COLLEGE OF ENGINEERING & TECHNOLOGY, SRMIST
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
Cycle Test – II Set A

Register Number of the Student	
Academic Year	2022-2023(EVEN SEM)
Year / Sem	III&IV / V&VII
Course Code	18EEO306T
Course Title	Energy Conservation
Maximum Marks	50
Duration	90 Minutes
Date	13.10.2023

Bloom's Level Assessment			
Bloom's Level	Level of Thinking	Weightage Required (%)	Weightage Provided (%)
1	Remember Understand	100 %	100 %
2	Apply Analyze	0 %	0 %
3	Evaluate Create	0 %	0 %

Course Articulation Matrix (CAM)

CO / PO	Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	Gain knowledge of world energy scenario	*3*	-	-	-	-	-	-	-	-	-	-	-	*1*	*1*	*1*
CO2	Understand the concepts of electrical system	*3*	-	-	-	-	-	-	-	-	-	-	-	*2*	*2*	*2*
CO3	Assess the energy efficiency in industrial system	*3*	-	-	-	-	-	*3*	*3*	-	-	-	-	*2*	*3*	*2*
CO4	Analyse the energy policies, energy planning and policy making in india	*3*	-	-	-	-	-	*1*	*3*	-	-	-	-	*2*	*2*	*3*
CO5	Correlate with various methods of energy conservation	*3*	-	-	-	-	-	*1*	*3*	*2*	*2*	-	-	*2*	*3*	*2*
CO6	Implement energy conservation methods and laws to save energy	*3*	-	-	-	-	-	*2*	*3*	*2*	*2*	-	-	*2*	*2*	*3*
Average of COs Program Articulation Matrix (PAM)		3	-	-	-	-	-	*1.17*	*2*	*0.67*	*0.67*	-	-	*1.83*	*2.17*	*2.17*

Q. No.	Marks Allotted	Course Outcome (CO)	Bloom's Taxonomy	Program Outcome (PO)	PI code	Marks Scored
1	1	CO2	Remember	PO1	1.4.1	
2	1	CO2	Understand	PO1	1.4.1	
3	1	CO2	Remember	PO1	1.4.1	
4	1	CO2	Remember	PO1	1.4.1	
5	1	CO2	Remember	PO1	1.4.1	
6	1	CO3	Understand	PO1	1.4.1	
7	1	CO3	Understand	PO1	1.4.1	
8	1	CO3	Understand	PO1	1.4.1	
9	1	CO3	Remember	PO1	1.4.1	
10	1	CO3	Understand	PO1	1.4.1	
11	4	CO2	Remember	PO1	1.4.1	
12	4	CO2	Apply	PO1	1.4.1	
13	4	CO2	Understand	PO1	1.4.1	
14	4	CO3	Understand	PO1	1.4.1	
15	4	CO3	Understand	PO1	1.4.1	
16. a	12	CO2	Understand	PO1	1.4.1	
16. b	12	CO2	Understand	PO1	1.4.1	
17. a	12	CO3	Understand	PO1	1.4.1	
17. b	12	CO3	Understand	PO1	1.4.1	

CO ASSESSMENT

Course Outcomes	CO1	CO2	CO3	CO4	CO5	CO6	Total
Marks Allotted	-	25	25	-	-	-	50
Marks Scored	-			-	-	-	

PO ASSESSMENT

Program Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Marks Allotted	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marks Scored	-	-		-	-	-	-	-	-	-	-	-	-	-	-

Signature of the Faculty

PART – A (10 X 1 = 10 Marks)
Answer ALL questions

1. Power plant to Long distance power transmission will be in the range of _____.
   a) **33kV- 66kV** b) 11kV-6.6kV c)415V-230 V d) 220-400 kV

2. Which loss is independent of loading of transformer?
   a) Copper loss b)Heat loss c) **Iron loss** d) Conductor loss

3. Presenting the load demand of a consumer against time of the day is known as____.
   a) Time Curve b**) Load curve** c) Demand curve d) Energy curve

4. Which Harmonics will make most distortion?
   a**) 3rd, 5th and 7th** b) 2nd, 4th and 8th c) 54th, 64th and74th d) 94th, 96th and100th

5. Which type of motor is used in industries widely?
   a) DC motor b) **Induction motor** c) Synchronous motor d) BLDC motor

6. Most humans feel comfortable when the Relative Humility is between _____
   a) 80% and 90%. b) 10% and 30%. c) 65% and 75%. d) **40% and 60%.**

7. A 10°C raise in evaporator temperature can help to save almost _____on power consumption.
   a) 1% **b) 10%** **c) 3%** **d) 20%**

8 Specific ratio of fan is?
   a) **Up to 1.11** b) more than 1.20 c) 2.11 and above d) more than 1.50

9. Fan law states that ____.
   a) Power ∝ speed b) Flow ∝ volume c) **Flow ∝ speed** d) Pressure ∝ speed

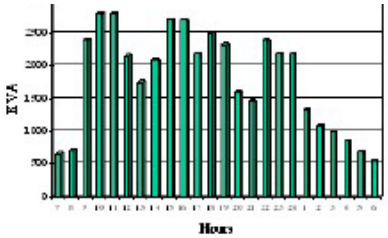
10. Find the approach value of cooling tower when, Outlet temperature of Cooling Water-31°C, Air Wet Bulb temperature 25°C and inlet temperature of Cooling Water-41°C .
   a) 5°C b) 10°C c) 16°C d) **6°C**

PART – B (4 X 4 = 16 Marks)
Answer any FOUR questions

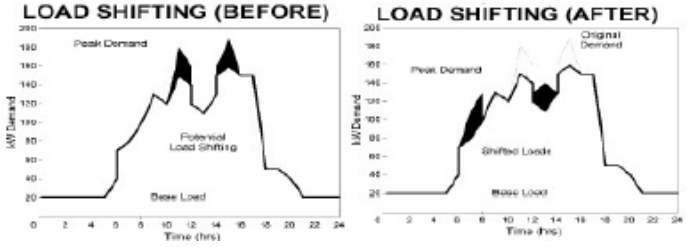
11. Discuss different Load Management Strategies?

What are the Load Management Strategies

1. Load Curve Generation
2. Rescheduling of Loads
3. Storage of Products/process material like refrigeration
4. MD Control-by Shedding of Non-Essential Loads
5. Operation of Captive Diesel Generation Sets
6. Reactive Power Compensation



Rescheduling of Loads: Staggering of motors



12. What are the key concepts associated with lagging and leading power factors, and how do they influence electrical systems??

Two types of Electrical loads in industries

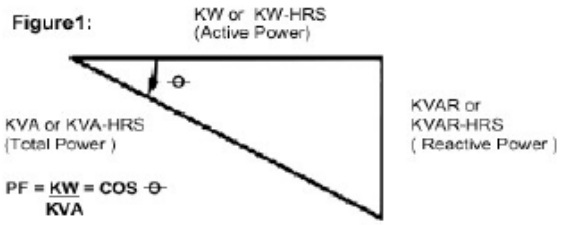
1) Resistive loads are incandescent lighting and resistance heating.
2) Inductive loads are A.C. Motors, induction furnaces, transformers and ballast-type lighting.

Inductive loads require two kinds of power:

1. Active power to perform the work (motion) and
2. Reactive power to create and maintain electro-magnetic fields.

The vector sum of the active power and reactive power make up the total (apparent) power used. This is the power generated by the utility for the user to perform a given amount of work.

Figure1:



$PF = \frac{KW}{KVA} = \cos\theta$

Advantages of PF improvement Cost benefits

- Reduced kVA (Maximum demand) charges in utility bill
- Reduced distribution losses (KWH) within the plant network (I^2R power losses)
- Better voltage at motor terminals and improved performance of motors
- A high power factor eliminates penalty charges
- Investment on system facilities such as transformers, switchgears

13. Explain the significance of lighting terms 1.Color Rendering Index (CRI) and Luminous Efficacy.

Color rendering index (CRI) is a measure of the degree of color shift that objects undergo when illuminated by the light source as compared reference source. In general, a lower CRI indicates that some colors may appear unnatural when illuminated by a lamp. Color rendering is measured on an index from 0-100, with natural daylight equal to 100.

Luminous Efficacy (lm/W): is the ratio of luminous flux emitted by a lamp to the power consumed by the lamp. Unit: lumens per lamp Watt (lm/W).

14. What are the primary factors that influence the performance and energy efficiency of refrigeration plants?

Multi-Staging for Efficiency

- For low temperature applications involving high compression ratios, and for wide temperature requirements, it is economical to employ multi-stage reciprocating machines or centrifugal / screw compressors.

Matching Capacity to System Load

- Part-load operation is important, as most refrigeration applications have varying loads.

Capacity Control and Energy Efficiency

- Reciprocating compressors through cylinder unloading(step-by-step) modulation)
- continuous capacity modulation of centrifugal **through vane control**
- Screw compressors **through sliding valves.**

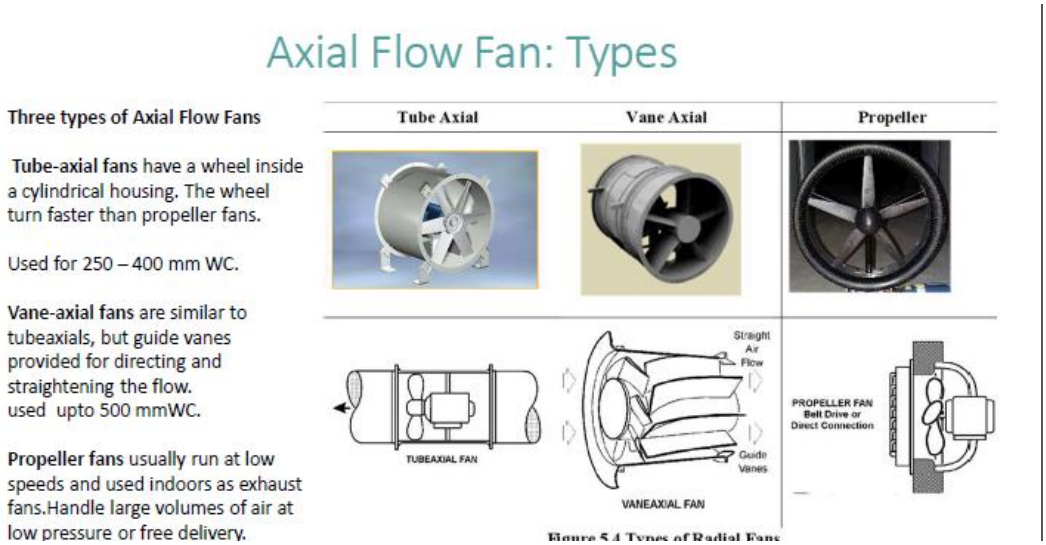
Multi-level Refrigeration for Plant Needs

- For diverse applications requiring a wide range of temperatures, it is generally more economical to provide several packaged units (several units distributed throughout the plant) instead of one large central plant.

Chilled Water Storage

- Depends on the nature of the load, it is economical to provide a **chilled water storage** facility

15. What are the different axial fan configurations and how do they impact performance?



PART – C (2 X 12 = 24 Marks)

Answer ALL questions

16. a. Explain factor to be addressed in selection of motor. How to design energy efficient motor?

2.2 Type of Motors	Motor Features and Advantages
Induction Motors	Rotor runs slower than the speed of the stator field. rotor of a squirrel cage motor is comprised of aluminum bars embedded in the steel laminations. Ends of the rotor bars are shorted
Slip-ring motor	• ideal for very high inertia loads • used in applications for driving variable torque/ variable speed loads. (printing presses, compressors, conveyer, hoists and elevators)
Direct-Current Motors	• unidirectional, current. • applications- high torque starting or smooth acceleration over a broad speed range is required.
Synchronous Motors	synchronous motor rotate with no slip, i.e., RPM is same as the synchronous speed
Permanent Magnet Synchronous Motor (PMSM)	contain permanent magnets. advantages such as power density, better cooling, smaller size, better efficiency motors perform best when driven by sinusoidal waveforms.
Synchronous Reluctance Motors	rotor is built with magnetic materials superior performance ,achieving IE4 efficiency class rotor losses are very small compared to induction motor.

(OR)

16.b. What is cable? Explain different types of cables with neat diagram.

Cable ▪ A cable is an insulated conductor which could carry and transmit electric power, data, signals from one place to another. ▪ It is an assembly of two or more conductors usually held together with an overall sheath. ▪ Power cables can be installed as permanent wiring within a building, buried in the ground, run overhead

Properties required for cables

▪ High resistivity ▪ High dielectric strength ▪ Low thermal-coefficient ▪ Low water absorption ▪ Non-inflammable ▪ High mechanical and tensile strength

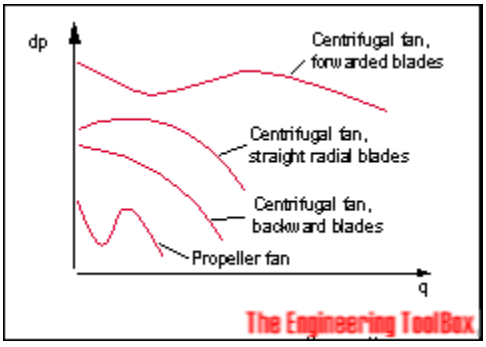
Types of cables ▪ Cables are classified according to the voltage level for it is manufactured and the material which is used for the insulation. ▪ Classification of cables according to the voltage level is low tension cables, medium, and tension voltage cables ✔ Belted cables ✔ Screened type cables ✔ Super tension cables ✔ Oil filled cables ✔ Gas pressure cables

17.a. Explain the types of fans with their sketches.

It is common to classify fans in

- Axial and/or propeller fans
- Centrifugal (radial) fans
- Mixed flow fans
- Cross flow fans

The pressure head of different types of fans with equal periphery speed of the wheel are compared in the capacity diagram below:



Centrifugal fans with forwarded blades are suited for application with higher air flow volumes and pressures. Axial propeller fans are more suited for applications with lower volumes and pressures.

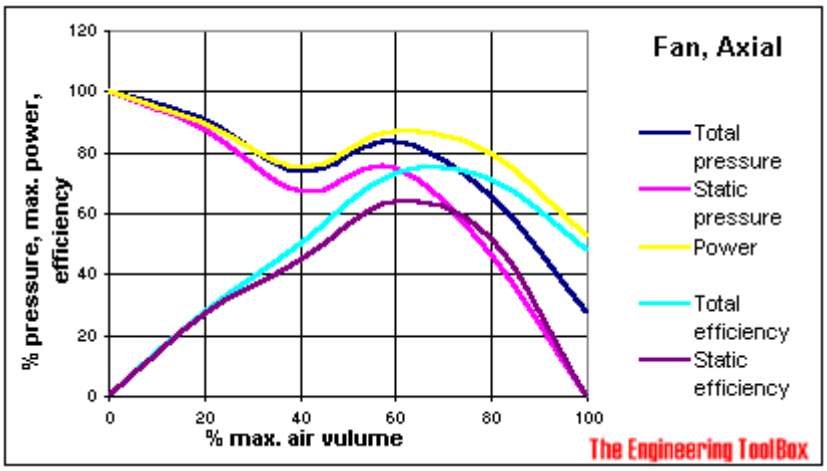
Axial and Propeller Fans

In an axial fan the air flows in parallel to the shaft. It is common to classify axial fans upon their wheel like:

- C-wheel - Blades can be adjusted when running. High efficiency, small dimensions, variable air volume
- A-wheel - Blades can be adjusted only when the fan is standing still. High efficiency, small dimensions, adaptive to recommended air volume

- K-wheel - Blades can not be adjusted. Simple, small dimensions

The pressure head developed for single stage is up to 300 N/m^2. Axial fans are suited for relatively large volumes compared to pressure.



Centrifugal fans (Radial fans)

In a centrifugal fan the air flows is in a radial direction relative to the shaft. Centrifugal fans can be classified by their wheel like:

- F-wheel - Curved forward blades. High efficiency, small dimensions, changing in pressure have little influence on pressure head.
- B-wheel - Curved backward blades. High efficiency, low energy consumption, changing in pressure have little influence on air volume. Low noise emission, stable in parallel running.
- P-wheel - Straight backward blades. High efficiency, self cleaning, changing in pressure have little influence on air volume
- T-wheel - Straight radial blades. Self cleaning. Suitable for material transport

TABLE 5.3 TYPES OF FANS, CHARACTERISTICS, AND TYPICAL APPLICATIONS

Centrifugal Fans			Axial-flow Fans		
Type	**Characteristics**	**Typical Applications**	**Type**	**Characteristics**	**Typical Applications**
Radial	High pressure, medium flow, efficiency close to tube-axial fans, power increases continuously	Various industrial applications, suitable for dust laden, moist air/gases	Propeller	Low pressure, high flow, low efficiency, peak efficiency close to point of free air delivery (zero static pressure)	Air-circulation, ventilation, exhaust
Forward-curved blades	Medium pressure, high flow, dip in pressure curve, efficiency higher than radial fans, power rises continuously	Low pressure HVAC, packaged units, suitable for clean and dust laden air / gases	Tube-axial	Medium pressure, high flow, higher efficiency than propeller type, dip in pressure-flow curve before peak pressure point.	HVAC, drying ovens, exhaust systems
Backward curved blades	High pressure, high flow, high efficiency, power reduces as flow increases beyond point of highest efficiency	HVAC, various industrial applications forced draft fans, etc.	Vane-axial	High pressure, medium flow, dip in pressure-flow curve, use of guide vanes improves efficiencyexhausts	High pressure applications including HVAC systems,
Airfoil type	Same as backward curved type, highest efficiency	Same as backward curved, but for clean air applications			

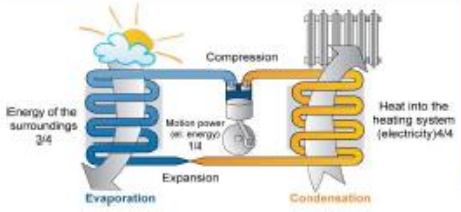
(OR)

17.b. Explain heat pump & cold storage concept in detail . Give its applications.

4.11 Heat Pumps and Their Applications

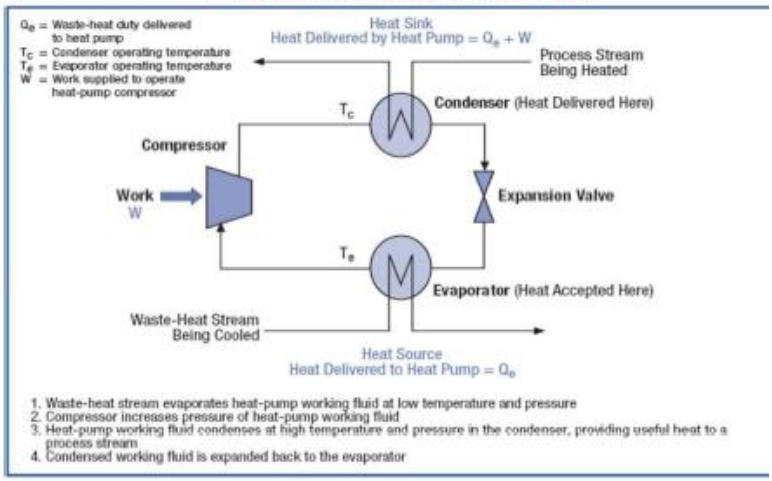
Heat Pump Technology

- A heat pump is same as an air conditioner except that the heat rejected in an air conditioner becomes the useful heat output.
- Heat flows naturally from a higher to a lower temperature.
- Heat pumps are able to force the heat flow in the other direction, using small amount of high quality drive energy (electricity, fuel, or high-temp. waste heat).



Heat Pump

Principle of operation of Heat Pump



4.10 Cold Storage Systems

A **Refrigerated storage** which includes **cold storage** and **frozen food storage** is the best known method of **preservation of food to retain its value and flavor.**

- Equipment's includes compressor, condenser, receiver, air cooling units and associate piping and controls.
- refrigerants used in small unis - HCFC-22, HFC-134a -
- large central plant use ammonia as the refrigerant.

Energy Saving Opportunities in Cold Storage

- **Cold Store Building Design:** Proper orientation, compact chambers, shading of exposed walls, adequate insulation etc. are the important factors.
- **Refrigeration System:** System must be designed for optimum operating conditions like evaporating and condensing temperatures which are direct bearing on energy consumption.
- **Control System:** Proper control for refrigerant level, room temperature, compressor capacity etc., are required to further optimize energy consumption.
- **Air Curtain or Strip Curtain**: The use of air curtains and strip curtains is a common feature to reduce air infiltration due to frequent/long door openings. Fan operated air curtains are expensive and work on electrical power whereas strip curtains are cheaper
- **Heat Recovery System**: WHR Can be installed to recover a part of the heat rejected by the refrigeration for generating hot water.