UNIT-1

1. Define light.

Light is defined as that radiant energy in the form of waves which produces a sensation of vision upon the human eye.

2. Define luminous flux.

Luminous flux is defined as the energy in the form of light waves radiated per second from a luminous body.(eg.: incandescent lamp).

3. Define luminous intensity.

Luminous intensity is defined as the flux emitted by the source per unit solid angle.

4. Define light energy.

- It is the energy obtained in visual radiations in a given time
- It is expressed in lumen – hour.
- It is denoted by Q.

5. Define radiant efficiency.

It is defined as the ration of energy radiated in the form of light to the total energy radiated by the body.

$$\text{Radiant efficiency} = \frac{\text{Energy radiated in the form of light}}{\text{Total energy radiated by the body}}$$

6. Define luminous efficiency.

It is defined as the output in lumens per watt of the power consumed by thee source of light. It is measured in lumens per wattage.

$$\text{Luminous efficiency} = \frac{\text{Lumens emitted by the source}}{\text{Wattage of source per light}}$$

7. Define plane angle.

When two straight lines lying in the same plane meet at a point, there will be an angle between these converging lines at the meeting point. This angle is termed as plane angle .In the above figure the angle AOB is the plane angle.

Unit of plane angle is radians.

$$\text{Plane angle} = \frac{\text{Arc}}{\text{Radius}}$$

8. Define solid angle.

The angle subtended at a point in space by an area is termed as solid angle.

In plane angle it is the area which is enclosed by two lines, but in case of solid angle. It is the Volume enclosed by numerous lines lying on the surface and meeting at a point.

Solid angle is denoted by ω.

Unit of solid angle is steradian.

$$\text{Solid angle} = \frac{\text{Area}}{(\text{Radius})^2}$$

9. Define lumen. (April/May 2005)

It is a unit of flux and is defined as the luminous flux per unit angle from a source of one candle power.

Lumens = Candle power X Solid angle.

= C.P. X ω.

The total flux emitted by the source of 1 C.P. is 4π lumens.

10. Define candle power.

Candle power is the light rendering capacity of a source in a given direction and is defined as the number of lumens given out by the source in a unit solid angle in a given direction.

$$C.P. = \frac{\text{Lumens}}{\omega}$$

11. Define illuminance (or) illumination (or) Degree of illumination.

When the light falls on a surface it is illuminated. The illuminance is defined as the luminous flux received per unit area.

Illuminance is denoted by the symbol E and is measured in lumens/m^2

or lux or metre-candle.

12. Define foot candle.

It is illumination produced by a uniform source of one CP on the inner surface of sphere of one foot radius.

1 foot candle = 1 lumens/ft^2

15. Define lux. (April/May 2005)

It is a metre candle and is defined as the illumination of the inside of the sphere of radius 1 metre at the center of which there is a source of 1 CP.

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13. Define mean horizontal candle power.

The mean horizontal candle power of a souce of a light is the mean or average of the candle power in all directions on horizontal plane which passes through the source.

14. Define mean spherical candle power.

The mean spherical candle power of a source of light is the mean or average of the candle power in all directions in all the planes.

15. Define mean hemispherical candle power.

The mean hemispherical candle power of a source of light is the mean or average of the candle power in all directions within the hemisphere either above the horizontal plane or below the horizontal plane.

16. Define reduction factor.

Reduction factor of a source of light is defined as the ratio of its mean spherical candle power to its mean horizontal candle power.

Reduction factor = M.S.C.P / M.H.C.P.

17. Define reflection factor (or) Co efficient of reflection (or) reflection ratio.

It is defined as the ratio of the ratio of reflected light to the incident light. It is always less than unity.

$$\text{Reflection factor} = \frac{\text{Reflected light}}{\text{Incident light}}$$

18. Define candela.

It is the unit of luminous intensity. It is defined as $1/60^{th}$ of the luminous intensity per cm^2 of a black body radiator at the temperature of solidification of platinum (2043k).

19. Define lamp efficiency.

Lamp efficiency is defined as the ratio of luiminous flux to the power input. It is expressed in lumens/watt.

20. Define brightness.

It is defined as the flux emitted per unit area or the luminous intensity per unit projected area of the source in a direction perpendicular to the surface.

21. What are the laws of illumination.

1. Inverse square law.

2. Lambert's cosine law.

22. State Inverse square law

The illumination of a surface is inversely proportional to the square of the distance of the surface from the souce of light. This is true only if the source is a point source.

23. State Lambert's cosine law.

The illumination is proportional to the souce of angle between the normal and the line of flux.(OR)

The illumination of a surface at any point is dependent upon the cube of cosine of angle between the line of flux and the normal at the point.

24. What are the polar curves?

The luminous flux emitted by a source can be determined from the intensity distribution curve. The luminous intensity or candle power of a practical lamp is not uniform in all directions due to its unsymmetrical shape. The distribution of light is given by polar curves.

25. What are the uses of Rousseau's construction?

The mean spherical candle power of a symmetrical source of light can be found out from the polar curve by means of Rousseau diagram.

26. Define utilization factor in the design of the lighting scheme.

Utilization factor is defined as total lumens utilized on working plane to the total lumens radiated by lamp.

27. Define depreciation factor.

Depreciation factor is defined as , illumination under normal working condition to illumination when everything is clean. So this occurs when the source is not clean.(eg. lamps covered with dust, dirt or smoke).

28. State the different lighting schemes.

Depending upon the requirement of light the lighting schemes can be classified as follows.

i) Direct lighting

ii)Indirect lighting

iii)Semi-direct lighting

iv)Semi- indirect lighting

v) General diffusing system

29.Write the Stephen law of radiation.

$H = 5.72 \times 10^4 Ke [(T1/1000)^4 - (T2/1000)^4] w/m^2$

where , K is a constant known as radiating efficiency.

Thus Stephen derived relationship between the heat transmitted and the difference of temperature.

Here H represents amount of heat transmitted.

30.What are advantages of dielectric heating?

i)Possibility of applying accurate quantity of heat.

ii)Increase in production

iii)High uniformity and quality of the products.

iv)Improvement in working condition.

v)Limited space requirement

vi)Easy maintenance.

31.What are the applications if Arc furnaces?

i)It is suitable for non-ferrous castings of copper, Bronze, Gun metal, Nickel alloys etc.

ii)High melting point

iii)Low metal losses

iv)Very high temperatures of heat.

32.Mention any two advantages of electric heating.

i)Cleanliness

ii)Absence of flue gases

iii)Easy of control

iv)Cheap furnaces.

33.Name the uses of dielectric heating.

i)For baking foundry cores

ii)For food processing

iii)For wood processing industry.

34.Name the uses of induction heating.

i)Surface hardening

ii)Deep hardening

iii)Tempering

iv)soldering

v)Melting.

35.Name the different types of electric welding.

i)Electric arc welding

ii)Electric resistance welding

iii)electron beam welding.

36.Where is spot welding employed?

Spot welding is usually employed for joining or fabricating sheet metal structure.

37.Where is carbon arc welding employed?

Carbon arc welding is usually employed in welding copper metal and its alloys.

38.What are the advantages of flash butt welding?

i) Power requirement is less

ii)No speed attention is to be paid to the surfaces being joined

iii)All the foreign metals appearing on the joining surfaces will be burnt due to flash, thus the weld obtained is clean and pure.

39.Distinguish between Butt welding and spot welding.

S.No	Butt Welding	Spot Welding
1.	There is no mechanical Force required.	Mechanical force is required .
2.	Only two joints are heated up.	Here three joints are to be heated. Hence excessive energy is needed.

40.State different types of arc welding.

i)Electric arc welding

ii)Metal arc welding

iii)Helium or Argon arc welding.

iv)Carbon arc welding

v)Submerged arc welding.

41.State different types of electric arc welding.

i)Metal arc welding

ii)Inert arc welding

iii)Carbon arc welding

iv)Atomic hydrogen arc welding.

42.What are the two types of Butt welding?

i)Upset butt welding

ii)Flash butt welding.

43.What are the various types of electric resistance welding?

i)spot welding

ii)Projection welding

iii)Seam welding

iv)Butt welding

44.What are the advantages of coreless induction furnaces?

i)It takes lesser amount of time to reach the melting temperature.

ii)Its erection cost is low.

45.State the difference between core type and coreless type induction furnaces.

S.No	Core type	coreless type
1.	The leakage reactance is very high.	No leakage reactance
2.	Crucible of any shape can be used.	Standard form is used
	Operation cost is high.	
3.		Operation cost is low

46.What are the advantages of Ajax Wyatt furnace?

i)Good operating conditions for the refractory lining, no part of the furnace being hotter than the metal itself.

ii)Accurate temperature control, uniform castings, minimum metal losses and reduction of rejects.

47.What is the principle of arc furnace?

When voltage across two electrodes separated by an air gap is increased, a stage is reached when voltage gradients in the air gap is such that air in the gap becomes good conductor of electricity. Arc is said to exist when current passes through air gap.

48.Why Nichrome element is used as a heating element in a resistance oven?

This type of element is used for high temperature in the oven. It contains 80% Ni and 20% Chromium.

49.What are the uses of electric arc welding?

i)Both ac and dc supply can be used, So it can be performed on single operator sets.

ii)It is non pressure welding because no mechanical pressure is employed.

50. Give two applications of dielectric heating.

i)Synthetics -Dielectric heating is most suitable for pressed synthetic goods.

ii)Wood processing industries - Dielectric heating has been usefully employed in wood industry.

51.What are the advantages of dielectric haeating?

i)This method of heating non conducting material in very speedy.

ii)Normally material heated by this method are combustible which cannot be heated by the flame.

52.What are the methods of controlling the temperature of resistance ovens?

i)Varying the number of elements

ii)Adding variable external resistance in series with the element

iii)Changing transformer tappings.

53.What are the advantages of electric heating?

There are enormous advantages of electric heating over hte other systems and they are

i)Economical

ii)High efficiency of utilization

iii)Cleanliness

iv)Absence of flue gases

v)Ease of control.

54.Write any two reasons for the failure of heating element. (May/June 2006)

Reasons for failure of heating elements are

i)Formation of hot spots

ii)Oxidation of element and intermittent operation

iii)Embrittlement due to grain growth

iv)Contamination of element.

12 Mark Questions:

1.i) State the types of electric lamps used for illumination in different applications.(B1 4.24)

ii) Draw the circuit diagram of low-pressure discharge tube used as light source. Explain the operating principle of this device. (B1 4.18)

2.i) Distinguish between MHCP and MSCP. (B1 4.8)

ii) Explain the operating principle of anyone type of photometer. (B1 4.11)

iii) Draw the circuit diagram of high - pressure neon lamp and describe its operating principle(B2 3.27)

3. Explain the construction and working of

i) Carban arc lamp(B2 3.19)

ii)Flame arc lamp(B2 3.19)

iii) Magnetic arc lamp. (B2 3.19)

4. i) Define MSCP and luminous efficiency. (B1 4.8)

ii)When a 250 V lamp takes a current of 0.8A,it produces a total flux of 3260 lumens . Calculate a) MSCP of the lamp b)efficiency of the lamp.

5.i) What are the various types of lighting scheme? (B2 3.37)

ii) Enumerate the various factors, which have to be considered while designing lighting scheme. (B2 3.40)

6.i) Define candle power and lux. (B1 4.3)

ii) A workshop measuring 15m X 25m.,is lighted by 30 lamps of 200W, each having an efficiency of 15 lumens/watt. Assuming utilization factor of 0.5 and depreciation factor of 0.75. Find the illumination on the working plane.

7. Describe the salient features of (B1 4.35)

a) Street lighting

b) Flood lighting

8. A corridor is lighted by lamps spaces 9.15m apart and suspended at a height of 4.575m above the centerlines of the floor. If each lamp gives 100 candle power in all directions below the horizontal . Find the maximum and minimum value of the illumination on the floor along the centerline.

9. A hall 30 metre long and 12 metre wide is to be illuminated and illumination required is 50 meter candles. compute the number, wattage, location and mounting height of lamps. Depreciation factor = 1.3 and utilization coefficient = 0.5. Light output of different lamps are given below.

Watts	100	200	300	500	1000
Lumens	1615	3650	4700	9950	21500

10. i) Explain the construction and working of a sodium vapour lamp.(B1 4.21) (April-2005)

ii) A lamp giving out 1200 lumens in all directions is suspended 8m above the working plane. Calculate the illumination at a point on the working plane 6m away from the foot of the lamp.

11. i) Write short note on flood lighting. (B1 4.36)

ii) It is required to provide an illumination of 100m. Candle in a factory hall 40m X 10m. Assume the depreciation factor as 0.8 and co efficient of utilization as 0.4 and efficiency of lamp as 14 lumens per watt. Calculate the number of lamps and their disposition.

12.i) A 250V lamp takes a current of 1A and produces a total flux of 4000 lumens. Determine the MSCP of the lamp and the efficiency of the lamp.

ii) Enumerate the various factors to be considered in designing a flood lighting installation.

13. Describe with a simple sketch the construction, operation and applications of sodium vapour lamp. (B2 3.45)

14. Draw schematic diagram of low pressure mercury vapour fluorescent lamp and explain the operation of the lamp. State the relative merits of this lamp. (B1 4.20)(May/June 2009)

15. A room measuring 10m X 10m is to be illuminated by 5 lamps. The average illumination required is 40 lumens per square metre. Utilization factor = 0.5 and depreciation factor = 1.2. Compute MSCP OF EACH lamp.

16. A lamp of 300 CP is hung at the center of a room 8m X 6m at a height of 3m from the floor. Calculate the maximum and minimum illumination produced and mention the places where it occurs.(April/May 2008)(May/ June 2009)

17. i) State the laws of illumination.(B1 4.8)

ii) It is required to provide an illumination of 100 lumen/m^2 in a workshop hall

40m X 10m. Assume that efficiency of lamp is 14 lumens/watt, coefficient of utilization is 0.4 and depreciation factor as 0.8. Calculate the number and rating of lamps and their positions when trusses are provided at mutual distance of 5m.

18. Draw the connection diagram of fluorescent tube. Explain the working principle. What are the advantages of fluorescent tube over the incandescent lamp? (B1 4.18)

19. Explain with a neat diagram the principle and operation of sodium vapour lamp. Mention its uses.(B1 4.21) (April/May 2008)

20. It is required to provide illumination of 100 lux in a workshop hall 40m X 10m and efficiency of lamp is 14 lumens per watt. Calculate the number and rating of lamps and their positions when seven trusses are provided at mutual distance of 5 meters. Take coefficient of utilization as 0.4 and depreciation factor as 0.8.

21.i)State merits of electric furnaces.(B1 3.17)

ii)Draw the diagram of arc furnace showing all the essential components including the power source. Describe the operating principle of this device. (B1 3.37)

iii)Describe the operation of high frequency dielectric heating system with relevant diagrams(B1 3.26)

22.i)Explain the principle of Butt-welding and spot welding with relevant diagrams. (B1 3.46)

` ii)Describe the characteristics of carbon and metallic arc welding(B1 3.50)

23.What are the different types of arc welding? Describe in detail(B2 3.80)

i)Metal arc welding

ii)Carbon arc welding

24.Describe i)Direct core type ii)Ajax wyalt vertical core type furnaces with neat sketches(B1 3.18)

25.Draw the neat sketch of Ajax wyalt core type induction furnace. Explain its principle of working.(B1 3.18) (May/June2006)

26.Discuss the various types of electric welding with the help of neat diagrams.

27.Explain resistance welding.What are the various methods of resistance welding? Describe any two of them. (May/June2006)(B2 3.76,3.81)

28. Derive the expression for d and l of a heating element.(April/May 2008)(B1 3.7)

B1- Electric energy generation , Utilization and Conservation- Lakshmi publications

B2-Electric energy generation,Utilization and Conservation-Charulatha Publications.

UNIT-2

1.Name the systems of traction.

The various systems of traction are

i) Direct stream engine system.

ii) Direct internal combustion engine.

iii) Internal combustion engine combined with electric drive

iv) Battery electric drive

v) Electric drive.

2.What are the advantages of direct steam engine system?

i)Initial cost is low in comparison with other systems.

ii)the haulage capacity is very high as compared with the direct engine drive and battery operated vehicles.

3. What are the disadvantages of direct steam engine system?

i)The cost of maintenance is high.

ii)the steam locomotive has limited capacity and the maximum speed that the steam locomotive can achieve is much less than an electric locomotive.

4. What are the advantages of direct internal combustion engine system?

i)The low initial cost and is a compact self contained unit.

ii)Speed control with gear arrangement is quite simple.

iii)The braking arrangement is quite simple.

5. What are the disadvantages of direct internal combustion engine system?

i)The life of the engine is comparatively shorter.

ii)The overload capacity is limited on account of its speed-torque characteristics.

6. What are the advantages of internal combustion engine with electric drive?

i)The time required for maintenance work is only about 5 to 10 percent of its working duty.

ii)The haulage capacity is larger as compared with a steam locomotive.

7. What are the disadvantages of internal combustion engine with electric drive?

i)Operating and maintenance cost is high.

ii)The overload capacity of the design engine is limited.

8.Mention the advantages of electrification of track.

It is the cleanest of all other types of traction systems which alone makes it ideally suitable for the underground railway.

9. Mention the disadvantages of electrification of track.

i)The greatest disadvantage that electric traction suffers from is the high capital cost whether of initial outlay or of conversion from steam electric traction. If the factor can be overcome other disadvantages would not prevent the conversion from one system into the other.

10.What are the various types of electric traction?

i)Self contained electric vehicle.

ii)Electric vehicle fed from the distributed network.

11.What are the various vehicle falling under electric vehicle fed from the distributed network?

i)Tram ways

ii)Trolley buses

iii)Electric locomotives or trains.

12.What are tramways?

The tramcar collects current from an overhead collector and runs on steel track laid on the road. There are two driving axles to secure good adhesion and control is provided from both ends so that it may run from any end. The tram way motors are usually of de type being operated from 600V supply.

13.What are Trolley buses?

Trolley buses do not require track like tramways. So they can be manipulated better in dense traffic than tramways. Since the weight can be carried on rubber typed wheels is limited, a minimum amount of electrical equipment is provided.

14.What are the advantages of diesel electric system?

i)Existing track is not required to be modified.

ii)No overload network is to be constructed.

15.How power is supplied to railway trains?

There are two systems for supplying power to railway trains. They are

i)Overhead system

ii)Conductor rail system.

16.State any four advantages of electric traction. (April-2005)

i)Initial cost and running cost of the system are low.

ii)It has efficiency.

iii)The wearing of the track is minimum.

iv)There is no expensive wear and tear.

17.How would you analyze the speed time curve for electric train? (May/June 2006)

The speed time curve can be analyzed with respect to

i)Acceleration

ii) Speed-constant or free running

iii)Period of coasting

iv) Braking period

18.What is crest speed?

It is the maximum speed attained by a train during a run.

19.What is average speed?

It is the mean speed maintained by a train during a run and is given by

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

20.What is scheduled speed?(April/May 2008)

It is the ratio of the distance between the spots and the total time taken including time for stops to cover the distance.

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

Actual time of run in hr + stop time in hr

21.What are the factors affecting the schedule speed of the train?

i)Crest speed

ii)Acceleration

iii)Braking retardation

iv)Duration of stops.

22.What is tractive effort? (April-2005)

It is the effective force on the wheel of a locomotive which is necessarily required for its propulsion. The tractive effort is a vector quality and it is tangential to wheel. It is measured in Newtons.

23.Write the formula for tractive effort of an electric train.

The tractive effort is given to be

$$Ft = F_a + F_g + F_r$$

Where, F_a = Force to overcome linear or angular motion

F_g = Force to overcome effect of gravity

F_r = Tractive effort to overcome the frictional resistance.

24.Define coefficient of adhesion.

Coefficient of adhesion = Tractive effort to slip the wheel

Adhesive weight

25.Why bridge transition is preferable for suburban service?

In bridge transition, jerks will not be experienced and both the motor will exert normal accelerating torque throughout the starting period.

26.Define dead weight.(April/May 2008)

It is the gross weight of the train including locomotive to be moved on the rail track.

27.Define accelerating weight.

The dead weight of the train comprises of

i)The weight which has linear acceleration and

ii)The weight which has angular acceleration

Due to the rotation inertia for angular acceleration the total effective weight of the train will be more than the dead weight. Thus the effective weight is termed as the accelerating weight of the train.

28.Define adhesive weight.(April/May 2008)

It is the weight carried on driving wheel.

29.Why bridge transition is preferable for suburban service?

In bridge transition, jerks will not be experienced and both the motor will exert normal accelerating torque throughout the starting period.

30. Name the advanced methods of speed control of traction motors.

- Tap changer control
- Thyristor control
- Chopper control
- Microprocessor control

12 Marks Questions:

1.i)State different types of electric traction systems (May/June 2006)**(**B1-5.4)

ii)Explain series - parallel control of dc motors with relevant diagrams. (April-2005)

2.i)State the merits of dc motor when applied to electric traction

ii)Outline the salient features of tramways and trolley buses.

iii)Explain the operation of A.C.traction system and point out relative merits of this system.(B1-5.5)

3.Describe the characteristics of an ideal traction system.(B2-4.10)

4.Define coefficient of adhesion. Derive an expression for the tractive effort for the propelling a train. ((April-2005) (B1-5.20)

5.A locomotive accelerates a 350 tonne train up a gradient of 1 in 100 at 0.8 kmphps. Assuming the coefficient of adhesion to be 0.25, determine the minimum adhesive weight of the locomotive . Assume train resistance 45 N per tonne and allow 10% for the effect of rotational inertia.

6.i)Explain the speed -time curve for traction system. (B1-5.7). (May/June 2009)

ii)Prove that the overall starting efficiency in series- parallel starting of two motors is 66.67%.

7.i)What do you understand by tractive effort? Derive an expression for the same. (B1-5.20)

ii)Discuss the AC traction system currently used. (B1-5.5)

8.An electric locomotive is required to accelerate a train weighing 100 tonnes up a gradient of 1 in 200 at an acceleration of 1.5 km per hour per second. Assuming coefficient of adhesion as 10%, train resistance as 30 N/tonne and effect of rotation inertia as 15%, determine the tractive effort required in newtons.

9.i)Compare and contrast DC and AC supply used for traction applications.

ii)Write a note on recent trends in electric traction.(B2-4.56)

10. Describe the series -parallel starting of electric traction motors with the help of diagrams. What are its advantages? ((April-2005)(B1-5.38)

11. Write about the various methods of traction motor control.(B2-4.32)

12.Explain about multiple unit control and braking of traction motor.(B2-4.40)(April/May 2008)

13.An electric train is required to be driven up an inclined plane having a gradient of 0.5% at a speed of 40 Kmph.The train resistance is 40 N per tonne. If the power taken by the motor from the traction network is 200Kw, compute the maximum permissible weight of the train. The combined efficiency of the motor and the gearing system is 75%..(May/June 2009)

14.i)Explain briefly the recent trends in electric traction. (B2-4.56)

ii)Define and explain coefficient of adhesion. (B1-5.20)

15.Explain shunt transition and bridge transition methods of series-parallel starting of series motors. State the advantage of bridge transition over shunt transition method. (B2-4.33)

16.Derive the expression for energy output from driving axles.(B1-5.23)

17.A train runs with an average speed of 40Kmph. Distance between stations is 2 km.Values of acceleration and retardation are 1.5 Kmphps and 2.5 Kmphps respectively. Find the maximum speed of train assuming trapezoidal speed time curve.(May/June 2009)

18.Two 600V dc series motors are started by series parallel control. Each motor takes 500 ampere during starting time of 20 seconds and 0.1 ohms resistance. Calculate the starting efficiency.

19.Write short notes on different types of current collection schemes.(B2-4.54)

20.Derive the expression for specific energy output.(B1-5.25)

21.Write in detail about mechanics of train movement.(April/May 2008)(B1-5.19)

UNIT-3

1. **What is meant by electrical drives?**

   Machines employed for motion control are called as drives and may employ any one of the prime movers for supplying the mechanical energy for motion control. The drives employing electric motors as prime movers are called as electric drives..

2. **List out some advantages of electric drives**.

   i. Availability of electric drives over a wide range of power a few watts to mega watts.
   ii. Ability to provide a wide range of torques over wide range of speeds.
   iii. Electric motors are available in a variety of design in order to make them compatible to any type of load.

3. **Give some examples of Electric Drives.**

   i. Driving fans, ventilators, compressors and pumps.
   ii. Lifting goods by hoists and cranes.
   iii. Imparting motion to conveyors in factories, mines and warehouses
   iv. Running excavators & escalators, electric locomotives trains, cars trolley buses, lifts & drum winders etc.

4. **What are the types of electric drives**

   Group electric drives (Shaft drive), I

   Individual Drives,

   Multi motor electric drives.

5. **What is a Group Electric Drive (Shaft Drive)?**

   - This drive consists of single motor, which drives one or more line shafts supported on bearings.
   - The line shaft may be fitted with either pulleys & belts or gears, by means of which a group of machines or mechanisms may be operated.

6. **What are the advantages and disadvantages of Group drive (Shaft drive)?**

Advantages:

- A single large motor can be used instead of a number of small motors.
- The rating of the single motor may be appropriately reduced taking into account the diversity factor of loads.

Disadvantages:

- There is no flexibility, Addition of an extra machine to the main shaft is difficult.
- The efficiency of the drive is low, because of the losses occurring in several transmitting mechanisms.
- The complete drive system requires shutdown if the motor, requires servicing or repair.
- The system is not very safe to operate

- The noise level at the work spot is very high.

7. What is an individual electric drive? Give some examples.

In this drive, each individual machine is driven by a separate motor. This motor also imparts motion to various other parts of the machine.

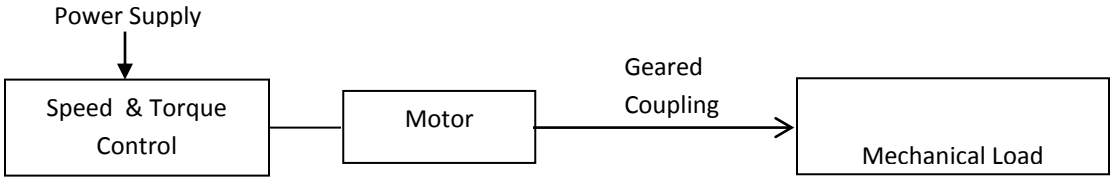
Single spindle drilling machine, Lathe machines etc.

8. What is a multi motor electric drive? Give some examples.

In this drive, there are several drives, each of which serves to activate on of the working parts of the driven mechanisms.

Metal cutting machine tools, paper making machines, rolling mills, traction drive, Traveling cranes etc.,

9. What are the typical elements of an Electric Drive?(Nov/Dec2005)



10. Define equivalent current method?

The motor selected should have a current rating more tan 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 the motor is known as the equal current method.

11. What are the three methods of operation of electric drive?

- Steady state
- Acceleration including starting
- Deceleration including stopping

12. Indicate the importance of power rating & heating of electric drives.

Power rating: Correct selection of power rating of electric motor is of economic interest as it is associated with capital cost and running cost of drives.

Heating: For proper selection of power rating the most important consideration is the heating effect of load. In this connection various forms of loading or duty cycles have to be considered.

13. Mention the types of braking?

- Regenerative braking
- Dynamic braking
- Plugging
-

14. What are the classes of duties?

1. Continuous duty
2. Short time duty operation of motor
3. Intermittent periodic duty
4. Intermittent periodic duty with starting
5. Intermittent periodic duty with starting & braking
6. Continuous duty with intermittent periodic loading
7. Continuous duty with starting & braking
8. Continuous duty with periodic load changes

15. Define four quadrant operation.

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

16.What are the different types of electric braking?

- Dynamic or Rheostatic braking,
- Counter current or plugging and
- Regenerative braking

17. What is meant by plugging?

The plugging operation can be achieved by changing the polarity of the motor there by reversing the direction of rotation of the motor. This can be achieved in ac motors by changing the phase sequence and in dc motors by changing the polarity.

18. What is meant by regenerative braking?(May/June 2007)

In the regenerative braking operation, the motor operates as a generator, while it is still connected to the supply here, the motor speed is grater that the synchronous speed. Mechanical energy is converter into electrical energy, part of which is returned to the supply and rest as heat in the winding and bearing.

19. What are the methods available for speed control of 3 ph induction motor?

a) Stator side
Stator supply voltage control

Stator frequency control

Stator pole control

b) Rotor side
Rotor resistance control

Cascade operation

Injecting emf in the rotor.

20. What are the ways of field control in DC series motor?

* Field diverter control
* Armature diverter control
* Motor diverter control
* Field coil taps control
* Series-parallel control

21. What are the main applications of Ward-Leonard system?(May/June 2007)

* It is used for colliery winders.
* Electric excavators
* In elevator
* Main drives in steel mills and blooming and paper mills.

22. What are the merits and demerits of rheostatic control method?

* Impossible to keep the speed constant on rapidly changing loads.
* A large amount of power is wasted in the controller resistance.
* Loss of power is directly proportional to the reduction in speed. Hence efficiency is decreased.
* Maximum power developed is diminished in the same ratio as speed.
* It needs expensive arrangements for dissipation of heat produced in the controller resistance.
* It gives speed below normal, not above.

23.What are the advantages of field control method?

* More economical, more efficient and convenient.
* It can give speeds above normal speed.

24.What is meant by stator frequency control?

In stator frequency control the speed control of induction motor is done by varying the supply frequency. Since N= 120f/p, the speed can be controlled.

25.What are the two types of slip power recovery scheme?

i) Kramer system
ii) Scherbius system

26.Give the advantages of Kramer system.

- Used for large rating motors
- Speed control is smooth
- Wide range of speed control is possible.
- Working power factor can be increased.

27.Give the limitations of cascade operation.

This method requires two motors

More expensive

Wide range of speed control is not possible

It cannot be operated at $P_1=P_2$

16 Mark Questions:

1. Define electric drive. Mention its advantages and write about the types of electric drives. (B1-6.3)

2. State and explain the important parts of an electric drives. (B2-5.6)

3. Explain the performance of different types of dc motors with its performance curves. .(B1-6.3)

4. What are the different modes of speed control of dc motors? .(B2-5.21)

5. Explain in detail, the speed torque characteristics of induction motors. .(B2-5.29)

6. Explain about the factors affecting the choice of electric motors. .(B1-6.4)

7. Explain about the load characteristics of dc drives. .(B1-6.9)

8. Explain about load equalization. .(B1-6.16)

9. Write in detail about industrial applications of drives. .(B1-6.22)

10. Explain about rating and heating of motors. .(B1-6.31)

11. What is meant by braking? Explain the types of electrical braking. (B1-6.42)

12. Write in detail about the modern methods of speed control industrial drives.(B1-6.53)

B1: Electric energy generation Utilization and conservation-V.Ramanathan, P.S.Kannan-Charulatha publications.

B2: Electric energy generation Utilization and conservation-V.Thiyagarajan-Lakshmi publications.

UNIT-4

1.What are the two types of electric conductor used in electrochemistry?

The two types of electric conductor used in electrochemistry are

i)Metals

ii)Electrolytes

2.What are electrolytes?

Electrolytes are simple inorganic compounds which when dissolved in water conduct electricity.

3.State the applications of electrolytic process.

The various applications of electrolytic process are:

i)Electro deposition, that includes

a)Electroplating

b)Electro deposition of rubber

c)Electrometallisation

d)Electrofacing

e)Electroforming

f)Electrotyping

ii)Manufacture of chemicals

iii)Anodizing

iv)Electro polishing

v)Electro cleaning or pickling

vi)Electro pasting or electro stripping

vii)Electro metallurgy.

4. Name the factors which affect electro deposition.

The factors which affect electro deposition are

i)Current density

ii)Electrolyte concentration

iii)Temperature

iv)Addition agents

v)Nature of electrolyte

vi)Nature of the metal on which the deposit is to be made

vii)Throwing power of the electrolyte.

5.What is electroplating?

Electro plating is defined as electro deposition of metal upon metallic surfaces.

6.What are the uses of electro plating?

The various uses of electroplating are

i)Protection of metals against corrosion

ii)Giving a shiny appearance too articles

iii)Giving reflecting properties to reflectors

iv)Replacing worn out material.

7.What is meant by electrolyte process?

If two metal rods are connected to two poles of a battery and then are immersed in an aqueous solution of acid or an electrolyte, then the bubbles of hydrogen and oxygen are evolved on the two metal rods connected to negative and positive poles respectively. This process is known as electrolytic process.

8.What electrolytes must be used for refining the following metals?

a) Copper b) Iron

a)Copper- Copper sulphate

b)Iron - Iron ammonium sulphate.

9.What are the main components of Nickel, Cadmium battery?

i)Ni(OH)4 for the positive plate

ii)a mixture of cadmium or Cadmium Oxide and iron mass to which is added about 3% of solac oil for stabilizing the electrode capacity.

iii)The electrolyte is 21% solution of KOH to which is added a small quantity of LiOH for increasing the capacity of the cell.

10. What is polarization?

As electroplating current density is increased , rate of deposition of metal is also increased upto certain limit after which electrolyte surrounding the base metal becomes so much depleted of metal ions that rate of deposition does not increase with increase in current density. If current density more than this limit is employed it will result in electrolysis of water and hydrogen deposition on the cathode. This hydrogen evolved blankets the base metal which diminishes the rate of metal deposition. This phenomenon is known as polarization.

11.What is electro metallisation?

It is a process of depositing metal on conducting base for decoration and for protective purposes. Non conductive base is made conductive by a coating of graphite which is made the cathode.

12.What is electrofacing?

It is the process of coating of metallic surface with a harder metal by electro deposition to make it more durable.

13.What is electrotyping?

This is special application of electro forming where reproduction of printers type and engravings are made.

14.Define electro chemical equivalent. (April 2005)

According to Faraday's second law of electrolysis the mass of the element liberated per unit quantity of electricity is defined as electro chemical equivalent.

15.Define chemical equivalent or equivalent weight.

It is defined as the ratio of atomic weight to valency.

$$\text{Chemical equivalent} = \frac{\text{Atomic weight}}{\text{Valency}}$$

16.What are electrodes?

Electrodes are metal plates placed or immersed in electrolytes and DC current is passed through them.

17.Define current efficiency.

Current efficiency is defined as the ratio of the actual quantity of substance liberated or deposited to the theoritical quantity.

$$\text{Current efficiency} = \frac{\text{Actual quantity of substance liberated}}{\text{Theoritical quantity}}$$

18.Define energy efficiency.

Energy efficiency is defined as the ratio of the theoritical energy to the actual energy required.

$$\text{Energy efficiency} = \frac{\text{Theoritical energy}}{\text{Actual energy required}}$$

19.What are the electrolytes used for Aluminium ,copper and Zinc?

Electrolytes used for

i)Aluminium = fused cryolite

ii)Copper = copper sulphate

iii)Zinc = Zinc chloride and zinc sulphate.

20.What is an electrode potential?

The potential difference between the electrolyte and electrode is known as electrode potential.

21.State Faraday's law of electrolysis

Faraday's first law:

The amount of material deposited or liberated over an electrode in an electrolyte cell is proportional to the quantity of electricity which has passed through it.

Faraday's second law:

The amount of different substance deposited or liberated by the given quantity of electricity are proportional to their chemical equivalent.

22.What is back emf?

The back emf is the opposing emf which is produced in an electrolyte due to the absorption of gaseous ion by the electrlyte from the two electrodes is known as the back emf of electrolysis or polarization.

23.What are the indications of a fully charged cell?

The indication of a fully charged cell are:

i)Gassing

ii)Voltage

iii)Specific gravity

iv) Colour of the plates.

24.What is the function of a battery charger?

The battery chargers are so connected that they are being charged when load demands are light and automatically discharged during peak periods when load demands are heavy or when the usual power supply fails or is disconnected.

25.What are the different methods of battery charging?

1.Floating on the line

2.System governed

3.The constant current system

4.The constant voltage system.

26.What are Edision batteries? Give its active materials.

The Edision batteries are otherwise called Nickel iron batteries.

The active materials are:

i)Nickle hydroxide Ni(OH)4 or apple green Nickel peroxide Nio2 for positive plate.

ii)Powdered iron and its oxides for the negative plate.

iii)The electrlyte is 21% solution of caustic potash KOH to which is added a small quantity of lithium hydrate LiOH for increasing the capacity of the cell.

27.How is the capacity rating of a battery specified? (April 2005)

Ampere-hour Capacity- It is a function of the total plate area. i.e Size of the individual plate multiplied by the number of plates.

28.Define polarization. (May 2006)

Hydrogen forms a blanket over the base metal when current is increased beyond a limit and electrolyte is depleted of metal ions. This reduces the rate of metal deposition. The blanketing of hydrogen is called polarization. Polarisation can be reduced by agitating the electrolyte or by changing the current direction periodically.

12 Marks Questions

1.What is electroplating? What are its types? Discuss in detail about the preparatory work required for electroplating.(B1-615) (April 2005)(May 2006)

2.With neat diagram explain the operation of any one type of battery charger. (B2-363)

3.Draw the cross section of a Nickel iron battery. Explain its operation with necessary chemical reactions taking place during charging and discharging. (B2-367)

4.i)Explain the operating principle involved in the process of storing electrical energy in chemical form. (B2-344)

ii)Draw the cross section view of Nickel Cadmium battery and explain the working principle of this type of battery. (B2-370) (April 2005)

5.i)Describe the various factors which control the process of electro deposition. (B1-608)

ii)Draw the circuit diagram of any one type of battery charger and explain its operation.(B2-363)

6.i)Explain electrolytic refining or metals. (B1-594)

ii)Describe how chemicals are manufactured by electrolysis. (B1-595)

iii)In a chromium plating process, current efficiency is 20%.What showed be the weight of chromic acid to be added per 1000 Ah, to replace chromium removed by deposition.(B3-356)

7.i) State Faraday's laws of electrolysis and explain them clearly. (B1-596) (May-2006)

ii)What is the effect of increasing the current density in the electrolyte on the quantity of electroplating? (B1-608)

8. Write notes on

i)Electrofacing(B3-358)

ii)Nickel plating(B1-619)

iii)Power supply for electrolytic processes. (B1-610)

9.Write short notes on Nickel Cadmium batteries and Nickel iron batteries. (B2-367-370)

10.i)Illustrate with an example the application of the principle of electrolysis for refining. (B3-349)

ii)Calculate the steady current which will deposit 5 gms of copper from a copper sulphate solution in one hour.*(Electro chemical equivalent of copper is 0.000328) (B1-599)

11.i)Explain briefly the various methods of charging and maintaining the batteries. (B2-362) ii)Explain the terms

a)Capacity rating of batteries(B2-355) (April 2005)

b)Battery chargers. (B2-362)

12.Explain Electro-extraction of Aluminium metal. (B1618) (May 2006)

B1-G.C.Garg –Utilization of Electric Power & Electric Traction-Khanna Publishers.

B2-B.L.Theraja-Electrical Technology-S.Chand Publications

B3-J.B.Gupta-Electric Power-S.K.kataria & Sons.

UNIT V

ENERGY CONSERVATION

2 Marks Questions & Answers:

1.What is meant by Depreciation?

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

2. Define interest.

The cost of use of money is known as interest.

3.What is economics of power generation?

The art of determining the per unit cost of production of electrical energy is known economics of power generation.

4.Define fixed cost.

It is the cost which is independent of maximum demand and units generated.

5.What is semi-fixed cost?

It is the cost which depends upon maximum demand but is independent of units generated.

6.What is meant by running cost?

It is the cost which depends only upon the number of units generated

7.How is the total cost of electrical energy generation divided?

1.Fixed cost

2.Semi-fixed cost

3.Running or operating cost

8. What is variable load on power station?

The load on a power station varies from time to time due to uncertain demands of the consumers and is known as variable load on the station.

9.What is load curve?

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

10. Define connected load.

It is the sum of continuous ratings of all the equipments connected to supply system.

11.What is maximum demand?

It is the greatest demand of load on the power station during a given period.

12.Define demand factor.

It is the ratio of maximum demand on the power station to its connected load.

$$\text{Demand factor} = \frac{\text{Maximum demand}}{\text{Connected load}}$$

The value of demand factor is usually less than 1.

13.Define Average load.

The average of loads occurring on the power station in a given period (day or month or year) is known as average load or average demand.

$$\text{Daily average load} = \frac{\text{No. of units(Kwh)generated in a day}}{\text{24 hours}}$$

$$\text{Monthly average load} = \frac{\text{No. of units(Kwh)generated in a month}}{\text{No. of hours in a month}}$$

$$\text{Yearly average load} = \frac{\text{No. of units(Kwh)generated in a year}}{\text{8760 hours}}$$

14.What is load factor?

The ratio of average load to the maximum demand during a given period is known as load factor.

$$\text{Load Factor} = \frac{\text{Average load}}{\text{Maximum demand}}$$

15.Define Diversity factor.

The ratio of the sum of individual maximum demands to the maximum demand on power station is known as diversity factor.

$$\text{Diversity factor} = \frac{\text{Sum of individual max. demands}}{\text{Max. demand on power station}}$$

Diversity factor is always greater than one.

16.Define plant capacity factor.

It is the ratio of actual energy produced to the maximum possible energy that could have been produced during a given period.

$$\text{Plant capacity factor} = \frac{\text{Actual energy produced}}{\text{Max. energy that could have been produced}}$$

$$= \frac{\text{Average demand} \times T}{\text{Plant Capacity} \times T}$$

$$= \frac{\text{Average demand}}{\text{Plant Capacity}}$$

Thus if the considered period is one year,

$$\text{Annual plant capacity factor} = \frac{\text{Annual kwh output}}{\text{Plant capacity} \times 8760}$$

17.What is plant use factor?

It is the ratio of kwhr generated to the product of plant capacity and the number of hours for which the plant was in operation.

$$\text{Plant use factor} = \frac{\text{Station output in kwhr}}{\text{Plant capacity x Hours of use}}$$

18.Define units generated per annum.

It is often required to find the kwhr generated per annum from maximum demand and load factor. The procedure is as follows,

Units generated per annum =Max. demand (in kw) x L.F x 8760

19.What are the types of loads?

1.Domestic load

2.Commercial load

3.Industrial load

4.Municipal load

5.Irrigation load

6.Traction load

20.Define 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 a load duration curve.

21.Write the three part form in economics of energy.

The annual cost of Energy = Rs (a + b kw + c kwhr)

Where

a- Annual fixed cost independent of maximum demand and energy output.
b- Constant which when multiplied by maximum kw demand on the station gives the annual semi-fixed cost.
c- Constant which when multiplied by kwhr output per annum gives the annual running cost.

22.Write the two part form in economics of energy.

Total annual cost of energy = Rs (A kw + B kwhr)

Where

A – a constant which when multiplied by maximum kw demand on the station gives the annual cost of the first part.

B – a constant which when multiplied by the annual kwhr generated gives the annual running cost.

23.What are the different methods of determining depreciation?

1.Straight line method

2.Diminishing method

3.Sinking fund method

24.What is the value of annual depreciation charge in straight line method?

Annual depreciation charge =(P-S)/n

Where

P-Initial cost of equipment

n- Useful life of equipment in years

S- Scrap or salvage value after the useful life of the plant.

25.What is the value of scrap in diminishing method?

Scrap value, $S = P (1-x)^n$

Where

P-Initial cost of equipment

n- Useful life of equipment in years

S- Scrap or salvage value after the useful life of the plant.

26.What is the sinking fund factor ?

Sinking fund factor = $r / [(1+r)^n - 1]$

Where

r – Annual rate of interest expressed as a decimal.

n – useful life of equipment in years

27.What is the sinking fund ?

Sinking fund, $q = (P-S) [r / [(1+r)^n - 1]]$

Where

P-Initial cost of equipment

n- Useful life of equipment in years

S- Scrap or salvage value after the useful life of the plant.

r – Annual rate of interest expressed as a decimal.

28.What is meant by energy conservation ? (Apr-2005)

Energy conservation means using the energy effectively and efficiently. Conservation does not mean that stop using the electrical energy but use it effectively.

29.What are the energy conservation in Commercial sector?

i). Air conditioners

ii).Lighting and Fans

iii) Appliances such as computers and small motors.

30.What are the different types of Tariffs?

a).Flat demand tariff.

b).Flat rate tariff.

c).Step rate tariff.

d).simple tariff.

e).Block rate tariff.

f).Hopkinson demand rate or two part tariff.

g).Three part tariff or Doherty rate.

h).Off peak tariff

i).Three part tariff

16 Marks Questions

1. Define power factor. What are the disadvantages of lower power factor? How to avoid it.

2.With neat diagram explain the load duration curve and load duration curve.

3. Write notes on i) Plant capacity factor ii) Plant use factor iii) Load factor iv) Diversity factor

4.What is the need for electrical energy conservation? Explain about energy efficient equipment.

5.Explain about Base load and Peak load on power station. Explain about selection of number and size of generating units.

6. List and explain in detail the methods of power factor improvement.

7.Explain about cost of electrical energy and explain the methods of determining depreciation.

8.Define depreciation and give its objectives. Explain any two popular methods of providing depreciation. (Apr – 2005) (May 2006)

9. What are the measures relates to power quality?

10.Define and explain the types of tariffs.

11 What is meant by energy Audit? What is the need for energy Audit? Explain the various types of energy Audit. (Apr-2005) (May-2006)