UNIT 1
Electrical Energy generation utilization and conservation
GENERATION

1) What are the sources of energy?

Electrical energy is produced from energy available in various forms in nature. The sources of energy are

- The Sun
- The wind
- Water
- Fuels
- Nuclear energy

2) Name the different types of power generation.

Conventional methods (With prime movers)

a) Hydro power generation
b) Thermal power generation
c) Nuclear power generation

Non-Conventional methods (Without prime movers)

d) MHD (magneto hydro dynamic) power generation
e) Solar power generation
f) Fuel cells generation
g) Thermo electric generation
h) Thermionic converters
i) Solar cells
j) Wind power generation
k) Geo-thermal energy generation
l) Tidal power generation

3) How will you classify hydro-electric plants according to nature of load?

Classification according to nature of load

- ✓ Base load plants
- ✓ Pear load plants
- ✓ Pumped storage plants for peak load.

4) What is penstock?

From the reservoir the water is carried to valve house through pressure tunnel and from valve house to the water turbine through pipes of large diameter made of steel or reinforced concrete, called the penstock.

5) What is the principle of pumped storage scheme?

The basic principle of pumped storage scheme is to convert the surplus electrical energy generated by a power plant or available in a system in off-peak periods, to hydraulic potential energy, in order to generate power in periods where the peak demand on the system exceeds the total available capacity of the generating stations.

6) What are the factors to be considered while selecting a site for steam power plants?

The factors to be considered for selecting the steam power plant are as follows:

- Nearness to the load centre
- Availability and supply of cooling water
- Availability of coal
- Land requirement
- Transport facilities and Ash disposal facilities.

7) What is the function of deaerator in steam power plant?

The function of deaerator is to reduce dissolved oxygen content in the condensate i.e. in the feed water. The feed water is then pumped into boiler through economizer in which it is further heated by the heat of the flue gas passing through it on the way to chimney.

8) What are the disadvantages of steam power plants?

The disadvantages are

- ✓ High maintenance and operating cost.
- ✓ Pollution of atmosphere due to fumes and residues from pulverized fuels.
- ✓ Requirement of water in huge quantity.
- ✓ Handling of coal and disposal of ash is quite difficult.
- ✓ Troubles from smoke and heat from the plant.
- ✓ Requires long time for erection and put into action.

9) What is nuclear fission?

In nuclear station, heavy elements such as Uranium (U235) or Thorium (Th232) are subjected to nuclear fission in a special apparatus known as reactor.

Fission:

The breaking up of nuclei of heavy atoms into two nearly equal parts with release of huge amount of energy is known as nuclear fission.

10) What are the components of nuclear reactor?

The nuclear reactor consists of the following basic components

- Reactor core
- Moderator
- Control rods
- Coolant
- Reflector
- Thermal shielding
- Reactor vessel
- Biological shield.

11) What are the merits of nuclear power plants?

The advantages are

- ✓ The amount of fuel required is small; therefore, there is no problem of transportation, storage etc.
- ✓ The demand for coal, oil and gas is reduced which are tending to rise in cost as the stocks are becoming depleted.
- ✓ These plants need less area as compared to any other plant. A 2000MW nuclear plant needs 80 acres whereas thermal stations need about 250 acres of land.
- ✓ Most economical in large capacity.
- ✓ The operating cost is quite low and once the installation is completed, the loading of the plant is always operated as a base load plant.

12) What are the advantages of MHD generation?

The advantages are

- ✓ The conversion efficiency is around 50% to 60%.
- ✓ No moving part, so more reliable.
- ✓ Capital cost is less compared with conventional steam plants.
- ✓ Overall generation cost is less.
- ✓ Economic and reduced fuel consumption.
- ✓ The closed cycle system produces power free of pollution.
- ✓ Elimination of energy losses.

13) What is solar cell?

The solar cells operate on the principle of photo voltaic effect, which is a process of generating an emf as a result of the absorption of ionizing radiation.

It is possible to convert solar energy directly into electrical energy by means of silicon wafer photo-voltaic cells, also called the solar cells, without any intermediate thermodynamic cycle.

Thus a solar cell is a transducer, which converts the sun's radiant energy directly into electrical energy and is basically a semi-conductor diode capable of developing a voltage of 0.5-1 volts and a current density of 20-40 mA/sq.cm depending on the materials used and the conditions of sunlight.

14) What are the types of collectors used in solar power generation?

Types of collectors

- Flat plate collectors(60°C)
- Focusing or concentrating collectors
  - Cylindrical parabolic concentrator (100-200°C)
  - Paraboloids, Mirror Arrays(<200°C)

15) What is the basic principle of wind power generation?

Winds are essentially caused by the solar heating of the atmosphere. They carry enormous quantity of energy. Wind as a source of power is very attractive because it is plentiful, inexhaustible, renewable and non-polluting. There is no depletion of scarce resources. In large portion of the world, wind blows for 320 days in a year and this gives them an advantage over sunlight in direct conversion programmes, operating cost of a wind mill is negligible. Further, it does not impose extra burden on the environment.

The ideal maximum efficiency using Froud momentum theory is equal to 59% but an overall efficiency of 30% could be had due to aerodynamic and other mechanical losses. This gives a power of about 0.3KW/sq.m for a wind velocity of 10m/s.

16) What is tide?

TIDE is a periodical rise and fall of the water level of sea which are carried by the action of the sun and moon on the water of the earth.

The main feature of the tidal cycle is the difference in water surface elevations at the high tide end, the tidal energy can be converted into electrical energy by means of a generator.

17) What is the function of moderator in nuclear power plant?

- ✓ A nuclear reactor is a cylindrical stout pressure vessel and houses fuel rods of Uranium, moderator and control rods. The fuel rods constitute the fission material and release huge amount of energy when bombarded with slow moving neutrons.
- ✓ The moderator consists of graphite rods which enclose the fuel rods. The moderator slows down the neutrons before they bombard the fuel rods.

18) What are the merits and demerits of tidal power generation?

The advantages of tidal power are

- It is free from the problems of uprooting the people and disturbing the ecology balance.
- It is everlasting and is not influenced by the charging mood of the nature such as failure of the monsoon.
- No extra submerging of land is involved.

The major drawback of tidal power plants is their uneven operation. Variations in the tidal energy available through the lunar day and lunar month different from their solar counterparts prevent the tidal power from being regularly used in power systems during the periods of peak demand.

19) What is thermal efficiency?

The ratio of heat equivalent of mechanical energy transmitted to the turbine shaft to the heat of combustion of coal is known as Thermal efficiency of Steam power station.

20) What are the types of wind mills?

Wind energy conversion system are classified into two types,

i) Horizontal axis wind mills

The axis of rotation is horizontal and in the aero turbine, plane is vertical facing the wind.

ii) Vertical axis wind mills

The axis of rotation is vertical, the blades also be vertical.

UNIT-2
CONSERVATION

21) What do you mean by Economics of power generation?

The art of determining the per unit i.e. one KWh cost of production of electrical energy is known as Economics of power generation.

22) Explain the term depreciation.

The decrease in the value of the power plant equipment and building due to constant use is known as depreciation.

In practice, every power station has a useful life ranging from fifteen to thirty years. From the time the power station is installed, its equipment steadily deteriorates due to wear and tear so that there is a gradual reduction in the value of the plant. This reduction in the value of plant every year is known as annual depreciation.

23) Define load factor.

Load factor is the ratio of average demand to the maximum demand during a certain period of time and is applicable to both generating equipment and receiving equipment.

$$\text{Load factor} = \frac{\text{Average demand}}{\text{Maximum demand}}$$

24) What is load curve?

The curve showing the variation of load on the power station with reference to time is known as a load curve.

The load curves supply the following information

- ✓ The variation of the load during different hours of the day.
- ✓ The area under the curve represents the total number of units generated in a day.
- ✓ The peak of the curve represents the maximum demand on the station on the particular day.
- ✓ The area under the load curve divided by the number of hours represents the average load on the power station.
- ✓ The ratio of the area under the load curve to the total area of the rectangle in which it is contained gives the load factor.

25) Define diversity factor.

Diversity factor is defined as the state of being dissimilar to one another. It is defined as the ratio of sum of the maximum demands of individual consuming units in a group during a specified period to the maximum demand of the whole group during the same period.

$$\text{Diversity factor} = \frac{\text{Sum of individual demands of different units in a group}}{\text{Maximum demand of the entire group}}$$

The value of diversity factor is always greater than one. If the diversity factor is higher, the cost per unit of generation will be lesser.

26) What do you mean by utilisation factor?

It is a measure of the utility of the power plant capacity and is the ratio of maximum demand to the rated capacity of the power plant. It is always less than unity.

$$\text{Utilisation factor} = \frac{\text{Maximum Demand on the power station}}{\text{Rated capacity of the power station}}$$

A low value of utilisation factor indicates that the plant has been installed much in advance of need. A high value indicates that the plant is probably most efficient in the system. If its value exceeds unity, it means that the load has been carried in excess of rated capacity of the plant.

27) Write short note on load duration curve?

When the load elements of a load curve are arranged in the order of descending magnitudes, the curve thus obtained is called load duration curve.

The load curve is obtained from the same data as the load curve but the ordinates are arranged in the order of descending magnitudes. In other words, the maximum load is represented to the left and decreasing loads are represented to the right in the descending order. Hence the area under the load duration curve and the load curve are equal.

or and diversity factor.

Load factor and diversity factor play a vital role in the cost of the supply of electrical energy. Higher the values of load factor and diversity factor, lower will be the overall cost per unit generated.

28) Write the significance of load factor?

Higher load factor means greater average load, resulting in greater number of units generated for a given maximum demand. Thus, the standing charges, which are proportional to maximum demand and independent of number of units generated, can be distributed over a large number of units supplied and therefore overall cost per unit of electrical energy generated will be reduced.

29) What is mean by base load?

The unvarying load which occurs almost the whole day on the station is known as base load.

30) What are the methods for determining depreciation charges?

The decrease in the value of the power plant equipment and building due to constant use is known as depreciation. The cost of depreciation will depend on the size and type of equipment and on its estimated life.

The reduction in the value of the plant every year is known as annual depreciation. Due to depreciation the plant has to be replaced by new one after its useful life. Therefore a suitable amount must be set aside every year, so that by the time the plant retires the collected amount by way of depreciation equals the cost of equipment.

The methods commonly used for determination of annual depreciation charges are

- Straight line method
- Diminishing value method and
- Sinking fund method.

31) What are the objectives of tariff?

Electrical energy is sold at such a rate so that it not only returns the cost but also earns reasonable profit. Therefore, a tariff must cover the following items:

- Recovery of cost of capital investment in generating, transmitting and distributing equipment.
- Recovery of cost of operation, supplies and maintenance of equipment.
- Recovery of cost of metering equipment, billing, collection costs etc.
- A satisfactory return on the total capital investment.

32) Define energy audit.

Energy Audit means studying the energy consumption pattern in the utilities or equipments by obtaining necessary data analyse the same to identify the areas where wastages or loses occur and suggest methods to

avoid wastages or loss and also other consumption measures to ensure efficient use of energy.

33) What are the causes of low power factor?

The following are the causes of low power factor

- ✓ Most of the a.c motors are of induction type which have low lagging power factor. These motors work at a power factor which is extremely small on light load 0.2 to 0.3 and rises to 0.8 to 0.9 at full load.
- ✓ Arc lamps, electric discharges lamps and industrial heating furnaces operate at low lagging power factor.
- ✓ The load on the power system is varying, being high during morning and evening and low at other times. During low load period, supply voltage is increased which increases the magnetization current. This results in the decreased power factor.

34) Define the term connected load factor.

It is the sum of the continuous rating in KW of all electrical devices installed at the consumer's premises and connected to the supply system.

35) What are the important points to be taken into consideration while selecting the size and number of units?

- ✓ The load on a power station is never constant due to variable demands from time to time. The nature of these demands can be seen from the load curve. The load variation is greater with a poorer load factor.
- ✓ The selection of the number and sizes of the units is decided from the annual load curve of the station. The number and size of the units are selected in such a way that they correctly fit the station load curve.
- ✓ The capacity of the plant should be made 15% to 20% more than the maximum demand to meet the future load requirements. There should be a spare generating unit so that repairs and overhauling of the working units can be carried out.

ILLUMINATION, HEATING AND WELDING

36) Define luminous flux.

It is defined as the total quantity of light energy emitted per second from a luminous body. It is represented by symbol F and is measured in lumens. The conception of luminous flux helps us to specify the output and efficiency of a given light source.

37) What is meant by candle power?

It is defined as the number of lumens given out by the source in a unit solid angle in a given direction. It is denoted by CP.

$$CP = \frac{\text{lumens}}{\omega}$$

38) Define MHCP.

The mean of candle power in all directions in the horizontal plane containing the source of light is termed as Mean Horizontal Candle Power.

39) Define utilisation factor.

It is defined as the ratio of total lumens reaching the working plane to total lumens given out by the lamp.

$$\text{Utilisation factor} = \frac{\text{Total lumens reaching the working plane}}{\text{Total lumens given out by the lamp}}$$

40) What are the laws of illumination?

Law of Inverse Squares:

Illumination at appoint is inversely proportional to square of its distance from the point source and directly proportional to the luminous intensity (CP) of the source of light in that direction.

If a source of light emits light equally in all directions be placed at the centre of a hollow sphere, the light will fall uniformly on the inner surface of the sphere. If the sphere be replaced by one of the larger radius, the same total amount of light is spread over a larger area proportional to the square of the radius.

Lambert's cosine law:

The illumination at a point on a surface is proportional to cosine of the angle which ray makes with the normal to the surface at that point.

41) What is meant by luminance?

It is defined as the luminous intensity per unit projected area of either a surface source of light or a reflecting surface and is denoted by L.

42) Define space-height ratio.

It is defined as the ratio of horizontal distance between adjacent lamps and height of their mountings.

$$\text{Space-height ratio} = \frac{\text{Horizontal distance between two adjacent lamps}}{\text{Mounting height of lamps above working plane}}$$

43) What is polar curve?

In most lamps or sources of light the luminous intensity is not the same in all directions. If the luminous intensity, i.e. the candle power is measured in a horizontal plane about a vertical axis and a curve is plotted between candle power and the angular position, a curve is obtained is called as horizontal polar curve.

The luminous intensity in all the directions can be represented by polar curves. If the luminous intensity in a vertical plane is plotted against the angular position, a curve known as vertical polar curve is obtained.

44) Name the various photometer heads.

1. Bunsen Head (or) Grease spot photometer
2. Lummer-Brodhun photometer head

There are two types of Lummer Brodhun heads

a) Equality of Brightness type photometer head
b) Contrast type photometer head

45) What are all the sources of light?

According to principle of operation the light sources may be grouped as follows.

- ✓ Arc lamps
- ✓ High temperature lamps
- ✓ Gaseous discharge lamps
- ✓ Fluorescent type lamps

46) What is stroboscopic effect of fluorescent tubes?

With a.c. supply frequency of 50 cycles per second, discharge through the lamp becomes zero, 100 times in a second. Due to the persistence of vision, our eyes do not notice this. If this light falls on moving parts, they may appear to be either running slow or in the reverse direction or even may appear stationary. This effect is called stroboscopic effect.

47) Define beam factor.

The ratio of lumens in the beam of a projector to the lumens given out by lamps is called the beam factor. This factor takes into account the absorption of light by reflector and front glass of the projector lamp. Its values vary from 0.3 to 0.6.

48) Mention the types of lighting schemes.

The distribution of the light emitted by lamps is usually controlled to some extent by means of reflectors and translucent diffusing screens or even lenses. The interior lighting schemes may be classified as

- Direct lighting
- Semi-direct lighting
- Indirect lighting
- Semi-indirect lighting
- General lighting

49) What are the drawbacks of discharge lamps?

Drawbacks of discharge lamps:

- Take time to attain full brightness.
- High initial cost and poor power factor.
- Starting requires trigger-starter.
- Light output fluctuates at twice the supply frequency. The flicker causes stroboscopic effect.
- These lamps can be used only in particular position.

50) What are the requirements of lighting system/

The following factors are required to be considered while designing the lighting scheme.

- ✓ Illumination level
- ✓ Uniformity of illumination
- ✓ Colour of light
- ✓ Shadows
- ✓ Glare
- ✓ Mounting height
- ✓ Spacing of luminaries
- ✓ Colour of surrounding walls.

51) What are the advantages of electric heating?

The main advantages of electric heating over other systems of heating such as coal, oil or gas heating are given below.

- Economical
- Cleanliness
- Absence of flue gases
- Ease of control or adaptation
- Automatic protection
- Upper limit of temperature
- Special heating features
- High efficiency of utilisation
- Better working conditions
- Safety
- Heating of non-conducting materials

52) Classify the methods of electric heating.

Kinds of electric heating

A. Power frequency heating

a. Resistance heating

i) Direct resistance heating

ii) Indirect resistance heating

iii) Infrared or Radiant heating

b. Arc heating

i) Direct arc heating

ii) Indirect arc heating

B. High frequency heating

a. Induction heating

i) Direct induction heating

ii) Indirect induction heating

b. Dielectric heating

53) What is meant by indirect resistance heating?

- ✓ In this method, the current is passed through a high resistance wire known as heating element. The heat produced due to I2 R loss in the element is transmitted by radiation or convection to the body to be heated.
- ✓ Applications are room heaters, in bimetallic strip used in starters, immersion water heaters and in domestic and commercial cooking and salt bath furnace.

54) What are the properties of heating element material?

The material of the heating elements should posses the following desirable properties for efficient operation and long life.

High resistivity: It should have high specific resistance so that the overall length to produce a certain amount of heat may be smaller.

High melting point: It should have high melting point so that high temperatures can be produced without jeopardizing the life of the element.

Free from oxidation: It should be able to resist oxidation at high temperatures, otherwise its life will be shortened.

Low temperature coefficient: It should have a low temperature coefficient so that resistance remains appreciably constant even with increases of temperature. This helps in accurate control of temperature.

55) What are the causes of failure of heating elements?

Principle causes are

- ✓ Formation of hot spots
- ✓ General oxidation of the element and intermittency of operation
- ✓ Embrittlement caused by grain growth
- ✓ Contamination of element or corrosion

56) Write short note on infrared heating.

In radiant heating, the elements are of tungsten operating about 2300°C as at this temperature a greater proportion of infra-red radiation is given off.

Heating effect on the charge is greater since the temperature of the heating element is greater than in the case of resistance heating. Heat emission intensities up to 7500 watts/sq.m can be obtained leading to heat absorption up to 4300 watts/sq.m. This reduces the time taken by various drying process.

57) What is the basic principle of induction heating?

It works on the principle of electromagnetic induction as same as a transformer. It has a metal disc surrounded by a copper coil in which a.c supply is flowing. The disc has a finite value of diameter and thickness and

is spaced a given distance from the coil and concentric to it. We find that a secondary current is caused to circulate around the outer surface of the disc.

58) What are the different types of resistance welding?

The different types are as follows

- Butt welding
- Spot welding
- Projection welding
- Seam welding
- Percussion welding

59) Compare DC welding and AC welding.

Sl.no	Factors	D.C welding	A.C welding
1.	Equipment	Motor-generator set or rectifier is required in case of availability of a supply; otherwise oil generator set is required.	Only a transformer is required.
2.	Prime Cost	Two or three times of transformer.	Comparatively low
3.	Operating efficiency	Low	High 85%
4.	No-Load voltage	Low	Too high
5.	Power factor	High	Low
6.	Heating	Uniform heating	Non-uniform heating
7.	Arc stability	Higher	-
8.	Arc blow	Pronounced	Not so pronounced with a.c

60) What is LASER welding?

LASER (Light Amplification by Stimulated Emission of Radiation) welding is a welding process that uses the heat from a laser beam impinging on the joint. The process is without a shielding gas and pressure.

UNIT-4
ELECTRIC TRACTION

61) What are the requirements of an ideal traction system?

The requirements of an ideal traction system are as follows

- ✓ The starting tractive effort should be high so as to have rapid acceleration.
- ✓ The wear on the track should be minimum.
- ✓ Pollution free
- ✓ Speed control should be easy.
- ✓ The equipment should be capable of withstanding large temporary loads.
- ✓ Low initial and maintenance cost.
- ✓ There should be no interference to the communication lines running along the lines.
- ✓ Braking should be such that minimum wear is caused on the brake shoes.

62) Name the various systems of traction.

1. Direct steam engine drive
2. Direct Internal Combustion Engine Drive
3. Steam Electric Drive
4. Internal Combustion Engine Electric Drive
5. Petrol Electric traction
6. Battery Electric Drive
7. Electric Drive

63) Classify the supply system for electric traction.

A. D.C system

B. A.C system

i) Single phase

ii) Three phase

C. Composite system

i) Single phase AC-DC

ii) single phase-Three phase

64) What are the advantages of electric traction?

- ❖ High starting torque
- ❖ Less maintenance cost
- ❖ Cheapest method of traction

- ❖ Rapid acceleration and braking
- ❖ Less vibration
- ❖ Coefficient of adhesion is better
- ❖ It has great passenger carrying capacity at higher speed.

65) What are the disadvantages of electric traction?

- High capital cost
- Problem of supply failure
- Additional equipment is required for achieving electric braking and control
- The leakage of current from the distribution mains and drop of volts in the track are to be kept within the prescribed limits.
- The electrically operated vehicles have to move on guided track only.

66) What is meant by speed-time curve? Why it is used?

The movement of the train and their energy consumption can be studied by means of speed-time and speed-distance curves, which shows the speed at different time instants after start of run and speed at different distances from the starting point respectively. Of the two, the speed-time curve is generally used.

The curve drawn between speed in Kw/hr along Y-axis and time in seconds along X-axis is called speed=time curve. The speed-time curve gives the complete information about the motion of the train.

This curve gives the speed at various time instants after the start of run directly. Slope of the curve at any point gives the speed at that instant. The area under the curve gives the total distance traveled by the train.

67) What do you mean by average speed in electric traction?

The mean of the speeds from the start to stop i.e the distance between two stops divided by the actual time of run is known as average speed.

$$\text{Average speed} = \frac{\text{Distance between stops in km}}{\text{Actual time of run in hours}}$$

68) What do you mean by schedule speed in electric traction?

The ratio of distance covered between two stops and total time of run including time of stop is known as schedule speed.

$$\text{Schedule speed} = \frac{\text{Distance between stops in km}}{}$$

Actual time of run in hours+ Stop time in hours

The schedule speed is always smaller than the average speed. The difference is large in case of urban and suburban services and is negligibly small in case of main line service.

69) What is tractive effort?

The effective force necessary to propel the train at the wheels of the locomotive to which the motor is geared is called the geared effort. It is measured in Newtons and is tangential to the driving wheels.

Total tractive effort required to run a train on track

= Tractive effort to produce acceleration +
Tractive effort to overcome effect of gravity +
Tractive effort to overcome train resistance.

70) What are the factors affecting energy consumption?

The various factors affecting energy consumption are

(i) Distance between the stops

The greater the distance between the stops, the lesser will be the specific energy consumption for suburban service is 50 to 75 watts-hour/ ton-km and for main line service it is between 18 to 32 watt-hour/ton-km.

(ii) Train resistance

The train resistance depends upon the nature of track, speed of the train and shape of the rolling stock, particularly the front and rear portions of the train. If the train resistance is greater, the specific energy consumption is more.

(iii) Acceleration and retardation

If the acceleration and retardation increases, the specific energy consumption is increased.

(iv) Gradient

The steep gradients will involve more energy consumption though regenerative braking is applied.

(v) Train equipment

More efficient train equipment will reduce the specific energy consumption.

71) Define dead weight, adhesive weight.

(i) Dead weight

The total weight of locomotive and train to be pulled by the locomotive is known as dead weight.

(ii) Adhesive weight

The total weight to be carried on the driving wheels is known as the adhesive weight.

72) Name the various methods of traction motor control.

There are various methods for controlling the speed of d.c series motors. They are

- ✓ Rheostatic control
- ✓ Series parallel control
- ✓ Field control
- ✓ Buck and Boost method
- ✓ Metadyne control
- ✓ Thyristor control

73) What are the basic requirements of braking system?

The basic requirements of a braking system are given below

- It should be simple, robust, quick and reliable in action.
- Easy to use for driver to operate.
- Maintenance should be minimum.
- The braking system should be inexhaustible.
- In case of emergency braking, safety consideration is taken into account.
- Kinetic energy of the train must be storable during braking which could be used subsequently during acceleration of the train.

74) What are the various methods of applying electric braking?

There are three methods of applying electric braking are

- Plugging or Reverse current braking
- Rheostatic braking
- Regenerative braking.

75) Name the advanced methods of speed control of traction motors.

The latest methods of speed control of traction motors are

- ❖ Tap changer control
- ❖ Thyristor control

- ❖ Chopper control
- ❖ Microprocessor control

76) What are the advantages of microprocessor based control of traction motors?

The advantages of microprocessor based drives are

- ✓ High speed of response
- ✓ High accuracy
- ✓ Over voltage and over speed protection.
- ✓ Electronic interlocking
- ✓ Less sensitive to temperature variations and drift.
- ✓ Numbers of components used are less.

UNIT-5
DRIVES AND THEIR INDUSTRIAL APPLICATION

77) What is meant by electrical drives?

Systems employed for motion control are called "DRIVES" and drives employ any of the prime movers such as, diesel or petrol engines, gas or steam turbines, hydraulic motors and electric motors for supplying mechanical energy for motion control. Drives employing electric motion known as "Electric Drives".

78) Mention the parts of electrical drives?

- Electric motors and load
- Power modulator
- Sources
- Control unit
- Sensing unit

79) Mention the application of electric drives?

- Paper mills
- Electric traction
- Cement mills
- Steel mills.

80) Mention the different types of classes of duty?

- Continuous duty
- Discontinuous duty

- Short time duty
- Intermittent duty

81) Define equivalent current method.

The motor selected should have a current rating more than or equal to the current. It is also necessary to check the overload capacity of the motor. This method of determining the power rating of motor is known as the equivalent current method.

82) What are the three methods of operation of electric drive?

- Steady state
- Acceleration including starting
- Decceleration including stopping.

83) Define four-quadrant operation?

A motor operate in two modes, motoring and braking. In motoring, it converts electrical energy into mechanical energy, which supports its motion. In braking it works as a generator converting mechanical energy into electrical energy and thus, opposes the motion. Motor can provide motoring and braking operations for both forward and reverse directions.

84) Mention the types of braking?

- Regenerative braking
- Dynamic braking
- Plugging

85) Define and mention different types of braking in a dc motor?

In braking, the motor works as a generator developing a negative torque which opposes the motion. Types of regenerative braking are Dynamic (or) Rheostat braking; and plugging (or) reverse voltage braking.

86) List the drawbacks of armature resistance control?

In armature resistance control, speed is varied by wasting power in external resistors that are connected in series with armature. Since it is an inefficient method of speed control, it was used in intermittent load

application where the duration of low speed operation forms only a small proportion of total running time.

87) Mention the methods of armature voltage control dc motor?

When the supply voltage is ac

i) Ward-Leonard schemes

ii) Transformer with taps and uncontrolled rectifier bridge

iii) Static Ward-Leonard scheme (or) controlled rectifiers

When the supply is dc

i) Chopper control

88) What are the disadvantages of conventional ward-Leonard schemes?

- Higher initial cost due to use of two additional machines.
- Large weight and size.
- Needs more floor space and proper foundation.
- Required frequent maintenance.
- Higher noise and higher loss.

89) Mention the drawbacks of rectifier fed dc drives?

- Distortion of supply
- Low power factor
- Ripple in motor current

90) What are the different methods of speed control of induction motors?

- Stator voltage control
- Supply frequency control
- Rotor resistance control
- Slip power recovery control

91) What is meant by stator voltage control?

The speed of the induction motor can be changed by changing the stator voltage. Because the torque is proportional to square of the voltage.

92) Mention the applications of stator voltage control?

The stator voltage control method is suitable for applications where torque demand reduced with speed, which points towards its suitability for

i) Fan ii) Pump drives

93) Mention the applications of AC drives?

AC drives are used in a number of applications such as fans, blowers, mill run-out tables, cranes, conveyors, traction etc.

94) What are the advantages of stator voltage control method?

- The control circuitry is simple
- Compact size
- Quick response time
- There is considerable savings in energy and thus it is economical method as compared to other methods of speed control.

95) What are the features of variable frequency control?

- ✓ Speed control and braking operation are available from zero speed to above base speed.
- ✓ Drop in speed from no load to full load is small.
- ✓ Copper losses are low. Hence efficiency and power factor are high as the operation is restricted between synchronous speed and maximum torque point at all frequencies.
- ✓ During transient (starting, braking and speed reversal) operation can be carried out at the maximum torque with reduced current giving good dynamic response.

96) What is meant by frequency control of induction motor?

The speed of the induction motor can be controlled by changing the supply frequency, because the speed is directly proportional to supply frequency. This method of speed control is called frequency control.

97) What is meant by V/F control?

When the frequency is reduced, the input voltage must be reduced proportionally so as to maintain constant flux. Otherwise the core will get saturated resulting in excessive iron loss and magnetizing current. This type of induction motor behaviour is similar to the working of dc series motor.

98) What is meant by regenerative braking?

Regenerative braking occurs when the motor speed exceeds the synchronous speed. In this case, the induction motor would runs as the induction machine is converting the mechanical power into electrical power,

which is delivered back to the electrical system. This method of braking is known as regenerative braking.

99) What is meant by dynamic braking?

Dynamic braking of electric motor occurs when the energy stored in the rotating mass is dissipated in an electrical resistance. This requires the motor to operate as a generator to convert this stored energy into electrical.

100) What is meant by plugging?

It is one method of braking of induction motor. When phase sequence of supply of the motor running at a speed is reversed, by interchanging connections of any two phases of stator with respect to supply terminals, operation shifts from motoring to plugging region.