SOLUTIONS FOR THE FINAL OUIZ FOR THE CRASH COURSE IN ENERGY

I. MODULE 1 : - Solar Thermal

Q1- What are the missing labels (a, b and c) ?



Part a - Glass cover, Part b- Insulation, Part c- Absorber plate

Q2- A solar water heating system in Ram's house is said to have open loop system and is active solar heating system. Which of the following would be it's characteristics?

- A. It has a pump to circulate water
- B. Storage tank located at a lower level than the collector
- C. Storage tank located at a higher level than the collector
- D. It has two independent fluid loop systems.

Active systems require pump because they have collector located at a higher level than the storage than so the cold water has to be pumped up. Open loop system is a single loop system with the same fluid to be distributed being directly heated.

Q3- A home in Phoenix (Arizona) requires 62 kWh of heat on a winter day to maintain a constant indoor temperature of 20 °C. How much collector surface area does it need for an all-solar heating system that has a 20% efficiency? (Round it off to nearest tens)

Given: The average solar radiation in winter is about 6.5 kWh/m2/day at Phoenix

- A. <u>30 m2</u>
- B. <mark>50 m2</mark>
- C. 70 m2
- D. 100 m2

Q4- A home in Phoenix (Arizona) requires 62 kWh of heat on a winter day to maintain a constant indoor temperature of 20 °C. How large does the storage tank (capacity in litters) have to be to provide this much energy if it stores water?(Round it off to nearest hundreds)

Given: The average solar radiation in winter is about 6.5 kWh/m2/day at Phoenix. Also water in the tank is at constant 20 °C and the secondary fluid loop running in the tank to maintain the temp is at 60 °C. Ignore heat losses

A)700 lts B)1000 lts C)1300 lts D)1700 lts

The average solar radiation in winter is about 6.5 kWh/m²/day. Hence, the daily quantity of thermal energy obtained using collectors will be:

Thermal energy =
$$6.5 \frac{[kWh (solar)]}{m^2 day} \frac{[0.20 kWh (thermal)]}{[1 kWh (solar)]} = 1.3 \frac{kWh}{m^2 day}$$

This means that for every square meter of collector surface area, 1.3 kWh of heat are produced every day. Therefore, the required collector surface area is obtained as follows:

Collector surface area =
$$\frac{62 \frac{\text{kWh}}{\text{day}}}{1.3 \frac{\text{kWh}}{\text{m}^2 \text{ day}}} = 48 \text{ m}^2$$

So a collector 6 m long and 8 m wide would do the job. Obviously, it can be placed on the roof. The size of the storage tank can be obtained by remembering the quantitative definition of heat

Heat = [Mass] [Heat capacity] [Temperature difference]

Here the mass is that of the storage medium, water, which needs to be determined. The heat capacity of water is 1 kcal/kg/°C (see Table 3-2), and the temperature difference is that between the hot fluid in the secondary loop and the cold water going into the storage tank (say, 60 - 20 = 40 °C); see Figure 17-4. Therefore, the required mass of water for a day's worth of heat is obtained as follows:

Mass = Heat [Heat capacity] [Temperature difference] =

$$\frac{62 \text{ kWh}}{(1 \frac{\text{kcal}}{\text{kg °C}}) (40 \text{ °C}) (\frac{1.16 \text{x} 10^{-3} \text{ kWh}}{1 \text{ kcal}})} - 1336 \text{ kg H}_2\text{O}$$

This is equivalent to a volume of 1336 liters (or about 350 gallons), because the density of water is 1 kg/L.

Q5- Which of the following is the most appropriate substance to use as a refrigerant in solar absorption cooling?

A)Lithium Bromide **B)Ammonia** C)Acetone D)Calcium chloride Fact based question refer slides

II. MODULE 2 : - Oil and Petroleum

Q1- OPEC consists of:

- 1. Oil importing countries
- 2. Oil exporting countries
- 3. Oil-producing countries
- 4. All of these

OPEC is the organization of Petroleum exporting countries

Q2- Water or gas injection is a part of:

1. Extraction

- 2. Refining
- 3. Storage
- 4. Transportation

When the pressure of the well falls below a certain value, water and steam is injected through another bore that creates pressure and helps to pump the oil up.

Q3- Which of the following is present at the bottom of the refinery?

- 1. Gasolene oil
- 2. Kerosine oil
- 3. Diesel oil
- 4. Lubrication oil/ paraffin wax

Lubrication oils are the heaviest products of the distillation tower and are liquid at even 400 degrees celsius.

Q4 - Which of the following is a sector of the oil industry?

Up-stream
High- stream
Down- stream
Low- stream

The three sectors of oil-industry are up-stream, midstream, and down-stream.

Q5- For how long can we extract oil?

- 1. Conventional oil-400 years
- 2. Unconventional oil 50 years
- 3. Conventional oil-50 years
- Unconventional oil 400 years

Conventional oil is easy to extract and can be used just for more 50 years, whereas unconventional oil, being more diversely spread, has a capability to fulfill our needs for next 400 years.

III. MODULE 3 : - Economics and Politics :-

Q1- The first step for calculating net present value is to find out

A]present value of equity B]future value of equity C]present value of cash flow D]future value of cash flow

Q2- If the payback period is 4 years and uniform increase in cash flow per year is ₹2750000 then the net initial investment can be

A] ₹ 1,05,11,000 B] ₹ 1,21,05,000 C] ₹ 11,00,000 D] ₹ 1,10,00,000

Q3- EROEI(EROI) of certain energy resources is 37. What % of that energy is lost during the extraction of the same energy resource?

A]37% B]2.7% C]27% D]None of these.

Q4- Which of the following is not actually paid by producers in the cost of energy devices or plants?

A]Operation and maintenance cost.(two options correct) B] labor cost. C]Social cost D]Environmental Cost.

Q5- Which of the following statements are incorrect? (two options correct)

A]The long-form of OPEC is an organization of the petroleum exporting countries. B]The presidents of some powerful countries in the world are quite supportive of wind energy. C]In politics there is a chance that due to opposition of the opposite party, the ruling party cannot implement renewable technologies in their own country. D]Australia is not involved in south-china sea problem.

IV. MODULE 4 : - Nuclear Energy

Q1- Which of the following classes of reactors can be refueled during operation

a. Pressurized Light Water Reactor

- b. Pressurized Heavy Water Reactor
- c. Boiling Water Reactor

d. None of the above

>>>Fact based

Q2- TRIGA is a fuel:

- a. Which consists of U-Zr alloy and has enhanced reactivity at higher temperatures
- b. Which consists of U-Zr-H composition and has enhanced reactivity at higher temperatures
- c. Which consists of U-Zr alloy and has deprecated reactivity at higher temperatures
- d. Which consists of U-Zr-H composition and has deprecated reactivity at higher temperature

>>>Fact based

Q3- Fukushima Daiichi incident made the nuclear power authorities understand:

- a. Natural Disasters can be risky so we must pay more attention to the constructions and cut some expenses on worker equipment
- b. Natural Disasters will anyway occur so we must pay more attention to worker equipment
- c. Natural Disasters will occur so we should make structures as invulnerable as possible.
- d. Natural Disasters are something which can happen only in cursed lands.

>>> Basic comprehension of the precautions taken post Fukushima Daiichi

Q4- Which of the following systems need not be deep buried or taken extreme precautions for during disposal?

- 1. Heavy Thickness Steel used to build the walls of the nuclear reactor
- 2. Painting Brushes that where used to paint the outside of the reactor initially.
- 3. Mechanical Equipment at the Steam Collection Point
- 4. Electronic Equipment monitoring the gate of the plant
- 5.

>>> These materials arent predominantly radioactive,

Q5- Which of the following is not a fissile material

- a. <u>U-235</u>
- b. <mark>U-238</mark>
- c. U-233
- d. Th-232

V. MODULE 5 : - Wind Energy

Q1- What is the use of an anemometer?

- 1. To calculate the acceleration due to gravity
- 2. To calculate the acceleration of the wind
- 3. To calculate the RPM of wind turbine
- 4. To find out the direction of wind

Q2- From which of the following countries the Northeasterly wind blows?

- 1. Argentina
- 2. Mexico
- 3. India
- 4. Canada

Q3- The overall turbine efficiency of the wind turbine (Cp) is a product of which terms

- 1. Electrical and mechanical efficiency
- 2. Electrical efficiency only
- 3. Cp do not depend on efficiency. Its a universal constant.
- 4. Electrical, mechanical and turbine efficiency

Q4- What are the disadvantages of Vertical Axis Wind Turbines

- 1. These structures are low to ground, where wind speeds are lowest
- 2. They have good self sarting capabilities
- 3. They are omnidirectional in nature
- 4. Blades can be damaged due to the centrifugal force

Q5- Which of the following is a false fact?

- 1. 3 blade wind turbine system is the most efficient system
- 2. Wind energy share has the highest share of the renewable energy production in India **3.** Finland first start siting offshore wind energy farms.
- 4. Wind energy share more than 50% of the total energy in Denmark

VI. MODULE 6 : - Geothermal Energy :-

Q1- Which is more suitable for tapping geothermal energy?

- 1. Hot water springs
- 2. Stored heated water below impeding layers
- 3. Hot water geysers
- 4. None of these

Hot water springs and geysers can also be used for tapping geothermal energy but not in huge amounts as much as in impeding layers.

Q2- Which type of plate gives rise to geothermal reservoirs?

- 1. Conservative
- 2. Diverging
- 3. Converging
- 4. Depends upon plate arrangement

Fact based

Q3- Which disaster could be potentially caused by geothermal power plants?

- 1. Hurricanes
- 2. Earthquakes
- 3. Forest fires
- 4. All of these

Fact based

Q4- What makes a site good for geothermal electric development?

- 1. Hot geothermal fluid with low mineral and gas content
- 2. Deep aquifers for producing and reinjecting the fluid
- 3. Availability of make-up water for evaporative cooling
- 4. Location on private land to simplify proximity to existing transmission lines

Option 2 is wrong because there should be the presence of shallow aquifer in producing and reinjecting the fluid.

Q5 - What is the major difference between a binary power plant and the other two(Dry steam and Flash steam power plant)?(2 correct)

- 1. Water or steam from the geothermal reservoirs never come in contact with turbines in binary power plants.
- 2. Water or steam from the geothermal reservoirs comes in contact with turbines in binary power plants.
- 3. Binary power plant uses another fluid apart from water and steam.
- 4. In a binary power plant, there is non-availability of injection well.

Description- Water and steam from geothermal reservoirs never come in contact with turbines in binary power plants because it uses another fluid like isobutane for that purpose. All the three types of geothermal power plants have injection well.

VII. MODULE 7 : - Solar P.V. :-

Q1- The sun in the northern hemisphere traverses from east to south (in the sky) to west. What is the optimal orientation of a solar module in India?

- a. South facing (15 degree)
- b. East facing (15 degree)
- c. West facing (15 degree)
- d. North Facing (15 degree)

Q2- Which of these has the highest solar pv potential?

a. Rajasthan

- b. J&K
- c. Maharastra
- d. Tamilnadu

Q3- Which of these are optimal solutions to the duck curve problem?

- a. Improving Energy Storage options
- b. Install more solar capacity

- c. Reduce solar capacity already Installed
- d. Improve Grid Flexibility

Q4- Select Off grid solar pv system characteristics [2M]

- a. Needs storage capacity
- b. Doesn't need inverter
- c. Works on Net Metering
- d. 100% renewable

Q5- Which of these is not a part of the module manufacturing process ?

- a. Silicon wafers
- b. Ingots
- c. Doping
- d. Copper

VIII. MODULE 8 : - BATTERY TECHNOLOGY

Q1)(1M) Lithium-ion Battery was first commercialised by:

- 1. Sony
- 2. Toshiba
- 3. Panasonic
- 4. Tesla

Description: John B. Goodenough, after discovering the Lithium-ion Battery, gave away its mass production to Sony Electronics, while not even keeping a penny for himself.

Q2)(1M) Battery Capacity of a battery depends on:

- 1. Volume of the Battery
- 2. Density(Kg/L) of the Battery
- 3. Total mass of the Battery
- 4. Active mass of the Battery

Description: Only the active mass(mass that is still able to produce charge) of the battery generates the charge that is inside and to be provided by the battery,other mass is used and needs to be replenished.

Q3)(1M)Rechargeable batteries have higher energy density than Non-rechargeable batteries.



Description: Rechargeable batteries need to be recharged and thus the material should be of that kind, though primary(non-rechargeable) batteries give out all their charge in a single go, thus requiring them to have higher energy density

Q4)(2M)Which of the following future developments regarding batteries are based upon Lithium ion batteries (3 correct):

- 1. Silica anodes
- 2. Advanced cathodes
- 3. Supercapacitors
- 4. Solid-State Electrolytes

Description: Supercapacitors are focused on improving capacitors, while all other are developments on the currently existing structure of lithium-ion battery technologies.

Q5) (2M)Which of the following parameters is regarded to the voltage of the battery (2 correct)?

- 1. Nominal Voltage
- 2. Cutoff Voltage
- 3. Cold Cranking Voltage
- 4. Self-discharge voltage

Description: Nominal voltage is usually the open load voltage in equilibrium conditions, while cutoff voltage refers to the minimum voltage the battery can be discharged to so that it can be charged again. There are no terms as Cold-Cranking Voltage and Self-discharge voltage but rather Cold-Cranking current and Self-discharge current respectively.

IX. MODULE 9 : - ELECTRICITY DISTRIBUTION

2. 230 V

Q1- Which scheme of connection has no single path between consumer and substation?

- 1. Radial distribution
- 2. Loop distribution
- 3. Interconnected distribution

4. Both 2 & 3.

Q2- The voltage between single-phase and neutral in secondary AC distribution is-

1.110 V

3.440 V

4. Any of the above

Q3- Classify segments "AB", "BC", "SA" as Feeder, Distributor and Service Mains. Select the correct option. (Single Correct Answer type)



AB-Feeder, BC-Distributor, SA-Service Mains
AB-Distributor, BC-Service Mains, SA-Feeder
AB-Distributor, BC-Distributor, SA-Feeder
AB-Service Mains, BC-Feeder, SA-Distributor

Q4- Which of the following is/are correct about feeder?

- 1. Feeders connect the distributor to the consumer's meter.
- 2. No tapings are taken from the feeder.
- 3. Current remains the same in the feeder.
- 4. Current carrying capacity is the main consideration while designing feeders.

Q5- Which of the following is/are not correct?

- 1. In Secondary AC distribution, the voltage between any two phases is 230V and between any phase and neutral is 400V.
- 2. In Two Wire DC distribution, the loads are not connected in parallel.
- 3. In Three Wire DC distribution, the voltage between outer is twice the voltage between either outer and neutral.
- 4. Secondary Ac distribution consists of three phases, three wires.

I. MODULE 10 : - ENVIRONMENTAL IMPACTS

Q1)A uranium rod is no longer useful in a nuclear reactor after how many years?

- A. 1-3 years
- B. 6-8 years
- C. 10-12 years
- D. 14-16 years

Description: fact based

Q2)How is there a pressure on water resources when biofuels are produced?

- A. Irrigation used for crops used as feedstock
- B. Boiling and cooling in biofuel production refineries

C. Both of the above

D. None of the above

Description: Fact based

Q3) Which of the following pair of renewable and non-renewable sources has the least carbon intensity in electricity generation? (From the sources we've learnt in the course)

- a. Solar PV, Coal
- b. Wind, Petroleum
- c. Nuclear, Coal
- d. Wind, Natural Gas

Description: Natural gas is the cleanest amongst itself, coal and petroleum. Wind is the cleanest renewable source amongst the ones we've learnt in the course.

Q4) Which of the following is not a step involved in Life Cycle Analysis?(2 correct options)

- a. Survey conduction
- b. Goal and scope definition
- c. Impact analysis
- d. Replenishing depleted resources like land, water, etc.

Description: The steps involved in LCA are Goal and scope definition, Inventory analysis, impact assessment, and finally Interpretation, in that order specifically.

Q5) What are reasons why solar PV systems are generally not planted in agricultural areas?(2 correct options)

- a. Temperature rise disturbs the vegetation growth
- b. Not enough water resources available
- c. Economical reasons, since floodplains cannot support panels and they have to be raised
- d. Unavailability of a dry environment

Description: As discussed in the video.