

Course Code	Course Name	Credits
MEC603	Heating, Ventilation, Air Conditioning and Refrigeration	03

Objectives:

1. Learning the fundamental principles and different methods of refrigeration and air conditioning
2. Study of various refrigeration cycles and evaluate performance of each cycle.
3. Study of components of refrigeration and air-conditioning systems along with the applications.

Outcomes: Learner will be able to...

1. Illustrate the fundamental principles and applications of refrigeration and air conditioning systems.
2. Identify various HVAC&R components
3. Evaluate performance of various refrigeration system
4. Estimate cooling and heating loads for an airconditioning system.
5. Select air handling unit & design air distribution system
6. Apply the knowledge of HVAC for the sustainable development of refrigeration and airconditioning systems.

Module	Details	Hrs
1.	<p>1.1 Basic Knowledge: Carnot refrigerator, Carnot heat pump, Carnot coefficient of performance, Reversed Carnot cycle, and its limitation, Effect of temperature and pressure on COP of the cycle</p> <p>1.2 Refrigerants: Classification, Designation, Selection of refrigerant, Physical and chemical properties of refrigerants, Secondary refrigerants</p> <p>1.3 Air Refrigeration System: Bell Coleman cycle, Necessity of air cooling, Factors considered for the selection of air refrigeration system, Types of air refrigeration system with schematic and T-S diagram, Numerical based on simple and bootstrap air refrigeration system.</p>	06
2.	<p>2.1 Vapour Compression Refrigeration System: Simple system on P-h and T-s diagrams, analysis of the simple cycle, factors affecting the performance of the cycle, actual cycle, Numerical based on standard vapour compression system by using P-h chart and refrigerant table</p> <p>2.2 Vapour Absorption Refrigeration System. Simple and practical, vapour absorption system, Refrigerant-adsorbent properties, COP of ideal vapour absorption system, Domestic Electrolux refrigerator, Lithium bromide absorption system.</p> <p>2.3 Heat Pump performance, Primary energy ratio, Energy efficiency Introduction, Coefficient of ratio, Heating season performance factor, Seasonal energy efficiency ratio, Classification of heat pump, Vapour compression heat pump systems, Heat pump application in an industry.</p>	08

3.	<p>3.1 Thermal Comfort Conditions: Selection of inside design conditions, thermal comfort, heat balance equation for a human being, factors affecting thermal comfort, Effective temperature, comfort chart and factors governing effective temperature, selection of outside design conditions</p> <p>3.2 Psychrometry:of Air Conditioning Processes Psychrometry properties,relations and processes ,Adiabatic air mixing ,processPsychrometric chart,,RSHF,GSHF,ERSHF,Bypass factor ,Apparatus dew pointNumericalbased on psychrometric chart and .Classification of air conditioning system,relations</p> <p>3.3 :Cooling Load Estimation ,Introduction,Components of cooling loadDifferent heat sourcesV,arious load Estimation,Design of air conditioning systemBuilding survey and economic , aspect used in design.</p>	10
4.	<p>4.1 Air DistributionSystem: 4.1.1 :Duct Classification of ducts,duct material, pressure in ductsF,low through duct, pressure losses in ductA,ir flow through simple duct systemE,ivalent diameter,Methods of duct system design:</p> <p>4.1.2 :Air Handling Unit ,oductionIntrFan coil unit, Types of fans used air conditioning applications, Fan lawsF,ilters,supply and return grills,Sensors.</p>	06
5.	<p>5.1 HVACR& C:omponents Working of reciprocating, screw and scroll compressors, working of air cooled, and water cooled andevaporative condensers, Working of DX, Flooded, and Forced feed evaporators, Expansion devices Capillary tube, TXV, EXV, Type of insulation materials.</p>	06
6.	<p>6.1 Application of HVAC&R Ice plant, Food storage plants, dairy and food processing plants, freeze drying, A/c in textile, Printing pharmaceutical industry and Hospitals ,Cold chain Technology, Transport air conditioning,Solar refrigeration.</p>	03

Assessment:

- **Internal Assessment for 20 marks:**
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on approximately %40 but excluding contents covered in Test I
- **End Semester Examination:**
 1. Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.
 2. Question paper will comprise of total **six questions, each carrying 20 marks**
 3. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
 4. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
 5. Only **Four questions need to be solved**

Text/Reference Books:-

1. Refrigeration and Air Conditioning by C.P.Arora, McGraw Hill education (India) (P) limited, New Delhi
2. Principles of Refrigeration by Roy J. Dossat, Pearson education, New Delhi
3. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
4. Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpatrai and sons, Delhi
5. Khurmi R.S. and Gupta J.K., Refrigeration and Air conditioning, Eurasia Publishing House Pvt. Ltd, New Delhi
6. ISHRAE Air Conditioning Handbook
7. ISHRAE Refrigeration Handbook
8. ASHRAE Handbook of Fundamentals
9. ASHRAE Handbook of Equipment
10. ASHARE Handbook of System
11. Open Source Software/learning website

Links for online NPTEL/SWAYAM courses:

<https://nptel.ac.in/courses/112/107/112107208/> - Refrigeration and Air Conditioning, IIT Roorkee
<https://nptel.ac.in/courses/112/105/112105128/> - Refrigeration and Air Conditioning, IIT Kharagpur