M.E Semester: 1 Mechanical Engineering (Thermal Engineering)
Subject Name: Advanced Refrigeration

A. **Course Objective**

- To present a problem oriented in depth knowledge of Advanced Refrigeration
- To address the underlying concepts and methods behind Advanced Refrigeration

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	
METH107-B	Advanced Refrigeration	4	0	2	6	5	3	70	30	20	30	150

C. **Detailed Syllabus**

1. Balancing of vapor compression refrigeration system
2. Dual pressure vapor compression system and its analysis.
3. Compound compression with flash cooler and flash intercooler, multiple expansions, parallel operation, sectionalizing, booster operations, various types of cascade systems analysis
4. Refrigerants: Ecofriendly refrigerants & their properties, secondary Refrigerants, mixture of refrigerants, azeotropics, salient characteristics of various refrigerants. Synthetic lubricating oil &their properties
5. Absorption refrigeration: H-x charts of LiBr-H2O and NH3-H2O solutions. analysis of vapor absorption refrigeration system on H-X charts, mass concentration &equilibrium charts , heat balance, COP comparison with vapor compression refrigeration systems, two stage vapor absorption refrigeration system, balancing of vapor absorption refrigeration systems.
6. Air cycle refrigeration, Analysis of various cycles and their applications. Calculations of COP
7. Steam jet refrigeration - cycle analysis, analysis on H-O charts performance, control and various applications.
8. Thermo-electric refrigeration: Thermo-electric effects, analysis of thermoelectric cooling, COP, FOM, thermoelectric, materials.
9. Heat pumps: Sources and sinks, refrigerant circuits, heating and cooling performance of heat pumps.
10. Design of refrigeration systems for industrial &other application for transport refrigeration, walk in coolers & cold storages for different applications.
11. Preservation & processing of food by use of refrigeration

D. **Lesson Planning**

Sr.No.	Date/Week	Unit No.	% Weightage	Topic No:
1	1^{st} ,2^{ed} ,3^{ed}	Unit 1	20 % .	1,2,3
2	4^{th} ,5^{th} ,6^{th}	Unit 2	20 %	4,5
3	7^{th} ,8^{th} ,9^{th}	Unit 3	20 %	6,7
4	19^{th} ,11^{th} ,12^{th}	Unit 4	20 %	8,9
5	13^{th} ,14^{th} ,15^{th}	Unit 5	20 %	10,11

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. Experiments shall be performed in the laboratory related to course contents.
9. **List of Experiments:**

1. Study of advanced refrigeration systems.
2. Performance and analysis of VCR system using capillary tube as a throttling device.
3. Performance and analysis of VCR system using thermostatic expansion valve as a
4. throttling device.
5. Study and design of a steam jet refrigeration system.
6. Study and design of cascade refrigeration system.
7. Performance and analysis of VAR system in "Electrolux" refrigerator.
8. Performance and analysis on Heat Pump system with different working conditions.
9. Design and selection of different components of VCR system.
10. Study of NH3 condensing plant of a cold storage.
11. Study of freeze drying machine.

F. **Students Learning Outcomes**

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

G. **Recommended Study Materials**

- **Text & Reference Books:**

1. Threlked, J.L., "Thermal Environmental Engineering", Prentice Hall, N. Y., 1970.
2. Air conditioning principles and systems –pita
3. ASHRAE Data Book, (1) Fundamentals (2001) (2) application (1999) (3) System and Equipments (2000)
4. Refrigeration and air conditioning, stocker
5. Refrigeration and air conditioning, Jordan and Priester
6. Refrigeration and air conditioning, C. P. Arora
7. Industrial refrigeration handbook, stoecker,1998