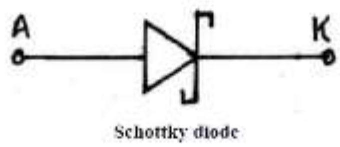
WINTER– 18 EXAMINATION

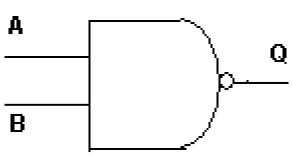
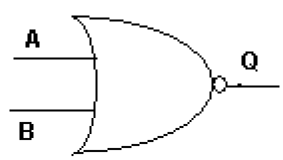
Subject Name: Basic Electronics **Model Answer** Subject Code: 17321

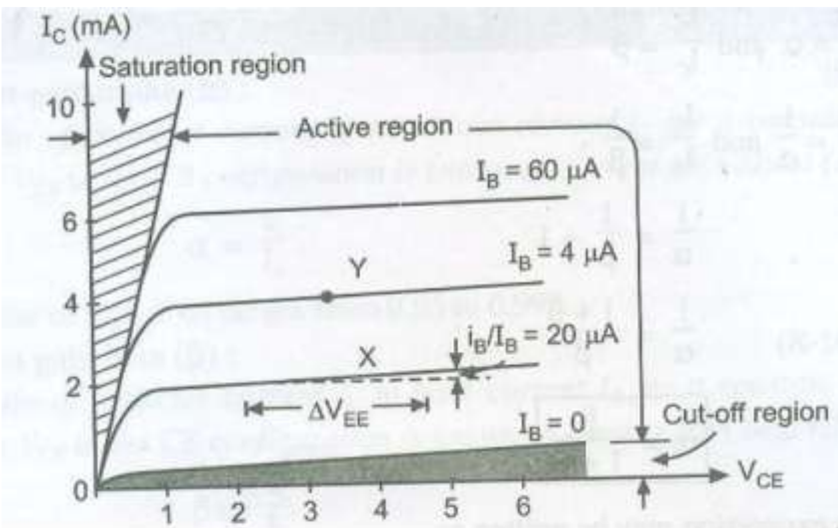
Important Instructions to examiners:

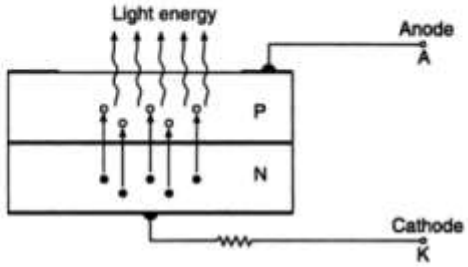
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		Attempt any TEN of the following:	20
	a)	Draw the symbols of Schottkey-diode and Varactor diode. **Schottkey-diode**  **Varactor diode**  	1 mark each
	b)	Define ripple factor and PIV of HWR Ans: **Ripple Factor:** Ripple Factor is defined as the ratio of RMS value of the AC component of output to the DC or average value of the output. **PIV:** Peak Inverse Voltage (PIV) is defined as the maximum negative voltage which appears across non-conducting reverse biased diode.	(1M Each)
	c)	State the types of filters. Ans:	(4 Types-2M)

		Types of filters: 1. Capacitor input filter (shunt capacitor filter) 2. Choke input filter (series inductor filter) 3. LC filter 4. π type filter OR CLC filter 5. RC filter.	
	d)	List various transistor biasing methods. Ans: **Types of biasing methods:** i. Base bias (or fixed bias) ii. Base bias with emitter feedback. iii. Base bias with collector feedback iv. Voltage divider bias (or self bias) v. Emitter bias.	(Any 4 Biasing Methods-2M)
	e)	Define α and β of the transistor. Ans: **α:** The ratio of collector current IC to emitter current IE for a constant collector to base voltage VCB in the CB configuration is called current gain alpha (α). **β :** The ratio of collector current IC to base current IB for a constant collector to emitter voltage VCE in the CE configuration is called current gain beta (β) .	(1M Each)
	f)	State reason BJT is called as bipolar junction transistor. Ans: BJT is called bipolar junction transistor because in BJT current conduction takes place due to majority as well as minority charge carriers.	(Correct reason-2M)
	g)	State the application of FET (any four). Ans: **Applications of FET: (Any Four)** i. It is used as a high impedance wideband amplifier. ii. It is used as a buffer amplifier. iii. It is used as an electronic switch. iv. It is used as a phase-shift oscillator.	(Four application-2M)

		v. It is used as a constant current source. vi. It is used as a voltage variable resistor (VVR) or voltage dependent resistor (VDR)	
	h)	Define line regulation and load regulation. Ans: **Line regulation**: The line regulation rating of a voltage regulator indicates the change in output voltage that will occur per unit change in the input voltage. **Load Regulation:** The load regulation indicates the change in output voltage that will occur per unit change in load current.	(1M Each)
	i)	State the Barkhausen criteria of oscillations. Ans: **Barkhausen's criteria:** 1. Loop gain (β.Av) should be $\geq$ 1. 2. Phase shift between the input and output signal must be equal to 360^0 or 0^0.	(Correct Statement-2M)
	j)	Sketch symbol of NAND gate and NOR gate. Ans:  NAND  NOR	(1M Each)
	k)	Convert: i) $(AFB2)_{16}=(?)_{10}$ ii) $(43)_8=(?)_2$ Ans: i)$(AFB2)_{16}=(?)_{10}$ $= (10*16^3+15*16^2+11*16^1+2*16^0)_1$ $= (44978)_{10}$ ii) $(43)_8=(?)$ $= (101\ 011)_2$	(1M Each)

	l)	Give the different types of amplifier coupling. Ans: 1. Resistance – capacitance (RC) coupling. 2. Inductance (LC) coupling. 3. Transformer coupling (TC) 4. Direct coupling (D.C.)	(4 Types-2M)
	m)	Sketch output characteristics of CE configuration. Show all the regions. Ans:  Output characteristics of CE configuration	(Correct Sketch-2M)
	n)	State the need of biasing of BJT. Ans: **Need of biasing:** • The basic need of transistor biasing is to keep the base-emitter (B-E) junction properly forward biased and the collector-emitter (C-E) junction properly reverse biased during the application of A.C. signal. • This type of transistor biasing is necessary for normal and proper operation of transistor to be used for amplification.	(Correct need-2M)
2	 a)	Attempt any FOUR of the following: Describe working principle of LED with diagram. Ans: **Diagram:**	16 (Diagram-2M, Working principle-2M)



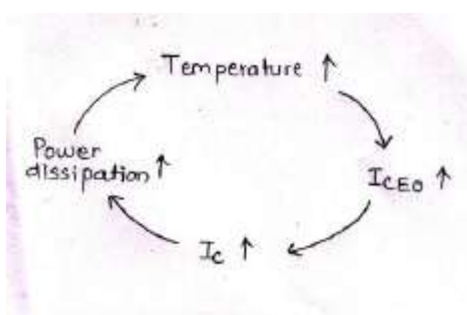
Working:

A PN junction diode, which emits light when forward biased, is known as a Light Emitting Diode (LED). The emitted light may be visible or invisible. The amount of light output is directly proportional to the forward current. Thus, higher the forward current, higher is the light output.

When the LED is forward biased, the electrons and holes move towards the junction and the recombination takes place. After recombination, the electrons, lying in the conduction bands of N region, fall into the holes lying in the valence band of a P region. The difference of energy between the conduction band and valence band of a P region is radiated in the form of light energy. The semiconducting materials used for manufacturing of Light Emitting Diodes are Gallium Phosphide and gallium Arsenide Phosphide. These materials decide the colour of the light emitted by the diode.

b) Describe thermal runaway of transistor and explain how it can be avoided. (Description-2M, How it avoided-2M)

Ans: **Thermal Runaway**



- The reverse saturation current in semiconductor devices changes with temperature. The reverse saturation current approximately doubles for every 100 c rise in temperature.
- As the leakage current of transistor increases, collector current (Ic) increases
- The increase in power dissipation at collector base junction.
- This in turn increases the collector base junction causing the collector current to further increase.
- This process becomes cumulative. & it is possible that the ratings of the transistor are exceeded. If it happens, the device gets burnt out. This process is known as 'Thermal

Runaway'.

Thermal runaway can be avoided by

1) Using stabilization circuitry

2) Heat sink

c) Compare half wave rectifier and full wave rectifier on the basis of: i) No. of diode ii) PIV iii) Ripple factor iv) Type of transformer used

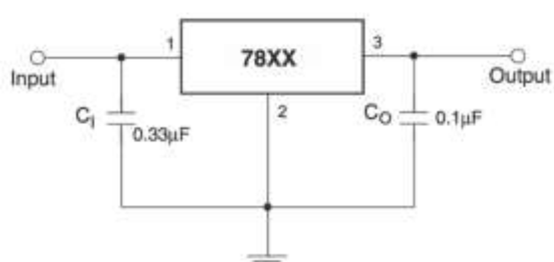
Ans: (1M Each)

Rectifier Parameters	Half-wave Rectifier	Full wave Centre tap Rectifier	Full wave Bridge Rectifier
No. of diode	1	2	4
PIV	Vm	2 Vm	Vm
Ripple factor	1.21	0.482	0.482
Type of transformer used	step up or step down transformers	Centre tap step up or step down transformers	step up or step down transformers

d) Describe the functional pin diagram of regulator IC 78XX and 79XX.

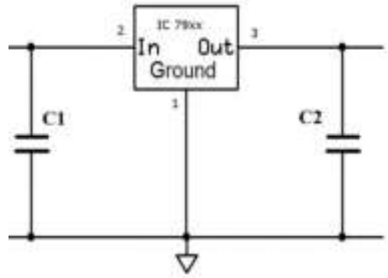
(2M Each -1 mks diagram,. 1mks explanation)

Ans: **IC 78XX:**



Explanation: 78XX series of IC regulators is representative of three terminal devices that are available with several fixed positive output voltages. It has three terminals labeled as input, output and ground. The last two digits (mark XX) in the part no. designate the input voltage. Above fig. shows a standard configuration of a fixed positive voltage IC regulator of 78XX series. The capacitor C1 is required only if the power supply filter is located more than three inches from the IC regulator. The capacitor C0 acts basically as a line filter to improve transient response.

IC 79XX:

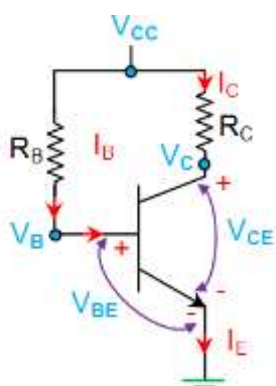


Explanation: 79xx series of voltage regulators are the commonly used negative voltage regulators. These are three terminal regulators and is available with fixed output voltages of -5V, -12V and -15V. These ICs have internal current limiting protection and thermal shut down protection to protect the ICs from overload conditions. IC 79xx is used in circuits as shown in the circuit. In order to improve stability two capacitors – C1 and C2 are used. The capacitor C1 is used only if the regulator is separated from filter capacitor by more than 3". It must be a 2.2 μF solid tantalum capacitor or 25μF aluminum electrolytic capacitor. The capacitor C2 is required for stability. Usually 1 μF solid tantalum capacitor is used. One can also use 25μF aluminum electrolytic capacitor. Values given may be increased without limit.

Usually 1 μF solid tantalum capacitor is used. One can also use 25μF aluminum electrolytic capacitor. Values given may be increased without limit.

e) Explain with circuit diagram fixed bias method of BJT. (Diagram-2M, Explanation-2M)

Ans:



Explanation: The biasing circuit shown by Figure has a base resistor R_B connected between the base and the V_{CC}. Here the base-emitter junction of the transistor is forward biased by the voltage drop across R_B which is the result of I_B flowing through it. From the figure, the mathematical expression for I_B is obtained as

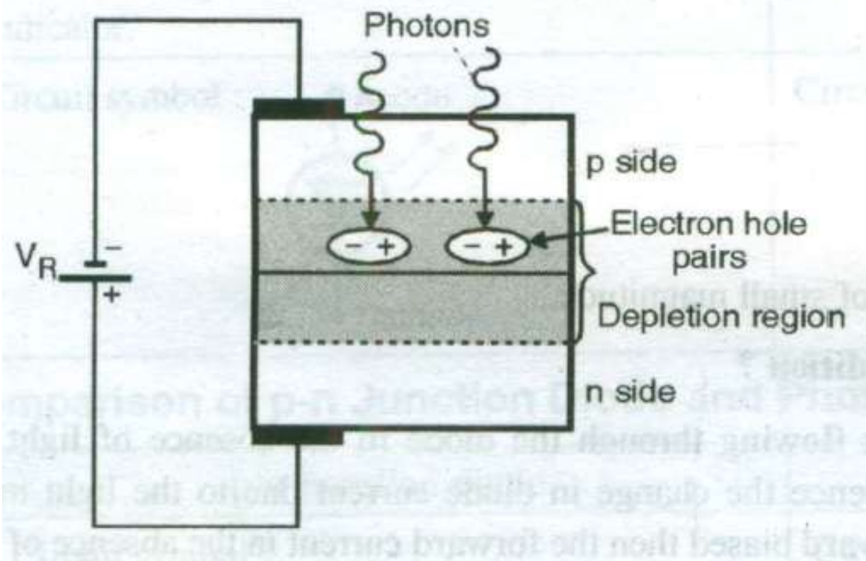
$$I_B = \frac{V_{CC} - V_{BE}}{R_B}$$

Here the values of V_{CC} and V_{BE} are fixed while the value for RB is constant once the circuit is designed. This leads to a constant value for I_B resulting in a fixed operating point due to which the circuit is named as fixed base bias. This kind of bias, results in a stability factor of (β+1) which leads to very poor thermal stability. The reason behind this is the fact the β-parameter of a transistor is unpredictable and varies up to a large extent even in the case of transistor with the same model and type. This variation in β results in large changes in I_C which cannot be compensated by any means in the proposed design. Hence it can be concluded that this kind

		of β dependent bias is prone to the changes in operating point brought about by the variations in transistor characteristics and temperature. However it is to be noted that fixed base bias is most simple and uses less number of components. Moreover it offers the chance for the user to change the operating point anywhere in the active region just by changing the value of R_B in the design. Further it offers no load on the source as there is no resistor across base-emitter junction. Due to these factors this kind of biasing is used in switching applications and to achieve automatic gain control in the transistors. Here, the expressions for other voltages and currents are given as $$V_B = V_{BE} = V_{CC} - I_B R_B$$ $$V_C = V_{CC} - I_C R_C = V_{CC} - V_{CE}$$ $$I_C = \beta I_B$$ $$I_E \approx I_C$$	
	f)	State advantages and disadvantages of positive and negative feedback related to oscillator. Ans:	(2M Each)

	Positive feedback	Negative feedback
Advantages	Voltage gain increases -1 mks	(any 1 – 1 mks) Bandwidth increases Noise decreases Distortion decreases voltage stability is high
Disadvantages	(any 1 – 1 mks) Noise increases Distortion increases voltage stability decreases Bandwidth decreases	Voltage gain decreases- 1 mks

3		**Attempt any FOUR of the following:**	**16**
	a)	Describe operating principle of photo diode with neat diagram. Ans:	(Diagram-2M, Operating Principle-2M)



(a) Construction of a photodiode

Operating Principle:

- The photodiode is a p-n junction semiconductor diode which is always operated in the reverse biased condition.
- The light is always focused through a glass lens on the junction of the photodiode.
- As the photodiode is reverse biased, the depletion region is quite wide, penetrated on both sides of the junction, as shown in fig a.
- The photons incident on the depletion region will impart their energy to the ions present there and generate electron hole pairs
- The number of electron hole pairs will be dependent on the intensity of light (number of photons). These electrons and holes will be attracted towards the positive and negative terminals respectively of the external source, to constitute the photo current.
- With increase in the light intensity, more number of electron hole pairs are generated and the photocurrent increases.
- Thus the photocurrent is proportional to the light intensity.

	b)	Explain with circuit diagram two stage transformer coupled amplifier using transistors. Ans:-	(diagram = 2 marks, Explanation = 2 marks)

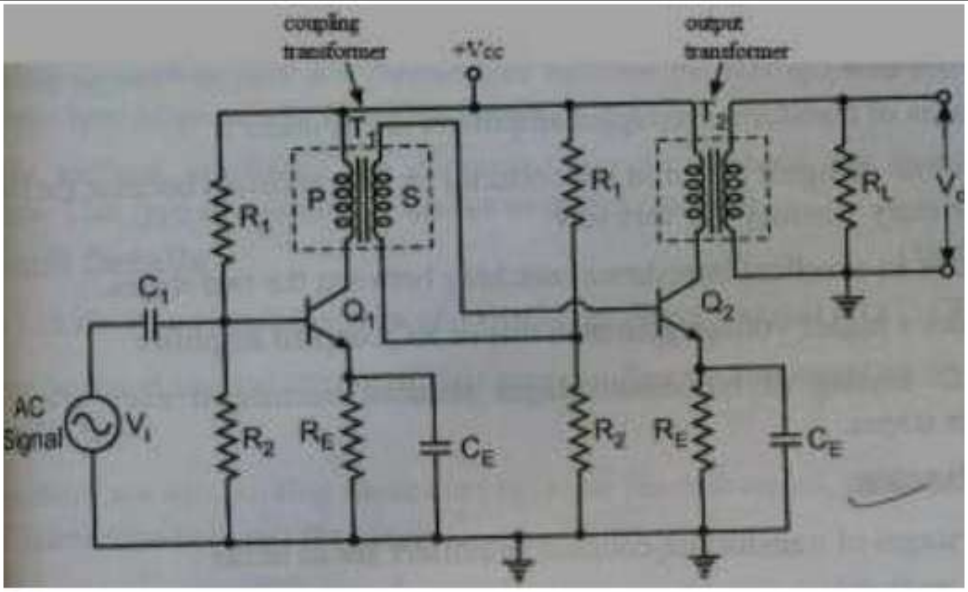


fig: two stage transformer coupled amplifier using transistors

Explanation:

- The function of a coupling transformer T1 is to couple the output AC signal from the output of the first stage to the input of the second stage,while transformer T2 couples the output of AC signal to the load RL.
- The input capacitor C1 is used to couple the input signal to the base of transistor Q1.
- The capacitor CE connected at the emitters of transistor Q1 and Q2 are used to bypass the emitter to ground.
- The resistors R1, R2, RE and a capacitor CE form the DC biasing and stabilization.
- Note that, in this circuit, there is no coupling capacitor. The DC isolation between the two stages is provided by the transformer itself.
- There exists no DC path between primary and secondary windings of a transformer.

	c)	Draw the circuit of centre tapped rectifier with LC filter, also draw input output waveforms.	Ans: (Circuit diagram-2M, Waveforms-2M)

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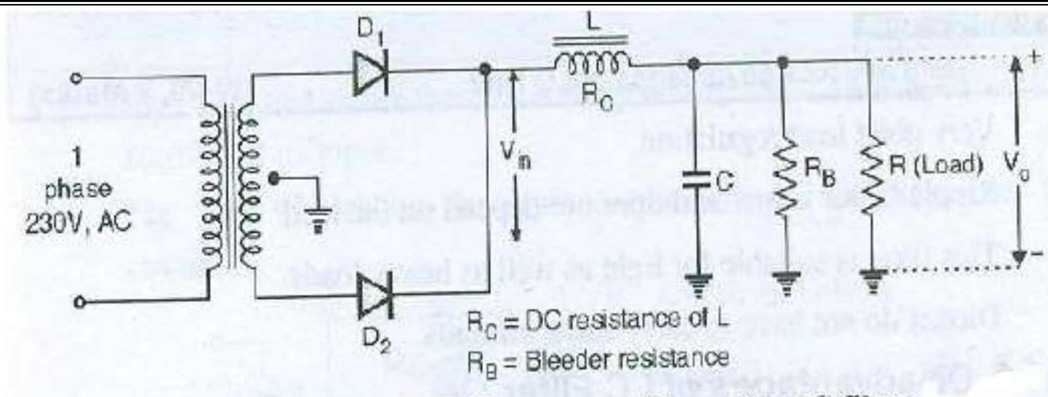
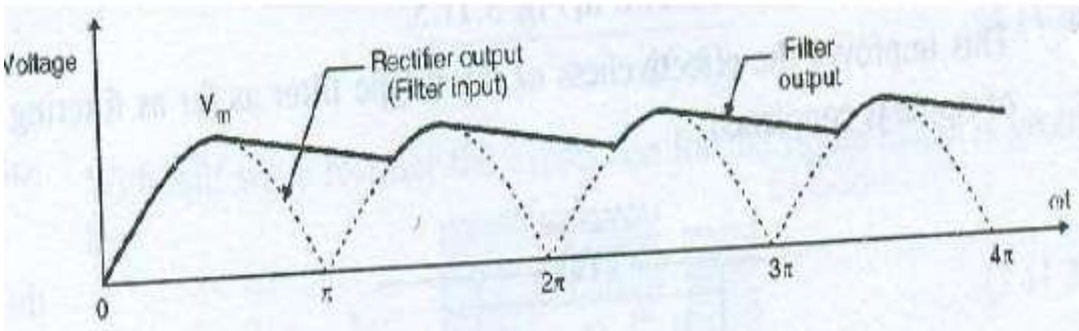


Full wave rectifier with LC filter



Input output voltage waveforms

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<tr><td></td><td>d)</td><td>

Draw V. I. characteristics of UJT and explain its working principle.

Ans:

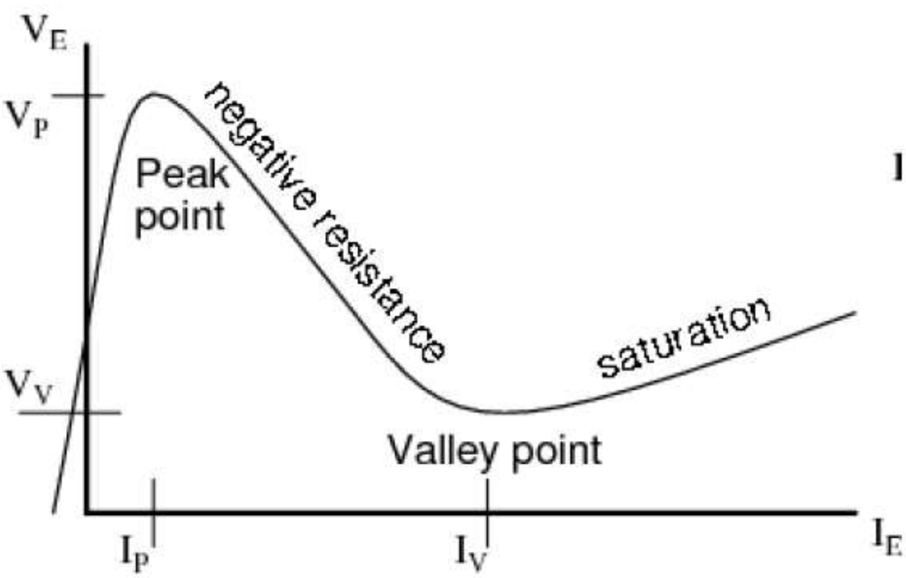

Fig: V. I. characteristics of UJT

Explanation- The VI characteristic of UJT is curve showing the relation between emitter voltage VE and emitter current IE of a UJT at a given inter base voltage VBB .

</td><td>[Characteristics -2M, working principle- 2 M]</td></tr>
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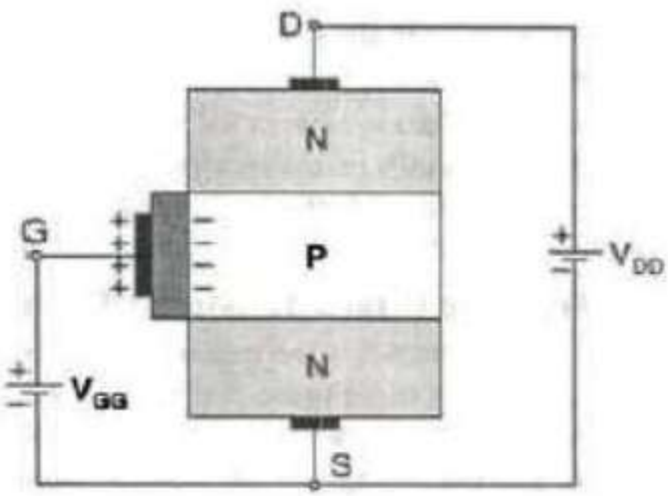
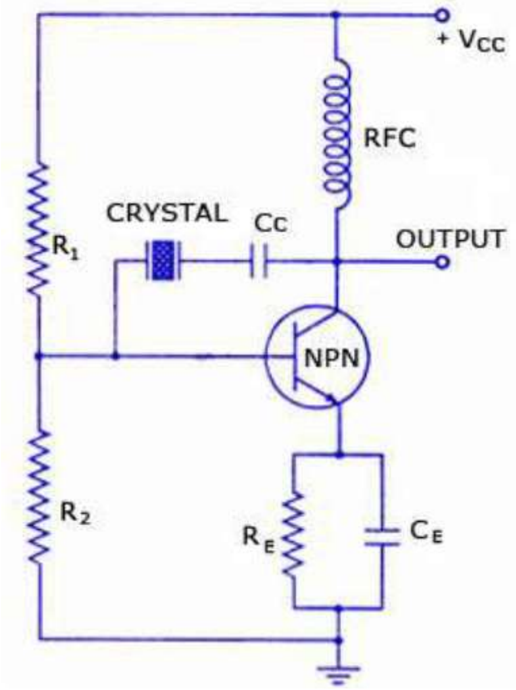
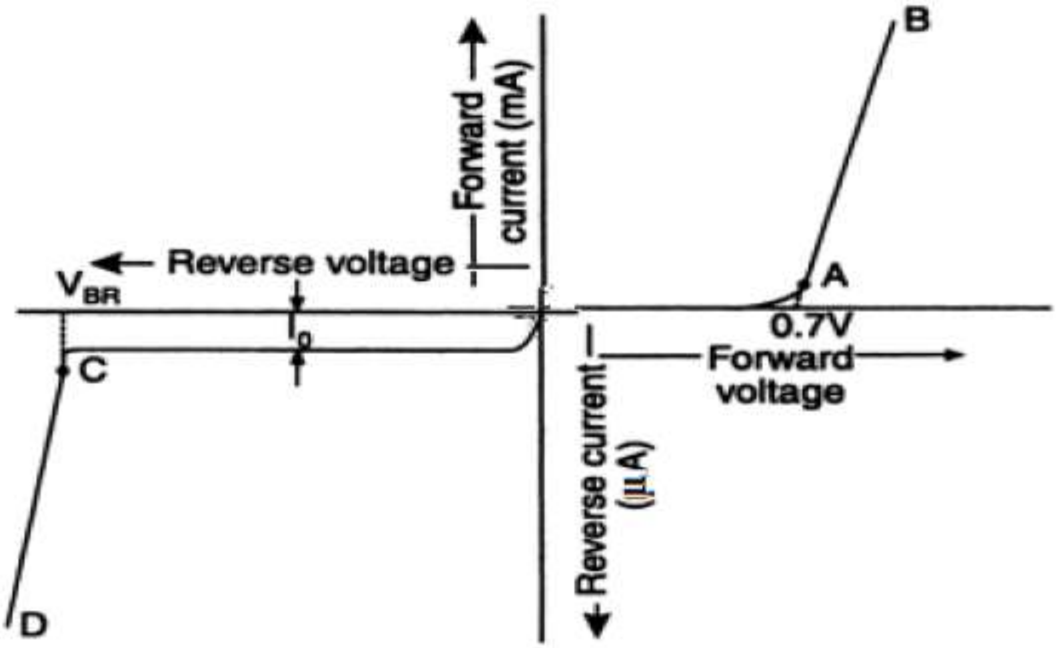
		1. From above graph it is noted that when emitter voltage less than peak point voltage a very small current flows through UJT , IEo and in this region UJT is in the cut-off region. 2. Once conduction is established at VE = VP the emitter potential VE starts decreasing with the increase in emitter current IE. This Corresponds exactly with the decrease in resistance RB for increasing current IE. Emitter voltage decreases upto valley point. 3. After valley point any further increase in emitter current IE places the device in the saturation region.	
	e)	Describe the working principle of N channel enhancement MOSFET. **Ans:**  **Working:** When V_{GS} is set at 0V and a voltage is applied between the drain and source, no current flows due to the absence of an N-channel. By keeping V_{DS} at some positive voltage and when V_{GS} is increased, the positive potential at the gate will push the holes (since like charges repel) in the P-substrate along the edge of the SiO_2 layer. The result is a depletion region near the SiO_2 insulating layer void of holes. However, the electrons in the P-substrate (the minority carriers of the material) will be attracted to the positive gate and accumulate in the region near the surface of the SiO_2 layer. This is called Inversion layer. As V_{GS} increases in magnitude, the concentration of electrons near the SiO_2 surface increases, until eventually, the induced N-type region can support a measurable flow between drain and source.	**(Diagram:2 M & Explanation :2M)**
	f)	Explain crystal oscillator with circuit diagram. Ans:	(Circuit diagram – 2M, explanation- 2 M)



Explanation- To excite a crystal for operation in the series-resonant mode it may be connected as a series element in a feedback path, the crystal impedance is the smallest and the amount of positive feedback is the largest.
Resistor R1, R2 and RE provide a voltage-divider stabilized dc bias circuit, the capacitor CE provides ac bypass of the emitter resistor RE and the radio-frequency coil (RFC) provides for dc bias -while decoupling any ac signal on the power lines from affecting the output signal.
The voltage feedback signal from the collector to the base is maximum when the crystal impedance is minimum.
The coupling capacitor Cc has negligible impedance at the circuit operating frequency but blocks any dc between collector and base.
The circuit shown in figure is generally called the Pierce crystal. The resulting circuit frequency of oscillations is set by the series resonant frequency of the crystal.
Variations in supply voltage, transistor parameters, etc. have no effect on the circuit operating frequency which is held stabilized by the crystal.
The circuit frequency stability is set by the crystal frequency stability, which is good.
The resonant frequency is given as-
$F_o = 1/(2\pi\sqrt{LC})$

4		**Attempt any FOUR of the following:**	16
	a)	Draw VI characteristics of P-N junction diode in forward and reverse bias. Define static and dynamic resistance.	**[Forward characteristics 1M , Reverse characteristics 1M, Definition: static resistance-1M, Dynamic resistance - 1M]**



(i) Static resistance:

The resistance of a diode at the operating point can be obtained by taking the ratio of V_F and I_F. The resistance offered by the diode to the forward DC operating conditions is called as **"DC or static resistance"**.

$$R_F = \frac{V_F}{I_F}$$

(ii) Dynamic resistance:

The resistance offered by a diode to the AC operating conditions is known as the **"Dynamic Resistance"**. It is the ratio of change in voltage to the resulting change in current.

$$r_{ac} = \frac{\Delta V_F}{\Delta I_F}$$

	b)	Explain with circuit diagram transistorized shunt voltage regulator.	Diagram-2M, Explanation-2M

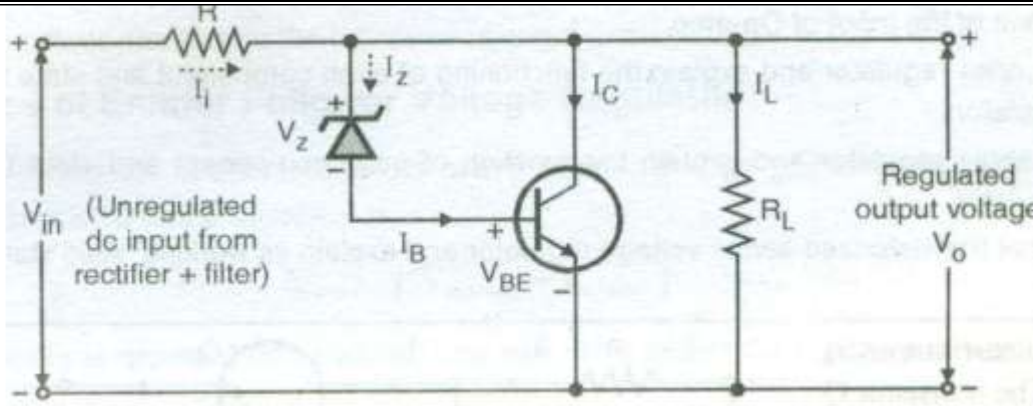


Fig: transistorized shunt voltage regulator.

Explanation/ Operation:

1. From Fig. the output voltage is given by.

$$Vo = Vz + V_{BE}$$

2.V_{in} is the unregulated de power supply sending a current I, through the limiting resistor R.

3.Regulation action:

- If the output voltage decreases due to any reason. then ($V_z + V_{BE}$) will also decrease. But V_z is constant so V_{BE} will decrease.
- This will reduce the collector current I_c. So more current will flow through the load and the load voltage will increase.
- If the output voltage increases. then exactly opposite action will take place to regulate the output voltage.

	c)	Compare CB and CE configurations w.r.t. (i) input resistance (ii) Output resistance (iii) current gain (iv) voltage gain Ans:	(1M for each parameter)

Parameter	CB	CE
Input Impedance	Low Or 50Ω	Medium Or 600Ω to 4kΩ
Current Gain	Less than or equal to 1 Or $\alpha = \frac{I_C}{I_E}$	High Or $\beta = \frac{I_C}{I_B}$
Voltage Gain	Medium	Medium
Output Impedance	High Or 50 kΩ	Medium Or 10 kΩ to 50 kΩ

d) Describe the emitter biasing technique of BJT with ckt. Diagram. (circuit diagram-2M, Description-2M)

Ans:

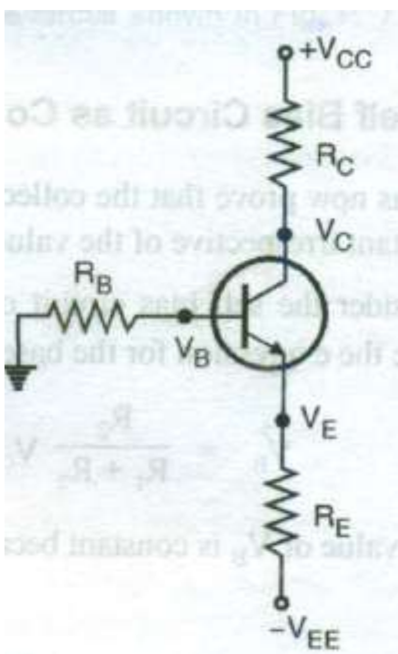


Fig: Emitter bias circuit

•In the emitter bias circuit, both positive as well as negative supply voltages (+ V cc and - V_{EE}) are used as shown in Fig.

•In this circuit the negative supply voltage - V_{EE} is used to forward bias the base-emitter junction.

•TIle positive supply voltage + Vcc is used to reverse bias the collector-base junction.

Analysis of Emitter bias:

Step 1 : Obtain the expression for IB :

•Refer to the base loop shown in Fig~ 7.7.1 (b). Apply KVL to the base loop to write,

V_{EE} IB RB + V_{BE} + IERE

But IE (1 + ~)lB

∴ V_{EE} IB RB + V_{BE} + (1 + ~) IB RE

∴ IB $\frac{V_{EE} :- V_{BE}}{RB + (1 +\sim) RE}$ ... (7.7.1)

Step 2 : Obtain the expression for Ie :

$I_C = \beta I_B$

$(V_{EE} - V_{BE})$

~ RB + (1 +~) RE

Analysis of Emitter Bias :

Step 1 : Obtain the expression for I_B :

- Refer to the base loop : Apply KVL to the base loop to write,

$$V_{EE} = I_B R_B + V_{BE} + I_E R_E$$

But $I_E = (1+\beta) I_B$

$$\therefore \quad V_{EE} = I_B R_B + V_{BE} + (1+\beta) I_B R_E$$

$$\therefore \quad I_B = \frac{V_{EE} - V_{BE}}{R_B + (1+\beta) R_E}$$

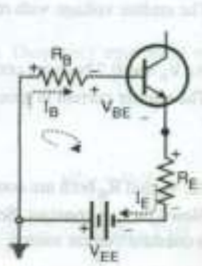


Fig. : Base loop

Step 2 : Obtain the expression for I_C :

$$I_C = \beta I_B$$

$$= \beta \frac{(V_{EE} - V_{BE})}{R_B + (1+\beta) R_E}$$

Step 3 : Obtain the expression for V_{CE} :

- Refer to the collector loop Apply KVL to the collector loop to write,

$$V_{CC} + V_{EE} = I_C R_C + V_{CE} + I_E R_E$$

Assume $I_E \approx I_C$

$$V_{CC} + V_{EE} = I_C R_C + V_{CE} + I_C R_E$$

$$\therefore \quad V_{CE} = V_{CC} + V_{EE} - I_C (R_C + R_E) \qquad ...(7.7.3)$$

This is the required expression for V_{CE}.

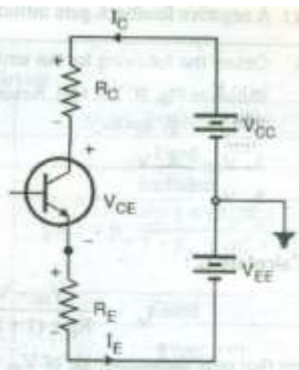


Fig. : Collector loop

Q point Stability of Emitter Bias Circuit :

Consider Equation (7.7.2).

$$I_C = \frac{\beta (V_{EE} - V_{BE})}{R_B + (1+\beta) R_E}$$

Divide numerator and denominator by β to get.

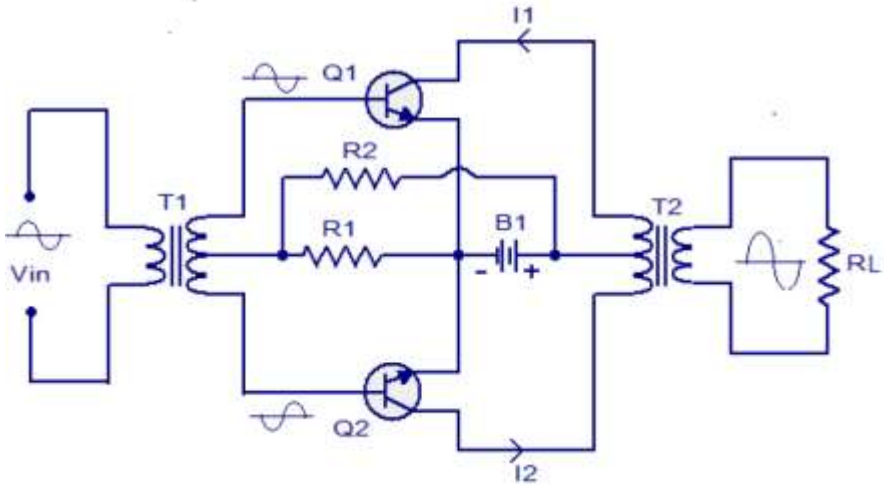
$$I_C = \frac{V_{EE} - V_{BE}}{(R_B / \beta) + \left(\frac{1+\beta}{\beta}\right) R_E}$$

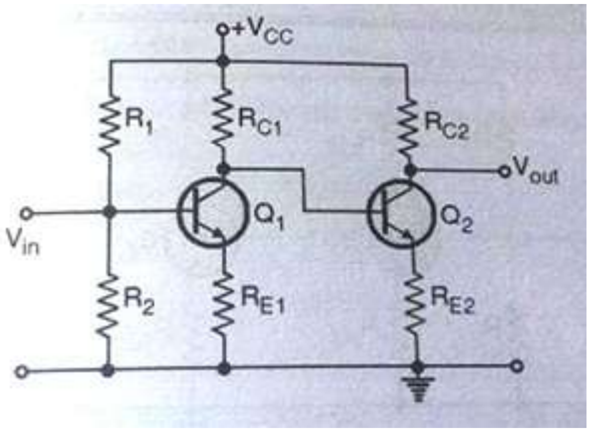
$\frac{R_B}{\beta}$ is very small and $(1+\beta)/\beta \approx 1$

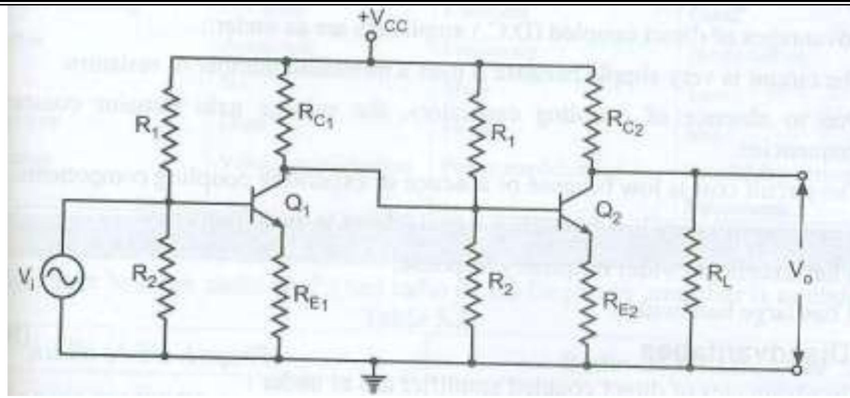
$$\therefore \quad I_C \approx \frac{V_{EE} - V_{BE}}{R_E}$$

If we assume $V_{BE} << V_{EE}$ then

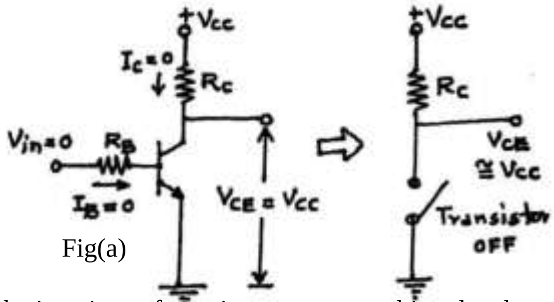
$$\therefore \quad I_C \approx \frac{V_{EE}}{R_E}$$

	e)	Draw and explain the circuit diagram of class A push pull amplifier. **Ans:**  Fig: class A push pull amplifier. **Explanation:** • The transformer T1 is used to as a phase splitter .The input signal the phase splited signals being applied to the base of each transistors. • When Q1 is driven positive using the first half of its input signal, the collector current of Q1 increases. • At the same time Q2 is driven negative using the first half of its input signal and so the collector current of Q2 decreases. • From the figure you can understand that the collector currents of Q1 and Q2 ie; I1 and I2 flows in the same direction trough the corresponding halves of the T2 primary. • As a result an amplified version of the original input signal is induced in the T2 secondary. • It is clear that the current through the T2 secondary is the difference between the two collector currents.	**[Circuit diagram: 2M, Explanation: 2M]**
	f)	Define terms: (i) Drain resistance (ii) Mutual conductance (iii) Amplification factor (iv) pinch off voltage of FET Ans: **(i) Drain Resistance:** **DC drain resistance**, also known as static or ohmic resistance of channel, is expressed as, $R_{DS} = \frac{V_{DS}}{I_D}$ **OR**	1M for each definition

		AC drain resistance, also known as dynamic resistance of channel, is defined as resistance between drain to source when JFET is operating in pinch-off or saturation region and expressed as, $r_d = \frac{\Delta V_{DS}}{\Delta I_D}$ **(ii) Mutual conductance :** It is also known as forward transconductance (gm). It is the ratio of small change in drain current to corresponding change in gate to source voltage. $g_m = \frac{\Delta I_D}{\Delta V_{GS}}$, keeping V_{DS} constant. **(iii) Amplification Factor:** It is defined as the ratio of small change in drain voltage to small change in gate voltage at constant drain current. Amplification factor $\mu = \frac{\Delta V_{DS}}{\Delta V_{GS}}$, keeping I_D constant. **(iv) Pinch-off Voltage:** It is the value of the drain to source voltage VDS at which the drain current ID reaches its constant saturation value. Any further increase in VDS does not have any effect on the value of ID. It is denoted by VP.	
5		**Attempt any FOUR of the following :**	16
	a)	**Draw the circuit diagram of direct coupled amplifier and explain function of each component.**  **OR**	**(Circuit diagram -2M, Function of components- 2M)**

		 **Function of components:** 1. Transistors Q1 and Q2 used to provide gain 2. R1 and R2 form a voltage or potential divider network used for biasing purpose **3.** RE1 and RE2 are used for stabilization of operating point against temperature and β variations**.**	
	b)	**State applications of FET and MOSFET.** **Ans: Applications of FET:** 1. FETs are widely used as input amplifiers in oscilloscopes 2. input amplifiers electronic voltmeters and other measuring and testing equipment 3. Chopper switch 4. Current limiter circuit **Applications of MOSFET:** 1.MOSFET as an analog switch 2.Depletion MOSFET as a linear regulator 3.Depletion MOSFET as a linear LED driver 4.In current limiter	**(Any relevant two applications of Each – 2M)**
	c)	**Describe the working of transistor as a switch with neat circuit diagram.** **Ans: Transistor as Switch:** A transistor can be used for two types of applications viz. amplification and switching. For amplification, the transistor is biased in its active region. For switching applications, transistor is biased to operate in the saturation (full on) or cut-off (full off) region.	**(Circuit diagram - 2M,Working - 2M for each on condition and off condition)**

(i) Transistor in cut-off region (Open switch):



Fig(a)

In the cut-off region, both the junctions of transistor are reverse biased and very small reverse current flows through the transistor.

The voltage drop across the transistor (V_{CE}) is high, nearly equal to supply voltage V_{CC}. Thus, in cut-off region the transistor is equivalent to an open switch as shown in fig.(a).

(ii) Transistor in Saturation region (Closed switch):

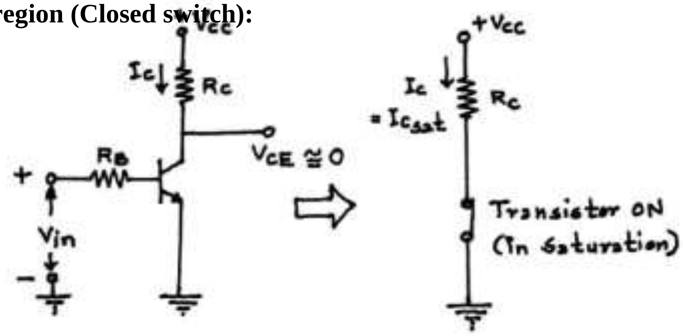


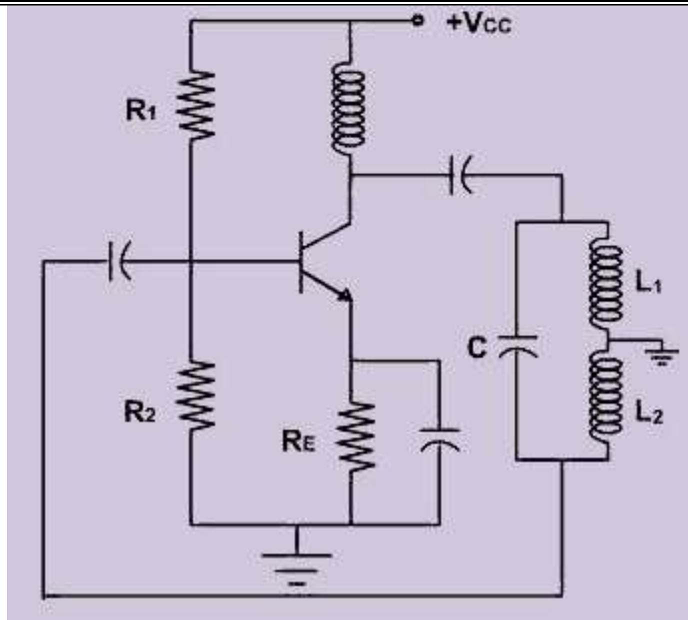
Fig.(b)

When V_{in} is positive, a large base current flows and transistor saturates. In the saturation region, both the junctions of transistor are forward biased. The collector current is very large, the voltage drop across the transistor (V_{CE}) is very small, of the order of 0.2V to 1 V, depending on the type of transistor. Thus in saturation region, the transistor is equivalent to a closed switch.

d) **Describe the working of Hartley Oscillator with neat diagram.**

(Circuit diagram- 2M, Working- 2M)

Ans: Circuit diagram:

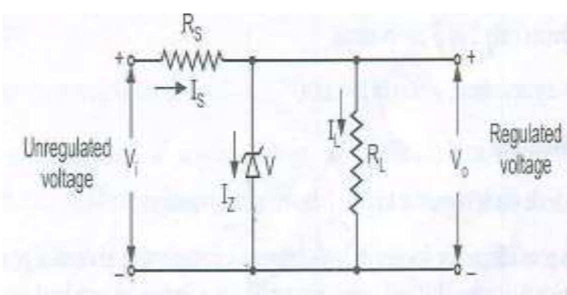


Working: When the DC supply (Vcc) is given to the circuit, the collector current starts raising and begins with the charging of the capacitor C. Once capacitor C is fully charged, it starts discharging through L1 and L2 and again starts charging. This back-and-fourth voltage waveform is a sine wave which is a small and leads with its negative alteration. It will eventually die out unless it is amplified. The sine wave generated by the tank circuit is coupled to the base of the transistor through the capacitor CC1. Thus the transistor provides amplification along with inversion to amplify .The mutual inductance between L1 and L2 provides the feedback of energy from collector-emitter circuit to the base-emitter circuit. In this circuit tank circuit provides 180ºphase shift and CE transistor provides 180ºphase shift and total phase shift around the loop is 360º.

	e)	**Explain how zener diode is used as a voltage regulator .**	**(Circuit diagram-2M, Explanation-2M)**

Ans:

Circuit diagram of Zener Diode as Voltage Regulator:

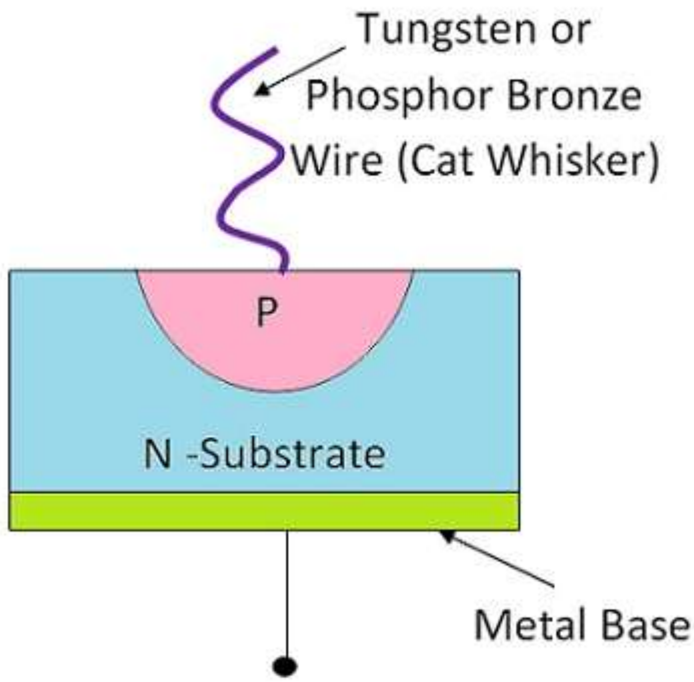


Zener regulator

		Working • For proper operation, the input voltage Vi must be greater than the Zener voltage Vz. This ensures that the Zener diode operates in the reverse breakdown condition. The unregulated input voltage Vi is applied to the Zener diode. • Suppose this input voltage exceeds the Zener voltage. This voltage operates the Zener diode in reverse breakdown region and maintains a constant voltage, i.e. Vz = Vo across the load inspite of input AC voltage fluctuations or load current variations. The input current is given by, IS = Vi – Vz / Rs = Vi – Vo / Rs • We know that the input current IS is the sum of Zener current Iz and load current IL. Therefore, IS = Iz + IL or Iz = Is - IL • As the load current increase, the Zener current decreases so that the input current remains constant. According to Kirchhoff's voltage law, the output voltage is given by, Vo = Vi – Is. Rs • As the input current is constant, the output voltage remains constant (i.e. unaltered or unchanged). The reverse would be true, if the load current decreases. This circuit is also correct for the changes in input voltage. • As the input voltage increases, more Zener current will flow through the Zener diode. This increases the input voltage Is, and also the voltage drop across the resistor Rs, but the load voltage Vo would remain constant. The reverse would be true, if the decrease in input voltage is not below Zener voltage • Thus, a Zener diode acts as a voltage regulator and the fixed voltage is maintained across the load resistor RL.	
	f)	**State applications of digital electronics** **Ans:** Many of our household items make use of digital electronics. This could include laptops, televisions, remote controls and other entertainment systems, 1. Kitchen appliances like microwave oven , dishwashers and washing machines. 2. Computers are one of the most complex examples and will make use of numerous, complex circuits. 3. Elevator displays 4. Traffic lights 5. In Digital Watch 6. In Networking Communication	**(Any four applications for -4M)**

6		**Attempt any FOUR of the following:**	**16**
	a)	**Draw and explain construction of point contact diode.**	**(Construction-2M,Explanation-2M)**

Ans :-



Construction: It formed by a contact of an N-type semiconductor substrate and tungsten or **phosphor bronze wire (Cat whisker)**. The semiconductor used in the construction of point contact diode can be either silicon or germanium but Germanium is used extensively because it possesses higher carrier mobility.

The dimension of the semiconductor substrate is about 1.25 mm square and its thickness is 0.5 mm thick. One phase of the semiconductor substrate is soldered to the metal base by the technique of radio frequency heating.

	b)	**Define term w.r.t. transistor.**	**(Each definition -2M)**

(i) DC load line

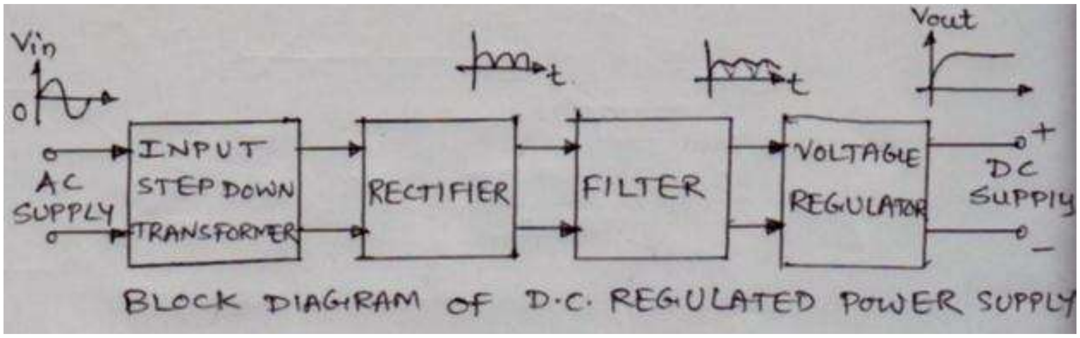
(ii) Operating point

Ans: DC load line: The dc load line is the locus of I_C and V_{CE} at which BJT remains in active region i.e. it represents all the possible combinations of I_C and V_{CE} for a given amplifier.

Operating point: Operating point is also called Q-point. The dc operating point between saturation and cutoff is called the Q-point. The goal is to set the Q-point such that that it does not go into saturation or cutoff when an a ac signal is applied. It is operating point of the transistor (ICQ,VCEQ) at which it is biased.

c) **Draw the block diagram of DC regulated power supply and state function of each block.** **(Block diagram 2 M, Function of each block 2 M)**

Ans : Block diagram of regulated power supply:



1) **Tranformer :** It is used to convert ac voltage either ac high value or ac low value as per requirement
2) **Rectifier :** Rectifier converts the transformer secondary a.c. voltage into pulsating voltage .
3) **Filter :** The pulsating d.c. voltage is applied to the filter it reduces the pulsations in the rectifier d.c. output voltage . Basically filter is used to remove ac components which are present in the rectifier output.
4) **Voltage regulator :** Finally, the voltage regulator performs two functions. Firstly, it reduces the variations in the filtered output voltage. Secondly, it keeps the output voltage (Vout) nearly constant whether the load current changes or there is change in input a.c. voltage.

d) **Compare BJT and FET (any 4 points).** **(Any four points for 4M)**

Ans:

Sr. no.	BJT	JFET
1.	It is bipolar device i.e. current in the device is carried by electrons and holes.	It is unipolar device i.e. current in the device is carried by either electrons or holes.
2.	It is current controlled device i.e. base current controls the collector current.	It is voltage controlled device i.e. voltage at the gate terminal controls the amount of current flowing through the device.
3.	Input resistance is low, of the order of several KΩ	Input resistance is very high, of the order of several MΩ
4.	It has positive temperature coefficient of resistance at high current levels i.e. current increases as the temperature increases.	It has negative temperature coefficient of resistance at high current levels i.e. current decreases as the temperature increases.

e) **Describe EX-OR gate Draw its symbol and truth table.**

(Symbol - 1M,Truth Table-1M, Description- 2M)

Ans:

EXOR gate

2 Input EXOR gate		
A	B	A⊕B
0	0	0
0	1	1
1	0	1
1	1	0

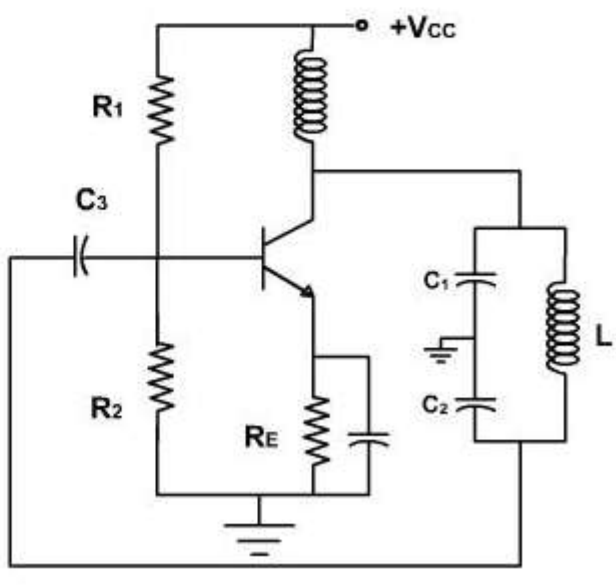
Output of an Exclusive-OR gate **ONLY** goes "HIGH" when its two input terminals are at "**DIFFERENT**" logic levels with respect to each other and output of an Exclusive-OR gate **ONLY** goes "LOW" when its two input terminals are at "**SIMMILAR**" logic levels.

Boolean expression of EX-OR gate is:

$$Q = (A \oplus B) = \overline{A}.B + A.\overline{B}$$

f) **Draw circuit diagram of colpitts oscillator .Colpitts oscillator has C_1= 250 PF, C_2=100PF and L=60 µH . Find the value of frequency of oscillation.**

Ans: Circuit Diagram:



Given :

C1=250PF, C2=100PF, L=60µH

Find f_{osc}

		$C1=250PF=250*10^{-12}$ F , $C2=100PF=100*10^{-12}$F **$L=60\mu H= 60*10^{-6}$H** **Frequency of oscillation** $$f_{osc}=\frac{1}{2\pi\sqrt{L\left(\frac{C_1 C_2}{C_1+C_2}\right)}}$$ **$=2.431MH_z$**	