



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC-27001-2005 Certified)

Winter– 2016 Examinations

Subject Code: 17506

Model Answer

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Important suggestions to examiners:

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skills)
- 4) While assessing figures, examiner may give credit for principle components indicated in a figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case some questions credit may be given by judgment on part of examiner of relevant answer based on candidate understands.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q.1 A	Attempt any THREE of the following :	12 Marks
a)	State at least eight salient features of Energy Conservation Act-2003.	
Ans:	Salient features of Energy Conservation Act 2003: 1) The Central Government to prepare a National Electricity Policy in consultation with State Governments. 2) Thrust to complete the rural electrification and provide for management of rural distribution by panchayats, Co-operative Societies, non-Government organizations, franchisees etc. 3) Provisions for license free generation and distribution in the rural areas. 4) Generation being delicensed and captive generation being freely permitted. Hydro projects need clearance from the Central Electricity Authority. 5) Transmission utility at the central as well as state level to be government company with responsibility for planned and co-ordinated development of transmission network. 6) Provision for private licensees in transmission and entry in distribution through an independent network. 7) Open access in transmission from the outset. 8) Distribution licensees would be free to undertake generation and generating companies would be free to take up distribution businesses.	(Each Point : 1 Mark)



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OR

1. **Role of Government:** Central government shall prepare national electricity policy and tariff policy in consultation with state government. Central government shall notify a national policy for rural areas permitting stand alone systems based on renewable energy sources in consultation with state government.
2. **Rural electrification:** Concerned state and central government shall jointly take effort to provide supply of electricity to villages. No requirement of license if a person intends to generate and dis
3. **Generation:** Generation free from licensing captive generation is free from controls. Clearance of central electricity authority required for hydro projects. Generation from Nonconventional sources/captive generation to be promoted.
4. **Transmission:** There would be transmission utility at the centre and in the states to undertake planning and development of transmission system. Load dispatch to be in the hands of Government company / organization. Load dispatch centre / Transmission utility / Transmission Licensee not to trade in power. Open access to the transmission lines to be provided to distribution licenses, generating companies.
5. **Distribution:** Distribution to be licensed by state electricity regulatory commission. Retail tariff to be determined by the Regulatory commission. Metering made mandatory provision of suspension or revocation of license by Regulatory commission . Open access to distribution to be allowed by SERC in phases.
6. **Regulatory commission / Appe:** commission to be constituted within six months. Provision for Joint Commission by more than one state / UT. Appellate tribunal to hear appeals against orders of CECC/SERC and also to exercise general supervision and control over state and central commissions.
7. **Central Electricity Authority:** CEA to continue as the main technical advisor of Govt. of India / state Government with responsibility of overall planning. CEA to specify technical standards for electrical plants and electrical lines. CEA to specify safety standards.
8. New central law as compared with state Reform / Amendment laws: Provision of state Reform laws not inconsistent with provisions of the new central law will continue to apply in the state. state Government can defer implementation of the new Act by a maximum period of six months.

b) What are the various ways of light control techniques available in a facility

Ans: **Following are the various ways of light control techniques available in a facility:**

(Any Four step expected : 1 Mark each)

Step I: prepare Inventories lighting system elements roughly as given below.



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Device rating, population and use profile					
Sr no	Plant location	Lighting device and ballast type	Rating in watts: lamp and ballast	Population numbers	Operation hours per day

Lighting transformer/rating and population profile:				
Sr no	Plant location	Lighting transformer rating	Installed numbers	Meters installed: V, I, kW, kWh.

Step II:

Use lux meter to measure and note the light levels at different places of work at day time and night time with the lamps put on during measurements.

Step III:

Using portable load analyser, measure and note the V, I, pf, and power consumed at different input points as lighting transformers, DBs etc.

Step IV:

Compare measured lux values with standard required and classify locations as under lit and over lit.

Step V:

Collect and analyze failure rates of lamps, ballasts, and actual life expectancies from past data.

Step VI: (optional step for this question not expected)

Suggest improvement options based on above study as:

- Maximize sunlight use by transparent roofs and other means.
- Replacement of existing low efficacy fixtures with those with high ones without compromising the CRI, required lux etc.
- Interior re-coloring.]



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	<ul style="list-style-type: none">➤ Modify layout for optimization.➤ Form/Modify control groups for lights.➤ Use sensor operated fixtures.➤ Install control gears or regulators.➤ Replacement of Lamp➤ Using separate Transformer➤ Using light control gears.
c)	Describe the need of energy conservation in induction motor.
Ans:	<p>The need of energy conservation in induction motor. (Any for point expected: 1 mark each)</p> <ol style="list-style-type: none">1) Electric motors are a major part of the industrial arena (about 60% to 70%) and consume a huge amount of energy, 60 % of agriculture load, 40% of commercial load and 23 % of residential load.2) Cost of electricity is increasing.3) For maximum savings motors must work at higher efficiencies.4) Production costs cannot be reduced till the operating costs of machines used therein are reduced without sacrificing the quality.5) Most of the electricity produced and utilized to drive the electrical motors comes from the burning of precious fuels or using natural resources as coal, oil etc.6) Inefficient motors need large powers of which a major portion is lost.
d)	State at least eight positive features of energy efficient induction motor (I.M.) as compared to conventional induction motor.
Ans:	<p>Positive features of energy efficient induction motor (I.M.) as compared to conventional induction motor:</p> <p style="text-align: right;">(Any Eight point expected: 1/2 Mark each)</p> <ol style="list-style-type: none">1. Material used is of high quality. (High flux density & High current density)2. Due to high quality material laminations used are thin hence core size will be less so that losses will be less.3. Due to precise air gap between stator and rotor power factor will be improved.4. The starting and running torque is more.5. The noise & vibration level is less.6. Less (negligible) maintenance.



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	<p>7. Operating temperature is more without any problem.</p> <p>8. Starter core length is more than conventional motor.</p> <p>9. Due to super quality ball bearings friction & winding losses will be less.</p> <p>10. These motor are used only for continuous rating operation.</p>
Q.1 B)	Attempt any ONE of the following: 06 Marks
a)	Describe the following energy conservation methods of electrical motor : (i) Matching motor rating with required load. (ii) Improving power quality.
Ans:	<p>Following energy conservation methods of electrical motor:</p> <p>(i) Matching motor rating with required load: (3 Marks)</p> <ul style="list-style-type: none">➤ The point worth to be noted in this power drawn by motor depends on load not necessarily with size.➤ A 10 kW fan drawn by 10 kW motor can be said a well matched. The same fan can also be drawn by 20 kW motor which will work but not with desired efficiency. E.g. Over sizing leads to lower efficiency, lower power factor and higher initial cost of motor.➤ The motor is preferred to be selected on highest anticipated load.➤ The every motor is designed to perform any other electrical load or mechanical load and it is coupled together.➤ The total capacity of these loads on the motor & the output rating of motor if is same then this motor is called as a best matching motor because these motor always works at maximum efficiency. <p>(ii) Improving power quality : (3 Mark)</p> <ul style="list-style-type: none">1) Voltage2) Frequency3) Closeness of the supply to sine waveform, which also is a means for knowing the harmonic content of the supply. <p>1) Voltage: Maintaining the voltage at the rated value for motors results in the properly expected torque speed characteristics available to drive the load. Lower voltage leads to excessive current drawn due to which the line losses increase, machine copper losses</p>



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	<p>increase, line voltage drops increase. Even if voltage is above required value higher flux density results in motors that leads to higher iron losses. These lead to decrease in efficiency. Hence proper voltage has to be maintained.</p> <p>2) Frequency: It governs the speed related losses and iron losses. If its value is more than rated these losses increase as speed is directly proportional to the frequency the speed dependent friction & windage losses increase that will decrease the efficiency. Lower value of frequency leads to lower speed that affects the output power. Hence frequency has to be maintained at rated value.</p> <p>3) When the supply waveform is purely sinusoidal the harmonics are absent which means no iron & copper losses due to harmonic voltage & currents. Also the harmonics even if very small lead to production of unwanted harmonic torques in motors which need to be overcome & this requires energy which is wasteful. Hence the supply voltage must be as near as possible to sine wave in case of AC motors.</p>
b)	<p>An Industrial plant has an incandescent lighting load of comprising 100 Nos. of 60 W and 140 Nos. of 100 W. Calculate the energy savings and simple payback period if each incandescent load is replaced by 1 x 40 W florescent lighting load. Lighting is required for 4000 hours/year and cost of electricity is Rs. 6.00 per kWh. Replacement cost is Rs. 150 per unit. Consider ballast consumption as 15 watt.</p> <p>Given Data : 100 W incandescent lamp = 2200 lumens, 60 W incandescent lamp = 1320 lumens, 40 W florescent lamp = 2400 lumens</p>
Ans:	<p>Given Data : 100 W incandescent lamp = 2200 lumens, 60 W incandescent lamp = 1320 lumens, 40 W florescent lamp = 2400 lumens</p> <p>For Old System:</p> <p>$60 \text{ watt} \times 100 \text{ Nos} = 6000 \text{ watt}$ $100 \text{ watt} \times 140 \text{ Nos} = 14000 \text{ watt}$ $Total \text{ wattage} = 20000 \text{ watt} \cong 20 \text{ kW}$</p> <p>$Total \text{ cost} = 20 \text{ kW} \times 4000 \text{ hrs} \times Rs. 6 \text{ per unit}$</p> <p>$Total \text{ cost} = Rs. 4,80,000/-$ ----- (1 Mark)</p>



Lumens required for industrial = $2200 \times 140 = 3,08,000$ lumens

Lumens required for industrial = $1320 \times 100 = 1,32,000$ lumens

Total Lumens required for industrial = $3,08,000 + 1,32,000 = 4,40,000$ -- (1/2 Mark)

For New System:

No. flurosent lamps = $\frac{\text{Total lumens}}{\text{Lumens output by one lamp}}$ ----- (1 Mark)

No. flurosent lamps = $\frac{4,40,000}{2400}$

No. flurosent lamps = $183.33 \text{ Nos} \cong 184 \text{ nos}$ ----- (1/2 Mark)

flurosent lamps wattage = $40 + 15 \text{ watt} = 55 \text{ Watt} = 0.055 \text{ kW}$

Total Energy cost for new system = $0.055 \text{ kW} \times 184 \text{ Nos} \times 4000 \text{ hrs} \times \text{Rs. } 6/-$

Total Energy cost for new system = $\text{Rs. } 2,42,880/-$ ----- (1/2 Mark)

$\therefore \text{Annual Saving} = \text{Rs. } 4,80,000 - \text{Rs. } 2,42,880 = \text{Rs. } 2,37,120/-$ ----- (1/2 Mark)

Replacement cost (first cost) = $150 \times 184 = \text{Rs. } 27600/-$ ----- (1/2 Mark)

Pay back period = $\frac{\text{First cost (Re placement cost)}}{\text{Annual Saving}}$ ----- (1 Mark)

Pay back period = $\frac{\text{Rs. } 27600}{\text{Rs. } 2,37,120}$

Pay back period = $0.116 \text{ Year} \cong 1.39 \text{ Month}$

Pay back period = 1.4 Month ----- (1/2 Mark)



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Q.2	Attempt any FOUR of the following :	16 Marks
a)	Describe how the lighting performance is assessed from installed load efficacy ratio ILER in existing lighting installation.	
Ans:	Lighting performance is assessed from installed load efficacy ratio ILER in existing lighting installation: (Any Four point expected: 1 Mark each) <ol style="list-style-type: none">1. Measure the floor area of given working plane in m²2. Find out the RI (Room Index): more than 9 measuring points are required, for RI 1 to 2- 16 measuring points are required, 2 to 3- 25 measuring points are required, More than 3- 36 measuring points are required3. Find out the circuit wattage.4. Find out the total circuit wattage per floor area in watt/m².5. Measure the illumination level by lux meter & find out average illumination as per the room index6. Find out the average illumination per circuit watt per floor area $E_{av}/W/m^2$7. Get the target lux as per application as per illumination engineering society & CIBSE (charted institute of building services engg.)8. Find out the ILER (Installed load efficiency ratio) $ILER = \frac{Actual \text{ lux } / W / m^2}{Target \text{ lux } / W / m^2}$9. If the ILER is more than 0.75 then lighting system is very good.10. If the ILER is between the 0.5 to 0.75 then quality of lighting is medium.11. If it is less than 0.5 then lighting system is very poor & immediate action is to be taken.	
b)	What should be the criteria for selecting energy efficient lamps replacement options ? State the energy efficient lamps for Domestic Installation.	
Ans:	criteria for selecting energy efficient lamps replacement options: (4 Mark) <ol style="list-style-type: none">i) While replacing the lamps by higher energy efficient ones we must ensure that the required color rendering (CRI) is maintained otherwise it has an adverse effect on the quality & rate of the work output .Also the cost involved must also be considered.ii)The glare to the human eyes should be less by any lighting method	



	<p>iii) By proper selection of lighting method the surrounding condition should be pleasant to Every body.</p> <p>iv) By any lighting method the electrical and mechanical accidents should be less.</p> <p>Following are the energy efficient lamps for Domestic Installation for replacing Lamps as follows:</p> <p>i) Replacing incandescent lamps (14 lumens/W) by Compact Fluorescent Lamps (CFL's) (70 to 90 lumens/W)</p> <p>ii) Replacing conventional fluorescent lamp (50 lumens/W) by energy efficient fluorescent lamp (70 to 90 lumens/W)</p> <p>iii) Replacing filament lamps (10 to 15 W) on panels by LEDs (< 1 W).</p> <p>Using LED lights in place of all other lamps above as feasible (in terms of cost)</p>
c)	State the advantages of Installing High frequency electronic ballasts in place of conventional ballasts for florescent lamp.
Ans:	advantages of Installing High frequency electronic ballasts in place of conventional ballasts for florescent lamp: (4 Mark) <ol style="list-style-type: none">1. Instant light2. Lighter in weight3. power saving is up to 35%4. Heat output is negligible, that reduces load on air conditioning.5. Improved power factor6. Operates at low voltage7. Enhances life of lamp
d)	A 50 kW induction motor with 84% full load efficiency is being considered for replacement by an 89% efficiency motor. What will be the saving in energy if motor works for 5000 hrs per year and cost of energy is Rs. 5/- per kWh ?
Ans:	Given data: <p>Motor output : 50 KW, full load efficiency : 84%, No. of Hrs = 5000 Hrs</p> <p>Cost of energy : Rs. 5/ KWh</p>



	<p>Case I : full load efficiency : 84%,</p> $\text{Power drawn by motor} = \frac{KW}{\text{efficiency}}$ $\text{Power drawn by motor} = \frac{50}{0.84}$ $\text{Power drawn by motor} = 59.52 \text{ KW} \text{ ----- (1/2 Mark)}$ <p>Cost of energy consumed = power drawn by motor x working hours x cost per unit</p> $\text{Cost of energy consumed} = 59.52 \times 5000 \times 5$ $\text{Cost of energy consumed} = \text{Rs. } 14,88,095/- \text{ ----- (1/2 Mark)}$ <p>Case II : full load efficiency : 89%,</p> $\text{Power drawn by motor} = \frac{KW}{\text{efficiency}}$ $\text{Power drawn by motor} = \frac{50}{0.89}$ $\text{Power drawn by motor} = 56.1797 \text{ KW} \text{ ----- (1 Mark)}$ <p>Cost of energy consumed = power drawn by motor x working hours x cost per unit</p> $\text{Cost of energy consumed} = 56.1797 \times 5000 \times 5$ $\text{Cost of energy consumed} = \text{Rs. } 14,04,494 - \text{ ----- (1 Mark)}$ <p>Saving in energy per year = Case I - Case II</p> $\text{Saving in energy per year} = \text{Rs. } 14,88,095 - \text{Rs. } 14,04,494$ $\text{Saving in energy per year} = \text{Rs. } 83600.61/- \text{ ----- (1 Mark)}$
e)	<p>Describe the use of Epoxy Resin cast/Encapsulated Dry type transformer from energy conservation point of view</p>
Ans:	<p>Epoxy Resin cast/Encapsulated Dry type transformer from energy conservation point of view: (Any four point expected: 1 Mark each)</p> <ol style="list-style-type: none">1. Core used is of CRGO M4-M3 circular size therefore minimum leakage reactance and hence core losses will be less.2. Winding consist of flexible rope of copper instead of rectangular strips or rod. Therefore current carry capacity is more and better cooling effect.3. Insulation consists of high quality epoxy resin which is capable to withstanding high temperature and also provides minimum clearance as per voltage requirement.



	<ol style="list-style-type: none">4. As the transformer is fully encapsulated, routine maintenances is less.5. As cooling oil is absent the total weight of transformer is less.6. Due to less weight loading & unloading of the transformer is easy.7. In the absence of oil there is no need of testing the dielectric strength of oil or no filtration of oil.
f)	State the various measures for minimizing of non-technical or commercial losses in T & D system.
Ans:	<p>Following are the various measures for minimizing of non-technical or commercial losses in T & D system.: (Any four commercial losses expected: 1 Mark each)</p> <ol style="list-style-type: none">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. <p style="text-align: center;">OR</p> <p>Power losses in T&D system can be classified as Technical losses and Commercial losses. Quantifying and assessing the performance of T&D system is very difficult mainly due to combination of factors listed as below,</p> <p>Technical losses :-</p> <ol style="list-style-type: none">1. Transformer losses2. Transmission line losses3. Inter-link losses4. Distribution losses <p>Commercial Losses :-</p> <ol style="list-style-type: none">1. Metering2. Inefficient management3. Improper/ maintenance



Q.3	Attempt any FOUR of the following :	16 Marks
a)	How energy efficiency improvement is achieved in energy efficiency motor for following? Power loss area : (i) Iron loss (ii) Stator and Rotor Cu loss	
Ans:	<p>(i) Iron loss: (2 Mark)</p> <ul style="list-style-type: none">➤ Iron losses are found in the stator and rotor magnetic steel and are due to hysteresis effect and eddy current effect during 50Hz magnetization of the core material.➤ The hysteresis losses which are a function flux density are be reduced by utilizing low loss grade of silicon steel laminations➤ The reduction of flux density is achieved by suitable increase in core length of stator and rotor.➤ Eddy current losses are generated by circulating current within the core steel laminations.➤ Core losses are reduced by using thinner laminations. <p>(ii) Stator and Rotor Cu loss: (2 Mark)</p> <ul style="list-style-type: none">➤ Stator and rotor copper losses are measure losses and typically account for 55 % to 60%. Of the total losses.➤ Copper losses are heating losses resulting from current passing through stator and rotor conductors.➤ Copper losses are the function of conductor resistance and the square of current.➤ Resistance of conductor is a function of conductor material, length and cross sectional area. The suitable selection of copper conductor size will reduce the resistance.➤ Reducing the motor current is most readily accomplished by decreasing the magnetizing component of current.➤ Rotor copper losses are a function of the rotor conductors and the rotor slip. Utilization of copper conductors will reduce the winding resistance.➤ Motor operation closer to synchronous speed will also reduce rotor copper losses.	



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b)	State the factors governing the selection of Induction motor.
Ans:	<p>Following are the factors governing the selection of Induction motor:</p> <p style="text-align: right;">(Any Four factor are expected: 1 Mark each)</p> <ol style="list-style-type: none">1) Load torque required at normal speed matches with available torque of motor.2) Break down torque or pull out torque or maximum torque must match with the maximum torque requirement by load.3) Starting torque of motor must be more than that needed by load.4) The duty or load cycle of the motor determines the motor's thermal loading, hence it should be such that sufficient time is available for cooling between the cycles.5) The torque speed characteristics available from the motor must match the requirements of the load.6) The environment/atmosphere in which the motor is to be installed govern the motor operating characteristics required. Eg. Corrosive atmospheres, dusty atmospheres, high temperature spaces need properly chosen motors for drives.7) Cost of the motor plays an important role if a range is available.8) Easily procurable, quick and easily serviceable motors are normally preferred. Standard motors are normally preferred.9) Normally while selecting motors its performance is verified from the test certificate.10) The power factor (reactive power drawn) and performance between 70% load to 100% load are considered. A motor having good characteristics in this regards will be always be preferred.11) If selecting an energy efficient motor the cost benefit analysis over the long run must be worked out.
c)	State at least eight energy conservation opportunities in Transformer.
Ans:	<p>Following are the energy conservation opportunities in Transformer:</p> <p style="text-align: right;">(4 Mark)</p> <ol style="list-style-type: none">1. Using energy efficient transformer.2. Use amorphous core containing ferromagnetic elements like iron, cobalt alloy. This material has high resistivity than silicon steel. Due to this low core losses so less energy wasted.3. Use encapsulated dry type transformer.4. Use tapped transformer, usually auto wound for saving in copper.5. Use better quality low resistance copper conductors to reduce copper losses.6. Maintain operating voltage, form factor and frequency at the rated values (power quality) so that losses are minimized.7. Use better quality insulation materials to improve overload capacity.8. By keeping the proper maintenance of transformer.



d)	Describe the importance of amorphous core transformers from the energy conservation point of view.
Ans:	<p>Importance of amorphous core transformers from the energy conservation point of view: (4 Mark)</p> <p>Major energy losses in distribution transformers are the iron losses (hysteresis + eddy current) that occur continuously in the core while maintaining the operating flux throughout the day. These core losses in the conventional transformer whose core is made of silicon alloyed grain oriented iron laminations occur constantly during the time when the transformer is working for all loads: no load included. Amorphous cores are made of metallic glass (iron alloy) alloy that have these losses lower by about 70 %.</p> <ol style="list-style-type: none">1. Due to lower iron losses the loss at all loads is reduced resulting in Each point significant improvement in the efficiency which may increase upto 98.5 % even at low loads.2. This material has high electrical resistivity. This is 2-3 times higher than that of silicon steel. This is partially responsible for low core (eddy current) losses.3. Amorphous steel has lower hysteresis losses. So, this means that less energy wasted in magnetizing & demagnetizing during each cycle of supply current.4. The all day efficiency of the transformers is increased that results in huge energy savings.5. As losses get reduced cooling problems are reduced and heat related problems are reduced.
e)	What are the reasons for high technical losses in transmission and distribution system ?
Ans:	<p>Following are the reasons for high technical losses in transmission and distribution system: (Any Four point expected: 1 Mark each)</p> <ol style="list-style-type: none">1) A loss due to insufficient investment on transmission & distribution system.2) Losses due to random growth of sub transmission & distribution system: planned growth/expansion maintains the losses to optimum values as the any 4 system conductors and other components are judiciously selected.3) Losses due to large scale rural electrification through long 11KV & LT lines unbalanced loading.



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	<p>4) Losses due to many stages of transformation. (Large no. of transformers).</p> <p>5) Losses due to improper load management such as unbalanced loading, excessive overloads for large time periods.</p> <p>6) Losses due to unsatisfactory reactive power compensation.</p> <p>7) Losses due to poor quality of equipment used.</p> <p style="text-align: center;">OR</p> <p>1) Low power factor: for a certain real power load low pf leads to increase in the current in the different conducting sections.</p> <p>As $I = P/(V \times \text{pf})$.</p> <p>This increased current leads to higher copper losses in the connected system conductors. Hence losses increase with fall in power factor.</p> <p>2) Low transmission voltage: Motoring devices supplied with lower voltage draw excess current to handle the load as $I = (o/p)/[\eta V \text{ pf}]$. This excess current leads to increased copper losses in the supply lines & machine windings that lead to decrease in efficiency.</p> <p>3) Transmission line voltage imbalance: due to this the currents in the different phases will be unequal that will lead to higher currents in the neutral and hence increased losses especially in the motor loads. A 5% imbalance causes 40 % increase in motor losses. Also the negative phase sequence currents will be active and create extra losses.</p>
Q.4 (A)	Attempt any THREE of the following : 12 Marks
a)	Define the following terms related to Tariff : (i) Billing Demand (ii) Contract Demand (iii) Sanctioned Load (iv) Maximum Demand
Ans:	<p>(i) Billing Demand : (Each definition : 1 Mark)</p> <p>The electric utility uses demand meters that measure flowing electricity as the board in the above example measures flowing water. Demand meters register the highest rate of electrical flow (or current) during a billing period. It's actually a little more complicated than that, because the meter records an average flow for every 15 minute interval. The customer is billed for the highest average 15 minute flow during the billing period.</p> <p style="text-align: center;">OR</p> <p>The demand on which the actual Billing is done which is recorded in the billing</p>



	<p>period i.e. one month.</p> <p>(ii) Contract Demand :</p> <p>It is demand of power made by the consumer and mutually agreed through written documents between the consumer and the supply authority in KW or KVA</p> <p>(iii) Sanctioned Load :</p> <ul style="list-style-type: none">➤ It is the load which a consumer is going to use for his machinery, equipments etc and is mutually agreed between the consumer and supply agency.➤ It is also measured in KW or KVA <p>(iv) Maximum Demand :</p> <ul style="list-style-type: none">➤ It is the maximum power that the consumer may demand at any time➤ It is measured in KW or KVA using M.D. meter.
b)	Describe the application of Tariff system to reduce the energy bill.
Ans:	<p>Following application of Tariff system to reduce the energy bill:</p> <p style="text-align: right;">(Any four point expected: 1 Mark each)</p> <p>Rate of payment/ schedule of rates on which charges to be recovered from electricity consumer or Rate at which electrical energy is supplied to consumer is defined as Tariff.</p> <p>Following are some points from which energy bills can be reduced by proper tariff:-</p> <ol style="list-style-type: none">1. EC by improving Reducing Fixed /Demand charges :<ul style="list-style-type: none">➤ By reducing unnecessary load, optimization of power consumption by equipments, proper load distribution /scheduling.2. EC by improving Reducing Energy charges:<ul style="list-style-type: none">➤ Switching off unwanted load, shifting load to off-peak period, Using energy efficient lamps and apparatus.3. EC by improving Prompt payment of bills and taking advantages of incentive / discount.<ul style="list-style-type: none">➤ (Prompt payment discount of 1% on monthly energy bill excluding taxes & duties).➤ creating awareness of Self discipline among consumers for less energy consumption



4. EC by improving Power Factor Incentive:

- By improving p.f. and maintaining at > 0.95 , (incentive is 1% of amount of monthly bill including energy charges, ASC, FAC & fixed /demand charges but excluding taxes & duty for every 1% improvement in p.f. above 0.95)

5. EC by improving Load Factor Incentive:

- load factor above 75% up to 85% will be entitled to a rebate of 0.75% on energy charges for every percentage point increase in load factor from 75% to 85%
- Consumers having a load factor above 85% will be entitled to a rebate of 1%
- Consumers will be entitled to a total rebate of 15% .
- Generate load curve which helps to observe energy use trend (Monitor power consumption and max. demand)
- Rescheduling of loads, storage of products, shedding of non-essential loads.

6. EC by Avoiding penalty for exceeding contract demand:

- In case a high tension consumer exceeds his contract demand he will be billed at the appropriate demand charges for demand actually recorded and will be charged at the rate of 150% of the prevailing demand charges for the excess demand over the contract demand
- Re calculate and estimate existing connected load and assuming proper DF, decide max. demand.

7. EC by improving Reactive power compensation:

- Some utilities charge for reactive power consumption.
- By providing capacitor bank and maintaining optimum p.f.(also reduces max. demand)

OR

1. Energy Bill is decided by following points also :

- Load factor of the consumer
- Maximum demand of the consumer
- Power factor of the consumer.
- TOD tariff system

2. Time of use metering:-

- In this method the day, month & year are divided into tariff slots.
- Then apply higher tariff rates at peak load periods & low tariff rates at off peak load periods.



	<ul style="list-style-type: none">➤ Therefore automatic control on use of energy is done by customer.➤ It is customer's responsibility to control his own use & pay accordingly. <p>3. Domestic use meter:-</p> <ul style="list-style-type: none">➤ Domestic variable rate meters normally gives peak & off peak tariffs.➤ In such installation a simple electromechanical time switch may be used. <p>4. Getting benefit by improving energy efficiency:-</p> <ul style="list-style-type: none">➤ Power factor incentives can be taken by installing power factor correcting devices at Consumer level.➤ Give discount on the monthly energy bill is available to all consumer categories if bill are➤ Paid within seven days from issue of the bill.
c)	What are the various costs which have to be taken into account in fixation of Tariff ?
Ans:	<p>Following are the various costs which have to be taken into account in fixation of Tariff:</p> <p style="text-align: right;">(Any eight point expected : 1/2 Mark each point)</p> <ul style="list-style-type: none">2. Fuel Cost3. Maintenance cost4. Operation cost5. Other tax citation6. Depreciation cost7. Return of investment8. Profit9. Other duties <p>The following terms are always required to decide & implement the tariff</p> <ul style="list-style-type: none">10. Unit consumed by consumer.11. Total connected load of every consumer12. Fixed charges13. Electricity charges & tax14. Tariff structure15. Service tax etc.16. This above charges are also converted into fixed demand charges, running charges and semi fixed charges to decide the tariff.



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d)	State the factors governing the selection of cogeneration system.
Ans:	<p>Following factors governing the selection of cogeneration system -</p> <p style="text-align: right;">(Any four point expected: 1 Mark each)</p> <ol style="list-style-type: none">1) Base electrical load matching: - The co-generation system is designed to each any 5 meet the minimum electricity demand. The remaining power required is purchased from the utility grid.2) Base thermal load matching: - The co-generation system is designed to supply the minimum thermal energy requirement. Stand by boilers/ burners Other valid are used if the demand for heat is higher.3) Electrical load matching:- This is stand alone system. The co- eneration considered system is designed such that total electricity required is enerated. Therefore this co-generation system is totally independent of the electricity utility grid. Sometimes if energy demand is higher, auxiliary boilers are used.4) Thermal load matching:- The co-generation system is designed such that the total heat energy require is generated. If required energy demand is higher electricity purchased from grid.5) Availability of fuel: cheap and easy availability of fuel helps to achieve good co-generation.6) Space requirements: the site if very limited in space does not support cogeneration whereas ample space helps in installing the co-generation system.7) Initial and operating costs: lower values encourage the installation of cogeneration systems.8) Use thinner lamination in transformer core to reduce iron losses. Adequate Periodic maintenance of transformer.
Q.4 (B)	Attempt any ONE of the following : 06 Marks
a)	Describe the following energy conservation techniques in Transmission and Distribution system : (i) Compensating Reactive power flow (ii) Balancing Phase currents
Ans:	<p>(i) Compensating Reactive power flow: (3 Mark)</p> <ul style="list-style-type: none">➤ The reactive power drawn through lines due to heavy reactive loads or conditions leads to increase in the kVA [as $kVA = \sqrt{(kW^2 + kVAR^2)}$]. Higher kVA means higher current in lines.➤ This current leads to higher line heating losses (I^2R) and hence drop in line efficiency and heavy line voltage drops. If this reactive power is compensated near the load ends such that the kVAR in line reduces leading to drop in kVA demand the current gets



	<p>reduced thus decreasing the line losses and lowering the line voltage drops.</p> <ul style="list-style-type: none">➤ The compensation also helps to supply higher loads as per the system capacity.➤ There are reactive power compensating devices as capacitor banks and static VAR compensators that are used to carry out the compensation.➤ Both lagging and leading reactive powers are compensated. Thus the energy is saved / conserved. <p>(ii) Balancing Phase currents: (3 Mark)</p> <ul style="list-style-type: none">➤ Proper (healthy balanced) three phase loads always draw equal currents in all lines but single phase loads in the 3 phase 4 wire system or loads connected between two phase lines lead to unequal currents in the lines. This leads to circulating currents in transformers/ neutral conductors due to which losses increase. Hence balancing of such feeder currents is needed to reduce the feeder copper losses.➤ As a result of unequal loads on individual lines, sequence components in them cause overheating of transformers, cables, conductors, motors. These increase losses and resulting in motor malfunctioning under unbalanced voltage conditions.➤ Due to unequal loading on the single phase lines of a 3 phase, 4 wire supply system the voltage drops in lines are different that create unequal (non-rated) phase and line voltages at the load leading to unhealthy effects on the loads. Large ovens/furnaces of the single phase and two phase types are such loads. Hence it becomes necessary to equate/balance the three phase/line currents at the supply terminals.➤ For furnaces the Scott connection transformers are employed to derive the two phase supply from the three phases which transforms the two phase load equally over the three phases.➤ Unequal loading is also created due to unequal lengths of feeders of the three phases. Hence it is necessary to obtain current balance to the maximum.
b)	<p>Describe the energy conservation by improving load factor and power factor in industry. What incentives are given to industrial consumers for the improvement of load factor and power factor?</p>
Ans:	<p>The energy conservation by improving power factor in industry: (3 Mark)</p> <p>For higher Power factor: (highest unity)</p> <ol style="list-style-type: none">1) The KVA rating of equipment's is reduced making equipment smaller and less costly.2) Conductors carry less current, so no need of large conductor (savings created)



- 3) Less I^2R losses, higher efficiency of system.
- 4) Less voltage drop in alternator, transformer, and transmission lines hence better voltage regulation.
- 5) This improves power handling capacity & efficiency of the system.
From above points at high power factor conserve the energy.

The energy conservation by improving load factor in industry:

If Load factor is higher (highest unity):

- 1) System capacity is properly utilized.
- 2) This increases production efficiency as even consumption over large time span.
- 3) This distributes loads over different time lower rating supply system components.
- 4) Lower max demand means lower current and hence lower power losses which gives higher system efficiency.

From above points Maximum load factor means more number of units generated per year.

If better load factor lower the cost of electric service & conserve the energy.

Incentives is given to industrial consumers for the improvement of load factor and power factor: (3 Mark)

1. Power factor incentive:

1. It is given to consumers who have maximum demand based tariff and provided with meters to measure their power factor.
2. Whenever the average power factor is more than 0.95, an incentive at the rate of 1% of the amount of the monthly bill is given. It includes energy charges, Additional supply charges(ASC) , Fuel Adjustment cost (FAC) & fixed / demand charges .But excludes taxes and duties for energy 1% improvement in the power factor
3. For power factor of 0.99 – effective incentive 5%
4. For unity power factor - effective incentive 7%



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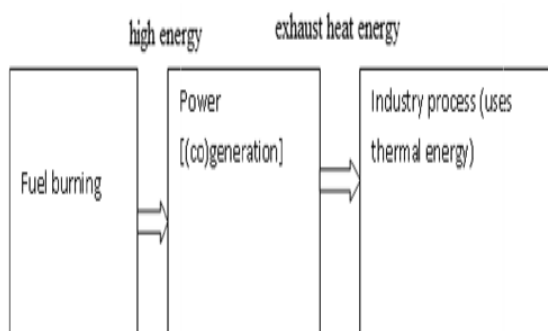
	<p>2. Load factor incentive:</p> <ol style="list-style-type: none">1. This incentive is applicable to the consumers where payment of arrears has been granted by the MSEDCL, & the same is being made as scheduled.2. Consumers having load factor above 75% up to 85%: rebate of 0.5% on the energy charges for every 1% increase in load factor.3. Consumers having load factor over 85% will be entitled to rebate of 1% on the energy charges for 1% increase in load factor from 85% <p>The total rebate under this head will be subject to a ceiling of 15% of the energy charges for that consumer.</p> <ol style="list-style-type: none">6. The load factor rebate is given only if the consumer has no arrears MSEDCL7. The payment is made within 7 days from the date of bill or within 5 days of the receipt of the bill whichever is later.8. In case the billing demand exceeds contract demand in any month, then the load incentive will not be payable in that month.9. The billing demand definition excludes the demand recorded during the non peak hours ie. 22 hrs to 6 hrs & so even if maximum demand exceeds the contract demand in that duration, load factor incentives would be available10. However, the consumer would be subjected to the penal charges for exceeding the contract demand & has to pay the applicable penal charges.
Q.5	Attempt any FOUR of the following : 16 Marks
a)	Describe the scenario of transmission and distribution losses at state level and national level.
Ans:	<p>Scenario of transmission and distribution losses at state level and national level: (Any four point expected: 1 Mark each)</p> <ol style="list-style-type: none">1) In our nation electrical generation for over all country electrical generation is 253200 MW up to June 2012.2) Out up this total electrical generation 68% is by thermal power station, 16 % is hydro power station, 8 % is gas power station, 4% is due to oil consumption, 2 % by nuclei power station and 2 % is non- conventional energy source (Solar, wind etc).3) In our country per capta energy conservation is 733 KWH per year but in USA it is 13647 KWH per year.



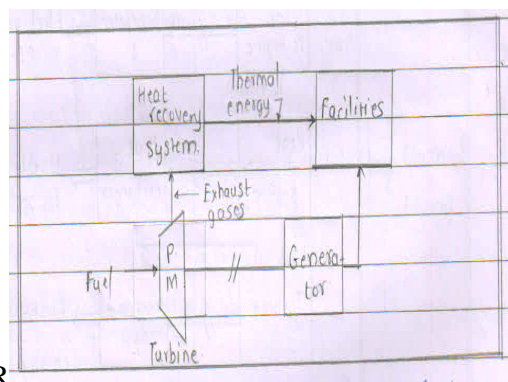
- 4) In our country due to globalization and industrialization electrical power demand is continuously increases.
- 5) In our country total T & D losses are 23 % out of total energy generation.
- 6) In the Delhi and Jammu & Kashmir state there maximum T & D losses it is near about 40 % to 50 % .
- 7) These T & D Losses are due to improper design of power system network, all types of electrical machines, poor quality of T & D lines etc.
- 8) By using the proper energy conservation techniques, these losses can be improved.

b) Describe with suitable example. The Topping cycle cogeneration system.

Ans: **Topping cycle cogeneration system:** (Figure :2 Mark & Explanation : 2 Mark)



OR



- The energy from fuel burnt is used to first produce power and then the thermal energy which is a by-product is used to supply process heat or fulfill other thermal requirements. Suitable where the processes of the industry need low heat (low temperatures).
- In Topping cycle co-generation system the fuel is burnt for electricity generation.
- At the time of fuel burning process the excess thermal energy present in the system is recovered by heat recovery system and it is utilized.
- The topping cycle co-generation system is popular method and it is widely used.
- As per block diagram the fuel is burnt for to run the prime mover which is directly coupled to the generator. So that in 1st stage electricity is generated and it is utilized in various facilities
- In next stage, the exhaust gases after the prime mover is carried out in heat recovery system by which excess thermal energy is recovered and being utilized by facilities.



c)	List any three Energy conservation equipments in T & D system. Describe the role of any one equipment in T & D system from the energy conservation point of view.
Ans:	List any three Energy conservation equipments in T & D system: (2 Mark) <ul style="list-style-type: none">➤ Maximum Demand controller➤ Automatic Power factor controller➤ Kilovar Control➤ Intelligent P.f. controller➤ Voltage stabilizer➤ Static VAR➤ Microprocessor based centralized control equipment 1) Maximum Demand controller: (Any one explanation expected: 2 Mark) <ul style="list-style-type: none">➤ High – Tension (HT) users have to pay a maximum demand charge in addition to the usual charge for the number of units consumed.➤ This charge is usually based on the highest amount of power used during some period during the metering month.➤ The maximum demand often represents a large proportion of the total bill and may be based on only one isolated 30 minutes episode of high power used.➤ Considerable saving can be realized by controlling power used and turning of f or reducing non- essential loads during such periods of high power use.➤ Maximum demand controller is a device design to meet the need of industries conscious of the value of load management.➤ Alarm is sounded when demand approaches a preset value. If corrective action is not taken a controller switches of non-essential load.➤ Demand control scheme is implemented using suitable control contactors. 2) Automatic Power factor control: <ul style="list-style-type: none">➤ The pf controller is used to maintain the pf at unity across the lines it is connected.➤ Maintaining the pf at unity leads to reduction in the current through the lines as real power = apparent power x pf. The apparent power decides the MD for which the



consumer is billed.

- For a certain motor the current in the lines will depend on its pf which is lagging. For higher pf near unity maintained at the motor terminals the line currents are minimized leading to lower MD and hence saving in MD charges.
- Also as the current is minimized line voltage drops and power losses are reduced leading to improvement in the motor power supply system efficiency. The pf controller does not efficiency.

3) Kilovar Control:

- KiloVar sensitive controls are used at locations where the voltage level is closely regulated and not available has a control variable.
- The capacitor can be switched to respond to a decreasing power factor as a result of change in system loading.
- This type of control can also be used to avoid penalty on low power factor by adding capacitors in steps as the system power factor begins to lag behind the desired value.
- Kilovar control requires two inputs, current and voltage from the incoming feeder which are fed the PF correction mechanism either the microprocessor or the relay
- Intelligent P.f. controller

4) Intelligent P.f. controller:

- This controller determines the rating of capacitance connected in each steps.
- During the first hour of its operation and stores them in memory.
- Based on this measurement, the IPFC switches on the most appropriate steps.
- Thus eliminating the hunting problems normally associated with capacitor switching.

5) Voltage stabilizers:

- Wherever, installation of separate transformer for lighting is not economically attractive servo stabilizer can be installed for the lighting feeders.
- This will provide stabilized voltage for the lighting equipment. The performance of chokes, ballasts, will also improve due to the stabilized voltage.
- This system also provides the option to optimize the voltage level fed to the lighting



	<p>feeder.</p> <ul style="list-style-type: none">➤ In many plants, during the non-peaking hours, the voltage levels are on the higher side. During this period, voltage can be optimized, without any significant drop in the illumination level.➤ High voltages lead to higher light output (un-necessary) consuming higher energy, hence stabilizers are used to control the voltage to such light sources <p>6) Static VAR:</p> <ul style="list-style-type: none">➤ For measurement and control of reactive power. <p>7) Microprocessor based centralized control equipment</p> <ul style="list-style-type: none">➤ In the microprocessor based centralized control equipment the voltage across the lighting devices and its lighting intensity is controlled by using computer.➤ Microprocessor and microcontroller based system the sensors gives signal in analog form to digital converter.➤ Due to this analog to digital converter all these analog signals are converted into digital form & they are provided to control unit of micro-processor.➤ These reference signals are compared with reference signals which are stored in RAM or EPROM.➤ After this voltage across the lighting device is controlled.
d)	<p>State the benefits of VFDs. How energy conservation is achieved by using VFDs ?</p>
Ans:	<p>Following are the benefits of variable frequency drive:</p> <p style="text-align: right;">(Any Four benefits expected: 1/2 Mark each)</p> <ol style="list-style-type: none">1) Energy saving.2) Better process control.3) Cost saving.4) Less maintenance cost.5) Large life for bearing & motors.6) Improved power quality.7) Smooth starting.8) Improved power factor9) Reduced M.D. Charges



	<p>Reason for energy conservation is achieved by using VFDs: (2 Mark)</p> <ol style="list-style-type: none">1) Energy saving due to optimum use for applications.2) Smooth starting. Can star avoided.3) Smooth speed control changing operations are avoided as smooth increasing (to 300%) or decrease (to 11%) of the rated speed is possible.4) Better process control, (with Micro controller and IGBT (Insulated Gate Bi-polar transistor) optimization of input variables to get required outputs5) Less maintenance cost due to optimum working.6) Higher life span with very low losses for bearing & motors due to which we have improved optimal output power quality.
e)	<p>What is energy conservation equipment? Explain any one energy conservation equipments in lighting system.</p>
Ans:	<p>Meaning of Energy Conservation Equipment: (2 Mark)</p> <p>In transmission and distribution system energy conservation is done by installing suitable equipments. These all equipments are called as energy conservation equipment.</p> <p>1. Following energy conservation equipments which can be implemented in lighting system: (Any one explanation expected : 2 Mark)</p> <ol style="list-style-type: none">1. Voltage stabilizers2. Dimmers3. Microprocessor based centralized control equipment4. Occupancy Sensor5. Servo-stabilizer6. Automatic Power factor control: <p>Explanation:</p> <p>1. Voltage stabilizers:</p> <p>Wherever, installation of separate transformer for lighting is not economically attractive servo stabilizer can be installed for the lighting feeders. This will provide stabilized voltage for the lighting equipment. The performance of chokes, ballasts, will also improve due to the stabilized voltage. This system also provides the option to optimize the voltage level fed to the lighting feeder. In many plants, during</p>



the non-peaking hours, the voltage levels are on the higher side. During this period, voltage can be optimized, without any significant drop in the illumination level. High voltages lead to higher light output (un-necessary) consuming higher energy, hence stabilizers are used to control the voltage to such light sources

2. Dimmers:

These are devices whose output voltage can be varied starting from a very low value to rated. When supplying to lighting loads these provide the required voltage level for optimum illumination thus avoiding excessive brightness and saving in the energy inputted to the light sources. These dimmers are available in rheostatic forms, auto-transformers & electronic regulator circuits (thyristor dimmers). The most energy efficient ones are the thyristor type.

3. Microprocessor based centralized control equipment

- In the microprocessor based centralized control equipment the voltage across the lighting devices and its lighting intensity is controlled by using computer.
- Microprocessor and microcontroller based system the sensors gives signal in analog form to digital converter.
- Due to this analog to digital converter all these analog signals are converted into digital form & they are provided to control unit of micro-processor.
- These reference signals are compared with reference signals which are stored in RAM or EPROM.
- After this voltage across the lighting device is controlled.

4. Servo-stabilizer:

- In this method the across the load is sensed by the output sensor and according to reference voltage set in the servo- stabilizer.
- The servo motor will be on and by servo mechanism the variable point register is changed.
- Due to these the buck and boost method is implemented.
- If the voltage is less than reference value then the specific voltage is boosted by servo mechanism and transformer and output voltage is regulated.



- If the input voltage is more than the reference value then this additional voltage is dropped in transformer winding and servo mechanism.

5. Automatic Power factor control:

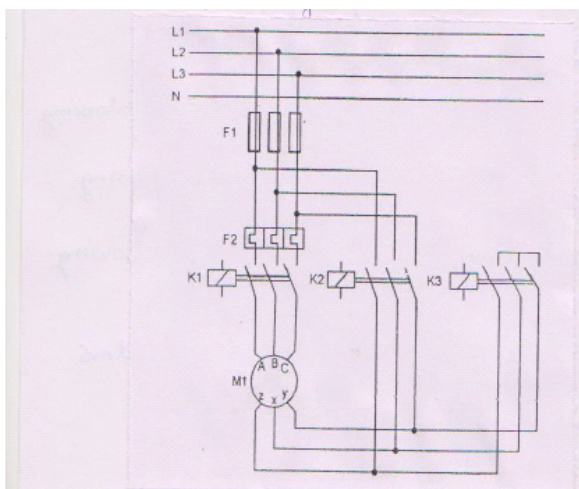
- The pf controller is used to maintain the pf at unity across the lines it is connected.
- Maintaining the pf at unity leads to reduction in the current through the lines as real power = apparent power x pf. The apparent power decides the MD for which the consumer is billed.
- For a certain motor the current in the lines will depend on its pf which is lagging. For higher pf near unity maintained at the motor terminals the line currents are minimized leading to lower MD and hence saving in MD charges.
- Also as the current is minimized line voltage drops and power losses are reduced leading to improvement in the motor power supply system efficiency. The pf controller does not efficiency.

f)

Describe with circuit diagram, the operation of automatic star delta starter from the energy conservation point of view.

Ans:

Circuit diagram of automatic star delta starter: (Figure: 2 Mark & Explanation: 2 Mark)



or equivalent figure

Explanation:

Motors having higher capacity (more than 10Hp) are provided with star delta windings. During initial startup motor is connected in star mode to reduce the initial inrush current. Once motor achieves the requires speed, it switches the delta mode after which motor can be loaded. Automatic star delta converter switches motor to star mode during less



than 40% load on motor and as load increases above 40% it switches motor to delta mode. When motor operates in star mode its current consumption drops by 1/3rd, thereby saving energy. The savings are about 10 to 40% depending on motor load and load variation

L1, L2, L3 – external conductor

N – Neutral conductor

F1 – Fuses

F2 – Thermal cutout

K1 – Main contactor

K2 – delta contactor

K3 – star contactor

M1 – three phase motor.

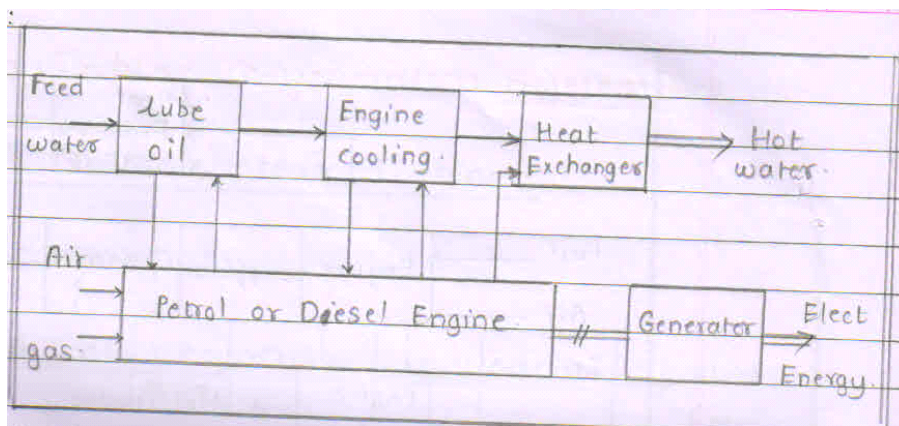
Q.6 Attempt any FOUR of the following : **16 Marks**

a) Describe with suitable diagram ; the reciprocating engine cogeneration system.

Ans: Reciprocating engine cogeneration system:

(Any one type expected: Figure: 2 Mark & Explanation: 2 Mark)

1) Spark Ignition Gas System:



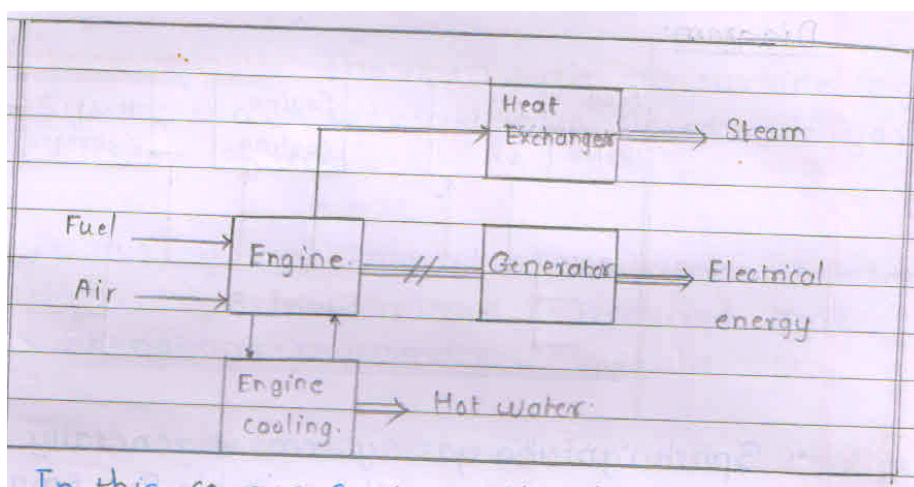
Explanation

- Spark ignition gas system is generally manufactured upto 4 MW. Generally for small capacity co-gen plant.
- In this system, Natural gas is provided & for burning of the gases the spark ignition method is applied.



- The spark ignition method is similar to petrol or diesel engine. This is used to extract low pressure steam.
- In this co-generation system the duel fuel mode is not available. Efficiency of the plant is almost 35%.

2) Compressed Ignition Co-gen System:



Explanation

- Compressed ignition engine is suitable for large capacity co-generation system upto 15 MW. Efficiency of this co-generation plant is almost 40%.
- In this co-gen system, the duel fuel mode can be used. The additional firing can be possible by excess air, for this co-generation system complex cooling system is implemented.
- The engine is directly coupled to the generator to get the electrical energy in 1st stage & in another stage the engine temperature is utilized for conversion of steam & hot water for further process applications

b) **List the circumstances under which cogeneration will become attractive and more meaningful?**

Ans: **Following are the list the circumstances to get the advantages under which cogeneration will become attractive and more meaningful :** (Any Four point expected: 1 Mark each)

- 1) Design and layout should be simple.



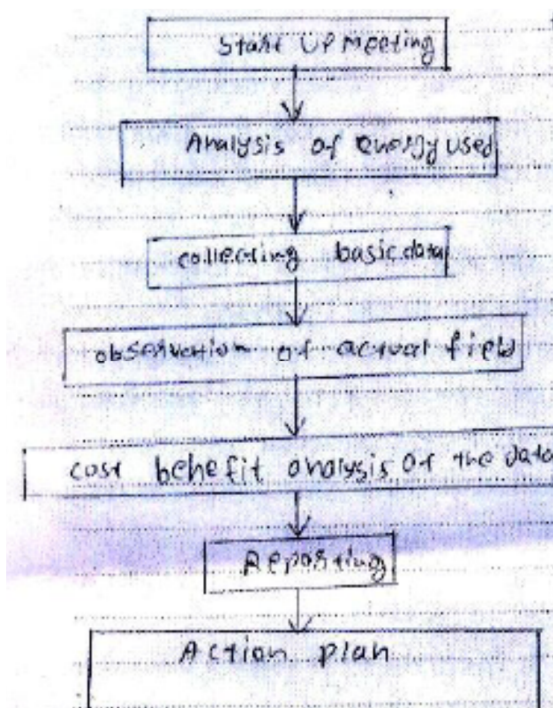
	<ol style="list-style-type: none">2) Cost should be less.3) Co-generation can meet both power & heat energy needs.4) A much more efficient use of primary energy can be achieved as compared to separate production of electricity and heat.5) Many times it is implemented in a very cost effective manner.6) Increases overall efficiency of system.7) Reduction in emission of pollutants due to reduced fuel consumption.8) Helps to maintain grid stability.9) In co-generation heat is by product of electricity generation process.10) Due to decentralization of electricity, it avoids transmission losses and makes system more flexible.
c)	What is ABC analysis? State its three advantages referred to Energy Audit projects.
Ans:	<p>Definition:- (2 Marks)</p> <ul style="list-style-type: none">➤ 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 to achieve the goal of energy audit. <p>Advantages referred to Energy Audit projects:</p> <p style="text-align: right;">(Any three advantages expected: 1 Mark each)</p> <ol style="list-style-type: none">1) The audit helps to identify items and the costs of energies involved there in.2) Schedule the different processes to achieve overall maximum useful Any three = output using the minimum inputs without losses of quality.3) Optimize the expenses on energy required.4) Maximize the savings.5) Reduce energy losses.6) improved efficiency.



d) Describe detailed Energy Audit procedure to be carried out for an organization.

Ans: Detailed energy audit procedure Depending:

(Figure : 2 Mark & explanation : 2 Mark)



A) **Start up meeting:** For this programmer, we proceed with this meeting. If then continue us until implementation of energy saving measures.

B) **Analysis of energy used:** Identify where energy used & it shows on which area should be concentrate.

C) **Collecting basic data:** At site load, some of the following important points:

1. Operating hours 2. Duty cycle 3. Actual power consume

D) **Observation of actual field:** After collecting data, we start actual field work. It means we have find out process where energy saving can be done. Always apply the 80 by 20 rule. It means concentrate on opportunities that require 20% input & gives 80% of the saving.

E) **Cost benefit analysis of the data:** The energy conservation opportunities analysis should be in terms of cost of carrying out that project v/s the benefit that can be earned.

F) **Reporting:** We have to submit the detail report. Then we have to take sanction of that report from final Authority.



G) **Action plan:** In this all the measure steps must be included in the action plan for the proper implementation.

OR

1. Collect information about the plan:

In this information, the measured energy used, raw material required & components required for the plant are considered.

2. Collect production process:

In this process, the design the flowchart of production process, the schedule of operation & its time frame is also considered.

3. Energy and utility system:

In this step, load variation in pumps, fans & compressors are considered, the analysis of energy loss and measurement of insulation level is also considered.

4. Bridge description of each utility:

In this step, the electricity the steam, water, cooling water an compressed air is to be considered.

5. Detailed process flow diagram:

In this step the flow chart, the flow rate & boiler efficiency is to be considered.

6. Energy efficiency in utility & process system:

In this step, consider the following things i) specific energy consumption ii) furnace iii) DG set performance analysis iv) lighting system.

7. Energy conservation option & recommendation:

The energy conservation & recommendation of better energy source is to be considered.

OR

(Any Four point expected: 1 Mark each)

1) Depending on the nature and complexity of the organization, a comprehensive audit can take from several weeks to several months to complete.

2) Detail studies to establish and investigate energy & materials balances for specific organization departments of process equipment are carried out.

3) Whenever possible checks of organization operations are carried out over extended periods



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	<p>of time at nights and at weekends.</p> <p>4) The audit report will include a description of energy inputs and product outputs by major departments & will evaluate the efficiency of each step of the manufacturing process.</p> <p>5) The improve this efficiency will be listed and at least a preliminary assessments of the cost of the improvement will be made to indicate the expected payback on any capital investment needed.</p> <p>6) The audit report should conclude with specific recommendations for detailed engineering studies & feasibility analysis which must be performed to justify the implementation of those conservation measures that require investments.</p>
e)	List the instruments used for conducting Energy Audit and state their use.
Ans:	<p>Following Instruments used for conducting Energy Audit and state their use:</p> <p style="text-align: center;">(Any Four instruments are expected: 1 Mark each)</p> <ol style="list-style-type: none">1) Flow meter: Measures the rate of flow of fluids such as flue gases etc.2) Thermometers: Measure the temperatures of enclosures, flue gases, fluids each any etc.3) Gas analyzer: Analyze gases such as flue gases, exhaust gases for their content of oxygen, carbon dioxide, carbon monoxide, nitrous oxides, sulphur dioxide etc. Students may list4) PH meter: measure the PH (acids and bases) value of solutions to give idea instruments of their corrosion, polluting capacity etc other than these for5) Voltmeters: DC and AC: used for measuring the voltages at different points which the in electric systems. Assessor has to make6) Ammeters (AC and DC): clip on and direct connection types. Measure the currents in different sections or branches of the electric system. intelligent evaluation7) Wattmeters: measure the electrical power.8) Trivector meters: measure multiple quantities as voltages, currents, kW, kVA, kVARh, TOD units, etc.9) Energy meters: measure the electric energy supplied to circuits continuously.10) Lux meters: measure the luminous intensity at required locations in lux.11) Meggers: Measures the insulation resistance of machines and electrical components.

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