

COVER PAGE

Electrical Machines (787)

Marking Scheme

Class XII - 2018-19

Time: 2 Hours

Total Marks: 40

General Instructions:

1. *Marking Scheme is divided into two sections: Section-A and Section- B.*
2. **Section–A:**
 - i. *Multiple choice question/Fill in the blanks/Direct Questions of 1 mark each. Answer any 10 questions out of the given 12 questions.*
 - ii. *Very Short Answer of 2 marks each. Answer any 5 questions from the given 7 questions.*
 - iii. *Short Answer of 3 marks each. Answer any 5 questions from the given 7 questions.*
3. **Section–B:***Long/Essay type questions of 5 marks each. Answer any 3 questions from the given 5 questions.*
4. *All questions of a particular section must be attempted in the correct order.*
5. *Please check that this question paper contains 31 questions out of which 23 questions are to be attempted.*
6. *The maximum time allowed is 2 hrs.*
7. *The marking scheme carries only suggested value points for the answers. These are only guidelines and do not constitute the complete answers. The students can have their own expression and if the expression is correct, the marks be awarded accordingly.*

Q.NO.	Expected Answer/Value Points	Marks	Total Marks
1	series motor(a)	1	1
2	Differential compound motor (d)	1	1
3	Eddy current losses(b)	1	1
4	Voltage(b)	1	1
5	3000kVA(a)	1	1
6	Retain Heat((b)	1	1
7	Prevents oxide forming(d)	1	1
8	Low(b)	1	1
9	Which can run on ac as well as on dc(c)	1	1
10	Single phase induction motor(d)	1	1
11	Interchanging brush leads(c)	1	1
12	Less than stator speed(a)	1	1
13	<p>Speed control of DC motor implies:</p> <ul style="list-style-type: none"> • By varying the supply voltage • By varying the flux, and by varying the current through field winding • By varying the armature voltage, and by varying the armature resistance 	2	2
14	<p>Functions of pole core and pole shoe in DC motor:</p> <ol style="list-style-type: none"> 1. Pole core basically carries a field winding which is necessary to produce the flux. 2. It directs the flux produced through air gap to armature core, to the next pole. 3. Pole shoe enlarges the area of armature core to come across the flux. 	2	2
15	<p>The Starting capacitor value must be large.</p> <p>The value of the starting winding resistance must be low.</p> <p>The Torque</p>	2	2
16	<p>There are 3 different types of solders:</p> <ol style="list-style-type: none"> 1. soft soldering- It originally used a tin-lead alloy as the filler metal 2. silver soldering- It uses an alloy containing silver 	2	2

	3. brazing -It uses a brass alloy for the filler		
17	<p>The term 'fractional' indicates that the motor often has a power rating smaller than one horsepower</p> <p>Winding Details:</p> <ol style="list-style-type: none"> 1. The stator is a laminated magnetic core which holds electrical winding. Electricity flowing through these winding produces magnetic field. 2. Rotor is the part that runs and has no winding. 3. Bearing holds the rotating shaft. 	2	2
18	<p>There are many causes of faults in ac motors. Some are listed below:</p> <ol style="list-style-type: none"> 1. Low insulation resistance 2. Over-Current 3. Overheating 4. Vibrations 5. Dirt and moisture 6. Lack of maintenance 	2	2
19	<p>Applications of voltage and current transformer:</p> <ol style="list-style-type: none"> 1. Extending the range of measuring instruments such as ammeter, energy meter, KVA meters, wattmeter, etc. 2. Differential circulating current protection systems. 3. Distance protection in power transmission systems. 4. Over current fault protection. 	2	2
20	<p>A repulsion motor is a type of electric motor for using on alternating current (AC). Repulsion motors are based on the principle of repulsion between two magnetic fields.</p> <p>Application of single phase motor</p> <p>These are used in low power applications and widely used in domestic applications as well as industrial. And some of those are mentioned below</p> <ul style="list-style-type: none"> • Pumps • Compressors • Small fans • Mixers • Toys • High speed vacuum cleaners • Electric shavers • Drilling machines 	3	3
21	<p>Three phase induction motors can be started</p> <ol style="list-style-type: none"> 1. Direct Online- direct-on-line, which means that the rated supply is directly applied to the motor. 2. Starting Of Squirrel Cage Motors <p>Starting in-rush current in squirrel cage motors is controlled by applying reduced voltage to the stator.</p> <ol style="list-style-type: none"> 3. Auto-Transformers: It is basically a three phase step down transformer with different taps provided that permit the user to start the motor at, say, 50%, 65% or 	3	3

80% of line voltage.

4. Star-Delta Starter:
This method is used in the motors, which are designed to run on delta connected stator.

5. Starting Of Slip-Ring Motors:
Slip-ring motors are started with full line voltage, as external resistance can be easily added in the rotor circuit with the help of slip-rings.

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Construction & Principle :

A compound-wound motor has both a series and a shunt field winding, (i.e. one winding in series and one in parallel with the armature circuit), by varying the number of turns on the series and shunt windings and the directions of the magnetic fields produced by these windings (assisting or opposing).

Construction Diagram:

Schematic diagram of dc compound motor

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- Remove the springs and brushes by removing the cover typically with a slotted screw driver
 - Check the motor brushes are moving freely when disassembling
 - Check that the spring tension on all the brushes are about equal
 - Check the face of the brushes- it should be shiny or polished which will indicate good contact. If not replace
 - Check the brush length. Typical fanuc DC motor brushes when new are about .75" long. The less length the less spring tension on the brush.
 - Once brushes are removed shine a flashlight inside and look to see if there is build up on the commutator or in the housing. Use an air line/clean air supply to blow this out. Clean between all the commutator grooves and area for brushes. If there is black residue on the commutator polish with fine sandpaper.
 - Check for wear grooves on the commutator from the brushes rubbing. Consider replacement if extremely worn or pitted.
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Difference between DC series and DC shunt motor

Sno.	Parameter	DC Series motor	DC Shunt Motor
1	Connection of field winding with armature	Field is in series with armature	Field is in shunt with armature
2	Type of starter	4 point	3 point
3	Torque	high	low
4	Application	Electric trains, conveyers	Machine tool, printing, paper machine

Working principle of shunt motor:

When we apply a voltage to the motor a current produced in the armature and a strong magnetic field, by the way, produced this field interacts with the magnetic field and makes the armature rotate. When the armature rotates it produces a back EMF this EMF opposes

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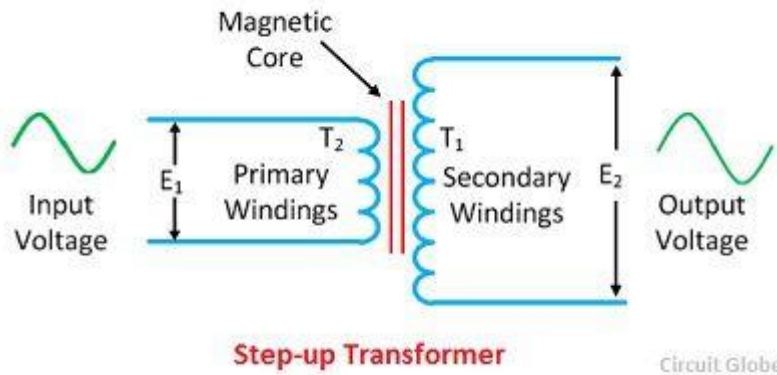
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the armature voltage and reduces the armature current if we increase the motor load the armature will rotate slowly and the back EMF will reduce.

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Step-up Transformer

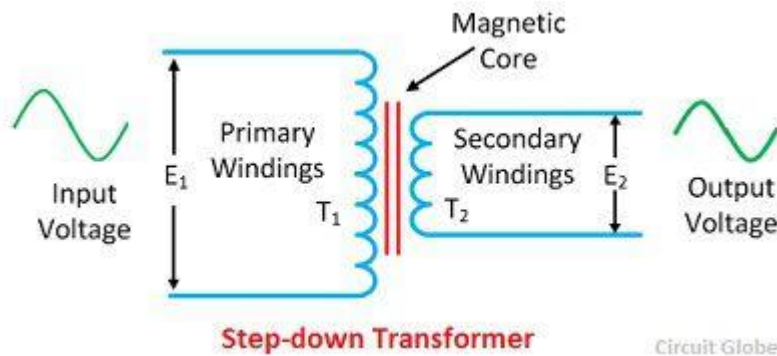
A transformer in which the output (secondary) voltage is greater than its input (primary) voltage is called a step-up transformer. The step-up transformer decreases the output current for keeping the input and output power of the system equal. Considered a step-up transformer shown in the figure below. The E_1 and E_2 are the voltages, and T_1 and T_2 are the number of turns on the primary and secondary winding of the transformer.



The number of turns on the secondary of the transformer is greater than that of the primary, i.e., $T_2 > T_1$. Thus the voltage turn ratio of the step-up transformer is 1:2.

Step-down Transformer

A transformer in which the output (secondary) voltage is less than its input (primary) voltage is called a step-down transformer. The number of turns on the primary of the transformer is greater than the turn on the secondary of the transformer, i.e., $T_2 < T_1$. The step-down transformer is shown in the figure below.



The voltage turn ratio of the step-down transformer is 2:1. The voltage turn ratio determines

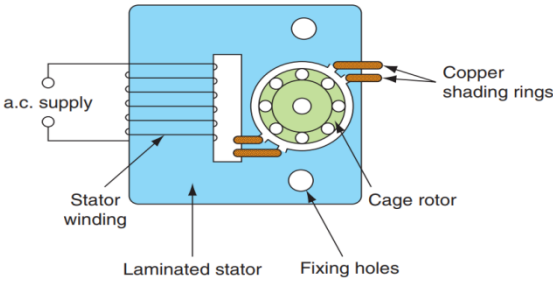
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the magnitude of voltage transforms from primary to secondary windings of the transformer.

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A shaded-pole motor is a small squirrel-cage motor in which the auxiliary winding is composed of a copper ring or bar surrounding a portion of each pole. This auxiliary single-turn winding is called a shading coil. A shaded pole motor may be 2 pole or 4 pole. Here we are considering a 2 pole shaded pole motor. The pictures in this article also shows a 2 pole motor.



The stator has salient poles. Each of the poles has its own exciting coil. A part of each pole is wrapped by a copper coil. The copper coil forms a closed loop across each pole. This loop is known as the **shading coil**. The poles are laminated. A slot is cut across the lamination of the pole. The short circuited copper coil described above is placed in this slot. So we can call this part as the shaded part and other part of the pole as unshaded part.

Rotor

The rotor of shaded pole induction motors is Squirrel Cage type rotor. The rotor bars are provided with a 60 degree skew. This is to obtain an optimum starting torque and for limiting the torque dip during run up. Airgap length between stator and rotor is of the order 0.25 to 0.5 mm. Too short air-gap may result in starting-torque variations due to rotor slotting. Shaded pole induction motor has no commutator, brushes, collector rings, contactors, capacitors or moving switch parts, so it is relatively cheaper, simpler and extremely rugged in construction and reliable. Absence of centrifugal switch eliminates the possibility of motor failure due to faulty centrifugal switch mechanisms.

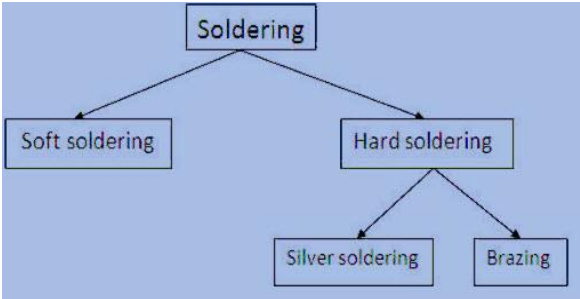
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Different Methods of Soldering

The methods of soldering process can be classified into two, namely soft soldering and hard soldering.



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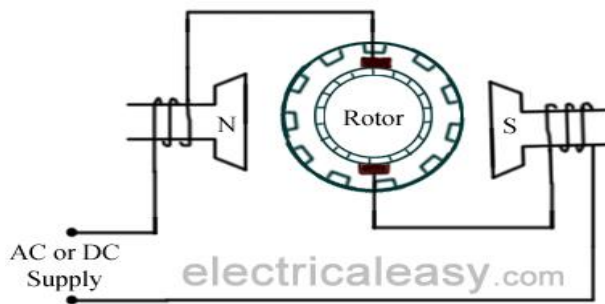
	<p>Soft Soldering</p> <p>Soft soldering is a process for fitting very minute compound parts possessing low liquefying temperature, which have been broken during the procedure of soldering is performed at high temperature. In this process, a tin-lead alloy is used as space filler metal. The liquefying temperature of the space filler alloy must not be less than 400oC / 752oF. A gas torch is used as a heat source, for the procedure.</p> <p>Hard Soldering</p> <p>In this type of soldering a solid solder unites two elements of metals by spreading out into the holes of the component that are unlocked due to high temperature. The space filler metal grips higher temperature more than 450oC/840oF. It comprises of two elements: Silver soldering and Brazing.</p> <p>Silver Soldering</p> <p>It is an unsoiled method supportive to fabricate small components, carrying out abnormal maintenance and built-up tools. It makes use of an alloy containing silver as a space filler metal. Though silver provides a free running individuality, yet silver soldering is not suggested for space filling, and thus, different flux is recommended for accurate silver soldering.</p> <p>Braze Soldering</p> <p>This type of soldering is a procedure for connecting two terminals of the base metals by forming liquid metallic space filler, which runs by the attraction of a vessel through the joints and cools down to give a solid union through diffusion and atomic magnetism. It produces a very strong joint. It makes use of a brass metal as a space filler agent.</p>		
28	<p>Classification of AC motors</p> <p>1. Classification Based On Principle Of Operation:</p> <p>(I)Synchronous motor (II)Asynchronous motor Induction motor (a)Squirrel cage(b) Slip ring Commutator motor (a) Series(b) Compensated(c) Shunt(d) Repulsion(e) Repulsion-start induction(f) Repulsion induction</p> <p>2. Classification Based On Type Of Current: (a)Constant Speed.(b). Variable Speed.(c) Adjustable Speed.</p> <p>3. Classification Based On Structural Features: (a)Open(b) Enclosed(c) Semi-enclosed(d) Ventilated(e) Pipe-ventilated</p> <p>Universal motor:A universal motor is a special type of motor which is designed to run on</p>	5	5

either DC or single phase AC supply.

Construction Of Universal Motor:

Construction of a universal motor is very similar to the construction of a DC machine. It consists of a stator on which field poles are mounted. Field coils are wound on the field poles. However, the whole magnetic path (stator field circuit and also armature) is laminated. Lamination is necessary to minimize the eddy currents which induce while operating on AC. The rotary armature is of wound type having straight or skewed slots and commutator with brushes resting on it

Working Of 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. (see working of a DC series motor here). When current flows in the field winding, it produces an electromagnetic field. The same current also flows from the armature conductors. When a current carrying conductor is placed in an electromagnetic 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 winding reverses at the same time.

Characteristics

