FIJI NATIONAL UNIVERSITY

COLLEGE:	COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)
SCHOOL:	ELECTRICAL & ELECTRONICS ENGINEERING
PROGRAMME:	TRADE DIPLOMA IN RENEWABLE ENERGY ENGINEERING
UNIT CODE:	REE 591
TITLE:	ENERGY AUDIT, SECURITY, POLICY & PLANNING

FINAL EXAMINATION – TRIMESTER 2, 2017

TIME: 3 HOURS 10 MINUTES

DAY/DATE: TBC/ TBC TIME: TBC ROOM: TBC

INSTRUCTIONS TO STUDENTS

1. You are allowed 10 minutes Extra reading time during which you are NOT to write.
2. Begin each section on a fresh page and use both sides of the sheet.
3. Write your candidate-number at the top of each attached sheet.
4. Insert all written foolscaps, graph paper, drawing paper, etc. in their correct sequence and secure with string.
5. For all sheets of paper on which rough or draft work has been done, cross it through and you MUST ATTACH to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. Answers to all questions must be written in INK on the Answer sheet provided and show all working where necessary.
8. Only Non-programmable calculators are allowed.
9. ATTEMPT all questions.

SECTION A – Theoretical Based, - 40 MARKS

1. State the importance of energy policy for industries. (5 marks)

2. Why a cube of ice at $0^{\circ}C$ is more effective in cooling a drink than the same quantity of water at $0^{\circ}C$? (3 marks)

3. What is a Sankey diagram and what are its uses ? Explain with an example. (7 marks)

4. What are the environmental impacts of combustion of fossil fuels? (5 marks)

5. What parameters are measured with the following instruments?

   a) Pitot tube
   b) Stroboscope
   c) Fyrite
   d) Lux meter
   e) Power analyser (5 marks)

6. From Industry-to-industry, the methodology of Energy Audits needs to be flexible. List down ten comprehensive steps of methodology for conducting of Energy Audit at field level. (10 marks)

7. Define the term Return on Investment and state its limitation. (5 marks)

SECTION B – Numerical Based - 60 MARKS

1. 10 kg of steam at 100 ^{o}C with latent heat of vapourisation of 2260 kJ is cooled to 50 ^{o}C. If the specific heat of water is 4200 J/kg ^{o}C, find the quantity of heat given out? (5 marks)

2. In a compressed air Dryer, electrical heater is used for regeneration of silica gel. The present Electrical energy consumption is 100 kWh/day. The management intends to replace the electrical heater by steam coil. (Assuming only latent heat of steam used. Latent heat of steam is 540 kCal/kg. Efficiency of steam heating is 70%, operating days = 300)

   a) How much steam is need per day? (2 marks)

   b) Calculate cost savings/year. Cost of power is $0.15/kWh and cost of steam is $33.33 / ton (3 marks)

3. Renovation and Modernization (R&M) of a 210 MW coal fired thermal power plant was carried out to enhance the operating efficiency from 28% to 32%. The specific coal consumption was 0.7 kg/kWh before R&M. For 8000 hours of operation per year, and assuming the coal quality remains the same, calculate:

   a) The coal savings per year (2 marks)

   b) The expected avoidance of CO_2 into the atmosphere in Tons/year if the emission factor is 1.53 kg CO_2 /kg coal (3 marks)

4. An energy meter connected to a 3 phase, 18.75 kW pump shows 108 units consumption for six hours of operation. The load on the motor was steady. The consumer doubted the energy meter reading and electrical parameter such as current, voltage and power factor were measured. The measured values were 430 V line volts, 25 amps line current and 0.80 Power Factor. Find out if the energy meter reading is correct. (5 marks)

5. A 500 MW coal plant based on conventional pulverized fuel has a gross efficiency of 38%. The Gross calorific value of the coal used is 4000 kCal/kg with 40% total carbon. A supercritical unit of 500 MW replaces the plant with a gross efficiency of 40% using the same characteristic coal. Calculate the following

(a) Specific coal consumption after replacement

(b) Amount of coal and carbon di-oxide saved during a year if the plant works for 8000 hours. (10 marks)

6. A 5 MW DG Set is operating at 70% load. A waste heat recovery boiler is installed to recover heat from exhaust gas to generate steam at 10 kg/cm^2. Find out the quantity of steam generated annually after installing the waste heat recovery boiler

Given Data:

- Flue gas exit temperature = 500 °C
- Flue gas temperature after Waste heat recovery boiler = 250 °C
- Specific heat of flue gases = 0.25 kCal/kg/°C
- Specific gravity of diesel oil = 0.85
- Air to fuel ratio = 30 kg/kg
- Specific fuel consumption = 4 kWh/liter
- Enthalpy of steam at 10 kg/cm2 = 660 kCal/kg
- Feed water temperature = 30 °C
- Operating hours per year = 6000 hrs (10 marks)

7. In an engineering industry, a heat treatment electrical furnace is consuming 500 kWh per batch. The Energy Manager of the company wanted to convert it to furnace oil firing for cost savings. Estimate the furnace oil requirement in litres and cost savings, per batch, considering the following data.

Calorific value of furnace oil	: 10,000 kCal/kg	
Specific gravity of furnace oil	: 0.9	
Efficiency of electrical furnace	: 70%	
Efficiency of furnace oil fired furnace	: 58 %	
Cost of electricity	: $0.3 / kWh	
Cost of furnace oil	: $1.33 / litre	(10 marks)

8. In a chemical process industry a coal fired boiler of 77% efficiency is proposed to be replaced with paddy husk fired boiler of 67% efficiency. Calculate the fuel cost savings for changing over to paddy husk?

GCV of coal	= 4800 kCal/kg	
Cost of coal	= $265/MT	
GCV of paddy husk	= 3500 kCal/kg	
Cost of paddy husk	= $150/MT	
Quantity of steam requirement	= 20 TPH	
Enthalpy of steam	= 760 kCal/kg	
Enthalpy of feed water	=120 kCal/kg	
Annual operating hours of boiler	= 7000 hours	(10 marks)

**********THE END**********