UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF INDUSTRIAL TECHNOLOGY

FINAL EXAMINATION

JANUARY 2016 SEMESTER

COURSE CODE	:	JFB 20403
COURSE TITLE	:	BOILER: OPERATION AND MAINTENANCE
PROGRAMME LEVEL	:	BACHELOR
DATE	:	29 MAY 2016
TIME	:	2.30 PM – 5.30 PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consists of TWO (2) sections.
4. Answer ALL questions in Section A. Choose THREE (3) questions in section B.
5. Please write your answers on the answer booklet provided.
6. Table and formula are enclosed as reference.
7. Please answer all questions in English only.

THERE ARE 4 PAGES OF QUESTIONS EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

(a) Describe the differences between a steam boiler and a steam generator.

(5 marks)

(b) Compare the advantages and disadvantages of fire tube and water tube boilers based on **FIVE (5)** parameters.

(15marks)

Question 2

The furnace of the boiler is where the fuel and air are introduced to combust; fuel/ air mixtures are normally introduced into the furnace by using burners, where the flames are formed. The resulting hot gases travel through a series of heat exchangers, where heat is transferred to the water flowing through them. The combustion gases are finally released to the atmosphere via the stack of exhaust section of the boiler.

(a) Explain the terms of boiler efficiency.

(5 marks)

(b) A boiler produces 220 tons of dry saturated steam per hour at a pressure of 60kgf/cm^2, abs. from feedwater at a temperature of 120^{0}C. Analyze the overall efficiency of the boiler system when the boiler operates at:
Coal consumption = 1200 tons/day
Calorific value of coal = 4200 kcal/kg
1% of coal escapes unburnt

(15 marks)

SECTION B (Total : 60 marks)

INSTRUCTION : Answer THREE (3) questions.
Please use the answer booklet provided.

Question 1

A boiler is a closed vessel in which water or other fluid is heated. The fluid does not necessarily boil. The heated or vaporized fluid exits the boiler for use in various processes or heating applications including water heating, central heating, boiler-based power generation, cooking and sanitation.

(a) Identify **FIVE (5)** types of boiler that is available in the industries.

(5 marks)

(b) With the aid of a diagram, analyze in the operation of a packaged boiler.

(15 marks)

Question 2

Air–fuel ratio (AFR) is the mass ratio of air to fuel present in a combustion process such as in an internal combustion engine or industrial furnace. The AFR is an important measure for anti-pollution and performance-tuning reasons.

(a) Explain the stoichiometric relation for a combustion of propane (C_3H_8)

(5 marks)

(b) A boiler is fired with coal having following percentage composition by mass:
C – 85%, H – 5%, S – 1%, O-2.5%; Incombustible – 6.5%. Evaluate the boiler efficiency from the given data in Table 1.

Table 1: Boiler Properties

Excess Air Supply	40%
Flue Gas Temperature at Boiler Exit	170^{0}C
Ambient Air Temperature	25^{0}C
Specific Heat of Flue Gas	0.25 kcal/kg^{0}C
Specific Heat of Steam	0.48 kcal/kg^{0}C
Uncounted Heat Loss	18%
Combustion	**Heat of Combustion**
$C + O_2 \rightarrow CO_2$	8075 kcal/kg
$S + O_2 \rightarrow SO_2$	2220 kcal/kg
$H_2 + O_2 \rightarrow H_2O$	34500 kcal/kg

(15 marks)

Question 3

Each year, hundreds of accidents are reported nationally involving steam and hot water heating boilers. Most are attributed to malfunctioning low water cutoffs, operator error, poor maintenance and/or corrosion. Properly functioning control or safety devices are absolutely essential.

(a) Explain the differences between boiler mountings and boiler auxiliary equipment.
(10 marks)

(b) Create the steps to perform steam pressure test on a safety valve.
(10 marks)

Question 4

(a) The following options are now available for optimizing emission control from utility and industrial power plants: - Pre-combustion options, In-furnace control options, Post-combustion control processes and Auxiliary equipment tie-ins. Outline **FIVE (5)** options of post-combustions to control the emission.
(5 marks)

(b) A number of advanced emissions control systems are under development with a focus on minimizing total cost and improving removal efficiency. With the aid of a diagram, explain the operation of SO_x-NO_x-Ro_x Box (SNRB).

(15 marks)

END OF EXAMINATION PAPER