Subject Name: Electrical Energy Conservation and Audit (ELO-412)

UNIT-2 (Theory part)

Q.1 A)	
a)	**Define Energy conservation.**
Ans:	**Energy conservation:** Reduction in the amount of energy consumed in a process or system, or by an organization or society, through economy, elimination of waste, and rational use is referred as energy conservation. **OR** It is defined as reducing growth of energy consumption by avoiding unnecessary usages of energy by applying the energy conservation techniques**.** **OR** It's the process of reduction in the growth of electrical power utilization and to avoid unnecessary use of electrical power and to increase the efficiency of every machine and material by minimizing the losses.
b)	**List any two functions of MEDA.**
Ans:	**Functions of MEDA:** 1. To decide long term energy conservation policy's for Maharashtra state. 2. To coordinate with central government organization i.e NPC, MNRE etc for energy conservation policy's with state government. 3. To decide delivery mechanism for energy efficiency services. 4. To promote/implement energy conservation techniques at state level. 5. To prepare public awareness regarding with energy conservation in our society. 6. To decide penalty, incentive, subsidy for energy conservation at state level.

Question: List of energy conservation techniques in electrical motors.
Following are the list of energy conservation techniques in electrical motors:

1) Reduction in iron losses by using low loss silicon steel core material laminated to thinnerdimension.
2) Using bigger length dimension (longer cores) to increase the area of magnetic flux due towhich the flux density is lowered to reduce the eddy currents & hysteresis losses.
3) Lowering the air gap that leads to reduction of the reluctance of the magnetic circuit & hencelower magnetizing current to produce the same flux density.
4) Using low resistance copper bars in rotors instead of high resistance aluminum bars leadingto reduction in the copper losses in rotor.
5) Use very smooth surface finishing of stator/rotor (air gap) leading to low windage losses
6) Use high quality bearings to reduce the frictional losses.
7) Use smaller diameter fans to reduce fan load (as above measures lead to lower heatproduction in motors & hence reduced cooling requirements).
8) By minimizing idle & redundant running.
9) By matching motor rating as per required load.
10) By Phase balancing.
11) By improving power quality.
12) Operating motor in star mode at light load.
13) By rewinding in induction motor
14) By motor survey

Question: State advantage of Co-generation.
Ans:-State the advantages of cogeneration:

1) Co-generation can meet both power & heat requirements.
2) Less cost than conventional generation.
3) Higher system efficiency due to energy wastage is highly reduced.
4) Reduction in emission of pollutions due to reduced fuel consumption.
5) A much more efficient use of primary energy can be achieved than with a separate production of electricity & heat.
6) In this system, heat generated is by-product in electricity generating process.
7) Due to decentralization of electricity supply it avoids transmission losses & makes system more flexible.
8) Overall cost of product reduces.
9) Transmission and distribution losses reduces due to cogeneration plant is located in same premises.
10) It can maintain grid stability

Question: List the different types of tariff.
Ans: Various types of Tariff:-

1) Flat-demand Tariff

2) Simple-demand Tariff or Uniform Tariff

3) Flat-rate Tariff

4) Step-rate Tariff

5) Block-rate Tariff

6) Two-part Tariff

7) Maximum demand Tariff

8) Three-part Tariff

9) Power factor Tariff :- a) KVA maximum demand Tariff

b) Sliding Scale Tariff or Average P.F. Tariff

c) KW and KVAR Tariff

10) TOD (Time of Day) Tariff

11) TOU (Time of Usage) Tariff

State the difference between energy conservation and energy audit.

S.No	**energy conservation**	**Energy audit.**
1	It is reducing the growth of energyconsumption by avoiding unnecessary usage of energy	It is an inspection, survey & analysis of energy flows in building or system to reduce the amount of energy input to the system
2	Energy conservation techniques can be carried out by energy manager.	Energy audit procedure can be carried out by energy auditor.
3	Energy conservation procedure is carried out after energy auditing.	Energy audit procedure for the given plan is carried out initially.

Question: State the needs and benefits of star labelling.
Ans: Needs of star labelling:

- Star labelling is meanly required to recognize quality of product
- Star labelling is also required to determine life and efficiency of the product.
- Star labels identifies percentage of energy conservation products.

Benefits of star labelling :

Due to the star labelling quality of the product is maintained.

1. It standard reduces energy cost.
2. The standard protects consumer rights.
3. Due to the standard green hose emission and air pollution will be reduces.
4. Market efficiency and compilation will be improve.
5.

Question: Describe the following energy conservation techniques in lighting system : (i) replacing lamp source (ii) using light control gear.

Energy conservation techniques in lighting system :

(i) Replacing lamp source

While replacing the lamps by higher energy efficient ones we must ensure that the required color rendering (CRI) is maintained else it has an adverse effect on the quality & rate ofthe work output .Also the cost involved must also be considered.

Replacing Lamps as follows:

i) Replacing incandescent lamps (14 lumens/W) by Compact Fluorescent Lamps (CFL's) (70 to 90 lumens/W)

ii) Replacing conventional fluorescent lamp (50 lumens/W) by energy efficientfluorescent lamp (70 to 90 lumens/W)

iii) Replacement of Mercury/Sodium Vapour Lamp (around 50 to 75 lumens/W) byHalides Lamps.

iv) Replacing HPMV Lamps (50 lumens/W) by High pressure sodium Vapour Lamp (HPSV) (150 lumens/W).

v) Replacing filament lamps (10 to 15 W) on panels by LEDs (< 1 W).

vi) Using LED lights in place of all other lamps above as feasible (in terms of cost)

Energy conservation techniques in lighting system :

(ii) Using light control gear

1. Flexibility can be obtained in lighting system by using following light control systems. It also saves power by switching off and by reducing luminance.
2. Grouping of light points: Grouping of lighting system, which can be controlled manually or by timer control. In this two or more no, of light points can be controlled by one switch. Such types of controllers are used in corridor lighting, go-downs, street lighting.
3. **Ballast:** It is the electrical or electronic chock which is commonly used in fluorescent tube or mercury vapour lamp. The main function of ballast is by applying the high voltage or high frequency across to the gas tube the light is emitted through the gas tube.

	At the time of supply voltage variation the current flowing through the discharge tube ismaintained constant, so that light intensity on working plane will be maintained. **4. Ignitor :** The ignitors are often called as starter or starting electrode. Generally ignitors are used in metal halide lamps or sodium vapour lamp. To increase the temperature surrounding the innertube by current flowing initially after the temperature increases then full light will be emitted through these discharge tube. **5. Illumination level:** As per the IES the lux level for every working plane is decided so these factors also used for control the lumens level on working plane. **OR** **1.** Specific amount of current flow is required for lamp operation. Light controlled gears aredevices which control the flow of current through light source and keep it in limit. **2.** Light controlled gears can be also known as Ballast **3.** Use electronic ballast instead of electrical choke. **4.** Electronic ballast operates at high frequency. It has low losses so lamp efficiency increases.
d)	**State ABC analysis related to energy audit.**
Ans:	**ABC analysis related to energy audit.-** **(4 Marks)** ➢ ABC analysis provides a mechanism for identifying different categories of activities/stocks/items that will require different management and controls. ➢ "A class inventory" contains items that account for 70% of total value. ➢ "B class inventory" contains items that account for 20% of total value. ➢ "C class inventory" contains items that account for 10% of total value. ➢ ABC analysis is the material management technique which helps energy audit process toachieve the goal of energy audit. **ABC Analysis Helps in Energy Audit:** An energy audit is an inspection survey and an analysis of energy flows for energy conservation in a building. It may include a process or system to reduce the amount of

	energy input into the system without negatively affecting the output. In commercial and industrial real estate, The ABC analysis works in a manner as to get prime attention to the important items or the critical few and not have unnecessary attention to be spent on the not so important items. This prioritization of attention and focus is vital to keep the costs in check and under control in the supply chain system. To get the best results, it is important that the items having a lot of costs are given the due management attention. **OR** 1. It helps to identify atoms and cost involved 2. Reduce Energy losses. 3. Improves efficiency. 4. Maximize the saving 5. Optimize the expenses on energy required. 6. It helps to achieve maxium useful any three output.
a)	**Why energy conservation technique should be adopted in transformer even though its efficiency is mostly more than 90%.**
Ans:	**Reason for energy conservation techniques should be adopted in transformers even though its efficiency is 90% :** ➢ Transformer performance depends on its efficiency. Transformers used in real-time applications suffer from load as well as no load losses. Loss of efficiency reduces transformerperformance. Hence, customers should try different types of methods to improve the efficiency of the transformer. ➢ Since transformer is almost connected in circuit for 24hrs. Continuously so it is necessary toreduce the losses. ➢ By different techniques it is possible to improve the efficiency of the transformer more than90% as there are no mechanical losses. ➢ In the Transmission and distribution system almost 40% losses of total TDL losses are occurring in transformers it very huge capacity (8000 MW to 9000 MW) , so we have to minimize it by energy conservation techniques.

b)	**State the various commercial losses in transmission & distribution system. Also, state EC technique adopted for optimizing distribution system.**
Ans:	**Following are the commercial losses in Transmission and Distribution :** 1) Make unauthorized extension of loads. (Direct Hooking) 2) Errors in meter reading & recording (faulty meter). 3) By passing the meter. (unmetered supply & unmetered bills) 4) Improper testing & calibration of meters. 5) Stopping the meters by remote control. 6) Changing the sequence of thermal wiring. 7) Changing the C.T. ratio. 8) Intentional burning of meters. 9) Billing issues 10) Lower collection efficiency. OR 1) Power theft (Direct hooking) 2) Unmetered supply 3) Meter in accuracies 4) Meter discrepancies 5) Small unmetered loads 6) Billing issues 7) Lower collection efficiency **EC (Energy conservation) technique adopted for optimizing distribution system:** ➢ **These can be reduced by:** Installing submeters for a group of customers to detect pilferage,fixing responsibility (on personnel) of the amount power drawn and amount of supplied by the agency personnel, installing accurate meters properly tested, resorting to regular testing/calibration of meters, conducting surprise raids/checks on consumers premises to detect theft or pilferage. ➢ These remedies lead to proper evaluation of the energy produced, distributed and utilized.

	They will lead to avoidance of improper /unwarranted use of available energy which in turnreduces the energy requirements by some scale in turn leading to saving in energy sources. ➢ Appoint vigilance squad for to avoid the energy theft. ➢ Make the necessary energy audit time to time. ➢ Apply high penalty for meter tampering cases. ➢ Faulty meter should be replaced immediately. ➢ Better coordination is essential for to avoid lack administration. ➢ Billing issues such as bill not received, lower collection efficiency and wrong bill received issues should be cleared. ➢ Defected or dissimilar meters should be replaced.
c)	**Discuss how power factor tariff results in energy conservation.**
Ans:	**Power Factor Tariff :** In addition to basic tariff (Maximum Demand Tariff / KVA Maximum Demand Tariff / Load factor tariff) the tariff in which P.F. of industrial consumer is taken into consideration is known as Power-factor tariff. If the P.F. of consumer is less than P.F. declared by Supply Company (say below 0.9 lag) then penalty will be charged in energy bill. If the P.F. of consumer is more than P.F. declared by Supply Company (say above 0.95 lag.) then incentive will be given in energy bill. As usual consumer has to pay actual energy consumption charges. In the power factor tariff the datum power factor is fixed by supply company. If this power factor is improved by using APFC or IPFC by the consumers then incentive (reward) in the consumers energy bill is immediately provided. If the consumer Power factor is poor (less than datum power factor) then penalty is applied to the consumers. It means by maintain the power factor reactive power is controlled and it is one of the energy conservation techniques.

d) State difference between "walk through audit" and "detailed audit".

Ans:

S.No	Walk Through Audit	Detailed Audit
1	It is also called as the preliminary audit or screening audit or simple audit	It is also called as general audit or siteenergy audit.
2	It is simplest, quickest and least expensive way.	It is nothing but expansion of the simple audit or more time consuming.
3	There are two resources: i) Operation and maintenance staff collects the data. ii) Serving utility provides this information.	In this method collect the information of system operation, but in more detailed form as compared to simple audit.
4	Basic information of the energysystem in the premises is collect as well.	Auditor collects utility bills of an year to find out tariff structure, usage profile etc
5	Only main issues are covered in walk through procedure.	This type of audit focus all the most suitable energy conservation measures for the system.

Question: Give a short description about Availability Based Tariff (ABT).

Introduction of availability based tariff(ABT) and scheduled interchange charges for power was introduced in 2003 for interstate sale of power , have reduced voltage and frequency fluctuation

- It is a performance-based tariff system for the supply of electricity by generators owned and controlled by the central government.
- It is also a new system of scheduling and dispatch, which requires both generators and beneficiaries to commit to day - ahead schedule.
- It is a system of rewards and penalties seeking to enforce day ahead pre-committed schedules, though variations are permitted if notified one and a half hours in advance.
- The order emphasizes prompt payment of dues , non-payment of prescribed charges will be liable for appropriate action.

Question: Explain Time of Day (TOD) Tariff and how it is beneficial for the power system and consumers?

- In Time of the Day Tariff (TOD) structure incentives for power drawl during off-peak hours and disincentives for power drawl during peak hours are built in. Many electrical utilities like to have flat demand curve to achieve high plant efficiency.
- ToD tariff encourage user to draw more power during off-peak hours (say during 11pm to 5 am, night time) and less power during peak hours. Energy meter will record peak, off-peak and normal period consumption, separately.
- TOD tariff gives opportunity for the user to reduce their billing, as off peak hour tariff is quite low in comparison to peak hour tariff.
- This also helps the power system to minimize in line congestion, in turn higher line losses and peak load incident and utilities power procurement charges by reduced demand.

Other Questions from Unit-2

1. Design the Basic Principles Energy conservation planning
2. Analyze the Energy efficiency of system
3. Explain the process of energy conservation by Predictive and preventive control maintenance.
4. Describe Electric energy conservation in distribution system
5. Explain Electric Energy conservation in building heating and lighting
6. Develop the strategies to improve power factor
7. Demonstrate the Approach for Maximum Demand Control
8. Demonstrate the Selection and location of capacitors for power factor improvement
9. Demonstrate the Performance Assessment of Power Factor Capacitors.
10. Demonstrate Energy conservation through controls and Demonstrate How energy cost of electrical energy has helped to develop ‘ two-part’ Tariff?
11. Explain Time of Day (TOD) Tariff and how it is beneficial for the power system and consumers.
12. Examine the need of Energy efficient motors. 13.Demonstrate Electric energy conservation in transmission.
13. Demonstrate Energy Conservation in lighting system.
14. Analyze the Energy Conservation Opportunities
15. Analyse energy conservation through predictive control method.
16. Explain ECBC for energy conservation.
17. Discuss power factor tariff and Identify the factors affecting tariff
18. Discuss block meter rate tariff
19. Discuss the Cost benefits of PF improvement
20. State the advantages of PF improvement by capacitor addition
21. Discuss the need for Electrical Load Management
22. Identify the factors to be considered in case of energy efficient motor?
23. Explain Energy efficient motor
24. Define time off day tariff.
25. State the importance of Indian Energy Conservation Act regarding energy policies of industries.
26. Discuss the electricity rate tariff structure.

Explain the energy conservation in small scale and large scale industries.

27. Explain various forms of energy and Law of conservation of energy
28. State the equation of three part electricity tariff
29. State the Purpose of the EC act 2001
30. Define energy intensity
31. Define energy planning
32. Define energy management
33. Define energy policy
34. Define energy efficiency
35. State Important features of energy conservation act 2001