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Scoring Indicators

COURSE NAME : FUNDAMENTALS OF ELECTRICAL ENGINEERING

COURSE CODE : 3024 (A) **QID : 2110220151**

Q No	Scoring Indicators	Split score	Sub Total	Total score
	PART A			**9**
I. 1	potential difference across its ends		1	
I. 2	form factor		1	
I. 3	Shunt motor		1	
I. 4	Pumps Compressors fans	½ each (any two)	1	
I. 5	melting and heat preservation of cast iron, brass, bronze, zinc and other metals	½ each (any two)	1	
I. 6	Conduction Convection Radiation		1	
I. 7	transistors and silicon-controlled rectifiers (SCRs)	½ each (any two)	1	
I. 8	PNP transistor		1	
I. 9	$1/R = 1/R_1 + 1/R_2$		1	
	PART B			24
II. 1	$R_{Total} = 2567$ ohm Current = 3.51mA	1.5 1.5	3	
II. 2	First law : When the magnetic flux linking a circuit is varied, an e.m.f. is induced in the circuit. Second law : Magnitude of the generated e.m.f. is proportional to the rate at which the conductor cuts the magnetic flux. $e = N \cdot \frac{d\phi}{dt}$	1.5 1.5	3	
II. 3	There are 3 main types of DC motor that are available. These terms relate to the type of connection of the field windings with respect to the armature circuit. 1.Series Motor 2.Shunt Motor 3. Compound Motor	1+1+1	3	

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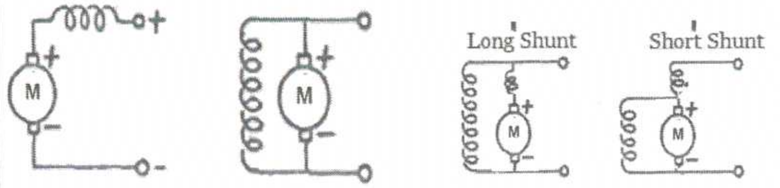
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>II. 4</td><td>When the stator winding is connected to a balanced three phase supply, a rotating magnetic field (RMF) is setup which rotates around the stator at synchronous speed (N_s)
The RMF passes through air gap and cuts the rotor conductors, which are stationary at start. Due to relative motion between RMF and the stationary rotor, an EMF is induced in the rotor conductors. Since the rotor circuit is short-circuited, a current starts flowing in the rotor conductors.
Now, the current carrying rotor conductors are in a magnetic field created by the stator. As a result of this, mechanical force acts on the rotor conductors. The sum of mechanical forces on all the rotor conductors produces a torque which tries to move the rotor in the same direction as the RMF.</td><td>1

2</td><td>3</td><td></td></tr>
<tr><td>II. 5</td><td>
Core Type Transformer   Versus   Shell Type Transformer
<table>
<tr><td>Winding surrounds the core</td><td>Core surrounds the winding</td></tr>
<tr><td>It has two limbs</td><td>It has three limbs</td></tr>
<tr><td>Requires less copper</td><td>Requires more copper</td></tr>
<tr><td>Laminations are usually in the form of alphabet letter L</td><td>Laminations are usually in the form of alphabet letter E and L</td></tr>
<tr><td>Flux is equally distributed on the side limbs</td><td>Side limbs carry the half of the flux while the central one carries the whole flux</td></tr>
<tr><td>Primary and secondary both windings are wound on the side limbs</td><td>Both windings are wound on the central limb</td></tr>
<tr><td>Only one magnetic circuit</td><td>There are two magnetic circuits</td></tr>
<tr><td>Easy to repair because assembly can be dismantled easily</td><td>Difficult to repair because both windings are on the same limb</td></tr>
<tr><td>Output is less because of more losses so less efficiency</td><td>Output is high because of less losses so efficiency is high in this type</td></tr>
</table></td><td>1 each (any three with respect to limbs, flux distribution and arrangement of winding)</td><td>3</td><td></td></tr>
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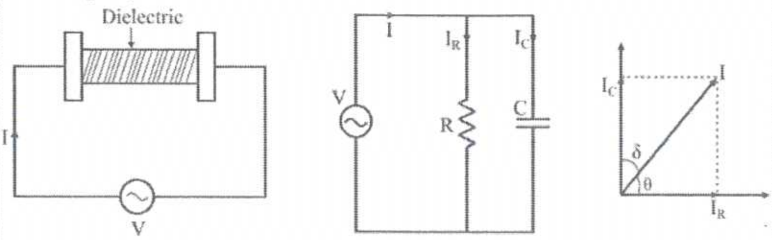
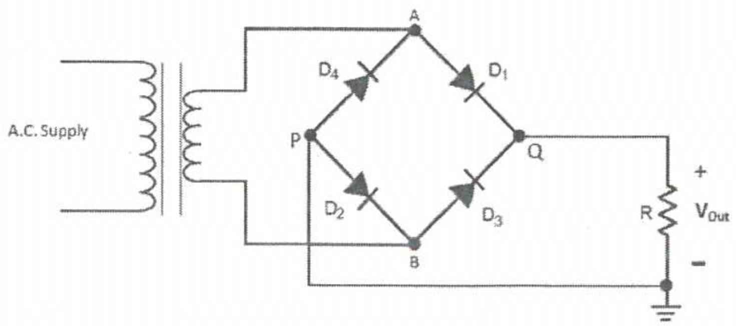
<table>
<tr><td></td><td>Easy in design and construction</td><td>Comparatively complex</td><td></td><td></td><td></td></tr>
<tr><td></td><td>Used for high voltage application like power transformers, autotransformers</td><td>Used for low voltage application like transformers in an electronic circuits</td><td></td><td></td><td></td></tr>
<tr><td>II. 6</td><td colspan="2">• Dielectric heating, also called Capacitance Heating, method by which the temperature of an electrically nonconducting (insulating) material can be raised by subjecting the material to a high-frequency electromagnetic field.
• For obtaining adequate heating, a voltage in the range of 15-20kV and a frequency of about 10-40MHz are usually employed.


Schematic Diagram   Equivalent Circuit   Phasor Diagram
• There are two electrodes which are separated by a dielectric medium (it is the material to be heated) and a potential difference of high frequency is applied across the electrodes. This arrangement forms a capacitor.
• The capacitor formed in the arrangement for the dielectric heating may not be a pure capacitor, thus a resistor 'R' is also shown in parallel in circuit.
• This causes some power loss in the dielectric material between the electrodes, thereby producing heat in the dielectric material as a dielectric loss.</td><td>1

1

1</td><td>3</td><td></td></tr>
<tr><td>II. 7</td><td colspan="2">
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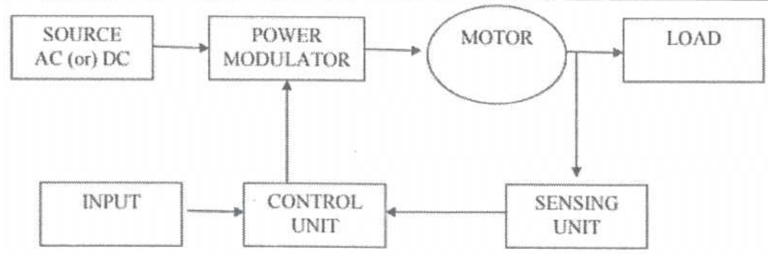
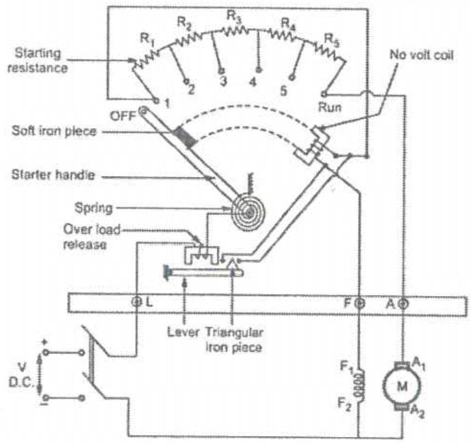
II. 8			3	
II.9	1. It can be put into service immediately. 2. No standby losses. 3. High efficiency. 4. More economical than other conventional types of heating system. 5. Easy to operate and control. 6. No air pollution. 7. System is clean, as there is no waste produced. 8. No fuel transportation cost. 9. No space is required for storage of fuel and waste. 10. Noiseless operation. 11. Uniform heating is possible; heating at particular point is also possible. 12. Dielectric material can be heated. 13. Electrical heating equipments are generally automatic, so it requires low attention and supervision. 14. Protection against overheating can be provided by suitable switch gear.	Any 6 points 1/2each	3	
II.10	**Power factor:** Cosine of the angle between voltage and current in a circuit Maximum value = 1	2 1	3	
	PART C			
III	Total load per day = 6.4kWHr Total load per month = 6.4*30 = 192kWHr = 192 units Monthly cost = Rs.480/-	2 3 2	7	

IV	R_{eff} = 7 ohm		7	
	(i) the current from the battery, $I = E/R_{eff}$ = 35/7 = 5 A	1		
	(ii) voltage across 3 Ω resistor, $V = I \times R_{eff}$ = 5 x 3 = 15 V	2		
	(iii) power dissipated in 3 ohm resistor = $I^2 R_{eff}$ 25 x 7 = 175 W	2 2		
V	 	Fig 3	7	
	• Initially the handle is in the OFF position. Neither armature nor the field of the motor gets supply. Now the handle is moved to stud number 1. In this position armature and all the resistances in series gets connected to the supply. Field coil gets full supply as the rectangular strip makes contact with arc copper strip. • As the machine picks up speed handle is moved further to stud number 2. In this position the external resistance in the armature circuit is less as the first resistance is left out. Field however, continues to get full voltage by virtue of the continuous arc strip. Continuing in this way, all resistances will be left out when stud number 12 (ON) is reached. • The electromagnet (NVRC) will attract the soft iron piece attached to the handle. Even if the operator removes his hand from the handle, it will still remain in the ON position as spring restoring force will be balanced by the force of attraction between NVRC and the soft iron piece of the handle. The no volt release coil (NVRC) carries same current as that of the field coil. In case supply voltage goes off, field coil current will decrease to zero. Hence NVRC will be deenergised and will not be able to exert any force on the soft iron piece of the handle. • The starter also provides over load protection for the motor. The other electromagnet, OLRC overload release coil along with a soft iron piece kept under it, is used to achieve this. The current flowing through OLRC is the line current IL drawn by the motor. As the motor is loaded, Ia hence IL increases. Therefore, IL is a measure of loading of the motor.	Exp 4		

<table>
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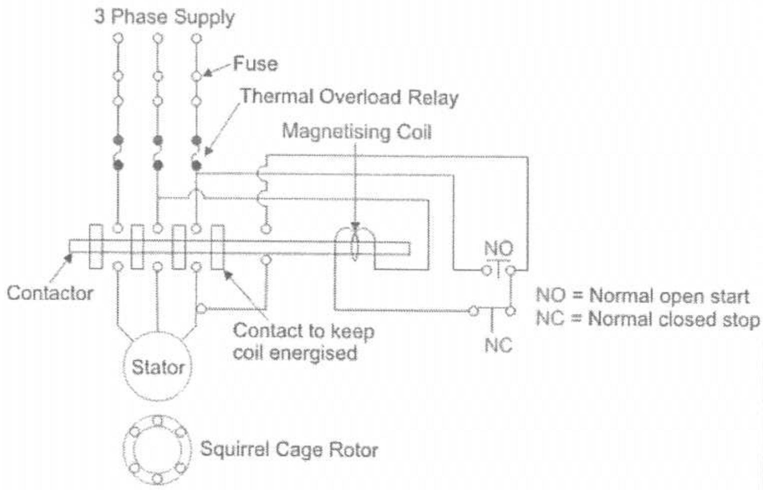
<td>VI</td>
<td>A DOL starter (also known as a direct on line starter or across the line starter) is a method of starting a 3 phase induction motor. In a DOL Starter, an induction motor is connected directly across its 3-phase supply, and the DOL starter applies the full line voltage to the motor terminals.


• The working principle of a DOL starter begins with the connection to the 3-phase main with the motor.
• The control circuit is connected to any two phases and energized from them only.
• When we press the start button, the current flows through the contactor coil (magnetizing coil) and control circuit also.
• The current energises the contactor coil and leads to close the contacts, and hence 3-phase supply becomes available to the motor.
• If we press the stop button, the current through the contact becomes discontinued, hence supply to the motor will not be available, and the similar thing will happen when the overload relay operates. Since the supply of motor breaks, the machine will come to rest.</td>
<td>Fig 3

Exp 4</td>
<td>7</td>
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<tr>
<td>VII</td>
<td>• Induction heating is based on the principle of transformer working.
• The primary winding which is supplied from an a.c. source is magnetically coupled to the charge (material to be heated) which acts as a short circuited secondary of single turn.
• When an a.c. voltage is applied to the primary, it induces voltage in the secondary i.e. charge.
• The secondary current heats up the charge in the same way as any electric current does while passing through a resistance.
• If V is the voltage induced in the charge and R is the charge resistance, then heat produced = V^2/R.
• The value of current induced in the charge depends on (i) magnitude of the primary current (ii) turn ratio of the transformer
• For heating by eddy-currents, charge/load is placed inside a high frequency a.c. current-carrying coil known as heater coil. The alternating magnetic field produced by the coil sets up eddy-currents in the article which, consequently, gets heated up.</td>
<td>Fig 3

Exp 4</td>
<td>7</td>
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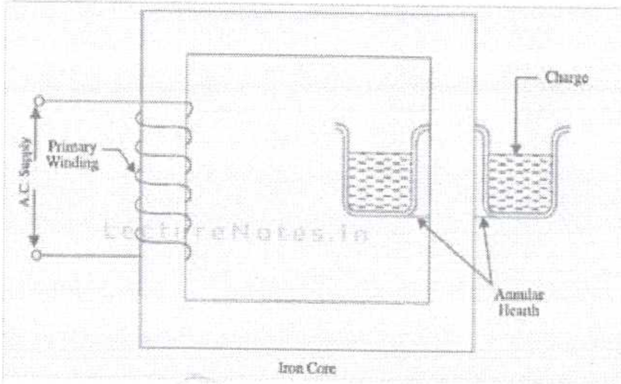
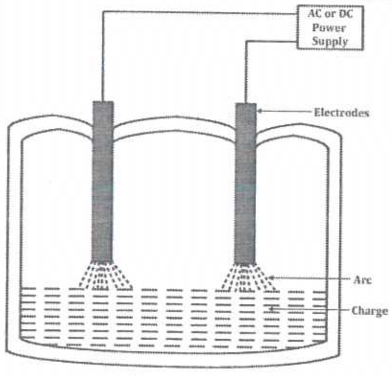
	Eddy-current loss which is responsible for the production of heat.  			
VIII	 *Figure 3.8 Direct Arc Furnace* • As the arc is in direct contact with the charge and heat is also produced by current flowing through the charge itself, it is known as direct arc furnace. • If the available supply is DC or 1-Φ AC, two electrodes are sufficient, if the supply is 3-Φ AC; three electrodes are placed at three vertices of an equilateral triangle. • The most important feature of the direct arc furnace is that the current flows through the charge, the stirring action is inherent due to the electromagnetic force setup by the current and such furnace is used for manufacturing alloy steel and gives purer product.	Fig 3 Exp 4	7	
IX			7	

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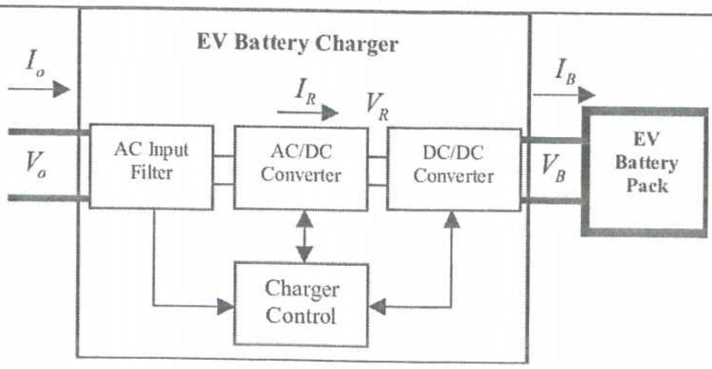
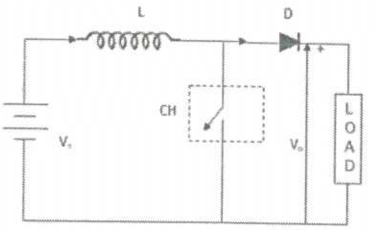
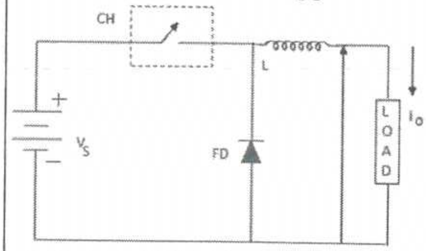
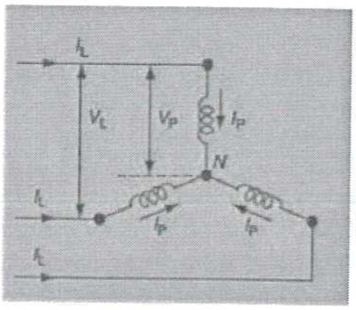
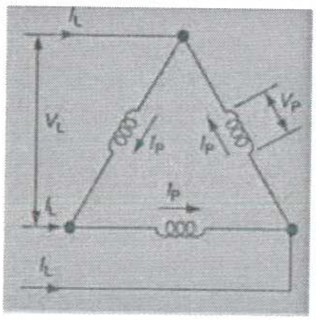
<tr><td></td><td>
</td><td></td><td></td><td></td></tr>
<tr><td>X</td><td>A chopper is a static device that converts fixed DC input voltage to a variable DC output voltage. It is a high-speed ON/OFF semiconductor switch.
Step-up Chopper:
It is a kind of chopper in which the average DC output voltage is more than the source voltage. In this chopper, power flows from load to source and load contains a source of emf and should be inductive.


Step-down Chopper:
A chopper whose average DC output voltage is less than the source voltage is called step-down chopper. Power flows is always from source to load in this chopper.

</td><td>3.5

3.5</td><td>7</td><td></td></tr>
<tr><td>XI</td><td><table><tr><td>STAR CONNECTION</td><td>DELTA CONNECTION</td></tr><tr><td>
</td><td>
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+
3.5</td><td>7</td><td></td></tr>
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<tr><td></td><td><table><tr><td>Line Current = Phase Current
$I_L = I_{PH}$</td><td>Line Current = √3 × Phase Current
$I_L = \sqrt{3} \times I_{PH}$</td></tr><tr><td>Line Voltage = √3 × Phase Voltage
$V_L = \sqrt{3} \times V_{PH}$</td><td>Line Voltage is Equal to the Phase Voltage.</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td>XII</td><td>RMS value(Root Mean Square value) of an alternating current is that DC which when flowing through a given resistance for a given time produces the same amount of heat as produced by the alternating current when flowing through the same resistance for the same time.

The average value of an alternating current is expressed by that DC which transfers across any circuit the same charge as is transferred by that alternating current during the same time..
Form factor. The ratio of r.m.s. value to the average value of an alternating quantity is known as form factor</td><td>2.5

2.5

2</td><td>7</td><td></td></tr>
<tr><td>XIII</td><td>Single phase induction motor is similar to a polyphase induction motor. It has distributed stator winding and a squirrel-cage rotor.
(i) Squirrel-cage rotor :
• The rotor consists of a cylindrical laminated core with parallel slots for carrying the rotor conductors which, it should be heavy bars of copper, aluminium or alloys.
• The rotor bars are brazed or electrically welded or bolted to two heavy and stout short-circuiting end-rings
(ii) Stator:
• The stator of a single phase induction motor is made up of a number of stampings, which are slotted to receive the windings.
• Its stator is provided with a single-phase winding and a centrifugal switch is used in some types of motors, in order to cut out a winding, used only for starting purposes.</td><td>Fig 3

Exp 4</td><td>7</td><td></td></tr>
<tr><td>XIV</td><td>An induction motor consists essentially of two main parts :
(a) a stator (b) a rotor.
Stator:
• The stator of an induction motor is made up of a number of stampings, which are slotted to receive the windings.
• The stator carries a 3-phase winding and is fed from a 3-phase supply.
• It is wound for a definite number of poles.
Rotor:
(iii) Squirrel-cage rotor :
• The rotor consists of a cylindrical laminated core with parallel slots for carrying the rotor conductors which, it should be heavy bars of copper, aluminium or alloys.
• The rotor bars are brazed or electrically welded or bolted to two heavy and stout short-circuiting end-rings
(iv) Wound rotor or slip-ring motors:
• This type of rotor is provided with 3-phase, double-layer,</td><td>Fig 3

Exp 4</td><td>7</td><td></td></tr>
</table>

	distributed winding consisting of coils. • The three phases are starred internally. The other three winding terminals are brought out and connected to three insulated slip-rings mounted on the shaft with brushes resting on them			