SCHEME OF EVALUATION

SCORING INDICATOR

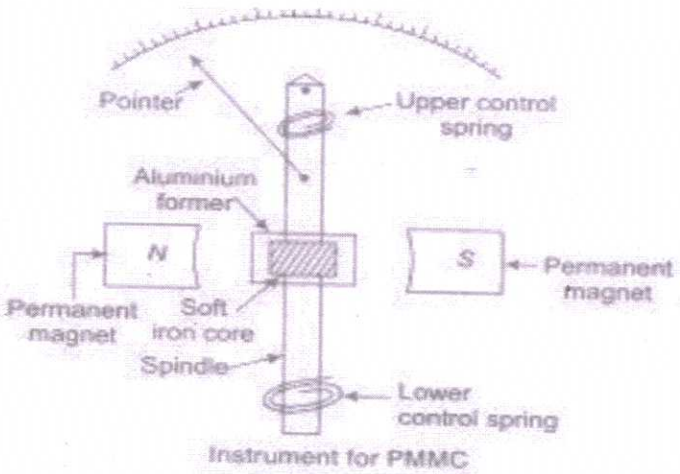
Revision : 2015 **Course Code : 3021**

Course Title : ELECTRICAL & ELECTRONICS ENGINEERING

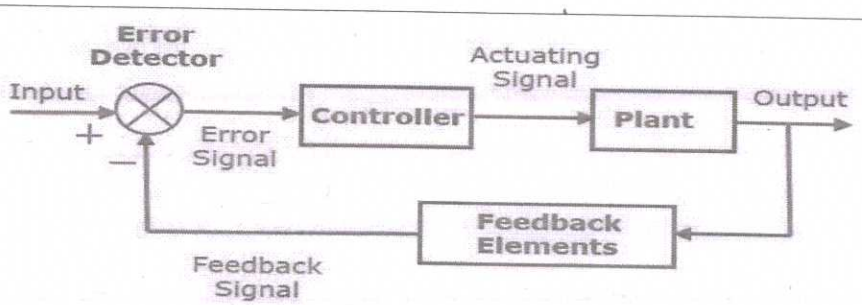
Qst No	Scoring Indicator	Split up Score	Sub Total	Total
	PART A			
I(1)	Unity or 1 & zero.	2		
I(2)	Cell, battery, generator, etc…(any two).	2		
I(3)	It is the ratio of no. of turns in primary winding to no. of turns in secondary Winding.	2	2x5 = 10	2x5 = 10
I(4)	In order to reduce number of oscillations of pointer at final position.	2		
I(5)	Potential developed across the depletion region due to the formation of negative and positive irons on either sides of the junction.	2		

II	**PART B**			
II(1)	**Star connection**	**Delta connection**	6	6
	• Similar ends of three coils are joined together. • Neutral point is present. • Line voltage is $\sqrt{3}$ times the phase voltage. • Line current is equal to the phase current. • Line voltage is 30° ahead of their respective phase voltage. • Total power is three times the power in each phase.	• Dissimilar ends of three coils are joined together. • No neutral point. • Line voltage is equal to the phase voltage. • Line current is $\sqrt{3}$ times the phase current. • Line currents are 30° behind of their respective phase current. • Total power is three times the power in each phase.		
II(2)	**Charging** Anode and cathode are connected to the positive and the negative terminal of the DC supply mains. The molecules of the sulfuric acid break up into ions of $2H^+$ and SO_4^{--}. The hydrogen ions being positively charged moved towards the cathodes and receive two electrons from there and form a hydrogen atom. The hydrogen atom reacts with lead sulphate cathode forming lead and sulfuric acid according to the chemical equation. $PbSO_4 + 2H_2O + 2H = PbSO_4 + 2H_2SO_4$ SO_4^{--} ion moves to the anode, gives up its two additional electrons becomes radical SO_4, react with the lead sulphate anode and form leads peroxide and		3 6	

	lead sulphuric acid according to the chemical equation. $PbSO_4 + 2H = H_2SO_4 + Pb$ **Discharging** When the electrodes are connected through a resistance, the cell discharge and electrons flow in a direction opposite to that during charging. The hydrogen ions move to the anode and reaching the anodes receive one electron from the anode and become hydrogen atom. The hydrogen atom comes in contacts with a PbO_2, so it attacks and forms lead sulphate ($PbSO_4$), whitish in colour and water according to the chemical equation. $PbSO_4 + 2H = PbO + H_2O$ $PbO + H_2SO_4 = PbSO_4 + 2H_2O$ $PbO_2 + H_2SO_4 + 2H = PbSO_4 + 2H_2O$	3		
II(3)	When the armature of the DC motor rotates, the armature conductor moves through the magnetic field and hence an emf induced them. This induced emf acts in opposite direction to the applied voltage known as Back EMF. At starting when the DC motor is stationary ,then there is no back EMF in the armature. If the motor is directly switched ON, armature current is very high because of small value of armature resistance. This high starting current may result in burning of armature due to excessive heating effect, damaging of commutator and brushes due to heavy sparking. In order to reduce heavy starting current a variable resistance known as starting resistance is inserted in series with the armature circuit. This resistance gradually reduced when motor gains speed and finally cut out completely after the motor attain full speed.	2 4	6	
II(4)	An auto transformer has only one winding which is shared by both primary			

	and secondary circuit, the primary and the secondary windings are connected magnetically as well as electrically. where number of turns shared by secondary is variable. EMF induced in the winding is proportional to the number of turns. Therefore, the secondary voltage can be varied by just varying secondary number of turns. As winding is common in both circuits, most of the energy is transferred by means of electrical conduction and a small part is transferred through induction.	6	6	
II(5)	 Instrument for PMMC	3		
	Moving Coil – The coil is the current carrying part of the instruments which is freely moved between the stationary field of the permanent magnet. The current passes through the coil deflects it due to which the magnitude of the current or voltage is determined. The coil is mounted on the rectangular former which is made up of aluminium. Damping torque is induced because of the movement of the aluminium core between the poles of the permanent magnet.		6	
	Magnet System – The instrument using the permanent magnet for creating the stationary magnetic field.	3		

II(6)	**Spring control-** control torque is because of the springs. The springs are made up of phosphorous bronze and placed between the two jewel bearings. The spring also provides the path to the current to flow in and out of the moving coil. **Pointer & Scale –** The pointer is linked with the moving coil. The pointer notices the deflection of the coil, and the magnitude of their deviation is shown on the scale. **<u>Active components</u>** are those who delivers or produce energy or power in the form of a voltage or current. They are energy donor and they can control the flow of current. Ex:- Diode, BJT, SCR, Integrated circuits,… **<u>Passive components</u>** are those who utilizes or store energy in the form of voltage or current.They are energy acceptor and they cannot control the flow of current. Ex:-resistor, Inductor, Capacitor,…	2 1 2 1	6	
II(7)	 Open Loop Control System Control system in which the output has no influence or effect on the control action of the input signal is called an **Open-loop system**	3		



Closed loop control system

Control system in which the output has an effect on the input quantity in such a manner that the input quantity will adjust itself based on the output generated is called **closed loop control system**

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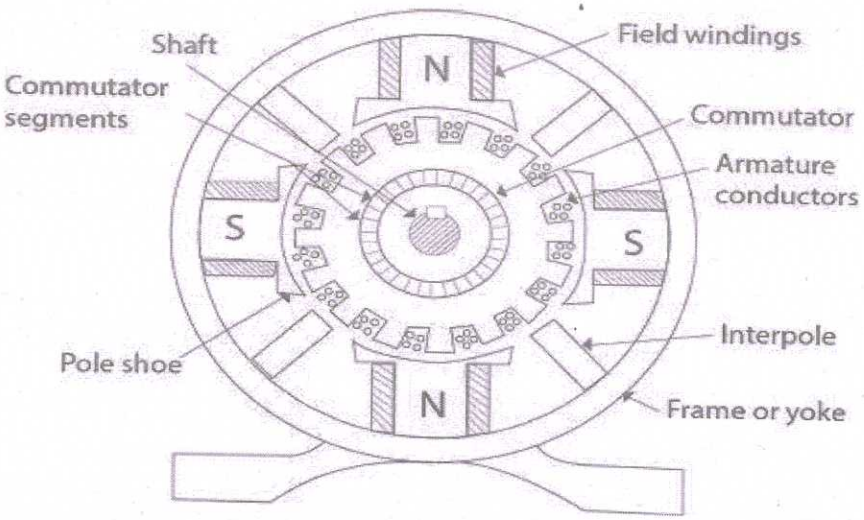
PART C

III(a)



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Yoke: The outer frame of a dc machine is called as yoke. It is made up of cast iron or steel. It not only provides mechanical strength to the whole assembly but also carries the magnetic flux produced by the field winding.

Poles and pole shoes: Poles are joined to the yoke with the help of bolts or welding. They carry field winding and pole shoes are fastened to them. Pole shoes serve two purposes; (i) they support field coils and (ii) spread out the

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	flux in air gap uniformly. **Field winding:** They are usually made of copper. Field coils are former wound and placed on each pole and are connected in series. They are wound in such a way that, when energized, they form alternate North and South poles. **Armature core:** Armature core is the rotor of a dc machine. It is cylindrical in shape with slots to carry armature winding. The armature is built up of thin laminated circular steel disks for reducing eddy current losses. It may be provided with air ducts for the axial air flow for cooling purposes. Armature is keyed to the shaft. **Armature winding:** It is usually a former wound copper coil which rests in armature slots. The armature conductors are insulated from each other and also from the armature core. Armature winding can be wound by one of the two methods; lap winding or wave winding. **Commutator and brushes:** Physical connection to the armature winding is made through a commutator-brush arrangement. The function of a commutator is to collect the current generated in armature conductors. A commutator consists of a set of copper segments which are insulated from each other. Brushes are usually made from carbon or graphite. They rest on commutator segments and slide on the segments when the commutator rotates keeping the physical contact to collect the current.			15
III(b)	RMS Value-It is steady equivalent value of time varying waveform which could also develop same amount of heat as given by the original wave form in the network for a definite period of time.	2		
	Average value-It is steady equivalent value of a time varying waveform which could also develop same amount of charge as given by original wave form in the network for a definite period of time.	2	6	
	Form factor- It is the ratio of RMS value of a sinusoidal wave form to its	2		

average value.

IV(a)

Phase voltage(V_{ph})= 1 kW/$\sqrt{3}$ — 3

= 1000/$\sqrt{3}$ = 578 V

Phase current = $\frac{V_{ph}}{R}$ = 578/50 =11.56A — 3

For a star connection, Phase current = Line current = 11.56A

Power consumed = $\sqrt{3}$ ×line voltage ×line current = $3\frac{V_{ph}^2}{R}$ — 3

= $\sqrt{3}$ × 1000× 11.56 = 20 kW(appox)

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~~IV(b)~~ IV(b)

Whenever magnetic field linked with a conductor changes an EMF is induced in the conductor OR whenever a conductor cuts magnetic field an EMF is induced in the conductor. — 3

The direction of induced EMF or induced current can be found by Fleming's right hand rule. This rule states "Hold out the right hand with the first finger, second finger and thumb at the right angle to each other. If forefinger represents the direction of the line of force, the thumb points in the direction of motion or applied force, then second finger points in the direction of the induced current". — 3

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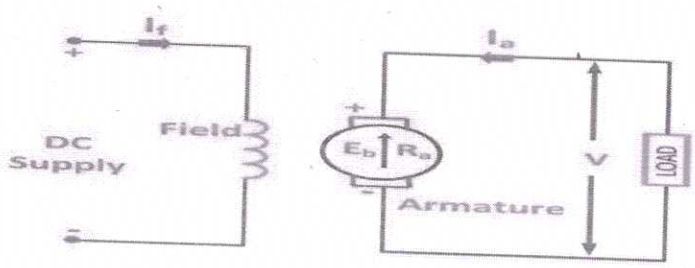
V(a)

Separately Excited DC Motor

The field coils or field windings are energized by a separate DC source as shown in the circuit diagram shown below. — 1



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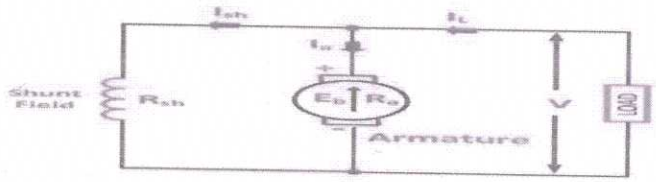
Shunt Motor

Field winding is connected in parallel with the armature as shown in the figure below. 1



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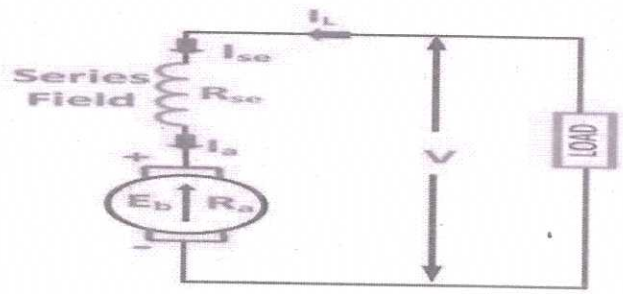
Series Motor

In the series motor, the field winding is connected in series with the armature winding. The connection diagram is shown below. 1



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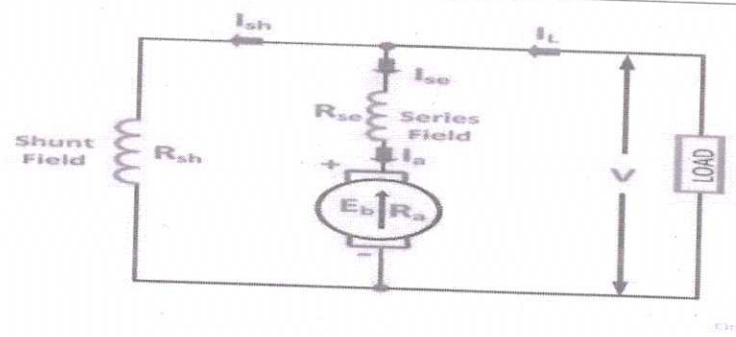
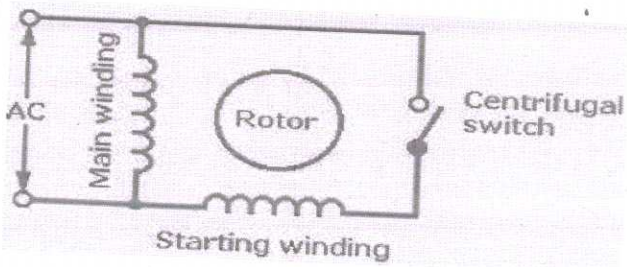
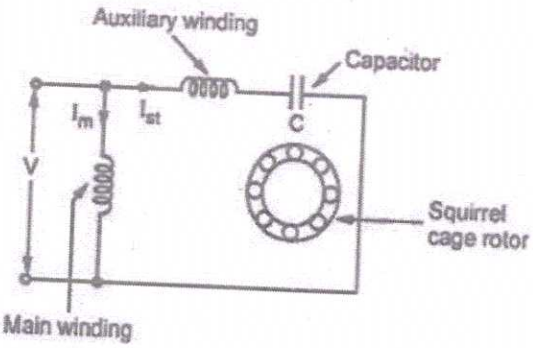
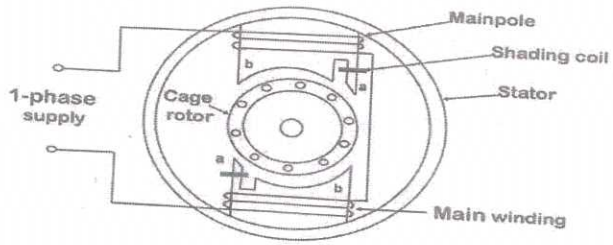
Compound Motor

A DC Motor having both shunt and series field windings is called a Compound Motor. The connection diagram of the compound motor is shown below. 1

V(b)	 The compound motor is further subdivided as **Cumulative Compound** Motor and **Differential Compound** Motor. In cumulative compound motor the flux produced by both the windings is in the same direction.In differential compound motor, the flux produced by the series field windings is opposite to the flux produced by the shunt field winding Application of DC series motor • Traction • Cranes • Elevator • Air compressor • Hoists (any 3 applications) Applications of 3-ph induction motor • Lathes • Agriculture and industrial pumps • Industrial drives • Drilling machines (any 3 applications)	1 1 3 3	6	15

VI(a)	Split phase method  		1		
	Consist of main winding and auxiliary winding on the stator. They are displaced in space by 90 degree. Main winding has relatively high inductance and low resistance where as auxiliary winding has high resistance and low inductance.		2		
	Capacitor start method  		1		
	Capacitor provided in the auxiliary winding to give a proper phase displacement between current of the two stator windings.		2	9	
	Shaded pole method The flux produced by the shaded pole lags behind the main pole flux hence there are two components of flux displaced in both time and space, which produce a revolving magnetic field, thereby starting torque.		2		



1

VI(b) When the motor is excited with three-phase supply, three-phase stator winding produce a rotating magnetic field with a constant magnitude which rotates at synchronous speed. This changing magnetic field cuts the rotor conductors and induces a current. As these rotor conductors are shorted, the current starts to flow through these conductors. According to the Lorenz force principle, a mechanical force acts on the rotor conductor, produces torque in the rotor which tends to move it in the same direction of rotating magnetic field. According to Lenz's law rotor starts rotating in the same direction of the stator rotating magnetic field

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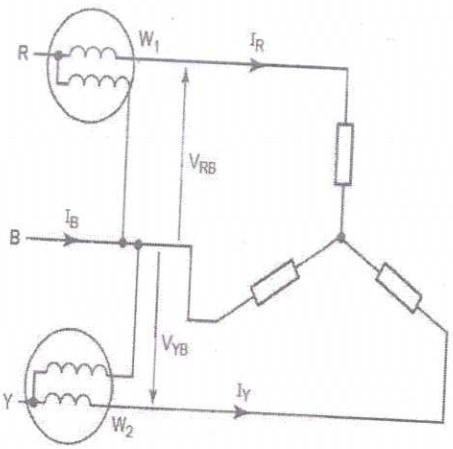
VII(a)



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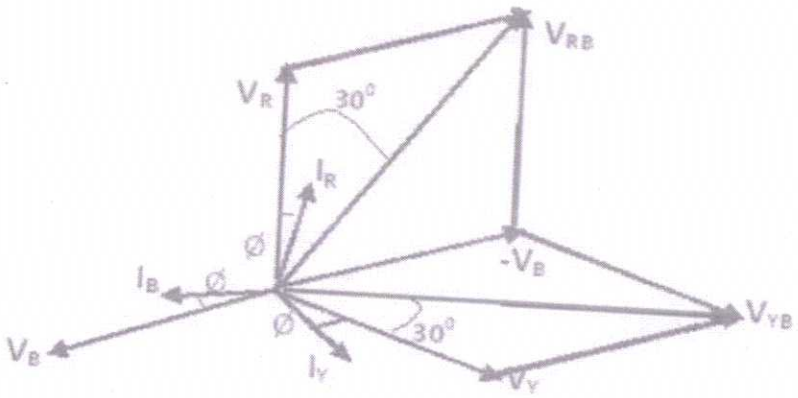

$I_R = I_Y = I_B = I$

$V_{RY} = V_{YB} = V_{RB} = V_L$

$W_1 = V_{RB}I_R\text{Cos}\,(30° - Ø) = V_L I\text{Cos}(30° - Ø)$ 6

$W_2 = V_L I\text{Cos}(30° + Ø)$

Hence, total power measured by wattmeters for the balanced three phase load is given as,

$W = W_1 + W_2 = V_L I \times \text{Cos}(30° - Ø) + V_L I \times \text{Cos}(30° + Ø)$

$= V_L I\,[\text{Cos}(30° - Ø) + \text{Cos}(30° + Ø)] = 2V_L I \times \text{Cos}30° \text{Cos}Ø$

$= \sqrt{3}V_L I\text{Cos}Ø$

Therefore, total power measured by wattmeters $W = \sqrt{3}V_L I\text{Cos}Ø$ 3

VII(b)

Electric heating is a process in which electrical energy is converted to heat energy. principle of electrical heating is Joule heating effect, an electric current passing through a resistor will convert that electrical energy into heat energy. 6

Applications: electric kettle, electric iron ,electric oven, melting of metals, etc(Any three….) 3

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VIII(a)

Attraction type	Repulsion type
• The stationary coil of the instrument is flat. The moving element is the flat disc of the iron core. The current flow through the stationary coil produced the magnetic field which attracts the iron coil. • Spring provides the controlling torque • Damping torque is provided by air friction damping. • Free from the direction of current passes through it. Thus, it is used for both AC and DC.	• Instrument has two vanes or iron plates. One is fixed, and the other one is movable. The vanes become magnetized when the current passes through the stationary coil and the force of repulsion occur between them • Spring provides the controlling torque • Damping torque is provided by air friction damping. • Free from the direction of current passes through it. Thus, it is used for both AC and DC.

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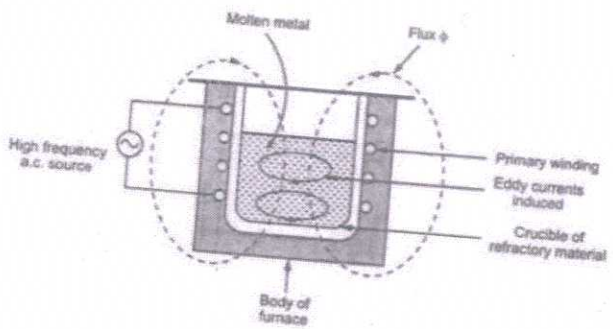
VIII(b)

Fig:



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Eddy current induced due to high frequency AC in the primary coil,work piece heated up, melted and metal change the phase.

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IX(a)

SCR working in 3 modes

Forward blocking mode - When the anode voltage is made positive with respect to the cathode, Junction J1 & J3 are forward biased and only a small leakage current will flow anode to cathode. SCR is said to be in the forward blocking mode — 3

Forward conducting mode – If the anode to cathode voltage is increased to a sufficiently large value, the reverse biased junction J2 breaks and the corresponding voltage is called forward break over voltage. Resulting large forward anode current. — 3

Reverse blocking mode - When the cathode voltage is positive with respect to anode junction J2 is forward biased but junctions J1 & J3 are reverse biased.SCR is said to be in reverse blocking state. — 3

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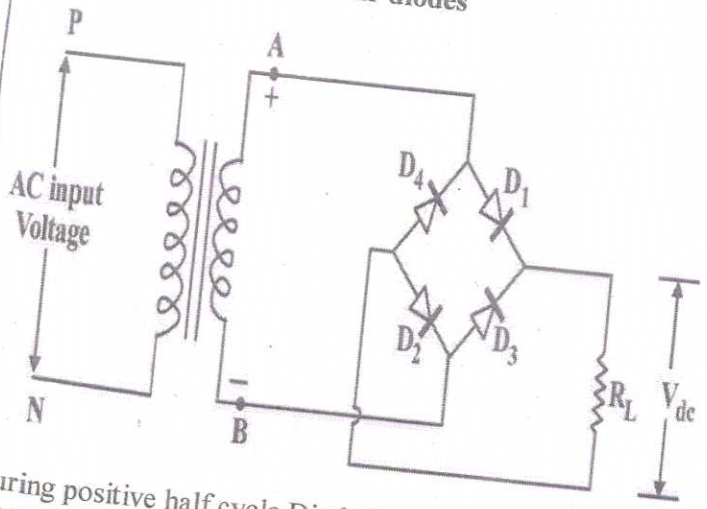
IX(b)

Full wave rectifier with four diodes



3

During positive half cycle Diode D1 & D2 forward biased .During negative half cycle Diode D3 & D4 forward biased. Output voltage will be DC wave form.

Full wave center tapped Rectifier

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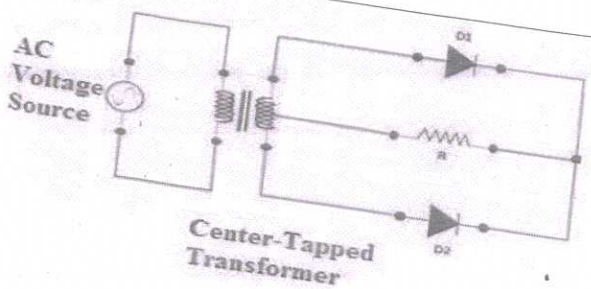

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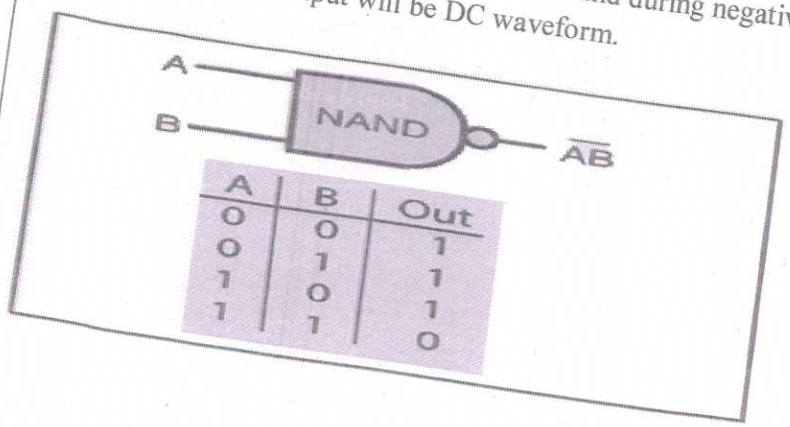
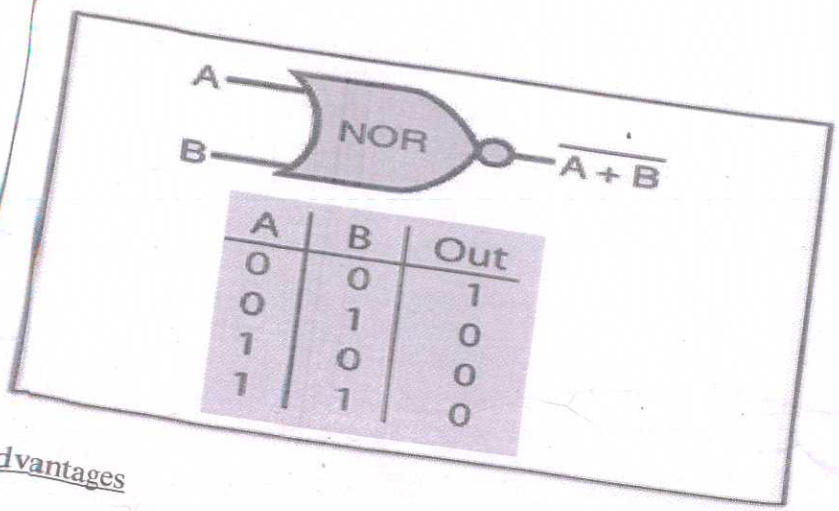
X(a) During positive half cycle D1 forward biased and during negative half cycle D2 forward biased. Output will be DC waveform.



A	B	Out
0	0	1
0	1	1
1	0	1
1	1	0

2.5



A	B	Out
0	0	1
0	1	0
1	0	0
1	1	0

9

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2.5

Advantages

- They can realize all the binary operation.
- All the basic logic gates can be derived from them
- Economical
- Easy to fabricate

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	• They can implement any Boolean functions **(Any four)**		
(b)	It is the technology by which a process or procedure is performed with minimal human assistance. Needs of automation	2	
	• Reduce human labour • Can be used in dangerous areas where human cannot work • Improved safety • Increased production rate and productivity • More economical operation can be implemented. • Reduced operation time, handling time, etc • Avoid human negligence and error **(Any four)**	4	6