WINTER – 2022 EXAMINATION
Model Answer
Subject Name: Electrical Engineering

22373: EEG

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 any equivalent 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.
8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE Diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1.		**Attempt any FIVE of the following:**	**10 Marks**
	a)	State Ohm's Law. **Ans:** **Ohm's law:** Ohm's law states that the voltage across a conductor is directly proportional to the current flowing through it provided the physical condition of the conductor remain the same. **OR** As long as physical conditions (such as dimensions, pressure and temperature) are constant, the potential difference or voltage applied across the conductor is directly proportional to current flowing through it.	2 Marks for correct statement
	b)	State faraday's Law of electromagnetic Induction. **Ans:** **Faraday's First Law:** Whenever the changing magnetic flux links with a coil or conductor, an EMF is induced in it. **OR** Whenever a conductor cuts across magnetic flux, an EMF is induced in the conductor. **Faraday's Second Law:** The magnitude of induced EMF is directly proportional to the rate of change of flux linkages.	1 Mark 1 Mark
	c)	Define Transformation Ratio of a Transformer. **Ans:** **Transformation Ratio (k):** It is the ratio of secondary number of turns to primary number of turns. **OR** It is the ratio of secondary emf (voltage) to primary emf (voltage). **OR** It is the ratio of primary current to secondary current. Transformation Ratio (k) = N_2/N_1 or = E_2/E_1 or = V_2/V_1 or = I_1/I_2	1 Mark for statement 1 Mark for equation
	d)	List different types of fuses.	

		Ans: **Types of Fuses:** 1. Rewirable Fuses 2. HRC Fuse 3. Cartridge type Fuses 4. D-type Cartridge Fuse 5. Link Type Fuse 6. Blade and Bolted type Fuses 7. Striker type Fuse 8. Switch type Fuse 9. HV (High Voltage) Fuses 10. Cartridge Type HRC Fuse 11. Liquid Type HRC Fuse 12. Expulsion Type HV Fuse	½ Mark for each of any four types = 2 Marks
	e)	State principle of operation of 3-phase induction motor. **Ans:** **Principle operation of 3-phase induction motor:** When three phase supply is given to three phase stator winding, three phase currents flow and rotating magnetic field (RMF) is produced in the air-gap. This RMF is cut by rotor conductors and emfs are induced in them. Since rotor conductors are short circuited, rotor induced emfs circulate currents in rotor conductors. According to basic motor principle, the force is exerted on current carrying rotor conductors placed in rotating magnetic field and rotor rotates in the same direction as that of rotating magnetic field.	2 Marks
	f)	State any two applications of MCB. **Ans:** **Applications of MCB:** 1. Used in lightning circuits. 2. Used in distribution feeders. 3. Used in switching motors. 4. Used in capacitors. 5. Used in power circuits.	1 Mark for each of any two applications
	g)	Give classification of electric drives. **Ans:** **Classifications of Electric Drives:** A) Based on Supply i) AC Motor drives ii) DC Motor drives B) Based on Number of Motors i) Individual ii) Multi Motor iii) Group Drive C) Based on Speed i) Constant Speed drive ii) Variable Speed drive D) Based on Control Parameters i) Vector Control Drive ii) Constant Power Drive iii) Constant Torque Drive	1 Mark for each of two types on any one criterion
2.		**Attempt any <u>THREE</u> of the following:**	**12 Marks**

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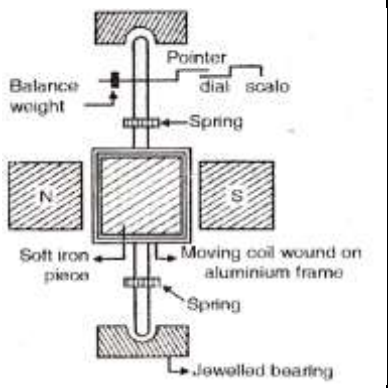
	a)	Explain necessity of starter. Give any two applications of starter. **Ans:** **Necessity of starter:** When an electric motor is directly connected to rated supply voltage, it draws very high starting current as its winding resistance is low. Due to such heavy inrush current at start – • There is possibility of damage to the motor windings due to high temperature rise caused by large copper loss (I^2R loss). • Such sudden inrush of current causes large line voltage drop. • Thus other appliances connected to the same line may be subjected to voltage spikes which may affect their working. • So to avoid such affects, it is necessary to limit the current drawn by the motor at start. To limit the heavy starting current, starter is necessary. The starter is a device which is basically used to limit the starting current by supplying reduced voltage to the motor at the time of starting. **Applications of starter:** 1. To start the motor safely. 2. To limit high starting current. 3. To protect the motor winding from overheating. 4. To protect the motor from overload. 5. Protection from under voltage condition. 6. To protect and safely start DC motors 7. To protect and safely start three phase induction motors.	2 Marks for necessity 1 Mark for each of any two applications = 2 Marks
	b)	Explain construction and working of PMMC meter. **Ans:** **Construction of PMMC instruments:** • The magnet system consists of horse-shoe type permanent magnet. • The coil is wound on rectangular aluminum former. The former is pivoted on jewel bearings so that the coil sides lie in the air gap between the poles of the permanent magnet and can rotate (move) in magnetic field, so called permanent magnet moving coil (PMMC) instrument. • The control torque in PMMC instrument is provided by two phosphor bronze hairsprings. These springs also allow the current to flow in and out of the coil.  • Eddy currents induced in aluminium former causes force to oppose movement, thus help to damp the oscillations. The bearing friction also provide the damping torque. • The pointer is mounted on a spindle that moves a graduated scale and it is balanced by the balancing weight which is connected to it. • A mirror is placed below the scale. **Working:** 1) It works on basic motor principle, i.e when a current carrying conductor is placed in magnetic field, force is exerted on conductor and it moves in the direction of that force. 2) Here when a current is passed through the coil wound on the aluminum former, as it is placed in a magnetic field of permanent magnet, a force is exerted on the moving coil. So this force causes deflecting torque. The coil rotate and pointer attached to the moving system shows deflection on the scale.	2 Marks for construction (Diagram is optional) 2 Marks for working

3) The spring control is used to produce controlling torque. When deflecting torque and controlling torque becomes equal, the pointer shows steady deflection of the calibrated scale showing value of current.
4) The pointer shows final steady deflection after undergoing some oscillations about final steady position. To damp these oscillations eddy current damping system is used. When moving system oscillates, the aluminium former cuts the magnetic field and emf is induced in it. This emf circulates circular currents, called eddy currents in aluminium former. The force is exerted on aluminium former due to interaction between eddy currents and magnetic field. The direction of force is always such that it opposes the cause of its production i.e oscillations. Thus oscillations are damped out and the pointer shows final steady deflection in less time.

c) Write function of safety tools used in Electrical workshop. (Any four)

Ans:

Safety tools used in Electrical workshop:

Sr. No.	Safety tools	Function
1	Face Shield	Protect eyes and face from grinding particles
2	Safety Goggles	Protect eyes and face from grinding particles
3	Insulation gloves	Protection against various mechanical and electrical risks.
4	Insulation mats	• A rubber floor covering which provides insulation in any standing area that puts a person at risk of an electric shock. • Used in high voltage environment for isolating people from earth / ground and prevent free flow of current to ground through body.
5	Insulation ladders	To protect a worker against electrocution whilst working in a potentially hazardous situation – ladders insulate the worker from earth.
6	Safety Shoes	• Keep feet safe in case an object falls over it. • To prevent current to flow to ground through body.
7	Helmet/ Hard hat	• Protection against electric shock, especially in those areas where there are overhead energized conductors. • Protection against a potential head injury due to many other factors like accidental falling or hitting.
8	Insulated pliers	Used to operate on live conductors to prevent current flow through the human body.

1 Mark for each of any four tools and their function = 4 Marks

d) Compare auto transformer with two winding transformer.

Ans:

Comparison between Auto-transformer and Two-winding transformer:

Sr. No.	Point of Comparison	Two-Winding Transformer	Autotransformer
1	Construction	It does not have rotary contact.	It has rotary contact.
2	Number of windings	Two-winding transformer consists two windings per phase	Autotransformer consists of only one winding per phase.
3	Electrical isolation	Windings are electrically insulated from each other.	Windings are not electrically insulated.
4	Working Principle	Two-winding transformer works on the principle of	Autotransformer works on the principle of self-induction.

1 Mark for each of any four points = 4 Marks

				mutual induction.	
		5	Physical size	Two-winding transformers are larger in size.	Autotransformers are relatively smaller in size.
		6	Copper saving	Two-winding transformer requires more winding conductor material.	For the same rating, an autotransformer requires less conductor material.
		7	Losses	Two-winding transformer has more losses.	The losses in an autotransformer are low as compared to two winding transformer.
		8	Efficiency	Efficiency of a two winding transformer is less due to more copper loss.	An autotransformer has more efficiency.
		9	Secondary voltage	Two-winding transformer generally provides fixed output voltage for given fixed input voltage.	For an autotransformer, variable output voltage can be obtained for given fixed input voltage.
		10	Voltage regulation	Two-winding transformer has poor voltage regulation than auto transformer.	Autotransformer has better voltage regulation.
		11	Cost	For the same VA rating, the cost of two winding transformer is more.	Autotransformer is less costly than two winding transformer.
		12	Applications	Step-up and Step-down the voltage for transmission and distribution purposes.	Laboratory transformer, Dimmer, Starter for induction motor, Voltage regulator, Power transformer when ratio is near to 1.

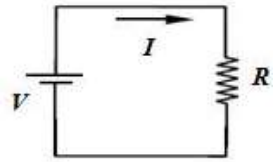
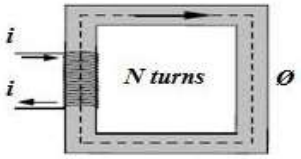
3. **Attempt any <u>THREE</u> of the following:** **12 Marks**

a) Compare electric and magnetic circuit (any four points).

Ans:

Sr. No.	Electric circuit	Magnetic circuit
1	Path traced by an electric current is known as electric current.	The magnetic circuit is a path in which magnetic flux is set up.
2	EMF is the driving force in the electric circuit which circulates electric current. Its unit is volt.	MMF is the driving force in the magnetic circuit which produces magnetic flux. Its unit is ampere turns.
3	There is a current in the electric circuit which is measured in amperes.	There is magnetic flux φ in the magnetic circuit which is measured in the weber.
4	The rate of flow of electrons decides the current in conductor.	The number of magnetic lines of force decides the magnetic flux.
5	Resistance (R) is the opposition by circuit to the flow of current. Its unit is ohm.	Reluctance (S) is the opposition offered by magnetic path to the magnetic flux. Its unit is ampere turn/weber.
6	Resistance is directly proportional to length of conductor and inversely proportional to the area of cross-section of conductor. $R = \rho . l/a.$	Reluctance is directly proportional to length of magnetic path and inversely proportional to the area of cross-section of magnetic path. $S = l/ (\mu_0.\mu_r.a).$

1 Mark for each of any four points = 4 Marks

7	Electric current I = EMF/ Resistance	Magnetic flux = MMF/ Reluctance	
8	Current density	Flux density	
9	Kirchhoff's current law and voltage law is applicable to the electric circuit.	Kirchhoff's flux law and mmf law is applicable to the magnetic circuit.	
10	For electric circuit we define the conductivity.	For magnetic circuit we define permeability.	
11	For electric circuit we define the resistivity.	For magnetic circuit we define reluctivity.	
12			

b) List advantages of AC quantity over DC quantity.

Ans:

Advantages of AC quantity over DC quantity:

1) AC is less expensive and easy to generate than DC.
2) AC can be transmitted over long distances without much energy loss, unlike DC.
3) The power loss during transmission in AC is less when compared to DC.
4) AC voltage has the advantage of stepping up and stepping down as per the requirement using transformer but changing DC voltage levels is difficult and complicated.
5) Ac is more economical than DC.
6) Regulation of AC is easier without much wastage of electrical energy with the help of a choke coil.
7) AC systems have higher efficiency than DC systems.
8) AC can be easily converted into DC as per the requirement but conversion of DC to AC is complicated.

1 Mark for each of any four advantages = 4 Marks

c) Define VFD. List any two advantages of VFD.

Ans:

Variable Frequency Drive (VFD) is a motor controller that changes the frequency and magnitude of voltage supplied to electric motor in order to control the speed of the motor.

Or any other equivalent answer

2 Marks for definition

Advantages: -

1) It saves the energy.
2) It limits the starting currents.
3) It reduces Peak Energy Demand.
4) It reduces power when not required.
5) It operates motor with Fully Adjustable Speed.
6) It controls starting, stopping, and acceleration.
7) It provides Dynamic Torque Control.
8) VFD improves efficiency.
9) It improves the power factor.
10) It reduces harmonics.
11) It provides communication features.
12) It reduces motor heating.

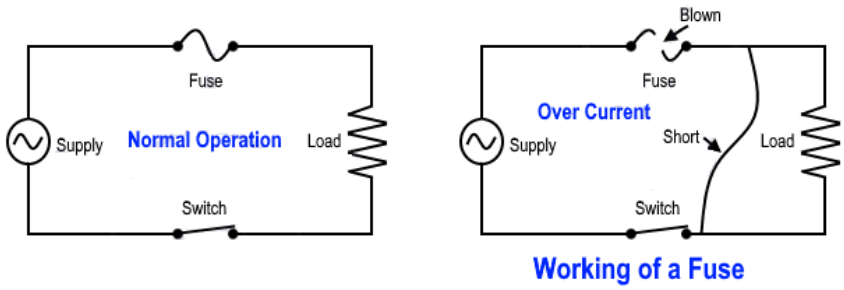
1 Mark for each of any two advantages = 2 Marks

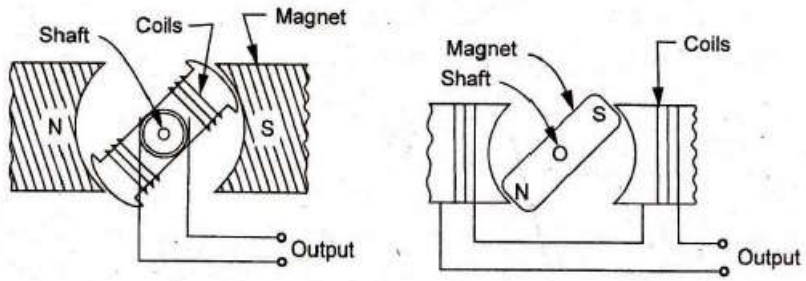
d) What is earthing? Give the importance of earthing.

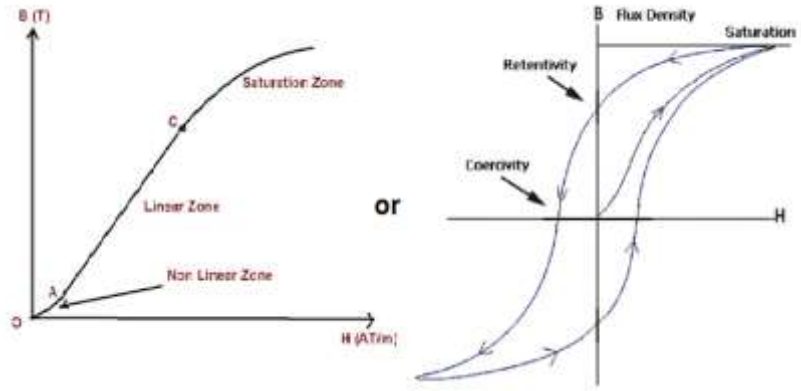
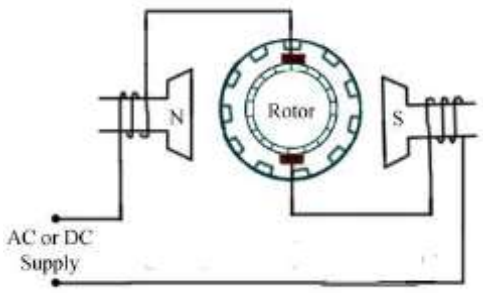
Ans:

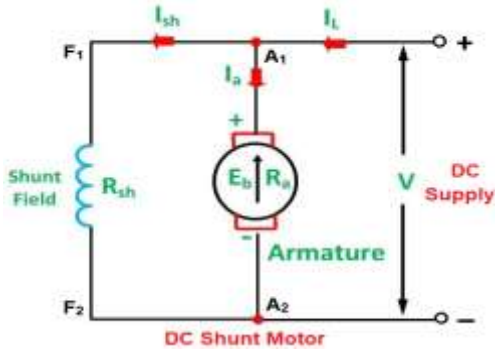
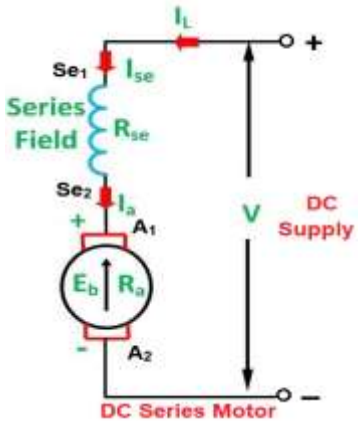
Earthing:

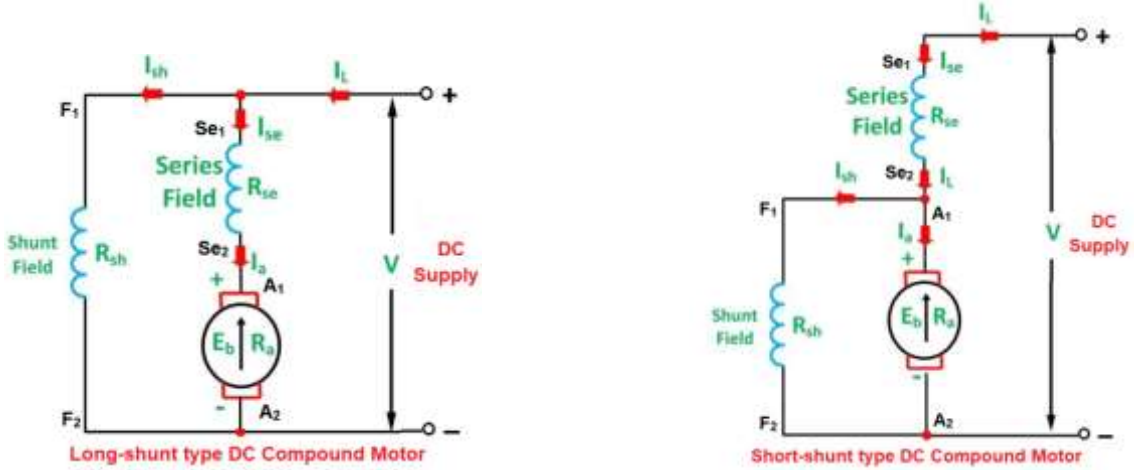
		1) **Equipment Earthing:** Earthing means connecting metallic cover of the electrical equipment to earth to avoid the hazards due to leakage current. If the live conductor accidently touches the metallic cover of the equipment, the cover gets charged and it might result in electrical shock to person who touches the metallic cover. By earthing the metallic cover, low resistance path is provided for leakage current from metallic cover to earth, so that when any person touches this cover, leakage current won't flow through the body of person, thus preventing the possibility of electric shock. 2) **Neutral Earthing:** Neutral earthing means connecting the neutral point of three-phase system to earth. **Importance of Earthing:** i) It provides protection and safety to the operator. ii) It provides protection and safety to the equipment. iii) It facilitates the balanced supply conditions. iv) It provides safe path to discharge lightning and short circuit currents. v) It helps to isolate the faulty section. vi) It protects installation from sudden high voltages, switching surges with lightning arrestor and surge suppressor.	2 Marks for earthing 1 Mark for each of any two advantages = 2 Marks
	e)	List any two advantages and disadvantages of Moving Iron Instrument. **Ans:** **Advantages of Moving Iron Instrument: -** 1) It is a universal instrument which can be used for the measurement of AC and DC quantities. 2) These types of instruments have high value of torque to weight ratio. Due to this, error because of friction is quite low. 3) It is very cheap due to simple construction. 4) These instruments are quite robust due to its simple construction. Above all, there is no moving part in the instrument which carries current. 5) Accuracy of any instrument depends on its design and workmanship. These instruments can be designed to provide precision and industrial grade accuracy. (an error of less than 2 % or less for DC & of the order of 0.2 to 0.3 % at 50 Hz for AC). 6) These instruments can withstand large loads and are not damaged even under sever overload conditions. **Disadvantages of Moving Iron Instrument: -** 1) The scale is not uniform and cramped at lower end. This is the reason why the accurate readings are not possible at lower range. 2) The power utilization is high for a low range of voltage. 3) These instruments suffer from error due to hysteresis, frequency change and stray losses. 4) Change in frequency can cause very serious errors in AC measurements. 5) This instrument is non-directional, so its accuracy is low. 6) Power consumption is high. 7) The calibration of these instruments should be done for both AC and DC. In fact, its calibration must be carried out at the frequency for which it is used in AC circuit. 8) Moving Iron Instruments are suitable for low frequency application. This is because at lower frequency, the eddy current error increases with square of frequency whereas at higher frequency this error is almost constant. Therefore moving iron instruments are not suitable for frequency above 125 Hz. 9) The reading of the instrument is affected by temperature variation. Increase in temperature decreases the spring stiffness and increases the resistance of coil.	1 Mark for each of any two advantages = 2 Marks 1 Mark for each of any two disadvantages = 2 Marks
4.		**Attempt any THREE of the following:**	**12 Marks**

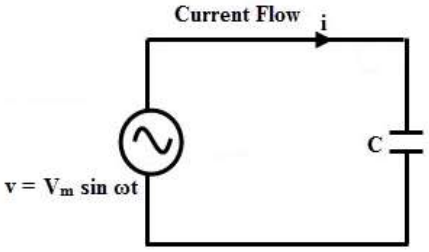
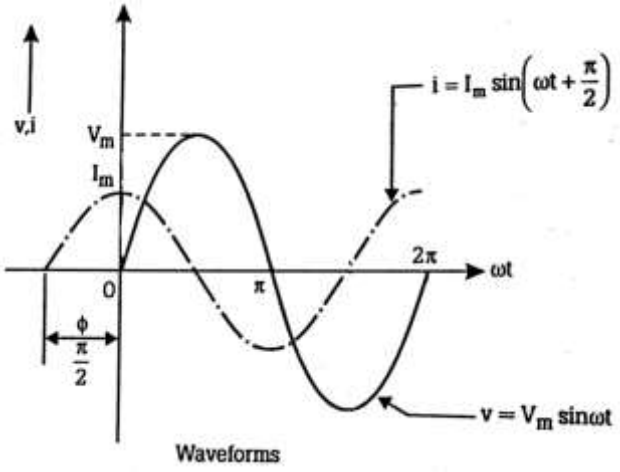
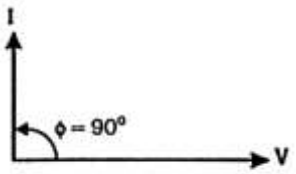
	a)	20kVA, 3300/240 V, 50 Hz single phase transformer has 80 turns on secondary winding. Calculate no of primary winding turns, full load primary and secondary currents. **Ans:** **Data Given:** Power rating S = 20 kVA Primary voltage = V_1 = 3300 volt Secondary Voltage = V_2 = 240 volt No. of turns on secondary = N_2= 80 Frequency f = 50HZ **1) Primary winding turns (N1)** $\frac{N1}{N2} = \frac{V1}{V2}$ $N_1 = \frac{3300}{240} \times 80 =$ **1100 turns** **2) Full load primary current (I_1):** Power rating in kVA $S = \frac{V1.I1}{1000}$ $I_1 = \frac{20\times1000}{3300}$ **I_1 = 6.06 A** **3) Full load secondary current (I_2):** Power rating in kVA $S = \frac{V2.I2}{1000}$ $I_2 = \frac{20\times1000}{240}$ **I_2 = 83.33 A**	1 Mark for N_1 1½ Mark for I_1 1½ Mark for I_2
	b)	Explain working principle of fuse. **Ans:** **Working principle of fuse:** • A fuse is an electric device which interrupts the flow of current in an electric circuit. • It is installed in a circuit to stop the flow of excessive current. • It is connected in series with the device to be protected. • Electric fuse works on the principle of the **heating effect of electric current**. • A fuse consists of a piece of wire or strip of wire made of a metal or an alloy of an appropriate melting point. If a current larger than the specified value flows through the circuit, the temperature of the fuse wire increases. This finally melts the fuse wire and breaks the circuit. • Once fuse wire melts, current is interrupted and further damage to the equipment due to heavy current is prevented.  Working of a Fuse **Or any other equivalent diagram**	3 Marks for explanation + 1 Mark for diagram = 4 Marks

	c)	Describe the working principle of tachometer. **Ans:** **Working Principle of Tachometer:** • Tachometer is a device which is used to measure rotational speed of a disk or a shaft of motors or other machines. • It counts the number of rotations the shaft is making per minute. • A Tachometer works on the principle of **relative motion** between the magnetic field and shaft of the coupled device. • The tachometer works as a generator, i.e. it produces the voltage based on the angular velocity of the shaft. Hence it is referred as tachogenetaor. • The device works on either an alternating or direct current. • In case of DC tachometer, the machine whose rotational speed is to be measured is coupled with the shaft of the DC tachometer. The armature (coil or winding) of the device rotates inside the constant magnetic field of the permanent magnet. This rotation induces an electromotive force. The developed electromotive force is directly proportional to the speed of the shaft. This implies a linear relationship between the electromotive force and speed of the shaft. • In case of AC tachometer, the armature (coil or winding) remains stationary but the magnetic field rotates. The rotation of the magnetic field induces electromotive force in the coil. Either the amplitude or frequency of the electromotive force can be used to measure the rotational speed. • The device counts the number of rotations that the shaft makes per minute.  *(a) D.C. tachometer* *(b) A.C. tachometer* **Or any other equivalent diagram**	3 Marks for description + 1 Mark for any one diagram = 4 Marks
	d)	Define:- (i) Cycle, (ii) Frequency, (iii) Period, (iv) Amplitude **Ans:** **(i) Cycle:** A complete set of variation of an alternating quantity which is repeated at regular interval of time is called as a cycle. **Or** Each repetition of an alternating quantity recurring at equal intervals is known as a cycle. **(ii) Frequency:** Number of cycles completed by an alternating quantity in one second is called as frequency. Its unit is cycles/second or hertz. **(iii) Period:** It is the time required for an alternating quantity to complete one cycle. It is measured in second. **(iv) Amplitude:** Amplitude is the maximum value of an alternating quantity. It is represented by	1 Mark for each definition = 4 Marks

		either of the two peaks of the sinewave.	
	e)	Explain B-H curve of magnetic material. **Ans:** **B-H curve:** The B-H curve is the graphical representation of relation between flux density (B) and applied field strength (H), with H plotted on the x-axis and B plotted on the y-axis. Typical B-H curve is as shown in figure below:  The B-H curve can be described by dividing it into 3 regions. • **Region OA:** For zero current, H = 0 and B is also zero. The flux density B then increases gradually as the value of H is increased. However, B changes slowly in this region. So this is called as nonlinear zone. • **Region AC:** In this region, for small change in H, there is large change in B. The B-H curve is almost linear in this zone. • **Region beyond C:** After point C, the change in B is small even for a large change in H. Finally, the B-H curve will tend to be parallel to X axis. This region is called as saturation zone.	2 Marks for diagram + 2 Marks for explanation = 4 Marks
5		**Attempt any <u>TWO</u> of the following:**	**12 Marks**
5	a)	Explain principle of operation of universal motor with neat diagram. Write any two applications of universal motor. **Ans:** **Universal motor:** • A universal motor works on either DC or single phase AC supply. When the universal motor is fed with a DC supply, it works as a DC series motor. When current flows in the field winding, it produces an electromagnetic field. The same current also flows through the armature conductors. When a current carrying conductor is placed in magnetic field, it experiences a mechanical force. Due to this mechanical force or torque, the rotor starts to rotate. The direction of this force is given by Fleming's left hand rule.  • When fed with AC supply, it still produces unidirectional torque. Because, armature winding and field winding are connected in series, they are in same phase. Hence, as polarity of AC changes periodically, the direction of current in armature and field	2 Marks for diagram 2 Marks for working 2 Marks for two applications

		winding reverses at the same time. Thus, direction of magnetic field and the direction of armature current reverse in such a way that the direction of force experienced by armature conductors remains same. Thus, regardless of AC or DC supply, universal motor works on the same principle that DC series motor works. **Applications of universal motor:** 1) Mixer 2) Food processor 3) Heavy duty machine tools 4) Grinder 5) Vacuum cleaners 6) Refrigerators 7) Driving sewing machines 8) Electric Shavers 9) Hair dryers 10) Small Fans 11) Cloth washing machine 12) Portable tools like blowers, drilling machine, polishers etc	
5	b)	Draw schematic representation of: i) DC Shunt motor ii) DC Series motor iii) DC Compound motor **Ans:** **i) Schematic representation of DC shunt motor :**  **ii) Schematic representation of DC series motor :**  	2 Marks for labelled diagram 2 Marks for labelled diagram

		iii) Schematic representation of DC compound motor : **1) Long shunt DC compound motor :** **2) Short Shunt DC Compound Motor:**  	1 Mark for labelled diagram of Long shunt type + 1 Mark for labelled diagram of Short shunt type
5	c)	A balanced 3-phase star connected load consist of three resistances each of 4 ohms connected to 400V, 3-phase 50Hz supply. Find: i) Phase voltage ii) Phase current iii) Line current iv) Power consumed **Ans:** **Data Given:** Balanced star connected load Line voltage V_L = 400V Frequency f = 50 Hz Resistance in each phase, R_{ph} = 4 Ω **i) Phase voltage:** For balanced star connection, Phase voltage = $\left(\frac{1}{\sqrt{3}}\right)$Line voltage i.e $V_{ph} = \frac{1}{\sqrt{3}} V_L$ ∴ Phase Voltage $V_{ph} = \frac{1}{\sqrt{3}}(400)$ = **230.94 V** **ii) Phase Current:** Phase Current, $I_{ph} = V_{ph} / R_{ph} = (230.94) / 4$ = **57.74 A** **iii) Line Current:** For balanced star connection, Line Current, I_L = Phase Current, I_{ph} = **57.74 A** **iv) Power consumed:** Total 3-ph Power $P = \sqrt{3}. V_L. I_L. \cos\phi$ OR $= 3V_{ph}.I_{ph}.\cos\phi$ For purely resistive load, $\cos\phi = 1$ ∴ **P** = $\sqrt{3}$ (400)(57.74) (1) = **40003.45 W**	1 Mark for Formula + ½ Mark for final answer = 1.5 Mark for each bit
6		**Attempt any <u>TWO</u> of the following:**	**12 Marks**

6	a)	Draw purely capacitive circuit with waveform of voltage and current. Write equation of current and draw phasor diagram. **Ans:** **Circuit diagram:**  **Waveform:**  Waveforms **Current equation:** $v(t) = V_m \sin \omega t$ $i(t) = I_m \sin (\omega t + \pi/2)$ **Phasor diagram:**  Phasor Diagram	1 Mark for circuit diagram 2 marks for labelled waveform 1 Mark for equation 2 Marks for labelled phasor diagram.
6	b)	Define the following terms (i) Magnetic flux (ii) Magnetic flux density (ii) Magnetic field strength (iv) Reluctance (v) Magnetic line of force (vi) Magnetomotive force. **Ans:** **1. Magnetic flux:** It is defined as the total number of magnetic lines of force passing through a magnetic circuit. **2. Magnetic flux density:** The magnetic flux per unit area measured in a plane perpendicular to the magnetic flux is known as magnetic flux density. **3. Magnetic field strength:** Magnetic field strength at a point in the magnetic field is defined as the force experienced by a unit North Pole placed at that point in magnetic field. **4. Reluctance:** It is the opposition offered by magnetic circuit to the magnetic flux. **5. Magnetic line of force:** Magnetic line of force is the path traced by unit north pole placed in magnetic field if it is allowed to move freely. Magnetic line of force represents how unit north pole will move due to force exerted by magnetic field.	1 Mark for each definition

6. Magneto-motive force:

Magneto-motive force or MMF is the force responsible for producing the magnetic flux.

6 c) State necessity of enclosures for motors. Enlist one application of each type of enclosure Used for electric ~~devices~~ drives.

Ans:

Necessity of enclosures:

2 Marks for 2 points of necessity

The enclosures for electric motors are necessary -

1. To protect the motor from foreign body particles such as dust, dirt and severe atmospheric conditions.
2. To protect the inner parts of the motor from external objects.
3. To protect the operating persons from live parts of the motor such as winding terminals, slip rings, brushes, etc.

Applications of Enclosures:

1 Mark for each of any four applications = 4 Marks

Types of enclosure	Applications
Open protected type	General industrial installations (non-explosive atmosphere) suitable where there is no unusual exposure to dust particles or dampness.
Screen protected type	General industrial installations (non-explosive atmosphere)
Drip proof type	General industrial installations (non-explosive atmosphere),Outdoor installation
Splash proof type	General industrial installations (non-explosive atmosphere), Can be used in rains.
Totally enclosed type	Used in motors installed in mill and factories where there are dust and moisture in the environment, General industrial installations (non-explosive atmosphere), Outdoor installation, Metal working machinery (non-explosive atmosphere), Chemical plant (Non-explosive atmosphere)
Totally Enclosed, Fan Cooled Type	used in saw mills, flour mills, cement works etc.
Pipe ventilated type	General industrial installations (non-explosive atmosphere)
Explosive proof type	Mines and other hazardous locations
Weather proof type	Outdoor installation