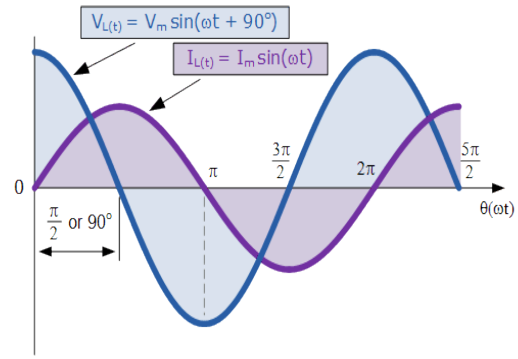
MODEL ANSWER
SUMMER– 18 EXAMINATION

Subject Title:- Electrical and Electronics Technology **Subject Code:-** 22232

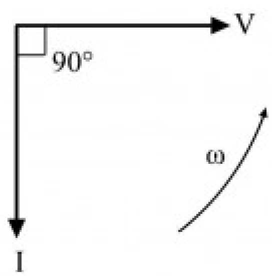
Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in 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.

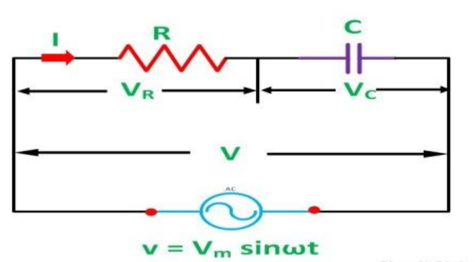
Q. No.	Sub Q.N.	Answer	Marking Scheme
Q.1		**Attempt any SIX of the following :**	**12 Marks**
	a)	**Define: (i) Electromagnetism (ii) Magnetic flux.**	**2 Marks**
	Ans:	**i)Electromagnetism :** It is the magnetism generated by electricity. **OR** It is defined as the phenomenon associated with electric and magnetic fields and their interactions with each other. **ii) Magnetic flux :** The total number of magnetic lines of force in a magnetic field is called magnetic flux.	**1 mark for each**
	b)	**List the types of induced emf.**	**2 Marks**
	Ans:	**The types of induced emf are :** i) Statically induced emf , ii) Dynamically induced emf	**1 mark for each**
	c)	**With the help of waveforms and phasor diagrams, show the phase relationship between voltage and current in pure inductive circuit.**	**2 Marks**
	Ans:		



Phasor Diagram:



		(waveform and phasor diagram above)	**1mark-waveform and 1 mark for phasor diagram**
	d)	**Define: (i) Inductive reactance (ii) Impedance.**	**2 Marks**
	Ans:	**i) Inductive reactance:** Inductive reactance is the opposition offered by an inductor to alternating current . It is denoted by X_L and given by $X_L = 2\pi f\, L\Omega = \omega L\ \Omega$ **ii)Impedance:** It is the total opposition offered to flow of AC current in an AC circuit. It is denoted by Z and the unit is ohm.	**1 mark for each**
	e)	**State the working principle of I ø transformer.**	**2 Marks**
	Ans:	Transformer works on the principle of mutual inductance. When an alternating voltage V_1 is applied to the primary winding of a transformer, an alternating flux φ is set up in the core. This alternating flux links with both the windings and induces self-induced emf E_1 in the primary winding and mutually induced emf E_2in the secondary according to Faraday's laws of electromagnetic induction.	**2 Marks**
	f)	**State the types of single phase induction motors.**	**2 Marks**
	Ans:	The types of single phase induction motors are: i) Resistance split phase induction motor. ii) Capacitor split phase inductor motor. a. Capacitor start induction run motor b. permanent capacitor motor c. capacitor start capacitor run induction motor	**2 marks for any four types**

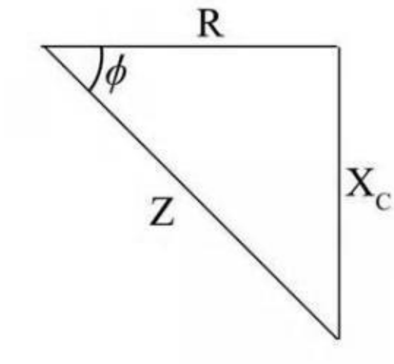
		iii) Shaded pole induction motor.	
	g)	**Write emf equation of a transformer.**	**2 Marks**
	Ans:	E.M.F equation of transformer is given by $$E.M.F = 4.44\ \Phi_m\ f\ \ N\ volts$$ where Φm= Maximum value of ac flux linking with primary and secondary winding. f = frequency of applied ac signal N= number of turns on primary or on secondary. Turns on primary winding = N_1 Turns on secondary winding= N_2 E.M.F= voltage induced in either primary or secondary winding Voltage induced in primary = $E_1 = 4.44\ \Phi_m\ f\ \ N_1$volts Voltage induced in primary = $E_2 = 4.44\ \Phi_m\ f\ \ N_2$volts	**1 mark for equation and 1 mark for terminology**
Q 2		**Attempt any THREE of the following:**	**12 Marks**
	a)	**State Faraday's first and second law of electromagnetic induction.**	**4 Marks**
	Ans:	i) **Faraday's First Law:** Whenever a conductor cuts the magnetic lines of force or is cut by the magnetic lines of force or flux linking with conductor changes, an emf is induced in the conductor. ii) **Faraday's Second Law**: The magnitude of induced emf is directly proportional to the rate of change of flux. $$e = -N \frac{d\phi}{dt}\ volts$$	**2 mark for each law**
	b)	**Draw series R-C circuit. Write its expression for impedance and show it on impedance triangle.**	**4 Marks**
	Ans:	**Series R-C circuit:**  	**Circuit diagram-2marks, expression-1 mark, impedance triangle-1mark**

Expression for Impedance:

$Z=\sqrt{R^2+Xc^2}$ $\phi = \tan^{-1}\frac{Xc}{R}$

Where , Z= impedance, R- resistance in Ω, Xc- capacitive reactance in Ω

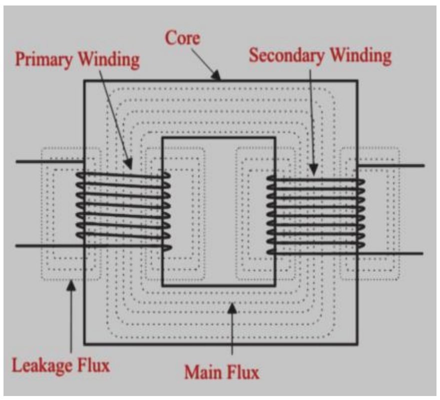
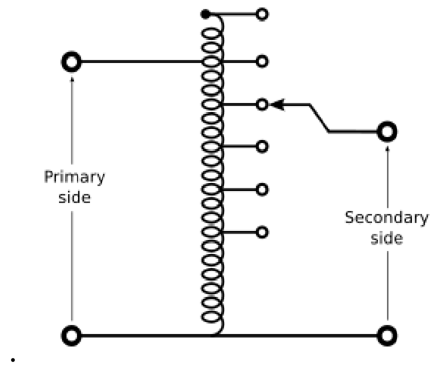
Impedance triangle:



c)	**Define: (i) Efficiency (ii) Voltage regulation of transformer.**	**4 Marks**
Ans:	i) **Efficiency :** It is the ratio of output power to the input power of the transformer.It is denoted by η. $$\eta = \frac{\text{output power}}{\text{input power}} = \frac{\text{output power}}{\text{output power + losses}}$$ $$\eta = \frac{\text{output power}}{\text{output power + iron losses + copper losses}}$$ $$\eta = \frac{V_2 I_2 Cos\varphi_2}{V_2 I_2 Cos\varphi_2 + P_i + P_c}$$ Pi = iron loss, Pc=copper loss of transformer $V_2I_2Cos\emptyset_2$ = output power of transformer **ii) Voltage Regulation of transformer:** The ratio of the change in Secondary Terminal Voltage from no load to full load (V_{FL}) to no load voltage.(V_{NL}) The Regulation is usually expressed in percentage of no load Secondary terminal Voltage. So Voltage Regulation = $\frac{VNL-VFL}{VNL}$ X100 where,	**2 marks for each definition**

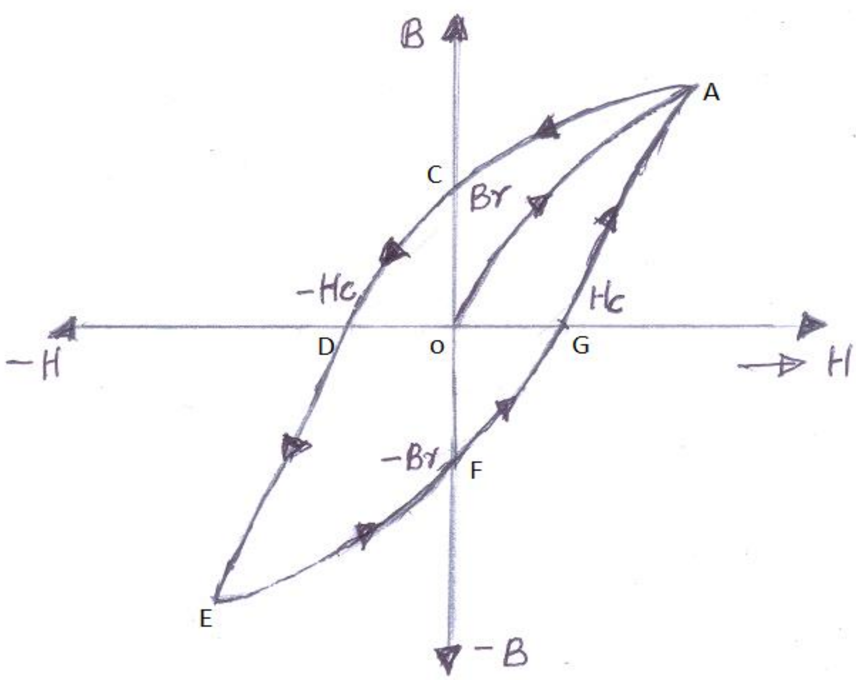
V_{NL} = No Load Secondary voltage
V_{FL} = Full load secondary voltage

	d)	**Compare autotransformer with two winding transformer. (4 points)**	**4 Marks**
	Ans:	(see table below)	**Each Point 1 Mark (Any 4)**

Two winding transformer	**Auto transformer**
1.It has two separate windings : a) primary, b)secondary.	1. An auto transformer has single winding which acts both as primary and secondary.
2. 	2. 
3. It provides good electrical isolation to both supply as well as load.	3. Electrical isolation is not provided by auto transformer as it has single winding only
4.Losses are higher than auto transformer due to its construction.	4. As only one winding is present, copper losses are less. Due to compact and simple structure of core, iron losses are also less.
5.Overall efficiency is lesser than auto transformer.	5. Overall efficiency is higher than two winding transformer.
6. Cost is higher than auto transformer.	6. Cost is lesser than 2 winding transformer.

7.Application : used in	7. Application:
1. power distribution, 2. audio transmission, 3. Current transformer ,Potential transformer. 4. Electric furnaces	1. used in both Synchronous motors and induction motors 2. used in electrical apparatus testing labs since the voltage can be smoothly and continuously varied. 3. They find application as boosters in AC feeders to increase the voltage levels.

Q. 3		**Attempt any TWO of the following:**	**12 Marks**
	a)	**Draw and explain B-H curve.**	**6 Marks**
	Ans:	**Diagram:**	**3 marks diagram (with complete detailing) & 3 marks explanation**



B-H Curve

Explanation:

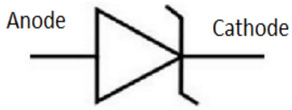
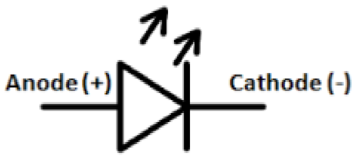
B-H curve is obtained while plotting the graph between B & H for a magnetic material while magnetized through one complete cycle of magnetization. The value of magnetizing force H can be increased or decreased by increasing or decreasing the current through the coil. Initially when H is increased from zero to maximum, flux density also increases rapidly at first and reaches maximum saturated (region OA).

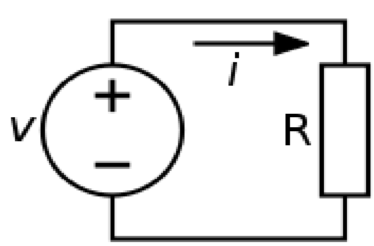
		Now when H is decreased, B varies less rapidly along OC. At C, when H = 0, flux density retains some value called residual flux density (Br). Br measures the retentively or remanence of the magnetic material. Now if the current is reversed to magnetize the material in the opposite direction, as H is increased Br decreases till the point D where it becomes zero. The magnetizing force required to be applied in the opposite direction to remove the residual flux density is called coercive force (Hc) and is a measure of coercivity of the material. For a further increase in H the material gets magnetized with opposite polarity reaching saturation at the point E. The loop can be traced back to the point A by varying the current. At F, B = -Br for H = 0 & at G, B = 0 for H = Hc. Thus the closed loop OACDEFGA obtained when the magnetic material is taken through one complete cycle of magnetization is called the hysteresis loop. It is a measure of the energy dissipated due to hysteresis, more the area higher is the hysteresis loss.	
	b)	**An alternating voltage is represented by the expression: V = 25 sin (200 nt), Calculate: (i) Amplitude (ii) Time period (iii) RMS value (iv) Average value (v) Form factor (vi) Crest factor.**	**6 Marks**
	Ans:	Comparing the given equation with the general form of sinusoidal alternating voltage, $v = V_m \sin\omega t$, we get, $V_m = 25V$ $\omega = 2\pi f = 200\pi$ i) Amplitude = 25V ii)Time period = $\frac{1}{f} = \frac{1}{100} = 0.01\text{sec}\left[2\pi f = 200\pi,\ f = \frac{200\pi}{2\pi} = 100\text{Hz}\right]$ iii)RMS value = $V = \frac{V_m}{\sqrt{2}} = \frac{25}{\sqrt{2}} = 17.68\text{v}$ iv) average value = $v_{av} = \frac{2V_m}{\pi} = \frac{2\times25}{\pi} = 15.92\text{v}$ v) form factor $= k_f = \frac{V}{V_{av}} = \frac{17.68}{15.92} = 1.11$ vi) Crest factor = $k_p = \frac{V_m}{V} = \frac{25}{17.62} = 1.414$	**1 mark each**
	c)	**A 200 kVA, 33001240 V, 50 Hz single phase transformer has 80 turns on secondary winding.** **Calculate:** **(i) Primary and secondary currents on full load.** **(ii) Maximum value of flux.** **(iii) Number of primary winding turns.**	**6 Marks**
	Ans:	i) Primary current on full load, $I_1 = \frac{kVA\times1000}{V_1} = \frac{200\times1000}{3300} = 60.6A$ Secondary current on full load, $I_2 = \frac{kVA\times1000}{V_2} = \frac{200\times1000}{240} = 833.33A$ ii) Let, $V_2 = E_2 = 4.44 f \emptyset_m N_2$ Hence, $\emptyset_m = \frac{240}{4.44\times50\times80} = 13.5\text{mwb} = 0.0135\text{ wb}$	**2 marks each**

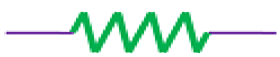
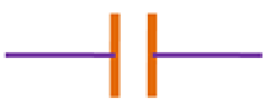
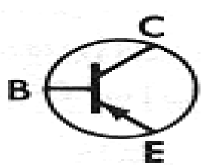
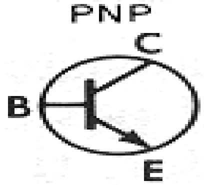
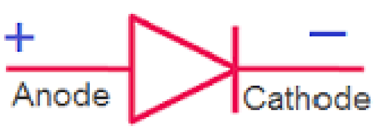
		iii) $\frac{V_1}{V_2} = \frac{N_1}{N_2}$, therefore $N_1 = \frac{V_1}{V_2} \times N_2 = \frac{3300}{240} \times 80 = 1100$	
Q. 4		**Attempt any FIVE of the following:**	**10 Marks**
	a)	**Compare analog and digital ICs.**	**2 Marks**
	Ans:	(see table below)	**2 marks for any two correct comparison**

Sr. No.	Analog ICs	Digital ICs
1	Analog ICs accept and output analog data through its pins.	Digital ICs deal with only logic data inputs and outputs.
2	Almost every analog IC requires external components for its functioning.	Digital ICs don't require external components.
3	Example: IC555	Example: any digital IC like 7404 which is a NOT gate
4	Variable input is accepted by IC for dedicated application.	Works with TTL logic level and works in voltage range of 0–5V only.

	b)	**Define passive components and classify them.**	**2 Marks**
	Ans:	**Passive components**: The components which by themselves are not capable of amplifying (or processing) electrical signals are known as passive components. They require external energy source for their functioning. These are bidirectional devices. **Classification:** Resistors, Capacitors, Inductors etc.	**Definition-1 marks Classification-1 marks**
	c)	**List any two applications of LED.**	**2 Marks**
	Ans:	1) LEDs are used in 7 segment display and dot matrix display. 2) They are used in opto couplers. 3) They are used for indicating power ON/OFF conditions. 4) They are used in infrared remote controls. 5) They are used as indicators in various electronic circuits.	**1 marks each for any two**
	d)	**Draw symbols of: (i) Zener diode (ii) LED.**	**2 Marks**
	Ans:		

		i) Zener diode  ii) LED  	**1 marks each**
	e)	**State why transistor is called as a bipolar device.**	**2 Marks**
	Ans:	In case of transistor (BJT), the current conduction takes place due to both electrons and holes, ie, due to both positive as well as negative polarity charge carriers. Therefore transistor is called a bipolar device.	**2 marks**
	f)	**List the different transistor configurations.**	**2 Marks**
	Ans:	The three different transistor configurations are, 1. Common emitter configuration(CE) 2. Common base configuration(CB) 3. Common collector configuration(CC)	**2 marks for correct listing**
Q.5		**Attempt any THREE of the following:**	**12 Marks**
	a)	**Find the resistor value from the given colour coding:** **(i) Blue Grey Black Red Gold.** **(ii) Brown Black Black Silver**	**4 Marks**
	Ans:	**Note: Assessor can give step marks for identifying at least correct digits for given colors, even if final answer is wrong.** i) Blue Grey Black Red Gold **6 8 0 x 10^2 $\pm$ 5%** **= 68 KΩ $\pm$ 5%** **ii)** Brown Black Black Silver **1 0 x 10^0 $\pm$ 10%** **= 10 Ω $\pm$ 10 %**	**2 marks for each correct calculation**
	b)	**State the need for filters and list the different types of filters.**	**4 Marks**
	Ans:	**Need for filters** 1) Output of all rectifiers is pulsating dc voltage and most of citcuits which work	**2 marks for need**

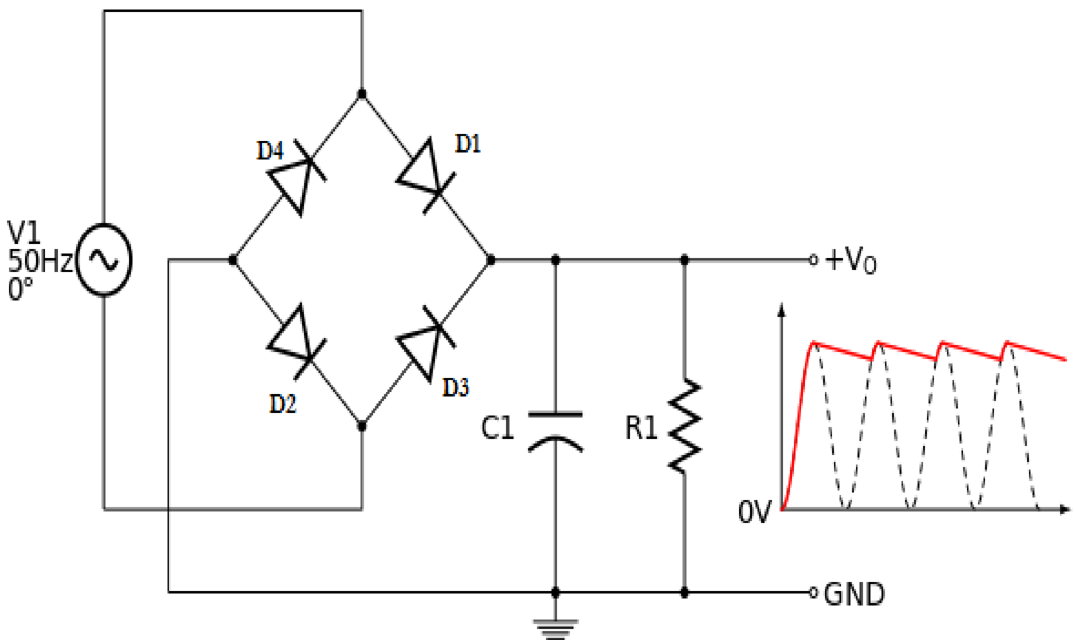
		on dc requires pure dc voltage. 2) So in order to get pure dc waveform, filters are connected at the output of rectifier to remove the ripple. 3) Thus filters are electronic circuits used alongwith rectifier in order to get a pure ripple free dc voltage. **Types of filters** 1) Capacitor input filter(Shunt capacitor filter) 2) Choke input filter(series inductor filter) 3) LC filter 4) π Filter 5) RC filter	**2 marks for types**
	c)	**Derive the relationship between α & β of transistor.**	**4 Marks**
	Ans:	We know, **$I_E = I_B + I_C$** **Dividing the above equation on both sides by I_C , We get** **$I_E/I_C = I_B/I_C + 1$** **Since $I_C/I_E = \alpha$ and $I_C/I_B = \beta$** **So $I_E/I_C = 1/\alpha$ and $I_B/I_C = 1/\beta$** **$1/\alpha = 1/\beta + 1$** **<u>Therefore $\alpha = \beta/ 1 + \beta$</u>** **The above expression may also be written as (OPTIONAL)** **$\alpha(1 + \beta) = \beta$** **$\alpha + \alpha\beta = \beta$** **$\alpha = \beta - \alpha\beta$** **$\alpha = \beta(1 - \alpha)$** **<u>Therefore $\beta = \alpha / 1 - \alpha$</u>**	**2 marks each derivation**
	d)	**Explain ideal voltage source with suitable diagram.**	**4 Marks**
	Ans:	 **Ideal Voltage Source**	**2 marks diagram**

		• A voltage source is a two terminal device which can maintain a fixed voltage. • An ideal voltage source can maintain the fixed voltage independent of the load resistance or the output current. • The source resistance of an ideal voltage source is zero. Therefore the terminal voltage remains constant equal to V volts without load ($R_L = \infty$) or with load	**2 marks explanation**
Q.6		**Attempt any TWO of the following:**	**12 Marks**
	a)	**Draw symbols for: (i) Resistor (ii) Capacitor (iii) Inductor (iv) PNP transistor (v) NPN transistor (vi) PN junction diode.**	**6 Marks**
	Ans:	 Resistor  Capacitor  Inductor  PNP  NPN  PN junction diode	**1 mark for each symbol**

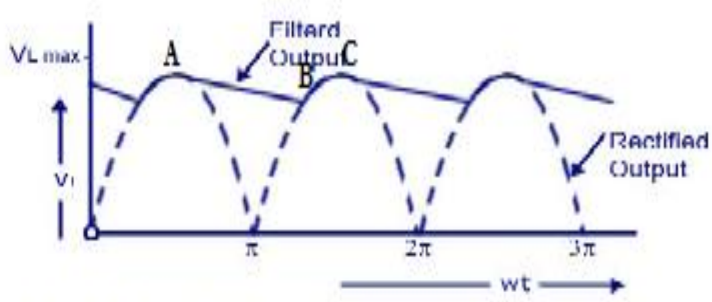
	b)	**Draw and explain: bridge rectifier with shunt capacitor filter.**	**6 Marks**

Ans:

3 marks Diagram



Operation of bridge rectifier with capacitor filter is explained in different intervals with the help of the following wave form.



Rectified and Filtered Output Voltage Waveform
Full-wave Rectifier With capacitor Input Filler

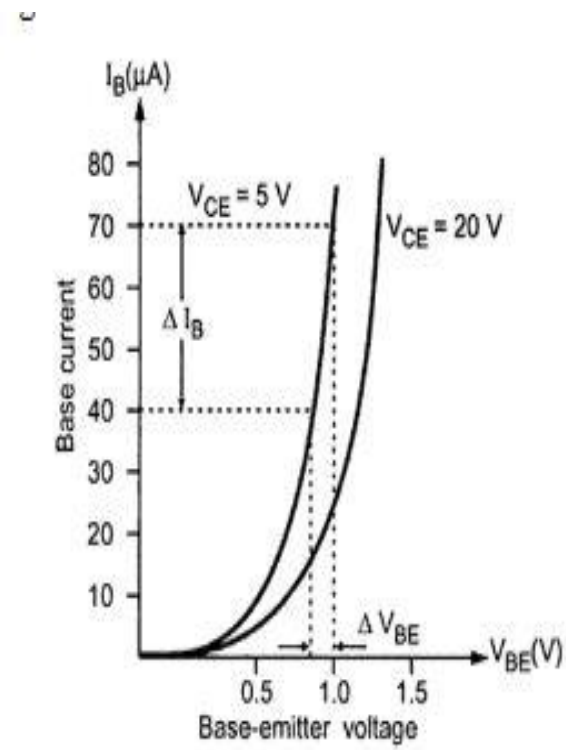
3 marks explanation and Waveform

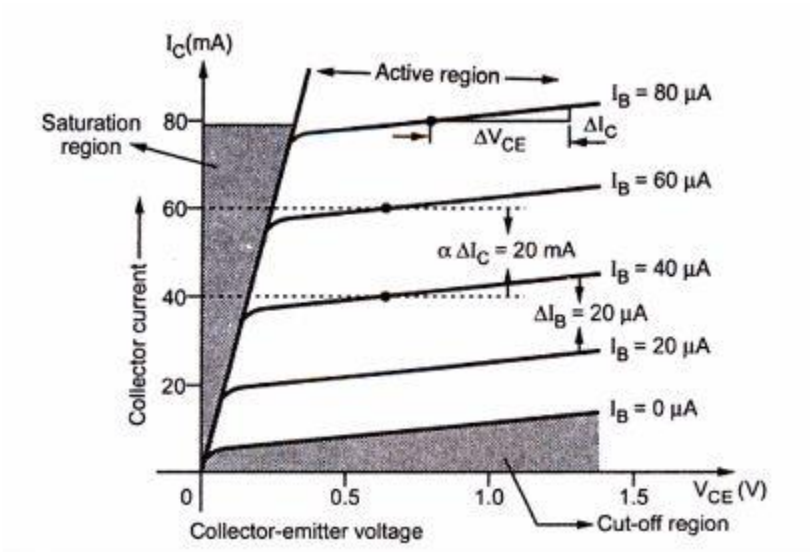
Operation in interval at 0 to A:

- The initial voltage on capacitor C is assumed to be 0.In first positive half cycle of the supply, diode D_1 and D_2 will forward biased and starts conducting. Diodes D_3 and D_4 are reversed biased and act as open switch. Forward biased diodes will provide charging current for capacitor and the load current.

- Capacitor starts charging through D_1 and D_2, and at the end of this interval , it charges to the peak value of secondary voltage Vm.

  Voltage at capacitor C is now Vm.

		After point A capacitor voltage starts reducing. **Operation in interval A to B:** • After point A, voltage on capacitor is higher than rectified output. Diodes D_1 and D_2 are reversed biased. So capacitor discharges exponentially through the load resistance R_L. • As value of R_L is much higher than R_F, the capacitor discharges slowly. • Value of C is large enough to make discharging time constant as large as possible. This will reduce ripple content in the output voltage. **Operation in interval B to C:** • After point B , rectified output again increases.So again capacitor C will start charging towards Vm in interval B to C abd the process repeats. • The load voltage waveform with capacitor filter is very close to theideal dc voltage waveform as most of the ripple is removed from rectified output.	
	c)	**Draw: (i) Input characteristics of transistor in CE mode.** **(ii) Output characteristics of transistor in CE mode and show different regions on it.**	**6 Marks**
	Ans:	 Input characteristics of the transistor in CE configuration	**2 marks for input characteristic**

		 **Output characteristics of the transistor in CE configuration**	**2 marks for output characteristics and 2 marks for different regions**