303

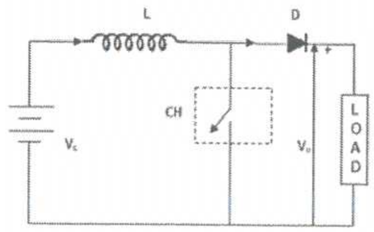
11

Scoring Indicators

COURSE NAME: Fundamental of Electrical Engineering

COURSE CODE :3024 (21) **QID :2110220149**

Q No	Scoring Indicators	Split score	Sub Total	Total score
	PART A			**9**
I. 1	Electric current	1	1	
I. 2	d) b and c	1	1	
I. 3	Flemings left hand rule	1	1	
I. 4	Washing machine,Fan,centrifugal pump, Air conditioners etc Any two	0.5+0.5	1	
I. 5	4.44fNØm	1	1	
I. 6	Convection	1	1	
I. 7	Thin filim,Carbon,Wire wound,Rheostat etc Any two	1	1	
I. 8	a) Heavy sparking at brushes	1	1	
I. 9	Holding current		1	
	PART B			24
II. 1	$\frac{1}{R_{eq}}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$ $=\frac{1}{7}+\frac{1}{5}+\frac{1}{2}=\frac{59}{70}$ $R_{eq}=\frac{70}{59}=1.2\Omega$ Equation -1.5marks Final answer -1.5 marks	1.5+1.5	3	
II. 2	I= 4A, V = 250V, t = 2 hrs Power, P = VI = 250 x 4 = 1000W 2 hours Electrical energy = power x time = 1 KW x 2 h = 2 KWh = 2 units Equation-1 mark Final answer -2 marks	1+1+1	3	
II. 3	• DC shunt • DC series • DC compound 1mark each 3*1=3		3	

<table>
<tr><td>II. 4</td><td>Squirrel cage motor
Pumps and submersible
Pressing machine
Lathe machine
Grinding machine
Conveyor
Flour mills
Compressor
And other low mechanical power applications
Slip ring motors
Steel mills
Lift
Crane Machine
Hoist
Line shafts
and other heavy mechanical workshops etc
Any 6 -6*0.5 =3</td><td>3</td><td>3</td><td></td></tr>
<tr><td>II. 5</td><td><table><tr><th>Sl No</th><th>Power transformer</th><th>Welding transformer</th></tr><tr><td>1</td><td>May be step up or step down</td><td>Step down</td></tr><tr><td>2</td><td>Used in generating and substations</td><td>Used for arc welding</td></tr><tr><td>3</td><td>Secondary may not have tappings</td><td>Secondary has tappings</td></tr><tr><td>4</td><td>Large size</td><td>Small size</td></tr><tr><td>5</td><td>Oil cooled</td><td>Air cooled</td></tr><tr><td>6</td><td>Carry current for entire period of working</td><td>Secondary carry high current for short duration only</td></tr></table>Any 3 3*1=3 marks</td><td>3</td><td>3</td><td></td></tr>
<tr><td>II. 6</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.

</td><td>1.5+1.5</td><td>3</td><td></td></tr>
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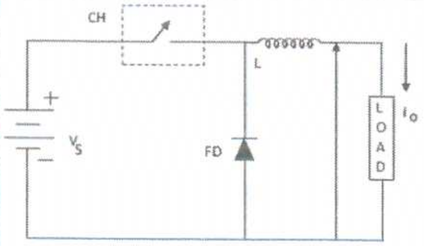
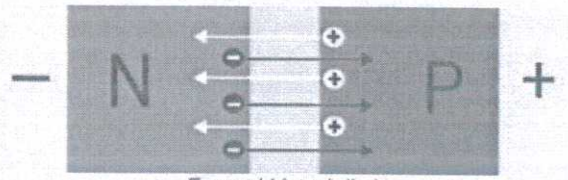
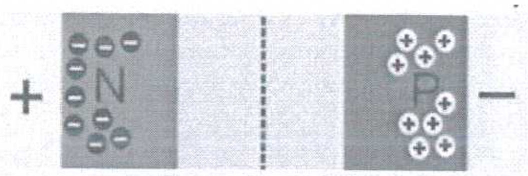
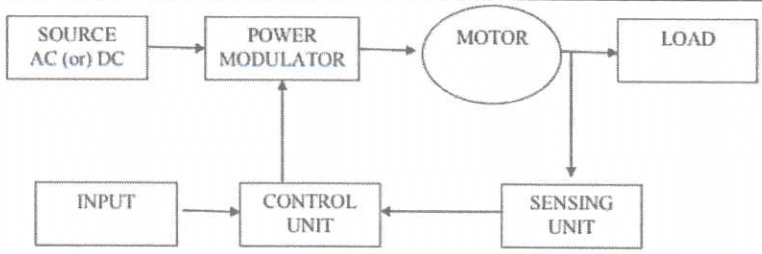
	 Any one chopper circuit fig -1.5 marks Explanation -1.5 marks			
II. 7	A P-N junction diode is one-way device offering low resistance when forward-biased and behaving almost as an insulator when reverse-biased. Forward Characteristic: • When the diode is forward-biased and the applied voltage is increased from zero, hardly any current flows through the device in the beginning because of the internal barrier potential.  Forward biased diode. Reverse Characteristic: • When the diode is reverse-biased, majority carriers are blocked and only a small current (due to minority carriers) flows through the diode.  Reverse biased diode. Fig -1.5 mark Expalanation -1.5 marks	1.5+1.5	3	

II. 8		3	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	• High efficiency and low operating cost. • Since both primary and secondary are on the same central core, its power factor is better. • The furnace is operated from the normal supply frequency. • Chances of discontinuity of the secondary circuit is less, hence it is useful for intermittent operations. Any 3 points 3*1 =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 Total energy consumption for the November -2 marks	3+2+2	7	7
IV	KVL: $70 - 5I - 7(I - 2) = 0$ $I = 7A$ KVL to 2nd loop: $7(I - 2) - 2R = 0$ $R=17.5\Omega$	7	7	7

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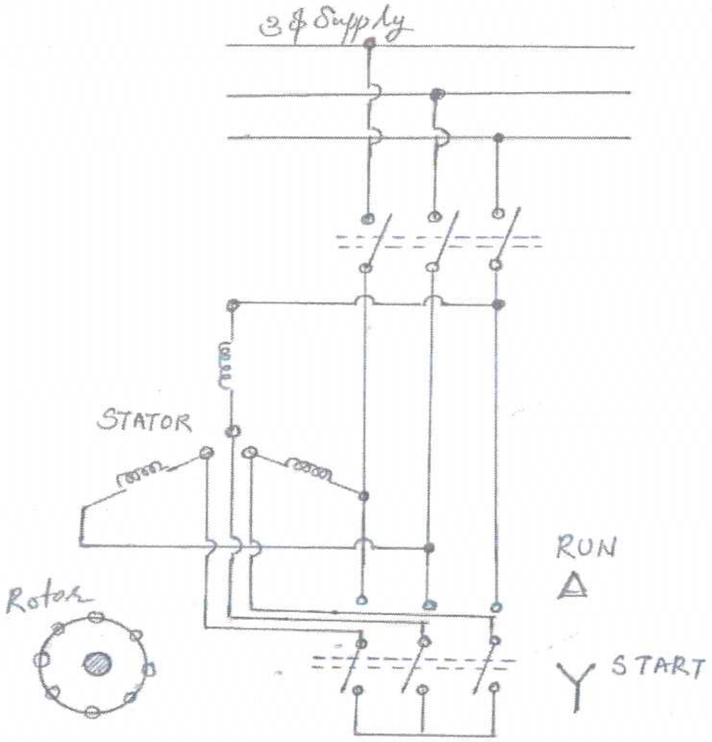
<td>V</td>
<td>When star connected the applied Voltage over each phase of the motor is reduced by a factor of $1/\sqrt{3}$ and hence the torque developed becomes 1/3 of that which would have been developed if motor were directly connected to delta. The line current is reduced to 1/3. Hence during starting period when motor is star connected is taken 1/3rd as much starting current and develops 1/3rd as much torque as would have been developed were it directly connected in delta.

Fig -4 marks
Explanation -3 marks

</td>
<td>2+2+3</td>
<td>7</td>
<td>7</td>
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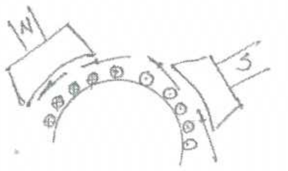
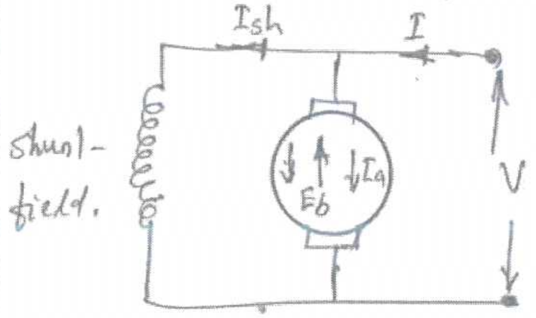
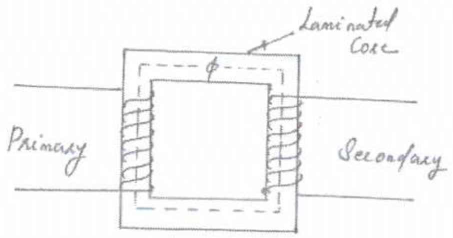
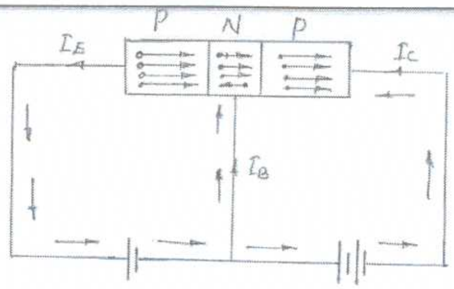
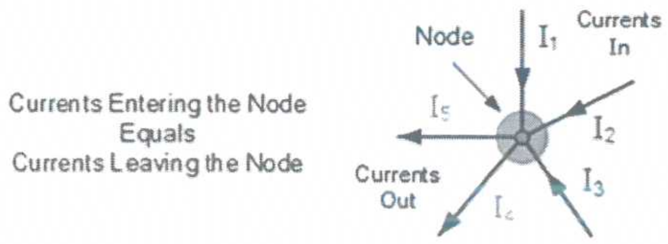
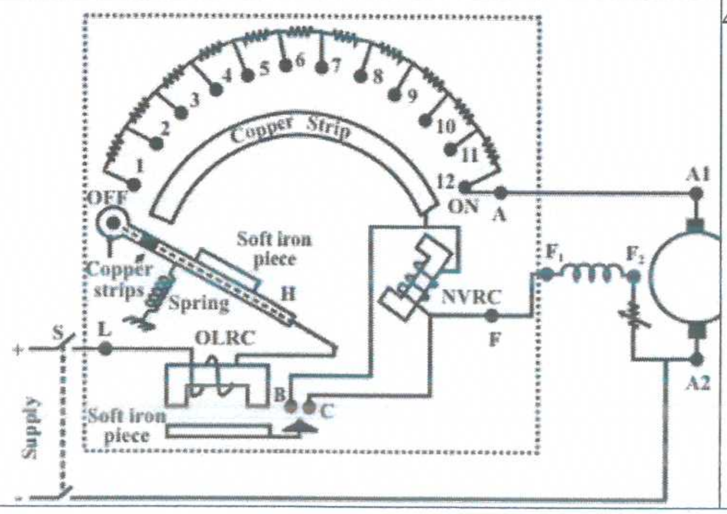
VI	 An electric motor is a machine which converts electric energy into mechanical energy. This will based on the principle that when a current carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Flemings left hand rule. When field magnets are excited and armature conductors are supplied with current from the supply mains, they experience a force tending to rotate the armature. Each conductor experiences a force 'F' which tends to rotate the armature in anticlockwise direction. These force collectively produces a driving torque which sets the armature rotating.  Diagram -3 marks Explanation -4 marks	3+4	7	7
VII	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	6+1	7	7

	Any example given - 1 mark			
VIII	 The physical basis of a transformer is mutual-induction between two circuits linked by a common magnetic flux. In the simplest form, it consists of two inductive coils which are electrically separated but magnetically linked through a path of low reluctance. If one coil is connected to alternating voltage, an alternating flux is set-up in the laminated core, most of which is linked with the other coil in which it produces mutually induced emf. If the second coil circuit is closed, a current flows in it and so electric energy is transferred from the first coil to second coil. Diagram -3 marks Explanation -4 marks	4+3	7	7
IX	There are three modes of operation for an SCR depending upon the biasing given to it: (i) Forward blocking mode (off state) (ii) Forward conduction mode (on state) (iii) Reverse blocking mode (off state) Forward Blocking Mode • Anode voltage is positive with respect to the cathode and gate current is zero • J1 and J3 junction is in forward bias • J2 junction is in reverse bias • Very low leakage current flows through the device. • SCR remains in off State • Can turn on SCR by applying a high voltage between anode and cathode even if the gate current is zero. The voltage at which the SCR turns on when the gate current is zero is the forward break-over voltage. Forward Conduction Mode • In forward conduction mode, we can make the SCR turn on at	3+4	7	7

	the lesser anode to cathode voltage on the application of small gate voltage momentarily. • The voltage cause gate current to flow. Thus, the gate current pulse is sufficient to switch on the SCR at the lesser anode to cathode voltage. • The SCR remains on after the removal of the gate current pulse. Reverse Blocking Mode of SCR • Anode is made negative with respect to the cathode The device remains in an off state because junction J1 and J3 are in reverse bias while junction J2 is forward bias. Mentioning the mode -3 marks Explanation -4 marks			
X	 The forward bias causes the holes in p type emitter to flow towards the base. This constitute the emitter current I_E. As these holes cross into the N type base, they tend to combine with the electrons. As the base is lightly doped and very thin, ∴ only a few holes combine with the electrons. The remainder cross into the collector region to constitute collector current I_C. Current conduction within the PNP transistor is by holes. However in the external connecting wires the current is still by electrons. Diagram -4 marks Explanation -3 marks	4+3	7	7
XI	1.Period The time taken by a alternating quantity (such as current or voltage) to complete one cycle is called its time period "T" 1marks 2.Form factor The ratio between RMS value and Average value of an alternating quantity (Current or Voltage) is known as Form Fa $\text{Form Factor} = \frac{\text{RMS Value}}{\text{Average Value}}$ 2 marks 3.Average value If we convert the alternating current (AC) sine wave into direct current (DC) sine wave through rectifiers, then the converted value to the DC is known as the average value of	1+2+2+2	7	7

	that alternating current sine wave. 2 mark 4) Peak factor It is the ratio between maximum value and RMS value of an alternating wave. $$\text{Peak Factor} = \frac{\text{Maximum Value}}{\text{R.M.S Value}}$$ 2 marks			
XII	Kirchhoff's First Law According to Kirchhoff's Current Law, The total current entering a junction is equal to the charge leaving the junction as no charge is lost. Put differently, the algebraic sum of every current entering and leaving the node has to be null. This property of Kirchhoff law is commonly called as Conservation of charge wherein, I(exit) + I(enter)  $I_1 + I_2 + I_3 + (-I_4 + -I_5) = 0$ Kirchhoff's Second Law According to Kirchhoff's Voltage Law, The voltage around a loop equals to the sum of every voltage drop in the same loop for any closed network and also equals to zero. Put differently, the algebraic sum of every voltage in the loop has to be equal to zero and this property of Kirchhoff's law is called as conservation of energy. Ist law -3.5 marks IInd law-3.5 marks	3.5+3.5	7	7
XIII		4+3	7	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. Figure -4 marks Explanation -3 marks			
XIV	**Working principle**: Induction motor works on the principle of electromagnetic induction. When three phase supply is given to the stator winding, a rotating magnetic field of constant magnetic field is produced The speed of rotating magnetic field is synchronous speed, NS r.p.m. ➢ $N_S = \frac{120f}{P}$ = speed of rotating magnetic field • f = supply frequency . This rotating field produces an effect of rotating poles around a rotor. Let direction of this magnetic field is clockwise as shown. Now at this instant rotor is stationary and stator flux R.M.F. is rotating. So its obvious that there exists a relative motion between the R.M.F. and rotor conductors. Now the R.M.F. gets cut by rotor conductors as R.M.F. sweeps over rotor conductors. Whenever a conductor cuts the flux, emf. gets induced in it. So e.m.f.gets induced in the rotor conductors called rotor induced emf. this is electro – magnetic induction.	1.5+4.5	7	7

	As rotor forms closed circuit, induced emf. circulates current through rotor called rotor current. Any current carrying conductor produces its own flux. So rotor produces its flux called rotor flux. For assumed direction of rotor current, the direction of rotor flux is clockwise as shown. This direction can be easily determined using right hand thumb rule. Now there are two fluxes, one R.M.F. and another rotor flux. Both the fluxes interact with each. On left of rotor conductor, two fluxes are in same direction hence added up to get high flux area. On right side of rotor conductor, two fluxes are in opposite direction hence they cancel each other to produce low flux area. So rotor conductor experiences a force from left to right, due to interaction of the two fluxes. As all rotor conductor experiences a force, overall rotor experiences a torque and starts rotating So interaction of the two fluxes is very essential for a motoring action Equation -1.5 marks Explanation-4.5 marks			