Government Engineering College, Dahod
MECHANICAL ENGINEERING DEPARTMENT

Renewable Energy Engineering (2181910)

Tutorial: 1 Introduction

1. What are the conventional & non-conventional energy sources? Describe briefly. (May'11, Dec'13)
2. Comment on the future availability trend of fossil fuels and renewable energy in the world.
3. Write a short note on classification of energy resources. Also explain which type of alternate energy source is the best suitable for rural & agricultural application and why? (May'12)
4. Explain reserves, production and utilization of primary energy sources in India. (May'12)
5. Describe the essentiality for exploration of renewable sources of energy. (Dec'11, Dec'10)
6. Classify the various non-conventional energy sources and their availability with reference to Indian context. (June'11, June'10, Dec'11)
7. Describe advantages and drawbacks of solar energy utilization. (June'13, Dec'10, Dec'11)
8. What is the difference between conventional & non-conventional energy sources? (Dec'12)
9. Explain in brief renewable energy sources with special reference to Indian context. (Dec'12)
10. Explain the principle of conversion of solar energy into heat. (Dec'12)
11. Discuss in brief advantages and limitation of renewable energy.

Tutorial:2 Solar Energy

1. Explain the term "solar constant" and "Air mass"? What is variation of solar constant with time and what is the reason for this variation? [May.'12]
2. Derive a general equation for flux incident on a solar collector in terms of hourly beam and diffuse radiations, tilt factors, angle of incidence, Zenith angle and absorptivity transmissivity products for beam and diffuse radiations. [May.'12]
3. Explain Extraterrestrial Radiation (Solar Radiation outside the earth's atmosphere. [Nov.'11]
4. Explain with neat sketch various sun-earth angles. [Jun.'11, Dec.'13]

Or

Define the following terms: [May.'11, Dec.'11, May.'13, Dec.'13, Jan.'13]
      (i) Solar Declination angle   (ii) Solar Zenith angle
      (iii) Aperture Inclination angle (iv) Solar Incident angle
      (v) Hour Angle   (vi) Solar Altitude Angle

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(vii) Azimuth Angle   (Viii) Concentration Ratio
(ix) Instantaneous collector efficiency   (x) Solar Tilt Angle

5. Describe the principle of measurement with sketch of solar radiation using (1) Pyranometers (2) Pyrheliometer (3) Angstrom Pyrheliometer (4) Abbot Silver disk Pyrheliometer

Or

Explain with neat sketch Abbot Silver disc Pyrheliometer. [May.'10, Dec.'12, May.'13]

Or

Which instruments are used for Solar radiation measurements? Explain construction and working of Pyranometer. [Dec.'11]

6. Write name of solar radiation measuring instruments. What is a sunshine recorder? Explain with help of diagram. [Dec.'12, May.'11, Dec.'11, Dec.'13]

7. Distinguish between beam radiation and diffuse radiation? What do you mean by global radiation? [Dec.'11, May.'12]

Or

Define the following terms. (i) Air Mass (ii) Global Radiation (iii) Diffuse Radiation. [Dec.'13]

8. Explain the following terms in context to Solar Flat Plate Collectors. (i) Aperture Area (ii) Stagnation Temperature. [Dec.'13]

9. Discuss the working of Compound Parabolic Concentrator (CPC) and state its advantages and disadvantages. [Dec.'12, Dec.'13]

Or

Give classification of Solar concentrating collectors. Explain Compound parabolic concentrator briefly. [Dec.'11]

10. What are the main components of a flat-plate collector? Explain function of each with sketch. [Dec.'12]

11. Describe the working of a flat plate collector using air as working fluid with the help of a neat sketch. [May.'13]

12. Describe briefly construction and working of a typical flat plate solar collector for air heating with figure. [Dec.'11]

13. The following data refers to liquid flat plate collector, Collector tilt = 22.15°, 07 Available radiation = 1100 W/m2, Absorber plate area = 2.1 m2, Plate emissivity = 0.12, Glass cover emissivity = 0.88, Number of covers = 2, Mean plate temperature = 68° C, Flux available at absorber plate = 800 W/m2, Side loss coefficient = 0.8 W/m2-K, Bottom loss coefficient = 0.6 W/m2-K, Inlet water temperature = 30° C, Ambient air temperature = 25° C, Wind speed = 1.8 m/s, Mass flow rate of water = 62 kg/hr. Determine, (1) Overall heat loss coefficient, (2) Outlet water temperature from the collector (3) Efficiency of collector. Use Test et al. Correlation. Take area of collector is 10% more that area of absorber plate.

14. What are the main components of a flat plate collector? Explain 'Solar Water Heating System' with neat sketch. [Dec.'13]

15. List different types of concentrating collectors. Explain any one with figure. [Dec.'11, Dec.'13]

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16. Explain the different heat losses in Flat plate Collector. [May.'13]
17. Write a brief note on effect of various parameters on performance of flat plate collectors. [Jan.'13]
18. Define Sun rise hour angle, also calculate the day length in Ahmedabad (23^0 N) on 22nd December and 22nd March. [Dec.'13]
19. Calculate the solar insolation on the top of the atmosphere on 23 March and 19 June, 2011. Take Solar constant = 1353 W/m^2. [Dec.'11, Dec.'11]
20. Calculate the number of daylight hours in Delhi on 22 December 1995. Take Latitude = $28^035'$ N. [Dec.'11]
21. Calculate day length at Delhi on Dec 21st and June 21st in year 2010. Take latitude = $28^038'$ N. [Dec.'13]
22. Calculate number of daylight hours at Delhi on Dec 21st and June 21st in year 2012. [Jun.'11]
23. Calculate monthly average of Daily Global Solar Radiation on a Horizontal Surface located in Ahmedabad Gujarat state ($22^o.00'$ N, $73^o.10'$ E) for the month of April. Average Solar day hours are 10 hrs. Angstrom's constants for Ahmedabad, a = 0.28, b = 0.48 [May.'12]
24. Calculate the local solar time and declination at a location latitude 23^0 15'N, Longitude 77^0 30'E at 12:30 IST on June 19, 2010. Equation of time correction is given form standard table or chart is 1'01''. [May.'10]
25. Calculate the day length on 1st April, 2013 at Ahmedabad. [Dec.'13]
26. Define Sunrise hour angle. Also calculate the day length in Ahmedabad (23^0 N) on 21st December and 21st March. [Dec.'11]
27. Calculate sun's altitude and azimuth angles at 9 A.M solar time on September 1 at latitude 23 degree N. [Jun.'11]
28. A researcher wants to calculate incidence angle for surface tilted at 30o with horizontal from the data available for horizontal surface:-
    Angle of incidence for horizontal surface : 45.6o
    Surface facing 10o East of South at location Date : 23rd December (Non leap year)
    Standard time of location: 12 p.m.
    Day length for horizontal surface: 10.7 hrs

Tutorial: 3 Solar Applications

1. Brief explain the various direct and indirect application of solar energy. [Nov.'11]
2. What do you mean by solar distillation? Explain construction and working of Basin Type Solar Still with neat figure. [Nov.'11, Jun.'12, Jun.'13, Dec.'13]
3. What is the principle of solar photovoltaic power generation? State the advantages and disadvantages of photovoltaic system. [Dec.'12, Dec.'10,Dec.'11]

Or

What is the principle of solar photo voltaic power generation? What are the main elements of a PV System? [Jun.'10]

Or

Write applications of SPV systems. [Jun.'11]

4. Describe in briefly the different energy storage methods used in the solar system. [Dec.'12]

5. Describe with neat sketch solar water heater. [Dec.'13]

6. Enumerate the different main applications of solar energy. Describe a Natural circulation solar water heating system. [Dec.'10]

<div align="center">Or</div>

How the solar water heating systems are classified? Explain the working of thermo-syphon solar water heating system with the help of a neat sketch. [May.'12]

<div align="center">Or</div>

Describe the construction and working of a passive space heating system with a schematic diagram. [Jun.'13]

7. Explain Domestic Solar Cooker (Box Type) and state the disadvantages of it. [Dec.'10]

8. Explain construction and working of a forced circulation type Solar Dryer with neat figure. [Dec.'11, Jun.'13]

9. Enlist types of solar thermal power plants. Describe working of Solar Pond as energy storage with the help of neat sketch. [May.'11, May.'12, Nov.'11, Dec.'11, Jun.'10, Dec.'13, Jan.'13]

10. Discuss performance analysis of a solar cell. [Jun.'11]

11. Explain the working of solar cell power plant with neat sketch. [Jun.'11, Dec.'13]

12. Describe the layout and working of a continuous solar cooling system. [May.'11]

13. What do you mean by Green House? Specify the main type of Green House. [Dec.'12]

14. What do you mean by solar distillation? Explain solar still with neat sketch.

15. Explain with neat sketch the working of Solar pump.

16. Derive the expression of collector efficiency factor, heat removal factor and useful heat gain for the air heater.

17. Explain the working of indirect solar drying system with neat sketch. Also 06 discuss the advantages.

Tutorial: 4 Wind Energy

1. Discuss the methods of site selection for installing wind mill. [June.'11, Nov.'11, Dec.'11, June.'13, Dec.'13, Nov.'13]

<div align="center">Or</div>

Describe the main considerations in selecting a site for wind generators. [Dec.'12]

2. Explain importance of drag and lift force in wind power generation.

3. Discuss the advantages and disadvantages of wind energy conversion system? [Dec.'12]

4. Classify the Wind Mills and explain Horizontal Axis Wind Mill. [Dec.'10]

<div align="center">Or</div>

Give detailed classification of Wind Mills. [Dec.'11]

Or

Classify wind mills and explain horizontal axis wind mill. [Dec.'13]

Or

Classify wind mills. Explain vertical axis wind turbine (VAWT). [Dec.'12]

5. Explain the methods are used to control the fluctuation of power in Wind turbine. [Dec.'10]

6. State the advantages and disadvantages of wind power. [Dec.'10]

7. Define: (i) Total Wind Power Density (ii) Power Coefficient [Dec.'11]

8. Prove that for a horizontal axis propeller type wind mill. Pmax=0.595Ptotal [June.'10]

Or

Prove that in case of Horizontal Axis Wind Turbine maximum power can develop when exit velocity = 1/3 of wind velocity and Pmax = 8 ρAVi^3 / 27 [May.'12]

Or

What is Optimum velocity? Derive an expression for maximum power, maximum torque and maximum axial thrust available from a wind turbine from basic principles. [May.'11, Dec.'12, June.'13]

9. Explain working of horizontal axis wind generator with the help of a schematic diagram. [June.'13]

10. Derive the one dimensional momentum theory and Beltz's limit for the wind **07** mill. Also state the assumption in theory and draw the variation of pressure and velocity in wind mill.

11. Write short note on : (i) Savonious rotor (ii) Darrieus rotor [Dec.'11]

Or

Write short note on Devious rotor. [May.'11, Dec.'13]

12. Explain with neat sketch the geometry of airfoil terminology. Also explain with **07** neat sketch indicating the direction of lift force, drag force, pitching moment coefficient.

13. The wind is blowing at the rate of 10m/s having the atmospheric condition at 1 bar, 300 k. the wind is harnessed by a wind turbine having its efficiency of 42%. Find the total power and actual power per square meter of rotor area, which can be developed by the turbine. Assume R = 287 N.m/Kg.K [June.'10]

14. Wind at 1 bar and 15°C has a velocity of 15m/s calculate i. Total power density in wind stream, ii. Maximum obtainable power density, iii. Power density obtainable at 35% of total power, iv. Power, torque and axial thrust. Assume turbine diameter=120m operating speed 40 at maximum RPM. [June.'12]

15. The following data refer to a wind mill of a wind farm in Gujarat. Average wind speed = 23.5 km/hr, Atmospheric pressure = 1.01 bar, Atmospheric temperature = 30^0C, Power coefficient = 0.41, Total power output capacity of wind farm = 1 MW, Determine, (1) Available power density of wind. (2) Actual power density of wind mill. (3) Number of wind mills in the farm if the rotor diameter is 25 m. [May.'12]

Tutorial: 5 Biogas and Biomass

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1. Explain construction and working of Fixed Dome Type (Constant Volume or Janta Model or Chinese) Biomass Plant with neat figure. [Jun.'10, Dec.'10, Dec.'11, Jan.'12, Dec.'13, Jun.'13]
2. Describe the suitability of Biogas for Petrol engines. [Jun.'13]
3. What is bio mass? Why is it considered as renewable source of energy?
4. State and explain various routes of Biomass energy conversion to other form of energy. [May.'12]
5. Explain about thermo chemical conversion of biomass. [Jun.'13]
6. Describe biochemical conversion of biomass into liquid and gaseous fuels. [May.'13, Jun.'13]
7. How is biogas plants classified? Explain them briefly. [Dec.'12]

<p align="center">Or</p>

Discuss briefly the types of Bio-gas plants. [Jun.'11]
8. Describe the main considerations for selection of site for a Biogas Plant. [Dec.'10, May.'11 Dec.'11 Dec.'12, Dec.'13]
9. Define biomass and biomass energy. Discuss various biomass resources with examples. [Dec.'10]
10. What is the difference between biomass and biogas? Explain the process - "Photosynthesis". What are the conditions, which are necessary for it? [Jun.'10]
11. Explain constructional details and working of KVIC digester. [Dec.'11, Jun.'12, May.'12, Dec.'13]

<p align="center">Or</p>

Describe the working of a floating dome type (Constant Pressure) biogas plant with the help of neat figure. [Jun.'13]
12. How are bio-gas plants classified? Explain continuous and batch type plants. [May.'11]
13. What is a community bio gas plant? What are the main problems encountered in its operation?
14. What is meant by energy plantation? What are its advantages and disadvantages?
15. Explain with neat sketch the three stage scheme for methane fermentation.
16. Discuss the following factors affecting the biogas generation
17. (1) pH (2) Nutrient (3) Temperature (4) Diameter to Depth ratio (5) Carbon – Nitrogen ratio.

Tutorial: 6 Energy from the Ocean

1. What is basic principle of OTEC? (Dec'13, Dec'11)
2. What are the main types of OTEC (Ocean Thermal Electric Conversion) power plants? Describe their working in brief. (Dec'12)
3. What are the difficulties in tidal power developments? (Dec'12)
4. Discuss open cycle OTEC system with the help of a neat diagram. (Dec'10, June'11, Dec'13, Dec'12, May'12)

5. Describe closed cycle OTEC system with advantages over open cycle system. (June'10, June'12, June'11, May'12)
6. Write short on Tidal power plant. (Dec'13)
7. Define the term 'Tidal range". (Dec'11)
8. Discuss the working of single basin type tidal power plant. (Dec'10, June'13)
9. Explain working of Double Basin Tidal Power Plant with figure. Also write advantages of it. (June'13, June'10, Dec'13, Dec'12)
10. Describe about Oscillating water column wave energy conversion system with figure. (June'13, May'12)
11. Write advantages and disadvantages of Wave energy. (Dec'11)
12. State different types of wave energy conversion devices and explain any one. (June'12)
13. Describe the advantages and disadvantages of OTEC system (June'13)
14. Explain with sketchs the various methods of tidal power generation. What are the limitations of each method? (May'11)
15. Tidal power plant of single basin type has a basin area of 25×10^6 sq.m. The tide has a range of 10m. The turbine however, stops operating when the head on it falls below 2m. calculate the energy generated in on filling process in kwh if the turbine generator efficiency is 75%(take sea water density=1025 kg/cu.m. (June'11, May'12)
16. The basin area of single basin type power plant is 107 m2. The Tidal range is 6 m. The turbine starts operating when the water head on it falls below2 m. The generator efficiency is 80%. Find the average power generated in kWh. Time between high tide and low tide is 22350 sec.
17. A typical Tidal project has an install capacity of 2176 MW in 64 units each of 34 MW rated output. The embankment is 6.4 km long and the head at rated output is 5.52m. The turbine and generator efficiency is 93 % each. If generation is 5 hrs twice a day calculate (11) The basin capacity (2) The annual energy generation per year assuming that power decrease linearly.

Tutorial: 7 Geothermal Energy

1. In what form the geothermal energy is obtained? Discuss origin of Geothermal Energy and also discuss geothermal field.
2. Write down Application (in detail), Advantage and Disadvantage of geothermal energy. [May.'12, June.'11, Nov.'11, Dec.'10, June.'10]
3. Discuss Vapour dominated (Dry Steam System) hydrothermal resources for power generation with diagram. [Dec.'11, June.'13, Jan.'13]
4. Discuss about Liquid dominated or Wet steam system. [May.'11, Nov.'11, May.'12]

Or

Discuss Liquid dominated flashed steam system. [May.'11]

Or

Discuss Liquid dominated binary cycle system. [June.'10]
5. Write a short note on Hot Dry Rock Resources or Petro thermal systems. [May.'12]
6. Discuss present Geothermal Energy scenario in India. [May.'12]

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7. Write a short note on Magma Resources.
8. A hot water geothermal plant of the total flow type receives water at 225^0 C. The pressure of turbine inlet is 10.5 bar. The plant uses a direct contact condenser that operates at 0.35 bar. The turbine has a cycle net output of 10 MW. Calculate: hot water flow, condenser cooling water flow. If such water is available at $27\ ^0$ C. the cycle efficiency and the plant heat rate.

Tutorial: 8 Magneto Hydrodynamic Power Plants

1. Explain with figure basic working principle of MHD system. Also compare with conventional power plants. [Nov.'11, Dec.'11, May.'12, Dec.'13]
2. Explain working of open cycle MHD power plant with necessary figure. [May.'11, Dec.'11, Jun.'12, Dec.'12, Jun.'13, Dec.'13]
3. Explain closed cycle MHD power plant

Or

Explain the working of liquid metal MHD system with neat sketch. [May.'12]

Or

Explain Seeded inert gas MHD generator.
4. State the advantages and disadvantages of Magneto hydrodynamic (MHD) system. [Dec.'10, Dec.'12, Jun.'13]
5. What is MHD? What are the various types of it? Explain any one of them. [Jun.'10, Dec.'13]
6. What are important factors to be considered while selecting materials in MHD power generation? [May.'12]
7. Calculate the open circuit voltage and maximum power output of MHD engine with following specifications. Plant area=0.2 sq.m, Distance between plates=0.4m. Flux density=2 wb/sq.m, Average gas velocity =1000m/sec Conductivity of gas=10 mho/m. [Jun.'11]
8. Write short note on Magnus effect.

Tutorial: 9 Economic Analysis

1. Why economic analysis of renewable energy system is required?
2. Explain initial and annual cost of renewable energy system.
3. Define following terms:
   Annual saving, Cumulative saving, Life cycle savings, Payback period
4. What is present worth? How it can be calculated.
5. Derive an expression for payback period.
6. Explain an expression for cumulative savings.
7. Explain annual saving deriving suitable equations.
8. With example explain why a project with a high IRR is not necessarily more attractive than a project with lower IRR?
9. What is clean development mechanism? How is it useful for developing nations?

10. For an 11,00,000/- investment in solar energy equipment which meets 56% of annual load of 156 GJ. If first year fuel cost is Rs. 800 per GJ and expected to inflate at 10% per year. Calculate (1) undiscounted payback time (2) discounted payback time if discount future cost at rate 8%.

11. For a non-solar process, using fuel only, calculate the present worth of fuel cost over 20 years if 1st year's cost is Rs. 125500/-. The market discount rate is 8% per year and fuel cost inflation rate is 10% per year.

12. Write a short note on solar saving

13. What is the annual payment and present worth of all interest payment on mortgage, if solar system is installed having worth Rs.11,00,000/- which is to be financed by a 10% down payment with the balance borrowed at an annual interest rate of 9% for 20 years? The payments are to be made at the end of the year. The market discount rate is 8%.

14. What are the basic sources of waste heat? How it utilized to increase the energy economic?

Tutorial: 10 Energy Management

1. Write briefly about the Strategy for Energy conservation. [Jun.'13]

   Or

   Explain, what do you understand by energy conservation and its importance? Also discuss some of the strategy used in the process of energy conservation? [May.'12]

2. Explain Energy Conservation and its importance. [Dec.'10]

3. Discuss the need of energy conservation in view of the effect on global warming scenario. [Dec.'12]

4. What are the co-generation plants? Explain the difference between bottoming and topping cycles. [Jun.'10]

5. Explain following : Energy Economics, Energy Audit, Energy Planning. [Jun.'12]

   Or

   Write note on 'Energy Audit. [Dec.'13]

6. Define: Energy Management. Discuss about the basic principles of 'Energy Management" [Jun.'13]

7. What is energy conservation act-2001? Write down few of the salient features of this act. [Jan.'12]

8. Discuss the various factors. Which can affect in energy saving in a compressed air system? [May.'11]

9. What do you understand by "Energy Management" and "Energy Audit"? Classify the energy audit and discuss them in brief. [May.'12]

   Or

   Describe about primary energy audit and detailed energy audit method. [Dec.'11]