Scoring Indicators

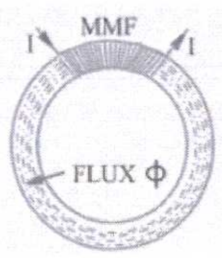
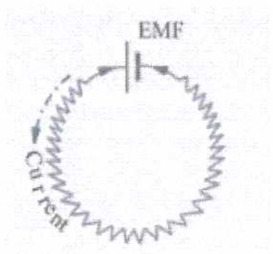
COURSE NAME : Elementary concepts of Electrical System

COURSE CODE : 2032 **QID :** 2106220067

Q No	Scoring Indicators	Split score	Sub Total	Total score
	PART A			**9**
I. 1	Earth leakage circuit breaker	1	1	
I. 2	Moulded case circuit breaker	1	1	
I. 3	• Extraction and Refining of Metals • Production of chemicals • Electroplating • Electro-forming • Electrolytic Reduction of Metals from their Compounds Any 2 2*0.5 =1 mark	1	1	
I. 4	Convection	1	1	
I. 5	Copper, Water, Bismuth, Zinc, Marble, Glass ,Gold Any two 2*0.5 =1 mark	1	1	
I. 6	Star rating	1	1	
I. 7	Lead-acid battery, alkaline batteries, nickel-cadmium batteries,lithium ion	1	1	
I. 8	1/C1 + 1/C2	1	1	
I. 9	Plates,Seperators,Electrolyte,Container.Any two 2*0.5=1 mark	1	1	

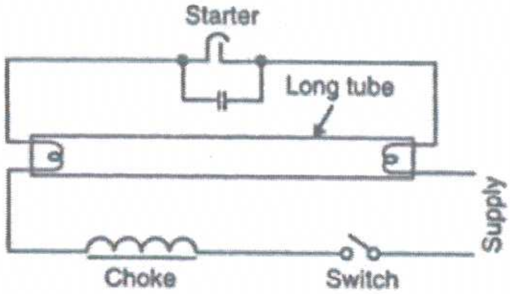
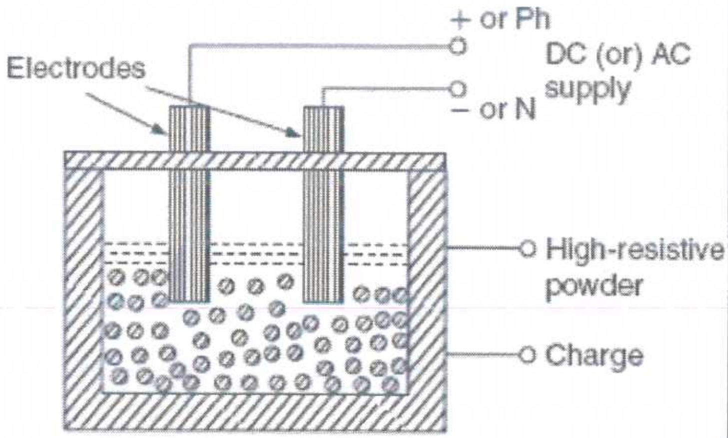
	PART B			24
II. 1	• Avoid contact with energized electrical circuits. • Treat all electrical devices as if they are live or energized. • Disconnect the power source before servicing or repairing electrical equipment. • Use only tools and equipment with non-conducting handles when working on electrical devices. • Never use metallic pencils or rulers, or wear rings or metal watch bands when working with electrical equipment. • Do not wear loose clothing or ties near electrical equipment; wear smart fitting overalls if possible. • Enclose all electric contacts and conductors so that no one can accidentally come into contact with them. • Drain capacitors before working near them and keep the short circuit on the terminals during the work to prevent electrical shock Any 6 points 6 *0.5=3 marks	3	3	

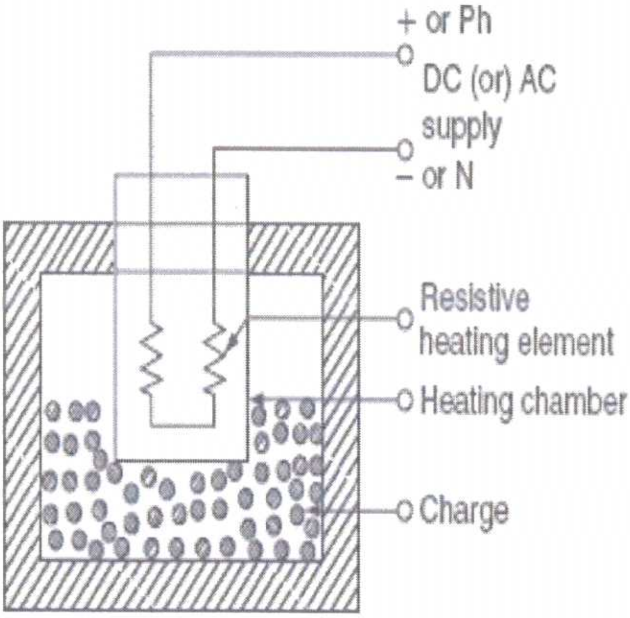
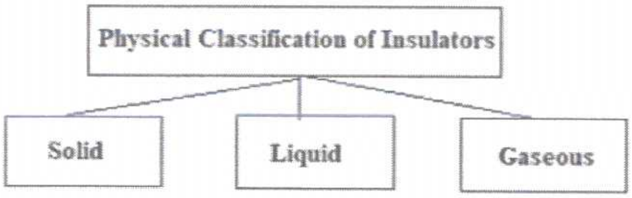
II. 2	Fuse,MCB,RCCB,ELCB List any three 3*1=3marks	1+1+1	3	
II. 3	• High specific resistance • High melting temperature • Low temperature coefficient of resistance • High oxidizing temperature • Positive temperature coefficient of resistance • High ductility and flexibility • High ductility and flexibility Any 6 point 6*0.5=3 marks		3	
II. 4	Diamagnetic materials • They have weak, negative susceptibility to magnetic fields. • Diamagnetic materials are slightly repelled by a magnetic field and the material properties when an external field is removed. • In diamagnetic materials all the electrons are paired so there is no permanent net magnetic moment per atom. • Most elements in periodic table including copper, silver, gold are diamagnetic. Paramagnetic materials • They have a small, positive susceptibility to magnetic fields. • These materials are slightly attracted by a magnetic field and the material does not retain the magnetic properties when the external field is removed. • Paramagnetic properties are due to the presence of some unpaired electrons, and from the realignment of electrons paths caused by the external magnetic field • Paramagnetic materials include magnesium, molybdenum, lithium etc. Ferromagnetic materials • They have a large, positive susceptibility to an external magnetic field • They exhibit strong attraction to magnetic fields and are able to retain their magnetic properties after the field has been removed. • Ferromagnetic materials have some unpaired electrons so their atoms have a net magnetic moment. • Iron, nickel and cobalt are examples of ferromagnetic Materials Any 2 properties for each type 3*1 =3	1+1+1	3	
II. 5	• Material and structure of anode and cathode plates • Electrolytes in battery • Separator material and its properties • Distance between plates • Purity of material • Charging and discharging cycle	3	3	

<table>
<tr><td></td><td>● Individual cell voltage
● Recharging process
● Deep discharge
● Regular maintenance
● Physical shocks and vibrations
● Ambient temperature
Any 6 6*0.5=3 marks</td><td></td><td></td><td></td></tr>
<tr><td>II. 6</td><td>An electrical shock is a physical reaction to electrical currents passing through the body.
Burn,Affects the nervous system,Irregular heart beat,Loss of consciousness,headache etc
Definition 1 marks
Any 4 effects 4*0.5 =2 marks</td><td>1+2</td><td>3</td><td></td></tr>
<tr><td>II. 7</td><td>
<table>
<tr><th>Magnetic Circuit</th><th>Electric Circuit</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Flux = $\frac{MMF}{Reluctance}$</td><td>Current = $\frac{EMF}{Resistance}$</td></tr>
<tr><td>MMF (ampere turns)</td><td>EMF (volts)</td></tr>
<tr><td>Flux φ (webers)</td><td>Current I (amperes)</td></tr>
<tr><td>Flux density B (Wb/m^2)</td><td>Current density (A/m^2)</td></tr>
<tr><td>Reluctance S = $\frac{l}{\mu A}$</td><td>Resistance R = $\rho\frac{l}{A}$</td></tr>
<tr><td>Permeance (= 1/reluctance)</td><td>Conductance (= 1/resistance)</td></tr>
<tr><td>Reluctivity</td><td>Resistivity</td></tr>
<tr><td>Permeability (= 1/reluctivity)</td><td>Conductivity (= 1/resistance)</td></tr>
</table>
Any 6 points 6*0.5 =3 marks</td><td>3</td><td>3</td><td></td></tr>
</table>

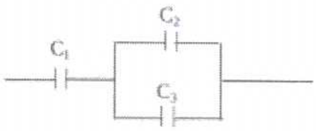
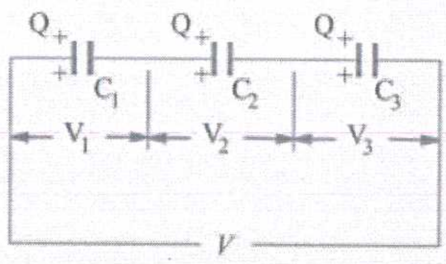
II. 8	First Law: Like charges of electricity repel each other whereas unlike charges attract each other. Second Law: Force exerted between two point charges I. is directly proportional to the product of their strength. II. is inversely proportional to the square of distance between them First law -1 mark Second law -2 marks	1+2	3	
II.9	Electric heating system is free from dirt. • It does not produce any gas and no provision has to be made for its exit. • Simple and accurate temperature control either manually or fully automatic. • Electric heating is cheaper. Low initial and maintenance cost. • Overall efficiency is very high. • Provides better working conditions. • No upper limit to temperature attainable Any 6 points 6*0.5 =3 marks	3	3	
II.10	Keep the top of every battery clean to prevent corrosion and leakage of current. • Keep the level of electrolyte battery. Distilled water is only added to the electrolyte till all plates are completely submerged in electrolyte. • Check the condition of electrolyte by checking specific gravity by hydrometer. • Do not charge the battery at high rise in temperature excessive gassing will take place. • Do not over charge the battery. • Do not keep the battery in a discharged condition for several days. • Do not allow the short circuit of terminals of the battery. Since internal resistance is very small, heavy current flows when short circuit occurs and plates of the battery get damaged Any 6 points 6*0.5 =3 marks	3	3	
	PART C			42
III	Energy consumed by 60W bulb for 5 hrs =60*5=300W Energy consumed by 100W bulb for 3 hrs = 100*3 =300 W Energy consumed by One 1kW electric heater for 2 hours daily =1000*2 =2000W Total energy consumption =300+300+2000=2600 W=2.6KWH Energy Consumed in the month of November =30*2.6 =78KWh Finding each appliance Energy consumed -1 mark each Total Consumed =2 marks	3+2+2	7	7

<table>
<tr><td></td><td>Total energy consumption for the November -2 marks</td><td></td><td></td><td></td></tr>
<tr><td>IV</td><td>
<table>
<tr><th>Sl. No.</th><th>Specifications</th><th>Ratings</th></tr>
<tr><td>1</td><td>Rated voltage</td><td>220-240V, AC, 50 Hz</td></tr>
<tr><td>2</td><td>Rated speed</td><td>340 – 370 rpm</td></tr>
<tr><td>3</td><td>Rated air delivery</td><td>210 m^3/min</td></tr>
<tr><td>4</td><td>Power consumption</td><td>Not more than 63 watts</td></tr>
<tr><td>5</td><td>Power factor</td><td>More than 0.9</td></tr>
<tr><td>6</td><td>Class of insulation</td><td>B</td></tr>
<tr><td>7</td><td>Capacitor</td><td>1.6 - 2.0 mF</td></tr>
</table>
Any 7 points</td><td>7</td><td>7</td><td>7</td></tr>
<tr><td>V</td><td>Construction
• The lamp is in the form of a long tube, coated inside with phosphor.
• The tube contains a small amount of mercury and a small quantity of argon gas at a pressure of 2.5mm of mercury.
• At each end of the tube the electrodes are spiral form made of tungsten and coated with an electron emitting material.
• A choke is connected in series with the tube filament.
• The filament is connected to a starter bimetallic strip.
Working
• When the starter is cold, the electrodes are open. When supply is given, full voltage acts on the starter.
• A glow discharge is set up in the starter which warms the electrodes and causes the bimetallic strip touch the electrodes.
• Circuit becomes complete and current flows causing emission of electrons.
• Now the starter voltage falls to zero and the bimetallic strip cools down.
• The starter switch is open and interrupts the current in the circuit causing a voltage surge of 1000V in the choke.
• This voltage produces the flow of electrons between the lamp electrodes and the lamp lights up immediately.</td><td>2+2+3</td><td>7</td><td>7</td></tr>
</table>

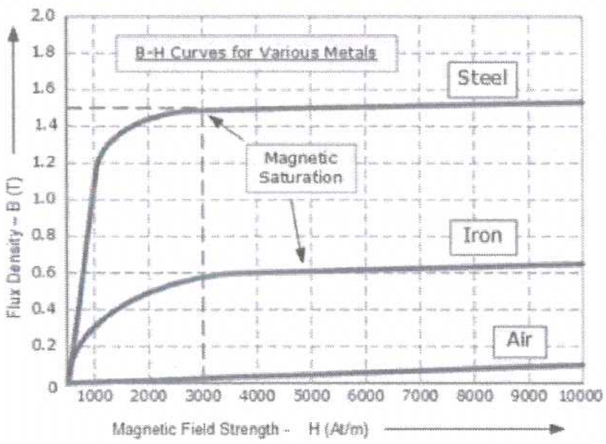
	 Diagram -2 marks Construction-2 marks Working -3 marks			
VI	Direct resistance heating In this method, electrodes are immersed in a material or charge to be heated. The charge may be in the form of powder, pieces, or liquid. The electrodes are connected to AC or DC supply When metal pieces are to be heated, the powder of lightly resistive is sprinkled over the surface of the charge (or) pieces to avoid direct short circuit. The current flows through the charge and heat is produced in the charge itself. So, this method has high efficiency Eg; Salt bath furnace, Electrode boiler  Indirect resistance heating In the indirect resistance heating method, high current is passed through the heating element. In case of industrial heating, some times the heating element is placed in a cylinder which is surrounded by the charge placed in a jacket is known as heating chamber The heat is proportional to power loss produced in the heating element is delivered to the charge by one or more of the modes of the transfer of heat viz. conduction, convection, and radiation This arrangement provides uniform temperature and automatic temperature control.	3+4	7	7

	 Diagram -3 marks Explanation -4 marks			
VII	 Solid insulators: These insulating materials are in solid state. They are further divided into two types. They are generally used as a coating over current carrying conductor or used to make switches. (a) Hard insulators eg: Bakelite, Porcelain, Wooden plank (b) Soft insulators eg: Rubber, Polyvinyl chloride, Varnish coated papers Liquid insulators: These insulating materials are in liquid state. They are generally used in transformers, circuit breakers etc. eg: Mineral oil, Shellac, Varnish Gaseous insulators: These are the insulating material in gaseous state. Electronegative gases make good insulators since the ions rapidly combine with the ions produced in the spark. Gases with electronegative species make good insulators eg: CCl_4, CCl_2F_2, CCl_3F Thermal Classification Thermally the insulators are classified into seven types or seven classes they are class-Y, class-A, class-E, class-B, class-F, class-H, and class-C.	3+4	7	7

	Class-Y The class-Y limitation temperature is 900 C and the materials come under class-Y are cotton, paper, silk, and similar organic materials. Class-A The class-A limitation temperature is 1050 C and the materials come under class-A are impregnated paper, silk, polyamide, cotton, and resins. Class-E The class-E limitation temperature is 1200 C and the materials come under class-E are enameled wire insulation on the base of powdered plastics, polyvinyl epoxy resins, etc. Class-B The class-B limitation temperature is 1300 C and the materials come under class-B are inorganic materials impregnated with varnish. Class-F The class-F limitation temperature is 1550 C and the materials come under class-F are mica, polyester epoxide varnished in the high heat resistance. Class-H The class-H limitation temperature is 1800 C and the materials come under class-H are composite materials on mica, glass, fiber, etc. Class-C The class-C limitation temperature is >1800 C and the materials come under class-C are glass, mica, quartz, ceramics, Teflon, etc Physical classification -3 marks Thermal classification -4 marks			
VIII	ADVANTAGES OF LITHIUM-ION BATTERIES • Eco-friendly • Lightweight and compact • High energy density • Low maintenance • More charge cycles • Low self-discharge rate Applications of Lithium-Ion Batteries Power backups/UPS Mobile, Laptops, and other commonly used consumer electronic goods Electric mobility Energy Storage Systems Any 4 advantages -4 marks	4+3	7	7

	Any 3 application -3 marks			
IX	Capacitor C1 = 2 μF Capacitor C2 = 4 μF Capacitor C3 = 4 μF Capacitor C2 and C3 connected in parallel. The equivalent capacitance : CP = C2 + C3 = 4 + 4 = 8 μF Capacitor C1 and Cp connected in series. The equivalent capacitance : 1/C = 1/C1 + 1/CP = 1/2 + 1/8 = 4/8 + 1/8 = 5/8 C = 8/5 μF  Marks can be given for any combination Parallel equivalent finding -2 marks Equivalent capacitance finding -5 marks	2+5	7	7
X	1)Series  C1, C2, C3 = Capacitances of three capacitors V1, V2, V3 = Potential difference across three capacitors. V = Applied voltage across combination C = combined or equivalent capacitance In series combination, charge on all capacitors is the same but potential difference across each is different V = V1 + V2 + V3 $\frac{Q}{C} = \frac{Q}{C1} + \frac{Q}{C2} + \frac{Q}{C3}$ $\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3}$ So for series combination of capacitors, reciprocal of equivalent capacitance is equal to the sum of reciprocals of	2+3+2	7	7

	individual capacitances. Diagram equivalent -2 marks Derrivation -3 marks Final expression -2 marks			
XI	Conduction Heat conduction is a process in which heat is transferred from the hotter part to the colder part in a body without involving any actual movement of the molecules of the body. Heat transfer takes place from one molecule to another molecule as a result of the vibratory motion of the molecules Eg frying vegetables in a pan Convection In this process, heat is transferred in the liquid and gases from a region of higher temperature to a region of lower temperature. Convection heat transfer occurs partly due to the actual movement of molecules or due to the mass transfer. For example. Heating of milk in a pan. Radiation It is the process in which heat is transferred from one body to another body without involving the molecules of the medium. Radiation heat transfer does not depend on the medium. For example: In a microwave, the substances are heated directly without any heating medium 2 marks for each mode 2*3 =6 marks Any example given - 1 mark	6+1	7	7
XII	Faraday's First Law of Electrolysis Faraday's First Law of Electrolysis states that "The mass of a substance deposited at any electrode is directly proportional to the amount of charge passed." Mathematically it can be expressed as follows $m \propto Q$ m = mass of a substance (in grams) deposited or liberated at an electrode. Q = amount of charge (in coulombs) or electricity passed through it Faraday's Second Law of Electrolysis Faraday's Second Law of Electrolysis states that "the mass of a substance deposited at any electrode on passing a certain amount of charge is directly proportional to its chemical equivalent weight." Or "when the same quantity of electricity is passed through several electrolytes, the mass of the substances deposited are proportional to their respective chemical equivalent or equivalent weight". Mathematically it can be represented as follows $w \propto E$ Where w = mass of the substance E = equivalent weight of the substance	3.5+3.5	7	7

	Ist law -3.5 marks IInd law-3.5 marks			
XIII	 The magnetisation curve the relationship between and H for different types of core materials. • The flux density increases in proportional to the field strength until it reaches a certain value where it cannot increase any more • This is because there is limit to the amount of flux density that can be generated by the core as all the • domains in the iron are perfectly aligned. • Any further increase will have no effect on the value of • flux density • The point where flux density reaches its limit is called magnetic saturation The B-H curve indicates the manner in which the magnetic flux density varies with the change in magnetising force Diagram -4 marks Explanation -3 marks	4+3	7	7
XIV	**Absolute permittivity** Absolute permittivity is defined as the measure of permittivity in a vacuum. he absolute permittivity is normally symbolised by ε0. The permittivity of free space - a vacuum - is equal to approximately 8.85 x 10-12 Farads / metre (F/m) (1 mark) **Relative permittivity** Relative permittivity is defined as the permittivity of a given material relative to that of the permittivity of a vacuum. It is normally symbolised by: εr (1 mark) **Flux density** Magnetic Flux Density is amount of magnetic flux through unit area taken perpendicular to direction of magnetic flux(1.5 mark) **Electric field** An electric field is a region of space around an electrically charged particle or object in which an electric charge would	1+1.5+ 1.5+1.5 +1.5	7	7