REFRIGERATION AND AIR-CONDITIONING
(Professional Elective I)

I Semester

Course Code: 19ME2250

L	P	C
3	0	3

Prerequisites: Engineering Thermodynamics and Thermal Engineering

Course Outcomes: At the end of the course the student shall be able to

CO1: Explain different refrigeration systems, design steam jet and non-conventional refrigeration systems.
CO2: Analyze simple vapor compression refrigeration systems, select refrigerants, design multi-evaporator systems.
CO3: Discuss and design low temperature systems and vapor absorption refrigeration systems, discuss different defrosting methods.
CO4: Explain psychrometric properties and analyze different air conditioning systems.
CO5: Determine capacities and design air conditioning systems at different loads.

UNIT-I: **(10-Lectures)**

Air refrigeration: Bell-Coleman cycle and Brayton Cycle, aircraft refrigeration, simple, bootstrap, regenerative and reduced ambient systems, problems based on different systems.
Steam jet refrigeration system: analysis, components of plant, advantages, limitations and applications, performance.
Non-conventional refrigeration systems: thermoelectric refrigerator, Vortex tube or Hirsch tube.

Learning Outcomes: At the end of this unit, the student will be able to

1. Explain the working principles of air refrigeration systems. (L2)
2. Solve air refrigeration systems to calculate their Coefficient of Performance, COP. (L3)
3. Explain the working principles of steam jet and non-conventional refrigeration systems. (L2)

UNIT-II: **(10-Lectures)**

Vapor compression refrigeration (VCR): Performance of VCR, properties and selection of pure and mixed refrigerants.
Multi-evaporator and compressors: methods of improving COP, sub-cooler heat exchanger, optimum inter stage pressure for two-stage refrigeration system, single load systems, multi load systems with single compressor, multiple evaporator and compressor system, dry ice system, cascade systems.

Learning Outcomes: At the end of this unit, the student will be able to

1. Explain the working principles of VCR systems with multi evaporators and compressors. (L2)
2. Discuss various methods to improve COP of VCR systems. (L6)
3. Solve various VCR systems to know their COP. (L3)

UNIT-III: **(10-Lectures)**

Vapor absorption system (VAR): simple absorption system, practical ammonia absorption system, Electrolux Refrigerator, Domestic Electrolux Refrigerator, Lithium–Bromide VAR system, actual analysis of ammonia absorption system.
Methods of Defrosting: automatic periodic defrosting, solid absorbent system, water defrosting, defrosting by reversing cycle, automatic hot gas defrosting, thermos-bank defrosting, electric defrosting, electric air switch defrosting system, two outdoor unit system, multiple evaporators defrosting system.

Learning Outcomes: At the end of this unit, the student will be able to

1. Explain the working of different types of VAR systems. (L2)
2. Identify and design an optimum method to reduce defrosting in a refrigeration unit. (L3, L6)
3. Solve VAR system to know its COP. (L3)

UNIT-IV: (10-Lectures)

Air-conditioning: psychrometric properties & processes, summer air-conditioning systems, winter air conditioning systems, year around air-conditioning, requirements of comfort air-conditioning, thermodynamics of human body, comfort chart-design considerations, need for ventilation. **Air-conditioning systems**: central station air-conditioning system, unitary air-conditioning system, self-contained air-conditioning units.

Learning Outcomes: At the end of this unit, the student will be able to

1. Outline psychrometric properties and explain psychrometric processes used in air-conditioning system design. (L2)
2. Classify different air-conditioning systems. (L2)
3. Choose and design an air conditioning system for different end applications. (L6)

UNIT-V: (10-Lectures)

Design of air-conditioning systems: cooling load calculations, different heat sources, bypass factor (BF), effective sensible heat factor (ESHF), cooling coils and dehumidifying air washers.

Learning Outcomes: At the end of this unit, the student will be able to

1. Summarize different heat sources, which generally encounters in the design of an air-conditioning system. (L2)
2. Apply basics of load calculations to design an air-conditioning system. (L3)
3. Classify different types of cooling coils and dehumidifying air washers. (L2)

TEXT BOOKS:

1. S.C. Arora and S. Domkundwar, *A Course in Refrigeration and Air Conditioning*, Eighth Edition, Dhanpat Rai & CO (P), 2012.
2. C.P. Arora, *Refrigeration and Air Conditioning*, Third Edition, Tata McGraw-Hill, 2017.

REFERENCE BOOKS:

1. Wilbert F. Stoecker and J.W. Jones, *Refrigeration and Air Conditioning*, 2nd Edition, Tata McGrawHill, 2014.

2. Roy J. Dossat, *Principles of Refrigeration*, 4th Edition, Pearson Education India, 2002.