VETRI VINAYAHA COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF EEE

IV YEAR / VIII SEMESTER-EEE

EE6801- ELECTRIC ENERGY GENERATION, UTILISATION AND CONSERVATION

Question Bank

Part – A

UNIT -1 Electric Drives and Traction

1. What are the requirements of an ideal traction system?

1. The starting tractive effort should be high so as to have rapid acceleration.
2. The wear on the track should be minimum.
3. The equipment should be capable of withstanding large temporary loads.
4. Speed control should be easy.
5. Pollution free.
6. There should be no interference to the communication lines running along the track lines.
7. Low initial and maintenance cost.
8. The locomotive should be self contained and able to run on any route.
9. Braking should be such that minimum wear is caused on the brake shoes.
10. If possible the braking energy should be regenerated and returned to the supply.

2. What are the advantages of electric traction?

1. It has great passenger carrying capacity at higher speed.
2. High starting torque.
3. Less maintenance cost.
4. Cheapest method of traction.
5. Free from smoke and flue gases hence used for underground and the tubular railways.
6. Rapid acceleration and braking
7. Less vibration
8. Coefficient of adhesion is better

3. What are disadvantages of electric traction?

1. High capital cost
2. Problem of supply failure

3. Additional equipment is required for achieving electric braking and control
4. The leakage of current from the distribution mains and drop of volts in the track are to be kept within the prescribed limits.
5. The electrically operated vehicles have to move on guided track only.

4. What are the different systems of traction?

1. Direct team 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

5. What are the types of supply system for electric traction?

A. D.C system

B. A.C. system

1. Single phase
2. Three phase

C. Composite system

1. Single phase AC-DC
2. Single phase-three phase.

6. What is the advantage of D.C system?

1. Better torque-speed characteristic.
2. Low maintenance cost.
3. The weight of d.c motor per H.P is less in comparison to a.c motors.
4. Efficient regenerative braking as compared to single phase a.c series motors.

7. What are the disadvantages of D.C System?

1. The overall cost is more because of heavy cost of additional substation equipment ie converting machinery boosters etc.
2. This system is preferred for suburban services and road transport where there are frequent stops and distance is less.

8. What are the needs for the control of traction motors?

1. Starting without drawing excessive current from supply
2. Smooth acceleration without causing sudden shock so as to avoid damage to the couplings and inconvenience to the passenger
3. Speed control as per requirement.
4. Providing rheostatic or regenerative braking.

9. What are the various methods for controlling the speed of d.c series motor?

They are

1. Rheostatic control
2. Series parallel control
3. Field control
4. Buck and boost method
5. Metadyne control
6. Thyristor control

10. What are the advantages of thyristor control?

1. Absence of bulky on- load tap changer and electromagnetic devices
2. Saving of energy
3. Notchless control
4. Minimum wear and tear
5. Increase in pulling ability of the motive power

12. What are the requirements of a braking system?

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

13. What are the advantages of electric braking?

1. Less maintenance
2. Smooth braking
3. No dust is produced

4. Replacement and adjustment of brake shoes is eliminated
5. Heat energy id fed back to the supply.

14. What are the disadvantages of electric braking?

1. The rating of braking equipment is required is higher than the rating required for motor alone
2. Additional equipment is required in some cases.
3. Economical consideration

15. What are the methods of applying electric braking?

1. Plugging or reverse current braking
2. Rheostatic braking
3. Regenerative braking

16. **Name the various systems of current collection system and where they employed?**

1. Trolley collector.
2. Bow collector
3. Pantagraph collector

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

1. tape changer method
2. Thyristor control
3. chopper control
4. Microprocessor control

18. What are the advantages of microprocessor control of traction motors?

1. High speed of response
2. High accuracy y
3. Over voltage and over speed protection
4. Electronic interlocking
5. Less sensitive to temperature variations and drift
6. Numbers of compensation used are less.

17. What is meant by Mechanical Braking? Name the types of brakes used.

In addition to electric brakes, mechanical brakes are also required to stop the train and hold it in stationary. Mechanical brakes are usually applied by brake block shoes pressed with force against the tread of the wheels. The braking force is caused by the movement of the piston which is transmitted to the brake blocks through a system of levers.

Mechanical brakes are of two types namely

(i) Compressed air brakes

(ii) Vacuum brakes

The Compressed air brakes are used extensively in electric railways whereas the vacuum brakes in steam railways.

Part-B

1. (i).Explain about multi motor speed control (8)
   (ii).A sub urban electric train has a maximum speed of 65kmph.The schedule speed including a station stop of 30seconds is 43.5kmph.If the acceleration is 1.3kmphps; calculate the value of retardation when the distance between stops is 3km. (8)

2. (i).Explain the principle and operation of a modern ac locomotive.(6)
   (ii).What is the various types of electric braking used in traction? Discuss in detail. (10)

3. The distance between two stations is 1.6 km and the average speed of the train is 40 kmph. The acceleration is 2 kmphps, retardation during coasting is 0.16 kmphps and braking is 3.2 kmphps respectively. Assuming a simplified quadrilateral speed-time curve, calculate duration of acceleration, coasting and braking periods and distance covered during braking period.(16)

4. Explain the supply system of electric traction in details. (16)

5. (i). Discuss the advantage and disadvantage of electric traction.(8)
   (ii).Summarize the requirement of idea traction system. (8)

6. (i). List the requirement of electric traction system. (8)
   (ii). Explain D.C series traction motor control. (8)

7. (i)Discuss and compare the various arrangements of current collection in traction(8).
   (ii) The maximum torque of a400v, three phase four pole 60c/s IM is 100NM at a slip of 0.1. If the motor works at 50c/s 400 V supply. Examine the maximum torque, slip and the speed at which it occurs. Neglect stator impedance. (10)

8. Generalize the recent trends in electric traction.

9. The distance between two stations is 1 km and the average speed of the train is 30 kmph. Station stopping time is 20 sec. Assume braking retardation 3 kmph.ps and maximum speed 1.25 times average speed Examine acceleration required to run the service if the speed time curve is approximated by a trapezoidal curve. (16)

10. Describe the different methods of traction motor control and explain. (16)

Unit 2 - ILLUMINATION

Part-A

1. Define plane angle

A Plane angle is subtended at a point end is enclosed by two straight lines lying the same plane. A plane angle is expressed in terms of degrees or radian. A radian is the angle subtended by an arc of a circle whose length equals the radius of the circle.

2. Define solid angle

Since light is emended from a source in all directions and not only in one plane, it becomes necessary to consider solid angles instead of ordinary plane angle.

Figure shows a solid angle, usually represented by symbol ω. The unit of solid angle is the steradian, and is defined as the solid angle subtended at the centre of sphere by an area on the surface of the sphere which is numerically equal to the $(radius)^2$

$$Steradians = area/ (radius)^2$$

3. Define luminous flux

It is the rate of energy radiation in the form of light waves and is denoted by $\Phi=Qt$ where Q is the radiant energy. Its unit is lumen.

4. Define lumen and its unit

One lumen is defined as the luminous flux emitted by a source of one candle power in a unit solid (i.e) lumen = candle power of source × solid angle

5 .Define candle power

Candle power of a source is defined as the no of lumens emitted by that source per unit solid angle in a given direction.

6. Define luminous intensity

The mean luminous intensity over a particular range of directions or zones is the flux contained per unit solid angle in that zone. If the solid angle is infinitely small the intensity is no lomger a mean value but the value in specific directions. The unit for luminous intensity is candela or lumens/steradian.

7. Define brighteness

It is defined as the intensity of a source in a given direction divided by the orthogonally projected area of the source in that direction. The unit for brightness is Lambert and is denoted by the letter'L'

8. Define illumination.

Illumination of a source is defined as the luminous flux received by the surface per unit area. It's unit is lux (or) foot-candle and is denoted by E. Illumination of one lux means one lumen per sq.metre whereas one foot-candle means one luman per sq.ft. A still bigger illumination is phot and is equal to lumen per sq.cm (i.e) 1 phot =10,000 lux

9. Define MHCP

It is defined as the mean of candle power in all directions and in the horizontal plane containing the source of light.

10. Define MSHP

It is defined as the mean of candle power in all directions and in all planes from the source of light.

11. Define M.H.S.C.P

It is defined as the mean of candle power in all directions above or below the horizontal plane passing through the source of light.

12. Define reduction factor.

Reduction factor of a source of light the ratio of its mean spherical candle power to its mean horizontal candle power. (i.e) Reduction factor = M.S.C.p / M.H.C.P

13. Define lamp efficiency.

It is defined as the ratio of the luminous flux to the power input. It is expressed in lumens per watt.

14. Define specific consumption

It is defined as the ratio of the power input to the average candle power. It is expressed in watt per candela.

15. Define glare

Glare may be defined as the brightness within the field of vision of such a character as to cause annoyance, discomfort, interference with vision or eye-fatigue.

16. Define space height ratio

It is defined as the ratio of horizontal difference between adjacent lamps and height of their mounting.

17. Define utilization factor.

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

18. Define maintenance factor.

The ratio of illumination under normal working conditions to the illumination when the things are perfectly clean is known as maintenance factor.

19. Define depreciation factor.

This is merely the reverse of the maintenance factor and is defined as the ratio of initial meter-candles to the ultimate maintained meter-candles on the working plane. Its value is more than unity.

20. Define waste light factor.

Whenever a surface is illuminated by a number of sources of light, there is always a certain amount of light on account of overlapping and falling of light at the edges of the surface. The effect is taken into account by multiplying the theoretical value of lumens required by 1.2 for rectangular areas and 1.5 for irregular areas and objects like statues, monuments etc.

21. Define absorption factor.

In the places where atmosphere is full of smoke fumes, such as in foundries, there is a possibility of absorption of light. The ratio of total lumens available after absorption to the total lumens emitted by the source of light is called the absorption factor. It's values varies from unity for clean atmosphere to 0.5 for foundries.

22. Define beam factor.

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

23. Define reflection factor.

When a ray of impinges surface it is reflected from the surface at an angle of incidence. A certain particle of incident light is absorbed by the surface. The ratio of reflected light to the incident light is called the reflection factor. It is always less than unity.

24. What are the two laws of illumination?

There are two laws of illumination

1. Law of inverse squares
2. Lambert's cosine law.

25. What is photometry?

Photometry is the comparison and measurement of candle powers. The candle power of a source in any given direction is measured by comparison with standard or substandard source employing photometer bench and some form of photometer.

26. What are the two types of photocells used for photometry?

The two types of photocells used for photometry measurements are

1. Photovoltaic cell and
2. Photo-emissive cell

27. What are the three major methods of lighting calculation?

The three major methods used for lighting calculations are as follows:

1. Watts per square meter methods
2. Lumen or light flux method
3. Point to point (or) inverse-square law method

28. List the classification of design of lighting system.

Design of lighting can be classified into

1. Direct lighting
2. Indirect lighting
3. Semi-direct lighting
4. Semi-indirect lighting

29. What are the requirements of a perfect lighting system?

A perfect lighting system should have to

1. Provide sufficient illumination
2. Provide uniform light distribution all over the working plane
3. Provide light of suitable colour
4. Avoid glare and shadow

30. List the various types of lamps

According to the principle of operation the lamps can be classified as follows

1. Arc lamps
2. High temperature lamps
3. Gaseous discharge lamps
4. Fluorescent lamps.
5.

31. What are the advantages of incandescent lamps?

1. Direct operation on standard distribution voltages
2. Operating power factor unity
3. Availability in various shapes and shades
4. Good radiation in the luminous range
5. No effect on surrounding temperature

32. What are the disadvantages of gaseous discharge lamps?

1. Starting is complicated. It requires starters (or) transformers
2. This takes time to attain full brightness
3. High initial and poor power factor
4. Ballasts or chokes are necessary
5. Light output fluctuates at twice the supply frequency
6. Limited application of lamps.

Part-B

1. (i) Describe and prove laws of illumination (6)

   (ii) Design a street lighting of a road of 300metres long which is required to be illuminated by providing 40W fluorescent lamp. The width of the road is 4 m. Illumination is 0.6 lux. Assume efficiency of lamp as70Lumen/watt. (10)

2. (i) With neat diagram explain the construction and working of CFL lamp. (8)
   (ii).Discuss the various steps followed in calculation of illumination for designing the residential lighting (8)
3. Two street lamps are 20m apart and are fitted with a 500 C.P. lamp at a height of 8m above the ground each. Calculate the illumination at a point
   (a) Under the lamps each.
   (b) Midway between the lamps (16)

4. A hall 30m long and 12m wide is to be illuminated and the illumination required is 50 Lumens/m2. Deduce the number of fitting required, taking depreciation factor of 1.3 and Utilization factor of 0.5.Given that the outputs of different types of lamp are given below:

Watts	100	200	300	500	1000
Lumens	1625	3650	4720	9970	21520

5. Describe the working of high pressure mercury vapour lamp with a neat sketch (16).

6. (i).Describe flood lighting with necessary definitions (8)
   (ii). Discuss the principle of street lighting. Explain different types of lighting with neat Sketches. (8)

7. (i) Discuss laws of illumination and its limitations in actual practice (8)
(ii)A lamp of 500cp is placed 2m below a plane mirror which reflects 80% of light falling on it. Calculate illumination at a point 5m away from the lamp which is hung 5m above the ground. (8)

8. (i) Describe the construction and principle of operation of mercury vapour lamp. (10)
(ii) Point out the various factors to be taken into account for designing street lighting and flood lighting (6)

9. (i) Discuss about Diffusion principle of street lighting (8)

(ii) A drawing hall 30*15*5 m is to be provided with a general illumination of 120Lux.Taking coefficient of utilization as 0.5, depreciation factor as 1.4, Design the number of fluorescent tubes required, their spacing height, mounting height and total wattage. Take luminous efficiency of fluorescent tubes as 40 Lumen/Watt for 80watts tube (8).

10. (i) With neat diagram describe the construction and working of sodium lamp(8)
(ii) Two lamp posts are 14m apart and are fitted with 200C.P lamp each at a height of 5m above the ground. Calculate illumination midway between them and illumination under each lamp. (8)

UNIT-3 - HEATING AND WELDING

Part-A

1. What are the advantages of electric heating?

1. Economical
2. Cleanliness
3. Absence of flue gases
4. Ease of control or adaptation
5. Automatic protection
6. Upper limit of temperature
7. Special heating features
8. High efficiency of utilization
9. Better working conditions
10. Safety
11. Heating of non-conducting materials.

2. Classify the methods of electric heating.

1. **Power frequency heating**

(a) Resistance Heating

1. Direct resistance Heating
2. Indirect resistance Heating
3. Infrared or radiant heating

(b) Arc heating

1. Direct Arc heating
2. Indirect Arc heating

2. High frequency heating

(a) Induction heating

1. Direct Induction heating
2. Indirect Induction heating

(b) Dielectric heating

3. 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 I^2R 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 salt bath furnaces.

4. What are the properties of heating element?

1. High resistivity
2. High melting point
3. Free from oxidation
4. Low temperature coefficient.

5. What are the causes of failure of heating elements?

1. Formation of hot spots
2. General oxidation of the element and intermittency of operation
3. Embrittlement caused by grain growth
4. Contamination of elements or corrosion.

6. Write the Stefan's law of heating.

Heat is transferred by means of heat waves, governed by Stefan's law of radiation which states that,

Heat dissipation = $5.72 \times 10^4 \, K \varepsilon \left[\left(\frac{T_1}{1000} \right)^4 - \left(\frac{T_2}{1000} \right)^4 \right]$ **Watts/**m^2

Where,

T1= Absolute temperature of radiating surface in °Kelvin

T2= Absolute temperature of absorbing surface in °Kelvin

K= Constant called as radiating efficiency

Ɛ= Emissivity.

7. 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 case of resistance heating. Heat emission intensities up to 7500 watts/m^2 can be obtained leading to heat absorption up to 4300 watts/m^2. This reduces the time taken by various drying processes.

8. What is the basic principle of induction heating?

It works on the principle of electromagnetic induction as same as a transformer. A metal disc is 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.

9. What is the difference between core type and coreless type induction furnaces?

1) **Drawbacks of Direct core type furnaces:**
    1. Due to poor magnetic coupling, leakage reactance is high and power factor is low.
    2. Low frequency supply is required and a frequency converter is required.
    3. Odd shape of crucibles is not convenient
    4. Furnace cannot function if the secondary circuit is open it must be closed.
2) **Advantages of coreless induction furnaces:**
    1. Precise control of power
    2. Fast in operation
    3. The crucible of any shape is used
    4. No dust, smoke and noise
    5. Erection cost and operation cost are low.
3) **Application of Coreless furnaces:**
    1. Steel production
    2. Melting of non-ferrous metals (Brass, bronze, copper, aluminum)

3. Soldering
4. Braking
5. Hardening and annealing
6. Drying paints
7. Sterilizing surgical instruments.

10. What are the different types of welding?

1. Gas welding

1. Oxy acetylene
2. Air acetylene
3. Oxy hydrogen

2. Resistance welding

1. Butt welding
2. Spot welding
3. Projection welding
4. Seam welding
5. Percussion

3. Arc welding

1. Carbon Arc welding
2. Metal Arc welding
3. Gas Metal Arc welding
4. Gas tungsten Arc welding
5. Atomic-hydrogen Arc welding
6. Plasma Arc welding
7. Submerged Arc welding
8. Flux-cored Arc welding
9. Electro slag Arc welding

4. Thermit welding

5. Solid state welding

1. Friction
2. Ultrasonic
3. Diffusion
4. Explosive

11. Compare DC welding and AC welding.

S.No	Factors	DC Welding	AC welding
1.	Equipment	Motor-generator set or rectifier is required in case of availability of AC supply; otherwise oil engine 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 AC
9.	Electrodes	Non-coated cheap electrodes can be used.	Only coated electrodes-expensive ones.

12. What are the modern welding techniques?

Drawbacks of convention welding methods

1. Excessive melting
2. Diffusion
3. Formation of inter metallic compounds
4. Tower ductility
5. Lower shock resistance capability
6. Difficult to weld some metals

Modern welding techniques are,

1. Ultrasonic welding
2. Laser welding
3. Electron beam welding

13. What is LASER welding?

LASER (Light Amplification Simulated 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.

1. The laser is a device that produces a concentrated coherent light beam by simulating electronic or molecular transitions to lower energy levels.
2. Coherent radiation: Bombardment of an atom by a proton of adequate energy, while it is an excited state, stimulates it to emit another proton and thus augment the one bombarding it. This gives rise to stimulated emission which is synchronous with the inducing radiation in direction, phase and wave length and thus amplifies the incident radiation. This is termed as coherent radiation.
3. Laser is effectively used in the welding of chromium, nickel, aluminum, tungsten, titanium etc.

Part-B

1. (i).Draw a neat sketch of induction furnace and generalize its working (6).
(ii).An insulating material 2cm thick and 150sq.cm. in area is to be heated by dielectric heating. The material has permittivity of 4 and p.f. as 0.04.Power requires is 400watts and frequency of 40MHz.Measure the voltage and current that will flow through the material. If the voltage were limited to 700 volts, what will the frequency to get the same loss? (10)

2. (i).Discuss the principle of arc welding and the difference between carbon and metal arc Welding and their relative merits and demerits.(8)
(ii).generalize the characteristics of a welding transformer. (8)

3. Discuss in details about any two types of resistance welding (16)

4. Calculate the efficiency of a high frequency induction furnace which takes 12 minutes to melt 1.3Kg of Aluminium. The input to the furnace being 4.5kW and the initial temperature is 15oC.Take specific heat of Aluminium is 880J/Kg/oC, melting point of Al is 660oC and latent heat of fusion of Al is 32KJ/Kg.

5. Examine the induction heating? What are the characteristics of induction heating? Explain Ajex-wyatt furnace. (16)

6. Analyze the efficiency of a high frequency induction furnace which takes 10 minutes to melt 1.815Kg of Aluminium. The input to the furnace being 5 kW and the initial temperature is 15oC.Take specific heat of Aluminium is 0.212 kcal/kg0c, melting point of Al is 660oC and latent heat of fusion of Al is 76.8 Kcal/Kg.

7. (i) Classify the various types of resistance heating. (8)
(ii) An insulating material 2cm thick and 150 sq.cm in area is to be heated by dielectric heating. The material has permittivity of 4 and p.f as 0.04.power required is 200watts and frequency of 300MHz.point out the voltage and the current that flows through the material. If the voltage were limited to 600v.what will be the frequency to get the same loss.(8)

8. With neat diagram describe the different type of arc welding. (16)

9. (i)Discuss in detail design of heating element. (8)
(ii) Summarize technical note on welding transformer. (8)

10. (i)What are the types of ARC furnace? Describe the operation of them. (8)
(ii) Describe the construction and working principle of dielectric heating (8).

UNIT-4
Solar Radiation and Solar Energy Collectors

Part-A

1. Define heliostats.

In solar tower concentration system (tower power concept)the incoming solar radiation is focused to a central receiver or a boiler mounted on a tall tower using thousands of plane reflectors which are steerable about two axes are called heliostats.

2. What is meant by Solar Energy?

The energy received in the form of radiation, can be converted directly or indirectly into other forms of energy, such as heat and electricity, which can be utilized by man.

3. List the drawbacks of Solar Energy.

(i) The intermittent and variable manner in which it arrives at the earth's surface and

(ii) The large area required to collect the energy at a useful rate.

4. Define solar constant.

Solar constant is defined as the amount of energy received in unit time on a unit area perpendicular to the sun's direction at the mean distance of the earth from the sun

5. Define solar time.

Solar time (Local Apparent Time) is measured with reference to solar noon, which is the time when the sun is crossing the observer's meridian.

6. What are the applications of solar energy?

Heating and cooling residential building
Solar water heating
Solar distillation
Solar engines for water pumping
Food refrigeration.

7. What are the types of wind mills?

Multi blade type
Sail blade type
Propeller type
Savonius type and
Darrieus type

8. State the causes of problems in wind mill.

Wind energy available is dilute and fluctuating in nature. Because of the dilute form, conversion machines have to e necessarily large.
Wind energy systems are noisy in operation a large unit can be heard many kilometers away.
Large areas are needed to install wind forms for electrical power generation.

9. What is meant by solar collector? Mention its types.

A solar collector is a device for collecting solar radiation and transfers the energy to a fluid passing in contact with it.

There are two types of collectors:
1. Non- concentrating or flat plate type solar collector.
2. Concentrating (focusing) type solar collector.

10. Mention the ways of solar energy can be utilized.

Solar energy can be utilized directly in two ways:

By collecting the radiant heat and using it in a thermal system

By collecting and converting it directly to electrical energy using a photovoltaic system

11. What are the indirect forms of solar Energy?

Wind energy, Biomass energy, Tidal energy, Ocean wave energy, Ocean thermal energy, Fossil fuels and other organic chemicals, Hydro energy.

12. What are the performance indices of a solar collector?

The performance indices of a solar collector are

Collector Efficiency:

It is defined as the ratio of the energy actually absorbed and transferred to the heat transport fluid by the collector (useful energy) to the energy incident on the collector.

Concentration Ratio:

It is defined as the ratio of the area of aperture of the system to the area of the receiver. The aperture of the system is the projected area of the collector facing (normal) the beam.

Temperature Range:

It is the range of temperature to which the heat transport fluid is heated up by the collector.

13. Name the basic design of solar cookers

The four basic designs of the solar cookers are:
Box type solar cooker,
Dish type solar cooker,
Community solar cooker,
Advanced solar cooker

14. List out the advantages and disadvantages of air flat plate collector.

Advantages of flat plate air heating collector are

It is compact, simple in construction and requires little maintenance.
The need to transfer thermal energy from the working fluid to another fluid is eliminated as air is used directly as the working fluid.
Corrosion is completely eliminated.
Leakage of air from the duct is less severe.
Possibility of freezing of working fluid is also eliminated.
The pressure inside the collector does not become very high.

Disadvantages of air collector are

A large amount of fluid is to be handled due to low density. As a result, the electrical power required to blow the air through the system can be significant if the pressure drop is not kept within prescribed limits.
Heat transfer between the absorber plate and air is poor.
There is less storage of thermal energy due to low heat capacity

15. What is meant by solar pond?

A natural or artificial body of water for collecting and absorbing solar radiation energy and storing it as heat. Thus a solar pond combines solar energy collection and sensible heat storage.

16. What is meant by solar photo voltaic?

The direct conversion of solar energy into electrical energy by means of the photovoltaic effect, that is, the conversion of light (or other electromagnetic radiation) into electricity. The photovoltaic effect is defined as the generation of an electromotive force as a result of the absorption of ionizing radiation

17. List the application of solar PV system.

Water pumping sets for micro irrigation and drinking water supply.
Radio beacons for ship navigation at ports
Community radio and television sets
Cathodic protection of oil pipe lines
Weather monitoring
Railway signaling equipment
Battery charging
Street lighting

18. What are the advantages & disadvantages of PV solar energy conversionsystem?

Advantages
Direct room temperature conversion of light to electricity through a simple solid state device.
Absence of moving parts
Maintenance cost is low so they are easy to operate
Do not create pollution
Long effective life
Highly reliable.

Disadvantages
High cost.
In many applications energy storage is required because of no insolation at night.

19. What are the advantages & disadvantages of concentrating collectors over flat plate type collectors?

Advantages:

Reflecting surfaces required less material and are structurally simpler than flat plate collectors. For a concentrator system the cost per unit area of solar collecting surface is therefore potentially less than that for flat plate collectors

The absorber area of a concentrator system is smaller than that of a flat plate system for same solar energy collection and therefore the insulation intensity is greater.

Little or no anti-freeze is required to protect the absorber in a concentrator system whereas the entire solar energy collection surface requires anti-freeze protection in a flat plate collector.

Disadvantages:

Out of the beam and diffuse solar radiation components, only beam component is collected in case of focusing collectors because diffuse component cannot be reflected and is thus lost.

Additional requirements of maintenance particular to retain the quality of reflecting surface against dirt, weather, oxidation etc.,
Non-uniform flux on the absorber whereas flux in flat plate collectors is uniform

Additional optical losses such as reflectance loss and the intercept loss,so they introduce additional factors in energy balances

High initial cost

20. Name the types of concentrating collectors.

The main types of concentrating collectors are:
Parabolic trough collector,
Mirror strip reflector,
Fresnel lens collector,
Flat plate collector with adjustable mirrors,
Compound parabolic concentrator (CPC)

21. What are the zones in solar pond?

Surface convective zone or upper convective zone (0.3-0.5m)

Non-convective zone (1-1.5m) salinity increases with depth.

Storage zone or lower convective zone (1.5-2m) salinity =20%

22. **What are the merits of solar cooker?**

No attention needed while cooking
No fuse required
Negligible maintenance cost
No pollution
Vitamins of food are not destroyed
No overflowing.

23. What are the limitations of solar cooker?

According to sunshine menu should be prepared
Short time cooking not possible
Cooking at night or cloudy days is difficult
Takes long time for cooking

Chapaties are not cooked because of high temperature requirement and needs manipulation at the time of baking

24. What are the reasons for solar pumping usage?

Need for pumping occurs during the summer when solar radiation is greatest. During periods of low radiation when pumping reduce evaporation losses from crops also low.

25. What is the need for solar crop drying?

High moisture crops are prone to fungus infection, attack by insects and rests. Solar dryers remove moisture with no ingress at just and the product can be preserved for a longer period at time.

26. State the use of solar kilns?

For large scale drying ie seasoning of timber, corn drying, tea processing, fish and fruit drying, solar kilns are in use.

27. List the different modes of solar cooling

Evaporative cooling
Absorption cooling and
Passive desiccant cooling.

28. What are the units of absorption type solar cooler?

Generator
Condenser
Evaporator

29 . What are the advantages of solar cells?

They need little maintenance
They have longer life
They do not create pollution problem
Their energy source is unlimited
Easy to fabricate
They can be made from raw materials which are easily available in larger quantities.

30. What are the disadvantages of solar cell?

Compares with other sources of energy solar cells produce electric power at very high cost
Solar cell output is not constant and it varies with the time of day and weather
They can be used to generate small amount of electric power.

31. What are the components of basic solar pumping system?

The solar collector
The heat transfer system
Boiler or heat exchanger
Heat engine
Condenser
Pump

32. List the types of heat engines used in solar system

Rankine engine
Reciprocating engine
Vapor engine
Stirling hot gas engine
Brayton cycle gas turbine
Rotary piston engine.

33. Write the equation for over all efficiency of solar pump?

Over all efficiency= Efficiency of the engine* Efficiency of the collectors

34. List the working fluids used in solar pumps

Foluene
Mono chloro benzene
Frifuluro ethanol
Hexa flura benzene.

35. What are the two types of flat plate collectors?

Liquid heating collectors
Solar air heaters

36. What is Green house effect?

The energy we receive from sun in the form of light is a shortwave radiation (not visible to human eye). When this radiation strikes a solid or liquid it is absorbed and transformed in to heat, the material becomes heat and conducts it to surrounding materials (air, water or liquids) or reradiates in to other materials of low temperature as long wave radiation.

37. What is concentration ratio?

Concentration ratio is the ratio between the aperture area and receiver /absorber area of the collector.

38. List the five advantages of solar energy

It is free from pollution

The plant requires little maintenance or help after set up

It is economical

They collect solar energy optically and transfer it to a single receiver thus minimizing thermal energy transport requirement

Concentration ration is 300 to 1500 and are highly efficient both in collecting energy and in converting energy.

39. List any four disadvantages of solar energy

It is available only by day and not when the sky is cloudy, thereby reducing the chances of it being totally reliable and requiring storage facilities.
It needs back up power plant to be kept hot and not to replace solar power stations they stop producing energy.
Keeping back up plants hot includes an energy cost which includes coal burning.
Places located at high altitudes or those that are often cloudy are not targets for solar power use.

PART-B

1. Explain in detail how solar energy can be effectively utilized in day-to-day life.

2. Draw illustrative diagram showing all the important components of solar heating and solar cooling unit. Explain the working principles of these devices.

3. Explain with necessary diagram the construction, principles of operation and applications of solar collector.

4. Explain with neat diagram solar space cooling and solar pond electric power plant.

5. Write short notes on:
a) Solar pumping b) Solar desalination.

6. Describe the photovoltaic principles of solar power generation. Compare the different types of solar cells with respect to power output and efficiency.

7. Write briefly about characteristics and principles of any three different types of solar collectors. Draw diagrams illustrating the constructional features of these collectors.

8. Draw and explain different types of solar cookers.
9. Explain with neat diagram about solar pond and its characteristics.

10. Discuss briefly about a) Solar drying b) solar cells

11. Draw schematic diagram of solar thermal power plant used for power production and explain the operation of this system in detail.
12. a) Give merits and demerits on solar energy.
    b) State some important the applications of PV.

UNIT-5

WIND ENERGY

Part-A

1. **What are the features of wind energy?**

The characteristics of wind energy are:
It is renewable source of energy
Like all forms of solar energy, wind power systems are non-polluting, so it has no adverse influence on the environment.
Wind energy systems avoid fuel provision and transport.
On a small scale, up to a few kilowatt system, is less costly.

2. What are the problems associated with wind energy?

The problems associated with wind energy are:
Wind energy available is dilute and fluctuating in nature. Because of the dilute form, conversion machines have to be necessarily large.
Unlike water energy, wind energy need storage means because of its irregularity.
Wind energy systems are noisy in operation; a large unit can be heard many kilometers away.
Large areas are needed to install wind farms for electrical power generation.

3. List out the factor led to accelerated development of wind power.

Availability of high strength fibre composites for constructing large low cost rotor blades
Falling prices of power electronics.
Variable speed operation of electrical generators to capture maximum energy
Improved plant operation, pushing the availability up to 95%
Economy of scale, as the turbines and plants are getting larger in size
Accumulated field experience improving the capacity factor
Short energy payback period of about one year

4. What are the features prefer for the wind turbine site?

No tall obstructions for some distance in the upwind direction and also a low a roughness as possible in the same direction
A wide and open view i.e., opens plain, open shore line or offshore locations
Top of smooth well-rounded hill with gentle slopes on a flat plain
An island in a lake or the sea
A narrow mountain gap through which wind is channeled
Site reasonably close to power grid
Soil conditions must be such that building of foundations of the turbines and transport of road- construction materials loaded in heavy trucks is feasible.

Production results of existing wind turbines in the area to act as a guide to local wind conditions.

5. What are the types of rotors for HAWT?

The different types of rotor for HAWT are:

Single blade rotor.
Two blade rotor
Three blade rotor
Sailing rotor
Chalk multiblade rotor
American multibladed rotor
Dutch type rotor

6. What are the types of generator drive for the operation of WECS?

The types of generator are suitable for the wind generations are:
DC generator,
Synchronous Generator,
Induction generator

7. Define gusts.

Rapid fluctuations in the wind velocity over a wide range of frequencies and amplitudes, due to turbulence caused by mechanical mixing of lower layers of atmosphere by surface roughness, are commonly known as gusts.

8. What are the features of VAWT?

The features of VAWT:
It can accept wind from any direction, eliminating the need of yaw control.
The gearbox, generator, etc., are located at the ground, thus eliminating the heavy nacelle at the top of the tower, thus simplifying the design and installation of the whole structure, including the tower.
The inspection and maintenance also gets easier
It also reduces the overall cost.

9. What are the types of rotors for VAWT?

The different types of rotor for HAWT are:
Cup type rotor
Savonious rotor
Darrieus rotor
Musgrove rotor
Evans rotor.

10. Define power coefficient

The fraction of the free flow wind power that can be extracted by a rotor is called the power-coefficient.

Power coefficient = Power of wind turbine/Power available in the wind

11. List out the merits of WECS.

It is a renewable source of energy like all forms of solar energy, wind power systems are non-polluting, so it has no adverse influence on the environment. Wind energy systems avoid fuel provision and transport. On a small scale upto a few kilowatt system is less costly. On a large- scale costs can be competitive with conventional electricity and lower coats can be competitive with conventional electricity and lower costs could be achieved by mass production.

12. List out the demerits of WECS

Wind energy available in dilute and fluctuating in nature. Unlike water energy wind energy needs storage capacity because of its irregularity Wind energy systems are noisy in operation; a large unit can be heard many kilometers away. Large areas are needed, typically, propellers 1 to 3 m in diameter, deliver power in the 30 to 300W range.

13. What are the components of wind turbine generator units?

A wind turbine unit consists of the following major assemblies: A wind turbine with vertical axis or horizontal axis. Gear chain An electrical generator (synchronous or asynchronous (induction)) Associated civil works, electrical and mechanical auxiliaries, control panels etc.,

14. Classify the schemes available for electric generation.

The schemes are available for electric generation is of three categories.

Constant-speed constant frequency systems (CSCF)
Variable speed constant frequency systems (VSCF)
Variable speed variable frequency systems (VSVF)

15. Define wind turbine.

A wind turbine which converts wind power into rotary mechanical power. A wind turbine has aerofoil blades mounted on the rotor. The wind drives the rotor and produces rotary mechanical energy.

16. What is cut in speed and cutout wind speeds for turbine?

CUT IN SPEED

Wind speed at which wind turbine starts delivering shaft power.

Cut in speed:

While operating - 7m/s

While stopping - 5m/s.

CUT OUT SPEED

At high velocities during storms, it is necessary to cut out the power conversion of wind turbine by furling the wind turbine blades.

The speed at which power conversion is cut out is called cut out wind speed or furling wind speed.

Cut out speed: While operating - 20m/s

While stopping - 17m/s

Rated speed - 14m/s.

17. Name the two natural phenomena in the atmosphere of different origins.

Winds are natural phenomena in the atmosphere and have two different origins.

Planetary Winds are caused by daily rotation of earth around its polar axis and unequal temperatures between Polar Regions and equatorial region.
Local Winds are caused by unequal heating and cooling of ground surfaces and ocean/lake surfaces during day and night.

18. **Name the characteristics in which the speed of a wind turbine rotor depends.**

The speed of a wind turbine rotor depends principally on
Wind speed
Pitch of the turbine blades
Mechanical and electrical load i.e., shaft load, friction, breaking force etc.,
Orientation of yaw with reference to the wind.

19. Mention the advantages of vertical axis wind turbine over horizontal axis

They will react to wind from any direction and therefore do not need yawing equipment to turn the rotor into the wind.

They can require less structural support because heavy components can be located at ground level. This configuration also eases installation and maintenance.

Since the blades do not turn end over end, the rotor is not subjected to continue cyclic gravity loads.

20. What are the factors consider for the electrical generators and controlmethod?

The choice of an electrical generator and control method can be considered by following three methods:
The basis of operation i.e., either constant tip speed or constant tip speed ratio
The wind power rating of the turbine
The type of load demand e.g. battery connection.

21. What are the main Environmental aspects due to wind turbines?

The main environmental aspects are:
Indirect energy use and emissions
Bird life
Noise

Visual impact

Telecommunication interference

Safety

Effects on ecosystem

22. What are the characteristics of good wind power site?

A site should have a high annual wind speed.
There should not be any obstructions for a radius of 3Km
An open plain or an open line may be a good location
The top of a smooth.

23. List the components of wind energy systems

A rotor
A gear box
An enclosure
A tail vane.

24. Explain the principles of wind energy conversion.

There are two primary physical principles by which energy can be extracted from the wind; these are through the creation of either lift or drag force (or combination of two)

25. What are the features of lift and drag?

Drag in the direction of air flow
Lift perpendicular to the direction of air flow
Generation of lift always causes certain amount of drag to be developed
Lift devices are more efficient than drag devices.

26. List wind speed types.

Start up wind speed
Cut in wind speed
Rated wind speed
Furling wind speed
Maximum design wind speed.

27. What are basic designs of wind turbines?

Vertical axis or egg beater style
Horizontal axis (propeller style)

28. What are the types of wind power plants?

Remote
Hybrid
Grid connected system.

29. What are the advantages of wind energy systems?

Inexhaustible fuel source
No pollution
Often an excellent supplement to other renewable sources
Reduces fossil fuel consumption
Wind power plant create may jobs
Increases local tax revenues
Least reliance on foreign oil
It's free.

30. What are the disadvantages of wind energy systems?

Large areas are needed

Suitable for wind power generation
Relatively expensive to maintain
Large numbers of wind generators are required to produce useful amount ofheat or electricity.

31. What are the safety systems in wind energy system?

The computer
Emergency stop
Revolution counters
Lightning

32. What are the environmental impacts of wind energy systems?

Electromagnetic interference
Noise
Visual effect.

33. List the classification of wind mills according to size.

Small scale (up to 2Kw)
Medium size machines .

34. List classification according to output power

DC output
AC output
a)Variable frequency variable or constant voltage AC
b) Constant frequency, variable or constant voltage AC.

35. What are the types of horizontal axis machines?

Single bladed
Multi bladed
By cycle multi blade type.

36. What are the vertical axis machines?

Savonius or S type rotor mill
Davieus type rotor mill.

PART-B

1. Is wind energy a better alternative source of energy for Indian demand? Explain in detail how wind energy is produced.
2. Explain in detail about the performance and efficiency of different types of wind mills.
3. Describe with a neat sketch the working of a wind energy conversion system (WECS) with its main components.
4. a) What is the origin of wind and what are the various factors which govern wind energy and direction?
   b) Determine the overall power coefficient for a wind turbine with a rated power of 3 MW, speed 18m/s and blade diameter 40 metre.
5. Explain the preliminary design of wind electric system.
6. Explain the working of a horizontal axis wind turbine driven generator with a diagram. Show the mechanism for the automatic reorientation of the turbine axis along the wind direction.

7. a) Explain the principle of electric power generation from wind mill.
   b) Discuss its types and components. Also indicate the best site for locating them.
8. Explain the principle of operation of any two types of wind mill with neat diagram and discuss its characteristics and constraints if any.
9. Discuss briefly about
   a) Performance of wind mills
   b) Wind power generation in India.
10. Describe the savonious type of rotor in wind mill.
11. Compare the performance of horizontal and vertical axis wind mills.
12. How wind energy conversion systems are classified? Discuss in brief. What are its advantages and disadvantages?
13. Explain the safety and environmental aspects of wind energy.