

**DETAILED SYLLABUS FOR THE POST OF JUNIOR INSTRUCTOR-  
REFRIGERATION AND AIR CONDITIONING IN INDUSTRIAL TRAINING  
DEPARTMENT**

*(CATEGORY NOS: 665/2023, 729/2023)*

*(TOTAL MARKS ±100)*

<b>MODULES</b>	<b>SUB-HEADINGS</b>	<b>TOPICS</b>	
<b>Module-1</b> Fitting, Sheet metal & Welding	Safety	Safety precautions	2
		First Aids	
		Personal Protective Equipments (PPE)	
		Fire fittings equipments	
		Electrical safety	
	Fitting	Different types of fitting hand tools, power tools	3
		Functions, constructions, specifications & application of hand tools and power tools	
		Care and maintenance of hand tool & power tools	
		Machineries and equipments like drilling machines, grinding machines etc	
		Function, construction, specification, application, care & maintenance of machineries & equipments	
		Precision measuring instruments like vernier calliper, micrometers, vernier height gauge etc	
		Functions, constructions, specifications & application of precision instruments	
		Care and maintenance of precision instruments	
		Sheet metal	
	Construction, working, use, application and specification		
	Care and maintenance of sheet metal tools, instruments & equipments		
	Types of sheet metal joints		
	Rivets & riveting, their types and uses		
	Welding	Welding tools and equipments, types specifications and use	2
		Oxy-Acetylene welding equipments & accessories	
Gas welding hand tools and safety apparels			
Arc welding accessories			
Classification of welding process			

		Methods of gas welding	
		Use of Oxy Acetylene, Oxy LPG, Air LPG and two stage regulator	
		Types of weld	
<b>Module-2</b> Electrical	Electrical	Electrical terms such as AC and DC supply, voltage, current, capacitors, resistors, power, energy, frequency etc	3
		Conductors and insulators	
		Series circuits, parallel circuits, open circuits, short circuits	
		Material used as conductors	
		Joints in conductors	
		Measuring instruments such as voltmeter, ammeter, ohmmeter, energy meter, frequency meter etc	
		Earthing and its importance	
		Earth resistance, insulation, and continuity testing	
	AC Motors	Single phase and three phase motors	3
		Construction and working principle of Capacitor start Capacitor run induction motor (CSR), Split phase induction motor (RSIR), Capacitor start induction motor (CSIR), Permanent Capacitor or capacitor run induction motor (PSC), Resistance start capacitor run induction motor (RSCR), Shaded pole motor etc	
		Centrifugal switch	
		Methods of changing the direction of rotation	
		Construction and working principle of squirrel cage induction motor, slip ring induction motor	
Common faults, causes and remedies in single phase and three phase motors			
Motor starters	Construction and working of Single phase and three phase motor starters such as DOL starter, Star delta starter, Auto transformer starter, Rotor resistance starter	2	
	Common faults, causes and remedies in single phase and three phase motor starters		
<b>Module-3</b> Electronics	Electronic components	Active and passive components	2
		Resistor, Capacitors, Semiconductors, Diodes, Transistors etc	
		Rectifiers (Half wave, Full wave, Bridge rectifier etc )	
		Zener diodes, voltage regulator, Amplification	
		Transistors-CB,CE,CC Configuration	
Photo diodes, Photo transistors, Multi vibrator, SCRs, UJTs, ICs etc			

<b>Module-4</b> Basic refrigeration	Refrigeration tools, instruments, and equipments	Refrigeration tools, instruments, and equipments	4
		Construction, working, use, application and specification	
		Care and maintenance of refrigeration tools, instruments & equipments	
	Fundamentals of refrigeration	Fundamentals of refrigeration	5
		Science related to refrigeration such as units, mass, weight, work, power, energy, force, pressure, heat, temperature, sensible heat, latent heat, super heating, sub cooling, saturation temperature, boiling point, freezing point, etc	
		Laws of thermodynamic, Laws of perfect gases	
	Different types of refrigeration system	Construction and working of ice refrigeration	3
		Construction and working of Dry ice refrigeration	
		Construction and working of Water vapour refrigeration	
		Construction and working of Liquid gas refrigeration	
		Construction and working of Evaporative refrigeration	
		Construction and working of Steam jet refrigeration	
		Construction and working of Thermo electronic refrigeration	
Construction and working of Vapour absorption refrigeration cycle			
Construction and working of Vapour compression cycle, fundamental operations, Sub cooling and super heating			
Application of vapour compression cycle			
COP, Ton of Refrigeration			
Study of Ph, Ts, Pv diagram			
Compressor	Construction, working, types and application of different compressors such as Reciprocating, Rotary, Scroll, Screw, Centrifugal, Swash plate etc	5	
	Volumetric efficiency, capacity control, factors influencing volumetric efficiency, piston displacement, compression ratio etc		
	Compressor lubrication oil, properties, types and lubrication methods		
	oil separator		
	Advantage and disadvantage of different types of compressors		
	Common faults, care and remedies in compressor		
	Construction, working, types and application of condensers such as air cooled, Water cooled, evaporative		

<b>Module-5</b> Refrigeration equipments	Condenser	Capacity of condensers, factors affecting the condenser capacity	3
		Advantage and disadvantage of different types of condensers	
		De-scaling, methods of descaling, fouling factor etc	
		Liquid receiver	
		Drier, types and application	
		Description of desiccants	
	Cooling tower	Construction and working principles of different types of cooling towers	3
		Types of cooling towers	
		Capacity of cooling towers, factors affecting the cooling tower capacity	
		Advantage and disadvantage of different types of cooling towers	
		Cooling tower approach, range, efficiency etc	
		Water treatment, water softening plant	
	Expansion valve	Construction and working principles of different types of expansion valves such as Thermostatic expansion valves (TXV), Automatic expansion valves (AXV), Float valve, Electronic expansion valves, Level master control (LMC), Capillary tubes etc	3
		Selection of expansion valves	
Evaporator	Construction and working principles of different types of evaporators	2	
	Capacity of an evaporator, factors affecting the capacity of an evaporator		
	Types of evaporators such as Natural convention, forced convention, flooded evaporator, Dry expansion evaporator, Bare tube coil evaporator, Finned tube evaporator, Plate evaporator, Shell and tube, Shell and coil, Tube in tube evaporator, frosting evaporator, non frosting evaporator etc		
	Methods of defrosting such as Manual defrosting, Pressure control defrosting, Temperature control defrosting, Water defrosting, Reverse cycle defrosting, Simple hot gas defrosting, Automatic defrosting, Electric defrosting etc		
	Accumulator		
	Heat exchanger, their function, construction, application & advantage		
	Properties of refrigerant		
	Classification of refrigerants		

<b>Module-6</b> Refrigerant	Refrigerant	Alternative refrigerants	5
		Climatic impact of refrigerants	
		Ozone depletion potential (ODP)	
		Green house effect- global warming (GWP)	
		ODP & GWP of various Refrigerants	
		Numbering of refrigerants	
		Refrigerant cylinders, Cylinder colour coding	
		Handling of refrigerant cylinders & Flammable refrigerant	
		Refrigerant leak detection methods	
		Flushing, leak testing, Evacuation, Gas charging in different system	
		Retrofitting	
<b>Module-7</b> Refrigeration system	Refrigerator (direct cool)	Construction and working principles of single door direct cool refrigerator	3
		Study the electrical and mechanical components	
		Testing of electrical and mechanical components	
		Door gasket	
		Heat insulation materials, types & properties	
		Trouble shooting of refrigerator	
		Installation method	
		Care and maintenance of refrigerator	
		Leak testing, Evacuation, Gas charging	
		Electrical circuit diagram	
	Frost free refrigerator	Construction and working principles of frost free refrigerator (2 or 3 door)	2
		Study the electrical and mechanical components	
		Testing of electrical and mechanical components	
		Trouble shooting of frost free refrigerator	
		Care and maintenance of frost free refrigerator	
		Installation method	
		Leak testing, Evacuation, Gas charging	
		Electrical circuit diagram	
	Refrigerator (inverter technology)	Construction and working principles of refrigerator	1
		Refrigeration cycle & Air cycle	
		Study the electrical and mechanical components	
Testing of electrical and mechanical components			
Trouble shooting of refrigerator			
Care and maintenance of refrigerator			
Leak testing, Evacuation, Gas charging			
Electrical circuit diagram			

<b>Module-7</b> Refrigeration system	Water cooler & Water dispenser	Construction and working principles of water cooler & water dispenser	2
		Types of water cooler & water dispenser	
		Refrigeration cycle of water cooler & water dispenser	
		Study the electrical and mechanical components	
		Testing of electrical and mechanical components	
		Trouble shooting of water cooler & water dispenser	
		Care and maintenance of Water cooler & Water dispenser	
		Leak testing, Evacuation, Gas charging	
		Electrical circuit diagram	
	Insulation materials		
	Visible cooler & Bottle cooler	Description, Construction and working principles	1
		Study the electrical and mechanical components	
		Testing of electrical and mechanical components	
		Trouble shooting of visible cooler & bottle cooler	
		Care and maintenance of visible cooler & bottle cooler	
		Leak testing, Evacuation, Gas charging	
	Deep freezer/Display carbine	Electrical circuit diagram	2
		Description, Construction and working principles	
		Study the electrical and mechanical components	
		Testing of electrical and mechanical components	
		Trouble shooting	
		Care and maintenance	
		Leak testing, Evacuation, Gas charging	
	Electrical circuit diagram		
	Ice cube machine/Soft y machine	Installation method	1
		Description, construction, working	
		Study the electrical and mechanical components	
		Testing of electrical and mechanical components	
		Trouble shooting	
		Care and maintenance	
		Leak testing, Evacuation, Gas charging	
		Electrical circuit diagram	
installation method			
Window Air Conditioner	Construction and working principles	5	
	Study the electrical and mechanical components		
	Testing of electrical and mechanical components		
	Trouble shooting and servicing		
	Installation method		
	Care and maintenance of refrigerator		
	Leak testing, Evacuation, Gas charging		
	Electrical circuit diagram		
	Energy Efficiency Ratio(EER)		
	Energy Efficiency labeling on Air-Conditioning system		
	Construction and working principles		
Study the electrical and mechanical components			

<b>Module-8</b> Air conditioning system	Split Air-Conditioner (Wall Mounted, Floor, Ceiling/Cassette mounted, Duct able)	Testing of electrical and mechanical components	2
		Trouble shooting and servicing	
		Installation method	
		Care and maintenance of refrigerator	
		Leak testing, Evacuation, Gas charging	
		Electrical circuit diagram	
		Energy Efficiency Ratio(EER)	
		Energy Efficiency labeling on Air-Conditioning system	
	Multi split Air-Conditioner	Construction and working principles	2
		Study the electrical and mechanical components	
		Testing of electrical and mechanical components	
		Trouble shooting and servicing	
		Installation method	
		Care and maintenance of refrigerator	
		Leak testing, Evacuation, Gas charging	
		Electrical circuit diagram	
	Inverter Split Air-Conditioner	Construction and working principles	1
		Study the electrical and mechanical components	
		Testing of electrical and mechanical components	
		Trouble shooting and servicing	
		Installation method	
Care and maintenance of refrigerator			
Leak testing, Evacuation, Gas charging			
Electrical circuit diagram			
<b>Module-9</b> Commercial	Ice candy plant	Function, construction, Working principle	1
		Circuit diagram	
		Capacity & types of compressor used	
		Brine solution types, properties	
		Testing of electrical and mechanical components	
		Trouble shooting and servicing	
		Installation method	
		Care and maintenance of refrigerator	
	Leak testing, Evacuation, Gas charging, Retrofit		
	Ice plant	Function, construction, Working principle	2
		Circuit diagram	
		Capacity & types of compressor used, agitator	
		Brine solution types, properties	
		Testing of electrical and mechanical components	
Trouble shooting and servicing			
Installation method			
Care and maintenance of refrigerator			
Leak testing, Evacuation, Gas charging			
		Function, construction, Working principle	
		Circuit diagram	

Refrigeration and air conditioning system	Walk in cooler & reach in cabinet	Capacity & types	1
		Trouble shooting and servicing	
		Installation method	
		Care and maintenance of refrigerator	
	Cold storage	Leak testing, Evacuation, Gas charging	3
		Function, construction, Working principle	
		Controls & Circuit diagram	
		Capacity & types of cold storage and its details	
		Trouble shooting and servicing	
		Installation method	
		Care and maintenance of refrigerator	
		Methods of Leak testing, Evacuation, Gas charging	
		Food preservation	
		Maintaining temperature in different places	
		Properties of commonly used refrigerants like ammonia and its safe handling	
use of vibration eliminator and shock absorber			
Mobile refrigeration in transport vehicle			
Deep freezing, Freezing tunnel, Blast freezing			
	Requirement of comfort Air-Conditioning		



<b>Module-9</b> Commercial Refrigeration and air conditioning system	Psychrometry		4	
		Study of psychrometric terms-DBI, WBT, RH, enthalpy, dew point, specific humidity etc		
		Study of psychrometric chart-Dry bulb temperature line, Wet bulb temperature line, Specific humidity or moisture content line, Dew point temperature line, Enthalpy (total heat) line, Vapour pressure line, Relative humidity line etc		
		Study of psychrometric process-Sensible heating, Sensible cooling, Humidification & Dehumidification, Cooling and adiabatic humidification, Cooling and humidification by water injection, Heating and humidification, Humidification by steam injection, Adiabatic chemical dehumidification etc		
		Heat load calculation for commercial and industrial buildings		
	Central Air-Conditioning system/HVAC plant	Introduction to HVAC	3	
		Fundamentals of central Air-Conditioning/ HVAC plant		
		Types of central Air-Conditioning (direct & indirect)		
		Construction & Working		
		Components, Fault, Care & Maintenance		
		Temperature & pressure control used in AC plant		
		Construction and working of safety devices in AC plant		
		Cooling tower, Pipe lines		
		Preventive maintenance schedule of central Air-Conditioning plant		
		Maintain log book for daily operation		
		Modulating valve for temperature control		
		Package chiller, Screw chiller, Reciprocating chiller		
		Humidity control		
		Humidifier		
	Dehumidifier			
	Air washer			
AHU, FCU				
Chilled water system				
Package Air-Conditioner (Air cooled, Water cooled condenser)	Construction & working principles	1		
	Types, application			
	Installation methods			
	Trouble shooting			
	Care and maintenance			
	Temperature & pressure control			
Construction and working of safety devices				

<b>Module-9</b> Commercial Refrigeration and air conditioning system	Split package	Construction & working principles	1
		Types, application	
		Study of various electrical & mechanical components	
		Installation methods	
		Trouble shooting	
		Care and maintenance	
		Temperature & pressure control	
		Construction and working of safety devices	
		VRV/VRF system	
		Details of piping	
		Common reason for error code	
		Types of ODU & IDU	
	Duct	Function, types	4
		Classification of ducts	
		Materials used for ducting	
		Duct designing	
		Pressure in ducts	
		Duct insulations	
		Properties of insulation materials	
		K-factors	
		Acoustic insulation	
		Air distribution methods	
		Air flow	
		Fan and blower	
		Function, types, classification of fan & blower	
		Static & Velocity pressure measurements	
	Air Filter	Construction, Function of air filters	3
Types of air filters			
Care & maintenance of air filter			
Effect of choked air filter			
Clean room			

<b>Module-10</b> Automobile air- Conditionin g	Car Air- Conditioner	Construction, working	2
		Study various electrical & mechanical components	
		Testing components	
		Electrical circuit diagram	
		Fault detection	
		Leak testing, evacuation, gas charging	
		Installation	
		Trouble shooting	
		Magnetic clutch operation	
		Free wheeling	
		Care and maintenance	
	Mobile Air- Conditioner (Bus, Train)	Study the refrigeration cycle in automobile AC	1
		Construction and working of bus AC	
		Magnetic clutch operation, free wheeling	
		Refrigerant used HCFC-22, HFC_134a, HFOs, Blends of HFCs, and HFOs	
		Construction and working of train AC	
		Trouble shooting of Bus AC & Train AC	
		Planning for Preventive maintenance and scheduling	
	Maintenance actives in large AC and Refrigeration plant		

**NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper**