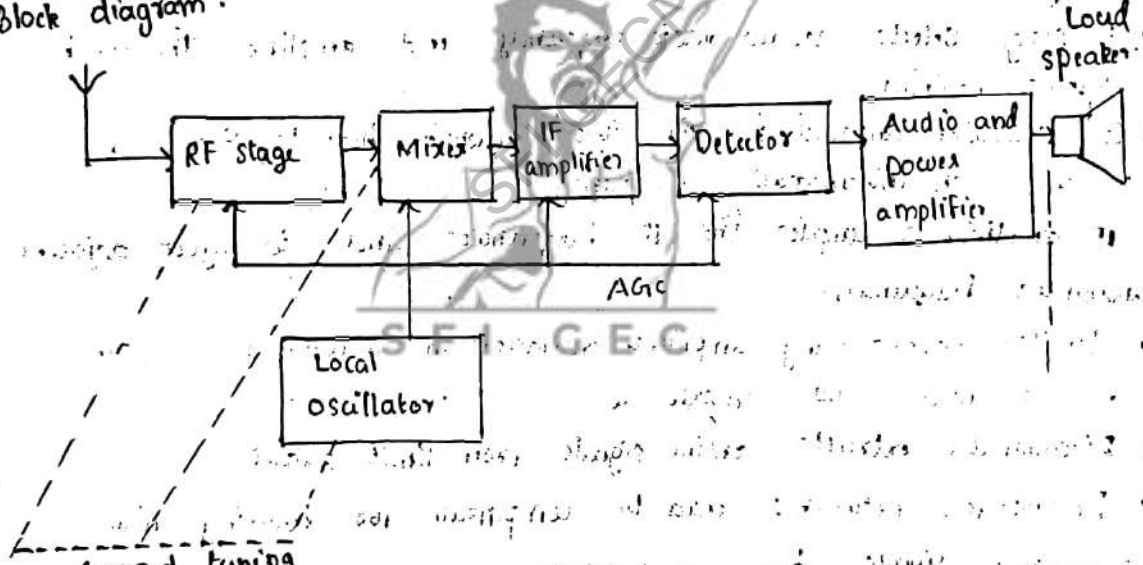
modulation index of an AM wave = $\frac{\text{message signal amplitude}}{\text{carrier amplitude}}$

$= \frac{3}{5} = 0.6$

b) AM super heterodyne radio reciever

Block diagram:



Working :- • antenna converts electrical signal to electromagnetic wave and viceversa.

• RF stage consists of a tunable circuit and an RF amplifier. It selects the desired radio frequency and amplifies the weak signals recieved. The o/p is fed to mixer. Mixer produces and Intermediate Frequency which is the difference b/w oscillator frequency and Selected radio Frequency.

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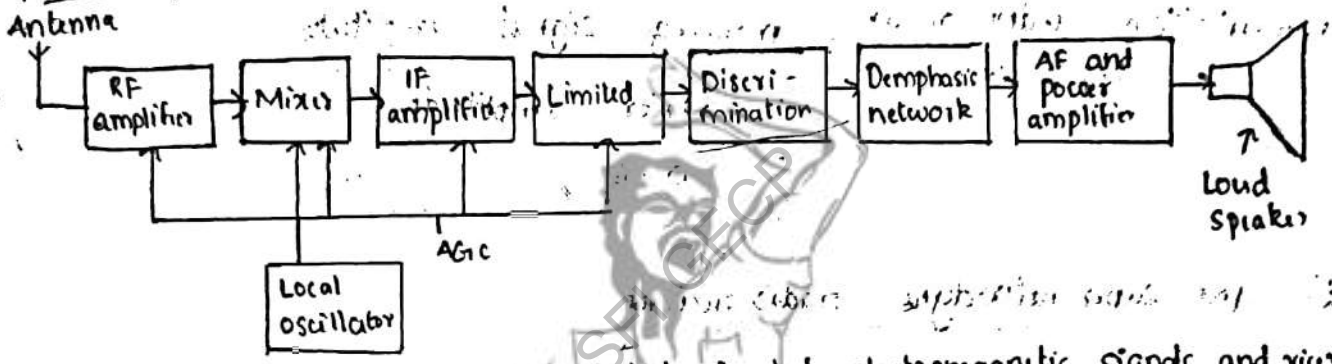
- IF amplifier : amplifies the IF signal and reject the unwanted Frequencies
- Detector : Here, the audio signal is extracted from the IF output For that a diode detector circuit is used
- Audio and power amplifiers: amplifies the detected audio signals by a series of audio and power amplifiers
- Loudspeaker : It converts audio frequency electrical signal into sound

FM Super heterodyne Reciever



working: • Antenna converts electrical signal to electromagnetic signals and viceversa
- RF stage selects desired radio frequency and amplifies the weak signals recieved.
- Local oscillator and mixer: the two frequencies beat together and produce an intermediate frequency.
- IF amplifier : amplies the IF Frequencies and to reject adjacent unwanted Frequencies.
- Limiter removes any amplitude variation in recieved FM signal due to noise and interference
- Discriminator extracts entire signals from limit output
- De-emphasis network : used to compensate for boosting high-Frequency signals before modulation.

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11) (a) Describe the principle of an antenna

(b) With necessary block diagrams explain working of a GSM systems.

(a) The working principle of an antenna is that it converts electrical currents into EM radiation in free space - or. vice versa. Therefore an antenna is used both to transmit and receive EM waves.

Fundamentally, from the Maxwell's Equations; Electromagnetic waves are generated by accelerating currents - and conductors carry those currents. The EM waves that are generated then propagate through space. We use them to communicate informations.

The way that an antenna radiates is determined by its geometry and materials. The goal of antenna design is to ensure the conversion between current and radiation occurs as effectently as possible, and that power is transmitted or received with desired characteristics.

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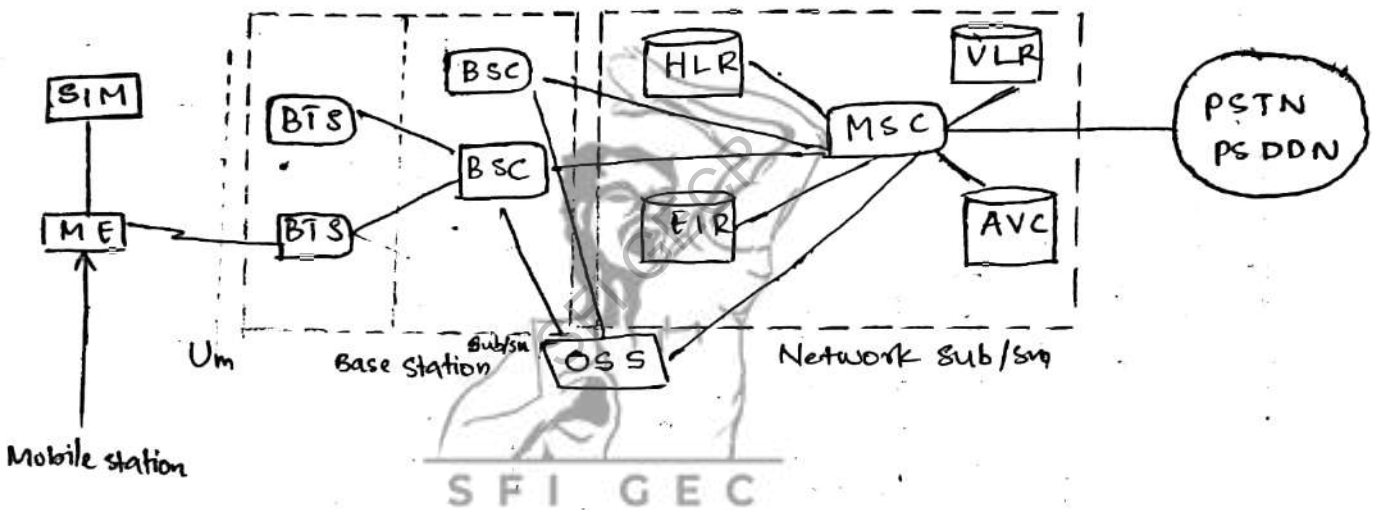
(b)



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The Mobile station (MS)

→ Consists of the physical equipment such as the mobile equipment and smart card called the SIM (Subscriber Identity Module)

→ SIM provides personal mobility, so that user can have access to all subscribed services irrespective of both the location of the terminal and the use of a specific terminal.

→ By inserting the SIM card into another GSM cellular phone, the user is able to receive calls at that phone, make calls from that phone, or receive other subscribed services.

ME + SIM = MS

→ The mobile equipment is uniquely identified by the International Mobile Equipment Identity Number.

~~→ The simcard~~

Base station Subsystem (BSS)

→ Consists of BTS (Base transceiver Station) and BSC (Base Station Controller)

Base transceiver station (BTS)

→ Handles the radio interface to Mobile station. It is the radio equipment

→ BTS encodes, encrypts, multiplexes, modulates, and feeds the RF signals to the antenna.

→ It communicates with mobile station and BSC.

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Base Station Controller

→ provides the control functions and physical links between the MSC & BTS. It provides functions such as handover, cell configuration data and control of RF power levels in BTS.

Network Switching Subsystem (NSS)

It consists the following

(a) Mobile Switching Center (MSC)

(b) Home location Registers (HLR)

(c) Visitor location Register (VLR)

(d) Authentication Center (AuC)

(e) Equipment identity register (EIR)

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