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MANIPAL INSTITUTE OF TECHNOLOGY

Manipal University, Manipal – 576 104



## IISEM.M.Tech. (ADVANCED THERMAL POWER AND ENERGY SYSTEM) DEGREE END SEMESTER EXAMINATIONS MAY2016

## SUBJECT: ENERGY AUDIT, CONSERVATION AND MANAGEMENT (MME-546) REVISED CREDIT SYSTEM

Time: 3 Hours.

MAX.MARKS: 50

## Instructions to Candidates:

- ✤ Answer ANY FIVEFULL questions.
- ✤ Missing data, if any, may be suitably assumed.
- $\checkmark$  Thermodynamic data hand book may be permitted.
- 1A) What is cogeneration? Differentiate between back pressure and extraction condensing (05) type of steam turbine with sketches. Also mention their applications.
- 1B) What are the different methods available to control excess air in a boiler? Explain

Find the efficiency and evaporation ratio of a boiler by direct method for the following details

Type of the boiler	Coal fired
Quantity of the steam generated	8 TPH
Steam pressure and temperature	10 bar, 350°C
Feed water temperature	85°C
Quantity of coal consumed	35kg/min
Gross calorific value	13376 kJ/kg
C <sub>p</sub> of super heated steam	2.1 kJ/kgK (05

- 2A) What is energy audit? Explain the different duties and responsibilities of the energy manager in an industry. (05)
- 2B) An industrial load takes 80000 units in a year the average power factor being 0.707 lagging. The recorded maximum demand is 500kVA. The tariff is Rs 120 per kVA of maximum demand plus 2.5 paise per kWh. Calculate the annual cost of supply and find out the net annual saving by installing phase advancing plant costing Rs 500 per kVAR which raises the power factor to its most economical value. Allow 10% per year on the cost of phase advancing plant to cover all additional cost.
- 3A) With a neat sketch explain the construction and working of a incandescent lamp. (05) Derive an expression to determine the diameter of the filament required.
- 3B) An electric cable of 12 mm diameter and 1 m length is insulated to increase the current capacity. Due to insulation the current carrying capacity is increased by 15% without increasing cable surface temperature above 70°C. Environmental temperature is 30°C. Assume that heat transfer coefficient from bare or insulated cable is 14 W/m<sup>2</sup>K.Calculate the conductivity of the insulating material. (05)
- 4A) Explain the process of induction, resistance and dielectric heating .Compare their (05)

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merits and demerits.

- 4B) A road 10 meters wide is to be illuminated by lamps mounted on poles on one side of the road at a distance of 50 meters from each other. The lamps are of 150 CP each and are mounted at a height of 8 meters above the road surface. Calculate the maximum (05) and minimum illumination on the center line of the road.
- 5A) How do you access the performance of a fan? Explain the different energy saving opportunities and methods used in cooling towers. (05)
- 5B) The furnace has 460 mm thick wall on the billet extraction outlet side, which is 1 m high and 1 m wide. Using the details given below find the different losses occurring in the furnace and hence find the efficiency by indirect method.

Data		
Operating temperature	$= 1550^{\circ}$ C.	
Exit flue gas temperature	$= 630^{\circ}\mathrm{C}$	
Specific heat of flue gases	= 0.24 kCal/kgK	
Specific heat of steam	= 0.45  kCal/kgK	
Ambient temperature	$= 30^{\circ}\mathrm{C}$	
Specific gravity	= 0.9	
Average fuel oil consumption	= 425 Litres / hr	(05)
Calorific value of oil	= 9000 kCal/kg	
Average O2 percentage in flue gas	= 13%	
Mass of moisture in the fuel	= 0.15 kg/kg of fuel	
Mass of H <sub>2</sub> in the fuel	= 0.112  kg/kg of fuel	
Black body radiation corresponding to 1550°C	= 36.00 kCal/cm <sup>2</sup> /hr	
The factor of radiation	= 0.71	
Emissivity	= 0.85	
Natural convection factor for the surface	= 2.8	
External surface area and temperature	$= 12 \text{ m}^2$ and $150^{\circ}\text{C}$	
Analysis of fuel C=84%.S=3%.H <sub>2</sub> =12% and O <sub>2</sub> =1%		

6A) With neat diagrams explain the construction and working following waste heat recovery devices. Also mention their advantages and disadvantages

(i) Convective radiative Recuperator (ii) Heat pump

6B) A process industry has decided to go for cogeneration plant. Steam is available at 31.25TPH with pressure of 6 bar and at 500°C.Steam for the process is required as per the following table.

Process	Steam (TPH)	Pressure (bar)	Temperature (°C)
Process 1	3.25	2	300
Process 2	8	1	200
Process 3	20	0.5	150

Arrive at a cogeneration scheme with a single turbine. Plant requires 4 MW of electrical power. Find out whether the cogeneration plants are self-sufficient or any additional power needs to be purchased from the grid assuming turbine efficiency of (05) the turbine as 70% and generator efficiency as 90%.

(05)