

**NATIONAL CERTIFICATION EXAMINATION 2004
FOR
ENERGY AUDITORS**

PAPER – EA1: GENERAL ASPECTS OF ENERGY MANAGEMENT & ENERGY AUDIT

Date: 22.05.2004 Timings: 0930-1230 HRS Duration: 3 HRS Max. Marks: 150

General instructions:

- Please check that this question paper contains **7** 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

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.	India's share of the world's total primary energy consumption in 2002 was a) 2.1% b) 3.5% c) 5.4% d) 10.6%
2.	The second major commercial energy consuming sector in the country is a) Industry b) Agriculture c) Residential d) Transport
3.	Non-commercial energy is a) not available in the market b) no definite price set c) always traded for free d) always ignored in energy accounting
4.	If Rs. 1 Crore = US\$ 200,000, then the annual current oil import bill of India is around a) 1.6 Billion US\$ b) 12 Billion US\$ c) 16 Billion US\$ d) 4 Billion US\$
5.	If the total installed power capacity in India was 100,000 MW at the beginning of 2001 and is increased annually by 7%, then the installed capacity requirement 10 years later will be a) 215,804 MW b) 183,846 MW c) 210,485 MW d) 196,715 MW
6.	A person can do the following with solar energy a) destroy it b) convert it c) create it d) burn it
7.	Select the source of stored mechanical energy a) compressed spring b) electricity c) water stored in reservoir d) coal

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8.	The quantity of heat required to raise the temperature of a substance by 1° C is known as a) sensible heat b) specific heat c) heat capacity d) latent heat
9.	A three phase induction motor is drawing 12 Ampere at 440 Volts. If the operating power factor of the motor is 0.85 and the motor efficiency is 96%, then the mechanical shaft power output of the motor is a) 7.46 kW b) 7.77 kW c) 5.3 kW d) 23.4 kW
10.	The term missing in the following equation: Active Power = 1.732 x V x I x ? a) sin phi b) cos phi c) efficiency d) a constant
11.	Electrical resistance is defined as a) Current/Voltage b) Voltage x Current c) Ohm x Voltage d) Voltage/Current
12.	Energy management involves... a) combination of technical and managerial skills b) managerial skills c) technical skills d) energy audit skills
13.	Water flow in pipes is measured by a) pitot tube b) x-rays c) doppler effect d) electric fields
14.	The benchmark for energy performance parameter for air conditioning equipment is a) kW/kg of refrigerant handled b) kW/ton of refrigeration c) kcal/m ³ of chilled water d) kWh/ton of refrigeration
15.	One kWh of electricity is equivalent to how many heat units in Btu ? a) 860 b) 3412 c) 746 d) 12000
16.	Matching energy usage to requirement means providing a) just theoretical energy needed b) just the design needs c) energy with minimum losses d) less than what is needed
17.	In a chemical process two reactants A (200 kg) and B (200 kg) are used. If conversion is 50% and A and B react in equal proportions, the mass of the product formed is a) 300 kg b) 150 kg c) 400 kg d) 200 kg
18.	Diagrammatic representation of input and output energy streams of an equipment or system is know as a) mollier diagram b) sankey diagram c) psychrometric chart d) balance diagram
19.	Coal with 30% ash is fired in a boiler. Coal consumption is 50 tonnes on a specific day. Clinker is formed by 1% of the ash sticking to boiler tubes. How many tonnes of ash are going out of the boiler on this day. a) 14.85 b) 15 c) 15.15 d) 13.5
20.	An oil fired boiler operates at an excess air of 15%. If the stoichiometric air to fuel ratio is 14 and oil consumption is 1000 kg per hour and 50% of the flue gas is diverted to a dryer, then the mass of flue gas leaving the boiler chimney in kg/ hour would be a) 3,990 b) 14,010 c) 8,050 d) 7,650

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21.	In a force field analysis one of the indicators below is not considered a positive force a) high price of energy b) energy efficient technology available c) salary of staff d) lack of awareness
22.	Which of the following is least important of a good energy information system a) data accuracy b) data relevance c) data volume d) data validation
23.	The first vital step in an energy management programme is a) top management commitment b) measurements c) setting goals d) energy audit
24.	A public expression of an organization's commitment on energy conservation is a) energy balance b) energy policy c) energy audit d) energy savings
25.	What is not the duty of an energy manager a) conduct an energy audit b) prepare an annual activity plan c) report to BEE and state level designated agency once a year d) prepare a scheme for efficient use of energy
26.	The factor that reflects best on the risk of the project while evaluating the present value of the expected future cash flow is a) life of project b) fuel cost inflation c) loan interest rate d) discount rate
27.	A sensitivity analysis is an assessment of a) cash flows b) risks due to assumptions c) capital investment d) best financing source
28.	The Return of Investment, ROI, is expressed as a) (first cost/first year benefits) x100 b) NPV/ IRR c) annual costs/capital cost d) (annual net cash flow/capital cost) x100
29.	The Net Present Value of a project at a discount rate of 16% with an investment of Rs 50,000 at the beginning of the first year, and savings of Rs 23,000 and Rs 36,000 at the end of the first and second year, respectively is a) 6,581 b) -246 c) 862 d) 3,419
30.	A sum of Rs 10,000 is deposited in a bank at the beginning of a year. The bank pays 6% interest annually. How much money is in the bank account at the end of the fifth year, if no money is withdrawn? a) 13,382 b) 12,625 c) 13,000 d) 10,937
31.	A contract in which the costs are paid from all or part of the energy cost savings is called a) performance contract b) traditional contract c) extended technical guarantee contract d) guaranteed savings performance contract
32.	A path is characterized by 4 parameters such as ES = earliest start time, EF= earliest finish time, LF = latest finish time, LS = latest start time. A path is critical if a) ES=EF or EF=LF b) ES=LS and EF=LF c) ES=LS or EF=LF d) LF=EF and EF=LS

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33.	The annual electricity bill for a plant is Rs 10 lakhs and accounts for 38% of the total energy bill. Furthermore the total energy bill increases by 5% each year. How high is the plant's annual energy bill at the end of the third year? a) Rs 30.46 lakhs b) Rs 26.32 lakhs c) Rs 38.42 lakhs d) none of the above
34.	In Project Management the critical path in the network is a) the quickest path b) the shortest path c) the path from start to finish d) the path where no activities have slack
35.	CPM in project management refers to a) critical periodic management b) critical project monitoring c) critical path method d) cost project management
36.	The major difference between CPM and PERT is a) CPM provides graphic and PERT does not b) CPM uses fixed time estimates while PERT uses several time estimates c) CPM is an expansion of PERT d) PERT is an expansion of CPM
37.	The calorific value of coal is 4000 kCal/ kg. Find out the oil equivalent of 100 kg of coal if the calorific value of oil is 41,870 kJ/ kg a) 40 kg b) 56 kg c) 52 kg d) None of the above
38.	Fixed energy consumption can be determined from a a) bar chart b) vertical line chart c) pie chart d) X Y coordinate system
39.	Energy consumed for the period is given as 110 kWh for 10 tons and 200 kWh for 20 tons of production. The fixed energy consumption in kWh is... (No graph is needed to arrive at correct answer). a) 10 b) 40 c) 20 d) None of the above
40.	Large scattering on production versus energy consumption trend line indicates a) poor process control b) many forced outages c) poor process monitoring d) none of the above
41.	The ratio of energy consumption to corresponding production is called a) energy intensity b) specific energy consumption c) production energy ratio d) specific production ratio
42.	In a cumulative sum chart, if the graph is horizontal, then a) nothing can be said b) energy consumption is reduced c) specific energy consumption is increasing d) actual and calculated energy consumption are the same
43.	A firm substitutes (replaces) expensive oil and starts firing wood in a boiler. The following scenario is most likely a) higher fuel cost b) better boiler efficiency c) higher energy consumption d) less smoke in the stack
44.	Assume project A has an IRR of 85% and NPV of Rs 15,000 and project B has an IRR of 25% and NPV of 200,000. Which project would you implement first if financing is available and project technical life is the same? a) B b) A c) cannot be decided d) question does not make sense

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45.	Which of the following is not a part of energy consumption monitoring a) data recording b) data analysis c) data reporting d) energy costing
46.	The commitment period for emission reductions of industrialized countries as per Kyoto protocol is a) since 2001 b) 2008 – 2012 c) there is none d) 2012 -2022
47.	Global warming is mostly caused by emission of a) sulfur dioxide b) carbon monoxide c) carbon dioxide d) methane
48.	Under the Kyoto Protocol India has to cut emissions by a) 0% b) + 8% c) -8% d) 12%
49.	The process under the Kyoto Protocol by which industrialized countries may invest into or buy certified emission reductions is called. a) cleaner development mechanism b) clean development mechanism c) prototype carbon trading d) none of the above
50.	The ozone depletion process is due to a) Carbon Dioxide b) UV light breaking the ozone c) Nitrogen d) chlorine atoms destroying ozone molecules

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

Section - II: SHORT DESCRIPTIVE QUESTIONS

Marks: 10 x 5 = 50

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

- S-1 Classify the types of energy available on earth.
- S-2 List five forms of energy with examples.
- S-3 A 10 kW rated motor has a full load efficiency of 85%. Actual input measurement at a particular loading shows 415 Volt, 10 Amps, and PF of 0.68. Find out the motor loading in percentage.
- S-4 Explain the difference between specific heat and heat capacity.
- S-5 Give any five bench marking parameters followed for either equipment or industrial production.
- S-6 State definition of energy audit as defined in the Energy Conservation Act 2001.

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- S-7 Calculate the net present value over a period of 3 years for a project with one investment of Rs 50,000 at the beginning of the first year and a second investment of Rs 30,000 at the beginning of the second year and fuel cost savings of Rs 40,000 each in the second and third year. The discount rate is 16%.
- S-8 In a heat exchanger steam is used to heat 40 kg/ hour of furnace oil from 30° C to 90° C. The specific heat of furnace oil is 0.22 kcal/ kg° C. How much steam per hour is needed? Latent heat of steam is 540 kcal/ kg.
- S-9 Explain briefly PERT.
- S-10 List at least 5 steps involved in CUSUM analysis.

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

Section - III: LONG DESCRIPTIVE QUESTIONS

Marks: 5 x 10 = 50

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

- L-1 Explain the difference between energy conservation and energy efficiency, and state one example where energy costs are reduced but energy consumption goes up.
- L-2 A plant is using 4 tonnes/day of coal to generate steam. The calorific value of the coal is 4000 kcal/ kg. The cost of coal is Rs. 2,000/tonne. The plant substitutes coal with rice husks, as a boiler fuel, which has a calorific value of 3000 kcal/ kg and cost Rs. 700/tonne. Calculate the annual cost savings at 300 days of operation, assuming that the boiler efficiency decreases from 78% on coal to 72% on rice husks.
- L-3 In a pumping system the motor operating efficiency is 90% and pump operating efficiency is 80%. The pump discharge flow is throttled causing 20% loss; moreover 28% are lost through friction in pipe fittings. The three phase motor operates at a power factor of 0.85, 440 Volt and 17 Ampere.
- (I) Calculate the water power available at the end of the piping system.
(II) Calculate the overall system efficiency.
- L-4 An investment of Rs 1 Lakh is made for a variable speed drive at the beginning of the year, which is also the date of first operation. Savings expected over 4 years are Rs. 10,000, Rs. 20,000, Rs. 30,000 and Rs. 35,000 respectively. Find out the Net Present Value at the end of the 4th year, if the discount rate is 18%. Would you invest in this measure? Explain your decision.

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- L-5 Use CUMSUM technique to develop a table and to calculate energy savings for a 6 months period. For calculating total energy saving, average production can be taken as 4000 MT per month. Refer to field data given in table below.

Month	Actual SEC, kWh/MT	Predicted SEC, kWh/MT
Jan	252	265
Feb	238	265
Mar	287	300
Apr	287	265
May	359	310
Jun	276	265

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