



Curriculum of the 5th Class (PE Syllabus)

Syllabus Section#	Outcomes	Objectives
A.	Act and Codes	
i.	<i>An understanding of the Safety Codes Act and applicable regulations.</i>	<ol style="list-style-type: none"> 1- <i>Explain the purpose and scope of your jurisdictional act and regulations.</i> 2- <i>Explain the purpose and intent of the regulations governing the operation of boilers and pressure equipment.</i> 3- <i>Discuss the regulations relating to power engineering qualifications.</i>
ii.	<i>Introduction to CSA and ASME Codes for Power and Heating Boilers</i>	<ol style="list-style-type: none"> 1- <i>Explain the content and use of the CSA-B51 Boiler, Pressure Vessel, and Pressure Piping Code.</i> 2- <i>Explain the content and use of the CSA-B52 Mechanical Refrigeration Code.</i> 3- <i>Explain the purpose of ASME Boiler and Pressure Vessel Code, Section I – Power Boilers</i> 4- <i>Explain the purpose of ASME Boiler and Pressure Vessel Code, Section VII – Recommended Rules for the Care and Operation of Power Boilers.</i> 5- <i>Explain the purpose of ASME Boiler and Pressure Vessel Code, Section IV – Heating Boilers.</i> 6- <i>Explain the purpose of ASME Boiler and Pressure Vessel Code, Section VI – Recommended Rules for the Care and Operation of Heating Boilers.</i>
B.	Applied Science	<ol style="list-style-type: none"> 1- <i>Perform basic arithmetic operations (addition, subtraction, multiplication and division) on whole numbers without the use of a calculator.</i> 2- <i>Perform basic arithmetic operations on decimal numbers.</i>



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		<ul style="list-style-type: none"> 3- Perform basic arithmetic operations on fractions 4- Reduce fractions to lowest terms Convert fractions to decimals and decimals to fractions 5- Evaluate percentage problems. 6- Given a ratio, determine the correct quantity of a substance. 7- List SI units for length, mass, temperature, speed, and their symbols. 8- Identify and list symbols for unit prefixes. 9- Perform conversions between basic SI, Imperial, standard (USCS) and US Customary units. 10- Transpose commonly used equations involving up to two variables and all basic mathematical operations. 11- Insert values into common equations and solve them.
i.	<i>Areas and volumes of solids</i>	<ul style="list-style-type: none"> 1- state the SI units for area and volume. 2- Calculate the surface area and volume of a rectangular tank. 3- Calculate the surface area and volume of a cylinder.
ii.	<i>Simple machines</i>	<ul style="list-style-type: none"> 1- Identify where simple machines are used in the plant. 2- Define mechanical advantage.
iii.	<i>Introduction to mechanics</i>	<ul style="list-style-type: none"> 1- Define the terms force, velocity, mass, pressure, energy, work, and power. 2- Explain the application of levers, pulleys, and inclined planes.



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	iv.	<i>Introduction to thermodynamics</i>	1- Describe the three states of matter 2- Describe the expansion of solids and liquids. 3- Explain the different temperature scales used in thermodynamics (Celsius and Fahrenheit) 4- Define sensible and latent heat. 5- Describe the three modes of heat transfer.
	v.	<i>Thermodynamics and properties of steam</i>	1- Appreciate the energy of the expansion of water to steam.
	vi.	<i>Thermodynamics and properties of refrigeration</i>	1- Describe the identification and classification of refrigerants. 2- Describe the characteristics and thermodynamic properties of refrigerants. 3- Describe the physical properties of refrigerants.
C.		Safety	
	i.	<i>Fire safety; classes of fires, types and operation of extinguishers</i>	1- Explain the overall need for and the intent of fire protection standards, laws and regulations. 2- Explain the different fire classifications and describe the extinguishing methods for each. 3- Explain the application and operation of standpipes, hoses and sprinklers in buildings. 4- Explain the various types of fire and smoke detectors. 5- Describe the operation, placement and maintenance of the common types of portable extinguishers. 6- Discuss the need and use of a fire-pump.
	ii.	<i>Building and occupant safety</i>	1- Explain the personal safety responsibilities and precautions that must



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			<i>be applied by the Power Engineer.</i>
	iii.	<i>Confined space entry</i>	1- <i>Define confined space, list some confined spaces and describe the hazards of being in a confined space.</i> 2- <i>Refer to local jurisdictional regulations and describe procedures to be followed when performing a confined space entry, including completion of an entry checklist.</i>
	iv.	<i>Safe storage of flammables</i>	1- <i>Compliance with NFPA 31, 37, 54, 58</i>
	v.	<i>WHMIS classification of controlled products</i>	1- <i>Explain who is responsible for maintaining WHMIS records.</i> 2- <i>Discuss your rights and responsibilities under WHMIS</i>
	vi.	<i>WHMIS labeling of controlled products</i>	1- <i>Explain the meaning, enforcement (labeling) and importance of WHMIS.</i>
	vii	<i>WHMIS material safety data sheets</i>	1- <i>Explain what Material Safety Data Sheets (MSDS) consist of.</i>
	viii.	<i>Personal safety equipment</i>	2- <i>Explain the general intent of Occupational Health and Safety Standards.</i>
	ix.	<i>Occupational health and safety legislation</i>	1- <i>Discuss some of the responsibilities, according to the Act, of workers, employers and others in relation to health and safety.</i> 2- <i>Describe the conditions that must exist before a worker can refuse to work.</i> 3- <i>Identify and discuss jurisdictional regulations related to health and safety.</i>
	x.	<i>Housekeeping</i>	1- <i>Describe the general safety precautions required in the maintenance and operation of buildings.</i>



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	xi.	<i>Artificial respiration/acceptable methods, CPR, treatment for electric shock</i>	1- <i>Identify common scenarios where the Power Engineer can prevent accidents and explain the importance of first aid and CPR training.</i>
	xii.	<i>Safe work systems</i>	1- <i>Describe the general safety precautions required in the maintenance and operation of buildings.</i>
D.		Welding and Plumbing	
	i.	<i>Welding terms and inspection</i>	1- <i>Define the common terms used in welding.</i> 2- <i>Describe the jurisdictional requirements for a weld repair.</i> 3- <i>Explain the role of the 5th Class Power Engineer in preparing for a welder.</i> 4- <i>Discuss the commonly used methods of weld inspection and testing.</i>
	ii.	<i>Hot water heaters; operation and maintenance</i>	1- <i>Describe the hot water distribution system in a building.</i> 2- <i>Describe the construction and operation of building system hot water heaters.</i> 3- <i>Explain what is meant by “backflow prevention” and describe the common methods used.</i> 4- <i>List and describe the construction and operation of water system protective devices in buildings.</i>
	iii.	<i>Building water supply systems; operation, maintenance, safety</i>	1- <i>Describe the cold water distribution system in a building.</i>
	iv.	<i>Sanitary drainage systems; repair, safety</i>	1- <i>Describe the overall layout of building drainage systems.</i> 2- <i>Describe storm water drainage systems for buildings.</i> 3- <i>List the steps to take in the routine maintenance of building sanitary drainage system devices.</i>



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			4- <i>Apply a troubleshooting guide for sanitary drainage systems.</i>
E.		Pumps, Piping and Valves	
	i.	<i>Types of Pumps</i>	1- <i>List the common applications of pumps in the power industry.</i> 2- <i>Define the terms associated with pump performance.</i> 3- <i>Sketch and describe the common types of pumps used in the power industry.</i>
	ii.	<i>Pump components</i>	1- <i>Describe the construction and function of pump wear rings.</i> 2- <i>Discuss pump shaft sealing and describe the process that is followed when replacing compression type packing.</i> 3- <i>Sketch and describe the standard types of mechanical seals.</i> 4- <i>Describe pump bearing and shaft alignment equipment and procedures.</i>
	iii.	<i>Pump operation and maintenance</i>	1- <i>Describe pump start-up and priming procedures.</i> 2- <i>Apply pump troubleshooting steps.</i> 3- <i>Discuss the concept of lubrication and list the purposes of a lubricant.</i> 4- <i>List the various classes and types of lubricants and describe their respective properties and application.</i> 5- <i>List the properties of lubricating oils and the additives used.</i> 6- <i>Define boundary and full fluid film lubrication.</i> 7- <i>Sketch and describe shell (sleeve) bearings.</i> 8- <i>Describe the construction and operation of thrust bearings.</i> 9- <i>Describe how to clean and replace roller</i>



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			<p><i>and ball type bearings.</i></p> <p>10- <i>List the causes of bearing failure.</i></p>
	iv.	<i>Piping materials and connections</i>	<p>1- <i>Explain the characteristics and applications of the various materials used to manufacture piping and fittings.</i></p> <p>2- <i>Explain pipe size schedules and classifications.</i></p> <p>3- <i>Identify screwed, flanged, and welded pipe connections.</i></p>
	v.	<i>Piping; expansion, support, insulation and drainage</i>	<p>1- <i>Explain pipe expansion and the principle of expansion bends and joints.</i></p> <p>2- <i>Explain the purpose of pipe supports and describe various pipe support designs.</i></p> <p>3- <i>Explain the purposes for pipe insulation and describe the use of the common insulation materials.</i></p>
	vi.	<i>Types and operation of steam traps</i>	<p>1- <i>Describe the design and operating principle of mechanical traps.</i></p> <p>2- <i>Describe the designs and operating principles of thermostatic steam traps.</i></p> <p>3- <i>Describe the correct piping arrangement and procedures for a steam trap.</i></p> <p>4- <i>Explain the purpose and design of a strainer.</i></p> <p>5- <i>Explain the causes, effects, and prevention of water hammer.</i></p>
	vii.	<i>Introduction to valves; types and applications</i>	<p>1- <i>Describe 5 standard valve designs: gate, globe, butterfly, ball, and plug.</i></p> <p>2- <i>Describe the design and operation of check and non-return valves.</i></p> <p>3- <i>Describe the function of a pressure-reducing valve.</i></p> <p>4- <i>Describe valve identification markings.</i></p> <p>5- <i>Describe typical valve maintenance requirements.</i></p>



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			6- Describe the stop valves and drain connections on hot water boilers.
F.		Boiler Details	
	i.	<i>Materials used in construction</i>	1- Describe the construction of watertube and copper-tubular boilers. 2- Describe the general design and construction of a typical large steam generating unit.
	ii.	<i>Basic boiler terminology</i>	1- Glossary of Terms
	iii.	<i>Watertube, tubular, firetube, cast-iron sectional and modular heating boilers</i>	1- Describe the water circulation in a longitudinal drum straight tube boiler. 2- Describe four-drum, three-drum, and two-drum bent tube boilers and the advantages of a bent tube boiler compared to a straight tube boiler. 3- Describe the construction of the A type, D type, and O type and the advantages of packaged watertube boilers. 4- Explain the difference between power and heating boilers. 5- Describe the construction and application of the horizontal return tubular, locomotive, and firebox boilers. 6- Describe the construction and application of wetback and dryback Scotch boilers. 7- Describe the construction and application of vertical firetube boilers used in heating plant service. 8- Describe the construction of packaged firetube boilers. 9- Describe the general construction of cast-iron sectional boilers. 10- List the advantages of cast-iron sectional boilers over watertube and firetube boilers. 11- Describe the arrangement of equipment in a multiple cast-iron sectional boiler



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			<p><i>heating plant.</i></p> <p>12- Describe the construction and operation of cast-iron modular boilers.</p> <p>13- Describe the principle of thermoil heating.</p> <p>14- Describe a direct heating thermoil system.</p> <p>15- Describe the design and operation of unfired steam generating systems.</p> <p>16- Explain the application of a microturbine as a Central Heating Plant (CHP) and the routine checks performed on a microturbine.</p> <p>17- Explain startup and shutdown procedures.</p> <p>18- Explain the proper routine pre-start and operational checks.</p> <p>19- Identify the three main methods of starting gen-sets.</p>
	iv.	<i>Electric boilers</i>	
	v.	<i>High pressure boilers; components, operation, maintenance, repair, inspections, knowledge of power plant auxiliary equipment</i>	<p>1- <i>Watertube, fire tube, electric boilers components, maintenance, and repair.</i></p> <p>2- <i>Auxiliary equipment in power plants.</i></p>
G.		Boiler Fittings	
	i.	<i>Basic fittings for steam heating boilers</i>	<p>1- Describe the construction, purpose, and operation of pressure gauges and siphons.</p> <p>2- Describe the testing of pressure gauges.</p> <p>3- Describe the purpose, function, and testing of gauge glasses and water columns.</p>
	ii.	<i>Operation and testing of boiler safety valves, boiler gauge glass and water column</i>	<p>1- Describe the construction, operation, mounting, and testing of safety valves.</p> <p>2- Explain how to change a gauge glass.</p>



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			3- Describe the construction, operation, and purpose of the following valves: gauge glass safety shutoff valves, gauge glass quick closing valves, stop valves, check valves, blowoff (blowdown) valves, and vent valves.
	iii.	Basic fittings for hot water boilers	1- Identify the operational fittings used in hot water heating boiler systems and explain the function of a pressure gauge. 2- Explain how to change a gauge glass. 3- Describe the operation of the "auto fill valve". 4- List the types of optional fittings that are used in hot water heating boiler systems.
H.		Fuels and Combustion	
	i.	Types of fuels, combustion principles, draft and flue gas analysis	1- Describe the use, advantages and characteristics of common boiler fuels. 2- State the requirements and reactions for complete and incomplete combustion.
	ii.	Gas burners for boilers	1- Describe the operation of atmospheric and ring gas burners. 2- Describe the construction and operation of automatic valves.
	iii.	Oil burners for boilers	1- Describe the principal oil atomizing burners for boilers. 2- List and describe the auxiliary equipment needed for an oil combustion system. 3- Describe the overall components and operation of fuel oil systems.
	iv.	Draft; natural, induced and forced	1- Explain natural and mechanical draft arrangements. 2- Describe draft measurement using U-tube and inclined draft gauges.
	v.	Boiler and furnace explosions	1- Explain the difference between a pressure explosion and a furnace



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		explosion.
I.	Boiler Controls	
i.	<i>Low water fuel cutoffs; operation and testing</i>	<ol style="list-style-type: none"> 1- Describe the construction and operation of float and electrode low water level fuel cut-off equipment. 2- Describe the testing and maintenance of float and electrode low water level fuel cut-offs.
ii.	<i>Heating boiler feedwater controls</i>	<ol style="list-style-type: none"> 1- Describe the operation of a feedwater float switch operating a valve and a float switch operating a pump. 2- Explain the purpose and function of heating boiler feedwater and condensate piping connections.
iii.	<i>Heating boiler operating controls</i>	<ol style="list-style-type: none"> 1- Describe the operation of the on-off control, the high-low fire control, the modulating control, and the high limit control found on low-pressure steam boilers and hot water heating boilers. 2- Explain the operation of the common control switches found on a low-pressure heating boiler. 3- Explain the required testing and maintenance of heating boiler controls.
iv.	<i>Heating boiler combustion controls</i>	<ol style="list-style-type: none"> 1- List and discuss the various types of boiler flame failure detectors. 2- Describe the testing of boiler flame failure safety devices.
v.	<i>Boiler programmable controls, safety interlocks</i>	<ol style="list-style-type: none"> 1- Describe the operation of the safety switches found on the fuel supplies of low-pressure heating boilers. 2- Describe the operation of equipment that is used to automatically startup and shutdown boilers. 3- List a typical sequence of startup and shutdown events.



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			4- Describe common 5th Class operator responses to a boiler programmer startup or shutdown.
J.		Boiler operation, maintenance and water treatment	
	i.	<i>Hot water heating boilers; start-up, operation and shut-down</i>	<ol style="list-style-type: none"> 1- Explain the preparation required before starting a steam or hot water boiler. 2- Explain the startup steps once the boiler has been prepared. 3- State possible abnormal conditions during startup, the cautions required to avoid uneven expansion and thermal shock. 4- Describe the procedure required when "cutting in" an additional boiler. 5- Describe the operating conditions for hot water boilers and steam boilers that must be checked daily and state the required monthly checks. 6- Explain the procedure for removing a hot water boiler from service. 7- Describe the procedure for removing a steam boiler from service. 8- Explain the emergency conditions that can occur during the operation of a steam boiler. 9- Explain the causes and prevention of furnace and pressure explosions. 10- Explain the reasons for boiler accidents and describe the role and design of operating logs in safe operation of a boiler. 11- Operator traits, good operating practice, curiosity, using your senses (sense-interpret-analyze-perform=SIAP), trusting your instincts, experience, and common sense.
	ii.	<i>Steam heating and power boilers; start-</i>	1- Explain the startup, operation, and shutdown of steam heating and power



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	<i>up, operation, shut-down</i>	<p>boilers.</p> <p>2- Describe the general servicing and routine maintenance of packaged firetube and cast-iron sectional boilers.</p> <p>3- Describe the inspection of a boiler.</p> <p>4- Describe the methods and tools used for mechanical cleaning of a boiler.</p>
iii.	<i>Testing safety devices</i>	<p>1- Describe the construction, operation, mounting, and testing of safety valves.</p>
iv.	<i>Cause and prevention of boiler explosions</i>	<p>1- Pressure explosions: high a steam pressure fuel cut off failure, metal weakening (heating the boiler up too quickly during startup, low water condition due to low-water fuel cut-off failure, scale and sludge build up.</p> <p>2- Furnace Explosions: Insufficient pre-purge, admission of fuel before pilot flame is established, weak pilot flame, weak flame, flame out fuel shut of failure, insufficient combustion air.</p>
v.	<i>Boiler maintenance and preparation for inspection</i>	<p>1- List the steps and precautions to be taken to prepare a boiler for inspection.</p>
vi.	<i>Replacement of tubes and stays</i>	<p>1- Describe the symptoms of a leaking firetube.</p>
vii.	<i>Boiler cleaning</i>	<p>1- Describe the methods and tools used for mechanical cleaning of a boiler.</p>
viii.	<i>Boiler lay up</i>	<p>1- Explain the importance of layups and the procedures to be followed for wet and dry boiler layups.</p>
ix.	<i>Boiler water treatment basic chemistry, monitoring and testing</i>	<p>1- List the 4 classes of impurities and the problems they cause.</p> <p>2- Explain the purpose of external filtration and describe the design of pressure, filter-aid and cartridge filters.</p> <p>3- Explain the prevention of scale, corrosion and foaming.</p>



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			4- Explain boiler blowoff / blowdown. 5- Describe the operating principles of a sodium zeolite water softener. 6- Explain troubleshooting and common operating problems associated with water softeners. 7- Describe methods of feeding treatment chemicals into a boiler. 8- Explain how to obtain a “representative” water sample. 9- Discuss testing methods. 10- Describe the principles and procedures for a hardness, dissolved solids, molybdate and pH test. 11- Define potable water and explain the importance of backflow prevention. 12- Describe the testing of potable water.
	x.	<i>Boiler hydrostatic testing and safety precautions</i>	1- Explain hydrostatic test procedure
K.		Heating Systems and Human Comfort	
	i.	<i>Heat gains and losses</i>	1- Define heat transmission terminology and identify conversions or related units. 2- Describe the heat gains that occur in a building due to conduction, infiltration, ventilation, and radiation. 3- Describe the heat gains that occur in a building due to people, lighting, electric motors, appliances, and cooking. 4- Describe the heat losses that occur in a building due to conduction, convection, radiation, infiltration, and ventilation.
	ii.	<i>Steam heating equipment</i>	1- Describe the construction and operation of steam heating system devices used to transfer heat from the steam to a heated space.



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			2- <i>List and describe the auxiliary equipment used in a steam heating system, including air vents, radiator valves and traps, and condensate return equipment.</i>
	iii.	<i>Steam heating systems and operation</i>	1- <i>Describe standard types of piping and equipment layout for steam heating systems.</i> 2- <i>Describe the general operation and maintenance of steam heating systems.</i> 3- <i>Apply a steam heating system troubleshooting guide.</i>
	iv.	<i>Hot water heating systems equipment and operation</i>	1- <i>Sketch and describe the standard piping and circulation layouts of hot water heating systems.</i> 2- <i>Compare the advantages and disadvantages of hot water and steam heating systems.</i> 3- <i>Describe radiant panel and snow melting hot water systems.</i> 4- <i>Describe the purpose and function of standard hot water heating system accessories such as diverter fittings, air vents, air separators, flow control valves, balancing valves and fittings, riser stop valves, pressure reducing valves, circulating pumps, expansion tanks, and steam to hot water converters.</i> 5- <i>Explain how the location of the hot water circulating pump and the expansion tank are determined.</i> 6- <i>Describe the cleaning, filling, starting, routine operation, and troubleshooting of hot water heating systems.</i> 7- <i>Apply a hot water heating system troubleshooting guide.</i>
	v.	<i>Steam to hot water convertor</i>	1- <i>Explain steam to hot water converters.</i>
	vi.	<i>Ventilation fans and air filters</i>	1- <i>Compare the advantages and disadvantages of forced and gravity</i>



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			<p>warm air systems.</p> <p>2- List and describe the common sources of warm air heat.</p> <p>3- List and describe the operational characteristics of directly fired space heaters.</p> <p>4- Describe the operation of furnace components, including both mechanical and electronic filters.</p> <p>5- Describe and discuss the relative merits of three types of air distribution and duct systems.</p> <p>6- Describe the recommended maintenance procedures for warm air heating and ventilating systems.</p> <p>7- Apply a troubleshooting guide for forced warm air systems and components.</p> <p>8- Explain the difference between natural and mechanical ventilation.</p> <p>9- Describe the types of contaminants found in air.</p> <p>10- Describe the types of air cleaning devices used in buildings.</p>
	vii.	<i>Infrared and electric heating</i>	<p>1- Discuss the concept and application of infrared heating.</p> <p>2- Describe the construction and operation of gas-fired and electric infrared heaters.</p> <p>3- List the advantages of electric heating systems compared to other types of heating systems.</p> <p>4- Describe the different methods of electric heating.</p>
	viii.	<i>Humidification</i>	<p>1- Describe the general purpose and principles of humidification.</p> <p>2- Describe residential and commercial types of humidifiers.</p> <p>3- Describe industrial types of humidifiers.</p>



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	ix.	<i>Electric controls for heating systems</i>	<ol style="list-style-type: none"> 1- <i>Discuss the various terms associated with electric control systems.</i> 2- <i>Describe the basic construction and operation of electrical thermostats, humidity controllers, and pressure controllers.</i> 3- <i>Describe the function and operation of the controlled devices in electrical control systems.</i> 4- <i>Explain the operating sequence of a basic electrical control circuit.</i>
L.		Refrigeration and Air conditioning; Systems and Auxiliaries	
	i.	<i>Refrigerants; CSA B-52, safety</i>	<ol style="list-style-type: none"> 1- <i>Describe the physical properties of refrigerants.</i> 2- <i>Describe the typical refrigeration system safety shutdown devices.</i>
	ii.	<i>Compression Refrigeration Systems</i>	<ol style="list-style-type: none"> 1- <i>Explain the fundamentals of refrigeration.</i> 2- <i>Describe the actual cycle of operations in a vapour compression refrigeration system.</i> 3- <i>State how the capacity of a refrigeration system is described and how refrigeration tables are used to calculate system performance.</i>
	iii.	<i>Refrigeration compressors</i>	<ol style="list-style-type: none"> 1- <i>Describe the construction and operation of a reciprocating refrigeration compressor.</i> 2- <i>Describe the construction and operation of a rotary refrigeration compressor.</i> 3- <i>Describe the construction and operation of a centrifugal refrigeration compressor.</i> 4- <i>Describe the construction and operation of seals for refrigeration compressors.</i> 5- <i>Calculate the capacity, efficiency, and compression ratio of a refrigeration</i>



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			<i>compressor.</i>
	iv.	<i>Heat exchangers for refrigeration systems</i>	<ol style="list-style-type: none"> 1- <i>Describe the designs and construction of refrigeration system evaporators.</i> 2- <i>Describe the designs and construction of refrigeration system condensers.</i> 3- <i>Discuss refrigeration condenser operation and maintenance.</i>
	v.	<i>Cooling towers</i>	<ol style="list-style-type: none"> 1- <i>List the factors that determine rate of cooling in a cooling tower and the basic components of a cooling tower.</i> 2- <i>Describe the construction and operation of a natural draft cooling tower.</i> 3- <i>Describe the construction and operation of a mechanical draft cooling tower.</i> 4- <i>Discuss cold climate operation for cooling towers.</i> 5- <i>Apply a cooling tower troubleshooting guide.</i>
	vi.	<i>Refrigeration system auxiliaries</i>	<ol style="list-style-type: none"> 1- <i>List and describe the operation of the gauges, separators, strainers, and indicators that are used as accessories in refrigeration systems.</i>
	vii.	<i>Elementary air conditioning systems and auxiliaries</i>	<ol style="list-style-type: none"> 1- <i>Describe the basic layout of compression refrigeration systems.</i> 2- <i>Distinguish between direct and indirect refrigeration systems.</i> 3- <i>Explain how compression refrigeration system temperatures and pressures are related.</i> 4- <i>Describe the layout of packaged refrigeration systems and the role of a refrigeration economizer.</i>
M.		Refrigeration and Air conditioning Controls	
	i.	<i>Refrigeration cycle controls</i>	<ol style="list-style-type: none"> 1- <i>Explain the refrigeration cycle controls.</i>



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			2- Describe the operation of the various operating controls for refrigeration systems. 3- Describe the actuators used in refrigeration control systems.
	ii.	Compression refrigeration system pre start-up checks	1- Describe how to perform refrigeration system leak tests. 2- Describe how a refrigeration system is dried and charged prior to startup. 3- Describe how a refrigeration system is purged of non-condensable gases prior to startup. 4- List the steps for adding oil to a refrigeration compressor when it is in service.
	iii.	Compression refrigeration system operation and shut-down	1- Describe the steps in the startup and shutdown of a compression refrigeration system. 2- List the safety shutdown devices that are specific to centrifugal compressors. 3- Describe the routine operation and associated log sheets for compression refrigeration systems. 4- List and describe the standard preventive maintenance procedures for compression refrigeration systems. 5- Apply a compression refrigeration system troubleshooting guide.
	iv.	Refrigeration system metering devices and capacity controls	1- Describe the construction and operation of compression refrigeration cycle expansion valves. 2- Describe the types of evaporator and compressor capacity controls.
N.		Air Compression	
	i.	Types of air compressors	1- Sketch and describe the main classifications and types of air



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		<i>compressors.</i>
ii.	<i>Components of air compressors</i>	1- <i>Explain the components of air compressors.</i>
iii.	<i>Auxiliaries used with air compressors</i>	1- <i>Sketch and describe air compressor auxiliary equipment, including capacity control systems.</i>
iv.	<i>Operation and maintenance of air compression systems</i>	1- <i>Discuss preventive maintenance for reciprocating air compressors.</i>
O.	Electricity	
i.	<i>Emergency generators; start-up, operation, shut-down, safety</i>	1- <i>Describe transformers and electric motors.</i> 2- <i>Explain motor types, bearing care, and troubleshooting of motors.</i> 3- <i>Explain the CSA approval and markings for electrical appliances.</i>
ii.	<i>Introduction to electricity</i>	1- <i>Explain electricity, electric circuits, and voltage drop.</i> 2- <i>Calculate current and power in an electric circuit, estimate the cost of electrical power for a facility, and describe how to read a power meter.</i>
iii.	<i>Lighting systems; incandescent, fluorescent</i>	1- <i>Explain what constitutes a good lighting system.</i> 2- <i>Explain maintenance of a lighting system and troubleshooting of incandescent and fluorescent systems</i> 3- <i>Describe the common types of lighting equipment and systems.</i> 4- <i>Explain the various methods of lighting control.</i> 5- <i>Describe the general requirements and criteria for emergency lighting in buildings.</i> 6- <i>Discuss the interrelationship between lighting, air conditioning, and energy</i>



Syllabus Section#		Outcomes	Objectives
			<i>conservation in buildings.</i>
	iv.	<i>Electrical safety, simple circuits, switches and fuses</i>	<ul style="list-style-type: none">1- <i>Explain the danger of electric shock.</i>2- <i>Describe circuit accessories, including switches, fuses, breakers, and receptacles.</i>3- <i>Describe simple electrical system problems, including short circuits, grounds, and bad connections.</i>4- <i>Describe static electricity.</i>