Uva Wellassa University, Sri Lanka
End Semester Examination – January 2010
ENG 407-2 Energy Management
Time: Two (02) hours

Total **04** Questions

Answer **ALL** the questions

If you have any doubts to the interpretation of the wording of a question, make your own decision, but clearly state it on your answer script.

The maximum marks attainable are indicated in the brackets.

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01) I. Explain the principle of photovoltaic conversion using Figure Q1.

(20 marks)

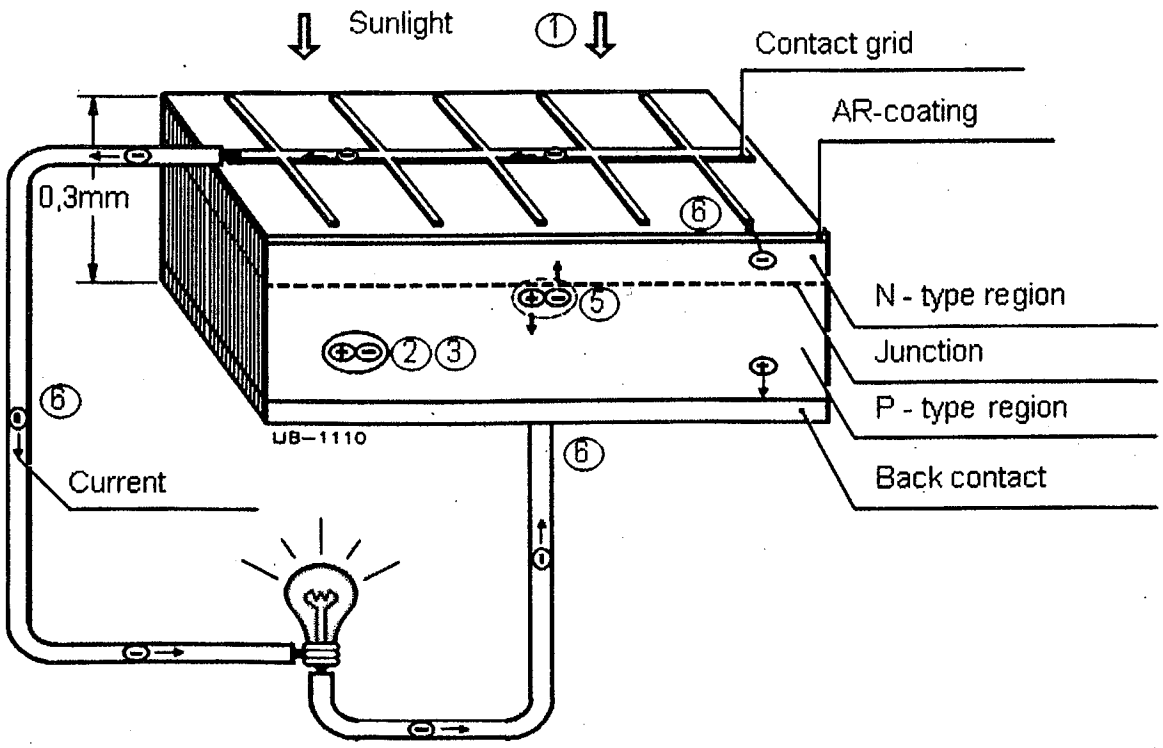

Figure Q1

II. Increased demand has led the solar industry to higher volumes for PV products and the ability to take advantage of economies of scale. Despite the constraints on solar power, there are also powerful drivers fueling this technology. Taking all these factors in to consideration, give the complete design details for a 1MW solar plant. You may use the data in Table Q1 for selecting solar panels. For cost-benefit analysis, you may assume the US $ dollar rate as US $ 1 = Rs. 115.

(80 marks)

[Take the solar constant as 1370 W/m2 for your calculations in the design]

Table Q1

PV Efficiency %	Rated PV Capacity (W)						
	100	250	500	1000	2000	4000	10000
4	30	75	150	300	600	1200	3000
8	15	38	75	150	300	60 0	1500
12	10	25	50	100	200	400	1000
16	8	20	40	80	150	320	800

02) Write short notes on the followings with suitable sketches where necessary.

I. Benefits of industrial energy audits.

(30 marks)

II. Demand side management of a large power system.

(30 marks)

III. Power generation using biomass.

(20 marks)

IV. Energy sources beyond fossil fuels.

(20 marks)

03) I. Developing countries today account for almost three quarters of the world's population, but approximately only one quarter of its energy consumption. The United States has by far the highest per capita energy consumption, its average citizen consumes about 300 times as much commercial energy as the average person from a country like Haiti or Nepal. Latest GDP and per capita figures in Table Q3 shows that rapid developments in China and India need huge amount of energy.

What are the regional energy options available to cater this?

(25 marks)

Table Q3

Country	GDP (US $ Billions)	Per Capita GDP (US $)
United States	11,750	40,100
China	**7,262**	**5,600**
Japan	3,745	29,400
India	**3,319**	**3,100**
Germany	2,362	28,700
United Kingdom	1,782	29,600
France	1,737	28,700
Italy	1,609	27,700
Brazil	1492	8,100
Source: IEEE Spectrum, June 2005		

II. In fact while energy consumption is far greater in industrialized nations, the growth rate is much higher in developing nations. How do you comment on this statement when it comes to Sri Lankan situation?

(15 marks)

III. A household small factory is having five induction motors (4 kW with 0.9 power factor lagging) and ten 15W CFL bulbs. There is a 4 hour shift on Saturdays in order to cater the demand and 15,000 [BTU] air-conditioner is operated in the office.

a. What is the total energy consumption of the factory
b. Calculate the possible electricity bill
c. What are the assumptions made during the calculation

(20 X 3 marks)

04)

I. Briefly explain the principle of operation of a wind turbine with the help of a suitable diagram

(30 marks)

II. The power ***P*** available in the wind for a turbine is given by

$$P = \frac{1}{2}\rho\pi R^2 v^3$$

Explain all the terms in the above equation with units and propose practical values.

(30 marks)

III. If the annual average wind speed is 7[m/s], calculate the possible annual energy extraction through a small size wind turbine. You should assume other desired parameters in calculating this value.

(40 marks)