WINTER– 18 EXAMINATION

Subject Name: Electrical and Electronics Technology **Model Answer Subject Code:** 22232

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues 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.

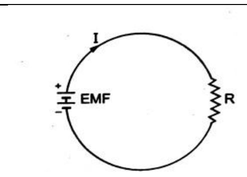
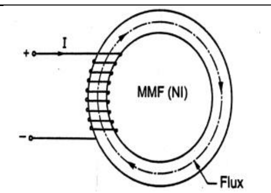
Q. No.	Sub Q. N.	Answers	Marking Scheme
		SECTION - I	
1	**(A)**	**Attempt any SIX of the following:**	**12-Total Marks**
	(a)	**Define EMF and state its unit.**	**2M**
	Ans:	**Electromotive force(EMF):** A potential difference generated by a source of electrical energy across its terminals which tends to produce an electric current in a circuit is called electromotive force. **Unit of EMF is Volt**	**1 mark for definition** **1 mark for unit**

(b)	**Define (i) Permeability (ii) Reluctance.**	**2M**
Ans:	**Permeability:** The capability of the magnetic material to conduct the magnetic flux is known as permeability (OR) It is defined as ratio of magnetic flux density B in a medium to the magnetic flux intensity H at the same location in the medium. **Reluctance**: It is defined as the property of a material due to which it opposes the creation of magnetic flux in it.	**1 mark for each definition**
(c)	**Write the relation between RMS value and Average value.**	**2M**
Ans:	The ratio of RMS value to average value is called the form factor of an alternating quantity. **Form factor** $K_F = \frac{rms\ value}{average\ value}$ For sinusoidal voltage and current, **Form factor** $K_F = \frac{rms\ value}{average\ value} = \frac{0.707 \times Vm}{0.637 \times Vm} = \mathbf{1.11}$ **Or** **Form factor** $K_F = \frac{rms\ value}{average\ value} = \frac{0.707 \times Im}{0.637 \times Im} = \mathbf{1.11}$	**2 Marks**
(d)	**State the working principle of transformer.**	**2M**
Ans:	**Working principle of transformer :** Transformer works on the principle of mutual electromagnetic induction. When AC voltage is applied to the primary winding of a transformer it causes ac current to flow through primary winding which in turn produces alternating flux in the core. This changing flux links with the secondary winding and according to Faraday's law of electromagnetic induction, an emf is induced in the secondary winding. The current flows in the secondary circuit if load is connected.	**2 marks**

	e)	**The frequency of an a.c quantity is 60Hz. Find the time period.**	**2M**
	Ans:	**F=60 Hz** **Time period** $T = \frac{1}{f}$ $T = \frac{1}{60}$ **=0.016 sec**	**2 marks**
	f)	**Define FHP motor and list various types.**	**2M**
	Ans:	Any motor rated less than one horse power may be called as fractional horse power motors(FHP) **various types of FHP motors are:** 1.Split phase induction motor 2. Capacitor start induction motor 3. Capacitor start capacitor run induction motor 4. Shaded pole induction motor.	**1 mark** **1 mark**
	g)	**Define transformation ratio of a transformer.**	**2M**
	Ans:	**Transformation Ratio (K) of a transformer:** It is the ratio of secondary number of turns to primary number of turns. (**OR**) It is the ratio of secondary voltage to primary voltage. (**OR)** It is the ratio of primary current to secondary current. **OR** Transformation ratio: $K=\frac{N_2}{N_1}=\frac{V_2}{V_1}=\frac{E_2}{E_1}=\frac{I_1}{I_2}$	**2 marks**
Q. No.	Sub Q. N.	Answers	Marking Scheme
2		**Attempt any THREE of the following:**	**12-Total**

			Marks
	a)	**Compare electric circuits and magnetic circuits on the basis of (i) Definition (ii) Diagram (iii) Analogy (iv) Dissimilarities.**	**4M**

Ans:

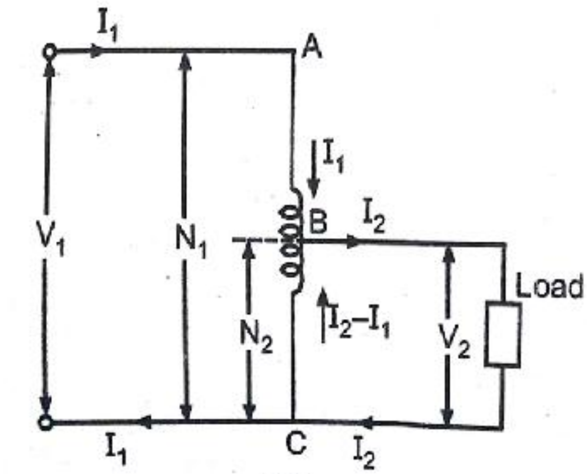
Parameter	**Electric Circuit**	**Magnetic circuit**
Definition	An **electric circuit** is a path in which electrons from a voltage or current source flow.	It is defined as the route or path which is followed by magnetic flux.
Diagram		
Analogy: Any one of these	1)Reluctivity 2)mmf 3)f/ux 4)reluctance 5)permeance 6)flux density 7)permeability	Resistivity Emf Current Resistance Conductance Current density conductivity
Dissimilarities : Any one of	1)Energy is continuously required to maintain the	Energy is needed only for creating the flux

1 marks for each bit

these	flow of current. 2)Magnetic flux does not flow in a circuit like current. 3) There is no known perfect insulator for magnetic flux.	initially but not for maintaining it. 2) Electric current actually flows through a given circuit. 3)There are good insulators for electric current

Note: Any relevant answer should be considered.

b)	**Explain the working of auto-transformer and state any two advantages of it.**	**4M**
	Working of auto transformer :-It is a transformer with one winding only, part of this being common to both primary and secondary. In this transformer the primary and secondary are not electrically isolated from each other as in case with a two winding transformer. But the theory and operation are similar to that of two winding transformer. In fig a below, AC acts as the primary winding and portion BC of the same winding behaves as secondary winding and load is connected across BC. The output voltage across load is less than the input voltage connected to AC .The auto transformer behaves like a step down transformer.	**2 marks for working and diagram of any one type**



(a)

In fig b below, AC acts as the secondary winding and load is connected across AC and portion BC of the same winding behaves as primary winding. The output voltage across the load will be greater than the input voltage across BC. So the auto transformer behaves like a step up transformer

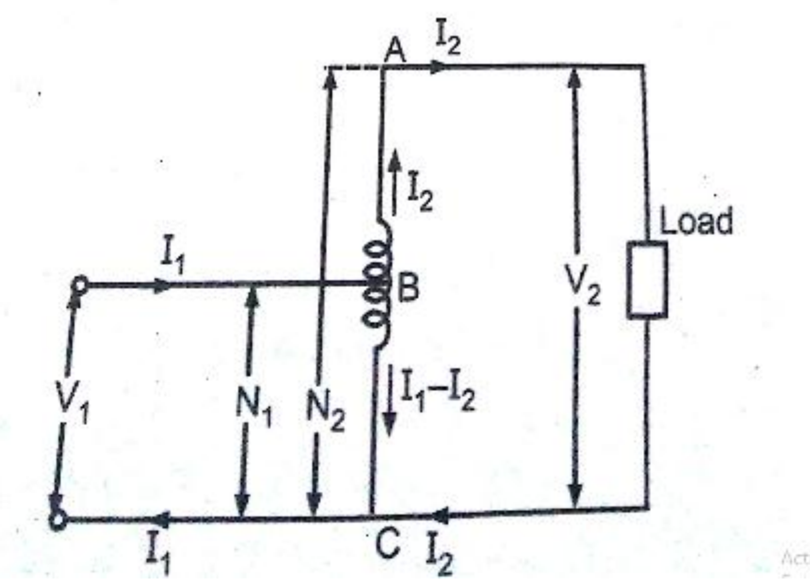
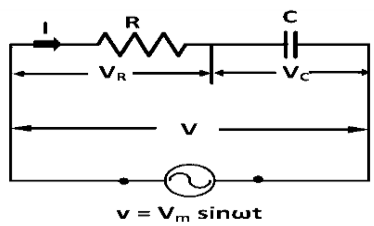
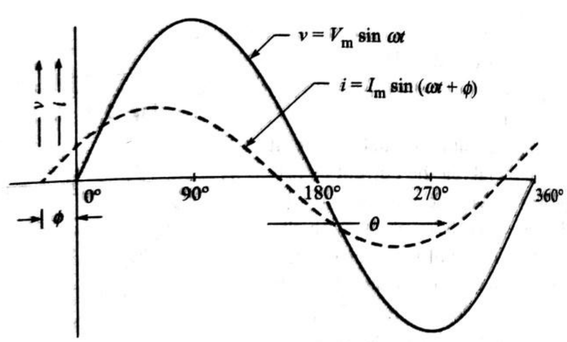
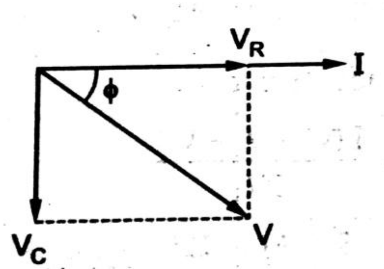
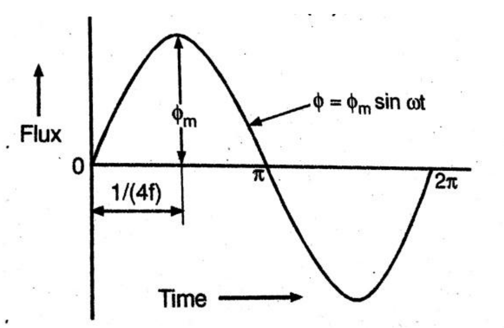


Fig b

		Advantages :- 1. Copper required in an auto transformer is less than that of conventional two winding transformer hence it is cheaper. 2. The resistance and leakage reactance of an auto transformer is less than the corresponding two winding transformer , so its regulation is better. 3. I^2R losses of an auto transformer are less, so the efficiency of auto transformer is higher than that of two winding transformer.	**2 marks for any two advantages**
	c)	**Write the voltage & current equations, draw the circuit, voltage & current waveforms and phasor diagram of a R-C series circuit when it is connected across AC supply.**	**4M**
	Ans:	**R-C series circuit:** **voltage equation :** $v = V_m \sin(\omega t)$ Volt **current equation:** $i = I_m \sin(\omega t + \phi)$ Amp **Circuit diagram :**  **voltage & current waveforms:**  	**1mark for equations** **1mark for circuit** **1mark for waveform**

		phasor diagram:  	**1mark for phasor diagram**
	d)	**Derive the EMF equation of a transformer.**	**4M**
	Ans:	Let N_1= No. of turns in primary N_2= No. of turns in secondary Φ_m=Maximum flux in the core in webers = $B_m \times A$ f= frequency of ac input in Hz  As shown in the figure flux increases from its zero value to maximum value Φ_m in one quarter of the cycle i.e. $\frac{1}{4f}$ second. Therefore average rate of change of flux = $\frac{\emptyset_m}{1/4f} = 4f\emptyset_m Wb/s\ \ or$ volt Now, rate of change of flux per turn means induced e.m.f. in volt. Therefore Average e.m.f. per turn = $4f\emptyset_m volts.$	**4 marks**

		As flux ϕ varies sinusoidally, the r.m.s. value of induced e.m.f. is obtained by multiplying the average value with form factor form factor of sine wave = 1.11 Therefore r.m.s. value of e.m.f. per turn = 1.11 × $4f\emptyset_m$= $4.44f\emptyset_m volts$ Now r.m.s. value of the induced e.m.f. in the whole of the primary winding = (induced e.m.f./turn) × No. of primary turns E_1 = 4.44 Φ_m f N_1 volts Similarly, E_2 = 4.44 Φ_m f N_2 volts E.M.F equation of transformer is given by E.M.F= 4.44 Φm f N volts	

Q. No.	Sub Q. N.	Answers	Marking Scheme
3		**Attempt any TWO of the following:**	**12-Total Marks**
	a)	**A sinusoidal current is given by i = 15 sin (520t - 45˚) Determine its (i) Amplitude (ii) RMS value (iii) Average value (iv) Frequency (v) Time period (vi) Phase.**	**6M**
	Ans:		**1 mark for each answer**

$$i = 15\sin(520t - 45^\circ)$$

(i) Amplitude = peak or maximum value

i.e $I_m = 15A$

(ii) RMS value =

$$i_{rms} = 0.707 \times I_m = 0.707 \times 15 = 10.605\,A$$

(iii) Average value

$$I_{av} = 0.637 \times I_m = 0.637 \times 15 = 9.555\,A$$

(iv) Frequency:

$$\omega = 2\pi f$$

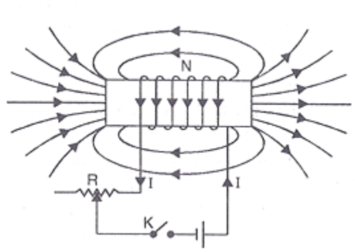
$$f = \frac{\omega}{2\pi} = \frac{520}{2\times\pi} = 82.760\,Hz$$

(v) $\text{Time period} = \frac{1}{f} = \frac{1}{82.760} = 0.012\,sec$

(vi) Phase = -45° (lagging current)

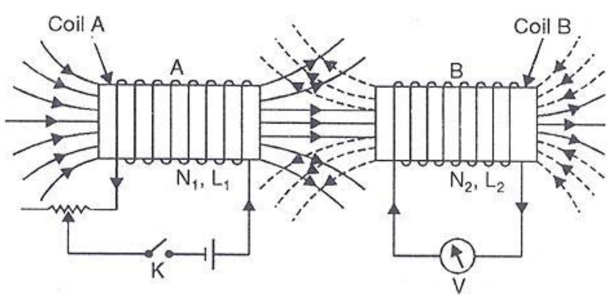
b)	**Explain statically induced EMF and Dynamically induced EMF with neat diagrams.**	**6M**
Ans:	**Statically Induced EMF:-** When changing magnetic field links with a stationary coil an emf is induced. This emf is called statically induced emf.	**1 mark**
	Statically induced EMF is of two types: Self-induced EMF and Mutually induced EMF	**1 mark**
	Self-induced EMF: The emf induced in one coil due to the linking of changing magnetic flux	

produced in the same coil is called self induced emf.



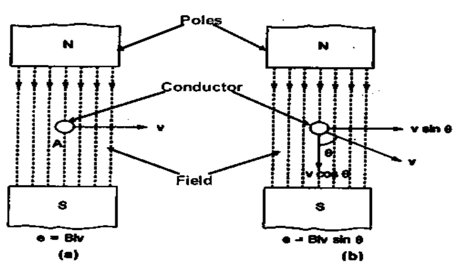
2 marks

Mutually induced EMF : The emf induced in one coil due to the linking of changing magnetic flux produced in another coil is called mutually-induced emf.

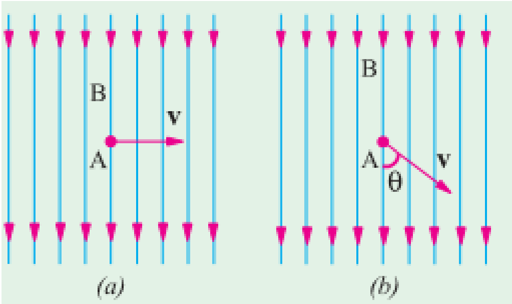


Dynamically Induced EMF:-When a conductor rotates in a stationary magnetic field, it cuts the field and an emf is induced. This emf is called dynamically induced emf.

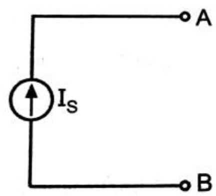
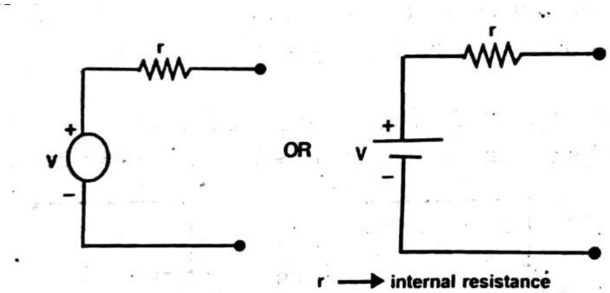
2 marks



Or

		 $E = B\, l.\, v.\, \sin\theta$ volts	
	c)	**A 1 KVA, 2000/200 V, 50 Hz single phase transformer has maximum flux of 20 mWb. Find (i) Number of turns in primary (ii) Number of turns in secondary (iii) Primary full load current (iv) Secondary full load current.**	**6M**
	Ans:	(i) No. of primary turns N_1: $\because E_1 = 4.44 f \phi_m N_1$ $N_1 = \frac{E_1}{4.44 f \phi_m}$ $N_1 = \frac{2000}{4.44 \times 50 \times 20 \times 10^{-3}} = 450$ $\therefore N_1 = 450$ turns// (ii) No. of secondary turns N_2: $\because E_2 = 4.44 f \phi_m N_2$ $N_2 = \frac{E_2}{4.44 f \phi_m}$ $N_2 = \frac{200}{4.44 \times 50 \times 20 \times 10^{-3}} = 45$ $\therefore N_2 = 45$ turns// (iii) Full load primary current I_1: $KVA = \frac{V_1 I_1}{1000}$ $\therefore I_1 = \frac{KVA \times 1000}{V_1}$ $I_1 = \frac{1 \times 1000}{2000} = 0.5$ $I_1 = 0.5$ A// (iv) Full load secondary current I_2 $KVA = \frac{V_2 I_2}{1000}$ $\therefore I_2 = \frac{KVA \times 1000}{V_2}$ $I_2 = \frac{1 \times 1000}{200} = 5$ $I_2 = 5$ A//	**1.5 M for each calculation**

Q. No.	Sub Q. N.	Answers	Marking Scheme
		SECTION - II	
4		**Attempt any FIVE of the following:**	**10-Total Marks**
	(a)	**List different types of resistors and capacitors.**	**2M**
	Ans:	**Types of Resistors:** 1. Carbon Composition resistor 2. Thin film resistor 3. Thick film resistor 4. Wire wound resistor 5. Thermistor 6. LDR 7. Photo resistor	**1 mark for Any 2 Resistor**
		Types of capacitors: 1. Electrolytic capacitor 2. Variable capacitor 3. Air ganged capacitor 4. PVC ganged capacitor 5. Trimmer capacitor	**1 mark for Any 2 Capacitor**

	(b)	**Draw the circuit symbol of ideal current source and practical voltage source.**	**2M**
	Ans:	Ideal current source  **practical voltage source** 	**1 Mark** **1 Mark**
	(c)	**Define filter and state it's types.**	**2M**
	Ans:	A filter circuit may be defined as a circuit, which removes (or minimizes)the unwanted a.c. component of the rectifier output and allows only the d.c. component to reach the load. **Types of filters** 1) Capacitor input filter(Shunt capacitor filter) 2) Choke input filter(series inductor filter) 3) LC filter 4) π Filter 5) RC filter	**1 mark** **1mark**
	(d)	**Draw the block diagram of regulated power supply.**	**2M**
	Ans:		

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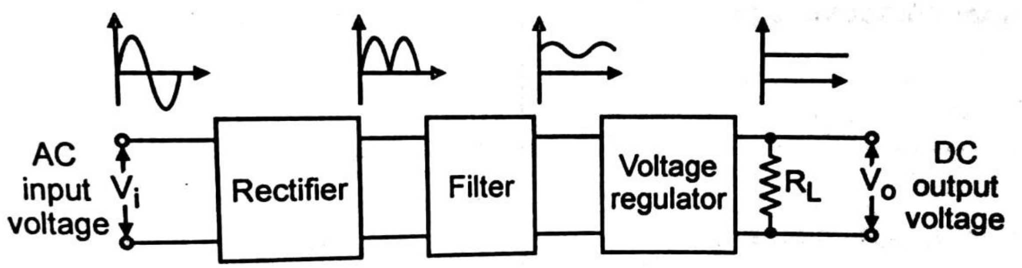
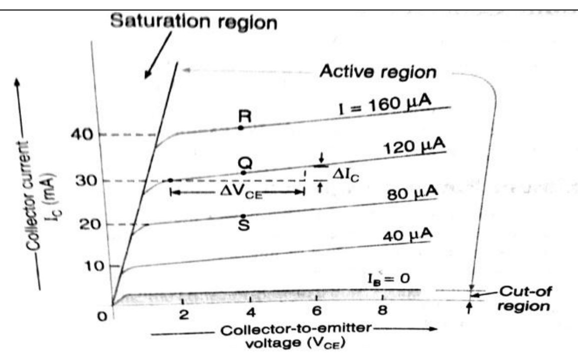
Subject Name: Electrical and Electronics Technology **Model Answer** Subject Code: 22232

		Block diagram of regulated power supply: 	**2 marks**
	(e)	**State the applications of BJT.**	**2M**
	Ans:	**Applications of BJT:** 1. As a switch 2. As an amplifier 3. As a multivibrator 4. As a oscillator 5. As a timer circuit 6. As a Logic circuits **7.** Delay circuits	**2 marks for Any two applications**
	f)	**Draw the output characteristics of BJT in CE configuration and label various regions on it.**	**2M**
		 **output characteristics of BJT in CE configuration**	**1 mark for o/p char.** **1 mark for label**

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Q. No.	Sub Q. N.	Answers	Marking Scheme
5.		**Attempt any THREE of the following:**	**12-Total Marks**
	a)	**Find the resistor value from the given colour code:-** **(i) Orange, Red, Brown, Silver** **(ii) Red, Black, Yellow, Gold**	**4M**
	Ans:	**According to resistor colour codes:** i) orange =3, red =2, brown=1 (multiplier), silver =±10% $=32*10^1$ =320Ω, ±10% tolerance ii) Red =2, black =0, yellow =4(multiplier), gold = ±5% $= 20*10^4$ =200 KΩ, ±5%	**2M each**
	b)	**Compare CE, CB, and CC configurations of a transistor.**	**4M**
	Ans:	(see table below)	**Any 4 point 1M each**

Parameter	Common Emitter	Common Base	Common Collector
Voltage Gain	Very High (about 500)	High(150)	Less than Unity
Current Gain	β value is High/ greater than unity/ about 100	Alpha value is Less than Unity	Gamma value is High (100)
Power Gain	High	Moderate	Moderate

Phase inversion	Yes/180° out of phase	No / in phase	No/ in phase
Input Impedance(R_i)	Moderate (1 KΩ)	Low (50 Ω)	High (300 KΩ)
Output Impedance(R_o)	Moderate (50 K)	High (1 MΩ)	Low (300 Ω)

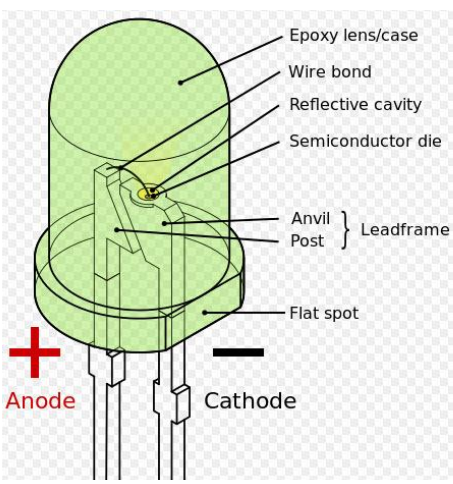
c) **Explain the construction of LED and state its principle of operation.** **4M**

Ans: **Construction (Any one of the following diagram)**

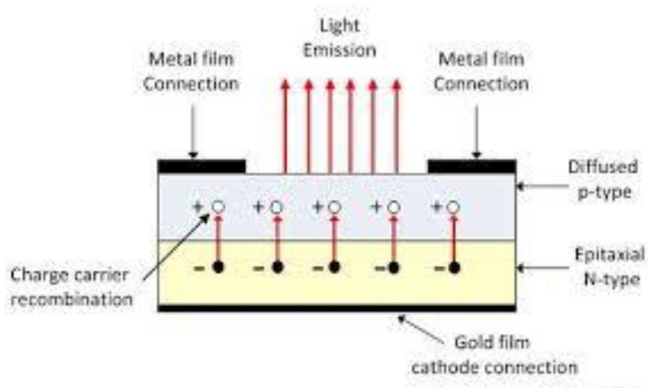
construction of LED: 2M

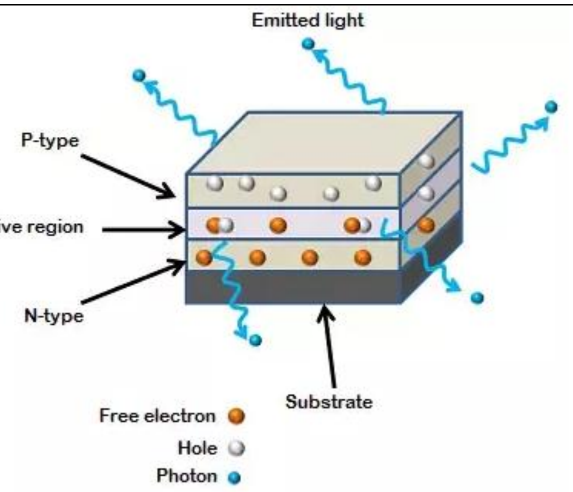
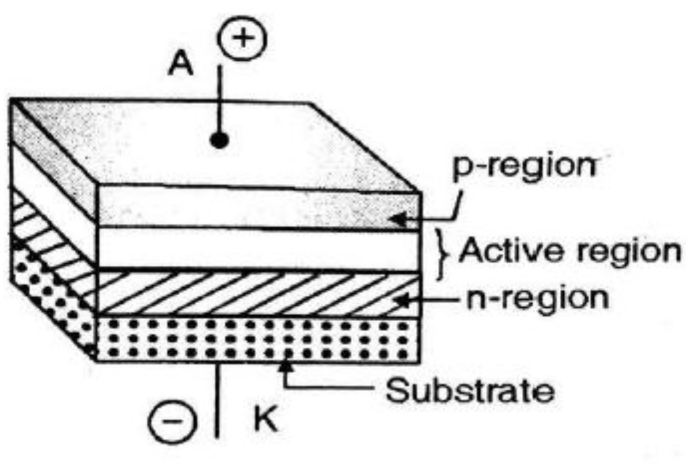
The lighting emitting diode is a p-n junction diode. It is a specially doped diode and made up of a special type of semiconducting materials like Gallium Phosphide(GaP), Gallium Arsenide Phosphide(GaAsP) and Gallium Nitride(GaN).

- The active region exists between the p and n regions.
- The light emerges from the active side in all the directions when electron hole-pairs recombine.



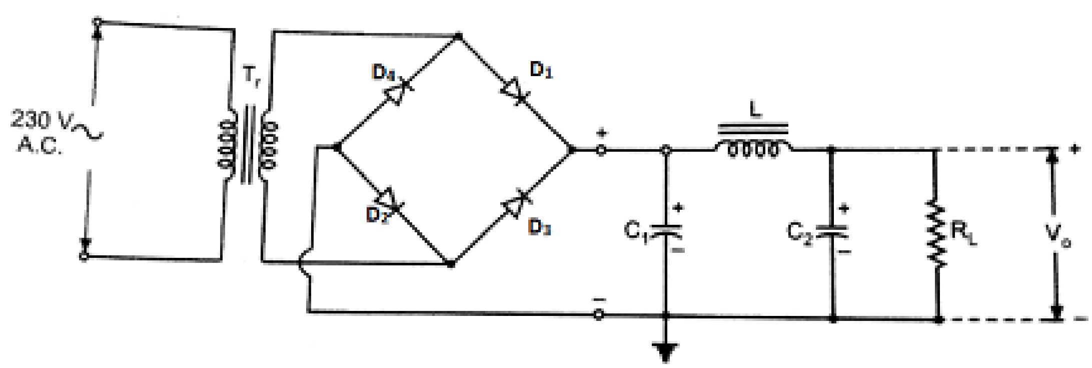
OR

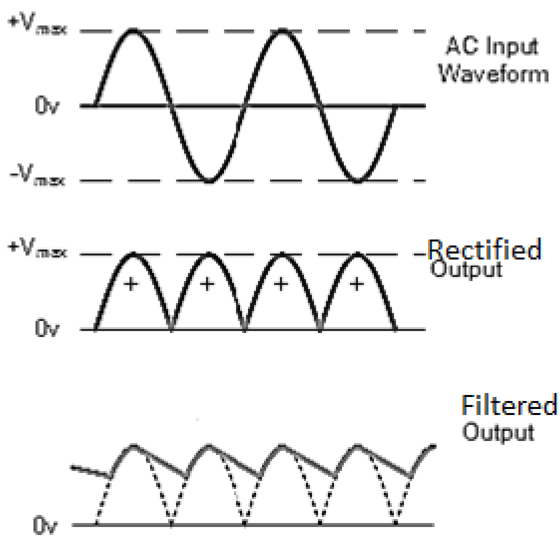


		 **Or**  (a) Basic Structure **Principle of operation** The working principle of the light emitting diode is based on the quantum theory. The quantum theory says that when the electron comes down from the higher energy level to the lower energy level then, the energy emits from the photon. When the LED is forward biased, the electrons in the n-region will cross the junction and recombine with the holes in the p-type material. These free electrons reside in the conduction band and hence at a higher energy level than the	**Principle of operation** **2M**

		holes in the valance band. When the recombination takes place, these electrons return to the valance band which is at lower energy level than the conduction band. While returning , the recombining electrons give away the excess energy in the form of light.	
	d)	**List any 4 advantages and any 4 disadvantages of Integrated circuits.**	**4M**
	Ans:	**Advantages of Integrated circuits:-** 1. Extremely small size. 2. Very small weight . 3. Very low cost . 4. More reliable . 5. Lower power consumption . 6. Easy replacement . 7. Close matching of components and temperature coefficients possible. 8. Improved functional performance . 9. Greater ability of operating at extreme temperatures. 10. Suitable for small signal operation . 11. No component projection above the chip surface. **Disadvantages of Integrated Circuits:-** 1. If any component in an IC fails, the whole IC has to be replaced by a new one. 2. Limited power rating. 3. Inductors cannot be fabricated directly 4. Operation at low voltage as ICs function at fairly low voltage. 5.Quite delicate in handling as these cannot withstand rough handling or excessive heat. 6.Fabrication of capacitors and resistors are limited in maximum value.. 7.High grade P-N-P assembly is not possible. 8.Low temperature coefficient is difficult to be achieved. 9.Large value of saturation resistance of transistors.	**2 marks for any 4 advantages** **2 marks for any 4 disadvantages**

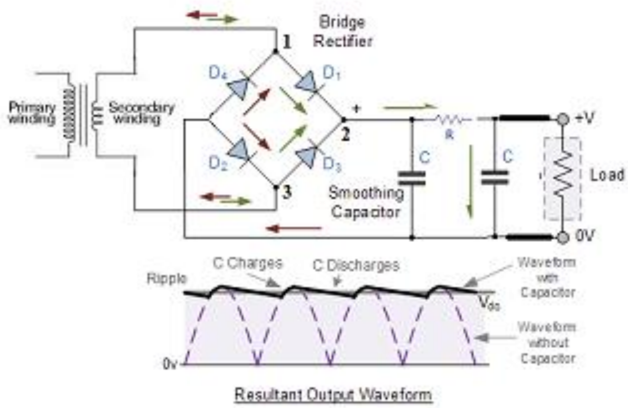
		10.Voltage dependence of resistor and capacitors.	

Q. No.	Sub Q. N.	Answers	Marking Scheme
6.		**Attempt any TWO of the following:**	**12-Total Marks**
	a)	**Explain the operation of a full wave bridge rectifier with π filter using a neat diagram. Draw input and output waveforms.**	**6M**
	Ans:	Or 	**Diagram 2M** **Waveform 1M** **Explanation 3M**



- During positive half-cycle of input, the secondary voltage V_{AB} is positive, so diodes D_1 and D_2 forward biased and D_3 and D_4 reverse biased.
- The load current flows from terminal A through D_1, L, R_L, D_2 to terminal B. The load voltage and load current are positive.
- During negative half-cycle of input, the secondary voltage V_{AB} becomes negative, i.e.V_{BA} is positive. So diodes D_3 and D_4 forward biased and D_1 and D_2 reverse biased.
- The load current flows from terminal B through D_3, L, R_L, D_4 to terminal A. The load voltage and load current are once again positive.
- The output of bridge rectifier is full wave rectified pulsating DC. The ripples in the current are reduced by filter inductor and the ripples in voltage are reduced by filter capacitors.
- Thus the pulsating DC is smoothened by filter and smooth DC voltage appears across the load. The input and output waveforms are shown in the figure.

OR



Explanation:

During first half cycle of the AC input, the upper portion of the transformer secondary winding is positive with respect to the lower portion. Diodes D_1 and D_2 are forward biased and diodes D_3 and D_4 are reverse biased. Current flows through path- D_1 –R- load resistance - D_2 and back.

During the next half cycle, lower portion of the transformer is positive with respect to the upper portion. During this half cycle diodes D_3 and D_4 are forward biased and D_1 and D_2 are reverse biased. Current flows through path- D_3 –R- load resistance– D_4 and back.

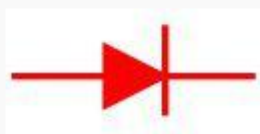
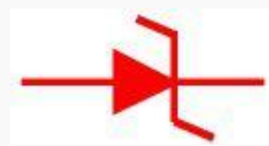
The output of bridge rectifier is full wave rectified pulsating DC. The ripples in the current are reduced by filter inductor and the ripples in voltage are reduced by filter capacitors.

Thus the pulsating DC is smoothened by filter and smooth DC voltage appears across the load. The input and output waveforms are shown in the figure.

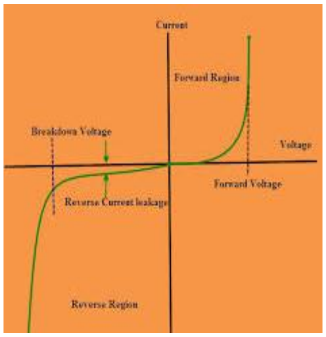
	b)	**(i) Derive the relation between alpha (α) and beta (β).** **(ii) Compare PN junction diode with zener diode.**	**6M**
	Ans:	**Relation between alpha (α) and beta (β):-** **Relation between α& β:** Current gain (**α**) of CB configuration = $\frac{I_C}{I_E}$ Current gain of (**β**) of CE configuration = $\frac{I_C}{I_B}$ We know that ; $I_E = I_B + I_C$……………………….(1) Dividing equation (1) by I_C $\frac{I_E}{I_C} = \frac{I_B}{I_C} + \frac{I_C}{I_C}$ Therefore $\frac{1}{\alpha} = \frac{1}{\beta} + 1$ [since $\alpha = \frac{I_C}{I_E}$, $\beta = \frac{I_C}{I_B}$] Therefore $\frac{1}{\alpha} = \frac{1+\beta}{\beta}$ $\alpha(1 + \beta) = \beta$ $\alpha + \alpha\beta = \beta$ $\alpha = \beta - \alpha\beta$ $\alpha = \beta(1 - \alpha)$ Therefore $\beta = \frac{\alpha}{1-\alpha}$ Or $\alpha = \frac{\beta}{1+\beta}$	**3M each**

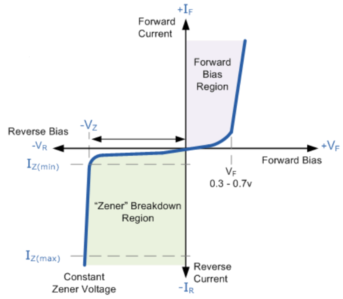
Comparison of PN junction diode with zener diode:-

Any three relevant points.

Basis For Comparison	PN Junction Diode	Zener Diode
Definition	It is a semiconductor diode which conducts only in one direction, i.e., in forward direction.	The diode which allows the current to flow in both the directions i.e., forward and reverse is called Zener diode.
Symbol		
Reverse Current Effect	Damages the junction.	Does not damage the junction.
Doping Level	Low	High
Breakdown	Occurs at higher voltage.	Occurs at lower voltage.
Applications	For rectification	Voltage stabilizer, regulators.

V-I characteristic





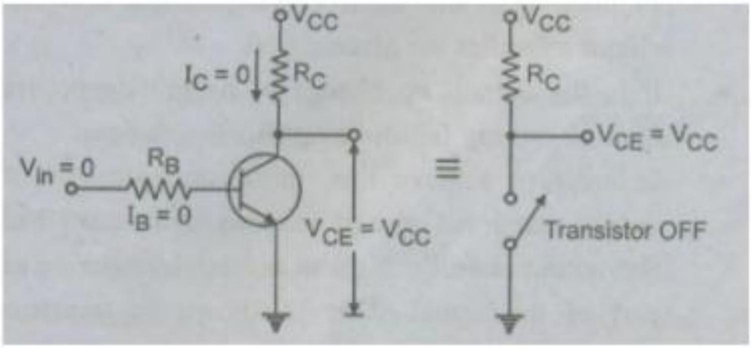
c) **Explain the operation of transistor as a switch and as an amplifier, with neat circuit diagrams.** **6M**

Ans: **Explanation of transistor as a switch:** **3M**

The transistor can be used for two types of application viz. amplification and switching. For the amplification, transistor is biased in its active region.

For switching applications it is biased to operate in the cut off (full OFF) region or saturation (full ON) region.

a.Transistor in cut- off region:

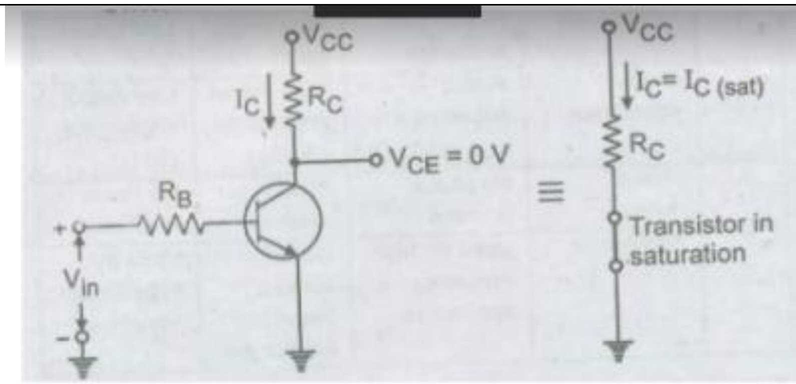


In the cut –off region both the junctions of the transistor are reverse biased and very small reverse current flows through the transistors.

- The voltage drop across the transistor (V_{CE}) is high nearly equal to supply voltage V_{CC}.

. So, in the cut off region the transistor is equivalent to an open switch as shown in figure.

b. **Transistor in the saturation region:**



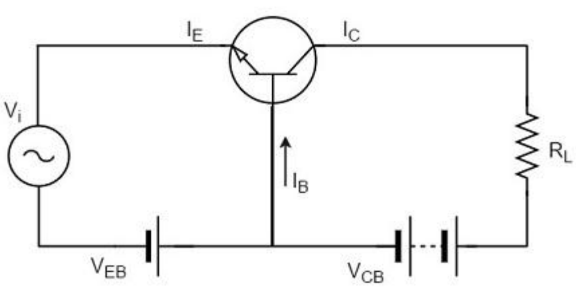
When Vin is positive a large base current flows and transistor saturates.

In the saturation region both the junctions of a transistor are forward biased. 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 and collector current is very large.

In saturation the transistor is equivalent to a closed switch.

Explanation of transistor as an amplifier: **3M**

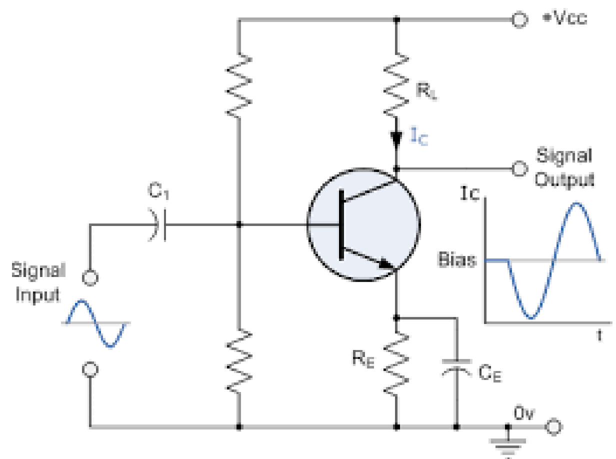
For a transistor to act as an amplifier, it should be properly biased. The Emitter Base junction is forward biased and collector Emitter junction is reverse biased.



The low resistance in input circuit lets any small change in input signal to result in an appreciable change in the output. The emitter current caused by the input signal contributes the collector current, which when flows through the load resistor R_L, results in a large voltage drop across it. Thus a small input voltage results in a large output voltage, which shows that the transistor works as an amplifier.

OR

(iii)Transistor in Active region (Amplifier):



- For amplification, the transistor is biased in its active region.
- Emitter Base junction is forward biased and collector Emitter junction is reverse biased.
- When input is applied as V_{BE} in CE configuration, as β is high, current gain is high, output current increases and as the voltage.
- So output signal is amplified w.r.t. input signal.