COLLEGE OF ENGINEERING, PUNE

Mechanical Engineering Department

Class: Final Year B. Tech. (Mech.),

End Semester Examination, November 2013

Subject: Energy Conservation and Management

Maximum Marks: 60

Instructions:

1. *Attempt all question*
2. *Figures to the right indicate full marks*
3. *Use of non-programmable calculator is permitted*
4. *Make suitable assumptions if necessary*
5. *Take latent heat of evaporation of water at atmospheric pressure to be 2200kJ/kg for all calculations*

Q1.A	In 2012 India consumed 230 Mtoe of crude oil with an import dependence of 77%. In 2012 average crude oil prices were 103 USD/barrel. In 2011, the average exchange rate for USD was 53 Rs. The API gravity of the imported oil has been 37°
	
	 In 2013, the consumption of crude oil increased by 1.5% whiles the import dependence increased by 2%. Crude oil import expenses increased by 24.5 %. In 2013, the average exchange rate for USD was 59 Rs. The API gravity of the imported oil has been 37°
	
	    1. What is cost of crude imported by India in 2012 in Rs.?
	    2. What is the average crude oil price in 2013 in USD?
		5

Q1.B	Write a brief note on Flow control strategies in centrifugal pumps	3
Q1.C	A batch of 150 kg of wet biscuits at 25°C is to be dried from 25% total moisture content to 3% total moisture content in 2 hrs. 9 such batches commence in a day. The factory works 300 days in year. Drying is done by an electric oven, what must be the rating of electric oven in kW if its efficiency is 80%? What will be the annual electricity bill? What is the cost of LPG consumed, if the drying is done using a LPG heater of 70% efficiency? Use following data Electricity cost 9 Rs/unit Calorific Value of LPG – 1.1 toe/ton Cost of LPG – 75 Rs./kg	4

Q2.A	As per the Kyoto Protocol Portugal is an Annex - A country. CO_2 emissions of Portugal were 36 Mt in 2008 and 15.2 Mt in 1990.
	
	    1. As per the Kyoto Protocol what is emission reduction target of Portugal for 2008 in Mt?
	    2. A multinational company in Portugal has been given CO_2 emission reduction
		1

	target that is X % of their national target in 2008. The multinational Company wishes to meet this target through CDM. The company has a capacity to invest 150 Million Euros (1 € = 87 Rs.) in Solar Photovoltaic Plants in India. By investing this amount how many CERs the company may earn in 2008? What is the corresponding value of X% contributed by the company in 2008? Data for SPV plants in India Capital cost: Rs. 9.5 Cr. per MW Number of units generated annually : 15 Lakhs per MW installed capacity Grid Intensity factor : 0.9 Tonnes of CO_2 per MWh	5
Q2. B	How to achieve energy conservation in lighting installations?	3
Q2. C	Why Electricity Act 2003 is considered to be revolutionary?	3
Q3.A	A 500 kVA Diesel Generating (DG) set is installed in a commercial complex for emergency power. The data of the DG set is as follows. Operating power factor : 0.8, Efficiency : 35% Diesel properties : Calorific Value 42 MJ/kg, Specific Gravity 0.8, Cost 60 Rs./lit Operation: 12 hrs per day for 300 days in year. Capital Cost : Rs. 20,000/- per kVA , Life: 15 yrs, Expected discount rate: 22% Take CRF = $\dfrac{d(1+d)^n}{(1+d)^n-1}$ 1. Determine cost of electricity generated by DG set in Rs./kWh 2. By taking at least 4 values of the fuel cost vis-à-vis 50 Rs./lit., 55 Rs./lit, 65 Rs./lit and 70 Rs./lit Show how the cost of electricity varies with the fuel prices. 3. Utility electricity is available at Rs. 8 Rs./kWh. What is the subsidy on fuel price required so that the cost of DG set power becomes equal to that of utility?	3 2 2
Q3.B	Capital cost of a heat treatment furnace is Rs. 80 lakhs and life 5 years. The discount rate for the company is 18%. By installing this furnace, the constant annual cash flow predicted in each year is Rs. 25 Lakhs. The annual maintenance cost in the first year is Rs. 50,000/- and increases by 15% in each year. A depreciation of 33% is allowed on the investment of the furnaces for the first three years only. The income tax rate is 30%. 1. To break even the investment without taking the depreciation benefit into account, at what cost the furnace should be sold at the end of five years? 2. With no consideration of break even and taking into account the depreciation benefit, what will be the Profitability Index of the investment?	5
Q4.	Following data refers to a boiler in a confectionary plant. Rating : 35 TPH, at F & A 100°C,	

Operation : 24 hours a day for 300 days in year

Capital cost of the boiler : Rs.5 Crores

Life of the boiler : 25 yrs

Annual maintenance cost : 3% of the capital cost

Expected discount rate : 16 %

Fuel : Biomass briquettes of Gross Calorific Value , 17 MJ/kg

Price of the fuel : 16 Rs./kg

Fuel firing rate : 7 TPH

Boiler Surface area : 65 m^2 , Boiler outer surface temperature : 58°C

Flue gas temperature : 288°C

Ultimate Analysis of the fuel by weight : Carbon 45%, Hydrogen 7%, Sulphur

0.5%, Oxygen 1.5%, Moisture 10%,

Ash Content 36%

Oxygen detected in the flue gas by volume : 8%

Ratio of fly ash to bottom ash : 3/11

Calorific value of Bottom Ash as well as Fly ash : 3.5 MJ/kg

Ambient air temperature : 30°C,

Specific humidity of ambient air: 14 gm/kg d.a.

Specific heat of flue gases : 1.005 kJ/kg-K

Specific heat of superheated steam : 1.88 kJ/kg-K

Combined convection and radiation heat transfer coefficient between boiler

surface and ambient : 25 W/m^2-K

Determine: 1. Direct efficiency of the boiler?

2. Indirect Efficiency of the boiler

5. If feed water is available at 4 Rs. /lit what is the cost of steam

generated in Rs./ kg. Take the obtained value of indirect efficiency for this

calculation.

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Q.5	A certain process industry operates for 30 days a month. Table 1 shows list of machines and appliances, their rating, number of hours of operation and energy consumed in kWh.	
	i. Draw a neat load curve of the Industry on single day basis?	2
	ii. Draw a neat load duration curve of the Industry on single day basis?	2
	iii. What is connected load and Maximum demand?	1
	iv. What is Demand Factor, Daily Load factor and Diversity Factor?	2
	v. What is monthly electricity bill of the industry? (Refer tariff charges given in Table 2)	2

			vi.	Select a suitable transformer for the industry. At an average utility rate of Rs. 11 per unit. Estimate loss of revenue in transformer losses. Take no load and load loss of the transformer as 2 kW and 8kW respectively. Take percentage loading of the transformer equal to the obtained daily load factor.	3

Table 1.Consumption of different machines in kWh

Sr. No.	Appliance/s and Rating, kW	Time, Hrs. 00 to 0300	0300 to 0600	0600 to 0900	0900 to 1200	1200 to 1500	1500 to 1800	1800 to 2100	2100 to 2400
1	Total Fan and Lighting in the Premises, Rating 5 kW	3	3	6	15	15	12	10	6
2	Central Compressor FacilityRating, 15kW	20	22	40	45	38	45	45	20
3	Metal Presses,Rating 20kW (Total)	0	0	35	60	60	60	60	60
4	Material Handling cranes, Rating20kW (Total)	0	0	0	0	60	60	60	60
5	Heating and drying ovens,Rating 15kW(Total)	45	45	45	45	0	0	45	45

Table 2. Slabs for Monthly Electricity tariff

Consumption, kWh	Tariff, Rs./kWh
Up to 1000	6
Above 1000 and up to 5000	7
Above 5000 and up to 20,000	9
Above 20,000	12

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