The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Bachelor of Technology Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**MEX6236 New and Renewable Sources of Energy**
Academic Year	:	2015/16
Date	:	01.12.2016
Time	:	0930-1230 hrs
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of 08 questions. All questions carry equal marks.
3. Answer any 05 questions only.
4. Formulas are provided at the end of the each question whenever needed.

Q1. (a) What are the most important factors influencing healthy growth of fuel wood plantations?

(b) What are the major drawbacks of biomass as a fuel?

(c) Name five major applications of wood as a fuel in Sri Lankan Industry.

(d) In a small village the electricity is supplied using a 1 MW Diesel Generator. If 50% of power is generated by using a wood gasifier (Dendro power) how many acres of land is required to supply wood for the gasifier per year?

The specific fuel consumption of the Diesel Generator = 0.4 liters of diesel per kWh

Conversion efficiency of the Gasifier = 50%

LHV of the moist wood = 14 MJ/kg

Water content of the moist wood =15%

Heat value of diesel = 10 kWh/liter

1kWh = 3.6 MJ

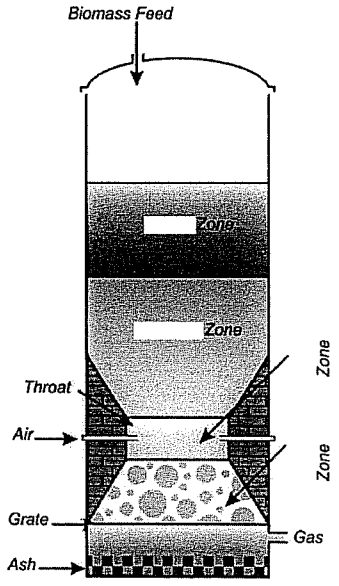
1 acres of land produced 3 tone's of wood

Q2.

(a) What is the difference of C3 and C4 species of biomass on earth?

(b) The Gasification process of a solid particle can be divided in to four steps. Name those 04 steps and describe each.

(c) Clearly write the names of the zones shown in the diagram given below.



(d) Write four thermal conversion processes of biomass and explain each.

(e) Write two biological conversion processes of biomass and explain each.

(f) Name the possible end products in (d) and (e) which can be used as a biofuel after conversion.

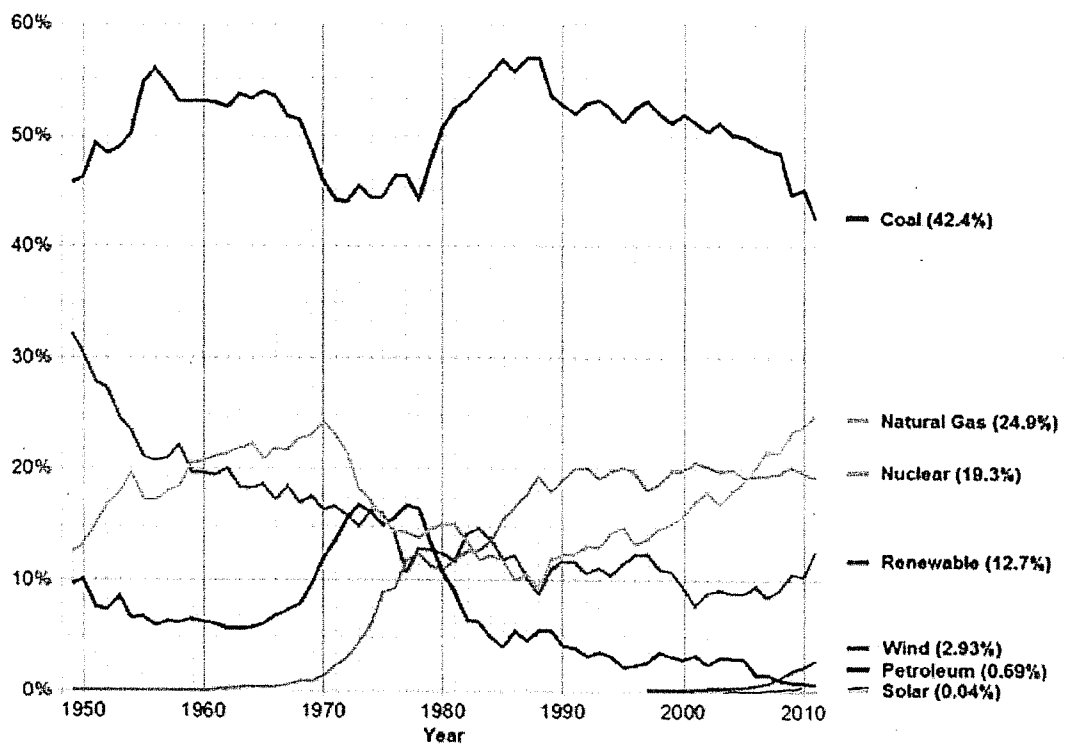
Q3.

(a) Define Non- renewable energy.

(b) Why should we encourage to use more renewable energy?

(c) What is the major drawback of renewable energy?

(d) Explain the term Global Warming Potential (GWP).



(e) Electricity generation by source in the United states of America since 1949 is shown in the above graph. After clearly observing the trends in renewable and nonrenewable energy developments in USA, give your opinion on future electricity generation in Sri Lanka.

(f) What are the possible threats according to this graph for future renewable energy Inventions?

Q4. (a) What are the main components of a Horizontal Axis Wind turbine?

(b) Horizontal Axis Wind Turbine is more popular than Vertical Axis Wind Turbines. Do you agree with this statements? If so give reasons.

(c) Wind turbines are noisy. Installation is a huge and costly exercise specially for very big turbines. It need a very good soil and a strong foundation. Soil erosion and visual pollution too are very much concern in todays context. An innovative Wind Turbine has been evolved to overcome all above concerns. Name it and describe its working principle.

(d) Explain the following terms.

(i) Beltz Limit

(ii) Tip Speed Ratio

(iii) Cut in Speed

(iv) Cut out speed

(e) If a wind turbine tower height is 50 m and rotor diameter is 10 m, and has power coefficient of 0.4 produce 10 Kw of Power, what would be the wind speed at this height?

(f) If the wind speed is doubled while the rotor diameter too is doubled what would be the power output of the wind turbine?

(g) If the same turbine is installed at a height of 100 m what would be the power output of the turbine? Assume wind speed is 3 times the wind speed you obtained in (i)

Density of air(ρ_{air}) = 1.225 kg/m^3 and Power (P) = 1/2 ρC_p A V^3

Q5. (a) Name four types of Hydro Dams and describe one of them in detail.

(b) Victoria, Randenigala, Kothmale and Three George dams come under which category?

(c) If you find a narrow site in a Hydro power project which type of a Dam is preferred and why?

(d) What are the two types of turbines used in Hydro power plants? Name two of them.

(e) Why Francis turbines are preferred in pump storage dams?

(f) In addition to Power generation, what are the main advantages of a Hydro power projects?

(g) Head of the Three George Dam is 175 m and the discharge of water at the turbine is 500 m^3/s. What is the power output of a one turbine? Assume the efficiency of the turbine is 80%.

(h) If Three George Dam power house consists with 32 Fransis Turbines, what is the total power capacity of the Three George Dam power plant?

Q6. (a) Describe the following

(i) Equinox

(ii) Sun Rise/Set angle (w_{ss})

(iii) Solar Incident angle (Θ)

(iv) Tilt angle (β)

(b) At 40^0 N Latitude determine the

(i) Sun rise time

(ii) Sun Set time

(iii) the day length

On March 21 and June 21

(c) Find the Sun rise/Set hour angle for south facing surface tilted at 60 ^{0} on 21st November located at 40 ^{0} N latitude.

Following equations are given with their usual notations.

$I_0 = I_{SC}$ [1 + 0.034 Cos (360N/365)] where I_{SC}=1353W/m^2,

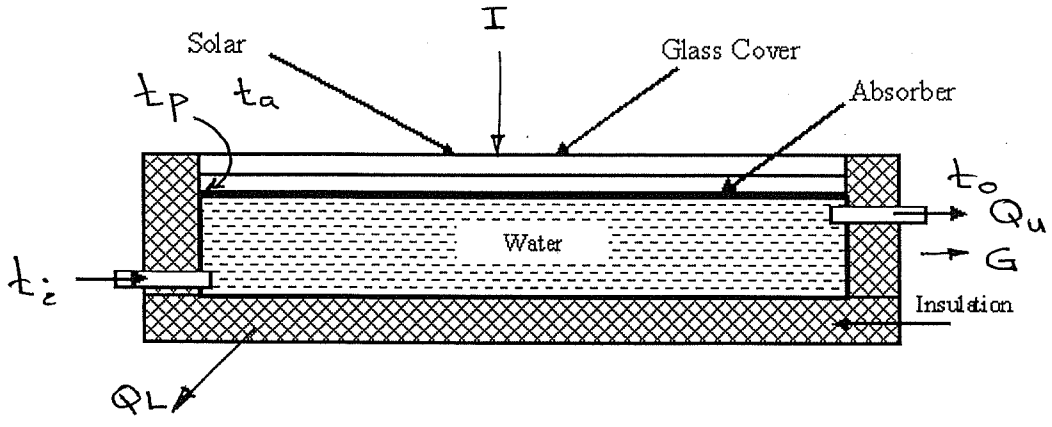
$\delta = 23.45$ Sin [360 (284+N)/365] where N is the day number from January 01

$W_{SS} = \cos^{-1}$ [- tanφ tanδ]

CosΘ = Sin δ (SinφCosβ – Cosφ Sinβ Cosτ_c) + Cosδ Cos w (Cosφ Cosβ+Sinφ SinβCosτ_c) + Cosδ Sinβ Sinτ_c Sin w

φ, δ , w are as usual notations and τ_c is the collector azimuth angle.

Q7.



A flat plate solar collector data is given below;

U_L - Overall heat transfer coefficient

Q_L - Total losses

Q_U - Useful energy (Energy gained)

I (Solar Intensity) =1000 W/m^2

C_p = 4.18 kJ/kg ^{0}C, U_L = 7.62 W/m^2

Γ (Transmittance) = 0.88

t_a (Ambient temperature)= 28^0C

t_p (Surface temperature)= 65^0C

t_0 = Outlet temperature

t_i = Inlet temperature

a (Absorptance) = 0.95

G (flow rate of working fluid) = 70 kg/h/m^2

Find

(a) the useful heat collected

(b) heat removal factor

(c) fluid outlet temperature

Q8. (a) From Geothermal point of view the earth surface can be classified into three areas. Name these areas and describe them in brief.

(b) In Geothermal energy, there are some heat sources which can be tapped in future to enhance geothermal power. Name three of them and describe each.

(c) Give few applications of Geothermal energy in the world.

(d) Commercial Viability of Geothermal fields for power generation needs to follow some guidelines. Write three of them.

(e) What factors influence the cost of a geothermal power plant?

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