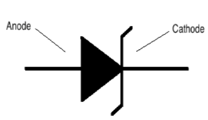
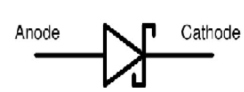
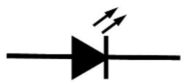
SUMMER– 18 EXAMINATION

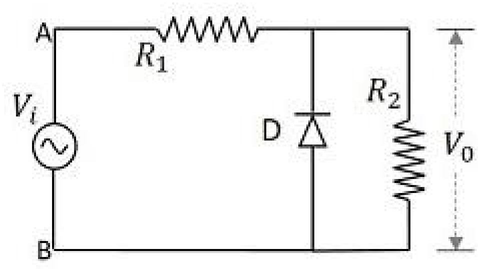
Subject Name: Elements of Electronics **Model Answer** Subject Code: 17215

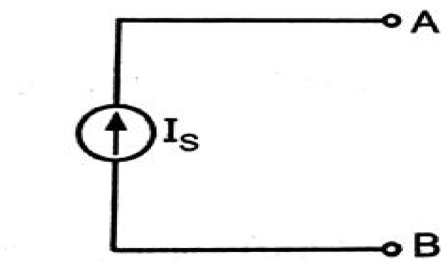
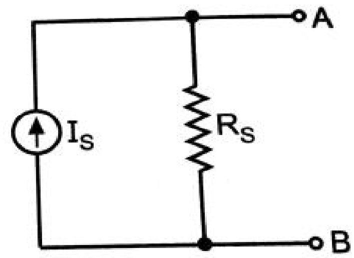
Important Instructions to examiners:

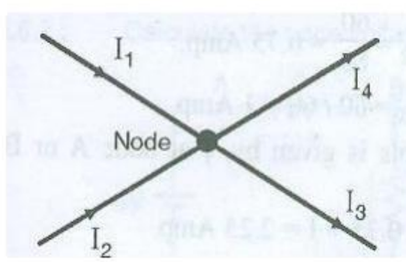
1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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
1	**A**	**Attempt any TEN:**	**20- Total Marks**
	a	**Write colour code of 1 kΩ resistor.**	**2M**
	Ans:	The colour codeof 1 kΩ resistor is : **Brown, Black, Red**	2M
	b	**Draw the symbol of (i) zener diode, (ii) Schottky diode, (iii) LED, (iv) Tunnel diode.**	**2M**
	Ans:	**Zener diode**  **Schottky diode** 	**½ M for each Symbol**

		LED **Tunnel diode**   	
	c	**List the two advantages of Bridge Rectifier.**	**2M**
	Ans:	**The advantages of bridge rectifier:** • The output is twice that of the center-tap circuit for the same secondary voltage. • The PIV is one half that of the center-tap circuit. • The need for center tapped transformer is eliminated and hence needs a simple small size transformer. • Transformer utilization factor, in case of a bridge rectifier, is higher than that of a centre-tap rectifier. • There is no possibility of core saturation of transformer secondary winding and hence transformer losses are reduced. • It can be used in applications allowing floating output terminals.	**Any two 1 mark for each**
	d	**List any four applications of laser diode.**	**2M**
	Ans:	**Applications of LASER diode:** • Fiber optics communication. • Barcode readers. • CD players, CD-ROMs and DVD • Image scanning • Optical data recording, • Laser surgery	**Any four ½ M for each**
	e	**State different types of filters.**	**2M**

	Ans:	**Types of filters**: 1. Series inductor (or choke) filter 2. Shunt capacitor filter 3. Choke input (LC or L type) filter 4. Capacitor input (CLC or πtype) filter	**(1/2 mark for each type**
	f	**Define clipper. Draw circuit of negative shunt clipper.**	**2M**
	Ans:	**Clipper:** The circuit with which the waveform is shaped by removing (or clipping) a portion of the applied wave is known as a clipper.  Negative Shunt Clipper	1M 1M
	g	**Define linear and non-linear wave-shaping circuit.**	**2M**
	Ans:	**Linear wave-shaping circuit** The circuit which makes use of only linear circuit elements is known as linear wave shaping circuits. Resistor, capacitor, inductor are used for the circuits. E.g. Integrator, Differentiator **Non-linear wave-shaping circuit** The circuit which makes use of nonlinear circuit elements is known as nonlinear wave shaping circuits .Diode, transistor, resistors and capacitors etc. are used for the circuits. E.g. Clipper, Clamper	**1M** **1M**
	h	**Draw an ideal current source and practical current source.**	**2M**

	Ans:	  **Ideal current source** **Practical current source** Where, Is = Current Source Rs = internal resistance of source.	**(1 mark for each)**
	i	**List any two applications of Schottkey diode.**	**2M**
	Ans:	**Application of Schottky diode:** • It is used in rectification of very high frequency signals. • It is used in communication system circuits. • It is used in AC to DC converters. • It is used in Radar system. • It is used in switched mode power supply.	**(Any 2 applications 1 M each)**
	j	**Define self-inductance and mutual inductance.**	**2M**
	Ans:	**Self-inductance:** As per the Lenz's law, the self-inducedemf opposes any current change taking place. This property of the coil to oppose any change in current flowing through it is known as the self-inductance or inductance. **Mutual inductance:** It is defined as the property due to which the change in current through one coil produces an emf in the other coil placed nearby, by induction. It is denoted by M and measured in Henry.	**(1 mark for each)**
	k	**State the necessity of wave-shaping circuit.**	**2M**
	Ans:	**Necessity of Wave-shaping circuits:**	

		1. To hold the waveform to a particular d.c level. 2. To generate one waveform from another. 3. To limit the voltage level of the waveform to some preset value and suppress all other voltage levels in excess of the preset level. 4. To cut off the positive and negative portions of the input waveform. **(OR)** In electronics application, it is often needed to alter the shape of waveform like cutting off positive or negative portion of wave, generation of one wave from other, holding wave at some dc level etc. To do this wave shaping circuits are needed.	**Correct statement 2M**
	l	**State Kirchoff' s current law along with its formulae.**	**2M**
	Ans:	In any electrical network, the algebraic sum of the currents meeting at a point or junction is zero. (**OR**) Total current entering a junction or node is exactly equal to the total current leaving the node. $\Sigma I = 0$  **Fig: Illustration for KCL** $\therefore I_1 + I_2 = I_3 + I_4 \text{ or } I_1 + I_2 - I_3 - I_4 = 0$	
	m	**State superposition theorem.**	**2M**

	Ans:	**Superposition theorem:** Superposition theorem states that in any linear network containing two or more sources, the response (current) in any element is equal to the algebraic sum of the response (current) caused by individual sources acting alone, while the other sources are replaced by their internal resistances.	**2M**
	n	**List any two applications of photo diode and IRLED (each).**	**2M**
	Ans:	**Applications of photo diode:-** • Cameras • Medical devices • Safety equipment • Optical communication device. **Applications of IRLED diode:-** • Light source in optical systems. • Burglar alarm systems. • In medical treatment appliances. • In space optical communication.	**(Any 2 applications ½ M each)** **(Any 2 applications ½ M each)**
Q. No.	Sub Q. N.	Answers	Marking Scheme
2		**Attempt any FOUR:**	**16- Total Marks**
	a	**Draw circuit diagram and waveforms for centre-tap full wave rectifier.**	**4M**
	Ans:	**Circuit Diagram:**	**Circuit diagram** 2M

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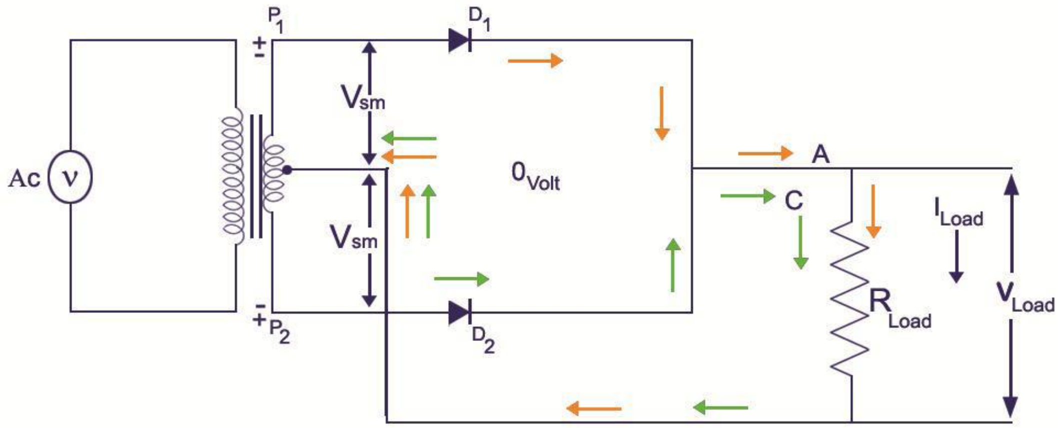
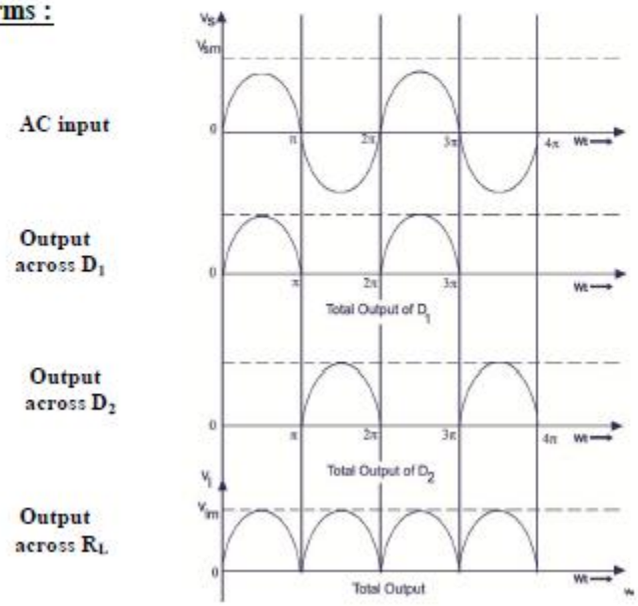
<tr><td></td><td></td><td>


CENTRE - TAP FULL- WAVE RECTIFIER CIRCUIT

Waveforms :



</td><td>Waveform 2M</td></tr>
<tr><td></td><td>b</td><td>Describe working of negative clamper circuit with neat diagram and waveform.</td><td>4M</td></tr>
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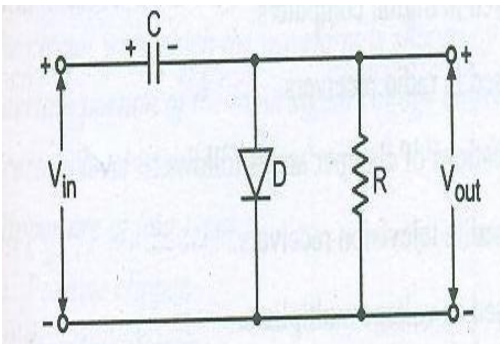
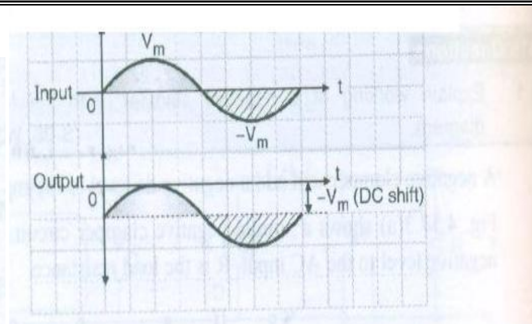
Ans: **2M**





Input output voltage waveforms for a negative clamper

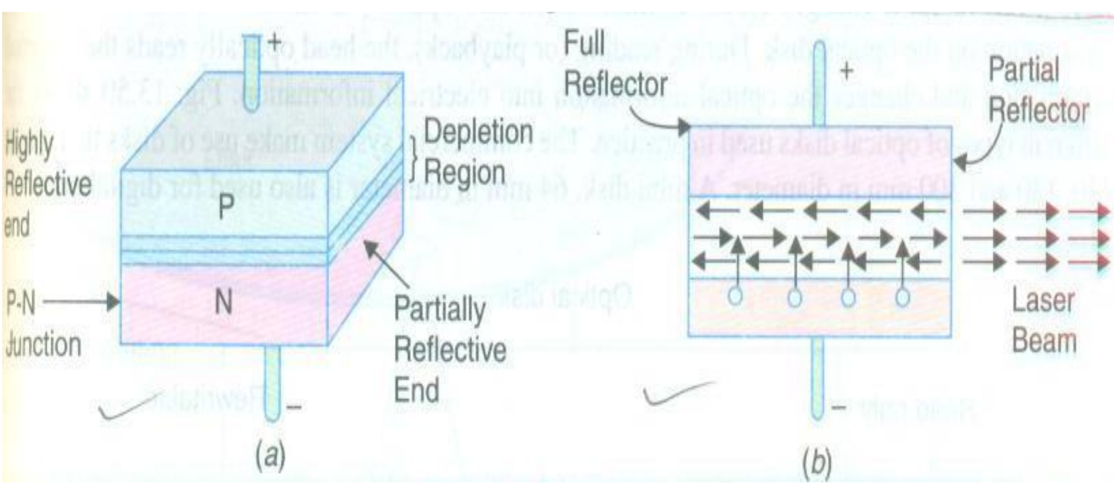
Negative Clamper

Working: **2M**

- In the first positive half cycle the capacitor will charge through the forward biased diode to peak voltage Vm as shown in circuit.
- Charging takes place very quickly as the diode resistance is negligibly small.
- Once the capacitor charges to Vm, diode is reverse biased and stop conducting.
- Negative clamper adds a negative DC shift as shown in waveform.

c **Describe the operating principle of LASER diode with diagram.** **4M**

Ans: **Diagram-2M**



Working principle 2M

When the P-N junction of a laser diode is forward-biased by an external voltage source, electrons move across the junction and recombination occurs in the depletion region which results in the production of photons. As forward current is increased, more photons are produced which drift at random in the depletion region. Some of these photons strike the reflective surface perpendicularly. These reflected photons move back and forth between the two reflective surfaces. The photon activity becomes so intense that at some point, a strong beam of laser light comes out of the partially reflective surface of the diode.

d **By using Maxwell's loop current method, calculate current in 4 W resistance for the network shown in figure no. 1.** **4M**

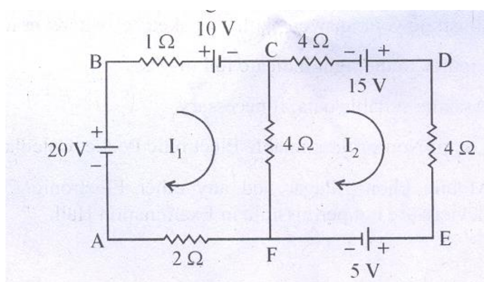


Fig. 1

Ans:

Apply KVL to loop BCFAB, we get

$-I_1 - 10 - 4(I_1 - I_2) - 2I_1 + 20 = 0$

$-I_1 - 4I_1 + 4I_2 - 2I_1 = -10$

$-7I_1 + 4I_2 = -10$ ---------- (1) **Equation1 1m**

Apply KVL to loop CDEFC, we get

$-4I_2 + 15 - 4I_2 - 5 - 4(I_2 - I_1) = 0$

$-4I_2 - 4I_2 - 4I_2 + 4I_1 = -10$

$4I_1 - 12I_2 = -10$ ---------- (2)

On solving equations (1) and (2), we get **Equation2 1m**

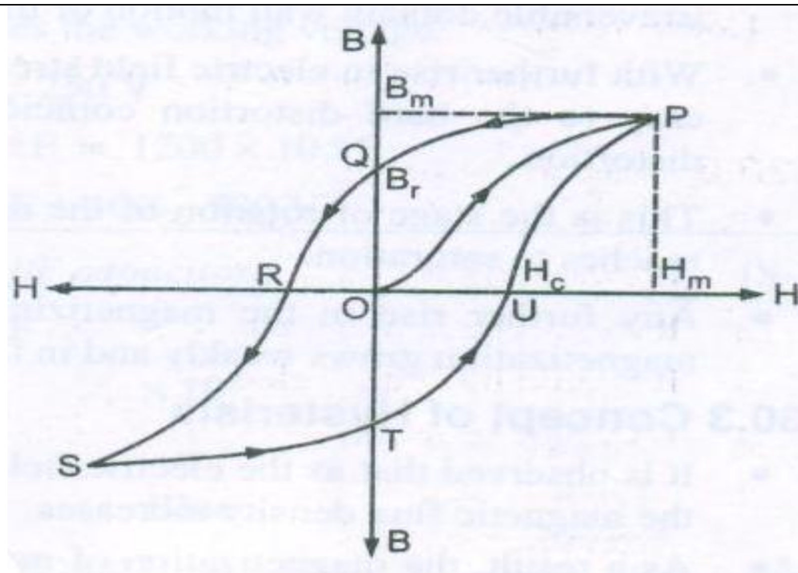
$I_1 = 2.35\,A$, $I_2 = 1.62\,A$

Current through 4Ω of branch CF $= I_1 - I_2$
$= 0.73\,A$ **Ans 2M**

current through 4Ω of branch CD = branch DE
$= 1.62\,A$.

	e	**Draw and explain B-H curve.**	**4M**

Ans:



B - H curve

(2M)

- The magnetization curve of magnetic material specimen between the flux density B and the field intensity H is known a B-H curve. It is also known as Hysteresis curve.
- The B-H curve can be plotted by increasing and then decreasing the field intensity as shown in figure. The flux density B increases, when external field intensity H applied to it is increased.
- When the saturation of flux density arises, the increase in flux density ceases even though the field strength is increased. This is shown by OP. If the external field is gradually reduced, then the original curve Op is not retraced, but follows the curve PQ.
- When external field is reduced to zero, the magnetic flux does not reduce to zero, i.e. material remains magnetized.
- The value of flux density OQ is called remanant flux density Br (or residual magnetism). In order to demagnetize the material completely, the external

(2M)

		magnetic field must be reversed and when it reaches the value OR in reverse direction, it is seen that the flux density is zero. • Further increase of field intensity in the reverse direction will now increase the flux density in reverse direction and again at the point S, the saturation occurs. • The residual magnetism in reverse direction is represented by OT and to neutralize it the magnetic field intensity must be increased in positive direction to the value OU. Further increase in field intensity will again magnetize the material and again saturation will occur at P. • When the magnetic material is taken through one complete cycle of magnetization, it traces the loop that is called hysteresis loop. When a material is subjected to cyclic changes of magnetization, the domains change the direction of their orientation in accordance with field intensity. • The work is done in changing the direction of domain which leads to the production of heat within the material. The energy required to take the material through one complete cycle of magnetization is proportional to the area enclosed by the loop.	
	f	**Define static and dynamic resistance of diode.**	**4M**
	Ans:	**Static resistance (Rf) :**Static Resistance of a P-N junction diode is the ratio of forward voltage to forward current. $R_f = \frac{\text{DC voltage}}{\text{DC current}}$ **Dynamic Resistance (rf):** Dynamic Resistance of a P-N junction diode is the small change in forward voltage to small change in forward current at a particular operating point. $r_f = \frac{\text{Change in voltage}}{\text{Change in current}}$	**1M** **1M** **1M** **1M**

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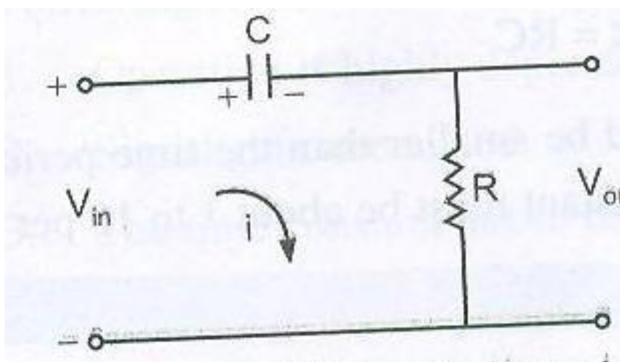
Q. No.	Sub Q. N.	Answers	Marking Scheme
3		**Attempt any FOUR:**	**16- Total Marks**
	a	**With the help of circuit diagram and waveforms, explain working of RC differentiator.**	**4M**
	Ans:	 **Fig: RC differentiating circuit** Figure shows a RC differential circuit. It is also known as high pass filter. The reactance of a capacitor decreases with increasing frequency. The higher frequency components in the input signal appear at the output i.e. the capacitor acts as a short circuit for very high frequencies and virtually all the input appears at the output. Therefore, it is also called as high pass RC circuit. In above circuit the voltage drop across R will be very small in comparison with the drop across C. Hence, the current is completely determined by the capacitance C. The value of current I will be,	2M – Diagram 1M- Working 1M- Waveform

I = C x dvi / dt

The output voltage Vo is as given,

. Vo = iR

Vo = RC x dvi / dt (where R and C are constants)

Vo α dvi / dt

i.e. the output signal is directly proportional to the derivative of the input signal.

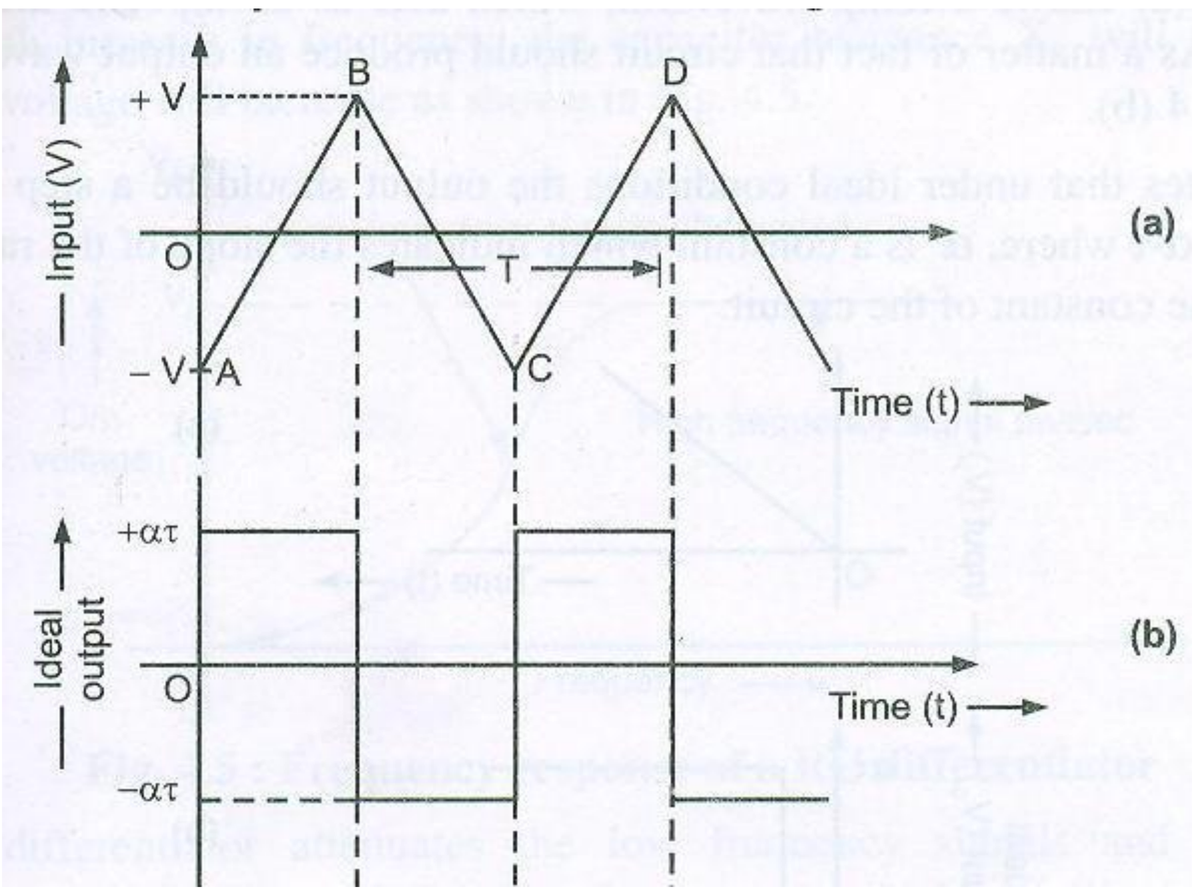
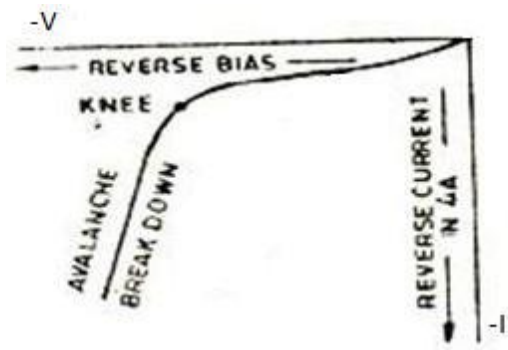


Fig: Generation of a square wave from a triangular wave.

	b	**State the advantages of L and C filter. (four points)**	**4M**
	Ans:	**Advantages of L filter**	**(½ Mark for each**

		1. It has low ripple factor at heavy load currents (i.e. low load resistance) 2. It has no surge current through the diode. 3. It reduces the ripple in the DC output of rectifier circuit. 4. The L filter is more suitable for heavy loads. **Advantages of C filter** 1. It is easy to design 2. It is small in size and cheap 3. It has low ripple factor for heavy loads. 4. It has high output DC voltage for light loads. 5. It is more suitable for light loads. 6. It has no load voltage equal to maximum transformer voltage.	**correct point)** **(½ Mark for each correct point)**
	c	**Describe avalanche and zener breakdown of PN junction with neat graph.**	**4M**
Ans :		**Avalanche Breakdown** It is observed in diodes having Vz> 8V. is called **Avalanche Breakdown** It occurs due to accelerating minority carriers. It shows gradual change. Breakdown voltage increases with increase in temperature.	**(2Mark for each Breakdown)**



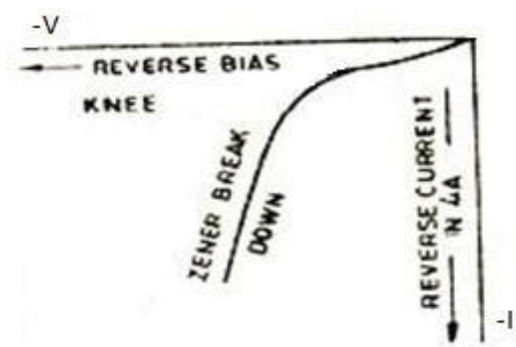
Zener Breakdown

It is observed in diodes having Vz = 5 – 8V. is called **Zener Breakdown.**

It occurs due to increased electric field.

Breakdown is very sharp.

Breakdown voltage decreases with increase in temperature



d	**Calculate current flowing through 6 Ω resistor using KVL (refer fig. 2)**	4M

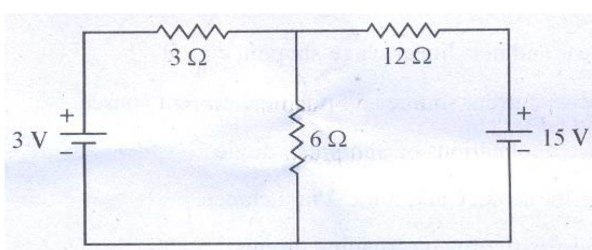


Fig. 2

Ans:

Note: (Marks may be awarded to solution by any other method)

Apply KVL to loop 1

$3 - 3I_1 - 6(I_1 + I_2) = 0.$

$3 - 3I_1 - 6I_1 - 6I_2 = 0$

$9I_1 + 6I_2 = 3$ ------ (1) — 1M

Apply KVL to loop 2

$15 - 12I_2 - 6(I_2 + I_1) = 0$

$15 - 12I_2 - 6I_2 - 6I_1 = 0$

$6I_1 + 18I_2 = 15$ ------ (2) 1M.

solving equations (1) and (2), we get

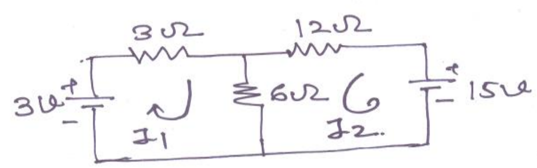
$I_1 = \frac{-6}{21} = -0.2857\ A.$

$I_2 = \frac{5.5713}{6} = 0.9285\ A$ } — 1M

current flowing through 6Ω

$= I_1 + I_2$

$= 0.64285\ A.$ } — 1M.

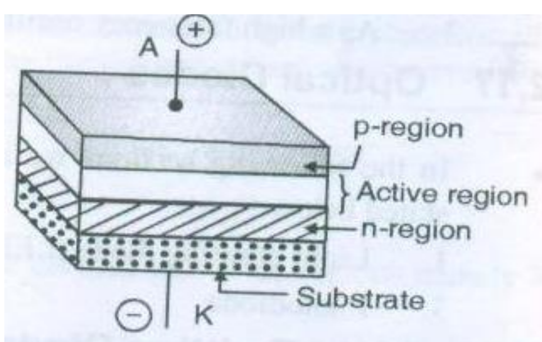


e **Draw and describe construction of LED .** **4M**

Ans:

Construction of LED

Draw: 2 Marks & describe : 2 Marks



Construction of LED

		Fig above shows the construction of LED. Here an N-type layer is grown on a substrate by a diffusion process. Then a thin P-type layer is grown on the N-type layer. The metal connections to both the layers make anode and cathode terminals as indicated. The active region exists between the P and N regions. The light energy is released at the junction when the electron hole pair recombination takes place. After passing through the P-region the light is emitted from the window provided at top.	
	f	**Define given parameters and state their values for bridge rectifier (i) Ripple factor (ii) PIV of diode.**	**4M**
	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. Mathematically it is expressed as, $\text{Ripple Factor} = \frac{\text{RMS value of the AC component of output}}{\text{DC or average value of the output}}$ (i) Ripple Factor for bridge rectifier – 0.48 **PIV:** Peak Inverse Voltage (PIV) is defined as the maximum negative voltage which appears across non-conducting reverse biased diode. (ii) PIV of diode for bridge rectifier-Vm	**Each Definition: 1Mark** **Each value: 1Mark**

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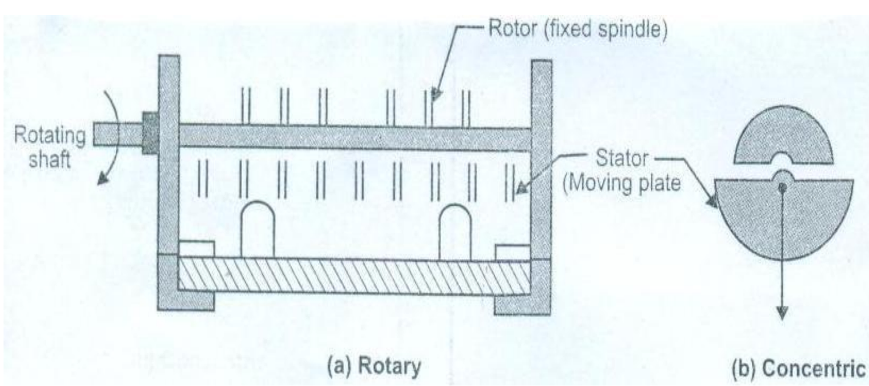
Q. No.	Sub Q. N.	Answers	Marking Scheme
4		**Attempt any FOUR:**	**16- Total Marks**
	a	**Write down the colour code for the following resistors :** **(i) 150 Ω ± 5% (ii) 3.3kΩ ± 20%**	**4M**
	Ans :	i. 150 Ω ± 5% $15 \times 10^1 \pm 5\%$ Brown,Green,Brown,Gold ii. 3.3kΩ ± 20% $3\ 3 \times 10^2 \pm 20\%$ Orange, Orange, Red, no colour	**Correct Code – 2 Marks Each**
	b	**Describe working of variable air gang capacitor with neat sketch.**	**4M**
	Ans :	 	2M- Diagram 2M- Working

(OR)

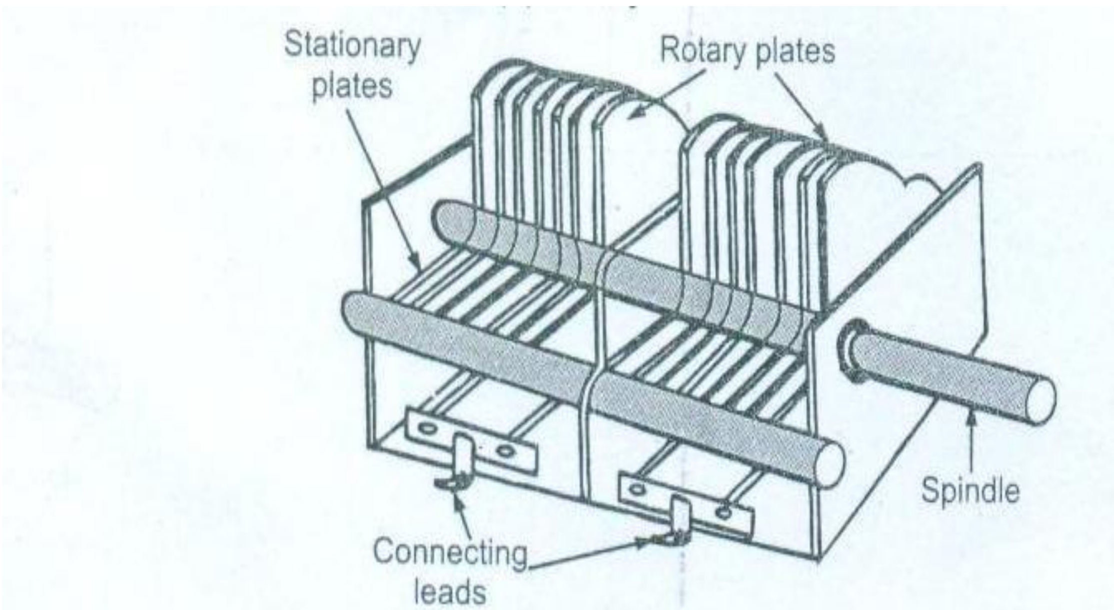


Fig: Air ganged capacitor

working:

Consider the structure of the above figure. It mainly consists of two sets of aluminium plates separated from each other by air. These metal plates may be rotary or concentric type.

The rotary type configuration has a rotor and a stator. The concentric type of configuration has two cups of aluminium.

The concentric type variable capacitor consists of two cups of aluminium, one moving in other. The movement is actuated by a threaded screw.

One set of the plates is fixed, while the other set is connected to a shaft and can be rotated.

The fixed set of plates is insulated from the body of a capacitor on which it is mounted.

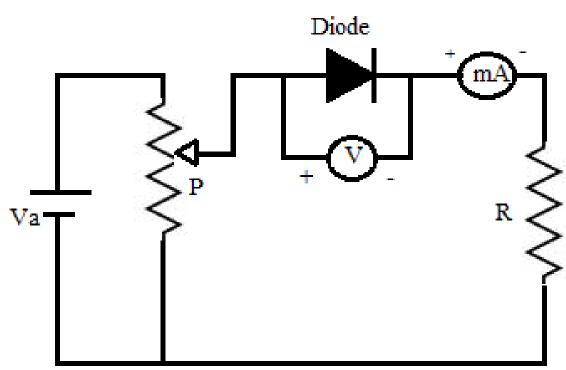
		The set of moving aluminium plates can be moved in or out of a fixed set of plates with the help of a suitable knob connected to a rotating shaft. As the plates are moved in and out of the fixed plates, the capacitance value varies. The capacitance is minimum, when the moving plates are completely out and it is maximum, when the moving plates are completely in. The fixed plates are called stators, which are normally made of brass, copper or aluminium. The cadmium plated steel is used for the frames in low cost capacitors. The outer set of plates is called rotors. They get interleaved with stators, when the shaft is rotated. Sometimes, two or more such capacitors are operated by a single shaft.	
	c	**Describe the working of PN junction diode with neat sketch under forward biased condition.**	**4M**
	Ans:	Working of PN junction diode under forward biased condition with help of following circuit diagram and graph **Region A to B:** In this region A to B of the forward characteristics shown in the fig, the forward voltage is small and less than the cut in voltage. Therefore the forward current flowing through the diode is small. With further increase in the forward voltage, it reaches the level of the cut in voltage and the width of depletion region grows on decreasing. **Region B to C:** As soon as the forward voltage equals the cut in voltage, current through the diode increases suddenly. The nature of this current is exponential. The large forward current in the region B-C of the forward characteristics is limited by connecting a resistor 'R' in series with the diode. Forward current is of the order of a few mA. The forward current is a conventional current that flows from anode to cathode.	Working:2 M Graph:2M

Therefore it is considered to be positive current, and the forward characteristics appears in the first quadrant as shown in the fig.

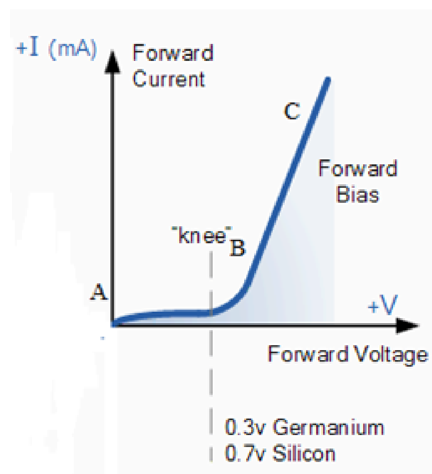
Cut in voltage (Knee Voltage):

The voltage at which the forward diode current starts increasing rapidly is known as the cut-in voltage of a diode. As shown in fig above, the cut in voltage is very close to the barrier potential. Cut-in voltage is denoted by . Cut-in voltage is also called as Knee voltage.

Generally a diode is forward biased above the cut-in voltage. The cut-in voltage for a silicon diode is 0.6V and that for germanium diode is 0.3V.



Circuit arrangement



Forward characteristics

d	**Compare soft magnetic materials and hard magnetic materials. (four points)**	**4M**
Ans:	(see table below)	**1mark for each for any four**

Hard magnetic materials	**Soft magnetic materials**
They have low resistivity	They have high resistivity
They have high coercivity.	They have low coercivity
They have high residual	They have low residual

		magnetism	magnetism.	
		They have high (B*H) energy	They have low (B*H) energy	
		They have high retentivity.	They have low retentivity	
		They cannot be easily magnetized	They are easily magnetized.	
		They have wide hysteresis loop.	They have narrow hysteresis loop.	

e	**In bridge rectifier load resistance R_L = 2 kW. The diode has forward dynamic resistance of 10 W. The AC voltage across the secondary winding of transformer is V = 50 sin 413t V. Determine : (i) Peak current (ii) DC value of current (iii) PIV of diode (iv) DC voltage.**	**4M**
Ans	given $R_L = 2\,k\Omega$, $V_{in} = 50V$, $R_F = 10\Omega$ i) Peak current- $I_m = \frac{V_m}{(R_s + 2R_F + R_L)}$ Assume $R_s = 0$ $I_m = \frac{50}{(2000 + 20)} = \frac{50}{2020}$ $I_m = 0.0247\,A$ ii) DC value of current I_{dc} $I_{dc} = \frac{2I_m}{\pi} = \frac{2 \times 0.0247}{\pi}$ $I_{dc} = 0.0157\,A$ iii) PIV of diode $V_m = 50V$ iv) DC voltage $V_{dc} = K\,I_{dc} \times R_L = 0.0157 \times 2000 = 31.4V$ $V_{dc} = 31.4V$	

f **Using Thevenin's theorem find load current I_L (refer figure 3)** **4M**

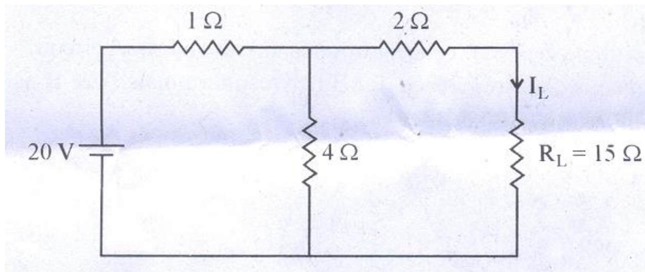
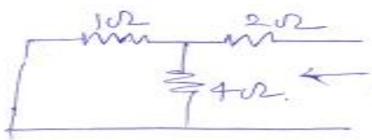


Fig. 3

Ans :

① Calculate Req or Rth remove R_L



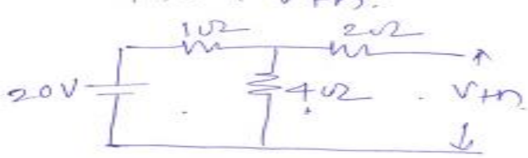
$R_{th} = 1 // 4 + 2$

$= \frac{4}{1+4} + 2$

$= 4/5 + 2 = 0.8 + 2 = 2.8$

$R_{th} = 2.8\Omega$ — 1 Mark

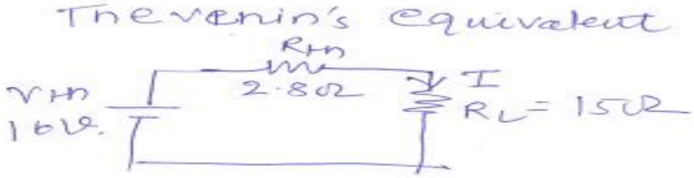
find V_{th}.



$V_{th} = \frac{20}{1+4} \times 4 = \frac{80}{5} = 16V$

$V_{th} = 16V$ — 1 Mark

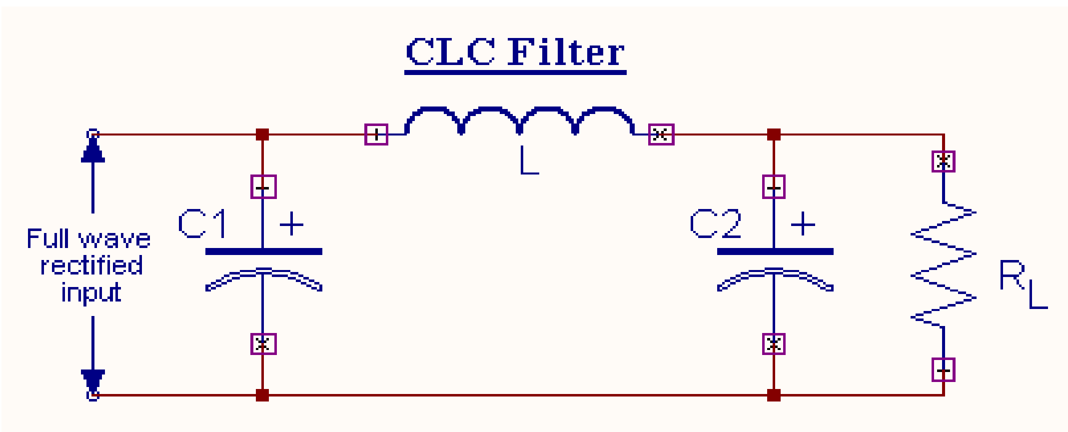
Thevenin's equivalent circuit.

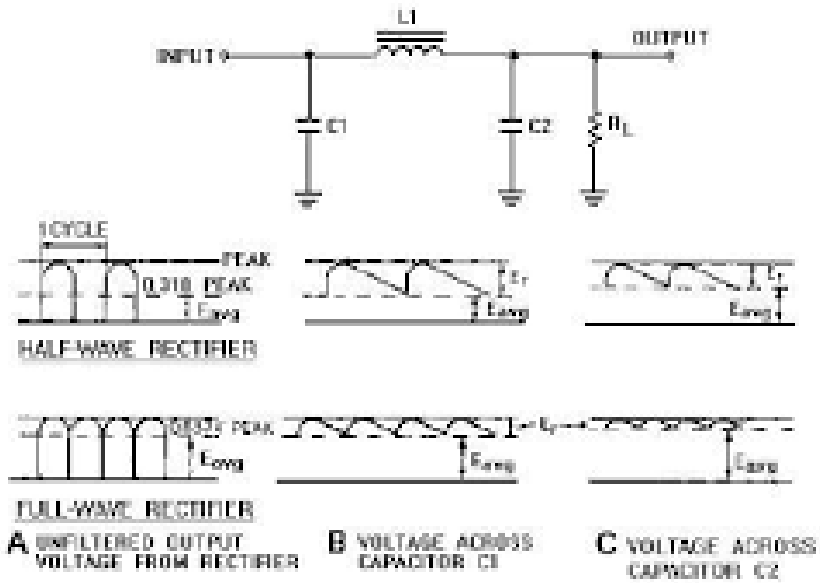
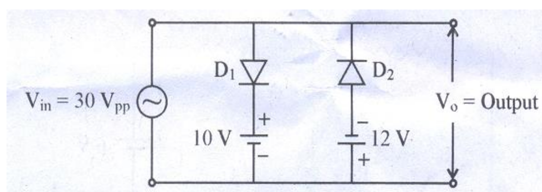


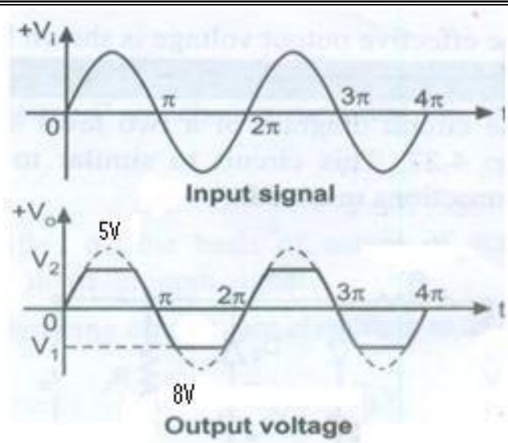
$$I_L = \frac{V_{th}}{R_{th} + R_L} = \frac{16}{2.8 + 15} = \frac{16}{17.8}$$

$$= 0.898 \text{ Amp.}$$

$$\boxed{I_L = 0.898A}$$ — 2 Marks

Q. No.	Sub Q. N.	Answers	Marking Scheme
5		**Attempt any FOUR:**	**16- Total Marks**
	a	**With help of circuit diagram & waveform, explain working of CLC or π filter.**	**4M**
	Ans:	 C_1 will bypass ac & blocks dc. This output is given to inductor,it will block ac and pass only dc. This output is given to C_2 it will again bypass remaining ac and block dc ,so at output we get	1 M Diagram,1M Waveform 2M Explanation

		ripple free dc.  	
	b	Identify the following circuit. Draw its input / output waveforms. (refer figure 4)  Fig. 4	4M
	Ans:	<u>Identification</u> The circuit is Combinational Clipper for waveform. <u>Waveform</u>	2M Identification 2M Waveform



In the output Voltage waveform instead of 5V and 8V it is 10V and 12V respectively.

c	**Compare HWR and FWR. (four points)**	**4M**
Ans:	(see table below)	Any 4 points- 4M

Parameter	Half wave rectifier	Center tap full wave rectifier	Bridge full wave rectifier
1.No of diodes	One	Two	Four
2.PIV	V_m	$2V_m$	V_m
3.ripple factor	1.21	0.48	0.48
4.ripple frequency	f	2f	2f
5.efficiency	40%	80%	80%

d	**State Maximum Power Transfer Theorem.**	**4M**

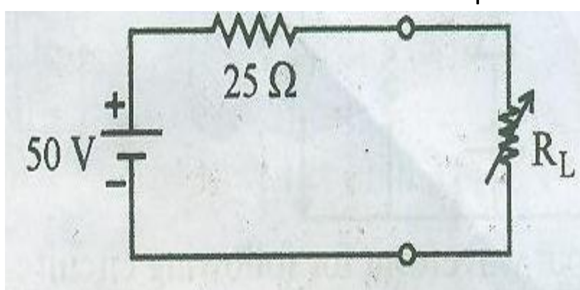
Ans: **Theorem – 2 marks**

The maximum power transfer theorem states that the maximum amount of power will be delivered to the load resistance when the load resistance is equal to the Thevenin/ Norton resistance of the network supplying the power. If the load resistance is lower or higher than the Thevenin/ Norton resistance of the source network, then the power delivered to load is less than maximum. That means the condition for maximum power transfer according to maximum power transfer theorem is,'

$R_L = R_{TH}$

Example:2M

For the circuit shown in fig, determine the value of load resistance when load resistance draws maximum power. Also find the value of the maximum power.



From circuit above,

RL = RTH = 25Ω

$P_{L\,max} = (V_{oC})^2 / 4R_L$

$= (50)^2 / 4 \times 25$

$P_{L\,max}$ = 25Watt

e	**Calculate the value of current in 10 Ω resistor using Norton's Theorem. (refer fig. 5)**	**4M**	

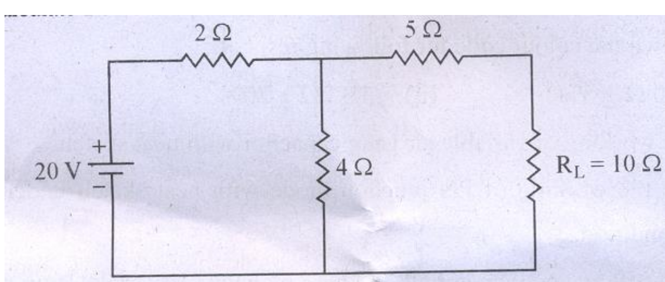


Fig. 5

Ans:

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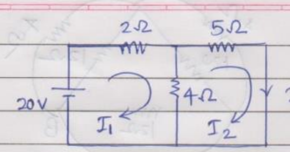
Q5e.



Apply KVL to loop 1

$20 - 2I_1 - 4(I_1 - I_2) = 0$

$20 - 2I_1 - 4I_1 + 4I_2 = 0$

$-6I_1 + 4I_2 = -20$ (I)

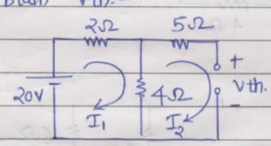
Apply KVL to loop 2:— $-4(I_2 - I_1) - 5I_2 = 0$

$4I_1 - 4I_2 - 5I_2 = 0$

$4I_1 - 9I_2 = 0$ (II)

$\therefore I_1 = 4.73A, \quad I_2 = 2.10A, \quad \therefore I_{sc} = I_2 = 2.10A.$

To obtain V_{th}:—



$I_2 = 0A$ (Due to open circuit)

$20 - 2I_1 - 4(I_1 - I_2) = 0$

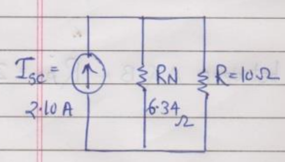
$20 - 2I_1 - 4I_1 = 0 \quad \therefore 20 - 6I_1 = 0 \quad \therefore I_1 = 3.33A$

$-4(I_2 - I_1) - 5I_2 - V_{th} = 0$

$4I_1 = V_{th} \quad \therefore V_{th} = 4 \times 3.33 = 13.32$ Volts.

By ohm's law:— $R_N = \frac{V_{th}}{I_{sc}} = 6.34\Omega$

Norton's equivalent circuit:—



$I = \frac{I_{sc} \times R_N}{R_N + R}$

$= \frac{2.10 \times 6.34}{6.34 + 10}$

$I = 0.8148A.$

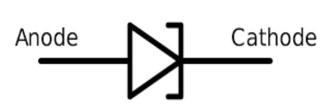
$\therefore$ Current in 10Ω resistor using Norton's Theorem is 0.8148 A.

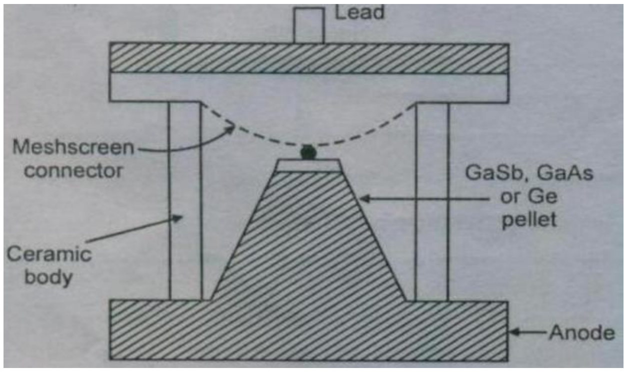
f	**Compare linear and logarithmic potentiometer.**	**4M**

Ans: (Any 4 points- 4M)

Sr. No	Linear Potentiometer	Logarithmic Potentiometer
1.	It has a linear variation of resistance with each degree of rotation of its shaft.	It has a logarithmic variation of resistance with each degree of rotation of its shaft.
2.	It is produced by taking resistive segments of uniform thickness over the entire length	It is produced by combining segments of

	of the segment.	resistance mixers having different resistivity to make up the total length of the film.
3.	Linear potentiometers are less expensive as compared to logarithmic potentiometers.	Logarithmic potentiometers are more expensive as compared to linear potentiometers.
4	In consumer electronics, user control uses linear potentiometers.	Logarithmic potentiometers are often used in connection with audio amplifiers.

Q. No.	Sub Q. N.	Answers	Marking Scheme
6		**Attempt any FOUR:**	**16- Total Marks**
	a	**Calculate value of capacitor if following is printed on body of capacitors : (i) 404 (ii) 2K3.**	**4M**
	Ans:	Capacitor marking is “404” It’s mean that = 40 + 4 Zeros = 400000 pF = 400 nF 2K3 = 2.3k = $(2.3 \times 10^3) \times 10^{-12} = 2.3 \times 10^{-9}$ =2.3nF	
	b	**Describe the working of tunnel diode. Draw its characteristics.**	**4M**
	Ans:	**Symbol of TUNNEL DIODE**  **operating principle of tunnel diode**	



Working

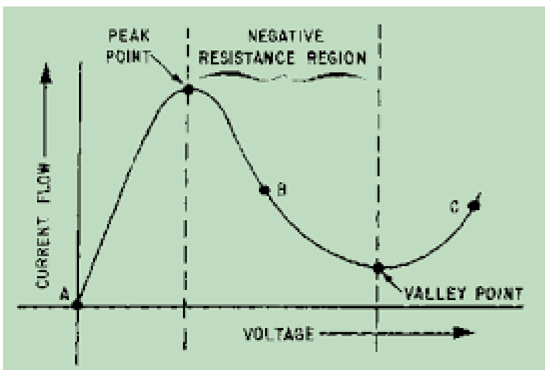
The operation of tunnel diode is based on special characteristics known as negative resistance.

The width of the depletion region is inversely proportional to the square root of impurity concentration.

So increase in the impurity concentration, the depletion region width will reduce. The thickness of depletion region of this diode is so small. That indicates there is large probability of an electron can penetrate through this barrier.

This behavior is called is tunneling & hence the name of the high impurity density PN junction is called as tunnel diode.

Tunnel diode characteristics



a)It is also capable for very fast operations.

b)It has heavily doped PN junction of only 10 nm wide .

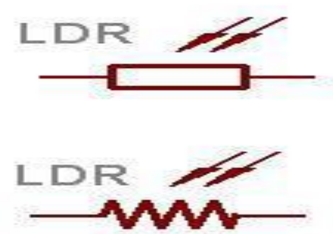
c)It exhibit negative resistance region.

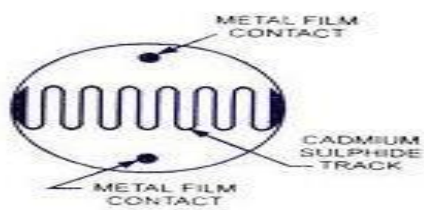
d)Applications:microwave applications,ultra high speed switching device,relaxation oscillators.

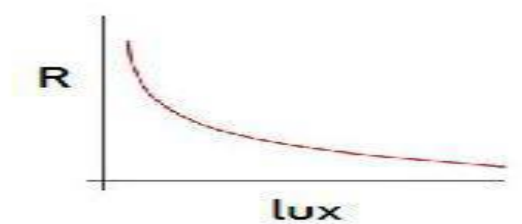
e)The process of penetrating charge carrier directly through potential barrier is called tunneling.

	c	**With the help of constructional diagram, explain the working of LDR with neat sketch.**	**4M**

Ans:



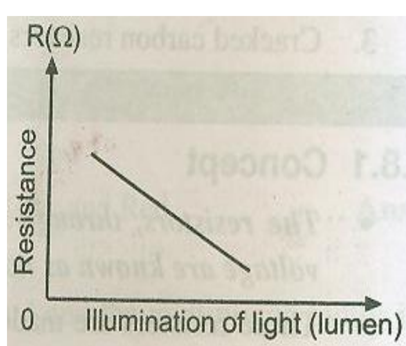


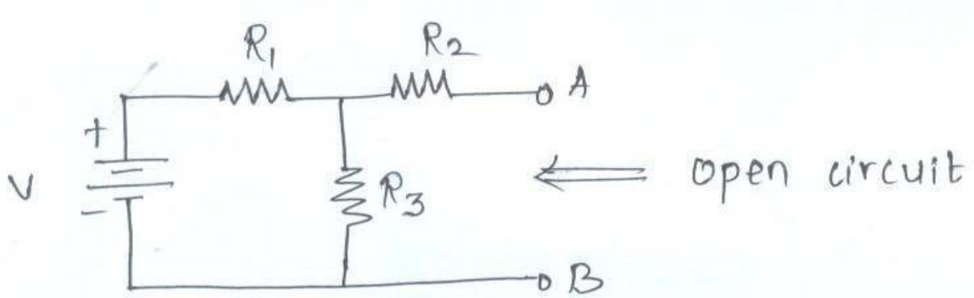


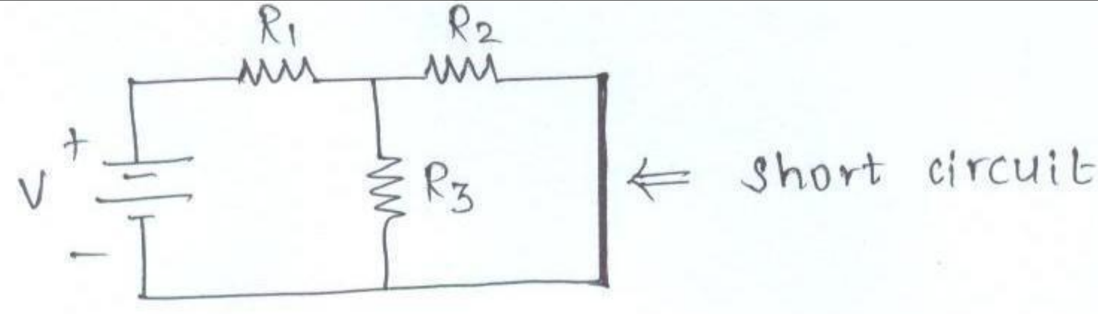
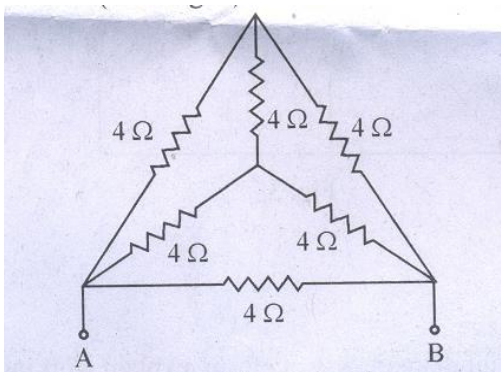
Working Principle

The resistance depends on the intensity of light, as resistance decreases with increase in light intensity.

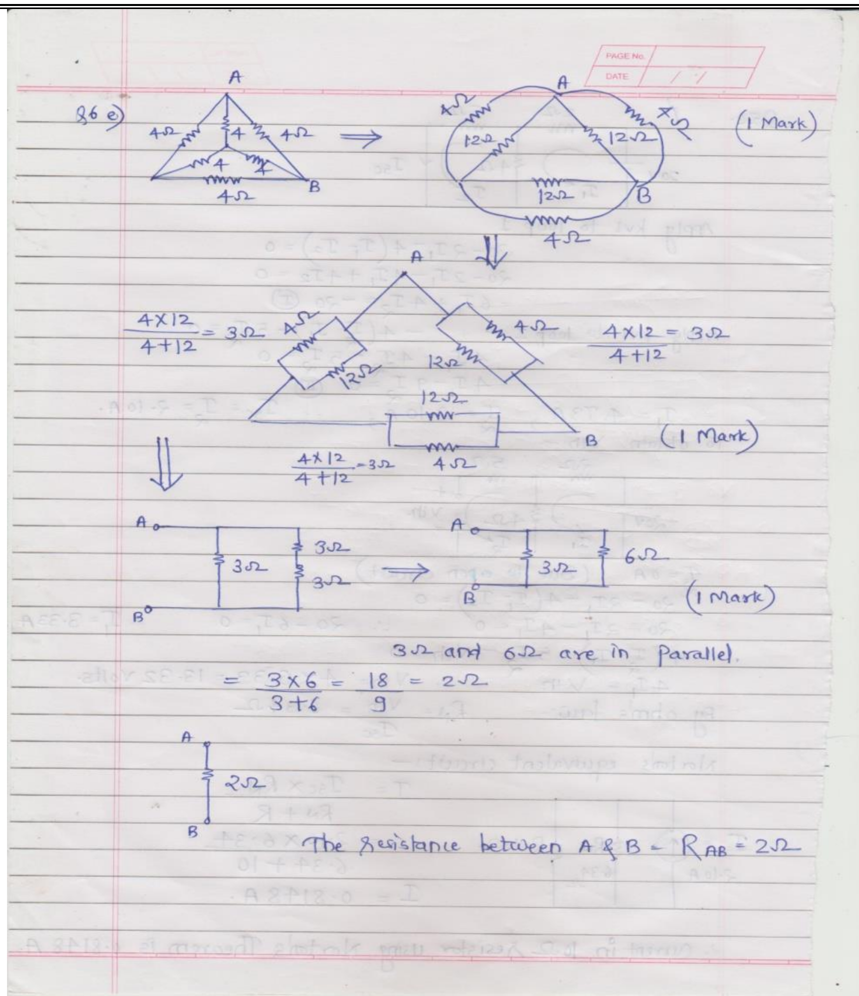
Characteristics



		Applications of LDR 1. They are often used as light sensors. 2. They are used when there is a need to detect absences or presences of light like in a camera light meter. 3. Used in street lamps, alarm clock, burglar alarm circuits, light intensity meters, for counting the packages moving on a conveyor belt, etc.	
	d	**Explain with neat circuit, concept of open circuit and short circuit.**	**4M**
	Ans:	<u>Open Circuit</u> **(2 Marks)** Two points in a circuit are said to be open circuited if there is no circuit element or direct connection between them. An open circuit exist between points „A" and „B" in below figure. The resistance between the open circuited points is infinite. $R_{AB} = \infty$  <u>Short Circuit</u> **(2 Marks)** Two points in a circuit are said to be short circuited when they are connected to each other by a good conducting wire. Points „A" and „B" are short circuited in below figure. The resistance between short circuited points is zero. $R_{AB} = 0\Omega$	

			
	e	**Calculate equivalent resistance, RAB between terminals A & B using delta —star transformation. (refer fig. 6)**  **Fig. 6**	**4M**

Ans:



f **Find current through resistance R_4 using super-position theorem. (refer fig. 7)** **4M**

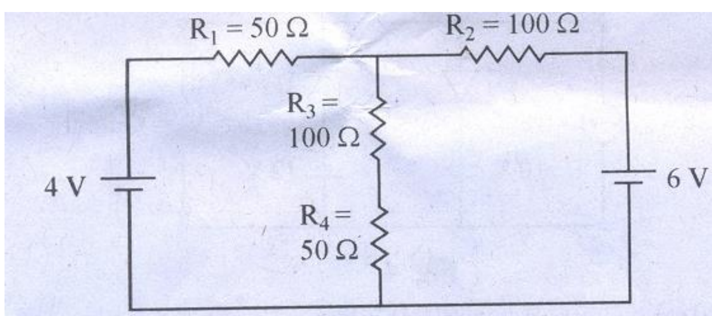
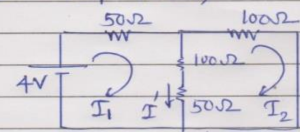


Fig. 7

Ans:

Q6f. Case I:— Keep 4V ON,



$4 - 50I_1 - 100(I_1 - I_2) - 50(I_1 - I_2) = 0$

$4 - 50I_1 - 100I_1 + 100I_2 - 50I_1 + 50I_2 = 0$

$-200I_1 + 150I_2 = -4$ (I)

$-50(I_2 - I_1) - 100(I_2 - I_1) - 100I_2 = 0$

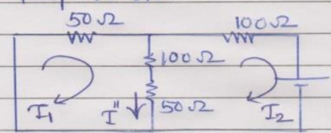
$50I_1 - 50I_2 + 100I_1 - 100I_2 - 100I_2 = 0$

$150I_1 - 250I_2 = 0$ (II)

$I_1 = 0.036A$ $I_2 = 0.0218\ A.$

$I' = I_1 - I_2 = 0.0142\ A.$

Case II:— Keep 6V ON.



$-50I_1 - 100(I_1 - I_2) - 50(I_1 - I_2) = 0$

$-50I_1 - 100I_1 + 100I_2 - 50I_1 + 50I_2 = 0$

$-200I_1 + 150I_2 = 0$ (I)

$-50(I_2 - I_1) - 100(I_2 - I_1) - 100I_2 - 6 = 0$

$-50I_2 + 50I_1 - 100I_2 + 100I_1 - 100I_2 = 6.$

$150I_1 - 250I_2 = 6$ (II)

$I_1 = -0.0327A$ $I_2 = -0.0436A.$

$I'' = I_1 - I_2 = 0.0109\ A.$

According to superposition Theorem.

Current through $R_4 = 50Ω$ resistor, $I = I' + I''$

$= 0.0142 + 0.0109$

$= 0.0251\ A.$