

**B.E Semester: 6 Mechanical Engineering**  
**Subject Name: Refrigeration & Air Conditioning (ME603-N)**

**A. Course Objective:**

- To present a problem oriented in depth knowledge of Refrigeration and Air Conditioning.
- To address the underlying concepts and methods behind Material Refrigeration and Air Conditioning.

**B. Teaching / Examination Scheme:**

Teaching Scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
4	0	2	6	5	3	70	30	20	30	150

**C. Detailed Syllabus:**

Unit No.	Details
1	<b>Refrigeration an Introduction:</b> heat load, development of refrigeration, aircraft refrigeration, Bell-Coleman cycle, Bootstrap air refrigeration system, types of air cycles, advantages and disadvantages
2	<b>Vapour Compression system:</b> Simple system on P-h diagram, analysis of the simple cycle, factors affecting the performance of the system, actual cycle considering different losses. <b>Compound Compression System:</b> 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	<b>Absorption refrigeration system:</b> Characteristics of refrigerant, selection of pair, practical water -NH <sub>3</sub> cycle, Li – Br system and its working; Domestic Electrolux (Ammonia hydrogen) refrigerator
4	<b>Refrigeration and air conditioning system components:</b> 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; fans types laws, classification and selection, air cleaning devices classification, types, construction and working, humidifiers and dehumidifiers
5	<b>Refrigerants:</b> designation of refrigerants, Types of refrigerants, desirable properties of refrigerants, development, classification, secondary refrigerants, Leak detection, Oil miscibility, future industrial refrigerants
6	<b>Psychrometry and psychrometric terms:</b> 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.

7	<b>Human comfort:</b> air temperature and human body, body thermoregulation, effective temperature, comfort chart and factors governing effective temperature
8	<b>Load analysis:</b> 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 sunlight 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.
9	<b>Duct Design and air distribution:</b> 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
10	<b>Air-conditioning systems:</b> 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
11	<b>Air conditioning system components:</b> fans types laws, classification and selection, air cleaning devices classification, types, construction and working, humidifiers and dehumidifiers
12	<b>Refrigeration and air-conditioning application:</b> food preservation, ice manufacturing, cold stores, air-conditioning of residential, commercial buildings, Clean Room, Tunnel Ventilation, AHU, AWU, Industrial HVAC Applications

<b>Total hours (Theory):64</b>
<b>Total hours (Practical):32</b>
<b>Total hours:96</b>

#### D. Lesson Planning:

Sr. No.	Date/Week	Unit	Weight age	Topic No
1	1 <sup>st</sup> ,2 <sup>nd</sup> ,3 <sup>rd</sup>	Unit 1	20%	1,2,6
2	4 <sup>th</sup> .5 <sup>th</sup> ,6 <sup>th</sup>	Unit 2	20%	3,4
3	7 <sup>th</sup> , 8 <sup>th</sup> ,9 <sup>th</sup>	Unit 3	20%	5,7
4	10 <sup>th</sup> .11 <sup>th</sup> . 12 <sup>th</sup>	Unit 4	20%	8,9,10
5	13 <sup>th</sup> , 14 <sup>th</sup> ,15 <sup>th</sup> ,16 <sup>th</sup>	Unit 5	20%	11,12

#### 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 Weight age 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 toequivalent 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. Suggested list of experiment is given below

#### F. List of Practical:

1	To find COP of Refrigeration test rig
2	To find COP of air conditioning test rig.
3	To study various refrigerants used currently in R&AC systems.
4	To calculate COP of domestic Electrolux refrigerator.
5	To study various components of refrigeration and air conditioning system.
6	To study various power saving technologies in recent air conditioning systems.
7	Case Study on Load Analysis.
8	Case Study on Duct Design.
9	Case Study on Fan.
10	Case Study on capacity determination of Air Conditioner.

#### G. Students Learning Outcomes:

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

#### H. Text Books & Reference Books:

1	Roy.J Dossat, "Principles of Refrigeration", Pearson Education 2009
2	Arora. C.P., Refrigeration and Air Conditioning, McGraw-Hill New Delhi, 1988
3	Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Ltd., 1983
4	W.F.Stocker and J.W.Jones, "Refrigeration and Air Conditioning", McGraw-Hill, 2009.
5	S.S Thispee Refrigeration and air-conditioning , Jaico Publications, 2009
6	ASHRAE Handbook (Fundamental), 2013