

**Q1. The efficiency of variable speed drives generally**

- a) Decreases with speed
- b) Increases with speed
- c) Remains constant with change in speed
- d) None of these

**Q2. The basic function of electronic ballast is**

- a) To ignite the lamp
- b) To stabilize the gas discharge
- c) To supply the power to the lamp
- d) All of these

**Q3. The rotational speed of an AC induction motor depends on the**

- a) Number of poles in stator
- b) Frequency of the applied AC power
- c) Both a and b
- d) None of these

**Q4. A conventional incandescent lamp has a luminous efficiency of**

- a) 10 lumens / watt
- b) 12 lumens / watt
- c) 14 lumens / watt
- d) 14.6 lumens / watt

**Q5. In valley filling, the incremental costs during peak hours are**

- a) Less than the average costs of electricity
- b) More than the average costs of electricity
- c) Equal to the average cost of electricity
- d) None of these

**Q6. The reduction of utility load primarily during peak demand is known as**

- a) Peak clipping
- b) Load shifting
- c) Valley filling
- d) MTP analysis



**Q7. The demand side management can be achieved by the technique of**

- a) Time of day pricing and metering
- b) Multi – utility power exchange model
- c) Load management
- d) All of these

**Q8. EPRI stands for**

- a) European power research institute
- b) Electrical power Russian institute
- c) Electrical power research institute
- d) Electrical power research industries

**Q9. The term Demand Side Management was coined during**

- a) 1936 energy crisis
- b) 1972 energy crisis
- c) 1973 energy crisis
- d) 1986 energy crisis

**Q10. The water pollution prevention and control act was formed in the year**

- a) 1986
- b) 1974
- c) 1981
- d) 1980

**Q11. The Indian electricity rules of 1956 cover**

- a) Inspections of electric installations
- b) Licensing
- c) General safety precautions
- d) All of these

**Q12. Energy conservation act was formed in the year**

- a) 1998
- b) 1999
- c) 2000
- d) 2001

**Q13. The rules of a particular electricity supply system provision for metering, earthing and for other installation matters are in accordance with the electricity supply act of**

**a) 1947**

**b) 1948**

**c) 1956**

**d) 1958**

**Q14. Which among the following is not the pronged approach to energy management?**

**a) Capacity utilization**

**b) Fine turning of equipment**

**c) Technology up gradation**

**d) None of these**



**Q15. LNG stands for**

- a) Liquefied natural gas
- b) Liquid natural gas
- c) Low nitrogen content gas
- d) Liquid nitrogen gas

**Q16. Which is the major energy source to meet the Indian energy demand?**

- a) Coal
- b) Oil
- c) Natural gas
- d) Lignite

**Q17. Which country has the biggest coal reserves?**

- a) Russia
- b) US
- c) China
- d) India

**Q18. Which country has highest energy usage per capita?**

- a) Iceland
- b) Qatar
- c) Kuwait
- d) United Arab emirates

**Q19. In the given options, the non-commercial source of energy is**

- a) Coal
- b) Lignite
- c) Firewood
- d) Refined petroleum products

**Q20. When was power development in India commenced?**

- a) 1897
- b) 1902
- c) 1954
- d) 1975

**Q1. Answer: a**

**Q2. Answer: d**

**Q3. Answer: c**

**Q4. Answer: b**

**Q5. Answer: a**

**Q6. Answer: a**

**Q7. Answer: d**

**Q8. Answer: c**

**Q9. Answer: c**



**Q10. Answer: b**

**Q11. Answer: d**

**Q12. Answer: d**

**Q13. Answer: b**

**Q14. Answer: d**

**Q15. Answer: a**

**Q16. Answer: a**

**Q17. Answer: b**

**Q18. Answer: a**

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**Q19. Answer: d**

**Q20. Answer: a**

### Part – I: Objective type questions and answers

1.	"The judicious and effective use of energy to maximise profits and enhance competitive positions". This can be the definition of: a) Energy conservation c) Energy policy	b) <u>Energy management</u> d) Energy Audit
2.	The energy management function is generally vested in – (a) Senior Management (b) One energy manager or co-ordinator (c) Distributed among number of middle manager (d) (b) & (c) together	
3.	The objective of energy management includes a) Minimising energy costs c) Minimising environmental degradation	b) minimising waste d) <u>all the above</u>
4.	The ratio of current year's production to the reference year's production is called as. (EA/EM) a) demand factor c) utilisation factor	b) <u>production factor</u> d) load factor
5.	Replacement of steam based hot water generation by solar system is an example of a) matching energy usage to the requirement b) maximising system efficiency c) <u>Energy substitution</u> d) Performance improvement	
6.	One unit of electricity is equivalent to ____ kcal heat units. a) 800 b) <u>860</u> c) 400 d) 680	
7.	The benchmarking parameter for air conditioning equipment is a) <u>kW/Ton of Refrigeration</u> c) kcal/m³ of chilled water	b) kW/ kg of refrigerant handled d) Differential temperature across chiller
8.	The percentage of energy saved at the current rate of use, compared to the reference year rate of use, is called a) Energy Utilization c) Energy Efficiency	b) <u>Energy Performance</u> d) None
9.	Which instrument is used to monitor O₂, CO in flue gas? (EA) a) <u>Combustion analyzer</u> c) Pyrometer	b) Power analyzer d) Fyrite



10.	<p>Lux meter is used to measure..... (E A)</p> <p>a) <u>Illumination level</u>                      b) Sound intensity and illumination level</p> <p>c) Harmonics                                  d) Speed</p>
11.	<p>For a cement plant the parameter, "kWh/MT of clinker "indicates</p> <p>a) <u>Energy Index parameter</u>                      b) Utility factor</p> <p>c) Production factor                                  d) load factor</p>
12.	<p>Energy manger should be well versed with</p> <p>a) Manufacturing and processing skills b) <u>Managerial and technical skills</u></p> <p>c) Technical and marketing skills                      d) Managerial and commercial skills</p>
13.	<p>An energy policy does not include</p> <p>a) Target energy consumption reduction</p> <p>b) Time period for reduction</p> <p>c) Declaration of top management commitment</p> <p>d) <u>Future production projection</u></p>
14.	<p>CO<sub>2</sub> measurement of Fyrite kit is based on (E A)</p> <p>a) Weight basis (dry)                                  b) <u>Volume basis (dry)</u></p> <p>c) Weight basis (wet)                                  d) Volume basis (wet)</p>
15.	<p>Non contact speed measurements can be carried out by</p> <p>a) Tachometer                      b) <u>Stroboscope</u></p> <p>c) Oscilloscope                      d) Speedometer</p>
16.	<p>The tool used for performance assessment and logical evaluation of avenues for improvement in Energy management and audit is</p> <p>a) Fuel substitution                      b) Monitoring and verification</p> <p>c) Energy pricing                                  d) <u>Bench marking</u></p>
17.	<p>Infrared thermometer is used to measure</p> <p>a) <u>Surface temperature</u>                      b) Flame temperature</p> <p>c) Flue gas temperature                      d) Hot water temperature</p>
18.	<p>Find out the 'odd' among the following choices for fuel substitution for industrial sector of India.</p> <p>a) LDO with LSHS                                  b) coal with rice husk</p> <p>c) natural gas for fertilizer plant                      d) <u>LPG for soft coke</u></p>
19.	<p>The various types of the instruments, which requires during audit need to be</p> <p>a) easy to carry                                  b) easy to operate</p> <p>c) inexpensive                                  d) <u>all (a) to (c)</u></p>



1.	<p>List any four important factors involved in deciding final cost of purchased electricity.</p> <p>The factors which are involved in deciding final cost of purchased electricity are</p> <ul style="list-style-type: none"><li>• Maximum demand charges, kVA</li><li>• Energy Charges, kWh</li><li>• TOD Charges, Peak/Non-peak period</li><li>• Power factor Charge, P.F</li></ul>
2.	<p>What are the principles of energy management?</p> <p>The principles of energy management involve the following:</p> <ol style="list-style-type: none"><li>i) Procure all the energy needed at the lowest possible price</li><li>ii) Manage energy use at highest energy efficiency</li><li>iii) Reusing and recycling energy by cascading (waste heat recovery)</li><li>iv) Use the most appropriate technology</li><li>v) Reduce the avoidable losses</li></ol>
3.	<p>What is the need for managerial skills in energy management?</p> <p>Managerial skills include bringing about awareness, motivating people at all levels, changing the structure &amp; procedure, monitoring the energy consumption, norms target setting, etc. Both the organizational and people changes are required. For example, a mere awareness campaign in an industry on switching off lights, fans and air conditioners brought about a significant reduction in energy consumption.</p>
4.	<p>What do you mean by energy audit?</p> <p>Energy Audit is defined as "the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption".</p>
5.	<p>Explain how matching energy usage to requirement can enhance energy efficiency</p> <p>Mismatch between equipment capacity and user requirement often leads to inefficiencies due to part load operations, wastages etc. Worst case design, is a designer's characteristic, while optimization is the energy manager's mandate and many situations present themselves towards an exercise involving graceful matching of energy equipment capacity to end-use needs. Example:</p> <ul style="list-style-type: none"><li>• Eliminate throttling of a pump by impeller trimming, resizing pump, installing variable speed drives</li></ul>

6.	<p>Give any four bench marking parameters followed in equipment/utility related in Industries.</p> <ul style="list-style-type: none"> <li>i) kWh/ton of refrigeration (on Air conditioning plant)</li> <li>ii) % thermal efficiency of a boiler plant</li> <li>iii) kWh/NM<sup>3</sup> of compressed air generated</li> <li>iv) kWh /litre in a diesel power generation plant.</li> </ul>						
7.	<p>List any one energy audit instrument used for power measurement and one for flue gas measurement along with parameters to be measured?</p> <table border="1"> <thead> <tr> <th>Instrument</th><th>Parameters measured</th></tr> </thead> <tbody> <tr> <td>Portable power analyser used for power measurement</td><td>Measure, record the V, A, pf, Frequency, kVA, kVAr, kW, KWh, KVA, harmonics etc.</td></tr> <tr> <td>Combustion analyser used for flue gas measurement (zinconia cell board or electro mechanical cell board)</td><td>           O<sub>2</sub>, CO, NO<sub>x</sub>, SO<sub>x</sub>, CO<sub>2</sub> (calculated), temperature            • Some instrument will also give excess air, efficiency, draft, etc.         </td></tr> </tbody> </table>	Instrument	Parameters measured	Portable power analyser used for power measurement	Measure, record the V, A, pf, Frequency, kVA, kVAr, kW, KWh, KVA, harmonics etc.	Combustion analyser used for flue gas measurement (zinconia cell board or electro mechanical cell board)	O <sub>2</sub> , CO, NO <sub>x</sub> , SO <sub>x</sub> , CO <sub>2</sub> (calculated), temperature • Some instrument will also give excess air, efficiency, draft, etc.
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8.	<p>What is the significance of an energy policy?</p> <p>A written energy management policy will guide efforts to improve energy efficiency, and represents a commitment to saving energy. It will also help to ensure that the success of the program is not dependent on particular individuals in the organization. An energy management policy statement includes a declaration of commitment from senior management, as well as general aims and specific targets relating to:</p> <ul style="list-style-type: none"> <li>➤ Energy consumption reduction (electricity, fuel oil, gas, petrol etc.)</li> <li>➤ Energy cost reduction (by lowering consumption and negotiating lower unit rates)</li> <li>➤ Timetables</li> <li>➤ Budgetary limits</li> <li>➤ Energy cost centers</li> <li>➤ Organisation of management resources.</li> </ul>						
9.	<p>How do you classify energy conservation measures?</p> <p>Based on energy audit and analyses of the plant, a number of potential energy saving projects may be identified. These may be classified into three categories:</p> <ol style="list-style-type: none"> <li>1. Low cost – high return;</li> <li>2. Medium cost – medium return;</li> <li>3. High cost – high return</li> </ol>						
10.	<p>Define 'energy management'.</p> <p>The judicious and effective use of energy to maximize profits (minimize the costs) and enhance competitive positions.</p>						



11.	<p>List steps involved in pre-audit phase.</p> <p>Pre-audit phase:</p> <ul style="list-style-type: none"> <li>• Plan and organise</li> <li>• Walk through audit</li> <li>• Informal interview with plant personnel</li> </ul>
12.	<p>What are the factors to be considered before procuring fuels for energy efficiency and economics?</p> <p>The following factors should be considered before procurement of fuel for energy efficiency and economics:</p> <ul style="list-style-type: none"> <li>o Price at source, transport charge, type of transport</li> <li>o Quality of fuel</li> <li>o Energy content</li> </ul>
13.	<p>What are the few comparative factors need to be looked in to for external benchmarking used for inter-unit comparison and group of similar units?</p> <p>Few comparative factors, which need to be looked into while benchmarking externally are:</p> <ul style="list-style-type: none"> <li>• Scale of operation</li> <li>• Vintage of technology</li> <li>• Raw material specifications and quality</li> <li>• Product specifications and quality</li> </ul>
14.	<p>What is the objective of energy management?</p> <p>The objectives of energy management is to achieve and maintain optimum energy procurement, utilisation throughout the organisation and</p> <ul style="list-style-type: none"> <li>a) To minimise energy costs/ waste without affecting production &amp; quality</li> <li>b) To minimise environmental effects</li> </ul>
15.	<p>What are the few important technical feasibility parameters that one should consider during analysis of energy conservation opportunities?</p> <p>The technical feasibility should address the following issues:</p> <ul style="list-style-type: none"> <li>• Technology availability, space, skilled manpower, reliability, service etc</li> <li>• The impact of energy efficiency measure on safety, quality, production or process.</li> <li>• The maintenance requirements and spares availability</li> </ul>
16.	<p>Define the energy audit as per the energy conservation Act 2001?</p> <p>As per the Energy Conservation Act, 2001, Energy Audit is defined as "the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption".</p>

17.	<p>What do you understand by 'plant energy performance' (PEP)?</p> <p>Plant energy performance (PEP) is the measure of whether a plant is now using more or less energy to manufacture its products than it did in the past: a measure of how well the energy management programme is doing. It compares the change in energy consumption from one year to the other considering production output. Plant energy performance monitoring compares plant energy use at a reference year with the subsequent years to determine the improvement that has been made.</p>
18.	<p>What are fuel substitution and list one example of fuel substitution?</p> <p>Fuel substitution is substituting existing fossil fuel with more efficient and less cost / less polluting fuels such as natural gas, biogas, and locally available agro residues. E.g. Natural gas is increasingly the fuel of choice as fuel and feedstock in fertilizers, petrochemicals, power and sponge iron industries.</p>
19.	<p>What are the base line data that an audit team should collect while conducting detailed energy audit?</p> <p>The audit team should collect the following baseline data:</p> <ul style="list-style-type: none"> <li>- Technology, processes used and equipment details</li> <li>- Capacity utilisation</li> <li>- Amount &amp; type of input materials used</li> <li>- Water consumption</li> <li>- Fuel Consumption</li> <li>- Electrical energy consumption</li> <li>- Steam consumption</li> <li>- Other inputs such as compressed air, cooling water etc</li> <li>- Quantity &amp; type of wastes generated</li> <li>- Percentage rejection / reprocessing</li> <li>- Efficiencies / yield</li> </ul>
20.	<p>List at least four examples falling under "optimising the input energy requirements" while maximizing system efficiency?</p> <ul style="list-style-type: none"> <li>• Shuffling of compressors to match needs.</li> <li>• Periodic review of insulation thickness</li> <li>• Identify potential for heat exchanger networking and process integration.</li> <li>• Optimisation of transformer operation with respect to load.</li> </ul>

Part – III      Long type questions and answers

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| 1. | <p>Briefly explain with examples on fuel and energy substitution</p> <p>Fuel substitution: Substituting existing fossil fuel with more efficient and less cost/less polluting fuel such as natural gas, biogas and locally available agro-residues.</p> <p>Energy is an important input in the production. There are two ways to reduce energy dependency; energy conservation and substitution.</p> <p>Fuel substitution has taken place in all the major sectors of the Indian economy. Kerosene and Liquefied Petroleum Gas (LPG) have substituted soft coke in residential use.</p> <p>Few examples of fuel substitution</p> |
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## Question bank for Energy Managers & Energy Auditors

- Natural gas is increasingly the fuel of choice as fuel and feedstock in the fertilizer, petrochemicals, power and sponge iron industries.

- Replacement of coal by coconut shells, rice husk etc.

- Replacement of LDO by LSHS

Few examples of energy substitution

- ✓ Replacement of electric heaters by steam heaters

- ✓ Replacement of steam based hot water by solar systems

2. Distinguish between 'preliminary energy audit' and 'detailed energy audit'?

Preliminary energy audit is a relatively quick exercise to:

- Establish energy consumption in the organization
- Estimate the scope for saving
- Identify the most likely (and the easiest areas for attention)
- Identify immediate (especially no-/low-cost) improvements/ savings
- Set a 'reference point'
- Identify areas for more detailed study/measurement
- Preliminary energy audit uses existing, or easily obtained data

Whereas, detailed energy audit

- Provides a detailed energy project implementation plan for a facility, since it evaluates all major energy using systems.
- Offers the most accurate estimate of energy savings and cost.
- Considers the interactive effects of all projects, accounts for the energy use of all major equipment, and
- Includes detailed energy cost saving calculations and project cost.

Arrives energy balance based on an inventory of energy using systems, assumptions of current operating conditions and calculations of energy use. This estimated use is then compared to utility bill charges.

4.	<p>Write down the steps involved in 'Energy management Strategy'? (EA)</p> <ol style="list-style-type: none"> <li>1. Identify a strategic corporate approach</li> <li>2. Appoint energy manager</li> <li>3. Set up an energy monitoring and reporting system</li> <li>4. Conduct energy audit</li> <li>5. Prepare an energy management policy statement</li> <li>6. Prepare and undertake a detailed project implementation plan</li> <li>7. Implement a staff awareness and training program</li> <li>8. Annual review</li> </ol>
5.	<p>List steps involved in 'detailed energy audit'. (EA)</p> <p>Pre-audit phase:</p> <ul style="list-style-type: none"> <li>• Plan and organise</li> <li>• Walk through audit</li> <li>• Informal interview with plant personnel</li> </ul> <p>Audit phase:</p> <ul style="list-style-type: none"> <li>• Primary data collection</li> <li>• Conduct survey and monitoring</li> <li>• Conduct detailed trials and experiments</li> <li>• Analysis of energy use</li> <li>• Identification and development of energy conservation opportunities</li> <li>• Cost benefit analysis</li> <li>• Report preparation and presentation to the plant personnel and management</li> </ul> <p>Post audit phase:</p> <p>Implementation and follow-ups</p>



3.	<p>Give a typical energy audit reporting format</p> <p>After successfully carried out energy audit energy manager/energy auditor should report to the top management for effective communication and implementation. A typical energy audit reporting contents and format are given below. The following format is applicable for most of the industries. However the format can be suitably modified for specific requirement applicable for a particular type of industry.</p> <ul style="list-style-type: none"> <li>• Acknowledgement</li> <li>• Executive summary - Energy audit options at a glance and recommendations</li> <li>• Introduction about the plant</li> <li>• Production process description</li> </ul>
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#### Question bank for Energy Managers & Energy Auditors

	<ul style="list-style-type: none"> <li>• Energy and utility system description <ul style="list-style-type: none"> <li>- List of utilities</li> <li>- Brief description of each utility</li> </ul> </li> <li>• Detailed process flow diagram and energy and material balance</li> <li>• Energy efficiency in utility and process systems</li> <li>• Energy conservation options and recommendations <ul style="list-style-type: none"> <li>- List of options in terms of no cost / low cost, medium cost, and high investment cost, annual energy and cost savings, and pay back</li> <li>- Implementation plan for energy saving measures / projects</li> </ul> </li> <li>• Annexures</li> </ul>
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