WINTER– 18 EXAMINATION

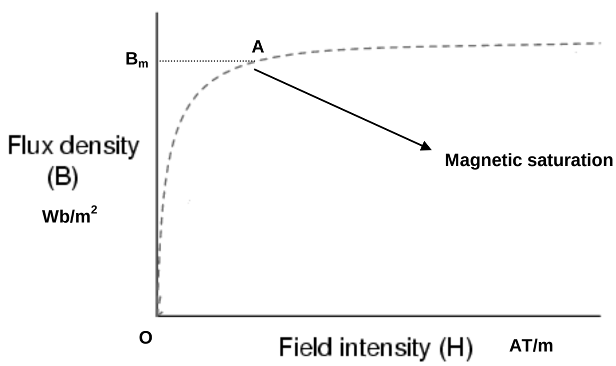
Subject Name: Basic Electrical & Electronics **Model Answer** Sub. Code 22310

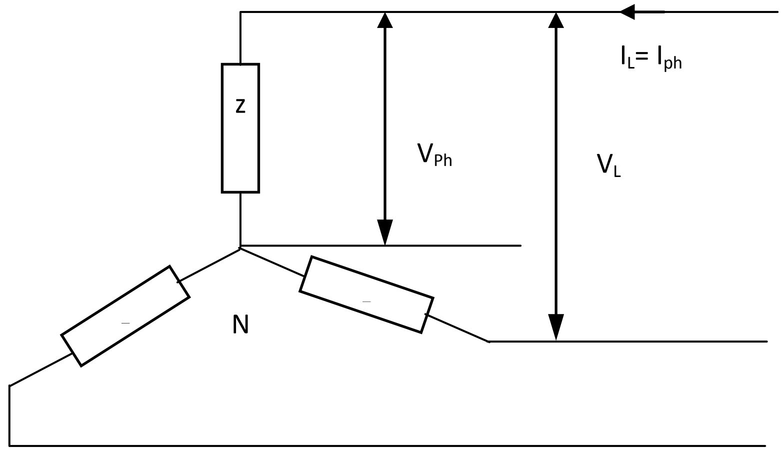
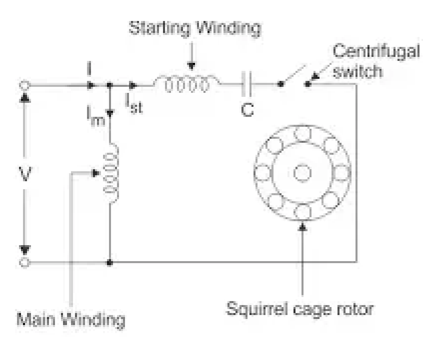
Important Instructions to examiners:

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.

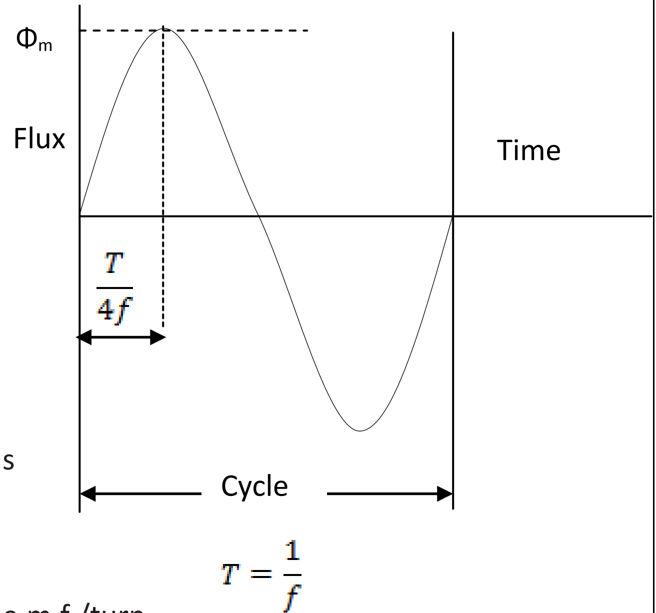
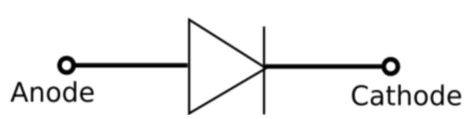
Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any Six of the following**	
	a	Permeability : It is the ability of a magnetic/Non magnetic material to allow setting up of flux in it.	2 Marks
	b	MMF : The magneto motive force (MMF) is the force required to setup flux in a magnetic /Non magnetic material.	2 Marks
	c	Form Factor (k_f) : Form Factor is defined as the ratio of RMS value of an a.c. to its average value	2 Marks
	d	Frequency : Frequency is defined as the number of cycles per second of an a.c. wave.	1 Mark
		Time Period : Time Period is defined as the time required to complete one cycle of an a.c. wave.	1 Mark
	e	Transformation Ratio (k) : (any one definition) Transformation Ratio is defined as the ratio of primary voltage to secondary voltage OR The ratio of primary number of turns to secondary number of turns or OR The ratio of secondary current to primary current.	2 Marks

	f	$E_1 = 4.44 f B_m A N_1$ or $E_1 = 4.44 \Phi_m A N_1$	1 Mark
		$E_2 = 4.44 f B_m A N_2$ or $E_1 = 4.44 \Phi_m A N_2$	
		Where : E_1 & E_2 – emf induced in primary & secondary winding N_1 & N_2 – Number of turns of primary & secondary winding f – Supply frequency A – Cross sectional area of core, B_m – Maximum flux density , Φ_m – Maximum flux	1 Mark
	g	Water pumps, ceiling fan, lathe machine (any two of such applications)	1 Mark each application

Q. No.	Sub Q. N.	Answer	Marking Scheme
2		**Attempt any Three of the following**	
	a	 **Key points** The B-H curve is the relation between Flux density B in Wb/m^2 (on Y Axis) and H in AT/m (on X axis) It is also known as magnetization characteristics. This curve particularly useful to know the characteristics of magnetic material which is generally used to construct pole of an electric machine. It also gives the behavior of the material to get magnetized with rise of current (AT) Initially the material doesn't have any flux, hence the curve starts at point o. As the process of magnetization starts & current increases, the flux density in the material also increases in proportion with the rise in current. The rise in flux density with rise in current will continue up to point 'A' till maximum flux density occurs. At point 'A' material gets magnetically saturated and the curve becomes flat (parallel to X axis)	Diagram 01 Mark Explanation 03 marks

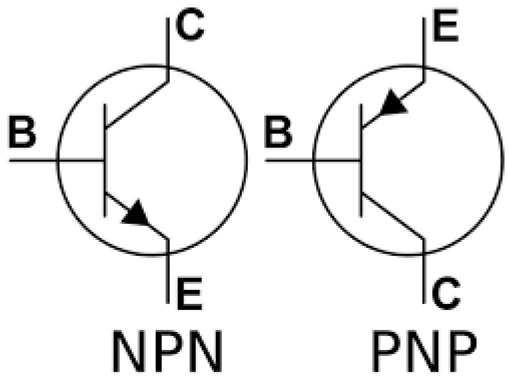
	Sub Q. N.	Answer	Marking Scheme
2	b	$V_L = \sqrt{3}V_{Ph}$ $I_L = I_{Ph}$  	Circuit diagram 03 Marks Relation /Equation - 01 Mark
	c	**<u>Key points</u>** Transformer is a static device (does not have any moving/rotating parts) Transformer has two windings: primary & secondary. Transformer works on the principle of mutual induction between two coils. Transformer transfers electrical energy from one circuit to another circuit with change in voltage &/or current. Transformer transfers electrical energy without change in frequency. Supply is given to primary winding & output is taken from secondary winding.	Any four key points 01 mark each
	d	**<u>Key points</u>** The Stator of single phase induction motor houses two windings 1. Main (Running) winding 2. Auxiliary (Starting) winding  Rotor of single phase induction motor is squirrel cage type These motors works on the principle of induction i.e. an emf is induced in the short circuited rotor circuit & the short circuit current makes the rotor to follow the stator magnetic field which is rotating. These motors are not self-starting. To make them self-starting auxiliary winding is used. The auxiliary winding may be more resistive, capacitive than main winding. A centrifugal switch may be connected in series with starting winding or a capacitor may be permanently connected in series with Auxiliary (Starting) winding.	Circuit diagram 02 Marks At least four key point 02 Marks

3		**Attempt any Two of the following**	
	a	Faraday's First Law : It states that Whenever the magnetic flux linked with a circuit changes, an e.m.f. is always induced in it. ***or*** Whenever a conductor cuts magnetic flux, an e.m.f. is induced in that conductor. Faraday's Second Law : it states that the magnitude of the induced e.m.f. is equal to the rate of change of flux linkages. **<u>Key points</u>** Consider a coil of *N* turns and flux through it changes from an initial value of Φ_1 Wb. to the final value of Φ_2 Wb. in time *t* seconds. The Initial flux linkages = $N\Phi_1$, Final flux linkages = $N\Phi_2$ induced emf $e = \frac{N(\Phi_1 - \Phi_2)}{t}$ Putting the above expression in its differential form, we get $e = -N\frac{d\Phi}{dt}$ The negative sign indicates that the direction of magnetic effect produced by it opposes the very cause producing it.	Laws 02 Marks Each Explanation 04 Marks
	b	Given R= 50 Ω, L= 0.1 H, f=50 Hz, V= 220V $X_L = 2\pi f L = 31.41\ \Omega$ $Z = \sqrt{R^2 + X_L^2} = \sqrt{50^2 + 31.41^2} = 59.047\ \Omega$ $Current\ i = \frac{V}{Z} = \frac{220}{59.047} = 3.725\ A$ $Power\ factor\ (cos\Phi) = \frac{R}{Z} = \frac{50}{59.047} = 0.8467\ A$ $Power\ consumed = Vicos\Phi = 220 * 3.725 * 0.8467$ $Power\ consumed = 693.87\ W$	02 Marks 02 Marks 02 Marks

3	c	Let N_1 = No. of turns in primary N_2 = No. of turns in secondary Φ_m = Maximum flux in core= $Bm \times A$ f = Supply frequency when the flux increases from its zero to maximum (Φ_m) in (1/4 f) of the cycle.  ∴ Average rate of change of flux = $\frac{\Phi m}{\frac{1}{4f}}$ = 4 f Φ_m Now, rate of change of flux per turn means induced e.m.f. ∴ Average e.m.f./turn = 4 f Φm As the flux Φ varies sinusoidally, then r.m.s. value = Form factor X Average e.m.f./turn Form Factor k_f= 1.11 ∴ r.m.s. value of e.m.f./turn = 4.44f Φ_m r.m.s. value of e.m.f. induced in primary = 4.44f Φ_m N_1 = 4.44f B_m A N_1 r.m.s. value of e.m.f. induced in Secondary = 4.44f Φ_m N_2 = 4.44f B_m A N_2	Figure 02 Mark Derivation 04 Marks
		SECTION B	
4		**Attempt any Five of following**	
	a	**Define Active component. Give two examples.** The component which requires power supply for its operation is called as Active component. e.g. Diode, Transistor, ICs	Def- 1 M Exmp- 1M
	b	**Draw symbol of PN-junction diode and give two applications.** **Symbol -**  **Applications:-** i) Rectifier ii) Detector in RF circuit. iii) Waveform shaping circuits – Clipper and Clampers	Symbol - 1 M Appl- 1 M

c

Draw symbol of PNP and NPN transistor



1 M each

d

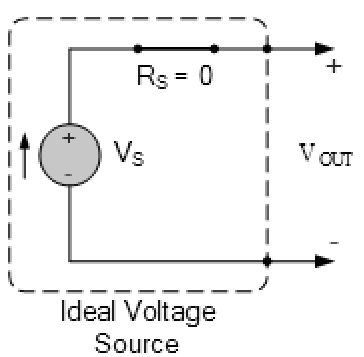
Define PIV

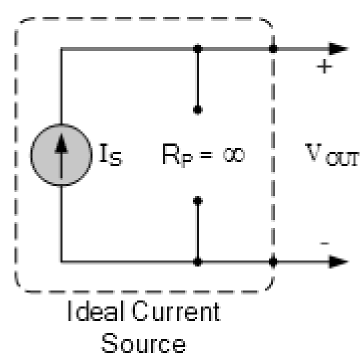
Peak Inverse Voltage (**PIV**) or Peak Reverse Voltage (PRV) refer to the maximum voltage a diode can withstand in the reverse-biased direction before breakdown. Also may be called Reverse Breakdown Voltage.

2 M

e

Draw the symbol of Ideal voltage source and ideal current source





1 M each

f

Define α and β of a transistor

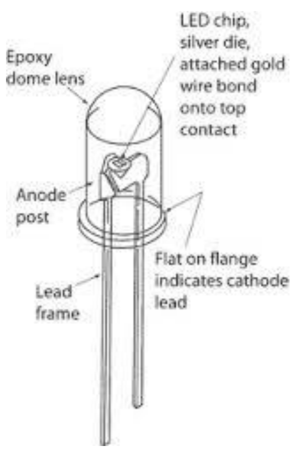
Alpha – it is ratio of collector current IC to emitter current IE of a transistor.

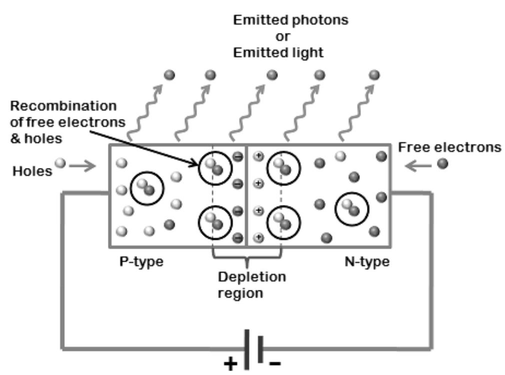
Beta – It is the ratio of Collector current IC to the Base current IB of a transistor.

02

$$\text{Alpha}, (\alpha) = \frac{I_C}{I_E} \quad \text{and} \quad \text{Beta}, (\beta) = \frac{I_C}{I_B}$$

5		**Attempt any THREE of the following**	
	a	**Define Amplitude and Phase of Sinusoidal quantity.** **Amplitudes** are expressed either as instantaneous values or mostly as peak values. **Amplitude** is the fluctuation or displacement of a wave from its mean value. **Phase** is the position of a point in time (an instant) on a waveform cycle. **Phase** an expression of relative displacement between or among waves having the same frequency .	2 M each
	b	**Explain the construction details of LED**	





Light Emitting Diode (LED)

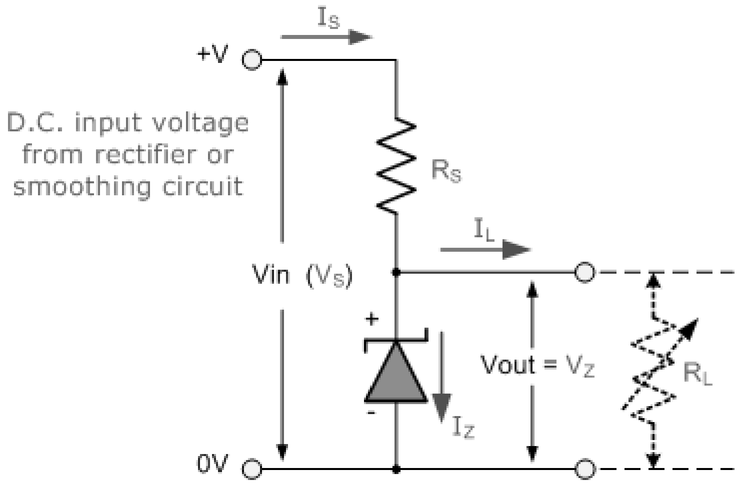
Dia-2M

The construction of LED differs from normal standard diode in many aspects. As shown in the figure the p-n junction of the LED bulb is enclosed by a transparent, hard plastic epoxy resin hemispherical-shaped shell or body which protects the LED from shock and vibration.

Exp-2M

LEDs have two terminals; a cathode and an anode. The cathode terminal is identified by either a flat spot on the body or notch or by one of the leads shorter than the other. The domed top of the LED is just like a lens concentrating the amount of light. The epoxy resin shell is constructed in such a way that the photons of light emitted by the junction are reflected away from the substrate base to which the diode is attached because LED junction does not emit that much light. Due to this, the brightest light will be emitted at the top of the LED.

5 c **Explain Zener diode as voltage regulator.**



Dia- 2M

Zener Diodes can be used to produce a stabilised voltage output with low ripple under varying load current conditions. By passing a small current through the diode from a voltage source, via a suitable current limiting resistor (R_S), the zener diode will conduct sufficient current to maintain a voltage drop of Vout.

Exp- 2M

The resistor, R_S is connected in series with the zener diode to limit the current flow through the diode with the voltage source, V_S being connected across the combination. The stabilised output voltage V_{out} is taken from across the zener diode. The zener diode is connected with its cathode terminal connected to the positive rail of the DC supply so it is reverse biased and will be operating in its breakdown condition. Resistor R_S is selected so to limit the maximum current flowing in the circuit.

With no load connected to the circuit, the load current will be zero, ($I_L = 0$), and all the circuit current passes through the zener diode which in turn dissipates its maximum power. The load is connected in parallel with the zener diode, so the voltage across R_L is always the same as the zener voltage, ($V_R = V_Z$). The supply voltage V_S must be greater than V_Z.

A zener diode is always operated in its reverse biased condition. A voltage regulator circuit can be designed using a zener diode to maintain a constant DC output voltage across the load in spite of variations in the input voltage or changes in the load current.

d **Find the value of resistor from given colour code**

02 for each

(1M for each step)

i) **Red Red Red Gold = 22 X** $10^2 \pm 5\%$

= 2.2 KΩ ±5%

ii) **Blue Orange Green Silver = 63 X** $10^5 \pm 10\%$

= 6.3 MΩ ±10%

5

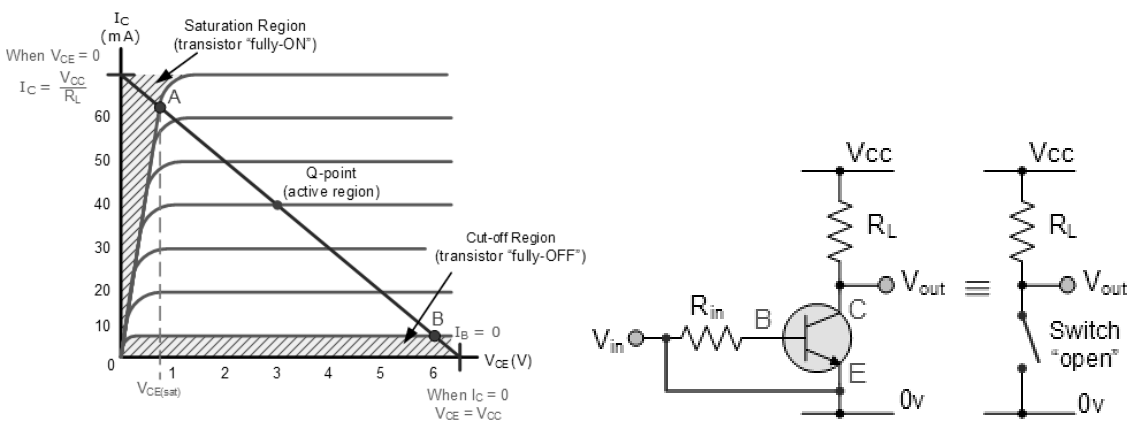
Explain with neat diagram how transistor can be used as a switch.

e

In Bipolar Transistor as a Switch the biasing of the transistor, either NPN or PNP is arranged to operate the transistor at both sides of the " I-V " characteristics curves. The areas of operation for a transistor switch are known as the Saturation Region and the Cut-off Region**.** This means then that we can ignore the operating Q-point biasing and voltage divider circuitry required for amplification, and use the transistor as a switch by driving it back and forth between its "fully-OFF" (cut-off) and "fully-ON" (saturation) regions as shown below.

02 sketch

02 explanation



1. Cut-off Region

Here the operating conditions of the transistor are zero input base current (I_B), zero output collector current (I_C) and maximum collector voltage (V_{CE}) which results in a large depletion layer and no current flowing through the device. Therefore the transistor is switched "Fully-OFF".

2. Saturation Region

Here the transistor will be biased so that the maximum amount of base current is applied, resulting in maximum collector current resulting in the minimum collector emitter voltage drop which results in the depletion layer being as small as possible and maximum current flowing through the transistor. Therefore the transistor is switched "Fully-ON".

6

Attempt any two of the following

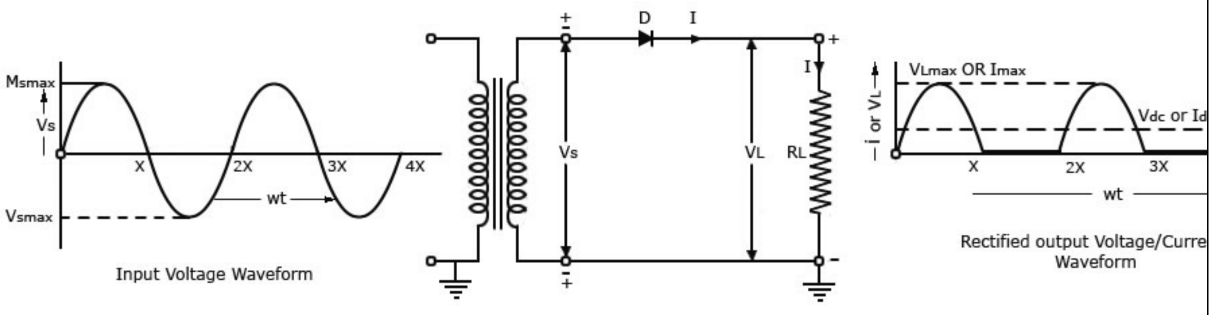
a

Differentiate between analog and digital ICs

Items	Analog IC	Digital IC
Signal Characteristics	Continuous, such as light, sound, speed, temperature, etc.	Discrete, 0 and 1.
Technological Complexity	High entry barrier with 10~15 years learning curve	Relying on Computer Aided Design (CA tools with 3~5 year learning curve
Product Accreditation	More than 1 year	3~6 months
Substitution	Low	High
Product Portfolio	Low volume, High variety	High volume, Low variety
Applications	Power management, Audio amplification, Signal transformation and monitoring	Logic computation, Control, Digital signal coding/decoding
Price	Stable	Volatile

01 for each

6 b **Explain the working of Half wave rectifier with suitable diagram**



Half-Wave Rectifier

Ckt- 1 M

Wf-2 M

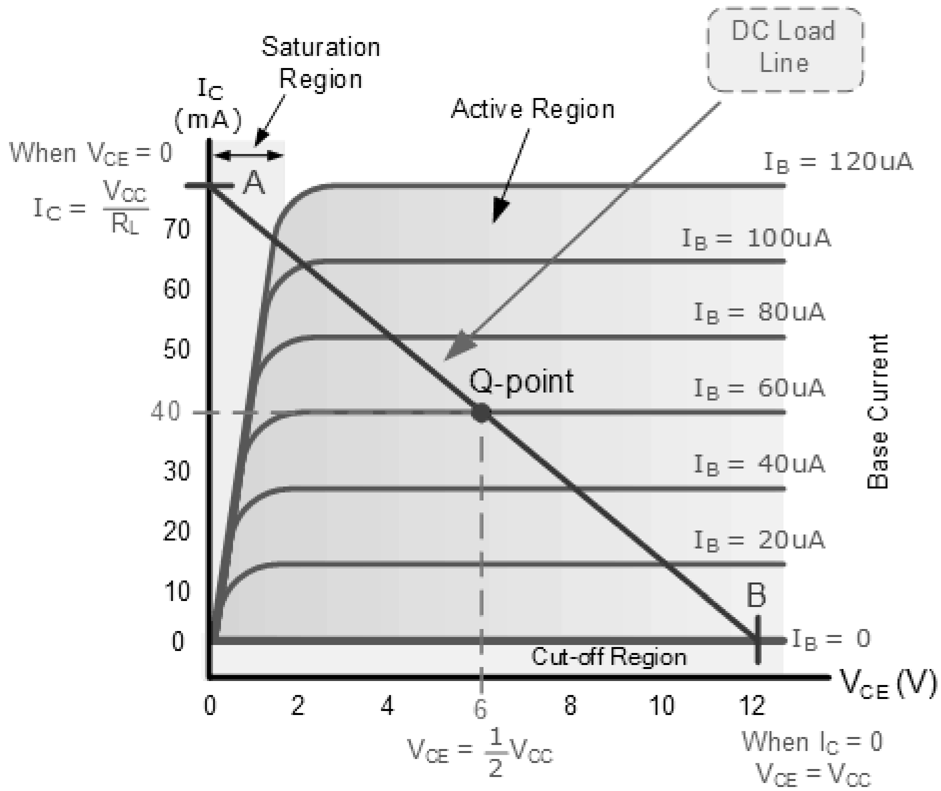
The half-wave rectifier circuit using a semiconductor diode (D) with a load resistance R_L but no smoothing filter is given in the figure. The diode is connected in series with the secondary of the transformer and the load resistance $R_{L.}$ The primary of the transformer is being connected to the ac supply mains.

Working- 3 M

The ac voltage across the secondary winding changes polarities after every half cycle of the input wave. During the positive half-cycles of the input ac voltage i.e. when the upper end of the secondary winding is positive w.r.t. its lower end, the diode is forward biased and therefore conducts current. If the forward resistance of the diode is assumed to be zero (in practice, however, a small resistance exists) the input voltage during the positive half-cycles is directly applied to the load resistance R_L, making its upper-end positive w.r.t. its lower end. The waveforms of the output current and output voltage are of the same shape as that of the input ac voltage.

During the negative half cycles of the input ac voltage i.e. when the lower end of the secondary winding is positive w.r.t. its upper end, the diode is reverse biased and so does not conduct. Thus during the negative half cycles of the input ac voltage, the current through and the voltage across the load remains zero. The reverse current, being very small in magnitude, is neglected. Thus for the negative half cycles, no power is delivered to the load.

Thus the output voltage (VL) developed across load resistance R_L is a series of positive half cycles of alternating voltage, with intervening very small constant negative voltage levels, It is obvious from the figure that the output is not a steady dc, but only a pulsating dc wave. To make the output wave smooth and useful in a DC power supply, we have to use a filter across the load. Since only half-cycles of the input wave are used, it is called a half wave rectifier.

	c	**Draw the diagram of transistor operating regions** 	06