Number of units 8	**T 5**	**P 2**	**Th 3**	Number of weekly hours	Annual System 30 weeks	**Al-Esra'a University College Department: Engineering of Refrigeration and Air Conditioning Technologies**
				Refrigeration Systems		Fourth stage

Course Objective

This course aims to enhance the students knowledge of the principles of vapor compression refrigeration systems and it's analysis, also studying types of refrigeration units and cryogenic refrigeration.

Week	Topic	Lab. Experiment Assignments	Notes
1-3	Condensers and Evaporators: Condensers and evaporators as heat exchangers, overall heat transfer coefficients, heat transfer and pressure drop for the fluid flow in heat exchanger tubes and shell. Extended surfaces, Heat transfer and pressure drop for air side.	Various refrigeration systems designing projects	
4-5	Condensers, Required condensing capacity, condensing coefficient, fouling factor, de-super heating, condenser design, Wilson plots, air and non-condensable gases.		
6-7	Evaporators, Boiling in the shell, boiling inside tube, evaporators performance, pressure drop in tubes, frost.		
8-10	Expansion devices: Purpose and types of expansion devices, capillary tube, selection of capillary tube ,analytical computation of pressure drop in capillary tube, increment length, chocked flow graphical method of capillary tube selection ,Constant pressure expansion valve, controlling of super-heating in thermostatic expansion valve.		
11-13	Vapor compression refrigeration system Analysis: balance point and system simulation, reciprocating compressors, condenser performance, condensing unit system mathematical and graphical analysis, evaporator performance, performance of complete system graphical and mathematical analysis, some performance trends, the expansion devices, sensitivity analysis.		

14-15	Cooling towers and evaporative condensers: Heat rejected to atmosphere, cooling towers, analysis of counter flow cooling tower, stepwise integration, acceptance test, predicting outlet conditions from tower, air conditions through tower, evaporative condensers, when using a cooling tower and evaporative condensers.		
Half-year Break			
16-18	Absorption refrigeration system: relation between vapour compression and absorption refrigeration units, the absorption refrigeration system, temperature and concentration properties of LiBr-water solution, calculations of mass flow rates in the absorption cycle, enthalpy of LiBr-water solutions, thermal analysis of simple cycle, absorption cycle with heat exchanger, crystallization, capacity control, aqua-ammonia system .	Various refrigeration systems designing projects	
19-20	Adsorption system : the relation between adsorption and absorption, absorption and vapour compression cycle, the analysis of adsorption system, mathematical analysis of the adsorption system .		
21	Steam jet refrigeration: system components, analysis of steam jet refrigeration system, approximation analysis, equilibrium concentration.		
22-23	Air refrigeration system : the working principle of the cycle, design considerations, atmosphere temperature, humidity and pressure, load calculation, refrigeration, heating, temperature control, ventilation, pressure control of zone, types of air system.		
24	Thermoelectric refrigeration: working principle, types of thermoelectric refrigeration systems, electro-acoustic refrigeration, working principle, types.		
25-26	Cryogenic and liquefaction of gases: Cryogenic, Joul-Thomson effect, air liquefaction by Hopson system (Joul-Thomson expansion)		
27-28	Temperature entropy diagram for air, calculation of work required for gas compression , Claude syst,em, cascade system, general consideration for gas liquefaction, Hydrogen , Pre-Cooling system for air liquefaction, Helium		
29	Vortex tube: Types and working principle.		
30	Heat Pipe: Types and working principle.		