

B.E Semester: VII

Mechanical Engineering

Subject Name: Refrigeration and Air-Conditioning

A. Course Objective

- To develop a solution oriented approach by in depth knowledge of Refrigeration and Air-conditioning.
- To address the underlying concepts, methods and application of AC.

B. Teaching / Examination Scheme

| SUBJECT | | Teaching Scheme | | | | Total Credit | Evaluation Scheme | | | | | Total Marks |
|---------|------------------------------------|-----------------|-----|-----|-------|--------------|-------------------|-------|-------|-------|------------|-------------|
| | | L | T | P | Total | | THEORY | | IE | CIA | PR. / VIVO | |
| CODE | NAME | Hrs | Hrs | Hrs | Hrs | | Hrs | Marks | Marks | Marks | Marks | |
| ME702 | Refrigeration and Air-conditioning | 4 | 0 | 2 | 6 | 5 | 3 | 70 | 30 | 20 | 30 | 150 |

C. Detailed Syllabus

1. Refrigeration an Introduction: heat load, development of refrigeration, aircraft refrigeration, Bell-Coleman cycle, Bootstrap air refrigeration system, types of air cycles, advantages and disadvantages

2. Vapor Compression system: Simple system on P-h diagram, analysis of the simple cycle, factors affecting the performance of the system, actual cycle considering different losses.

Compound Compression System: Need, flash tank, Compound compression with flash and inter cooler, all evaporators working at the same temperature, evaporators with back pressure valves and with multiple expansion valves without flash inter cooling, analysis of two evaporators with flash inter cooler and individual and multiple expansion valve, estimation of power requirement and COP.

3. Absorption refrigeration system:

Characteristics of refrigerant, selection of pair, practical water -NH₃ cycle, Li – Br system and its working.

4. Refrigeration system components: Compressors, condensers, expansion devises, evaporators its types construction and working, comparison and selection, refrigeration piping accessories and controls, thermal insulation properties and classification, thickness of insulation.

6. Refrigerants: designation of refrigerants, Types of refrigerants, desirable properties of refrigerants, development, classification, secondary refrigerants, future industrial refrigerants.

7. Psychrometry and psychrometric terms: properties of air, Daltons law of partial pressure, humidity, temperature, enthalpy of moist air, temperature and humidity measuring instruments, plotting psychrometric chart, psychrometric processes such a sensible heating, cooling, heating and humidification cooling and dehumidification, chemical dehumidification, adiabatic saturation.

8. Human comfort: air temperature and human body, body thermoregulation, effective temperature, comfort chart and factors governing effective temperature.

9. Load analysis: Site survey, outdoor design conditions. Indoor design conditions, classification of loads, Flywheel effect of building material and its use in design, effect of wall construction on cooling load, instantaneous heat gain (IHG) and instantaneous cooling load (ICL) heat transmission through sunlit and shaded glass using tables, method of reduction of solar heat gain thorough glass, total equivalent temperature difference, calculations of cooling load TETD due to sunlit and shaded walls using tables, air infiltration and load due to outside air, ventilation, heat gain from occupants, electric

lights, product, electric motor and appliances, use of load estimation sheet, Brief introduction about recent ASHRAE Methods.

10. Duct Design and air distribution: Function, classification economic factors influencing duct layout, duct design methods, velocity reduction, equal friction and static regain method, use of friction chart equivalent diameter, dynamic losses and its determination, Requirements of air distribution system, terms in air distribution, grills, outlets, application, location

11. Air-conditioning systems: classification, system components, all air, all water, air water systems, room air conditioners, packaged air conditioning plant, central air conditioning systems, split air conditioning systems

12. Air conditioning system components: fans types laws, classification and selection, air cleaning devices classification, types, construction and working, humidifiers and dehumidifiers

13. Refrigeration and air-conditioning application: food preservation, ice manufacturing, cold stores, air-conditioning of residential, commercial buildings, Clean Room, Tunnel Ventilation, AHU, AWU, Industrial HVAC Applications

D. Lesson planning

| SR. NO. | DATE/WEEK | UNIT NO. | %WEIGHTAGE | TOPIC NO. |
|----------------|--|-----------------|-------------------|------------------|
| 1 | 1 ST , 2 ND , 3 RD | 1, 2, 3 | 20 | 1, 2, 3 |
| 2 | 4 TH , 5 TH , 6 TH | 4, 5, 6, 7 | 20 | 4, 5, 6, 7 |
| 3 | 7 TH , 8 TH , 9 TH | 8, 9, 10 | 20 | 8, 9, 10 |
| 4 | 10 TH , 11 TH , 12 TH | 11, 12 | 20 | 11, 12 |
| 5 | 13 TH , 14 TH , 15 TH | 13 | 20 | 13 |

E. Instructional Method & Pedagogy

1. At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
2. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations.
3. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
4. One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
5. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
6. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.
7. The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures.
8. **Practical / Oral:** Term work shall be carried out to fulfill the practical credits related to course contents.

F. Students Learning Outcomes

- The student can identify different areas of Refrigeration and Air-conditioning.
- Can find the applications of all the areas in day to day life.

G. Recommended Study Materials

Text & Reference Books:

1. Arora. C.P., Refrigeration and Air Conditioning, McGraw-Hill New Delhi, 1988

2. Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Ltd., 1983
3. Ramesh Arora ,” Refrigeration and Air-conditioning”, Prentice Hall of India, 2010
4. Roy.J Dossat, “Principles of Refrigeration”, Pearson Education 2009.
5. W.F.Stocker and J.W.Jones, “Refrigeration and Air Conditioning”, McGraw-Hill, 2009.
6. Desai P.S, Modern Refrigeration and Air-conditioning Khanna Publishers, 2004
7. S C Arora & S Domkundwar, ‘Refrigeration and Air-Conditioning’ Dhanpat Rai Publication, 2009
8. Jordon and Prister, “Refrigeration and Air Conditioning”, Prentice Hall of India PVT Ltd., New Delhi, 2009
9. Sapali S.N., "Refrigeration and Air Conditioning", PHI Learning Private Ltd, 2009.
10. Ahmadul Ameen "Refrigeration and Air Conditioning", Prentice Hall of India Pvt. Ltd. 2010
11. S.S Thispee Refrigeration and air-conditioning , Jaico Publications, 2009
12. ASHRAE Handbook (Fundamental), 2013