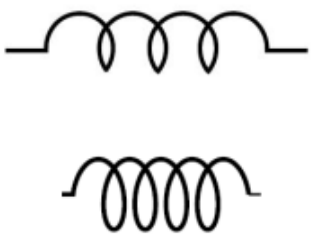
MODEL ANSWER

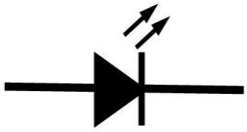
SUMMER– 17 EXAMINATION

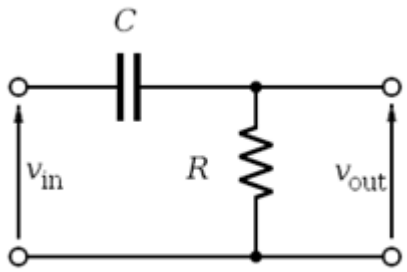
Subject Title: Elements of Electronics Subject Code: 17215

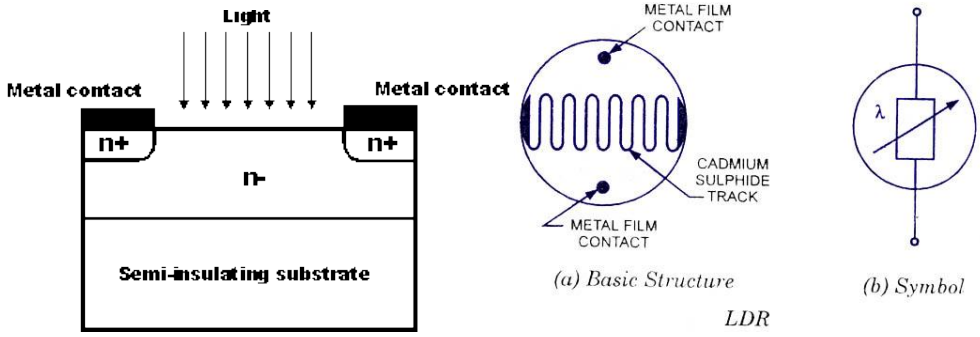
Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in 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 anyequivalent 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 TEN:**	**20-Total Marks**
	(a)	**What is magnetic material ? State it's two applications.**	**2M**
	Ans:	Magnetic materials are those materials that can be either attracted or repelled when placed in an external magnetic field and can be magnetized themselves. **OR** The materials which provide path to the magnetic flux and can be magnetized are called magnetic materials. **Applications:** 1.Floppy disc ,hard disc 2.Motors and generators 3.Biomedical equipment	**1M** **1M**
	(b)	**Define Inductor. Draw its symbol.**	**2M**
	Ans:	An inductor is a passive electronic component that stores energy in the form of a magnetic field 	**1M** **1M**

(c)	**What is dielectric material? Enlist dielectric material used in capacitor.**	**2M**
Ans:	A dielectric material *is* an electrical insulator that can be polarized by an applied electric field. **<u>Dielectric materials used in capacitor:</u>** porcelain (ceramic), mica, glass, plastics, and the oxides of various metals	**1M** **1M**
(d)	**State any Four applications of PN junction diode.**	**2M**
Ans:	1. Rectifiers in power supplies, 2. Detectors in RF, 3 .Clippers, 4. In clamping networks used as DC Restorers, 5. As switches in digital logic circuits.	**(½ M for each point)**
(e)	**Draw symbol of (i) Tunnel diode (ii) LED**	**2M**
Ans:	**(i) <u>Tunnel diode:</u>**  tunnel diode symbol **(ii) <u>LED:</u>** 	**1M** **1M**
(f)	**Calculate equivalent resistance IFRI and R_2 resistors are conncted in parallel R_1 = 10 Ω, R_2 = 5 Ω**	**2M**
Ans:	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ $\frac{1}{R} = \frac{1}{10} + \frac{1}{5}$ $R = 3.33\Omega$	**1M for Formula** **1M for Answer**
(g)	**Define (i) Open circuit (ii) Short circuit.**	**2M**
Ans:	**<u>Open circuit</u> :** An electrical circuit is said to be open,when any part of conducting path is open or broken and there is no continuity in the conducting path of an electrical circuit.	**1M**

		Short circuit : An electrical circuit is said to be short,when voltage source has closed path across its terminal.(or any relevent definition)	**1M**
	(h)	**State Kirchhoff's voltage law.**	**2M**
	Ans:	The algebraic sum of all the emf's in a loop is equal to zero.	**2M Correct Statement**
	(i)	**State the need of Rectifier circuits.**	**2M**
	Ans:	The DC power supply is essential for operation of many electronic devices and circuits.This DC voltage is obtained from AC source.Rectifier circuit is important circuit for this conversion.	**2M Correct Statement**
	(j)	**State types of filters.**	**2M**
	Ans:	1. Shunt capacitor filter 2. Series inductor filter (Choke filter) 3. Choke input filter (LC or L type filter) 4. Capacitor input filter (CLC or π)	**½ M for each point**
	(k)	**What is need of wave shaping circuit ?**	**2M**
	Ans:	In electronics application, it is often needed to alter the shape of wveform 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 waveshaping circuits are needed.	**Correct statement 2M**
	(l)	**Draw RC differentiator circuit.**	**2M**
	Ans:		**2M**
Q 2		**Attempt any FOUR :**	**16M**
	(a)	**Write down the colour code for following resistor :** **(i) 150 Ω ± 5% (ii) 4'6kΩ ±20%**	**4M**
	Ans:	**(i)** Brown, Green, Brown, Gold **(ii)** Yellow,blue,red,no colour	**2M** **2M**
	(b)	**With help of constructional diagram, explain working of LDR.**	**4M**
	Ans:		



(a) Basic Structure *(b) Symbol*

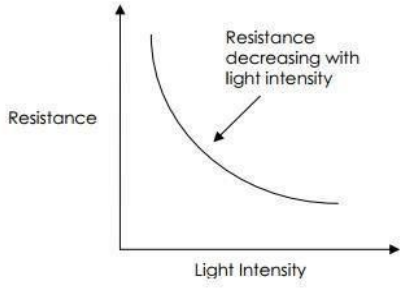
LDR

2M

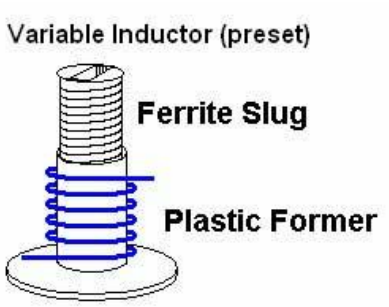
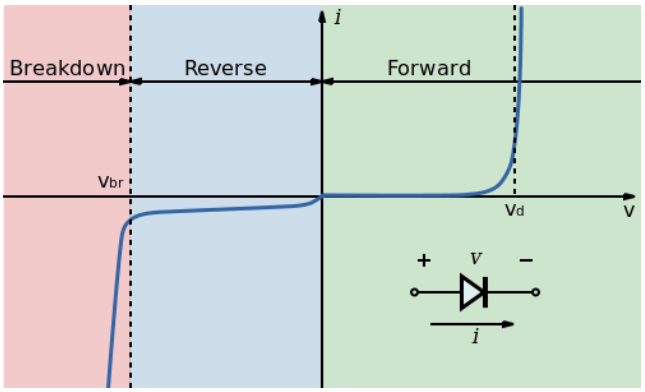
The structure of a light dependent resistor consists of a light sensitive material which is deposited on an insulating substrate such as ceramic. The material is deposited in zigzag pattern in order to obtain the desired resistance and power rating. This zigzag area separates the metal deposited areas into two regions. Then the ohmic contacts are made on the either sides of the area. The resistances of these contacts should be as less as possible to make sure that the resistance mainly changes due to the effect of light only. Materials normally used are cadmium sulphide, cadmium selenide, indium antimonide and cadmium sulphonide.

It is basically a photocell that works on the principle of photoconductivity. The passive component is basically a resistor whose resistance value decreases when the intensity of light decreases.

2M



(c)	**State any Four specifictions of capacitor and explain any two in details.**	**4M**
Ans:	**<u>Specifictions of capacitor:</u>** 1.Dielectric material 2.Capacitance value 3.Working voltage 4.Tolerence 5.Temperature coefficient 6.Power factor 7.C/V ratio 9.Insulation resistance	**2M**

		Explanation: 1.Working voltage : It is the maximum voltage at which capacitor can operate without failure 2.Power factor : It is the ratio of resistance to reactance at the operating frequency. 3 Tolerance: It is the maximum possible deviation on either side from actual value. 4.C/V ratio: It is the ratio of capacitance to volume. ***Note:-(Students can explain other specification)***	**2M**
	(d)	**With help of constructiobal diagram, explain working of slug tunned inductor.**	**4M**
	Ans:	 The variable inductor having an adjustable ferrite core is known as slug tuned inductor. The value of inductance increases or decreases respectively, due to the movement of a ferrite core into or out of the coil winding. The basic construction of a slug tuned inductor is shown in fig.This construction is similar to the fixed ferrite core inductor but the core is adjustable.The value of inductance increases, when the slug is moved into the coil windingand decreases the resonant frequency of the tuned circuit. When the slug is moved out of the coil winding, the inductance decrease and the resonant frequency of the tuned circuit increases.The value of inductance can be varied by using movable core which can be moved up or down by using screw driver.	**2M** **2M**
	(e)	**Draw and explain V-I characteristics of a P-N junction diode.**	**4M**
	Ans:		**2M**

		Forward V-I characteristics of p-n junction diode If the positive terminal of the battery is connected to the p type semiconductor and the negative terminal of the battery is connected to the n-type semiconductor, the diode is said to be in forward bias. In forward biased p-n junction diode, V_F represents the forward voltage whereas I_F represents the forward current. **Forward V-I characteristics :** If the external voltage applied on the silicon diode is less than 0.7 volts, the silicon diode allows only a small electric current. However, this small electric current is considered as negligible. When the external voltage applied on the silicon diode reaches 0.7 volts, the p-n junction diode starts allowing large electric current through it. At this point, a small increase in voltage increases the electric current rapidly. The forward voltage at which the silicon diode starts allowing large electric current is called cut-in voltage. The cut-in voltage for silicon diode is approximately 0.7 volts. **Reverse V-I characteristics :** If the negative terminal of the battery is connected to the p-type semiconductor and the positive terminal of the battery is connected to the n-type semiconductor, the diode is said to be in reverse bias. In reverse biased p-n junction diode, V_R represents the reverse voltage whereas I_R represents the reverse current. The wide depletion region of reverse biased p-n junction diode completely blocks the majority charge carrier current.	**2M**
	(f)	**Calculate the value of capacitor with the help of colour code.** **(i) Orange, Orange, Blue** **(ii) Yellow, Violet, Yellow**	**4M**
	Ans:	**(i) 33µF** **(ii) 0.47 µF**	**2M** **2M**
Q. 3		**Attempt any FOUR :**	**16M**
	(a)	**Define static and dynamic resistance of diode.**	**4M**
	Ans:	**Static resistance (R_f) :** 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 (r_f):** 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**

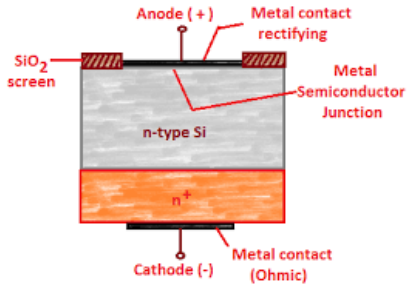
(b) Compare avalanche and zener breakdown. **4M**

Ans: **(1M each)**

	Avalanche breakdown		Zener breakdown
1	PN junction are lightly doped in avalanche breakdown	**1**	PN junction are heavily doped in zener breakdown
2	The avalanche breakdown occurs when carriers in the transition region are accelerated by the electric field to energies sufficient to create mobile or free electron-hole pairs via collisions with bound electrons	**2**	In the Zener effect or Zener breakdown , the electric field enables tunneling of electrons from the valence to the conduction band of a semiconductor in a reverse biased p-n diode
3	Charge carriers acquire energy from the applied potential	**3**	Zener current is independent of applied voltage
4	Electron hole pairs are generated	**4**	Large number of holes and electrons are produced

(c) Draw construction of Schottky diode and state it's four applications. **4M**

Ans: **2M**



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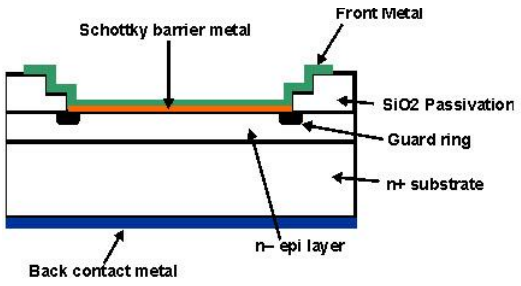


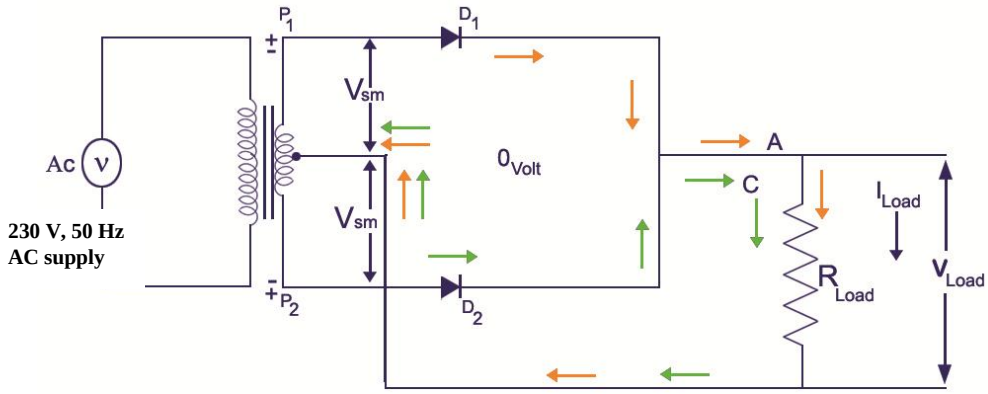
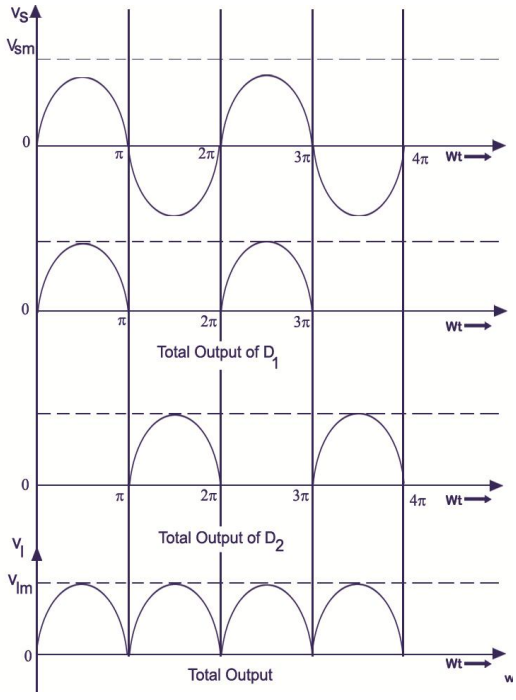
Applications :- **(Any four ½ M each)**

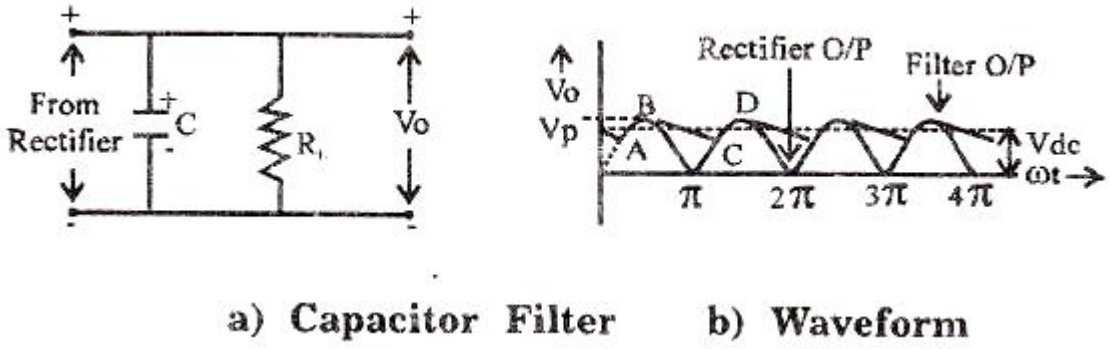
1. RF mixer and detector diode:
2. Power rectifier
3. Voltage clamping
4. Stand alone photovoltaic systems in order to prevent batteries from discharging purpose for the solar panels at night
5. Rectifiers in power supplies.

d) Which material is used for manufacturing of following LED ? **4M**

(i) Infrared LED (ii) Red or Green LED

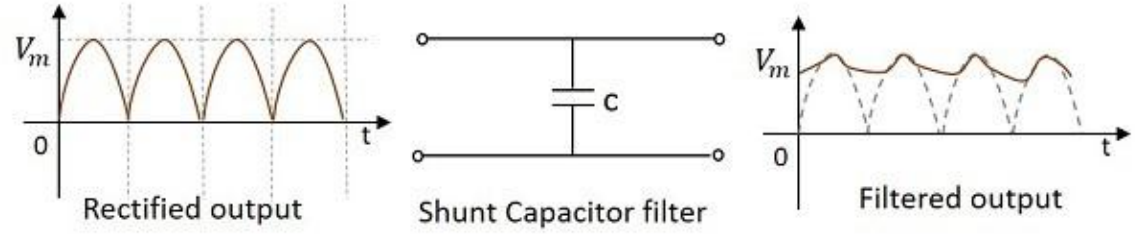
(ii) Red or Yellow LED (iv) Blue LED

	Ans:	• **Infrared LED :** Aluminum gallium arsenide (AlGaAs) • **Red or Green LED:** Indium gallium nitride (InGaN), Aluminum gallium arsenide (AlGaAs) • **Red or Yellow LED :** Aluminum gallium indium phosphide (AlGaInP), Aluminum gallium arsenide (AlGaAs) • **Blue LED :** Indium gallium nitride (InGaN)	**(1M each)**
	(e)	**Draw circuit diagram and waveforms for centre-tap full wave rectifier.**	**4M**
	Ans:	**Circuit Diagram:**  CENTRE - TAP FULL- WAVE RECTIFIER CIRCUIT **Waveforms :** AC input Output across D_1 Output across D_2 Output across R_L  	**2M** **2M**
	(f)	**With help fo circuit diagram and waveform, explain shunt capacitor filter.**	**4M**
	Ans:	**Circuit diagram and Waveform:**	**1M each**



a) Capacitor Filter **b) Waveform**

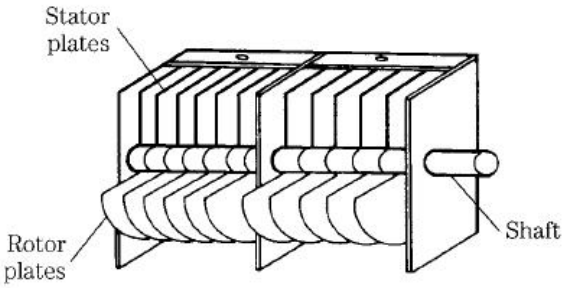
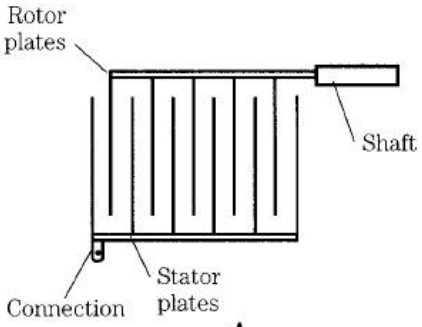
OR

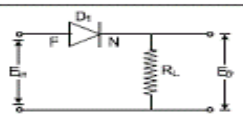
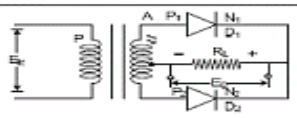
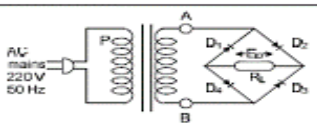
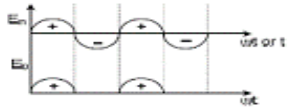
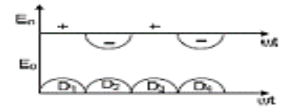
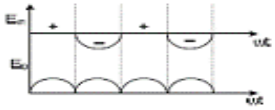
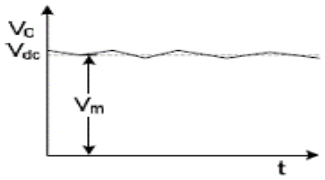
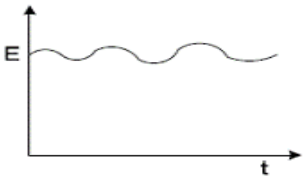
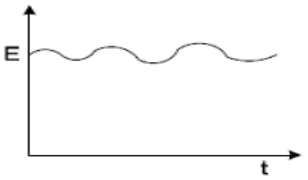


Explanation:

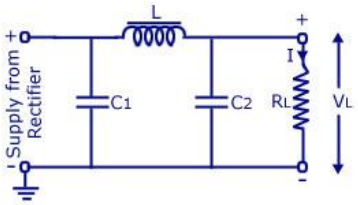
- A filter circuit is one which removes the ac component present in the rectified output and allows the dc component to reach the load.
- As a capacitor allows ac through it and blocks dc, a filter called Shunt Capacitor Filter can be constructed using a capacitor, connected in shunt, as shown in the above figure.
- The rectified output when passed through this filter, the ac components present in the signal are grounded through the capacitor which allows ac components. The remaining dc components present in the signal are collected at the output.

Q. 4	**A)**	**Attempt any FOUR :**	**16M**
	(a)	**Define : (i) Efficiency (ii) TUF of Rectifier**	**4M**
	Ans:		
		Rectifier efficiency (η) : it is defined as the ratio of DC power to the applied input AC power.	**1M**
		Rectifier Efficiency, $\eta = P_{dc} / P_{ac}$	**1M**
		Transformer utilization factor: It is defined as the ratio of the DC power available at the load resistor and the AC rating of the secondary coil of a transformer.	**1M**
		$$T.U.F = \frac{P_{odc}}{V_A \ rating \ of \ transformer}$$	**1M**
		The V_A rating of the transformer can be defined as: $V_A = V_{r.m.s}\dot{I}_{r.m.s}(For\ secondary\ coil.)$	

	(b)	**With help of constructional diagram, explain working of air-gang capacitor.**	**4M**
	Ans:	**Construction of air-gang capacitor :** Air gang capacitors are capacitors which use air as their dielectric. The simplest air capacitors are made of two conductive plates separated by an air gap.  B  A **Working :** Variable capacitors are made by placing two sets of metal plates parallel to each other (Fig. A) separated by a dielectric of air, mica, ceramic, or a vacuum. The difference between variable and fixed capacitors is that, in variable capacitors, the plates are constructed in such a way that the capacitance can be changed. There are two principal ways to vary the capacitance: either the spacing between the plates is varied or the cross-sectional area of the plates that face each other is varied. Figure B shows the construction of a typical variable capacitor used for the main tuning control in radio receivers. The capacitor consists of two sets of parallel plates. The stator plates are fixed in their position and are attached to the frame of the capacitor. The rotor plates are attached to the shaft that is used to adjust the capacitance.	**2M** **2M**
	(c)	**Compare half wave rectifier and full wave rectifier.**	**4M**
	Ans:		**(Any four points 1M each)**

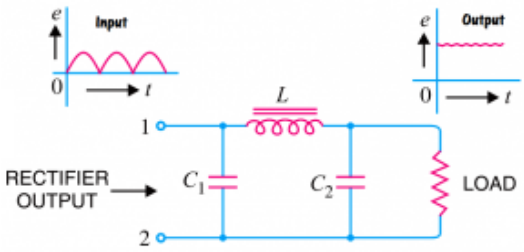
No.	Half-Wave Rectifier	Full Wave Rectifier centre taped	Full wave Bridge Rectifier
1.			
2.	In this, one diode or one semiconductor diode is used	In this, two diodes or one double diode or two junction diodes are used	In this four junction diodes from the bridge circuit.
3.	Ordinary transformer is used	Centre tap transformer is used	Transformer is not required
4.	It converts half cycle of applied A.C. signal into D.C. signal	It converts the whole cycle of applied A.C. signal into D.C. signal	It converts the whole cycle of applied A.C. signal into D.C. signal
5.	Input and output curves 	Input and output curves 	Input and output curves 
6.	The value of $I_{rms} = \frac{I_0}{2}$	$I_{rms} = \frac{I_0}{\sqrt{2}}$	$I_{rms} = \frac{I_0}{\sqrt{2}}$
7.	$I_{dc} = \frac{I_0}{\pi}$	$I_{dc} = \frac{2I_0}{\pi}$	$I_{dc} = \frac{2I_0}{\pi}$
8.	The value of ripple factor is $r = \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2} - 1 = 121\%$	The value of r in it is 48.2%	The value of r in it is 48.2%
9.	Efficiency (η) (a) $\eta = \frac{40.6}{\left(1+\frac{r_p}{R_L}\right)}$ (b) When $r_p = R_L$ then η = 20.3% (c) When $r_p << R_L$ then η = 40.6%	(a) $\eta = \frac{81.2}{\left(1+\frac{r_p}{R_L}\right)}$ (b) When $r_p = R_L$ then η = 40.6% (c) When $\frac{r_p}{R_L} << 1$ then η = 81.2%	Its efficiency is 81.2%
10.	Peak inverse voltage PIV = E_0	PIV = $2E_0$	PIV = $2E_0$
11.	Form factor $F = \frac{I_{rms}}{I_{dc}} = \frac{E_{rms}}{E_{dc}} = \frac{\pi}{2} = 1.57$	F = 1.11	F = 1.11
12.	The ripple frequency is equal to the frequency of applied e.m.f.	The ripple frequency is twice that of the applied e.m.f.	The ripple frequency is twice that of the applied e.m.f.
13.	Curve between the output voltage from filter circuit and time 	Curve 	Curve 
14.	The value of D.C. component in output voltage is less than the A.C.	The value of D.C. component in output voltage is more than that of A.C.	The value of D.,C. component in output voltage is more than that of A.C.
15.	The value of peak inverse voltage (PIV) is E_0	The value of PIV is E_0	The value of PIV is E_0
16.	The value of peak load current is $\frac{E_0}{r_p + R_L}$	The value of PLC is $\frac{E_0}{r_p + R_L}$	The value of PLC is $\frac{2E_0}{2r_p + 2R_L}$

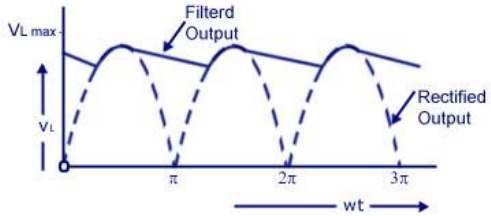
	(d)	**With help of circuit diagram and waveform, explain working of CLC or π- filter.**	**4M**
	Ans:	**Circuit diagram CLC or Π filter:**	**2M**



Circuit Digram

OR





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

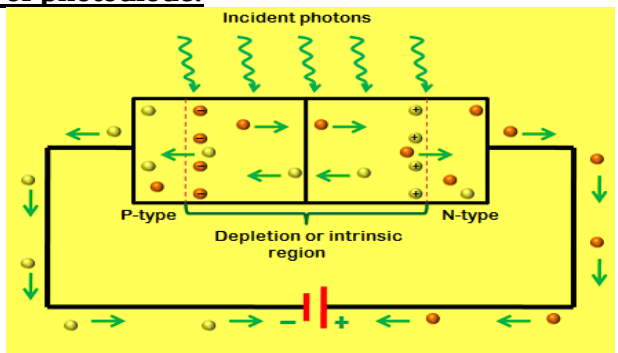
2M

Working :

It consist of a filter capacitor C1 connected across the rectifier o/p , a choke L is series and another filter capacitor C2 connected across the load. The pulsating o/p from the rectifier is applied across the i/p terminals 1 & 2 of the filter. The filtering action of the three components C1 C2 and L is described below:

- The filter capacitor C1 offers low reactance to a.c component of rectifier output while it offers infinite reactance to the d.c. component. Therefore, capacitor C1 bypasses an appreciable amount of a.c component while the d.c component continues its journey to the choke L.
- The choke L offers high reactance to the a.c component but it offers almost zero reactance to the d.c component. Therefore, it allows the d.c component to flow through it, while the unbypassed a.c component is blocked.
- The filter capacitor C2 bypasses the a.c component which the choke has failed to block. Therefore, only d.c component appears across the load and that is what we desire.

	(e)	**Write working principle of photodiode and state its two applications.**	**4M**
	Ans:	**Working principle of photodiode:**	**1M**



		Working principle: • A photodiode is a PN- junction diode that consumes light energy to produce electric current. Sometimes it is also called as photo-detector, a light detector, and photo-sensor. • Photodiodes are work in reverse bias condition, it means that the P-side of the photodiode is connected to the negative terminal of the battery and n-side is connected to the positive terminal of the battery. • When a photon of ample energy strikes the diode, it makes a couple of an electron-hole. This mechanism is also called as the inner photoelectric effect. If the absorption arises in the depletion region junction, then the carriers are removed from the junction by the inbuilt electric field of the depletion region. Therefore, holes in the region move toward the anode, and electrons move toward the cathode, and a photocurrent will be generated. **Applications :** • Fibre optic links • Optical communication • Optical remote control • Smoke detectors • Flame detectors • Intruder alert security system	**2M** **(Any two ½ M each)**
	f)	**Give four applications of LASER diode.**	**4M**
	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 1M each)**
Q.5		**Attempt any FOUR**	**16M**
	a)	**Compare linear and nonlinear wave shaping circuits.**	**4M**
	Ans:		

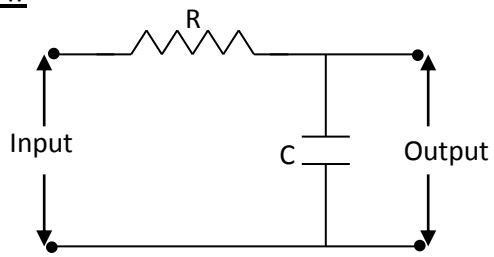
Sr. No.	Linear Wave shaping Circuit	Non Linear Wave shaping Circuits
1	The circuit which makes use of only linear circuit elements is known as linear wave shaping circuits.	The circuit which makes use of nonlinear circuit elements is known as nonlinear wave shaping circuits.
2	Linear circuit is an electric circuit in which circuit parameters (Resistance, inductance, capacitance, waveform, frequency etc) are constant. In other words, a circuit whose parameters are not	A nonlinear circuit is an electric circuit whose parameters are varied with respect to Current and Voltage. In other words, an electric circuit in which circuit parameters (Resistance, inductance, capacitance,

	changed with respect to Current and Voltage is called Linear Circuit.	waveform, frequency etc) is not constant, is called Non Linear Circuit.
3	Resistor, capacitor, inductor are used for the circuits.	Diode, transistor, resistors and capacitors etc. are used for the circuits
4	E.g. Integrator, Differentiator	E.g. Clipper, Clamper

b) Draw circuit diagram of RC Integrator and explain its working. **4M**

Ans: **1M**

The circuit of integrator is as below-



3M

Mathematical Analysis:-

V_i : ac input voltage.
i : Resulting alternating current.
q : Charge on the capacitor at any instant.

Since R is very large as compared to X_C , therefore voltage across R i.e.V_R is equal to the input voltage

i.e. $V_i = V_R$

$$i = \frac{V_R}{R} = \frac{V_i}{R}$$

The charge q on the capacitor at any instant.

$$q = \int i.dt$$

output voltage $V_O = \frac{q}{c}$

$$= \frac{\int i.dt}{c}$$

$$= \frac{\int \frac{V_i}{R}.dt}{c}$$

$$= \frac{1}{RC}\int V_i\,dt$$

$$V_O \propto \int V_i.dt$$

Hence, output voltage directly proportional to integration of input voltage.

c) Compare ; i) Active n/w and passive n/w **4M**
ii) Bilateral n/w and unilateral n/w

Ans: **i) Active n/w and passive n/w** **2M**

Sr.	Active n/w	Passive n/w

No.		
1	It is a network which contains active elements.	It is a network which does not contains active elements or any sources of emf in it.
2	Active elements such as battery, transistor, vaccum tube etc	Passive elements such as Resistor, capacitor, inductor

ii) Bilateral n/w and unilateral n/w

Sr. No.	Bilateral n/w	Unilateral n/w
1	In bilateral circuits, the property of circuit does not change with the change of direction of supply voltage or current. In other words, bilateral circuit allows the current to flow in both directions.	In unilateral n/w, the property of circuit changes with the change of direction of supply voltage or current. In other words, unilateral circuit allows the current to flow only in one direction.
2	Eg: transmission line	Eg: Diode rectifier

2M

(d) **Define ; i) Clipper**
ii) Clamper **4M**

Ans: **(2M Each For suitable definition)**

Clipper: The circuit with which the waveform is shaped by removing (or clipping) a portion of the applied wave is known as a clipper.

Clamper: A circuit that shifts either positive or negative peak of the signal at a desired dc level is known as a clamping circuits or clamper. These circuits are also called D.C. restorer or D.C. inserter

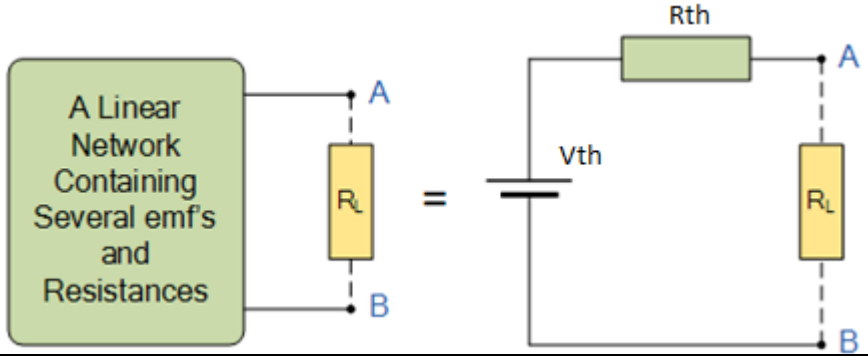
(e) **State and explain Thevenin's theorem** **4M**

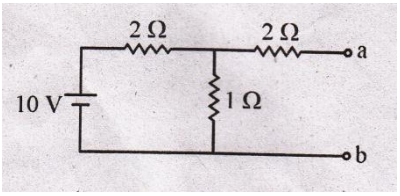
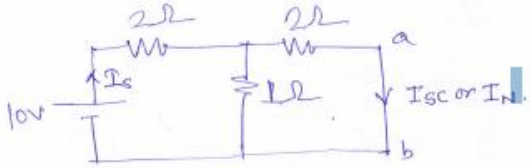
Ans: **(2M Statement)**

Thevenin's Theorem states that "Any linear circuit containing several voltages and resistances can be replaced by just one single voltage in series with a single resistance connected across the load".
As far as the load resistor R_L is concerned, any complex "one-port" network consisting of multiple resistive circuit elements and energy sources can be replaced by one single equivalent resistance Rth and one single equivalent voltage Vth. Rth is the source resistance value looking back into the circuit and Vth is the open circuit voltage at the terminals.

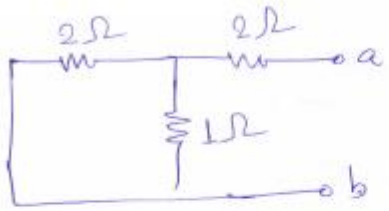
Thevenin's equivalent circuit:
A series combination of Thevenin's equivalent voltage source Vth and Thevenin's equivalent resistance Rth forms Thevenin's equivalent circuit as shown below.

(2M Explanation)



	(f)	**Using Morton's theorem find Morton's equivalent circuits of following:** 	**4M**
	Ans:	Ans: Short a & b.  $R_{eq} = \frac{2\times1}{2+1} + 2$ $= \frac{2}{3} + 2$ $\boxed{R_{eq} = 2.6667\ \Omega}$ — 1M $I_S = \frac{10}{2.6667}$ $I_S = 3.7499\ A$ $I_N = I_S \times \frac{1}{1+2}$ $= 3.7499 \times \frac{1}{3}$ $\boxed{I_N = 1.2483\ A}$ — 1M	

For Norton's equivalent Resistance R_N,



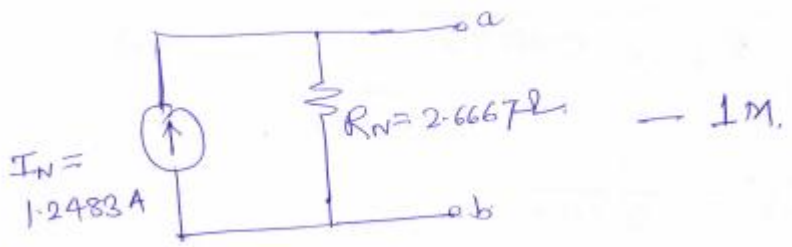
$R_N = 2 \| 1 + 2$

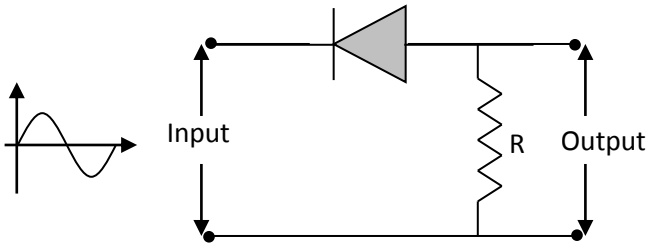
$= \frac{2}{2+1} + 2$

$= \frac{2}{3} + 2$

$R_N = 2.6667\ \Omega$ — 1M

Norton's equivalent circuit :



Q.6		**Attempt any of FOUR:**	**16M**
	a)	**With help of circuit diagram and waveform, explain working of positive series clipper.**	**4M**
	Ans:	**<u>Series Clipper (Positive):-</u>**  	**1M (Biased positive series clipper also can be consider)**

Working:

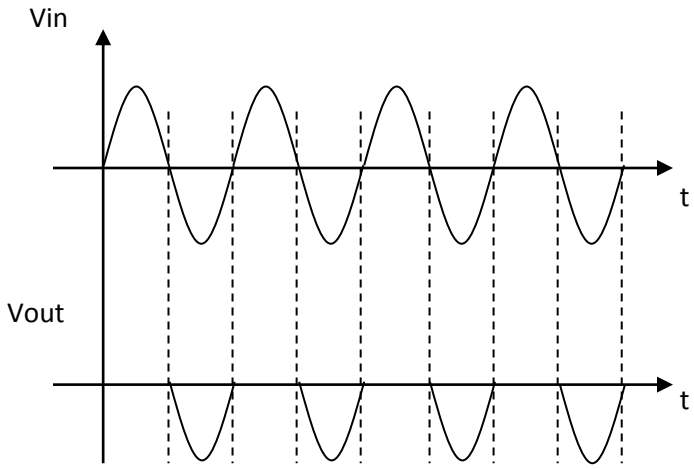
For positive cycle the diode D is reverse biased. Hence there is no voltage across the load R_L

While for negative half wave, the diode D is forward biased. Hence the voltage across the R_L is negative half cycle of the input. Hence the positive cycle of the input voltage gets clipped off.

2M

1M

Input & o/p wave form:-

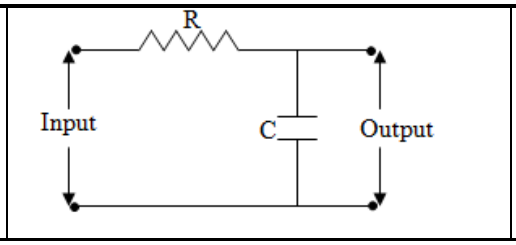
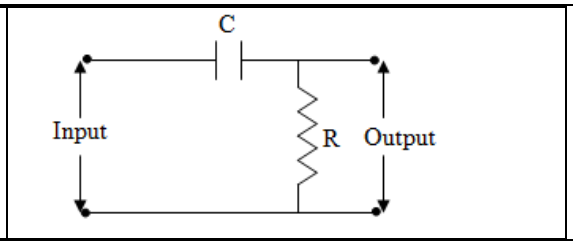
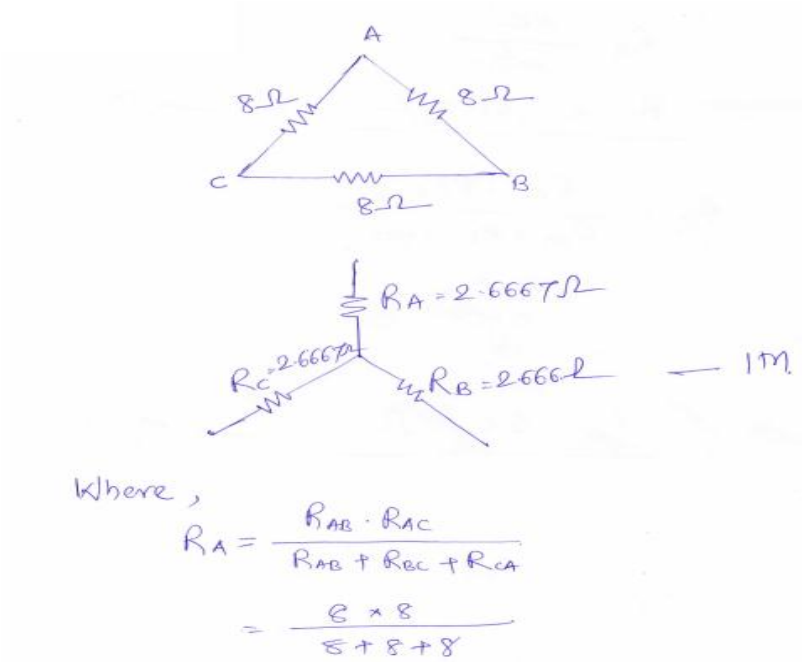


b) Compare Integrator and differentiator. **4M**

Ans:

Sr. No.	Integrator	Differentiator
1	A circuit that gives an output voltage directly proportional to the integral of its input is known as an integrating circuit.	A circuit that gives an output voltage directly proportional to the derivative of its input is known as a differentiating circuit.
2	The values of R & C are selected in such a way that the time constant (RC) of the circuit should be very large than the time period of the input wave. (i.e. $\tau >> T$)	The value of R & C are selected in such a way that the time constant (RC) of the circuit should be very small than the time period of the input.(i.e. $\tau << T$)
3	The value of R should be 10 times or more than 10 times than X_C. (i.e. R >> 10 X_C) at operating frequency.	The value of X_C [1/(2ЛIFC)] should be 10 or more than 10 times larger than R (i.e $X_C \geq 10$ R) at the operating freq.
4	It is a low pass filter.	It is a high pass filter.

(1M Any four points)

		5  	
c)	**State and explain superposition theorem.**		**4M**
Ans:	**<u>Superposition theorem states that:</u>** In a linear circuit with several sources the voltage and current responses in any branch is the algebraic sum of the voltage and current responses due to each source acting independently with all other sources replaced by their internal impedance. **<u>Steps to solve a circuit with the help of Superposition theorem</u>:** 1. First of all make sure the circuit is a linear circuit; or a circuit where Ohm's law implies, because Superposition theorem is applicable only to linear circuits and responses. 2. Replacing a Voltage source or Current Source replace with their internal resistance or impedance. If the Source is an Ideal source or internal impedance is not given then replace a Voltage source with a short; And replace a Current source with an Open. 3. Determine the branch responses or voltage drop and current on every branches simply by using KCL , KVL or Ohm's Law. Repeat step 2 and 3 for every source the circuit has. Now algebraically add the responses due to each source on a branch to find the response on the branch due to the combined effect of all the sources.	**(2M Statement)** **2M**
d)	**Three resistances of 8Ω each are connected in delta.Find equivalent star connected network.**		**4M**
Ans:			

$= \frac{64}{24}$

$R_A = 2.6667\,\Omega$ — 1M

$R_B = \frac{R_{AB} \cdot R_{BC}}{R_{AB} + R_{BC} + R_{CA}}$

$= \frac{8 \times 8}{8+8+8}$

$R_B = \frac{64}{24}$

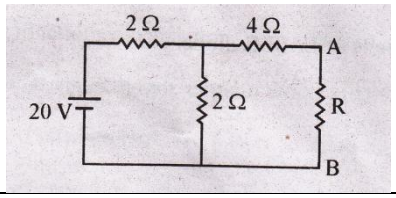
$R_B = 2.6667\,\Omega$ — 1M.

$R_C = \frac{R_{AC} \times R_{BC}}{R_{AB} + R_{BC} + R_{CA}}$

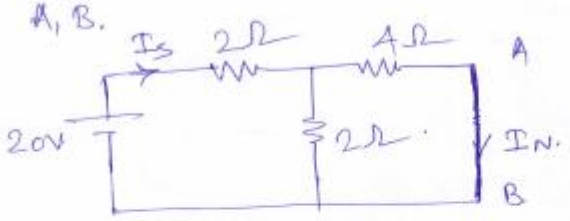
$= \frac{8 \times 8}{8+8+8}$

$= \frac{64}{24}$

$R_C = 2.6667\,\Omega$ — 1M.

	e)	**Calculate the value of resistance R in the branch AB so that maximum power is transferred to the load of the following circuit:** 	**4M**
	Ans:		

Ans: Remove load resistance R. and short terminal A, B.



$$Req = 4 || 2 + 2$$

$$= \frac{8}{4+2} + 2$$

$$= \frac{8}{6} + 2 = 3.33\ \Omega \quad \text{— 1M.}$$

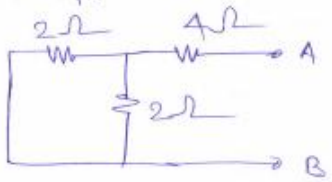
$$I_S = \frac{20}{3.33}$$

$$I_S = 6.006\ A$$

$$I_N = 6.006 \times \frac{2}{4+2}$$

$$I_N = 2.002\ A$$

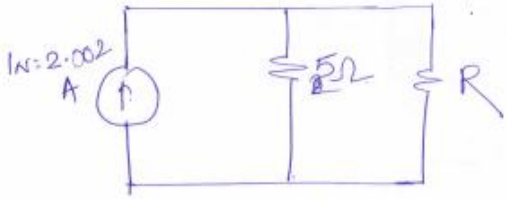
for R_N.



$R_N = 2 \| 2 + 4$

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

$R_N = 5\Omega$

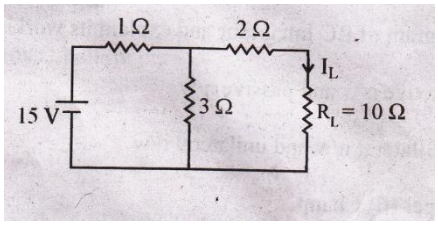


— any equivalent circuit 2M,

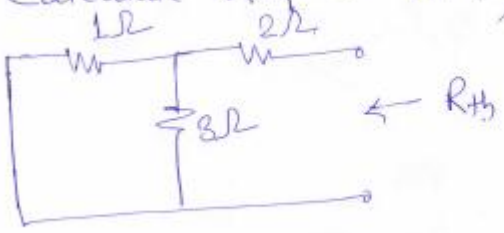
In a circuit, power supplied to the load is maximum when load resistance is equal to the source resistance.

i.e. $R = 5\Omega$ — 1M.

	(f)	**Using thevenin's theorem find load current I_L.**	**4M**
	Ans:		



Calculate R_{eq} or R_{th}, remove R_L

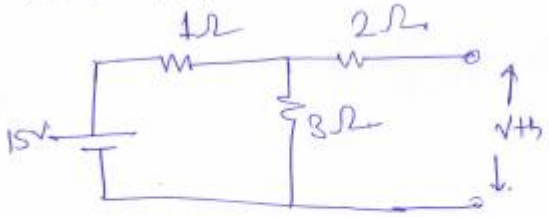


$$R_{th} = 1 \| 3 + 2$$

$$= \frac{3}{1+3} + 2$$

$$\boxed{R_{th} = 2.75\,\Omega}$$ — 1 M.

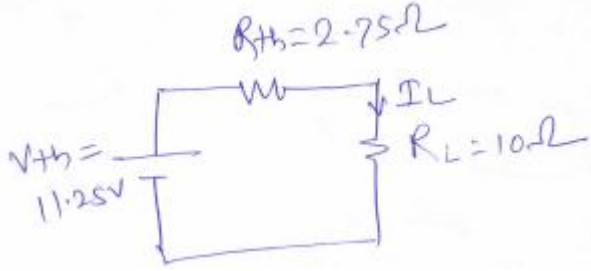
find V_{th}.



$$V_{th} = \frac{15}{1+3} \times 3$$

$$\boxed{V_{th} = 11.25\ V}$$ — 1 M.

Thevenin's equivalent circuit:



$$I_L = \frac{V_{th}}{R_{th} + R_L}$$

		$= \frac{11.25}{2.75+10}$ $I_L = 0.8823\ A$ — 2 M.	