COLLEGE OF ENGINEERING & TECHNOLOGY, SRMIST
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

CLA 1B

C

Register Number	
Academic Year	**2022-2023(EVEN SEM)**
Program offered	**B.Tech (Common for ALL)**
Year / Sem	**I/II**
Course Code	**21EES101T**
Title	Electrical and Electronics Engineering
Maximum Marks	**50**
Date	**05-05-2023**
Time	**12.30-2.15 PM**

Bloom's Level Assessment

Bloom's Level	Level of Thinking	Weightage Required (%)	Weightage Provided (%)
1	Remember	100 %	100 %
	Understand		
2	Apply	-	-
	Analyze		

COURSE ARTICULATION MATRIX

Course outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	3	2	-	-	-	-	-	-	-	-	-	-
CO-2	3	2	-	-	-	-	-	-	-	-	-	-
CO-3	3	-	-	-	-	-	-	-	-	-	-	-
CO-4	3	-	-	-	-	-	-	-	-	-	-	-
CO-5	3	-	-	-	-	-	-	-	-	-	-	-
Average of COs	**3**	**2**	-	-	-	-	-	-	-	-	-	-

Q. No.	Marks Allotted	Course Outcome (CO)	Bloom'sTaxonomy	Program Outcome (PO)	Marks Scored
1	2	CO3	Remember	PO1	
2	2	CO3	Understand	PO1	
3	2	CO3	Remember	PO1	
4	2	CO4	Understand	PO1	
5	2	CO4	Remember	PO1	
6	2	CO5	Understand	PO1	
7	2	CO5	Remember	PO1	
8 (a)	8	CO3	Understand	PO1	
8 (b)	8	CO3	Understand	PO1	
9 (a)	8	CO4	Understand	PO1	
9 (b)	8	CO4	Understand	PO1	
10 (a)	8	CO5	Understand	PO1	
10 (b)	8	CO5	Understand	PO1	
11	12	CO3	Remember	PO1	
12	12	CO5	Understand	PO1	

CO ASSESSMENT

Course Outcomes	CO1	CO2	CO3	CO4	CO5	CO6	Total
Marks Allotted	-	-				-	50
Marks Scored	-	-				-	

PO ASSESSMENT

Program Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Marks Allotted	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marks Scored		-	-	-	-	-	-	-	-	-	-	-	-	-	-

Signature of the Faculty

21EES101T – Electrical and Electronics Engineering– CLA 1A (05-05-2023)

C

PART A – Answer ALL Questions (7x 2= 14 Marks)

1. Write the working principle of DC motor

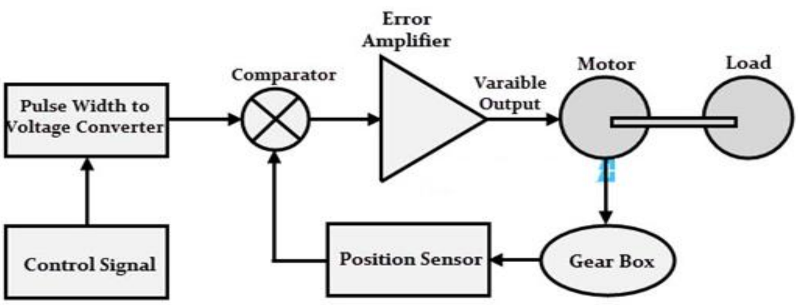
DC MOTOR

Principle

Whenever a current carrying conductor is kept in a stationery magnetic field an electromagnetic force is produced. This force is exerted on the conductor and hence the conductor is moved away from the field. This is the principle used in d.c. motors.

2. Draw the block diagram of servo motor in closed loop system

Closed loop system - Servo Motor:



3. List some applications of electric drive.

Applications of Electric Drives

Transportation Systems

Rolling Mills

Paper Mills

Textile Mills

Machine Tools

Fans and Pumps

Robots

Washing Machines etc

4. What is damping torque in measuring instruments?

2 (c) *Damping Torque* This torque is produced only when the instrument is in operation. This ensures that the moving system takes just the required time to reach its final deflected position.

5. Write the applications of Hall effect transducer
    1. Magnetic to Electric Transducer
    2. Measurement of Displacement
    3. Measurement of Current
    4. Measurement of Power

6. What is primary transmission system?

The power generated at the generating stations is transmitted at higher voltage to the main load centers. This transmission system is known as primary transmission system. The primary transmission system employs overhead lines in general.

7. Name the two types of instrument transformers.

8. **(i) Current transformer (C.T.):** A current transformer in essentially a step-up transformer which steps down the current to a known ratio.

(ii) Potential transformer (P.T.): It is essentially a step down transformer and steps down the voltage to a known ratio.

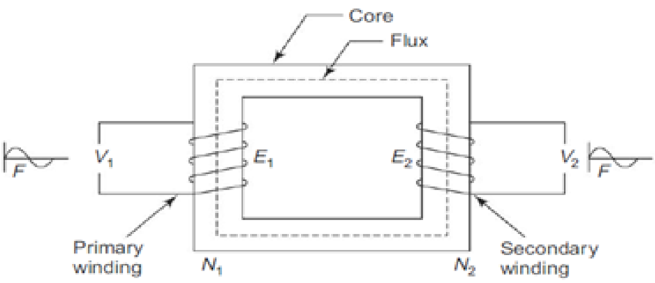
PART B – Answer ALL Questions (3 X 8 = 24 Marks)

9. (a) Explain the construction and working principle of single-phase transformer with neat diagram.

Principle of operation

The transformer works on the principle of electromagnetic induction. In this case, the conductors are stationary and the magnetic flux is varying with respect to time. Thus, the induced emf comes under the classification of statically induced emf.

The transformer is a static piece of apparatus used to transfer electrical energy
from one circuit to another. The two circuits are magnetically coupled. One of the circuits is energized by connecting it to a supply at specific voltage magnitude, frequency and waveform. Then, we have a mutually induced voltage available across the second circuit at the same frequency and waveform but with a change in voltage magnitude if desired. These aspects are indicated in Fig.



Construction

The following are the essential requirements of a transformer:

(a) A good magnetic core

(b) Two windings

(c) A time varying magnetic flux

The transformer core is generally laminated and is made out of a good magnetic material such as transformer steel or silicon steel. Such a material has high relative permeability and **low hysteresis loss**. In order to reduce the **eddy current loss**, the core is made up of laminations of iron. ie, the core is made up of thin sheets of steel, each lamination being insulated from others

(OR)

(b) Explain the construction and working principle of PMSM with neat diagram.

PMSM

5.2 Permanent Magnet Synchronous Machines

Permanent magnet synchronous machines generally have the same operating and performance characteristics as synchronous machines in general operation at synchronous speed, a single (or) polyphase source of ac supplying the armature windings, a power limit above which operation at synchronous speed is unstable, reversible power flow etc..

A PM machine can have a configuration almost identical to that of the conventional synchronous machine with absence of sliprings and a field winding.

Construction

Figure 5.1 shows an cross section of a very simple PM synchronous machine.

Stator

This is the stationary member of the machine. Stator laminations for axial airgap machines are often formed by winding continuous strips of softsteel. Various parts of the laminations are the teeth slots which certain the armature windings, yoke completes the magnetic path. Lamination thickness depends upon the frequency of the armature source voltage and cost.

Armature windings are generally double layer (two coil sides per slot) and lap wound. Individual coils are connected together to form phasor groups. Phasor groups are connected together in series/parallel combinations to form star, delta, two phase (or) single phase windings.

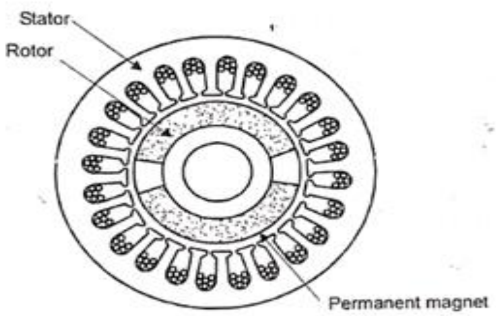


Figure 5.1

AC windings are generally short pitched to reduce harmonic voltage generated in the windings.

Coils, phase groups and phases must be insulated from each other in the end-turn regions and the required dielectric strength of the insulation will depend upon the voltage rating of the machine.

In a PM machine the airgap serves an role in that its length largely determines the operating point of the PM in the no-load operating condition of the machine. Also longer airgaps reduce machine windage losses.

10. (a) Explain the construction and working principle of dynamometer type MC instrument with neat diagram.

1 B DYNAMOMETER TYPE MOVING COIL INSTRUMENT

Principle Working principle of this type of instrument is same as that of permanent magnet moving coil type. But, the difference is that there is no permanent magnet in this instrument. Both the operating fields are produced by the current and/or the voltage to be measured.

Construction (Refer Fig. 7.11). The fixed coil (*FC*) is made in two sections. In the space between these two sections, a moving coil (*MC*) is placed. The moving coil is attached to the spindle to which is attached a pointer. The pointer is allowed to move over a calibrated scale. Two helical springs are attached to the spindle to give the required control torque. A piston attached to the spindle is arranged to move inside an air chamber.

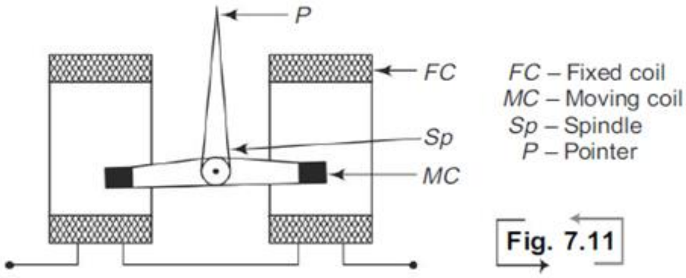


Fig. 7.11

(OR)

(b) Explain the working of (i) Proximity sensor and (ii) IR sensor.

(i)

Proximity sensor

A **proximity sensor** is a sensor able to detect the presence of nearby objects without any physical contact.

A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target.

Different proximity sensor targets demand different sensors. For example, a capacitive proximity sensor or photoelectric sensor might be suitable for a plastic target; an inductive proximity sensor always requires a metal target.

Operating Principles

Detection Principle of Inductive Proximity Sensors

Inductive Proximity Sensors detect magnetic loss due to eddy currents that are generated on a conductive surface by an external magnetic field. An AC magnetic field is generated on the detection coil, and changes in the impedance due to eddy currents generated on a metallic object are detected.

(ii)

IR Sensor

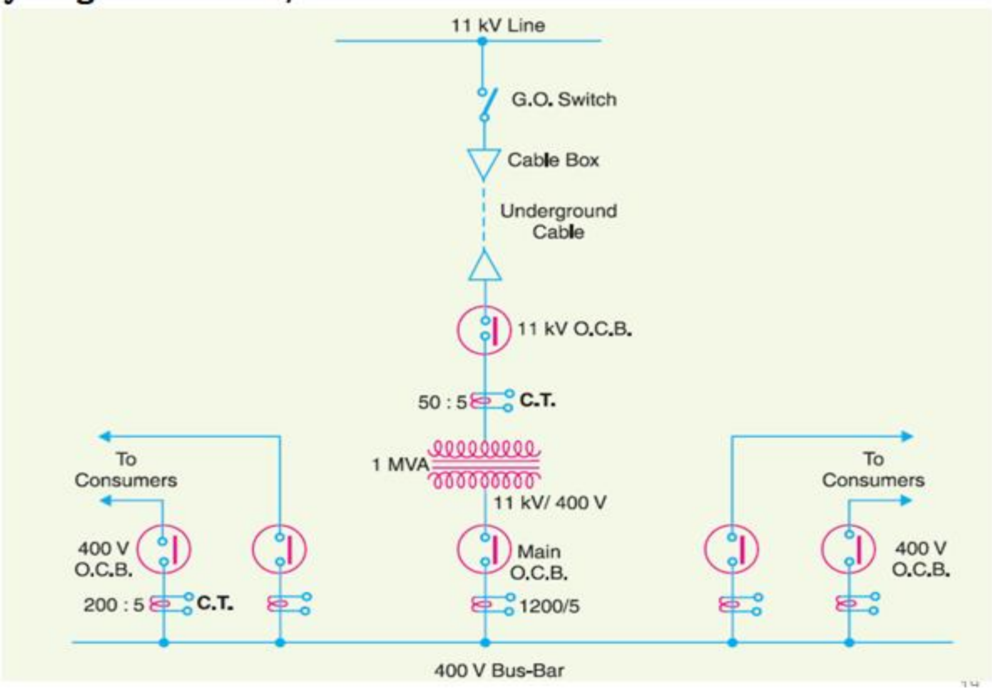
IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. It measures and detects infrared radiation in its surrounding environment.

There are two types of infrared sensors: active and passive. Active infrared sensors both emit and detect infrared radiation. Active IR sensors have two parts: a light emitting diode (LED) and a receiver. When an object comes close to the sensor, the infrared light from the LED reflects off of the object and is detected by the receiver. Active IR sensors act as proximity sensors, and they are commonly used in obstacle detection systems (such as in robots).

Passive infrared (PIR) sensors only detect infrared radiation and do not emit it from an LED. Passive infrared sensors are comprised of:
Two strips of pyroelectric material (a pyroelectric sensor)
An infrared filter (that blocks out all other wavelengths of light)
A fresnel lens (which collects light from many angles into a single point)
•A housing unit (to protect the sensor from other environmental variables, such as humidity)

11. (a) Draw the key diagram of 11 kV/400 V indoor substation and explain the operation.

Key Diagram of 11 kV/400 V Indoor Sub-Station



The key diagram of this 11 kV/400 V sub-station can be explained as under :

(i) The 3-phase, 3-wire 11 kV line is tapped and brought to the gang operating switch installed near the sub-station. The G.O. switch consists of isolators connected in each phase of the 3-phase line.

(ii) From the G.O. switch, the 11 kV line is brought to the indoor sub-station as underground cable. It is fed to the H.T. side of the transformer (11 kV/400 V) via the 11 kV O.C.B. The transformer steps down the voltage to 400 V, 3-phase, 4-wire.

(iii) The secondary of transformer supplies to the bus-bars via the main O.C.B. From the busbars, 400 V, 3-phase, 4-wire supply is given to the various consumers via 400 V O.C.B. The voltage between any two phases is 400 V and between any phase and neutral it is 230 V. The single phase residential load is connected between any one phase and neutral whereas 3-phase, 400 V motor load is connected across 3-phase lines directly.

(iv) The CTs are located at suitable places in the sub-station circuit and supply for the metering and indicating instruments and relay circuits.

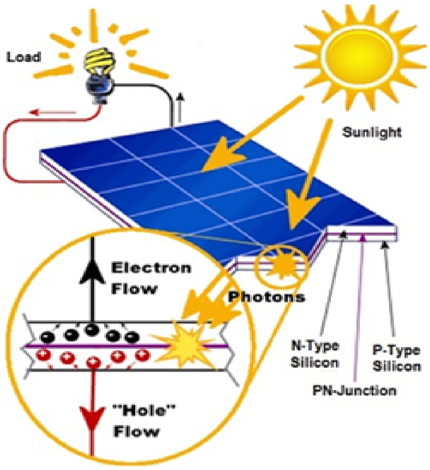
(OR)

(b) Write short notes on (i) solar photovoltaic system and (ii) energy storage systems.

(i)

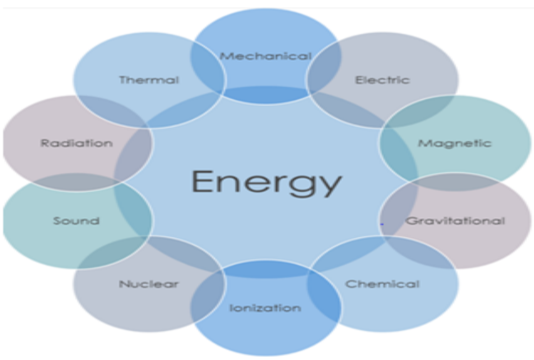
❑ Solar cells, a type of semiconductor device that efficiently absorbs solar radiation and converts it into electrical energy, are also known as photovoltaic cells because of their **photo-voltaic effect** using various potential barriers.

❑ A photovoltaic cell is also called a solar cell. It is a semiconductor device which converts sunlight into DC power using the photoelectric effect. Practically, all solar cells are photodiodes made of semiconductor material like silicon.



(ii)

Introduction to Energy Storage



✓ Energy storage systems have been in use for a very long time, for diverse applications.

✓ Quantitative property held by an object or a system that can be consumed to perform work or convert the form of energy.

✓ retention of anything, whether physical or virtual, for (possible) usage in the future.

(i) Portable electronics (ii) Uninterruptible Power Supplies (UPS)

(iii) Energy offset for renewable energy

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PART C – Answer ANY ONE Questions (1 X 12 = 12 Marks)

12. Explain the construction and working principle of squirrel cage induction motor with neat diagram

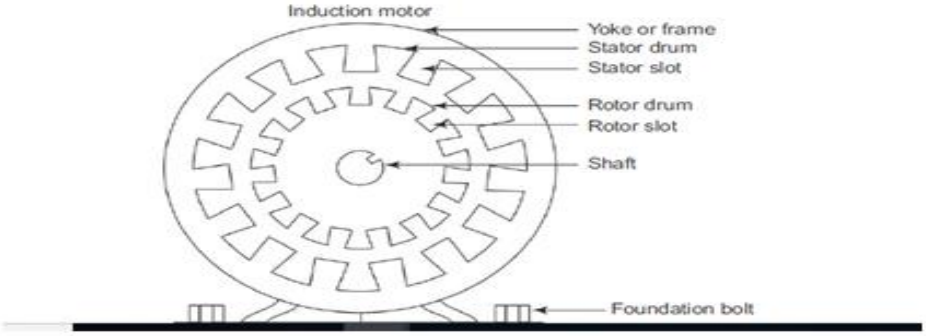
THREE PHASE INDUCTION MOTOR

Principle

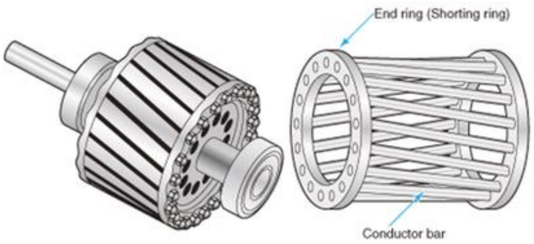
When a three phase balanced voltage is applied to a three phase balanced winding, a rotating magnetic field is produced. This field has a constant magnitude and rotates in space with a constant speed. If a stationary conductor is placed in this field, an emf will be induced in it. By creating a closed path for the induced current to flow, an electromagnetic torque can be exerted on the conductor. Thus, the conductor is put in rotation.

Construction

The important parts of a three phase induction motor are schematically represented in Fig. 6.47. Broadly classified, they are stator and rotor. Each of these is described below.



Construction (Rotor construction Squirrel cage)



(a) Rotor (b) Squirrel-cage conductor

Stator This is the stationary part of the motor. It consists of an outer solid circular metal part called the yoke or frame and a laminated cylindrical drum called the stator drum. This drum ash number of slots provided over the entire periphery of it. Required numbers of stator conductors are embedded in the slots. These conductors are electrically connected in series and are arranged to form a balanced three phase winding. The stator is wound to give a specific number of poles. The stator winding may be star or delta connected.

Rotor This is the rotating part of the induction motor. It is also in the form so slotted cylindrical structure. The air gap between stator and rotor is as minimum as mechanically possible. There are two types of rotors—squirrel cage rotor and slip-ring or wound rotor.

Working

A three phase balanced voltage is applied across the three phase balanced stator winding. A rotating magnetic field is produced. This magnetic field completes its path through the stator, the air gap and the rotor. In this process, the rotor conductors, which are still stationary, are linked by the time varying stator magnetic field. Therefore, an emf is induced in the rotor conductors. When the rotor circuit forms a closed path, a rotor current is circulated. Thus, the current carrying rotor conductors are placed in the rotating magnetic field. Hence, as per the law of interaction, an electromagnetic force is exerted on the rotor conductors. Thus, the rotor starts revolving.

According to Lenz's law, the nature of the rotor induced current is to oppose the cause producing it. Here the cause is the rotating magnetic field. Hence, the rotor rotates in the same direction as that of the rotating magnetic field.

In practice, the rotor speed never equals the speed of the rotating magnetic field (called the synchronous speed). The difference in the two speeds is called slip. The current drawn by the stator is automatically adjusted whenever the motor is loaded.

(OR)

13. Discuss the different types of earthing with neat diagrams.

.1 Earthing through a G.I. Pipe

In this method a G.I. pipe used as an earth electrode. The size of the pipe depends upon the current to be carried and type of soil in which the earth electrode is buried.

For ordinary soils the length of the G.I. pipe used as an earth elctrode is 2 m long and 38 mm in diameter or 1.37 m long and 51 mm in diameter. For dry and

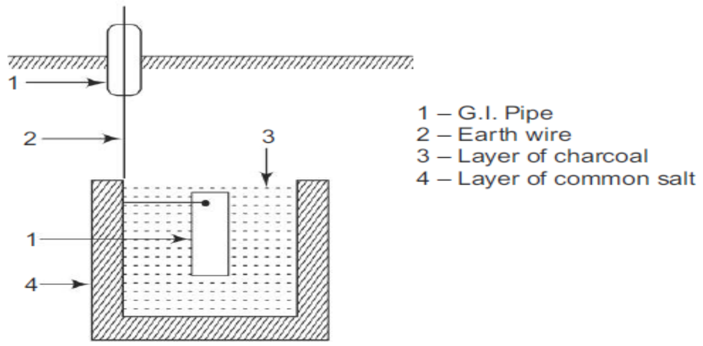


Fig. 8.3

rocky soils the length may be increased to about 2.75 metres and 1.85 metres respectively. The pipe is placed vertically, burying to a depth not less than 2 metres in as moist a place as possible, preferably in close proximity of water tap, water pipe or water drain and at least 0.6 metre away from all building foundations, etc as shown in Fig. 8.3. The pipe shall be completely covered by 80 mm of Charcoal with the layer of common salt 30 mm all around it. The charcoal and salt decreases the earth resistance.

.2 Earthing through a Plate

A G.I. or copper plate is used as an earth electrode. If a G.I. plate is used it shall be of dimensions 0.3 m × 0.3 m and 6.35 mm thick and if a copper plate is used it shall be of dimensions 0.3 m × 0.3 m and 3.2 mm thick. The plate is buried to a depth of not less than 2 m in as moist a place as possible preferably in close proximity of water tap, water pipe or water drain and at least 0.6 m away from all building foundations, etc. The plate shall be completely covered by 80 mm of charcoal with a layer of common salt of 30 mm all around it, keeping the faces of the vertical as shown in Fig. 8.4.