

**NATIONAL CERTIFICATION EXAMINATION 2004**  
for

**ENERGY AUDITORS**

**PAPER – EA4: Energy Performance Assessment for Equipment and Utility Systems**

**Date: 23.05.2004      Timings: 1400 – 1600 HRS      Duration: 2 HRS.      Max. Marks: 100**

**General instructions:**

- Please check that this question paper contains **3** printed pages
- Please check that this question paper contains **16** 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
- **Open book examination**

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**Section – I: Short Questions**

**Marks: 10 x 1 = 10**

- (i) Answer all **Ten** questions
- (ii) Each question carries **One** mark

- S-1 Define “sub - stoichiometric ratio” in combustion technology. State one technology applying “sub – stoichiometric” combustion?
- S-2 Why does radiation heat loss increase considerably with increase in the temperature of a furnace wall?
- S-3 Draw the schematic diagram of topping cycle cogeneration system.
- S-4 Name the two most common types of extended surface heat exchangers.
- S-5 Explain why efficiency testing of electric motors yields different results, even if same measuring equipment is used.
- S-6 What is meant by the term “specific power requirement” with respect to air compressors? State the units.
- S-7 Define “lamp circuit efficacy”. State the units.
- S-8 Explain why a project with a high IRR is not necessarily more attractive than a project with a lower IRR.
- S-9 How do you classify solar thermal devices?
- S-10 Explain how performance of an internal combustion engine changes when the fuel is switched from petrol to producer gas.

**----- End of Section - I -----**

## Paper EA4 - Energy Auditor - Set A

### Section - II: Long Questions

Marks: 2 x 5 = 10

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

- L-1 Assume that the boiler efficiency is calculated by the direct method using either NCV or GCV.
- (i) What is the difference in the efficiency calculation using NCV or GCV?
  - (ii) State an example where boiler efficiency is more than 100%, if not, explain why this is not possible.
- L-2 Which is one of the first essential steps in determining the suitability of a variable speed drive in a pump system? Explain why?

----- End of Section - II -----

### Section - III: Numerical Questions

Marks: 4 x 20 = 80

- (i) Answer all **Four** questions
- (ii) Each question carries **Twenty** marks

- N-1 Determine the simple payback period of the incremental investment for two transformers with the following details:

	Option A	Option B
Capacity	500 kVA	500 kVA
Efficiency at rated capacity	98%	98.5%
Capital cost	Rs. 3.15 lakhs	Rs. 4.05 lakhs

Assume the following for both the transformers

Operating PF at rated capacity	= 0.9
No load losses	= same
Energy charge	= Rs. 4.50/kWh

For the analysis consider two cases for the length of time during which the transformers are used at rated capacity

- (a) 10 hours/day and 250 days/year of operation
- (b) 16 hours/day and 300 days/year of operation

## Paper EA4 - Energy Auditor - Set A

N-2 A reciprocating single stage compressor coupled with an electric motor has a mechanical shaft power requirement of 50 kW at a discharge pressure of 700 kPa. Determine the energy cost savings if the discharge pressure is reduced to 600 kPa for both isothermal and adiabatic compression processes. Assume the following for the existing and modified pressure conditions:

Intake air pressure = 1 atmosphere,      motor operating efficiency = 90%  
Average load factor = 75%,                      operating hours = 8000 hours/year  
Average energy charge = Rs. 4.5/kWh      No change in remaining parameters

N-3 It is proposed to install at the beginning of the year a heat recovery equipment in a food processing industry. The capital cost of the equipment is Rs 20,000/-. The savings accrued by the unit are constant and Rs 5,000/- annually. The discount rate is 8%.

- (i) Calculate the Net Present Value (NPV) for 5 years.
- (ii) Is the investment recovered after 5 years? Explain!
- (iii) Is the investment recovered after 7 years? Explain!
- (iv) Estimate the IRR for this investment after 7 years if the salvage value of the equipment is Rs 2,000 at the end of 7<sup>th</sup> year.

N -4 The following are the data collected for a boiler using furnace oil as the fuel. Determine the boiler efficiency based on GCV by indirect method ignoring radiation and convection losses.

Ultimate chemical analysis (% weight): Carbon : 84, Hydrogen : 12, Nitrogen : 0.5, Oxygen : 1.5, Sulphur: 1.5, Moisture : 0.5, NCV of fuel 9,763 kCal/kg and humidity 0.025 kg moisture /kg of dry air.

Flue gas analysis: CO<sub>2</sub> : 9.8% volume, flue gas exit temperature : 190°C and ambient temperature : 30°C.

----- **End of Section - III** -----