

Paper EM2 – Energy Manager – Set A

NATIONAL CERTIFICATION EXAMINATION 2004 FOR ENERGY MANAGERS

PAPER – EM2: Energy Efficiency in Thermal Utilities

Date: 22.05.2004 Timings: 1400 - 1700 HRS Duration: 3 HRS Max. Marks: 150

General instructions:

- Please check that this question paper contains **6** printed pages
 - Please check that this question paper contains **65** questions
 - The question paper is divided into three sections
 - All questions in all three sections are compulsory
 - All parts of a question should be answered at one place
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Section – I: OBJECTIVE TYPE

Marks: 50 x 1 = 50

- (i) Answer all **50** questions
- (ii) Each question carries **one** mark
- (iii) Put a (✓) tick mark in the appropriate box in the answer book

1.	Excess air can be derived by measuring the percentage of ... in the flue gas. a) CH ₄ b) N ₂ c) CO d) CO ₂
2.	Which of the following fuel requires the least amount of excess air for complete combustion? a) furnace oil b) LDO c) coal d) natural gas
3.	LPG consists of one of the following a) Methane b) Butane c) Hexane d) Iso-Octane
4.	Suitable atomizing viscosity of furnace oil for use in LAP/MAP burners is a) 100 Redwood seconds-1 b) 300 Redwood Seconds-1 c) 600 Red wood seconds-1 d) 400 Redwood Seconds-1
5.	Stoichiometric air to fuel ratio for Indian coals used in thermal power plants is in the range a) below 3 b) 8 - 10 c) 3 - 6 d) 10 - 14
6.	Element in fuel oil responsible for corrosion is a) Carbon b) Sulphur c) Hydrogen d) Chlorine
7.	A system in which a package type boiler operates with a FD fan is called a) Natural draft b) Forced draft c) Induced draft d) Balanced draft

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8.	Steam generation in a boiler is 26 tonnes in 2 hours. Fuel consumption in the same period is 1 tonnes per hour. The evaporation ratio is a) 10 b) 12 c) 13 d) 26
9.	The limiting temperature to which the flue gases can be cooled is influenced by percentage of a) Carbon in fuel b) Hydrogen in fuel c) Sulphur in fuel d) Ash in fuel
10.	Economizer in boiler is used to extract heat from flue gases for pre-heating a) blow down b) fuel oil c) air for combustion of fuel d) feed water
11.	Concentration of solids in boiler drum is controlled by a) steam venting b) blow down c) steam trap d) excess air
12.	Major heat loss in an oil fired boiler is accounted by a) surface radiation loss b) stack loss c) un-burnt carbon loss d) blow down loss
13.	At which of the following pressure, the enthalpy of evaporation of steam will be highest a) 2 kgs/cm ² b) 8 kgs/cm ² c) 12 kgs/cm ² d) 20 kgs/cm ²
14.	Which of the steam trap operates on the principle of difference in density between steam and condensate a) thermodynamic b) inverted bucket c) thermostatic d) none of the above
15.	Steam mains should be run with a falling slope of ... in the direction of steam flow for effective line condensate drainage a) 125 mm in 30 metres b) 250 mm in 30 metres c) 50 mm in 30 meters d) 350 mm in 30 metres
16.	Heat loss through openings in furnaces is directly proportional to a) fourth power of absolute temperature b) square of absolute temperature c) absolute temperature d) fourth power of temperature
17.	Furnace wall heat loss does not depend on a) temperature of external surface b) temperature of air around the furnace c) emissivity of external wall surfaces d) stock to be heated
18.	The efficiency of a stand alone gas turbine without any heat recovery system will be in the range of a) 10 –15 % b) 15 –20 % c) 20 – 25 % d) 35 – 40 %
19.	Which of the following influences energy savings when ceramic coating is applied on furnace hot side a) conductivity b) convective heat transfer coefficient c) emissivity d) factor for total radiation

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20.	Which of the following is not a property of ceramic fibre insulation. a) low thermal conductivity b) light weight c) high heat capacity d) thermal shock resistant
21.	Fuel bed temperature in a FBC boiler is about a) 550 °C b) 900°C c) 1400 °C d) 1700 °C
22.	Low combustion temperature in FBC boilers results in reduced formation of a) SO _x b) NO _x c) CO ₂ d) O ₂
23.	A major advantage of PFBC boilers compared to conventional pulverised coal fired boiler is a) less ash removal b) low excess air c) low radiation loss d) much smaller size
24.	Which of the following industry may not be ideal for adoption of co-generation system a) fertilizer b) pulp & paper c) refinery d) foundry
25.	Ceramic recuperators can withstand gas side temperature up to a) 400°C b) 1300°C c) 1000°C d) 1700° C
26.	The waste heat recovery equipment in a combustion system will be more economical when the exit flue gases are at a temperature of a) 200°C b) 400°C c) 600°C d) 800°C
27.	Which among the following uses a sealed working fluid for heat recovery a) heat pipe b) recuperator c) heat wheel d) thermocompressor
28.	The device that upgrades a low temperature heat source to a higher temperature sink is called a) heat pipe b) heat pump c) plate heat exchanger d) economizer
29.	Which of the following equipment requires electricity for its operation a) thermocompressor b) heat pump c) heat pipe d) economizer
30.	The average reduction of flue gas temperature by results in an efficiency increase of the boiler by 1% point a) 12°C b) 22°C c) 32°C d) 42°C
31.	The equipment used to upgrade a low pressure steam to a higher pressure steam is known as a) heat pump b) thermocompressor c) heat pipe d) heat wheel
32.	Which of the following boiler has the largest permissible boiler drum TDS concentration a) low pressure water tube boiler b) high pressure water tube boiler c) lancashire boiler d) package and economic boiler

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33.	A power plant which uses first a gas turbine followed by a steam turbine for power generation is called a) topping cycle b) combined cycle c) Brayton cycle d) bottoming cycle
34.	The Gross Calorific Value of furnace oil, LSHS and LDO is of the order of a) 5,000 kilo calorie per kg b) 8,000 kilo calorie per kg. c) 10,000 kilo calorie per kg d) 13,000 kilo calorie per kg
35.	A co-generation system is also known as a) reversible system b) re-generation system c) combined heat and power system d) Brayton cycle system
36.	Which of the following will not conserve energy in a furnace a) preheating combustion air b) charge preheating c) optimizing excess air d) addition of more burners
37	Regenerators are widely used in a) reheating furnaces b) heat treatment furnaces c) baking ovens d) glass melting furnaces
38.	The efficiency of a re-heating furnace, operating at 10 tonnes per hour consuming furnace oil of 460 kg/hour for reheating the stock from 40°C to 1100°C. (Specific heat of material is 0.13 kCal/kg°C) is about a) 20 b) 30 c) 40 d) 50
39.	What is the major energy loss in an oil fired reheating furnace? a) loss due to evaporation of moisture in fuel b) skin losses c) sensible heat loss in flue gas d) heat loss through openings
40.	Which of the following does not contribute to efficient use of steam a) superheated steam for indirect process heating b) insulation of steam pipe lines c) reducing the work to be done by steam d) providing dry steam for process
41.	The purpose of venting air from steam systems is because air is a a) dilutant b) inert substance c) good conductor d) insulator
42.	Steam is used as a heat transfer medium in an industry because of the following main factor a) water is easily available b) steam can be transported c) releases maximum heat during heat transfer at a fixed temperature d) none of the above
43.	The coefficient of thermal expansion of refractory material should be a) very high b) high c) medium d) low

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44.	High emissivity coatings are most effective when applied on a) inner surface of furnace b) outer surface of furnace c) refrigeration pipings d) none of the above
45.	Alumina is atype of refractory. a) acid b) neutral c) basic d) none of the above
46.	The efficiency of a typical FBC boiler would be around a) 90% b) 80% c) 70% d) 40%
47.	In FBC boiler the combustion is carried out at a temperature a) closer to steam temperature b) below ash fusion temperature of fuel used c) at adiabatic combustion temperature d) at and above ash fusion temperature
48.	In a CFBC boiler the capture and recycling of bed materials is accomplished by a) cyclone b) back filter c) settling chamber d) scrubber system
49.	The equipment having the highest efficiency in case of conventional power plant is a) boiler b) electric generator c) cooling tower d) steam or gas turbine
50.	The major limitation of metallic recuperator is a) limitation of handling SO _x , NO _x gases. b) manufacturing difficulty of the required design c) limitation of reduced life for handling temperature above 1000°C d) none of the above

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Section – II: SHORT DESCRIPTIVE QUESTIONS

Marks: 10 x 5 = 50

- (i) Answer all **Ten** questions
- (ii) Each question carries **Five** marks

S-1. List some applications using ceramic fibre.

S-2. What are the important aspects to be considered for retrofitting a conventional boiler to FBC technology?

S-3. Explain what is meant by a combined cycle.

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- S-4. List at least five important parameters to be considered before installing a cogeneration system.
- S-5. What is a 'heat pipe'? How does it work?
- S-6. Explain the meaning of dryness fraction of steam.
- S-7. How is percentage of excess air level calculated from data obtained from a flue gas analysis of boilers or furnaces?
- S-8. What is meant by wall losses of a furnace? How can they be minimized?
- S-9. Explain the importance of deaeration of boiler feed water.
- S-10. In a boiler drum the permissible TDS is 2000 ppm, permissible make up water is 10 per cent of feed water and TDS of feed water is 200 ppm. Find out the blow down percentage?

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Section – III: LONG DESCRIPTIVE QUESTIONS

Marks: 5 x 10 = 50

- (i) Answer all **Five** questions
(ii) Each question carries **Ten** marks

- L-1. (i) Explain why the furnace efficiency is low in comparison to a typical steam boiler efficiency.
(ii) A furnace of 12 tonnes/ hr output consumes 900 kg/hr of fuel oil. Calculate the furnace efficiency by assuming specific heat of the stock material as 0.15 kcal/kg°C, stock material heated from 90°C to 1250°C, and GCV of fuel oil as 11500 kcal/kg.
- L-2. Discuss four major energy conservation opportunities in a boiler system?
- L-3. Describe any five properties of ceramic fibre from the point of view of their uses in furnace.
- L-4. Discuss advantages of condensate and flash steam recovery in steam systems.
- L-5. What is meant by heat- to- power ratio in a cogeneration system? Show in a sketch three different modes in which a single steam turbine can be used for cogeneration.

..... **End of Section – III**