V.S.B COLLEGE OF ENGINEERING TECHNICAL CAMPUS, COIMBATORE

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV EEE-VIII Semester all subjects 2 & 16 marks QP

EE6801 ELECTRIC ENERGY GENERATION, UTILISATION AND CONSERVATION

TWO MARKS QUESTIONS WITH ANSWERS

UNIT I

ELECTRIC DRIVES AND TRACTION

1. What is meant by electrical drives?

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

2. What are the requirements of an electric drive?

- Stable operation should be assured.
- The drive should have good transient response

3. Specify the functions of power modulator.

Power modulator performs one or more of the following four functions.

- Modulates flow of power form the source to the motor in such a manner that motor is imparted speed-torque characteristics required by the load.
- During transient operations, such as starting, braking and speed reversal, it Restricts source and motor currents within permissible values; excessive current drawn from source may overload it or may cause a voltage dip.

4. Mention the different types of drives.

- Group drive
- Individual drive
- Multimotor drive

5. List the different types of electrical drives.

- dc drives
- ac drives

6. What are the advantages of electric drives?

They have flexible control characteristics. the steady state and dynamic characteristics of electrical drives can be shaped to satisfy load requirements.

- Drives can be provided with automatic fault detection systems, programmable logic controllers and computers can be employed to automatically ctrl the drive

operations in a desired sequence.

- They are available in which range of torque, speed and power.
- It can operate in all the four quadrants of speed torque plane. Electric braking Gives smooth deceleration and increases life of the equipment compared to other forms of braking.
- Control gear required for speed control, starting and braking is usually simple and easy to operate

7. What are the functions performed by electric drives?

Various functions performed by electric drives include the following.

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

8. What are the disadvantages of electric drives?

The disadvantages of electric drives are

- Electric drives system is tied only up to the electrified area.
- The condition arising under the short circuits, leakage from conductors and breakdown of overhead conductor may lead to fatal accidents.
- Failure in supply for a few minutes may paralyses the whole system.

9. What are the advantages of group drive over individual drive?

The advantages of group drive over individual drive are

- Initial cost: Initial cost of group drive is less as compared to that of theIndividual drive.
- Sequence of operation: Group drive system is useful because all the operations are stopped simultaneously.
- Space requirement: Less space is required in group drive as compared to individual drive.
- Low maintenance cost: It requires little maintenance as compared to individual drive.

10. What the group drive is not used extensively.

Although the initial cost of group drive is less but yet this system is not used extensively because of following disadvantages.

- Power factor: Group drive has low power factor
- Efficiency: Group drive system when used and if all the machines are not working together the main motor shall work at very much reduced load.
- Reliability: In group drive if the main motor fails whole industry will come to stand still.
- Flexibility: Such arrangement is not possible ingroup drive i.e., this arrangement is not suitable for the place where flexibility is theprime factor.
- Speed: Group drive does not provide constant speed.
- Types of machines: Group drive is not suitable fro driving heavy machines such as cranes, lifts and hoists etc.

11. Write short notes on individual electric drives.

In individual drive, each individual machine is driven by a separate motor. This motor also imparts motion to various other parts of the machine. Examples of such machines are single spindle drilling machines (Universal motor is used) and lathes. In a lathe, the motor rotates the spindle, moves the feed and also with the help of gears, transmits motion to lubricating and cooling pumps. A three phase squirrel cage induction motor is used as the drive. In many such applications the electric motor forms an integral part of the machine.

12. Mention the different factors for the selection of electric drives?

- Steady state operation requirements.
- Transient operation requirements.
- Requirements related to the source.
- Capital and running cost, maintenance needs life.
- Space and weight restriction.
- Environment and location.
- Reliability.

13. Mention the parts of electrical drives.

- Electrical motors and load.
- Power modulator
- Sources
- Control unit
- Sensing unit

14. Mention the applications of electrical drives

- Paper mills
- Electric traction Cement mills
- Steel mills

15.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.

16. 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.

17. 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.

18. 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.

19. 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.

20. 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.

21. 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.

22. 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.

23 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.

24. What are the various types of electric traction?
    i)Self contained electric vehicle.
    ii) Electric vehicle fed from the distributed network.

25. What are the various vehicles falling under electric vehicle fed from the distributed network?
    i)Tram ways
    ii)Trolley buses
    iii)Electric locomotives or trains.

26. 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.

27. 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.

28. 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.

29. 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.

30. State any four advantages of electric traction.

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.

31.How would you analyze the speed time curve for electric train?

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

32. What is crest speed?

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

33. What is average speed?

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

34. What is scheduled speed?

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

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

35. What are the factors affecting the schedule speed of the train? i)Crest speed

ii)Acceleration

iii)Braking retardation

iv)Duration of stops.

36. What is tractive effort?

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.

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

The tractive effort is given to be

$$Ft = Fa + Fg + Fr$$

Where, Fa = Force to overcome linear or angular motion

Fg = Force to overcome effect of gravity

Fr = Tractive effort to overcome the frictional resistance.

38. Define coefficient of adhesion.

$$\text{Coefficient of adhesion} = \frac{\text{Tractive effort to slip the wheel}}{}$$

Adhesive weight

39. 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.

40. Define dead weight.

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

41. 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.

42. Define adhesive weight.

It is the weight carried on driving wheel.

43. 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.

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

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

UNIT II
ILLUMIINATION

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.

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

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.

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

UNIT III

IHEATING AND WELDING

1.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.

2 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.

3.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.

4. 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.

5.Name the uses of dielectric heating. i)For baking foundry cores ii)For food processing
iii)For wood processing industry.

6.Name the uses of induction heating.

i) Surface hardening
ii) Deep hardening iii)Tempering
iv)Soldering v)Melting.

7.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.

8. 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
3.	Operation cost is high.	Operation cost is low

9. 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.

10.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.

11.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.

12. 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.

13. What are the advantages of dielectric heating?

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.

14.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.

15.Write any two reasons for the failure of heating element.

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.

16. Classify the methods of electric heating. Kinds of electric heating

A. Power frequency heating

a. Resistance heating

i) Direct resistance heating

ii) Indirect resistance heating

iii) Infrared or Radiant heating

b. Arc heating

i) Direct arc heating
ii) Indirect arc heating

B. High frequency heating
a. Induction heating
i) Direct induction heating
ii) Indirect induction heating
b. Dielectric heating

17. What is meant by indirect resistance heating?

In this method, the current is passed through a high resistance wire known as heating element. The heat produced due to I2 R loss in the element is transmitted by radiation or convection to the body to be heated.

Applications are room heaters, in bimetallic srip used in starters, immersion water heaters and in domestic and commercial cooking and salt bath furnace.

18. What is meant by(1) infra red /radiant heating? (2)Dielectric heating?

(1)When current possess through a resistive element heat energy is produced and the same is dissipated in the form of infrared radiation this is focused upon a body to be heated .e.g. to dry the wet paint on an object.

(2)When a non metallic material is placed between two electrodes at high voltage the dielectric loss is dissipated in the form of heat which is used for heating purposes.

19.)What are the properties of a good heating material?

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

20. What is the basic principle of induction heating?

High frequency eddy current heating produced by eddy currents induced by electromagnetic action in the metal to be heated. It works on the principle of electromagnetic induction as same as a transformer. It has a metal disc surrounded by a copper coil in which a.c supply is flowing. The disc has a finite value of diameter and thickness and is spaced a given distance from the coil and concentric to it. We find that a secondary current is caused to circulate around the outer surface of the disc.

20.Name the different types of electric welding.

i)Electric arc welding
ii)Electric resistance welding iii)electron beam welding.

21. Where is spot welding employed?

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

22.Where is carbon arc welding employed?

Carbon arc welding is usually employed in welding copper metal and its alloys. 23.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.

24.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.

25.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.

26.State different types of electric arc welding.
i)Metal arc welding
ii)Inert arc welding
iii)Carbon arc welding
iv)Atomic hydrogen arc welding.

27.What are the two types of Butt welding?
i)Upset butt welding
ii)Flash butt welding.

28.What are the various types of electric resistance welding?
i)spot welding
ii)Projection welding
iii)Seam welding
iv)Butt welding

UNIT IV
SOLAR RADIATION AND SOLAR ENERGY COLLECTORS

1. 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.

2. List the drawbacks of Solar Energy.

The intermittent and variable manner in which it arrives at the earth's surface and
The large area required to collect the energy at a useful rate.

3. 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.

4. 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.

5. 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:
Non- concentrating or flat plate type solar collector.
Concentrating (focusing) type solar collector.

6. 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

7. 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

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

The performance indices of a solar collector are Collector Efficiency 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 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 is the range of temperature to which the heat transport fluid is heated up by the collector.

9.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

10.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.

11. 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.

12. 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.

13.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

14. What are the advantages & disadvantages of PV solar energy conversion system?

Advantages
Direct room temperature conversion of light to electricity through a simple solid state device.
Absence of moving parts Maintenance cost is low s 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.

15. 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 s olar 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 can not 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

16.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)

17What 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%

UNIT-V
WIND ENERGY

1. 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 upto 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 .

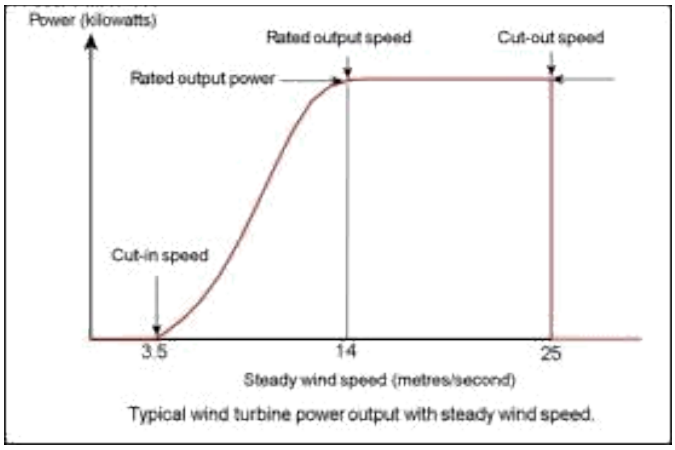
2. What are the features prefer for the wind turbine site?

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.

3. What are the merits and demerits of three blade rotor over two blade rotors?

Compared to the two blade design, the three blade machine has smoother power output and balanced gyroscopic force. There is no need to teeter the rotor, allowing the use of a simple rigid hub. The blades may be cross-linked for greater rigidity. Adding a third blade increases the power output by about 5% only, while the weight and cost of a rotor increases by 50%, thus giving a diminished rate of return for additional 50% weight and cost. The two blade rotor is also simpler to erect, since it can be assembled on the ground and lifted to the shaft without complicated maneuvers during the lift.

4. Draw the power Vs wind speed characteristics.



Typical wind turbine power output with steady wind speed.

5. Draw the block diagram of WECS.

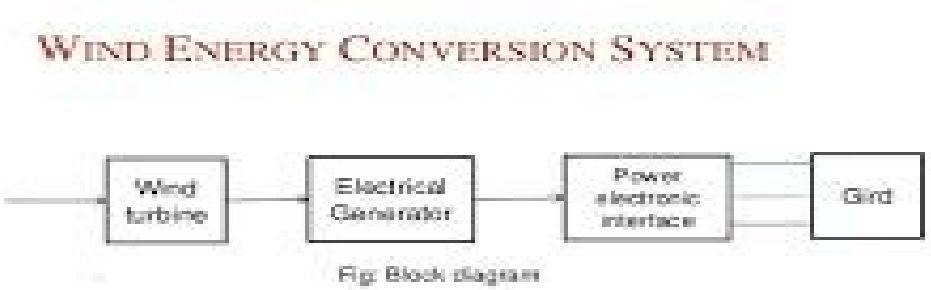


Fig: Block diagram

- Fixed speed wind turbines
- Partially Variable speed wind turbines
- Fully Variable speed wind turbines

3

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. 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

10. 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.

11. 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.
12. 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.,

13. 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)

14.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 Mark Questions

EE6801 ELECTRIC ENERGY GENERATION, UTILISATION AND CONSERVATION

UNIT I

ELECTRIC DRIVES AND TRACTION

1. Write the advantages and disadvantages of electric drives
2. Write about of choice of electrical drives
3. Write the advantages of electric traction systems and mention the requirements of electric traction systems
4. Decribe the supply system used in electric traction systems.
5. Define coefficient of adhesion. Derive an expression for the tractive effort for the propelling a train.
6. Write in detail about mechanics of train movement
7. Derive the expression for specific energy output
8. Write about the various methods of traction motor control
9. Explain briefly the recent trends in electric traction.
10. Explain series - parallel control of dc motors with relevant diagrams
11. 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.
12. 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.
13. Explain about multiple unit control and braking of traction motor
14. 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.
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. .Derive the expression for energy output from driving axles.

16. 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.

UNIT II
ILLUMIINATION

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

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

2. i) Explain the operating principle of anyone type of photometer.

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

3. Explain the construction and working of

i) Carban arc lamp ii) Flame arc lamp iii) Magnetic arc lamp.

4. i) Define MSCP and luminous efficiency.

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

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

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

6.i) Define candle power and lux.

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

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

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.

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.

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.

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.

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?

19. Explain with a neat diagram the principle and operation of sodium vapour lamp. Mention its uses.

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.

UNIT III

IHEATING AND WELDING

1. Mention the requirement of heating element. Explain the types of resistance heating.
2. Describe the operation and characteristics of welding generator sets (both AC and DC).
3. Explain the welding transformer and its characteristics
4. Explain the working of core type induction furnace with a neat sketch.
5. What is dielectric heating? How is this different? Explain the Explain the construction and working principle of dielectric heating.
6. Explain coreless type induction furnace?
7. Describe the operation of vertical core type or Ajax Wyatt induction furnace.
8. A 5KW, 440volts, 3 phase resistance oven is to have a 3star connected nichrome strip of 0.3mm thick heating element. If the wire temperature is to be 1500°c and that of the charge 1000°c, estimate the suitable width of the strip. Resistively of nichrome alloy is $1.016X10^{-6}$ Assume the radiating efficiency and emissivity of the element as 0.6 and 0.91respectively.
9. A laminated plywood board 40cm x 25 cm x 1.8 cm is to be heated from 25º C to 160º C in 12 minutes, using 25 MHz supply, specific heat of wood is to be taken as 0.32, density is 0.6 g / cm 3 , relative permittivity of wood is 6 and power factor 0.05. Find the supply voltage, power required and current drawn. Take the efficiency of the process as 75%
10. Calculate the energy required to melt one metric ton of brass in a single – phase Induction furnace. If the time taken is 1.5 hr, find the power input to the furnace.
Specific heat of brass = 0.094
Latent heat of fusion of brass = 38 kcal / kg Melting point of brass = 920º C
Furnace efficiency = 80%, Temperature of charge = 20º C (8)
11. A 105 KVA of tin is to be melt during an hour in a melting furnace. Determine a suitable rating of the furnace if melting temperature of tin is 240˚ C. Take initial temperature of metal as 35˚ C. Specific heat = 0.055 Kcal/kg ˚ C Latent heat of liquid = 13.3 Kcal/kg

UNIT IV
SOLAR RADIATION AND SOLAR ENERGY COLLECTORS

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-V
WIND ENERGY

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 saronious 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

EE6009 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

Unit – I

INTRODUCTION

1.Give any two environmental aspects of electric energy conservation.

Environment means surrounding.Nature has provided a clean environment to the human beings. But with the passage of time , the quality of the environment (main constituent air , soil, water) is degrading. Every step must be taken to conserve the environment while supplying increased energy demand. A trade off between the energy and environment is a must. To create public awareness June 5^{th} is observed as World Environment Day.

During every energy conversion process pollutants are produced as a by-product.The various pollutants and its harmful effects is an important environmental aspects of electric energy conservation. Particulate matter

,CO_2,CO,SO_X,NO_X are the various pollutants.Their harmful effects are change in climatic condition,global warming , depriving oxygen and increase in cardio- vascular diseases, corrosion of architectural buildings etc.

2. Discuss about GHG Emission? List the factors influencing the amount of GHG emissions.

Gases that trap heat in the atmosphere are called greenhouse gases (GHG) .The greenhouse is a n enclosure having transparent glass pane trapping the heat in the atmosphere. Similarly the CO_2 is an enclosure present around the globe which prevents the heat from the earth to escape. This cause the global warming. This effect of GHG such as methane, CO_2,nitrous oxide,sulphur hexafluoride,water vapour,hydroflurocarbon is lead to global warming.The CO_2 leads to 82% of total GHG emission.**The main factors which influence the GHG emission is –**

(i) Large scale fossil fuel combustion of power plant all over the world.
(ii) Felling of trees- deforestation –industrialization
(iii) Pollution due to vehicles and byproducts of industries.

GHG :

(i) Carbon dioxide enters the atmosphere through burning fossil fuels (coal, natural gas, and oil), solid waste, trees and wood products, and also as a result of certain chemical reactions (e.g., manufacture of cement).
(ii) Particulate matter lead to reduced sunlight and low visibility- respiratory problems
(iii) SO_2,SO_3 due to combustion of fuel from motor vehicles, power plant, waste disposal
(iv) Methane is emitted during the production and transport of coal, natural gas, and oil.
(v) Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.
(vi) Fluorinated gases: Hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes.

3.List various renewable energy resources.

Solar energy
Wind energy
Biomass
Geothermal energy
Ocean Tidal Power
Ocean Wave Power
Ocean Thermal energy conversion

4.List the significance of renewable energy resources.

- The conventional energy resources such as fossil fuel, hydro,nuclear etc are fast depleting and lead to climate change and global warming.
- The reneable energy resources are pollution free inexhaustible,available in abundance.
- Reliability, Stability are two significant factors which lead to hybrid systems.
- The cost of harnessing the energy is high. Diffuculty in transportation.
- Accessibility - Coal, natural gas and oil reserves are finite and hidden.

5. Discriminate spring and neap tides?

The difference between spring and neap tides is that spring tides are much higher than normal and neap tides are lower than normal. Spring tides occur because of the combined effects of the sun and moon, whereas neap tides happen when the sun and the moon are at right angles.

6. Explain the principle of power generation using tides?

Tide or wave is periodic rise and fall of water level of the sea. Tides occur due to the attraction of sea water by the moon. Tides contain large amount of potential energy which is used for power generation. When the water is above the mean sea level, it is called flood tide. When water level is below the mean level it is called ebb tide.

7. List the limitations of Tidal energy.

- Variations in tidal range cause the output to not uniformed throughout the day.
- Because of the variation of headwater throughout the day, the plants effectiveness is slightly compromised.
- Maintenance of machinery is difficult when preformed underwater or at sea.
- Construction of a solid tidal dam is difficult with tide changes.
- The corrosives nature of seawater is proven to corrode untreated modern machinery.
- Tidal fences in order to mitigate fish migration would be difficult to construct and maintain.
- Generation posts are usually far away from collection stations, leading to high cost of transmission lines.
- Tidal is a time-specific base load, meaning it cannot conform to peak demands.

8. Compose various ocean tidal energy conversion schemes available. [

- Tidal energy – from gravitational fields of sun and moon
- Thermal energy (OTEC) – from solar radiation
- Marine current – by thermal and salinity differences in addition to tidal effects.
- Ocean waves – by winds blowing over the ocean surface.
- Salinity gradient

9. Discuss about anaerobic digestion? And its advantages.

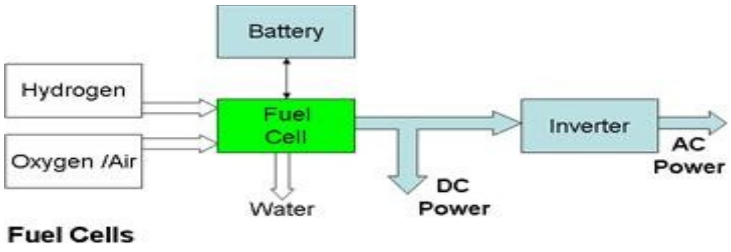
Anaerobic digestion is the natural breakdown of organic materials into methane and carbon dioxide gas and fertiliser. This takes place naturally, or in an anaerobic digester.

The process is used for industrial or domestic purposes to manage waste or to produce fuels. Much of the fermentation used industrially to produce food and drink products, as well as home fermentation, uses anaerobic digestion.

Advantages of Anaerobic Digestion

1. It is a net energy producing process which produces renewable energy in the form of biogas.
2. It produces a liquid and a fibrous fertilizer.
3. It sanitizes the feedstock/ waste which is put through it, as long as the temperature is held above a required temperature for a pre-defined time period.
4. It reduces odour below unprocessed waste odour levels.
5. It is much less likely to cause environmental pollution than spreading untreated organic waste on land.
6. The effect of the fertilizer is longer lasting than for untreated organic waste.

10. Discuss how to use hydrogen energy to generate electric power?



Hydrogen fuel is a zero-emission fuel when burned with oxygen or used in a contained cell. It often uses electrochemical cells, or combustion in internal engines, to power vehicles and electric devices.

Hydrogen gas is so light, it rises in the atmosphere and is therefore rarely found in its pure form, H_2. In a flame of pure hydrogen gas, burning in air, the hydrogen (H_2) reacts with oxygen (O_2) to form water (H_2O) and releases energy.

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

The energy released enables hydrogen to act as a fuel. In an electrochemical cell, that energy can be used with relatively high efficiency. If it simply is used for heat, the usual thermodynamics limits on the thermal efficiency apply.

11. Identify the problems associated with tapping solar energy?

Solar energy systems offer significant environmental benefits in comparison to the conventional energy sources, thus they greatly contribute to the sustainable development of human activities. At times however, the wide scale deployment of such systems has to face potential negative environmental implications. These possible problems may be a strong barrier for further advancement of these systems in some consumers.

The potential environmental impacts associated with solar power can be classified according to numerous categories, some of which are land use impacts, ecological impacts, impacts to water, air and soil, and other impacts such as socioeconomic ones, and can vary greatly depending on the technology, which includes two broad categories:

- Photovoltaic (PV) solar cells or
- Concentrating solar thermal plants (CSP).

12. Summarize the factors influencing solar power extraction?

- Cable Thickness
- Temperature
- Shading
- Charge Controller and Solar Cell's IV Characteristics
- Inverter Efficiency
- Battery Efficiency

13. Identify the limitation of solar power.

The chief limitations of solar energy include an inability to generate power at night, an inability to ramp up power production to meet demand, and the cost of solar panels. Transferring the electricity from areas where solar is more efficient to other areas of the planet is also a problem.

14. Explain about NOCT and STC of a solar cell.

Standard Test Conditions are the laboratory conditions under which all PV modules are tested. It can be said that STC is a benchmark for comparing different types of PV modules, even if they are not from the same provider. STC means:

- An irradiance of 1000 watts per square meter, which simulates peak sunshine on a surface directly facing the sun in a day without clouds.
- A surface temperature of 25°C
- A light spectrum that closely simulates sunlight: AM 1.5 G

However, these are idealized conditions which don't reflect the real site conditions under which a PV module will operate. The conditions at **Nominal Operating Cell Temperature** aim to simulate reality more closely:

- The irradiance is 800 watts per square meter, which takes into account the fact that PV modules don't always face the sun. It also considers atmospheric or geographic conditions what might diminish sunshine.
- Solar panels heat up considerably during operation, so the temperature considered is 45 (+/- 3) °C.
- The light spectrum is the same as for STC.
- A windspeed of 1 m/s is considered, with air at 20°C

This means that solar panels will always have higher ratings at STC compared with NOTC.

15. Discuss about fuel cell and mention its specification.

Basically, a fuel cell is a device that converts directly the chemical energy stored in gaseous molecules of fuel and oxidant into electrical energy. When the fuel is hydrogen the only by-products are pure water and heat. The overall process is the reverse

of water electrolysis. In electrolysis, an electric current applied to water produces hydrogen and oxygen; by reversing the process, hydrogen and oxygen are combined to produce electricity and water (and heat).

Fuel cells rely on an electrochemical reaction involving the fuel, and not on its combustion. A Carnot cycle involving the transformation of heat into mechanical and electrical energy is involved in conventional methods for generating electricity.

16. Show fuel cell characterization

Overall performance (i-V curve, power density)
Kinetic properties
Ohmic properties
Mass transport properties
reactant/product homogeneity
Parasitic losses
Electrode structure
Catalyst structure
Flow structure
Heat generation/heat balance;
Lifetime issues (lifetime testing, degradation, cycling, startup/shutdown, failure, corrosion, fatigue).

17. Classify the types of fuel cell.

- PEMFC, Proton Exchange Membrane Fuel Cell
- DMFC, Direct Methanol Fuel Cell
- PAFC, Phosphoric Acid Fuel Cell
- AFC, Alkaline Fuel Cell
- MCFC, Molten Carbonate Fuel Cell
- SOFC, Solid Oxide Fuel Cell

18. Explain how to assess the wind energy pattern for a particular location.

Level of wind power penetration; Grid size; and Generation mix of electricity in the system.

19. Point out the impact of wind power penetration in power grid.

- Voltage variations in Steady state voltage under continuous production of power
- Voltage fluctuations
- Harmonics

20. Name the domestic application of wind energy.

- Generating Power at Remote Sites
- Low-Power Applications - Electric fence charging, Cathodic protection.
- Village Electrification AND Interconnecting with the Utility

21. List the types of wind turbine and differentiate it

Sl.No	HAWT (Horizontal axis turbine)	VAWT (Vertical axis turbine)
1	It is used for low power application and use yaw control. It is more widely used one.	It can accept wind from any direction eliminating the need for yaw control.
2	Hawt capture more power than VAWT for the same tower height and wind speed.	The inspection and maintainance is easy and cheap.
3	More costly than VAWT.	The gear and generator are located at ground level which simplify the design of tower and installation cost.
4	It is less noisy than VAWT	It is noisy .

22. What is green power?

The **green power** is used to describe the sources of energy which are environmental friendly,non-polluting , and hving a remedy to effects of pollution and global warming. These sources are called renewable energy sources such as sun,wind, water, biomass,and waste.

23. What is Hydrogen energy?

The hydrogen alone or mixed with natural gas is used in a combustion based power generation such as gas turbine for stationary power generation in standalone power plants or in a fuel cell based generation unit. Hydrogen is an optimum choice for fuel cell, which are efficient energy conversion devicesThe HFI (HYDROGEN FUE CELL) is a cost effective project to produce fuel cell vehicles at low cost developed by George Bush in 2003 in US.

Unit – II

ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION

1. What is the application of reference theory?

- Reference frame theory is used to eliminate Rotor Position Dependence Inductances and Capacitances
- Transforms Nonlinear Systems to Linear Systems for Certain Cases
- Fundamental Tool For Rigorous Development of Equivalent Circuits
- Can Be Used to Make AC Quantities Become DC Quantities
- Used as a Framework for Most Controllers

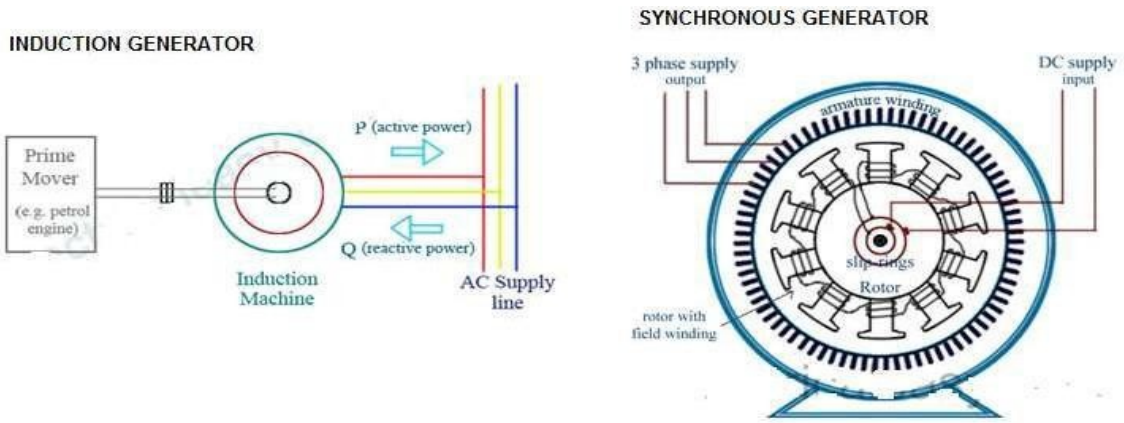
2. Explain the principle of operation of induction generators?

An induction generator or asynchronous generator is a type of AC electrical generator that uses the principle of induction motors to produce power. Induction

generators operate by mechanically turning their rotor in generator mode, giving negative slip. In most cases, a regular AC asynchronous motor is used as a generator, without any internal modifications .

3. Distinguish between induction generator and synchronous generator.

Sl.no.	Synchronous generator	Induction generator
1.	In a synchronous generator, the waveform of generated voltage is synchronized with (directly corresponds to) the rotor speed. The frequency of output can be given as f = N * P / 120 Hz. where N is speed of the rotor in rpm and P is number of poles.	In case of inductions generators, the output voltage frequency is regulated by the power system to which the induction generator is connected. If induction generator is supplying a standalone load, the output frequency will be slightly lower (by 2 or 3%) that calculated from the formula f = N * P / 120.
2.	Separate DC excitation system is required in an alternator (synchronous generator).	Induction generator takes reactive power from the power system for field excitation. If an induction generator is meant to supply a standalone load, a capacitor bank needs to be connected to supply reactive power.
3.	Brushes are required in synchronous generator to supply DC voltage to the rotor for excitation	Construction of induction generator is less complicated as it does not require brushes and slip ring arrangement
	The difference between the IG and SG can be understood from the Fig.1	



4. Show the merits of DFIG over SCIG for wind energy conversion?

An induction generator or asynchronous generator is a type of AC electrical generator that uses the principles of induction motors to produce power. Induction generators operate by mechanically turning their rotor in generator mode, giving negative slip. It is of two types :

1. SCIG (Squirrel cage IG) 2. DFIG (Doubly fed IG)

The DFIG consists of a stator connected directly to grid and a rotor via slip rings is connected to grid through four- quadrant ac-to-dc converter based on insulated gate bipolar transistors (IGBTs) . The merits of this system are :

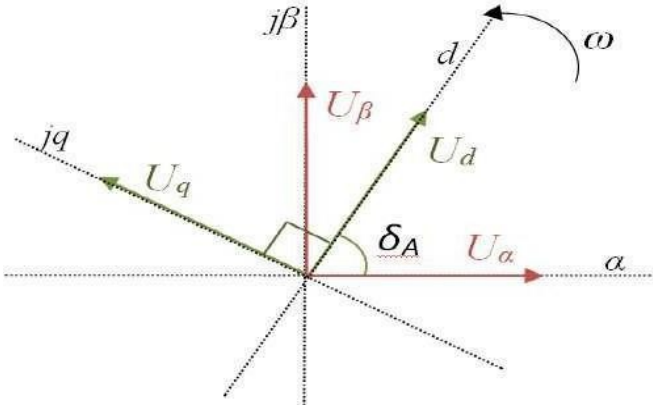
(i) Reduced inverter cost, because inverter rating is typically 30% of total system power.
(ii) Improved system efficiency.
(iii) Power-factor control can be implemented at lower cost.
(iv) It has a complete control of active and reactive power

5. Define Clarke transformation.

The inverse transformation from the dq0 frame to the natural abc frame:

$$\begin{bmatrix} u_a \\ u_b \\ u_c \end{bmatrix} = \begin{bmatrix} \cos(\theta) & -\sin(\theta) & 1 \\ \cos(\theta - \frac{2\pi}{3}) & -\sin(\theta - \frac{2\pi}{3}) & 1 \\ \cos(\theta + \frac{2\pi}{3}) & -\sin(\theta + \frac{2\pi}{3}) & 1 \end{bmatrix} \begin{bmatrix} u_d \\ u_q \\ u_o \end{bmatrix}$$

Is called the Clarke Transform, it is interesting to note that the 0-component above is the same as the zero sequence component in the symmetrical components transform. For example, for voltages Ua, Ub and Uc, the zero sequence component for both the dq0 and symmetrical components transforms



is $\frac{1}{3}(U_a + U_b + U_c)$.

6. Define Park transformation.

The dq0 transform (often called the Park transform) is a space vector

transformation of three-phase time-domain signals from a stationary phase coordinate system (ABC) to a rotating coordinate system (dq0).

The transform applied to time-domain voltages in the natural frame (i.e. u_a, u_b and u_c) is as follows:

$$\begin{bmatrix} u_d \\ u_q \\ u_0 \end{bmatrix} = \frac{2}{3} \begin{bmatrix} \cos(\theta) & \cos(\theta - \frac{2\pi}{3}) & \cos(\theta + \frac{2\pi}{3}) \\ -\sin(\theta) & -\sin(\theta - \frac{2\pi}{3}) & -\sin(\theta + \frac{2\pi}{3}) \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{bmatrix} \begin{bmatrix} u_a \\ u_b \\ u_c \end{bmatrix}$$

where is the angle between the rotating and fixed coordinate system at each time t and is an initial phase shift of the voltage.

$\theta = \omega t + \delta_A$

δ_A

7. Why are induction generators preferred over dc generators in WECS.

The system reliability will increase by elimination of the gear boxes and the power electronic convertersby using an IG.

Also the system efficiency will increase because the losses in the gear box and power electronic converters are eliminated.

8. Compare the PMSG and IG used in WECS?

For a sudden blow of wind the torque to the generator is increased ,this wind leads to large stresses on the wind turbine's drive train.

However IG allows a small change of speed with the change of torque going to the generator and lower stresses/tear and wear of the drive train.

As the IG and the PMSG machine have similar Stator, the cost difference is mainly due to the rotor.

PMSG generators have higher efficiency so the higher material cost may be somewhat compensated for the extra electricity generated. But the inductive power factor of the induction generators require capacitors for power factor correction and may increases the overall cost of the IG.

Hence the advantage of IG and PMSG depends on the application and differ from case to case.

9. Label slip-torque characteristics of induction generator.

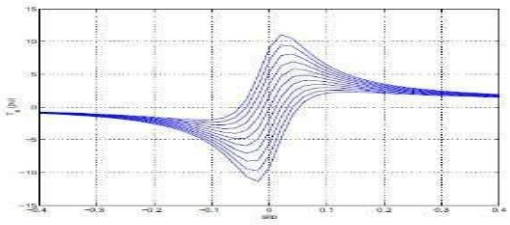


Fig: 4.3Torque-slip characteristic when the angle of Vr is 0. |Vr| is changing from -0.05 to +0.05 pu.

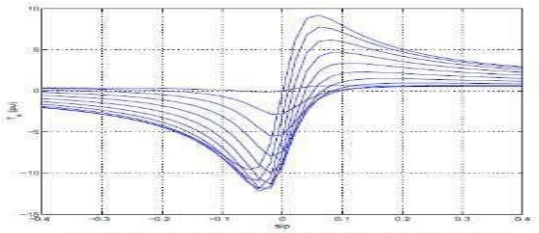


Fig: 4.4Torque-slip characteristic when |Vr| is 0.05 pu. The angle of Vr is changing from −90° to +90°.

10. Show the merits of PMSG for WECS?

IG and PMSG generators are both intended for fixed speed operations.

When the **PMSG generator** is connected to the grid, the speed is determined by the grid frequency and is constant.So, **if the torque to the generator is increased** (sudden blow

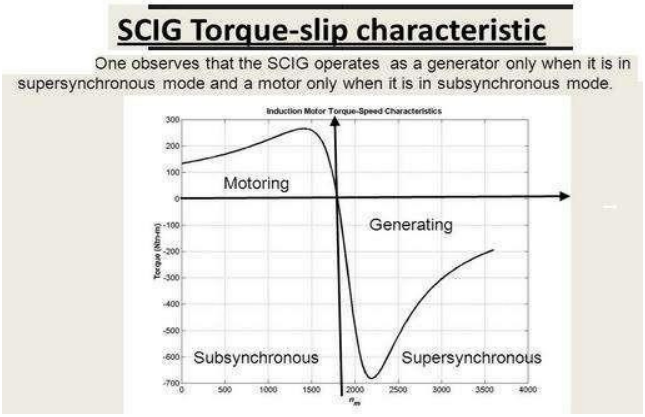
of wind), the generator will produce electromagnetic force to resist an increase in speed. So, a blow of wind **leads to large stresses on the wind turbine's drive train**. However **IG** allows a small change of speed with the change of torque going to the generator and **lower stresses/tear and wear of the drive train**.

As the IG and the PMSG machine have similar Stator, the cost difference is mainly due to the rotor. The **PM's cost** is always going to be **more** than that of aluminum and one can see that the cost of the induction generator is expected to be much lower than the PMSG generators for the same power rating. **But PMSG generators have higher efficiency so the higher material cost may be somewhat compensated for the extra electricity generated**. Also, inductive power factor of the induction generators require capacitors for power factor correction and may increases the overall cost of the IG. So, a trade-off analysis is needed for case by case basis before declaring any machine as best.

11. Differentiate between synchronous generator and PMSG.

A synchronous generator is essentially the same machine as a synchronous motor. The magnetic field of the rotor is supplied by direct current or permanent magnets. If it is supplied by permanent magnet it is called PM SG. If the field is supplied by a dc supply it is called a synchronous generator. Brushes are required in synchronous generator to supply DC voltage to the rotor(field) for excitation.
In both cases it is a synchronous generator because the waveform of generated voltage is synchronized with (directly corresponds to) the rotor speed. The frequency of output can be given as f = N * P / 120 Hz. where N is speed of the rotor in rpm and P is number of poles.

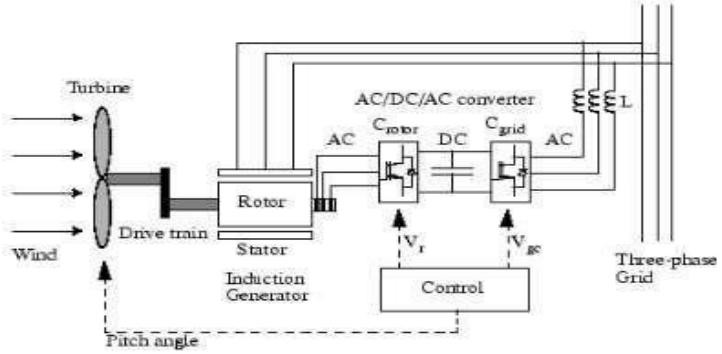
12. Compose the characteristics of SCIG?



13. What is the principle of DFIG.

Currently DFIG are increasingly used in large wind farms. A typical DFIG system is shown in the below figure. The AC/DC/AC converter consists of two components:the rotor side converter Crotor and Grid side converter Cgrid. These converters are voltage source converters that use forced commutation power electronic devices (IGBTS) to synthesize AC voltage from DC voltage source. A capacitor connected on DC side acts as a DC voltage source. The generator slip rings are connected to the rotor side converter,

which shares a DC link with the grid side converter in a so called back -to-back configuration. The wind power captured by the turbine is converted into electric power by the IG and is transferred togrid by stator and rotor windings. The control system gives the pitch angle command andthe voltage commands for Crotor and Cgrid to control the power of the wind turbine, DC bus voltage and reactive power or voltage at grid terminals.



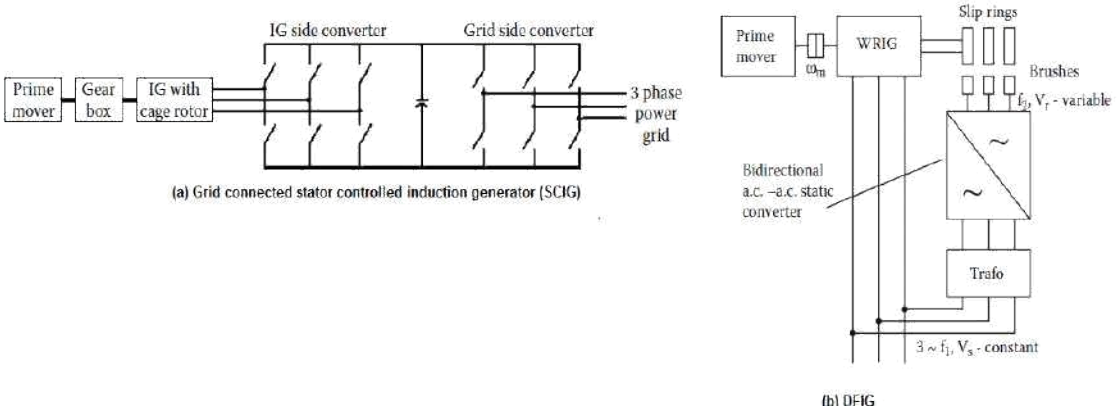
When the rotor speed is greater than the rotating magnetic field from stator, the stator induces a strong current in the rotor. The faster the rotor rotates, the more power will be transferred as an electromagnetic force to the stator, and in turn converted to electricity which is fed to the electric grid. The speed of asynchronous generator will vary with the rotational force applied to it.Its difference from synchronous speed in percent is called generator‘s slip. With rotor winding short circuited, the generator at full load is only a few percent.

With the DFIG, slip control is provided by the rotor and grid side converters. At high rotor speeds, the slip power is recovered and delivered to the grid, resulting in high overall system efficiency. If the rotor speed range is limited, the ratings of the frequency converters will be small compared with the generator rating, which helps in reducing converter losses and the system cost.

14. Differentiate between SCIG and DFIG.

	(SCIGs)	**(DFIGs)**
1.	Stator converter controlled induction generator (SCIG) are those which have a Full power bidirectional (four-quadrant AC–AC) PWM static converters as a soft interface between squirrel cage rotor induction generatorand the power grid.	The doubly fed induction generators (DFIGs) or double output induction generators (DOIGs) are also called wound rotor induction generators (WRIGs) . They are provided with three phase windings on the rotor and on the stator. **They may be supplied with energy at both**

		rotor and stator terminals.
2.	Four-quadrant PWM static converters may be of cascaded (indirect) type or of direct (matrix) type allow **variable speed operation** of the SCIG	They provides constant (or controlled) voltage *Vs* and frequency *f*1 power through the stator, while the rotor is supplied through a static power converter at variable voltage *Vr* and frequency *f*. WRIG is adequate in applications with **limited speed** control.
3.	The cascaded AC–AC PWM converter provides for smooth motor starting and then motoring or generating to the power grid. **The standard synchronization sequence is fully eliminated.** Safe and **soft connection** and disconnection to the power system are inherently available.	For operation at the power grid, **synchronization is required.** The whole synchronization process IS CONTROLLED by the static power converter without any special intervention by the prime mover's governor.
4.	Up to ±100% reactive power exchange with the power grid is available, which eliminates the external capacitor bank	The WRIG was proven to be **reliable for delivering power at variable speed with very fast decoupled active and reactive control in industry up to 400 MW/unit**
5.	The configuration of SCIG is shown in Fig.(a) with cascaded ac-ac pwm converter.	The configuration of DFIG is shown in Fig.(b)



15. List the different methods of generating synchronous electrical power . Systems 1,2, and 3 are all constant speed systems, which differ only in pitch control and gearbox details. A variable pitch turbine is able to operate at a good coefficient of performance over a range of wind speeds when turbine angular velocity is fixed. Systems 4 through 8 of Table are all variable speed systems and accomplish fixed frequency output by one of five methods.

TABLE Eight methods of generating synchronous electrical power.

Rotor	Transmission	Generator
1. Variable pitch, constant speed	Fixed-ratio gear	ac generator
2. Variable pitch, constant speed	Two-speed-ratio gear	ac generator
3. Fixed pitch, constant speed	Fixed-ratio-gear	ac generator
4. Fixed pitch, variable speed	Fixed-ratio gear	dc generator/ dc motor/ac generator
5. Fixed pitch, variable speed	Fixed-ratio gear	ac generator/rectifier/ dc motor/ac generator
6. Fixed pitch, variable speed	Fixed-ratio gear	ac generator/rectifier/inverter
7. Fixed pitch, variable speed	Fixed-ratio gear	field-modulated generator
8. Fixed pitch,	Variable-ratio	ac generator

Unit – III

POWER CONVERTERS

1.Draw and label the block diagram of solar photovoltaic system. Generally there are two types of solar photovoltaic system :

(1) Autonomous solar photovoltaic system
(or) Standalone solar photovoltaic system
(2) Grid connected photovoltaic system (a) with battery (b)without battery

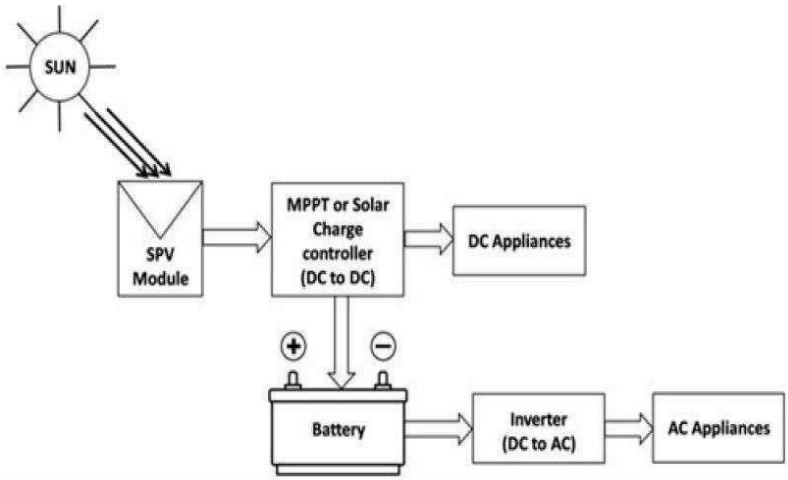


Fig 1 Simple Block Diagram of Standalone SPV system

2. Discuss line commutated converters. Draw the schematic diagram.

The line commutated converter is a power conditioner . It is the key link between the PV array and mains in the grid-connected PV system. It acts as an interface that converts dc current produced by the solar cells into utility-grade ac current. The PV system behavior relies heavily on the power-conditioning unit. They must produce good-quality sine-wave output, must follow the frequency and voltage of the grid, and must extract maximum power from the solar cells with the help of a maximum- powerpoint tracker. The input stage varies the input voltage until the maximum power point on the I V curve is found. They must monitor all the phases of the grid, and output must be controlled in terms of voltage and frequency variation using PWM Technique. The basic diagram for a converter used for power flow control in a photovoltaic system is shown below:

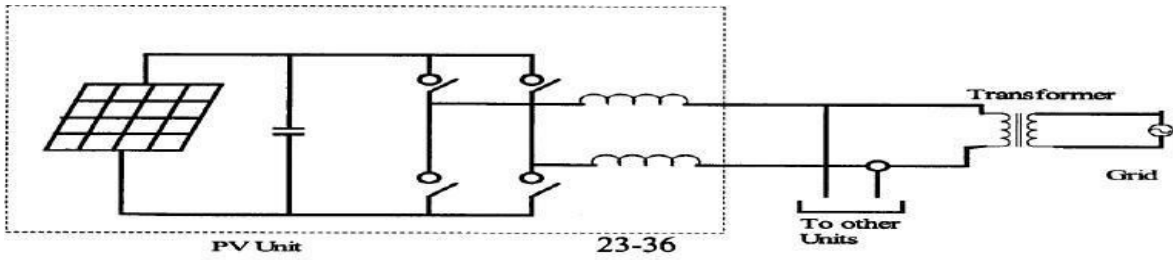


FIGURE 2a Converter using parallel PV units.

3. Explain inversion mode of operation of line commutated inverter. [CO3- L2]

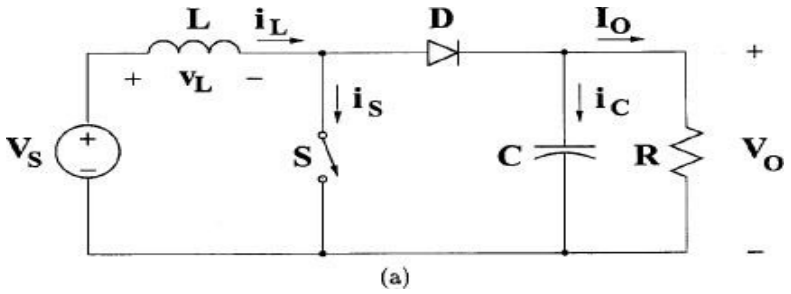
Line-commutated inverters are generally used for electric-motor applications. The power stage is equipped with thyristors. A maximum-power tracking control is required in the control algorithm for solar application. A typical grid-connected inverter may use a pulse-width modulation (PWM) scheme and operate in the range of 2 kHz up to 20 kHz.The driver circuit has to be changed to shift the firing angle from rectifier operation ($0 < \alpha < 90°$) to inversion mode of operation ($90 < \alpha < 180°$). Six-pulse or 12-pulse inverters are used for grid interfacing, but 12-pulse inverters produce fewer harmo nics. Thyrsistor-type inverters require a low-impedance grid interface connection for commutation purposes. If the maximum power available from the grid connection is less than twice the rated PV inverter power, then the line-commutated inverter should not be used .

The line-commutated inverters are cheaper but can lead to poor power quality. The harmonics injected into the grid can be large unless taken care of by employing adequate filters. These line-commutated inverters also have poor power factors that require additional control to improve them. Transformers can be used to provide electrical isolation. To suppress the harmonics generated by these inverters, tuned filters are employed and reactive power compensation is required to improve the lagging power factor.

4. Summarize the role of capacitor and the minimum value required for the boost converter. [CO3-L1]

The boost converter shown in Fig (a) output voltage Vo is always greater than the input voltage Vs as given in the voltage gain function

Vo= Vs / [1- D] where D is the duty cycle.



(a)

The current supplied to the output of the boost converter circuit is discontinuous. Hence a **larger filter capacitor C** is required in comparison to that in the buck-derived

converters to limit the output voltage ripple. The function of the capacitor **C is to provide the output dc current to the load when the diode D is off**. **The**

$$C_{\min} = \frac{DV_O}{V_r Rf}$$

minimum value of this filter capacitance that results in the voltage ripple Vr is given by

At D = 0.5, Vr/Vo .= 1%, R .= 10 ohms, and f = 100 kHz, the minimum capacitance for the boost converter is Cmin = 50 microFarad.

5. Generalize the significance of buck boost converter? [CO3-L3]

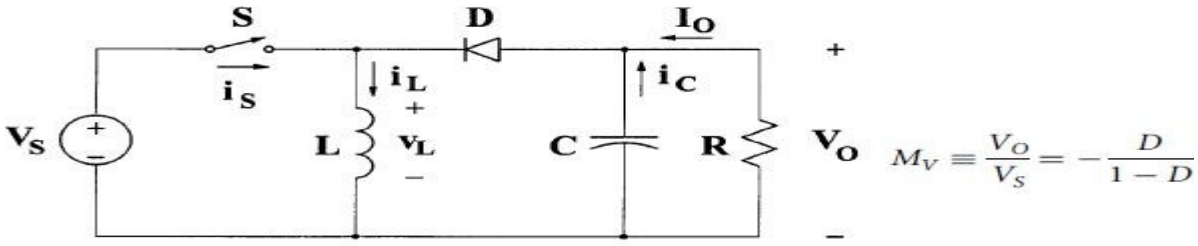
- The buck –boost converter operates on the principle of PWM technique uses a transformerless topology to obtain the output voltage greater i.e Boost (when D> 0.5) (or) lesser than the input voltage i.e Buck (or) (when D< 0.5) or equal to the input (at D =0.5).
- The **output voltage is negative with respect to the ground**.
- The current supplied to the output is discontinuous. Hence a **larger filter capacitor C is used** to limit the output voltage ripple.The minimum value of

$$C_{\min} = \frac{DV_O}{V_r Rf}$$

C is

- **It act as a power conditioner in utility grid-related application** by acting as an interfaces between ac networks and dc renewableenergy sources such as fuel cells and photovoltaic arrays.

6. Give the schematic diagram of buck boost converter.



$$M_V \equiv \frac{V_O}{V_S} = -\frac{D}{1-D}$$

Fig.6 . Buck Boost Converter

7.What is battery sizing? (or) Write about the aspects of battery sizing.

The battery sizing require 2 specifications :

1. The full capacity in Ah unit.
2. The usable depth of discharge recommended for that type of battery. eg.Lead acid battery should not be cycled over their full capacity or else its life will be shortened.
3. The size of battery depend on the total usable capacity needed in Ah.The

below formula is based on a nominal calculation of 12V battery.

$$\text{Total Usable capacity needed (A h at 12 V)} = \frac{\text{Daily requirement of appliances (W h per day)} \times \text{Period of storage required (days)}}{12\ \text{V}}$$

$$\text{Minimum number of 12 V batteries needed} = \frac{\text{Total Usable capacity needed (A h in 12 V)}}{\text{Maximum depth of cycles (\%)} \times \text{Full Capacity specified for one 12 V battery (A h)}} \times 100\ \%$$

When the batteries are connected in series the voltage gets added but the total usable capacity in Ah remains the same.

8. Define array sizing.

Sizing is about calculating the no.of solar modules and battery needed to run the required no. of appliances.

The first step in sizing is to calculate the daily requirement of electricity of each appliance.

$$\text{Power of Appliance (W)} \times \text{Expected daily use of appliance (hours per day)} = \text{Daily requirement of one appliance (W h per day)}$$

The second step is to determine how much electricity can be produced by one module.

The daily electrical output from one module in units of *W h per day at 12 V* is calculated

$$\text{Current at load or other current specification of module (A)} \times \text{Daily peak insolation (Peak-hours per day)} \times \text{12 V} = \text{Daily output of one module (W h per day at 12 V)}$$

The third step in sizing is to reduce the daily requirement by deciding carefully which appliance need to be run on solar electricity and for how long the y need to be used per day.

9. Show the weakness involved in sizing the solar arrays.

The sizing of a solar photovoltaic system is complicated because the electricity generated each day **depend** on the **rating of the solar module** and on the **amount of sunlight reaching the module through the day**.

(a) For calculating the daily output of the solar module we use peak hour per day.The peak hour are equivalent to the no. of hours of sunlight at an irradiance of $1000W/m^2$.

The weakness in determining the average output of a module using maps of daily insolation is that the map gives an approximate information based on daily insolation as an average over a 3 month period.There is no indication of how long the el.output can be got for one month period.

Also , Setting the tilt angle of the module at same angle as the latitude of the site is not optimum.

(b) The no. of cells in the module depend on the type of charge regulation to be used and the local temperature. The table below shows the selection of solar module based on open circuit voltage under standard test conditions (or) the no. of cells in the module.

Application	Local Climate			
	Mild (below 30 °C at midday)		Hot (above 30 °C at midday)	
	Crystalline Silicon	Thin-film Silicon	Crystalline Silicon	Thin-film Silicon
Self-regulating, no diode	18 V (30 cells)	20 V	19 V (32 cells)	21 V
Self-regulating, with a diode	19 V (32 cells)	21 V	20 V (34 cells)	22 V
With a charge regulator	≥ 20 V (32 cells)	≥ 22 V	≥ 21 V (> 34 cells)	≥ 23 V

10. Identify the factors to be considered for the selection of inverter and batteries for solar energy conversion.

The factors to be considered for the **selection of batteries** for solar energy conversion are :

i. Nominal Capacity in Ah
ii. Cost
iii. % Usable Cycle depth
iv. Life cycle of Battey (Cycles)
v. Relative value of money (or) cost of battery
vi. Usable Capacity in Ah
vii. Type of Rechargeable Battery : Low or high Antimony (or) Antimony free % of self discharge

There are two approaches to balance the cost of installation and maintainance :

(i) To minimize the installation cost , aim for high value of usable capacity in Ah.However the battery may have short life.

(ii) To minimize the maintainance cost , aim for high value of total usable capacity over cycle life in Ah.

The factors to be considered for the **selection of inverter for** solar energy conversion are

i. Type of operating voltage
ii. The maximum power point transfer (MPPT) voltage range.
iii. The solar PV string should be sized such that the inverter can operate within this range.
iv. The max. dc voltage of the solar PV string with no-load must not exceed an inverter maximum DC voltage.
v. If 120/240 V single phase is used in residential application then the inverter would connect to 240V ac.
vi. Type of distribution used in case of 3phase.
vii. Type of configuration (star / delta) of load in case of commercial and industrial buildings.

11. Identify advantages and limitations of AC voltage controller.

- The ac voltage controllers are used increasingly for soft-starting of induction motors, as they have a number of advantages over the conventional starters, such as smooth acceleration and deceleration, ease in implementation of current control, simple protection against single-phasing or unbalanced operation, reduced maintenance and losses, absence of current inrush, and so forth.
- Even for the fixedspeed industrial applications, the voltage controllers can be used to provide a reduced stator voltage to an induction motor to improve its efficiency at light load and result in energy saving.
- Operation at an optimum voltage reduces the motor flux, which, in turn, reduces the core loss and the magnetizing component of the stator copper loss.
- Considerable savings in energy can be obtained in applications where a motor operates at no load for a significant time, such as in drills, machine tools, woodworking machines, reciprocating air-compressors, and so forth.

The limitations of ac voltage controller is that it operates at variable voltage under constant frequency.

12. What is a matrix converter? Compose its merits.

The matrix converter (MC) is a development of the forcecommutated cycloconverter (FCC) based on bidirectional fully controlled switches, incorporating PWM voltage Control .

The merits of matrix converter are :

- It provides a good alternative to the double-sided PWM voltagesource rectifier- inverters having the advantages of being a single-stage converter with only nine switches for threephase to three-phase conversion

- It has inherent bidirectional power flow capability, sinusoidal input and output waveforms with moderate switching frequency, the possibility of compact design due to the absence of dc link reactive components .
- It has controllable input power factor independent of the output load current.

13. What are the limitations in the matrix converter?

The main disadvantages of the matrix converters developed so far are

(i) complexity in the circuit.
(ii) the inherent restriction of the voltage transfer ratio (0.866),
(iii) complex control and protection strategy, and
(iv) above all the nonavailability of a fully controlled bidirectional high-frequency switch integrated in a silicon chip.
(v) An ac filter is required to eliminate the ripples generated in the inverter when the load is inductive.

14. What are the applications of AC voltage controller or ac chopper

i. Soft starting of induction motors
ii. Controls rms value of v or i in lighting control.
iii. Domestic and industrial heating
iv. Speed cotrol of fans,pumps, hoists.
v. Temperature control,
vi. Capacitor switching in var compensation

Unit – IV

ANALYSIS OF WIND AND PHOTOVOLTAIC SYSTEM

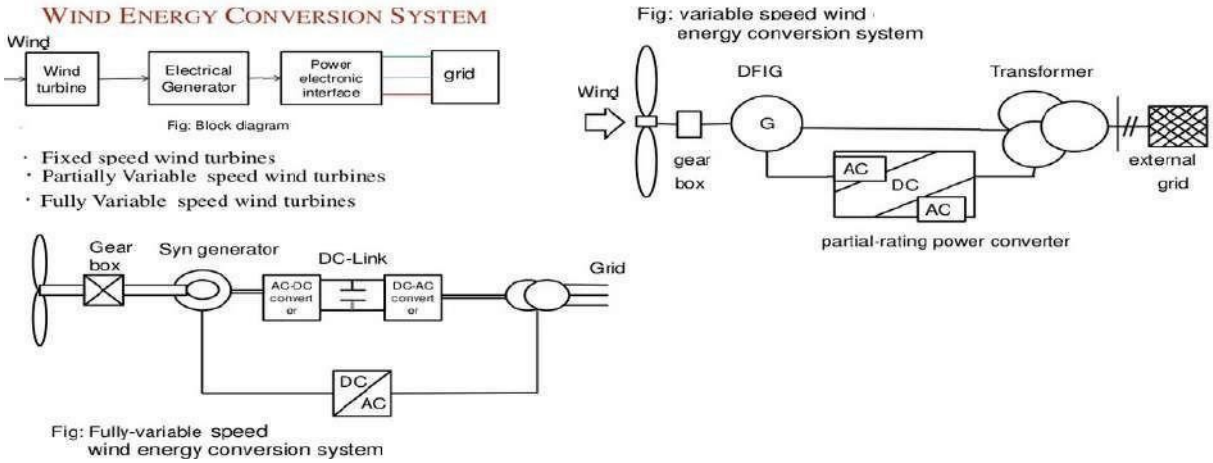
1. What is fault ride through capability?

In electric power systems, low-voltage ride through (LVRT), (or) fault ride through (FRT), sometimes under-voltage ride through (UVRT), is the capability of electric generators to stay connected in short periods of voltage dip. It is needed at distribution level (wind parks, PV systems, distributed cogeneration, etc.) to avoid that a short circuit on HV or EHV level which will lead to a widespread loss of generation.

In a wind energy system the Fault ride through capability is the ability of the system to maintain the grid stability and keep the wind farm connected in the power system for a defined time period during grid fault.The voltage does not always dip to zero, it can be just a voltage sag , hence the FRT is sometimes called low voltage ride -through problem. The main differences in FRTs requirement of different countries are the depth of voltage drop, the time period and the boundary where Wind Turbines can be tripped Similar requirements for critical loads such as computer systems[2] and industrial

processes are often handled through the use of an uninterruptible power supply (UPS) .

2. Label the basic block diagram of WECS.



3. What is the power obtained from the wind?

The power extracted from the wind by a wind turbine is

$$P_{wt} = 0.5\, Cp(\lambda, \beta)\, \rho\, A\, v^3$$

where v is the wind speed, ρ is the air density, A is the area swept by the blades and Cp is the wind power coefficient (denotes power extraction efficiency which is a function of β and λ, β being the pitch angle and λ being the tip speed ratio – TSR given by $R\,\Omega / v$ where R is turbine radius, Ω is turbine shaft speed). Thus, power captured by the wind turbine is heavily dependent upon TSR when β is unchanged. The power conversion efficiency has a well determined maximum $Cp\,max$ for a specific tip speed ratio λ.

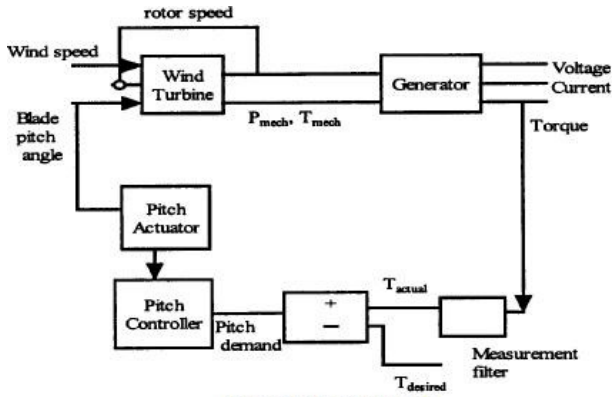
4. Why pitch angle control is used for WECS? Justify.

Wind turbines often are subjected to wind speeds that are very low (below cut-in speed) or high (above rated value) , (typical wind speed limit 4.5 to 26m/s). No pitch regulation is applied when the wind turbine is operating below rated speed, but **pitch control is required when the machine is operating above rated wind speed to minimize the stress**.

The **aims of pitch control** of medium- and largescale wind turbines is

(I) to help in **startup and shut-down** operation,
(II) to **protect against overspeed**, and (III) **to limit the load on the wind turbine** .

The wind turbine must be capable of being started and run up to speed in a safe and controlled manner. The **aerodynamic characteristics of some turbines are such that they are not self-starting**. The required **starting torque may be provided by** motoring or by **changing the pitch angle** of the blade. In the case of **grid-connected wind turbine system**, the rotational speed of the generator is locked to the frequency of the grid. When the generator is directly run by the rotor, the grid acts as an infinite load. When the grid fails, the load rapidly decreases to zero, causing the turbine rotor to accelerate quickly. Overspeed protection must be provided by rapid braking of the turbine. A simple mechanism of blade pitch-control techniques is shown below.



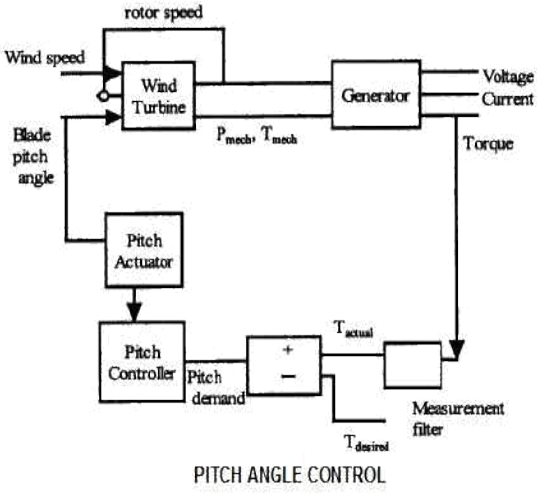
PITCH ANGLE CONTROL

The controller will keep adjusting the blade pitch angle until the desired power and torque output are achieved. **This modified pitch angle and new computed λ decide the new Cp, resulting in a modified wind generator power and torque output.**

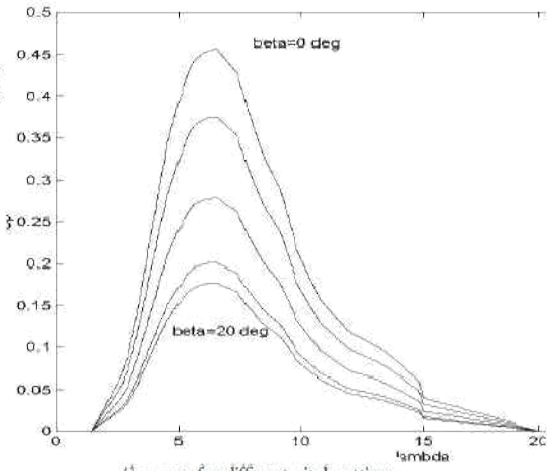
5. Discuss stand-alone operation of fixed speed WECS? State its advantages.

In case of a fixed-speed WECS, synchronous or squirrelcage induction generators are employed and are characterized by stiff power-train dynamics. The rotational speed of the wind turbine generator in this case is fixed by the grid frequency. The generator is locked to the grid, thereby permitting only small deviations of the rotor shaft speed from the nominal value. The speed is very responsive to wind-speed fluctuations. **The normal method to smooth the surges caused by the wind is to change the turbine aerodynamic characteristics, either passively by stall regulation or actively by bladepitch regulation**.

Wind turbines often are subjected to wind speeds that are very low (below cut-in speed) or high (above rated value). No pitch regulation is applied when the wind turbine is operating below rated speed, but pitch control is required when the machine is perating above rated wind speed to minimize the stress. Figure A shows the effect of blade pitch angle on the torque speed curve at a given wind speed.



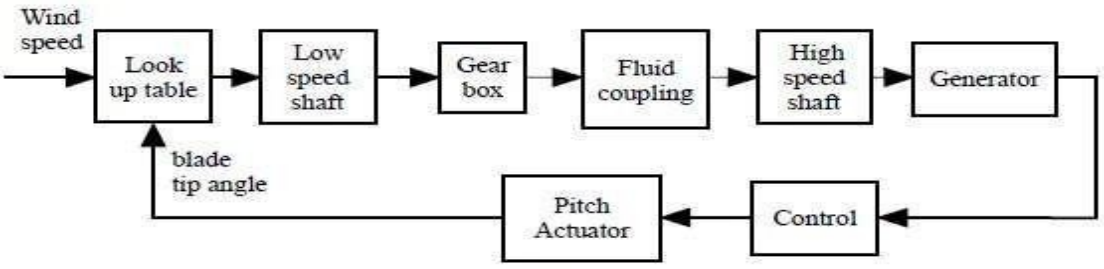
PITCH ANGLE CONTROL



C_p/λ curves for different pitch settings.

Blade pitch control is a very effective way of controlling wind turbine speed at high wind speeds, hence limiting the power and torque output of the wind machine.

Some wind-turbine generator include a gearbox for interfacing the turbine rotor and the generator. The **general drive train model for such a system** is shown in Fig. (B). This system also contains the blade-pitch angle control provision. The drive train converts the input aerodynamic torque on the rotor into torque on the low-speed shaft. This torque is converted to high-speed shaft torque using the gearbox and fluid coupling. The speed of the wind turbine here is low and the gearbox is required to increase the speed so as to drive the generator at the rated rpm, e.g., 1500 rpm. The fluid coupling works as a velocity-in–torque-out device and transfer the torque . The actuator regulates the tip angle based on the control system applied. **The control system here is based on a pitch regulation scheme where the blade-pitch angle is adjusted to obtain the desired output power**.



Block diagram of drive train model.

Merit : This type of system will be very helpful in the region where grid supply is not available. We can establish small wind energy based plant and store the generated voltage in controlled battery system for longer and further usage.

6. Generalize the limitations of fixed speed induction generator based wind power conversion.

The limitations of fixed speed induction generator based wind power conversion are the

(A) **lack of control possibilities of both active and reactive power**,
(B) gearbox breakdown due to large mechanical loads (because of power fluctuations are converted to torque pulsations) and
(C) the large fluctuations in output power.
Due to these reasons, wind turbine manufacturers are increasingly interested in variable speed devices.

7. Differentiate between fixed and variable speed wind energy conversion systems. [CO4-H1]

SL.NO.	Fixed speed WECS	Variable speed WECS
1	In the fixed speed WECS the Wind turbine rotor speed is fixed.the speed is determined by the grid frequency.	In the fixed speed WECS the Wind turbine rotor speed is variable , hence they cannot be directly connected to the grid. They require a power electronic converter interface.
2	synchronous or squirrelcage induction generators are employed with the turbine with soft starter and capacitor bank and directly connected to the grid.	Wound-rotor induction generator synchronous or squirrelcage induction generators , DFIG are employed with power electronics device such as ac-dc-ac converter .The induction generator are usually high slip IG or are operated in tandem to obtain variable speed.
3	Pitch angle and yaw control should be used to extract max. power from the wind turbine rotor.	The wind turbine rotor in this case is permitted to rotate at any wind speed by the power-generating unit.increased energy capture by maintaining the ratio of blade-tip speed to wind speed near the optimum value. **MPPT is necessary for harnessing highest energy from the wind.**
4	Simple robust construction,cheap,and reliable.	Costly, less variations in the electrical power, reduced acoustical noise at low wind speed.

8.**Summarize the impact of high penetration of wind power in to power grid?** The speed is very responsive to wind-speed fluctuations. **The normal method to smooth the surges caused by the wind is to change the turbine aerodynamic characteristics, either passively by stall regulation or actively by blade pitch regulation.** Blade pitch control is a very effective way of controlling wind turbine speed at high wind speeds, hence limiting the power and torque output of the wind machine **The impact of high penetration of wind power ,** the wind turbine is stopped to reduce wear and damage. The wind turbine must be capable of being started and run up to speed in a safe and controlled manner. The aerodynamic characteristics of some turbines are such that they are not self-starting. The required starting torque may be provided by motoring **or by changing the pitch angle of the blade** . In the case of grid-connected wind turbine system, the rotational speed of the generator is locked to

the frequency of the grid. When the generator is directly run by the rotor, the grid acts as an infinite load. When the grid fails, the load rapidly decreases to zero, causing the turbine rotor to accelerate quickly. Overspeed protection must be provided by rapid braking of the turbine.

9. List out grid interconnected issues. Point out the major problems related with grid interconnections of WECS?

The major problems related with grid interconnections

1) Poor grid stability
2) Low-frequency operation
3) Impact of low power factor
4) Power flow
5) Short circuit
6) Power Quality

High penetration of intermittent wind power (greater than 20 percent of generation meeting load) and may affect the network in the following ways and has to be studied in detail:

A. Poor grid stability :

For economic exploitation of wind energy, a reliable grid is as important as availability of strong winds. The loss generation for want of stable grid can be 10% to 20% and this deficiency may perhaps be the main reasons for actual

energy output of WEGs compared to the predicted output in known windy areas with adequate wind data.

B. Low-frequency operation

Low frequency operation affects the output of WEGs in two ways. Many WEGs do not get cut-in, when tfrequency is less than 48 Hz (for standard frequency of Hz) through wind conditions are favorable, with consequent loss in output [22].This deficiency apart, the outputWEGs at low frequency operation is considerably reduced, due to reduced speed of the rotor. The loss in output coulbe about 5 to 10% on the account of low frequency operation.

C. Impact of low power factor

WEGs fitted with induction generators need reactive power for magnetizing. Normally in conventional energy systems, generators apart from supplying active power will be supplying a reactive power. But in case of WEGs fitted with induction generators, instead of supplying reactive power to the grid, they absorb reactive power from grid, which undoubtedly is a strain on the grid. Suitable reactive power compensation may be required

to reduce the reactive power burden on the grid.

D. Power flow

It is to be ensured that the interconnecting transmission or distribution lines will not be over-loaded. This type of analysis is needed to ensure that the introduction of additional generation will not overload the lines and other electrical equipment. Both active and reactive power requirements should be investigated.

E. Short circuit

It is required to determine the impact of additional generation sources to the short circuit current ratings of existing electrical equipment on the network.

F. Power Quality

Fluctuations in the wind power may have direct impact on the quality of power supply. As a result, large voltage fluctuations may result in voltage variations outside the regulation limits, as well as violations on flicker and other power quality standards.

Unit – V

HYBRID RENEWABLE ENERGYSYSTEM

1. Define hybrid systems?

The combination of renewable energy system such as PV arrays or wind turbines, with engine-driven generators and battery storage, is widely recognized as a viable alternative to conventional remote area power supplies (RAPS). These systems are generally classified as hybrid energy systems (HES).

For eg. A **Photovoltaic–diesel hybrid energy systems** generate ac electricity by combining a photovoltaic array with an inverter, which can operate alternately or in parallel with a conventional engine-driven generator.

2. Summarize the need for hybrid energy systems.

NEED FOR HYBRID SYSTEM

- Hybrid Systems are powered by sun and wind or anyother renewanle energy source to meet the increasing power demand.
- Power electronics controllers manage multiple sources and monitor the status of the system voltage, power and frequency based on the load requirement.
- During grid failure the alternative resources supply the power demand.
- In remote areas renewable energy sources such as PV can be added to power systems using diesel and other fossil fuel powered generators to provide 24-

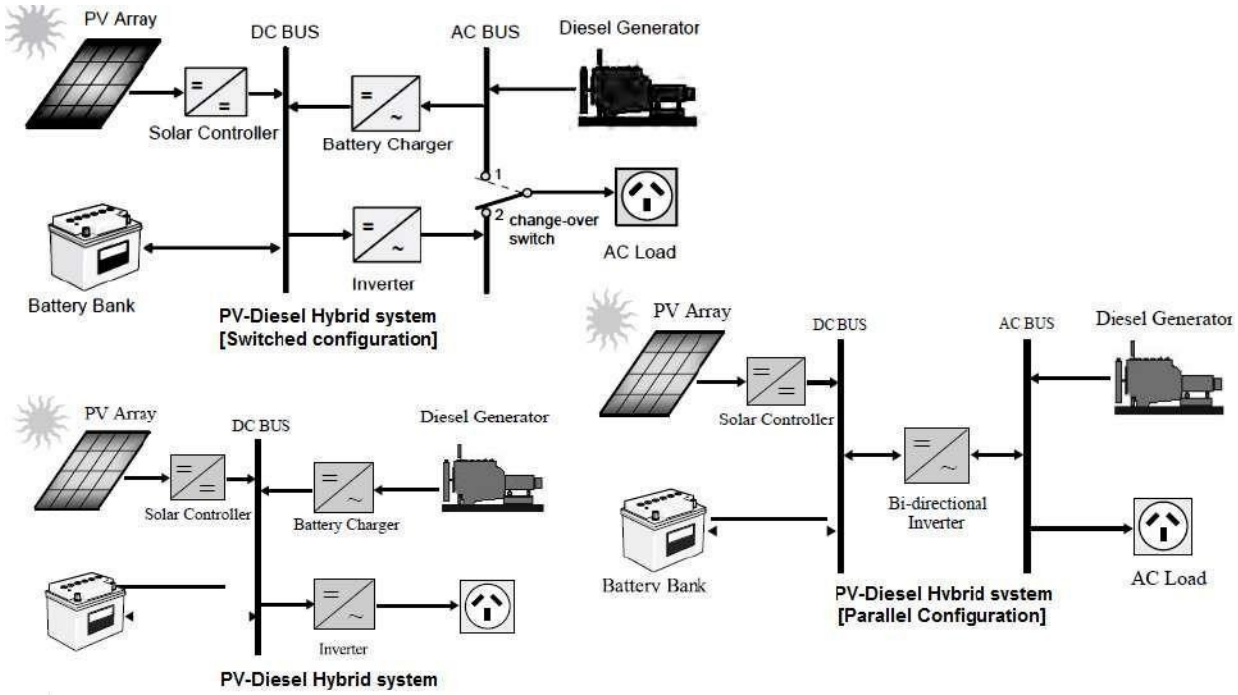
hour power economically and efficiently. Such systems are called ‘‘hybrid energy systems.

3. List out some of the hybrid systems used in industries.

(i) Solar PV- Diesel Hybrid system
(ii) PV-Diesel Hybrid system
(iii) Wind-PV Hybrid system
(iv) Wind-Diesel Hybrid system

4. Label the schematic diagram of PV-Diesel hybrid system.

PV-Diesel hybrid system as gvn below has 3 configurations : series,parallel and switched



4.List the merits and demerits of PV-Diesel hybrid system.

The advantages of **parallel configuration over over other system configurations** is

- The system load can be met in an optimal way.
- Diesel generator efficiency can be maximized.

- Diesel generator maintenance can be minimized.
- A reduction in the rated capacities of the diesel generator,battery bank, inverter, and renewable resources is feasible, while also meeting the peak loads.

The disadvantages are:

- Automatic control is essential for the reliable operation of the system.
- The inverter has to be a true sine-wave inverter with the ability to synchronize with a secondary ac source.
- System operation is less transparent to the untrained user of the system.

The switched configuration remains one of the most common installations today. despite its operational limitations. The advantages of this system are:

- The inverter can generate a sine-wave, modified square wave, or square wave, depending on the particular application.
- The diesel generator can supply the load directly, therefore improve the system efficiency and reduce the fuel consumption.

The disadvantages are:

- Power to the load is interrupted momentarily when the ac power sources are transferred.
- The engine-driven alternator and inverter are typically designed to supply the peak load, which reduces their efficiency at part-load operation.

6. What is the charge controller used for wind energy conversion system.

Charge controllers is a power conditioning device which regulate the charge transfer and prevent the battery from being excessively charged and discharged. The charge controller control the power flow to the utility grid. The real power is controlled by an outer maximum-power-point tracking (MPPT) algorithm with an inner dc link voltage-control loop .Three types of charge controllers are commonly used: Series charge regulators , Shunt charge regulators, Dc–dc onverters.

7. Define MPPT? List out various MPPT algorithms used.

MPPT is maximum power point tracking and the device that perform this is called a maximum power point tracker. A plot of power (P) against voltage (V) for solar array (Fig.b) shows that there is a unique point on the I V curve at which the solar cell will generate maximum power. This is known as the maximum power point (Vmp, Imp). To maximize the power output, steps are usually taken during fabrication to maximize the three basic cell parameters: open-circuit voltage, short-circuit current, and fill factor (FF) a term describing how ‘‘square’’ the I V curve is, given by

$$FF = (V_{mp} I_{mp}) / (V_{oc} I_{sc})$$

For a silicon solar cell, FF is typically 0.6–0.8.

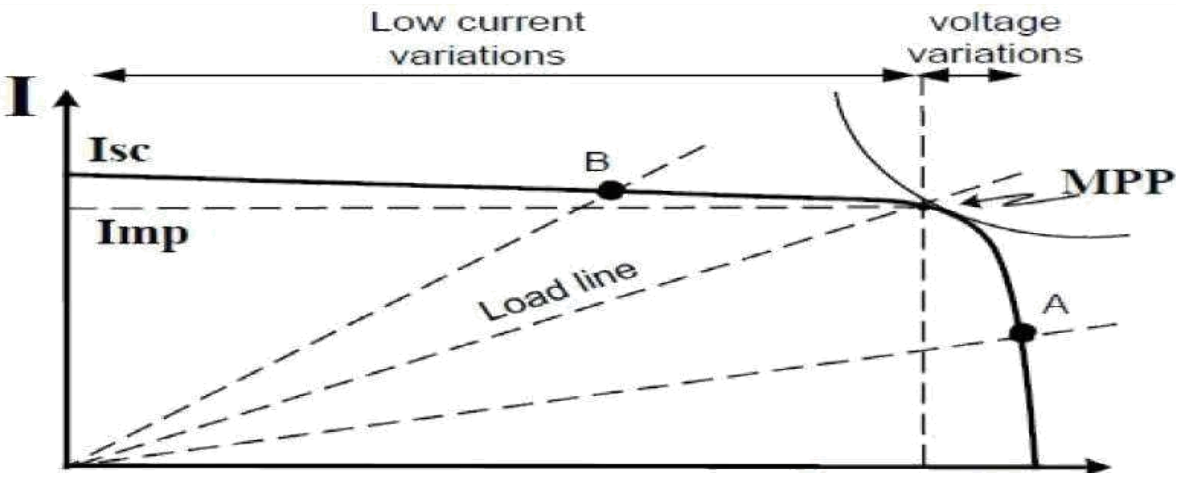
MPPT is the abiliy to extract the maximum available power from PV module by making them operate at the most efficient voltage.

MPPT Algorithms

- Perturb and Observe (PAO) ,
- Incremental Conductance Technique (ICT), and
- Constant Reference Voltage/Current.
- Flux magnitude angle control (FMAC).
- Hill climbing search (HCS).
- Tip speed ratio (TSR) control.
- Mapping power technique in which maps/curves are used to find out the optimum point.
- Anemometer method which uses the predetermined look up table.
- MPPT by maximum efficiency control and a maximum torque control.
- Advance hill climb search (AHCS) technique.
- MPPT algorithm by directly adjusting the DC/DC converter duty cycle.
- MPPT algorithms by changing the speed reference in the desired direction.
- MPPT using two converters and by adjusting the switching frequencies of the two converters achieve maximum power tracking g and output voltage regulation.
- Using matrix converter in DFIG.
- Using MPPT algorithms with current feedback.
- Sliding mode control using fuzzy for variable speed wind turbine.
- Unity power factor and maximum power point tracking using loop control.

8. What is the need for maximum power point tracking?

A maximum power point tracking control can prevent the collapse of the solar array voltage under excessive load demand, particularly when supplying a constant type of load.For a system without MPPT the voltage will quickly collapse to zero. This phenomenon is understood from the I-V char of solar array.The flatness of I-V curve on the left of MPP imply small incremental increase in the current demand lead to large voltage change. On the I-V curve the operating point correspond to the max. power point in the knee region.



MPPT's are most effective in Winter, and/or cloudy or hazy days - when the extra power is needed the most.

- Cold weather - solar panels work better at cold temperatures, but without a MPPT you are losing most of that. Cold weather is most likely in winter - the time when sun hours are low and you need the power to recharge batteries the most.
- Low battery charge - the lower the state of charge in your battery, the more current a MPPT puts into them - another time when the extra power is needed the most. You can have both of these conditions at the same time.
- Long wire runs - If you are charging a 12 volt battery, and your panels are 100 feet away, the voltage drop and power loss can be considerable unless you use very large wire. That can be very expensive. But if you have four 12 volt panels wired in series for 48 volts, the power loss is much less, and the controller will convert that high voltage to 12 volts at the battery. That also means that if you have a high voltage panel setup feeding the controller, you can use much smaller wire.

9.Give the applications of solar PV system?

- Water Pumping
- Battery Charging
- Grid-Interactive PV Power Generation
- Lightning
- Medical Refrigeration
- Village Power
- Telecommunication and Signaling

10.Discuss the significance of MPPT.

Consider a variable speed WECS, operating the turbine at constant TSR correspond to MPP at all times generates 20 - 30 % more electricity in a year. The power Vs speed curve has a well defined peak. If we operate the turbine at this peak

point a small increase or decrease in the turbine speed would result in no change in the power as the MPP lie in a flat neighbourhood.output. The condition for max power is given in Fig.a . This principle uses the speed is maintained at a level ΔP/Δω is zero. This method is insensitive to errorin local wind speed measurement and wind turbine design.

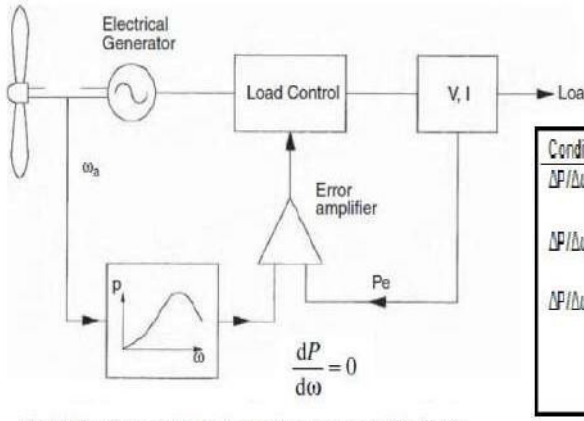


Fig.(a) Max power point tracking using power control scheme

Condition	Remarks	Power generation.
ΔP/Δω is positive	Speed is increased in small increments	Power generation isincreased.
ΔP/Δω is negative	Speed is decreased in small decrements	Power generation is decreased.
ΔP/Δω is close to zero	Speed is increased or decreased to satisfy the condition ΔP/Δω is close to zero	Power generation is maintained constant

Table with condition for MPPT

11. Classify the types of pumps used for solar water pumping applications? [CO5-L1]

Two types of pumps are commonly used for water-pumping applications:

- Positive displacement
- Centrifugal.

Both centrifugal and positive displacement pumps can be **further classified based on the type of motor** used for the pumping application

Surface mounted, and

Submersible (those that are submerged into the water).

Displacement pumps have water output directly proportional to the speed of the pump, but almost independent of head. These pumps are **used for solar water pumping from deep wells or bores**. They may be piston-type pumps or use a diaphragm driven by a cam or rotary screw, or use a progressive cavity system. The pumping rate of these pumps is directly related to the speed, and hence constant torque is desired.

Centrifugal pumps are used for **low-head applications**, especially if they are directly interfaced with the solar panels. Centrifugal pumps are designed for fixed-head applications, and the pressure difference generated increases in relation to the speed of the pump. These pumps are of the rotating impeller type, which throws the water radially against a casing shaped so that the momentum of the water is converted into useful pressure for lifting. The centrifugal pumps have relatively high efficiency, but it

decreases at lower speeds, which can be a problem for a solar water-pumping system.

12.Give the applications of solar PV system?

- Water Pumping
- Battery Charging
- Grid-Interactive PV Power Generation

EE6009 – POWER ELECTRONICS FOR RENEWABLE ENERGY SOURCES
16 MARKS QUESTIONS
UNIT – I
INTRODUCTION

1. Explain the impact of renewable energy generation on environment in detail.
2. How does environment get affected by the use of the renewable energy? and also discuss GHG emissions from the various energy sources.
3. Discuss the influence of different renewable energy sources with special reference to the global warming context.
4. Describe the consequences of greenhouse effect.
5. Explain the working principle of various types of concentrating solar collectors with neat sketch.
6. Compare the power extraction aspects of solar PV system with wind energy system.
7. Describe various types of wave energy conversion device and explain how to generate electrical power from waves.
8. Describe the principle of generation of Bio gas and mention the factors affecting its generation.
9. Explain the design and principle of operation of general Fuel cell and Fossil Fuel cell.
10. Enumerate the prospects of ocean and biomass energy.
11. What are the types of ocean thermal energy conversion power plants? Describe in detail the Anderson OTEC cycle.
12. What is Hydrogen energy? Explain the operation of Hydrogen energy system with a neat schematic.
13. Explain the following with neat schematic.

i. Wind energy conversion system ii. Energy from the Ocean

UNIT – II
ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION

1. Draw the schematic of Permanent Magnet Synchronous generator and explain the construction and principle of operation in detail. Also discuss the characteristics and issues briefly.

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2. Explain the principle of operation and constructional features of squirrel cage induction generator with a neat diagram. Analyse the merits and demerits of the above.
3. Explain construction, principle of working and characteristics of IG with neat sketches.
4. Explain the principle of operation of DFIG used for renewable energy conversion.
5. Explain machine capacity factor and capacity utilization factor. Explain the principle of

operation of double output induction generator system with neat diagram.
6. Draw the circuit model of self-excited induction generator and explain the methods used for steady state analysis.
7. Explain about DFIG based energy conversion system
8. Explain construction, principle of working and characteristics of SCIG with neat sketches.
9. Explain the analysis of Induction Generator used for Wind Energy Conversion System.
10. Draw the circuit model of PMSG and explain the methods used for steady state analysis.

UNIT – III
POWER CONVERTERS

1. Explain the converters used for solar energy conversion.
2. Describe the grid interactive inverters in detail.
3. Explain with neat diagram the philosophy of operation of a solar source fed boost converter.
4. Describe how a three phase line commutated converter is operated as an inverter.
5. Explain the operation of line commutated converter under inversion mode with the help of a neat circuit diagram and necessary waveforms.
6. Write short notes on the grid interactive inverters.
7. Consider a buck boost converter of input voltage Edc=14V. The duty cycle α=0.6 and the switching frequency is 25kHZ. The inductance L=180μH and the filter capacitance C=220μF. The average load current Io=1.5A. Compute the average output voltage and peak current of the device.
8. A single phase full bridge inverter has a resistive load of ΩR=a3nd the DC input voltage is Edc=50V. Compute the RMS output voltage at the fundamental frequency, the output power, the average and peak currents of each thyristor and peak reverse blocking voltage of each thyristor.
9. Describe working of AC-DC-AC converter with circuit and wave form for wind energy conversion.
10. Analyse the principle of working of buck-boost converter with time ratio and current limit control. Draw the circuit and necessary waveforms.
11. Describe principle of operation of PWM inverter and describe how it is used for wind energy conversion.
12. Draw the block diagram of the solar PV system and explain the principle of operation in detail.
13. Draw the schematic diagram of Buck-Boost converter and explain the operation in detail.
14. Explain the following in detail:
i. AC voltage controller ii. Voltage control in PWM inverters.

UNIT – IV
ANALYSIS OF WIND AND PV SYSTEMS

1. Explain the stand alone operation of fixed speed wind energy conversion system.
2. Explain the stand alone operation of variable speed wind energy conversion system.
3. Explain the block diagram of SCIG based wind energy conversion system.
4. Explain the operation of grid integrated PMSG system with a neat block diagram.

5. Explain with the help of a neat block diagram the functions of various blocks of a WECS.
6. A HAWT is installed at a location having free wind velocity of 15m/s. The 80m diameter rotor has three blades attached to the hub. Find the rotational speed of the turbine for optimal energy extraction.
7. Write short notes on grid integrated solar system.
8. Describe stand alone operation of solar energy conversion system.
9. Discuss in detail the grid system characteristics and explain with a neat diagram the stand alone and grid integrated solar system.
10. Explain how the isolation and temperature affects the I-V characteristics of a solar cell.
11. Explain about various grid connection issues and its impact on system stability.

UNIT – V
HYBRID RENEWABLE ENERGY SYSTEMS

1. Explain the hybrid energy conversion system with neat sketch.
2. Derive an expression for the total cost of a hybrid system and three from deduce a simple condition for the feasibility of the system.
3. Explain MPPT techniques for WECS.
4. Explain various strategies used for the operation of an MPPT.
5. Is wind energy an excellent supplement to the PV? If so justify with a suitable case study.
6. What is MPPT? Discuss the types of MPPT with its merits and demerits. Explain the incremental-conductance algorithm with a neat example.
7. Explain operating principle of PV Maximum Power Point Tracking in energy conversion.
8. Explain with case study how to get maximum power generation in wind energy
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conversion system.
9. With a neat sketch, explain the operation of PV-Diesel hybrid system.
10. Draw and explain the operation of Wind-PV hybrid system.

GE6075- PROFESSIONAL ETHICS IN ENGINEERING

UNIT I

HUMAN VALUES

1. What are human values?

Values decide the standard of behavior. Some universally accepted values are freedom Justice and equality. Other principles of values are love, care, honesty, integrity, self respect.

2. What are ethical values?

Trustworthiness, respect, responsibility, fairness, caring is ethical values

3. Distinguish values from ethics and culture.

Values are mainly related to individuals and since they are related to justice, they remain the some for everyone. E.g. truth, honesty, empathy, self respect.Values do not change from individual to individual. Ethics is common to a group ofindividuals; the group may be religious or professional. Ethics is mostly based on some code or law and judgment of any action is based on code of conduct or law. Ethics change from individual to individual Culture commonly refers to conduct of a group. E.g system of worship, marriage may differ from society to society, nation to nation or religion to religion.

4. What is integrity?

Integrity is the unity of character based on moral values. Consistency in attitudes, emotions and conduct in relations to morally justified actions and values are also the part of integrity of individual. It implies honesty, trustworthiness.

5. Define work ethics

By one's work one cannot harm others. Any worker cannot escape accountability. Worker has the moral responsibility to see that no other person's right, private or freedom is impaired or transgressed.

6. What is service learning?

Service learning tells that one has moral responsibility to increase the desirable effects and to decrease the harmful effects. Any service should increase the desirable result.

7. Mention some civic virtues?

Good citizen demand civic virtue. It is the principle of not harming the surroundings .It also includes living peacefully, respect for others, protecting the environment and being normally and ethically good.

8. Write short notes on caring and sharing.

Caring is the essence of moral life. Caring involves feelings, relationship, contends with other persons and protecting others and causing least damage to others.Sharing means sharing of

feelings, ideas thoughts, resources and profits. Sharing is always mutually beneficial. Sharing morally acceptable feelings, resources and materials is a value.

9. Write notes on honesty.

Any human being should imbibe honesty-honesty in acts, honesty in speech and honesty in beliefs. Honesty is the fundamental virtue in human relationship even though in may be difficult to follow some times.

10. What is courage as a value?

Courage implies self respect and governs confrontations with danger and risk. It is not excessive rashes or cowardice, but it is the middle ground. Taking calculated risks and boldness in facing crises are the hallmarks of courage as a human value. It defines the mental make up of an individual in taking bold decisions even under adverse situations.

11. Define co-operation.

Co-operation means extending help to others, for a good cause. Co-operation may be through an idea, a suggestion, an assistance or physical work which extends to others for common benefit.

12. Define empathy.

Empathy means putting self in a position of someone else and thinking as the later and reasoning suitable action.

13. Define spirituality.

Spirituality raises a man above the materialistic world into a realm where he seeks peace and real happiness.

14. Define Integrity?

Integrity is the bridge between responsibility in private and professional

life. 15. Define Compromise?

In a negative sense it means to undetermined integrity by violating one's fundamental moral principles. In a positive sense, however, it means to settle differences by mutual concessions or to reconcile conflicts through adjustments in attitude and conduct.

16. Give the two aspects of Honesty?

Truthfulness – meeting responsibilities concerning truth-telling.

Trustworthiness – Meeting responsibilities concerning trust.

17. Differentiate Self-respect and Self-esteem?

Self-respect: It is a moral concept; refers to the virtue properly valuing oneself. Self-esteem: It is a psychological concept; means having a positive attitude toward One self, even if the attitude is excessive or otherwise unwarranted.

18. Give the two aspects of Honesty?

- Truthfulness – meeting responsibilities concerning truth-telling.
- Trustworthiness – Meeting responsibilities concerning trust.

19. Differentiate Self-respect and Self-esteem?

Self-respect: It is a moral concept; refers to the virtue properly valuing oneself. Self-esteem: It is a psychological concept; means having a positive attitude toward oneself, even if the attitude is excessive or otherwise unwarranted.

20. What are the two forms of Self-respect?

- Recognition self-respect
- Appraisal self-respect

UNIT – II

ENGINEERING ETHICS

1. Define Ethics?

- Study of right or wrong.
- Good and evil.
- Obligations & rights.
- Justice.
- Social & Political deals.

2. Define Engineering Ethics?

- Study of the moral issues and decisions confronting individuals and organizations engaged in engineering / profession.
- Study of related questions about the moral ideals, character, policies and relationships of people and corporations involved in technological activity.
- Moral standards / values and system of morals.

3. What is the need to study Ethics?

- To responsibly confront moral issues raised by technological activity.
- To recognize and resolve moral dilemma.
- To achieve moral autonomy.

4. Differentiate Moral and Ethics?

- Refers only to personal behavior.
- Refers to any aspect of human action.
- Social conventions about right or wrong conduct.

ETHICS:

- Involves defining, analyzing, evaluating and resolving moral problems and
- Developing moral criteria to guide human behavior.
- Critical reflection on what one does and why one does it.
- Refers only to professional behavior.

5. What is the method used to solve an Ethical problem?

- Recognizing a problem or its need.
- Gathering information and defining the problem to be solved or goal to be achieved.
- Generating alternative solutions or methods to achieve the goal.
- Evaluate benefits and costs of alternate solutions.
- Decision making & optimization.
- Implementing the best solution.

6. What are the Senses of Engineering Ethics?

- An activity and area of inquiry.
- Ethical problems, issues and controversies.
- Particular set of beliefs, attitudes and habits.
- Morally correct.

7. Differentiate Micro-ethics and Macro-ethics?

Micro-ethics : Deals about some typical and everyday problems which play an important role in the field of engineering and in the profession of an engineer.

Macro-ethics : Deals with all the societal problems which are unknown and suddenly burst out on a regional or national level.

8. What are the three types of Inquiry? Normative

Inquiry – Based on values. Conceptual

Inquiry – Based on meaning. Factual

Inquiry – Based in facts.

9. What are the sorts of complexity and murkiness that may be involved in moral situations?

- Vagueness
- Conflicting reasons
- Disagreement

10. What are the steps in confronting Moral Dilemmas?

- Identify the relevant moral factors and reasons.
- Gather all available facts that are pertinent to the moral factors involved.
- Rank the moral considerations in order of importance as they apply to the situation.
- Consider alternative courses of actions as ways of resolving dilemma, tracing the full Implications of each.
- Get suggestions and alternative perspectives on the dilemma.

11. Define Moral Autonomy?

12. Give the importance of Lawrence Kohlberg's and Carol Gilligan's theory?

Kohlberg gives greater emphasis to recognizing rights and abstract universal rules.Gilligan stresses the importance of maintaining personal relationships based on mutual caring.

13. Give the need for Authority?

Authority provides the framework in which learning can take place.

14. What are the criteria required for a Profession?

- Knowledge
- Organization

- Public Good

15. Give the general criteria to become a Professional engineer?

- Attaining standards of achievement in education, job performance or Creativity in engineering that distinguishes engineers from engineering technicians and technologists.
- Accepting as part of their professional obligations as least the most Basic moral responsibilities to the public as well as to their employers, clients, colleagues and subordinates.

16. Define Integrity?

Integrity is the bridge between responsibility in private and professional life. 17. Define Compromise?

In a negative sense it means to undetermined integrity by violating one's fundamental moral principles. In a positive sense, however, it means to settle differences by mutual concessions or to reconcile conflicts through adjustments in attitude and conduct.

18. What are the senses of Responsibility?

- a virtue
- obligations
- general moral capacities of people
- liabilities and accountability for actions
- blameworthiness or praiseworthiness

19. When will you tell an Act as an involuntary one?

- Act done in ignorance
- Act performed under compulsion

20. What are the types of Theories about Morality?

- Virtue ethics – Virtues and vices
- Utilitarianism – Most good for the most people
- Duty ethics – Duties to respect people
- Rights ethics – Human rights

21. Differentiate Hypothetical imperatives and Moral imperatives?

Hypothetical imperatives are based on some conditions whereas Moral imperatives wont based on some condition.

22. Give the various tests required to evaluate the Ethical Theories?

- Theory must be clear, and formulated with concepts that are coherent and applicable.
- It must be internally consistent in that none of its tenets contradicts any other.
- Neither the theory nor its defense can rely upon false information.
- It must be sufficiently comprehensive to provide guidance in specific situations of interests to us.
- It must be compatible with our most carefully considered moral convictions about concrete situations.

23. Give the drawbacks of Utilitarianism?

- Sometimes what is best for the community as a whole is bad for certain
- Individuals in the community.
- It is often impossible to know in advance which decision will lead to the most good.

24. Give the drawback of Duty Ethics?

Duty ethics does not always lead to a solution which maximizes the public good.

25. Differentiate Ethical Relativism and Ethical Egoism?

Ethical egoism – the view that right action consist in producing one's own good.

Ethical relativism – the view that right action is merely what the law and customs of One's society require.

26. Define Ethical Pluralism?

Ethical pluralism is the view that there may be alternative moral perspectives that are reasonable, but no one of which must be accepted completely by all rational and morally concerned persons.

A religion is any set of articles of faith together with the observances, attitudes, obligations and feelings tied up therewith, which, in so far as it is influential in a person, tends to perform two functions, one social and the other personal.

28. Give the uses of Ethical Theories?

- In understanding moral dilemmas
- Justifying professional obligations and ideals
- Relating ordinary and professional morality

29. What are personal ethics and business ethics?

Personal ethics deals with how we treat others in our day- to- day lives. Business ethics deals with the desired norms of behavior that pertain to commercial transactions.

30. What do you mean by normative ethics?

Normative ethics deals with the professional codes of ethics that specify role norms or obligations that professions attempt to enforce. It is the recommendations of standards and guidelines for morally right or good behavior.

31. What is descriptive ethics or non-normative ethics?Descriptive ethics deals with the factual investigation of moral behavior and beliefs ie., the study not of what people ought to do but how they reason and how they act.

32. Mention some universally accepted ethical principles.

- Honesty
- Integrity
- Fulfilling commitments
- Abiding by agreements in both letter and spirit
- Willing to admit mistakes
- Having respect for human dignity

UNIT - III

ENGINEERING AS SOCIAL EXPREMENTATION

1. What are the conditions required to define a valid consent?

- The consent was given voluntarily.
- The consent was based on the information that rational person would want, together with any other information requested, presented to them in understandable form.
- The consenter was competent to process the information and make rational decisions.

2. What are the two main elements which are included to understand informed consent? Informed Consent is understood as including two main elements:

- Knowledge [Subjects should be given not only the information they request, but all the information needed to make a reasonable decision].
- Voluntariness [Subjects must enter into the experiment without being subjected to force, fraud, or deception].

3. What are the general features of morally responsible engineers?

- Conscientiousness.

- Comprehensive perspective.
- Autonomy.
- Accountability.

4. What is the purpose of various types of standards?
   - Accuracy in measurement, interchangeability, ease of handling.
   - Prevention of injury, death and loss of income or property.
   - Fair value of price.
   - Competence in carrying out tasks.
   - Sound design, ease of communications.
   - Freedom from interference.
5. Define Code?

6. Enumerate the roles of codes?
   - Inspiration and Guidance
   - Support
   - Deterrence and Discipline
   - Education and Mutual Understanding
   - Contributing to the Profession's Public Image
   - Protecting the Status Quo
   - Promoting Business Interests

7. Give the limitations of codes?
   - Codes are restricted to general and vague wording.
   - Codes can't give a solution or method for solving the internal conflicts.
   - Codes cannot serve as the final moral authority for professional conduct.
   - Codes can be reproduced in a very rapid manner.
8. What are the problems with the law in engineering?
   - Minimal compliance
   - Many laws are without enforceable sanctions.
9. What is the need to view engineering projects as experiments?

- Any project is carried out in partial ignorance.
- The final outcomes of engineering projects, like those of experiments, are generally uncertain.
- Effective engineering relies upon knowledge gained about products before and after they leave the factory – knowledge needed for improving current products and creating better ones.

10. Differentiate scientific experiments and engineering projects?

Scientific experiments are conducted to gain new knowledge, while "engineering projects are experiments that are not necessarily designed to produce very much knowledge".

11. What are the uncertainties occur in the model designs?

- Model used for the design calculations.
- Exact characteristics of the materials purchased.
- Constancies of materials used for processing and fabrication.
- Nature of the pressure, the finished product will encounter.

12. Comment on the importance of learning from the past, using Titanic disaster, as an example**?**

The Titanic lacked a sufficient number of lifeboats.

13. Comment on the importance of learning from the past, using the nuclear reactor accident at Three Mile Island, as an example?

Values are notorious for being among the least reliable components of hydraulic systems. It was a pressure relief valve, and lack of definitive information regarding its open or shut state. Similar Malfunctions had occurred with the identical values on nuclear reactors because of the same reasons at other locations, but no attention had been given to them

14. Give any two prominent features of contemporary engineering practice that differentiate casual influence and moral accountability in engineering?

- Large-scale engineering projects involve fragmentation of work.
- Due to the fragmentation of the work, the accountability will spread widely within an organization.
- There is frequently pressure to move on to a new project before the current one has been operating long enough to be observed carefully.
- The contagion of malpractice suits currently afflicting the medical profession is Carrying over into engineering.

15. Are SRBs inherently too dangerous to use on manned spacecraft? If so, why are the part of the design?

Yes, since they have the disadvantage that once the fuel is lit, there is no way to turn the booster off or even to control the amount of thrust produced. SRBs were used instead of safer liquid fueled boosters because they required a much smaller research-and development effort. Numerous other design changes were made to reduce the level of research and development required.

16. Under what conditions would you say it is safe to launch a shuttle without an escape mechanism for the crew?

- Design specifications C□310F
- Have given valid consent
- Instead of rubber, steel billets for O-rings
- Liquid fueled boosters instead of Solid rocket boosters

17. In your opinion, was the 'Right for informed consent' of the astronauts of Space Shuttle Challenger respected?

No.

18. Define Ethical Conventionalism?

Ethical conventionalism is the view that a particular set of conventions, customs, or laws is self-certifying and not to be questioned as long as it is the set in force at a given time or for a given place.

19. State Babylon's Building Code?

If a builder has built a house for a man and has not made his work sound, and the house which he has built has fallen down and so caused the death of the householder, that builder shall be put to death.

If it causes the death of the householder's son, they shall put the builder's son to death.

If it causes the death of the householder's slave, he shall give slave for slave to the householder.

If it destroys property he shall replace anything it has destroyed; and because he has not made sound the house which he has built and it has fallen down, he shall rebuild the house which has fallen down from his own property.

If a builder has built a house for a man and does not make this work perfect and the

Wall bulges, that builder shall put that wall into sound condition at his own cost.

20. What are the steps in confronting moral dilemmas?

- Identify the relevant moral factors and reasons
- Gather all available facts that are pertinent to the moral factors involved.
- Rank the moral considerations in order of importance as they apply to the situation.
- Consider alternative course of action as ways of resolving the dilemma, tracing the full implications of each.
- Talk with the colleagues seeking their suggestions and alternative perspectives on the dilemma.
- Arrive at a carefully reasoned judgment by weighing all the relevant factors and reasons in light of the facts.

UNIT – IV
SAFETY, RESPONSIBILITIES AND RIGHTS

1. Define Risk?

A risk is the potential that something unwanted and harmful may occur.

Risk = Probability X Consequences.

2. Define a Disaster?

A DISASTER = A seriously disruptive event + A state of unpreparedness.

3. Give the criteria which helps to ensure a safety design?

- The minimum requirement is that a design must comply with the applicable laws.
- An acceptable design must meet the standard of "accepted engineering practice."
- Alternative designs that are potentially safer must be explored.
- Engineer must attempt to foresee potential misuses of the product by the consumer and must design to avoid these problems.
- Once the product is designed, both the prototypes and finished devices must be Rigorously tested.

4. What are the factors for safety and risk?

- Voluntary and Involuntary risk
- Short-term and Long-term risk

- Expected probability
- Reversible effects
- Threshold levels to risk
- Delayed or Immediate risk etc

5. Give the categories of Risk?

Low consequence, Low probability (which can be ignored)

Low consequence, High probability

High consequence, Low probability

High consequence, High probability

6. What are the factors that affect Risk Acceptability?

- Voluntarism and control
- Effect of information on risk assessment
- Job related pressures
- Magnitude and proximity of the people facing risk

7. What is the knowledge required to assess the risk?

- Data in design
- Uncertainties in design
- Testing for safety
- Analytical testing
- Risk-benefit analysis

8. What are the analytical methods?

- Scenario analysis
- Failure modes & effect analysis
- Fault tree analysis
- Event tree analysis etc.

9. What are the three conditions referred as safe exit?

- Assure when a product fails it will fail safely.
- Assure that the product can be abandoned safely.
- Assure that the user can safely escape the product.

10. How will an engineer assess the safety?

- The risks connected to a project or product must be identified.
- The purposes of the project or product must be identified and ranked in importance.
- Costs of reducing risks must be estimated.
- The costs must be weighed against both organizational goals and degrees of acceptability of risks to clients and the public.
- The project or product must be tested and then either carried out or manufactured.

11. What are the reasons for Risk-Benefit Analysis?

- Risk-benefit analysis is concerned with the advisability of undertaking a project.
- It helps in deciding which design has greater advantages.
- It assists the engineers to identify a particular design scores higher with that of the another one.

12. Are the engineers responsible to educate the public for safe operation of the equipment? How?

Yes, as per the engineers are concerned with they should have their duty as to protect for the safety and well being of the general public. Analyzing the risk and safety aspects of their designs can do this.

13. Define Safety?

In the definition stated by William W. Lawrence safety is defined, as a thing is safe if its risks are acceptable. A thing is safe with respect to a given person or group, at a given time, if its risk is fully known, if those risks would be judged acceptable, in light of settled value principles. In the view of objective, safety is a matter of how people would find risks acceptable or unacceptable.

14. What is the definition of risks?

A risk is the potential that something unwanted and harmful may occur. Risk is the possibility of suffering harm or loss. It is also defined as the probability of a specified level of hazardous consequences, being realized. Hence Risk (R) is the product of Probability (P) and consequence(C) (i.e) $R = P * C$

15. Define Acceptability of risks?

A risk is acceptable when those affected are generally no longer apprehensive about it. Doubtfulness depends mainly on how the people take the risk or how people perceive it.

16. What are the safety measures an engineer must know before assessing a risk of any product? The factors are:

- Does the engineer have the right data?
- Is he satisfied with the present design?
- How does he test the safety of a product?
- How does he measure and weigh the risks with benefits for a product.

17. What is the use of knowledge of risk acceptance to engineers?

Though past experience and historical data give better information about safety of products designing there are still inadequate. The reasons are

- The information is not freely shared among industries
- There also new applications of old technologies that provides available data, which are less useful.
- So, in order to access the risk of a product, the engineers must share their knowledge and information with others in a free manner.

18. What is meant by Disaster? Give an example.

A disaster does not take place until a seriously disruptive event coincides with a state of insufficient preparation. Example: The Titanic collision with an iceberg

19. What are the positive uncertainties in determining risks?

There are three positive uncertainties. They are:

- Purpose of designing
- Application of the product
- Materials and the skill used for producing the product.

20. What is the use of Risk-Analysis? What are the three factors involved here?

Risk Analysis is used for the assessment of the hazardous associated with an industrial or commercial activity. It involves identifying the causes of unwanted hazardous events and estimating the consequences and likelihood of these events. Three factors involved in this are:

- Hazard Identification
- Consequences analysis
- Probability estimation.

21. Define Risk-Benefit Analysis?

Risk benefit analysis is a method that helps the engineers to analyze the risk in a project and to determine whether a project should be implemented or not. In risk benefit analysis, the risks and benefits of a product are allotted to money amounts, and the most benefit able ratio between risks and benefits is calculated.

22. Explain the two types of Risk?

- Personal Risk:

An individual, who is given sufficient information, will be in a position to decide whether to take part in a risky activity or not. They are more ready to take on voluntary risks than involuntary risks.

- Public Risks:

Risks and benefits to the public are more easily determined than to individuals, as larger number of people is taken into account. Involuntary risks are found here.

23. What does Strict Liability mean?

Strict liability means if the sold product is defective; the manufacturer concerned is liable for any harm that results to users. Negligible is not at all an issue based.

24. Give the reasons for the Three Mile Island disaster?

- Inadequate training to the operators.
- Use of B & W reactors.

25. What is the main barrier to educational attempts?

An important barrier to educational attempt is that people belief change slow and are Extraordinarily resistant to new information.

26. What happens to the products that are not safe?

Products that are not safe incur secondary costs to the manufacturer beyond the primary costs that must also be taken into account costs associated with warranty expenses, loss of customer will and even loss of customers and so.

27. What does Open-mindedness refer to?

Open-mindedness refers once again not allowing a preoccupation with rules to prevent Close examination of safety problems that may not be covered by rules.

28. What was the problem in the Chernobyl reactor?

The problem was that, The output was maintained to satisfy an unexpected demand. The control device was not properly reprogrammed to maintain power at the required level. Instead

of leaving fifteen control rods as required, the operators raised almost all control rods because at the low power level, the fuel had become poisoned.

29. What is called 'White-collar crime'?

Occupational crimes are illegal acts made possible through one's lawful employment. It is the secret violation of laws regulating work activities. When committed by office workers of professionals, occupational crime is called 'white-collar crime'.

30. What are the essential elements of IPR?

i. Patents

ii. Copyrights

iii. Trademarks

iv. Trade secrets

31. Define Collegiality?

Collegiality is a kind of connectedness grounded in respect for professional expertise and in a commitment to the goals and values of the profession and collegiality includes a Disposition to support and cooperate with one's colleagues.

32. What are the central elements of collegiality?

- Respect
- Commitment
- Connectedness
- Cooperation

33. What are the two senses of Loyalty?

- Agency Loyalty – Acting to fulfill one's contractual duties to an employer. It's a matter of actions, whatever its motives.
- ii. Identification Loyalty – Has as much as to do with attitudes, emotions, and a sense of personal identity as it does with actions.

34. When may an Identification Loyalty be said as obligatory?

- Employees must see some of their own important goals as met by and through a group in which they participate.
- Employees must be treated fairly, each receiving his or her share of benefits and burdens.

35. What is the relationship between the Loyalty to the company and Professional responsibility to the public?

- Acting on professional commitments to the public can be a more effective way to serve a company than a mere willingness to follow company orders.
- Loyalty to companies or their current owners should not be equated with merely

- An engineer might have professional obligations to both an employer and to the public that reinforce rather than contradict each other.

36. Define Institutional Authority?

Institutional Authority is acquired, exercised and defined within organizations. It may be defined as the institutional right given to a person to exercise power based on the resources of the institution.

Expert authority is the possession of special knowledge, skill or competence to perform task or give sound advice.

38. What is the basic moral task of salaried engineers?

The basic moral task of salaried engineers is to be aware of their obligations to obey employers on one hand and to protect and serve the public and clients of the other.

39. What are the guidelines to reach an agreement?

- Attack problem and not people.
- Build trust.
- Start with a discussion and analysis of interests, concerns, needs. It begin with interests, not positions or solutions.
- Listen.
- Brainstorm; suggesting an idea does not mean one aggress with it. Develop multiple options.
- Use objective criteria whenever possible. Agree on how something will be measured.

40. Define confidential information?

Confidential information is information deemed desirable to keep secret.

41. What are the criteria for identifying that information is “labeled” confidential at the workplace?

- Engineers shall treat information coming to them in the course of their as confidential.
- Identify any information which if it became known would cause harm to the corporation or client.
- Confidential information is any information that the employer or client would like to have kept secret in order to compete effectively against business rivals.

42. What are the terms associated with Confidentiality?
    - Privileged Information
    - Proprietary Information
    - Patents & Trade secrets

43. How will you justify the obligation of confidentiality?

    The obligation of confidentiality can be justified at two levels.

    FIRST Level: Moral Considerations

    Respect for autonomy

    Respect for promises

    Regard for public well-being

    SECOND Level: Major Ethical Theories

    Rights Ethicists

    Duty Ethicists

    Rule-utilitarians

    Act-utilitarians

44. Define Conflicts of Interest?

    Conflict of interests is a situation in which two or more interests are not simultaneously realizable. It is the disagreement between public obligation and self interest of an official.

45. Why does a conflict of interests arise?
    - Financial Investments
    - Insider Trading
    - Bribe
    - Gifts
    - Kickbacks

46. What is a Bribe?

A Bribe is a substantial amount of money or goods offered beyond a stated business contract with the aim of winning an advantage in gaining or keeping the contract.

47. What is a Gift?

Gifts are not bribes as long as they are small gratuities offered in the normal conduct of business.

48. What is called Kickbacks?

Prearranged payments made by contractors to companies or their representatives in exchange for contracts actually granted are called kickbacks.

49. What are the types of Conflicts of interest?

- Actual conflict of interest
- Potential conflict of interest
- Apparent conflict of interest

50. What are the forms of Conflicts of interest?

1. Interest in other companies 2. Moonlighting 3. Insider information

UNIT – V

GLOBAL ISSUES

1. What is meant by moral leadership?

- Whenever the goals of a leader become permissible and also morally valuable, it is known as moral leadership.
- Moral leadership also means that employing morally acceptable ways to motivate the groups to move towards morally desirable ways. The ways are depending on the situations.

2. What are the questions that arise while considering the voluntary service in the field of Engineering?

The following questions arise:

- Should engineering profession encourage rendering voluntary services with out fees or at moderate fees?
- Do the engineering professional societies really need this?

3. What is code of ethics?

- Code of ethics is a frame work for arriving at good ethical choices.

- The code of ethics establishes a frame work for ethical judgment for any profession.
- A code of ethics does not develop new moral principles.

4. What are the common features involved in the code of ethics for Engineers?

- Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
- Engineers shall perform services only in the areas of their competence.
- Engineers shall issue public statements only in an objective and truthful manner.
- Engineers shall act in professional matters for each employer or client as faithful agents or trustees.
- Engineers shall avoid deceptive acts in the solicitation of professional employment.

5. Differentiate eyewitness and expert witness?

Eye Witnesses

Eyewitnesses give evidences in the court about what they have seen actually.

Expert Witnesses

Expert witnesses are allowed larger freedom in giving evidence on facts in there areas of expertise on explaining facts in commenting on the views of the expert witnesses of the opposite side and also in reporting on the professional standards.

6. What is the need for Honesty?

Honesty is necessary to avoid deceiving and to be frank in giving all the relevant facts. It is also necessary to be truthful in interpreting the facts. Honesty in technical data is essential to be honest in engineer's role and for the values guiding his studies.

7. What is meant by Competence?

Competence means being well trained and having proper experience in the relevant field and also having the required additional skills planning and policy making.

8. What does Diligence mean?

Diligence means carrying out the given job carefully and in a prompt way.

9. Define Loyalty?

Loyalty refers to serving the interests of the clients. It includes avoiding conflicts of interests maintaining confidentiality and expressing concern for the interest of the clients.

10. What is the basic ethical and moral responsibility of a manager-engineer?

Ethical responsibility:

The basic ethical responsibilities of managers are to produce a good product or valuable service, only after taking into consideration maintaining respect for human beings, which includes customers, employees and the general public. Moral responsibility: As managers, engineer's moral responsibility is to produce safe and useful products that are also profitable.

11. .What is the different ways to create an ethical climate?

The following are the ways to create an ethical climate:

- Ethical values must be accepted and appreciated by the managers and employees with its full complicated features.
- The sincere use of ethical language has to be recognized as a justifiable part of the company.
- The management has to create a strong confidence among the employees that the management is more serious about ethics by establishing moral tone in words, in policies and also by personal example.

12. What are the important forms of conflicts that may arise for an engineering project manager?

The important forms of conflicts that may arise for an engineering project manager are,

- Conflicts based on schedules.
- Conflicts which arises in evolving the importance of projects and the department.
- Conflicts based on availability of personal for a project.
- Conflicts over technical matters.
- Conflicts which arises due to administrative procedure.
- Conflicts of personality.
- Conflicts over cost or expenditure.

13. What are the principles for conflict resolution?

- People must be separated from the problem
- Focus must be only on interest and not on positions
- Various options must be generated
- An evolution criteria should be established

14. Who are referred as consulting engineers?

Consulting engineers are those involved in private practice. For the services rendered by them, they will be paid some fees. They won't be compensated by salaries from employers. They are the sole employer of their practice. So they have greater freedom to take decisions on the tasks undertaken by them.

15. What are the rules framed by NSPE in case of professional advertisements?

The rules framed by NSPE (National Society of Professional Engineers) in case Of professional advertisements are as follows:

- The use of statements containing a material misrepresentation of fact or omitting a material fact necessary to keep the statement from being misleading.
- Statements intended or likely to create an unjustified expectation.
- Statements containing prediction of future success.
- Statements containing an opinion as to the quality of the engineer's services.

16. What do you mean by appropriate technology?

Appropriate technology means identification, transformation and implementation of the most suitable technology for a new set of conditions.

17. What are the ill effects of acid rain?

Bacteria's that are essential for life systems to be active are killed. High acidity results in reduced growth and killing of fishes. Vanishing of greenery and destruction of forests. Germination of seeds is affected affecting the growth of trees.

18. What do you mean by technology transfer?

Technology transfer is a process of changing the technology to a new setting and implementing it. Technology includes hardware such as machines and installations as well as techniques such as technical, organizational and managerial skills and procedures.

19. What are the ethical issues or questions that arise in environmental protection? Often the questions that arise in the ethical issues are,

Who is affecting?

Who are affected?

Does the environment gets disturbed?

When do the disturbances takes place and how does it happen?

20. Quote some examples of pollution that spoiled the environment?

Some examples of pollution that affected the environment are Bhopal gas tragedy, Chernobyl nuclear plant explosion, Artificial rains, Meuse valley disaster at Belgium, Oleum gas leak in Delhi, HPCL disaster in Vizag, Donova (USA)steel and chemical plant disaster, Tehri Dam in U. P. state, etc.

21. What is computer ethics?

Computers contribute to a variety of moral problems. In order to evaluate and act appropriately with such problems, a new field of applied ethics termed as 'computer ethics' has been developed.

22. Give any ten commandments of computer ethics?

a. Don't use a computer to harm other people.

b. Don't interfere with other people's computer works.

c. Don't snoop around in other people's computer files.

d. Don't use a computer to steal.

e. Don't use a computer to bear false witness.

23. What is hacking?

When computers are the main objects of an unethical act, it will create some ethical issues. This kind of act is called hacking.

24. What is autonomous computer?

The autonomy of computers means the ability of computer to make decisions without the interference of human beings. This autonomous function of computers creates a lot of implication.

25. What are the three versions of Relativism?

- Ethical Relativism
- Descriptive Relativism
- Moral Relativism

26. What are the moral dimensions of an Engineer-manager?

- Information rights and obligation
- Property rights
- Accountability and control
- System quality
- Quality of life

27. Give any ten International rights suggested by Donaldson?

I. The right to freedom of physical movement.

II. The right to ownership of property.

III. The right to freedom from torture.

IV. The right to a fair trial.

V. The right to nondiscriminatory treatment.

VI. The right to physical security.

VII. The right to freedom of speech and association.

VIII. The right to minimal education.

IX. The right to political participation.

X. The right to subsistence.

28. Give some of the Environmental issues of concern to engineers? a.

Releasing harmful substance into air and water.

b. Using toxic substance in food processing.

c. Disturbing land and water balances.

29. What are the issues in Computer ethics?

- Power Relationship
- Job Elimination
- Customer Relations
- Biased Software
- Stock Trading
- Unrealistic Expectations
- Political Power
- Military Weapons
- Property
- Embezzlement
- Data and Software
- Legal Responses
- Professional Issues
- Computer Failures
- Computer Implementation

- Health conditions

30. What are the problems of Defense industry?
    - Problem of waste and huge cost in implementing and maintaining a weapons system.
    - Problem of Technology creep.
    - Problems in maintaining secrecy.
    - Every country allocates large amount of its resources to defense sector [India spent ¼ of its resource for defense

31. What are ways to promote an Ethical climate?
    - Ethical values in their full complexity are widely acknowledged and appreciated by managers and employees alike.
    - The sincere use of ethical language has to be recognized as a legitimate part of corporate dialogue.
    - The top level management must establish a moral tone in words, in policies, by personal example etc.
    - The management has to establish some procedures for resolving conflicts.

32. What are the important forms of Conflicts?
    - Conflicts based on schedules
    - Conflicts which arises in evolving the importance of projects and the department.
    - Conflicts based on the availability of personal for a project.
    - Conflicts over technical matters.
    - Conflicts arise due to administrative procedure.
    - Conflicts of personality.
    - Conflicts over cost or expenditure or money.

33. What are the Principles of Conflicts of interest?
    - Separate people from the problem.
    - Focus on interest and not on positions.
    - Generate a variety of possibilities before deciding what to do.

- Insist that the result be based on some objective standard.

34. How can Deceptive advertising be done?
    - By outright lies.
    - By half-truths.
    - Through exaggeration.
    - By making false innuendos, suggestions or implications.
    - Through obfuscation created by ambiguity, vagueness or incoherence.
    - Through subliminal manipulation of the unconscious.

16 MARKS

UNIT – I

HUMAN VALUES

1. Write short notes on Work ethic and service learning.
2. Explain the following (i) Courage and Valuing time (ii) Co operation and commitment
3. Explain with a neat diagram, the contexts of potential professional disagreements Engineers may encounter.
4. Engineers who work for drug companies betray their moral integrity or can they provide an adequate moral accounting for their work? Justify your answer.
5. How does honesty exist as a fundamental virtue between employers, engineers and clients?
6. Explain the relation between character and spirituality.
7. Discuss the correspondence between caring and sharing.
8. What do you understand by the term civic virtue? What are the various aspects involved in civic virtue?
9. Describe honesty as a fundamental virtue between engineers, employers and clients.
10. Why is it essential for engineering students to learn professional ethics?

UNIT – II

ENGINEERING ETHICS

1. Discuss Kohlberg's model of moral development and Gilligan theory of moral Development?
2. Explain the concept of collegiality and loyalty.
3. Write short notes on Professional rights.
4. Write short notes on employee rights to privacy and choice of outside activities
5. Write short notes on consensus and controversy

6. Explain in detail about theories about right action?
7. Explain the uses of ethical theories and its limitations?
8. What do you understand by moral autonomy? Discuss the skills to be acquired by the engineers to become morally autonomous.
9. Write short notes on: (i) Ethical Relativism (ii) Abuses of codes of ethics
10. State the similarities to view engineering projects as experiments.

UNIT III

ENGINEERING AS SOCIAL EXPERIMENTATION

1. How engineering projects differs from standard experimentation?
2. In the Challenger Disaster, examine if and how the principal actors behaved as Responsible experimenters.
3. State the similarities to view engineering projects as experiments.
4. Write short notes on abuses on the codes of ethics
5. Write short notes on Ethical Relativism
6. List the steps in confronting moral dilemma.
7. Compare and contrast engineering experiments with standard experiments.
8. Describe the concept of risk – benefit analysis.
9. Give any four examples of improved safety and explain.
10. Write notes on: Personal risk, Public risk.

UNIT IV

SAFETY, RESPONSIBILITIES AND RIGHTS

1. What are the terms associated with Confidential Information in Industry? Explain.
2. Write short notes on: Employees rights for privacy and choice of outside activities.
3. Explain the concept of collegiality and loyalty.
4. What is whistle blowing? How can the employers prevent whistle blowing?
5. Describe the concept of risk –benefit analysis.
6. Under what circumstances the conflict of interest occurs with the employees?
7. What is meant by industrial espionage? What are the basic reasons for it? Explain with suitable examples.
8. What are the basic principles of 'Professional Rights' with reference to ethical theories?
9. Why is it necessary to protect intellectual property rights?
10. What are the possible forms of sexual Harassment that generally occur in industries?
11. Define the Collective Bargaining. Explain the role of collective bargaining in Workplace rights and responsibilities.

UNIT V

GLOBAL ISSUES

1. Describe the moral threats posed by the revolutionized communication using computers to the right to privacy.
2. Describe the concept of environmental ethics with a case study.
3. Discuss on the ways and means of reducing occupational crimes in industries
4. Write a brief account on Consulting Engineering
5. Explain Engineers as expert witness and advisors?
6. Discuss an Engineers involvement in weapons work?
7. Discuss on the Professional Societies?
8. Write a detailed note on the various aspects connected with the wide new field of computer ethics.
9. Discuss on three senses of 'Relative' values.
10. Give the philosophical views of nature and discuss them.