

5.1 REFRIGERATION AND AIR CONDITIONING

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RATIONALE

The diploma holders in Mechanical Engineering are responsible for supervising and maintenance of RAC system. For this purpose, the knowledge and skill covering basic principles of refrigeration and air conditioning is required to be imparted to the students. Moreover, RAC industry is expanding and employment opportunities in this field are good.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Explain the working and construction features of refrigeration and air conditioning systems
- Draw and interpret various refrigeration cycles.
- Make basic calculation of psychometric properties and processes.
- Calculate heating and cooling load requirements of a room.
- Explain latest developments in the field of refrigeration and air conditioning.
- Calculate the properties of air by using psychometric chart.
- Detect faults in an air-conditioner/refrigerator.
- Carry out charging of air conditioner.

DETAILED CONTENTS

REFRIGERATION

1. Fundamentals of Refrigeration (02 hrs)
Introduction to refrigeration, and air conditioning, meaning of refrigerating effect, units of refrigeration, COP, difference between COP and efficiency, methods of refrigeration, Natural system and artificial system.
2. Vapour Compression System (08hrs)
Introduction, principle, function, parts and necessity of vapour compression system, T- Φ and p-H charts, dry, wet and superheated compression. Effect of sub cooling, super heating, mass flow rate, entropy, enthalpy, work done, Refrigerating effect and COP. actual vapourcompression system
3. Refrigerants (03 hrs)
Functions, classification of refrigerants, properties of R-717, R-22, CO₂, R-11, R-12, R-502, R-32. Properties of ideal refrigerant, selection of refrigerant.
4. Refrigeration Equipment (06hrs)
 - 4.1 Compressors- Function, various types of compressors
 - 4.2 Condensers - Function, various types of condensers
 - 4.3 Evaporators- Function, types of evaporators

- 4.4 Expansion Valves - Function, various types such as capillary tube, thermostatic expansion valve, low side and high side float valves, application of various expansion valves
- 4.5 Safety Devices- Thermostat, overload protector LP, HP cut out switch

AIR CONDITIONING

5. Psychrometry (06 hrs)
Definition, importance, specific humidity, relative humidity, degree of saturation, DBT, WBT, DPT, sensible heat, latent heat, Total enthalpy of air. Psychrometric chart, various lines, Various psychrometric processes.
6. Heat Load Estimation and various type of Air Conditioning device (03hrs)
Heating and humidification, cooling and dehumidification, Heat load estimation, window air conditioning, split type air-conditioning, car air-conditioning, central air conditioning.
7. Latest development in refrigeration and air conditioning (02 hrs)
Inverter technology, auto-defrosting, blast cooling, star rating.

LIST OF PRACTICALS

1. Identify various tools of refrigeration kit.
2. Practice in cutting, bending, flaring, swaging and brazing of tubes.
3. Study of thermostatic switch, LP/HP cut out overload protector filters, strainers and filter driers.
4. Identify various parts of a refrigerator and window air conditioner.
5. To find COP of Refrigeration system
6. To measure air flow using anemometer.
7. Charging of a refrigerator/ air conditioner.
8. To detect faults in a refrigerator/ air conditioner
9. Visit to an ice plant or cold storage plant. or central air conditioning plant

INSTRUCTIONAL STRATEGY

1. Teachers should take the students to industry and explain the details of refrigeration and air-conditioning systems and their components.
2. While imparting instructions, focus should be on conceptual understanding.
3. Training slides of “Carrier Fundamentals of Refrigeration Air Conditioning” to be shown to students.

RECOMMENDED BOOKS

1. Domkundwar, “Refrigeration and Air Conditioning”, Dhanpat Rai and Sons, Delhi.
2. Arora, CP, “Refrigeration and Air Conditioning”, Tata McGraw Hill, New Delhi.
3. Khurmi, R.S, and J.K. Gupta, “Refrigeration and Air Conditioning”, S Chand and Company Limited, New Delhi.
4. Khanna, Dr. Harjeev, “Refrigeration and Air Conditioning”, Dhanpat Rai and Sons, Delhi.
5. Rajput, Dr. R.K, “Refrigeration and Air Conditioning”, S.K. Kataria and Sons, Ludhiana.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1.	02	08
2.	08	10
3.	03	07
4.	06	08
5.	06	08
6.	03	06
7.	02	03
Total	30	50

5.4 THEORY OF MACHINES

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RATIONALE

A diploma holder in this course is required to assist in the design and development of prototype and other components. For this, it is essential that he is made conversant with the principles related to design of components and machine and application of these principles for designing. The aim of the subject is to develop knowledge and skills about various aspects related to design of machine components.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Explain working of different types of mechanisms and draw their inversion.
- Determine the horizontal force required to move a body on an inclined plane and calculate the efficiency of screw jack.
- Solve problems on power transmission.
- Determine ratio of driving tension for flat and V-belt drive.
- Identify various types of gears and their applications.
- Construct turning moment diagram of flywheel for different types of engines.
- Explain working of different types of governors.
- Calculate balancing of rotating mass and its position.
- Identify different type of vibrations, their causes, harmful effect and remedies.

DETAILED CONTENTS THEORY

1. **Simple Mechanisms** (06 Hrs)
 - 1.1. Introduction to link, kinematic pair, lower and higher pair, Kinematic chain, mechanism, Inversions.
 - 1.2. Different types of mechanisms (with examples).
2. **Power Transmission** (08 Hrs)
 - 2.1. Introduction to Belt and Rope drives.
 - 2.2. Types of belt drives and types of pulleys.
 - 2.3. Concept of velocity ratio, slip and creep; crowning of pulleys (simple numerical on velocity ratio).
 - 2.4. Different types of chains and their terminology (without numerical).
 - 2.5. Types of gears and their applications, simple and compound gear trains (without numerical)
3. **Flywheel** (04 Hrs)
 - 3.1. Principle and applications of flywheel.
 - 3.2. Turning - moment diagram of flywheel for different engines.
 - 3.3. Fluctuation of speed and fluctuation of energy (Simple numerical).
 - 3.4. Coefficient of fluctuation of speed and coefficient of fluctuation of energy (Concept only).

4. **Governor** (04 Hrs)
- 4.1. Principle of governor.
 - 4.2. Simple description and working of Watt, Porter and Hartnell governor (simple numerical based on watt governor only).
 - 4.3. Hunting, isochronism, stability and sensitiveness of a governor.
5. **Balancing** (04 Hrs)
- 5.1. Concept of balancing.
 - 5.2. Introduction to balancing of rotating masses (without numerical)
6. **Vibrations** (04 Hrs)
- 6.1. Types-longitudinal, transverse and torsional vibrations (without numerical).
 - 6.2. Dampening of vibrations.
 - 6.3. Causes of vibrations in machines, their harmful effects and remedies.

INSTRUCTIONAL STRATEGY

1. Use teaching aids for classroom teaching
2. Give assignments for solving numerical problems
3. Arrange industry visits to augment explaining use of various machine components like belt, rope, chain, gear drives, action due to unbalanced masses, brake clutch, governors, fly wheels, cams and gear drives
4. Video films may be used to explain the working of mechanisms and machine components like clutch, governors, brake etc.

RECOMMENDED BOOKS

1. Malhotra, D.R., "Theory of Machines" , Satya Prakashan, New Delhi.
2. Singh, V.P, "Theory of Machines" , Dhanpat Rai and Sons, New Delhi.
3. Lal, Jagdish, "Theory of Machines" , Metropolitan Publishers, New Delhi.
4. Ubhi, B.S, "Theory of Machine" , S.K. Kataria and Sons, New Delhi.

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