

<b>Number of units</b> <b>9</b>	<b>T</b> <b>6</b>	<b>Pr</b> <b>3</b>	<b>Th</b> <b>3</b>	Number of weekly hours	Annual System 30 weeks	Al-Esra'a University College  <b>Department: Engineering of Refrigeration and Air Conditioning Technologies</b>
				<b>Control Circuits</b>		<b>Fourth stage</b>
<b><u>Course Objective</u></b>						
The subject aims to enable and qualify the student for the processes that deal with the HVAC&R control systems: maintenance, repairing, design, and reading the maps of control circuits.						

Week	Topic
1-2	Fundamentals of automatic control including: principles, aims of control in HVAC, elementary system, open & close control loops, block diagram, time respond, types of controllers, variables & parameters to be controlled, sensors, measurements, Symbol used in control circuits.
3-4	Principles of pneumatic control, components, elements, sensors, pneumatic relays, controlled devices (final elements; motors, valves), compressed air equipment.
5-6	Principles of electric control, components, elements, sensors, electric relays, controlled devices (final elements) , switches, power & control circuits , planning (mapping)..
7-8	Principles of electronic control, Wheatstone bridge, components of the system & circuits, elements, sensors, Transducers, operational amplifier, switches , final elements.
9	Refrigerant controllers included expansion valves: automatic, thermal, thermo-electric, electronic.
10	Regulators including: evaporator, condenser, suction compressor pressure regulators, temperatures, refrigeration capacity, ....etc.
11	Control circuits accessories, including valves: (solenoid, 3-way, 4-ways , safety) , dampers.
12	Power and control circuits for domestic refrigeration & air conditioning (refrigerator, freezer, water cooler, window type A/C )
13	Power & control circuits for Split A/C unit (for cooling and cooling – heating modes).
14	Power & control circuits for air cooled package unit.
15	Power & control circuits for water cooled package unit.
16	Components of refrigeration machine & the methods of its refrigeration capacity control through the operation of the evaporator, the compressor, and the expansion valve.

17	Refrigeration capacity control for different type of compressors.
18	Conditioned space outside air control including Economy, Enthalpy, Static Pressure types..., ..etc. & air mixing process control.
19	Humidity control in air washers and air handling units, Single A H U control systems.
20	Multi-zone AHU and its control systems.
21	Air conditioning with reheat system control.
22	Water A/C system (fan coils) control systems.
23	Programing computer (PC) using in Ref.& A/C systems controls, by using interface card contains ADC & DAC.
24-26	Concepts, components & characteristics of PLC, logic gets, secondary logic gets, applications of PLC in Ref. & A/C systems. Explanation the programing of a simple refrigeration unit and chiller unit)
27	Principles of direct digital controller (DDC), components, advantages and steps of construction.
28	Using of DDC in A/C systems: 1- economic air mixing control system 2- refrigeration & dehumidification
29	Control of constant volume system heating, ventilation and A/C.
30	DDC programs for Air conditioning.

## Practical Subjects

1	Over view on the control workshop , tools, and measuring devices
2	Knowledge of connection & operation of the measuring devices for temperature, pressure, humidity, fluid flow.
3	Built electric circuit (power & control) for domestic refrigerator or freezer and checking before operating the circuit.
4	Built electric circuit (power & control) for domestic water cooler and checking before operating the circuit.
5	Built electric circuit (power & control) for domestic window type A/C for cooling and checking before operating the circuit.
6	Built electric circuit (power & control) for domestic window type A/C for cooling & heating, and checking before operating the circuit.
7	Built electric circuit (power & control) for domestic defrost refrigerator and checking before operating the circuit.
8	Built electric circuit (power & control) for domestic clothes washer and checking before operating the circuit.
9	Check and calibration of thermal expansion valve.
10	Check and calibration for the contacts of the electric contactor & thermal switch.
11	Check and calibration of ON-OFF switches and Pressure switches.
12	Draw and Built a control circuit of refrigeration compressor ( safety & operation)
13-14	Experiments on the pneumatic valves
15	Examination
16	Built power and control circuits of air cooled A/C package unit, using lamps instate of its

	elementary components.
17	Comparison of the last exercise and an actual air cooled A/C package unit.
18	Built power and control circuits of water cooled A/C package unit, using lamps instate of its elementary components.
19	Comparison of the last exercise and an actual water cooled A/C package unit.
20	Built a control circuit for motor power circuit (ON-OFF) start and stop from one location.
21	Built a control circuit for motor power circuit (ON-OFF) start and stop from two deferent locations.
22	Built a control circuit for motor power circuit (star-delta) rotate in one direction, and other in two directions.
23	Practical study of the PLC gets.
24	Electronic control circuit for air cooled A/C unit.
25-26	Dissembles, checking, maintenance, and operate a split unit cart.
27-29	Working on the controlling programs of Ref. & A/C systems.
30	Final Exam.