National Curriculum of Pakistan
2022-23

TECHNICAL EDUCATION

HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION (HVACR)

Grades 9-12

NATIONAL CURRICULUM COUNCIL SECRETARIAT
MINISTRY OF FEDERAL EDUCATION AND
PROFESSIONAL TRAINING, ISLAMABAD
GOVERNMENT OF PAKISTAN

بسم الله الرحمن الرحيم

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It is with great pride that we, at the National Curriculum Council Secretariat, present the first core curriculum in Pakistan's 75-year history. Consistent with the right to education guaranteed by Article 25-A of our Constitution, the National Curriculum of Pakistan (2022-23) aspires to equip every child with the necessary tools required to thrive in and adapt to an ever-evolving globalized world.

The National Curriculum is in line with international benchmarks, yet sensitive to the economic, religious, and social needs of young scholars across Pakistan. As such, the National Curriculum aims to shift classroom instruction from rote learning to concept-based learning.

Concept-based learning permeates all aspects of the National Curriculum, aligning textbooks, teaching, classroom practice, and assessments to ensure compliance with contemplated student learning outcomes. Drawing on a rich tapestry of critical thinking exercises, students will acquire the confidence to embark on a journey of lifelong learning. They will further be able to acknowledge their weaknesses and develop an eagerness to build upon their strengths.

The National Curriculum was developed through a nationwide consultative process involving a wide range of stakeholders, including curriculum experts from the public, private, and non-governmental sectors. Representatives from provincial education departments, textbook boards, assessment departments, teacher training departments, *deeni madaris*, public and private publishers, private schools, and private school associations all contributed their expertise to ensure that the National Curriculum could meet the needs of all Pakistani students.

The experiences and collective wisdom of these diverse stakeholders enrich the National Curriculum, fostering the core, nation-building values of inclusion, harmony, and peace, making the National Curriculum truly representative of our nation's educational aspirations and diversity.

I take this opportunity to thank all stakeholders, including students, teachers, and parents who contributed to developing the National Curriculum of Pakistan (2022-23)

Dr. Mariam Chughtai
Director
National Curriculum Council Secretariat
Ministry of Federal Education and Professional Training

Heating, Ventilation, Air Conditioning and Refrigeration (HVACR)

Progression Grid

Grades 9-12

Domain A: Maintain Safe Work Environment HVACR

Standard I: Demonstrate the ability to identify and mitigate workplace hazards by reading and interpreting work processes, adhering to safety regulations and effectively utilizing personal protective equipment.

Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
Benchmark I: Students will demonstrate the ability to identify, assess and mitigate workplace hazards, ensuring compliance with safety regulations and effectively minimizing risks.			
Student Learning Outcomes			
Students will be able to: [SLO:HVACR-09-A-01]:	Students will be able to: [SLO:HVACR-10-A-01]:	Students will be able to: [SLO:HVACR-11-A-01]:	

read and interpret work processes and procedures correctly to identify risks of hazards at workplace. [SLO:HVACR-09-A-02]: recognize engineering processes, tools, equipment and consumable materials that have the potential to cause harm. [SLO:HVACR-09-A-03]: identify any potential hazards and take appropriate action to minimize the risk	work safely at all times, complying with health and safety precautions, regulations and other relevant guidelines [SLO:HVACR-10-A-02]: identify health and safety hazards in the workplace, so that the potential for personal injury, damage to equipment or the workplace is prevented and corrective action is taken [SLO:HVACR-10-A-03]: deal with problems that are within your control and report to the safety officer those problems that cannot be resolved [SLO:HVACR-10-A-04]: wear, adjust and maintain personal protective equipment to ensure correct	define hazards and their types [SLO:HVACR-11-A-02]: describe falling, lifting accident during installation and maintenance of [SLO:HVACR-11-A-03]: Commercial & Industrial HVAC system [SLO:HVACR-11-A-04]: explain material and tool handling safety [SLO:HVACR-11-A-05]: identify ergonomic safety at workplace [SLO:HVACR-11-A-06]: identify weather safety precautions.	

	fit and optimum protection in compliance with company procedures [SLO:HVACR-10-A-05]: Keep work area clean and clear of obstructions and storing tools or equipment, so that the risk of accident or injury is prevented	[SLO:HVACR-11-A-07]: use personal protective equipment(PPE) [SLO:HVACR-11-A-08]: recognize safety of chemical handling [SLO:HVACR-11-A-09]: perform safe use of scaffolding. [SLO:HVACR-11-A-10]: perform safe use of a ladder	

Domain B: **Personal & Professional Development and Communication Skill**

Standard I: Demonstrate workplace proficiency by creating and formatting CVs/resumes, registering on online job portals and conducting effective job searches based on job descriptions and will also demonstrate strong communication and collaboration skills in collecting and confirming work requirements.

Grade 9	Grade 10	Grade 11	Grade 12
Benchmark I: Students will create and format a CV/resume, register on online job portals and effectively search for jobs based on job descriptions.			
Student Learning Outcomes			
Students will be able to: [SLO:HVACR-09-B-01]: explain the importance of cv in job application [SLO:HVACR-09-B-02]: create and format CV/resume [SLO:HVACR-09-B-03]: access and register email account on various online job portals [SLO:HVACR-09-B-04]: search job as per job description and title	Students will be able to: [SLO:HVACR-10-B-01]: familiarize oneself with online travel e-commerce websites [SLO:HVACR-10-B-02]: find about hotel websites [SLO:HVACR-10-B-03]: find about freelancing websites and explore job opportunities	N/A	N/A

Benchmark II: Students will demonstrate proficiency in collecting and confirming work requirements from clients, providing clear information about costs and time, while negotiating effectively. Additionally, they will exhibit strong teamwork skills by treating team members with respect, actively listening to instructions and effectively communicating work-related information to ensure smooth collaboration.			
Student Learning Outcomes			
Students will be able to: [SLO:HVACR-09-B-05]: collect and confirm work requirements from clients using appropriate communication procedures [SLO:HVACR-09-B-06]: provide clear information to clients about work requirements including costs and time needed to accomplish the task [SLO:HVACR-09-B-07]: negotiate with clients regarding wages, time, labor\ requirements etc.	Students will be able to: [SLO:HVACR-10-B-04]: treat team members with respect and maintain positive relationships to achieve common organizational goals [SLO:HVACR-10-B-05]: listen to instructions carefully & comply with those instructions [SLO:HVACR-10-B-06]: provide work-related information to team members and identify interrelated work activities to avoid	Students will be able to: [SLO:HVACR-11-B-01]: recognize the importance of body language and effective communication [SLO:HVACR-11-B-02]: explain basic rules for effective communication [SLO:HVACR-11-B-03]: explain different methods of communication and the circumstances in which it is appropriate to use these [SLO:HVACR-11-B-04]:	Students will be able to: [SLO:HVACR-12-B-01]: define work ethics [SLO:HVACR-12-B-02]: describe impact of good work ethics [SLO:HVACR-12-B-03]: differentiate between poor and good work ethics

	confusion [SLO:HVACR-10-B-07]: adopt communication skills appropriate to work activities	Interact and communicate effectively with colleagues [SLO:HVACR-11-B-05]: Interact & communicate with other stakeholders	

Domain C: Basic Drawing

Standard I: Demonstrate precision by accurately measuring and collecting information related to work specifications. They will adeptly develop drawings in alignment with job requirements and confirm these specifications with clients or supervisors, making necessary adjustments as needed.

Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
Benchmark I: Students will demonstrate technical proficiency by consistently taking precise measurements, skillfully creating drawings based on job requirements and effectively confirming specifications with clients or supervisors. The ability to make necessary adjustments demonstrates a high level of competence in translating work specifications into accurate and actionable plans.			
Student Learning Outcomes			
Students will be able to:	N/A	N/A	N/A

[SLO:HVACR-09-C-01]: take accurate measurements and collect information regarding work specifications [SLO:HVACR-09-C-02]: develop drawings according to job requirement [SLO:HVACR-09-C-03]: confirm the job specifications and drawing from client or supervisor and make necessary adjustments, where required			

Domain D: **Fundamentals of HVACR**

Standard I: Demonstrate a fundamental understanding of physical concepts by defining key terms such as energy, heat, pressure, temperature and volume. They will comprehend various types within each category, understand interrelationships and apply essential laws governing these physical quantities.

Grade 9	**Grade 10**

Benchmark I: Students will apply by accurately defining, categorizing and explaining fundamental physical concepts. They will proficiently perform inter-conversions, apply refrigeration laws, Pascal's Law and Dalton's Law and showcase the ability to describe systems of units and perform unit conversions.	
Student Learning Outcomes	
The students will be able to: [SLO:HVACR-09-D-01]: define energy and its unit [SLO:HVACR-09-D-02]: know about the different types of energy (kinetic energy, potential energy, heat energy) [SLO:HVACR-09-D-03]: define heat and its unit [SLO:HVACR-09-D-04]: know about the different types of heat [SLO:HVACR-09-D-05]: explain heat transfer mechanism [SLO:HVACR-09-D-06]:	N/A

identify various types of heat transfer methods [SLO:HVACR-09-D-07]: define pressure and its unit [SLO:HVACR-09-D-8]: explain different types of pressure [SLO:HVACR-09-D-09]: Demonstrate use of pressure-measuring devices [SLO:HVACR-09-D-10]: Define temperature and its unit [SLO:HVACR-09-D-11]: know about the different scales of temperature (^{0}C, Kelvin, ^{0}F) [SLO:HVACR-09-D-12]: perform interconversion of temperature scales [SLO:HVACR-09-D-13]: define volume and its unit	

[SLO:HVACR-09-D-14]: explain interrelationship of temperature, pressure and volume [SLO:HVACR-09-D-15]: State refrigeration laws state Pascal`s Law state Dalton`s Law [SLO:HVACR-09-D-16]: define physical quantities define unit [SLO:HVACR-09-D-17]: describe systems of unit and perform unit conversion	

Standard II: Demonstrate fundamental principles of HVAC systems, covering psychrometric properties and air & water distribution techniques, to ensure optimal performance and energy efficiency.

Grade 11	**Grade 12**
Benchmark I: Students will demonstrate the ability to analyze and calculate psychrometric properties of air using a psychrometric chart. Additionally, exhibit proficiency in the design, installation and maintenance of air and water distribution systems, incorporating safety measures and adherence to industry standards.	
Student Learning Outcomes	
The students will be able to:	Students will be able to:

Introduction to HVAC Systems [SLO:HVACR-11-D-01]: define the basic concepts of HVAC systems. [SLO:HVACR-11-D-02]: identify the primary components of HVAC systems. [SLO:HVACR-11-D-03]: explain the importance of energy efficiency in HVAC. **Psychrometric Properties of Air** [SLO:HVACR-11-D-04]: define psychrometry and its relevance in HVAC. [SLO:HVACR-11-D-05]: identify and explain essential psychometric properties (dry bulb, wet bulb, dew point, relative humidity, specific humidity, specific volume, enthalpy). [SLO:HVACR-11-D-06]:	**Water Distribution System Overview** [SLO:HVACR-12-D-01]: define a water distribution system in HVAC. [SLO:HVACR-12-D-02]: explain the components and importance of water distribution. [SLO:HVACR-12-D-03]: recognize various types of pumps and valves. **Practical Water Distribution Skills** [SLO:HVACR-12-D-04]: conduct leak testing for water distribution systems. [SLO:HVACR-12-D-05]: identify and operate different types of pumps. [SLO:HVACR-12-D-06]: recognize and work with various valve types. **Thermal Insulation Concepts** [SLO:HVACR-12-D-07]:

Recognize lines and scales on a psychrometric chart. **Hands-On Psychrometric Chart Application** [SLO:HVACR-11-D-07]: identify and measure dry bulb and wet bulb temperatures using a sling psychrometer. [SLO:HVACR-11-D-08]: draw psychrometric properties on a stationary chart. [SLO:HVACR-11-D-09]: calculate basic air properties during heating or cooling processes. **Air Distribution System Basics** [SLO:HVACR-11-D-10]: define an air distribution system. [SLO:HVACR-11-D-11]: explain the components of an air distribution system. [SLO:HVACR-11-D-12]: recognize the importance of ducting and air filters.	explain the basic principles of thermal insulation. [SLO:HVACR-12-D-08]: recognize different types of insulating materials. [SLO:HVACR-12-D-09]: perform insulation on ducts and pipes. **Integration of HVAC Fundamentals** [SLO:HVACR-12-D-10]: demonstrate the integration of psychrometric knowledge with air and water distribution systems. [SLO:HVACR-12-D-11]: apply thermal insulation techniques to enhance system efficiency. [SLO:HVACR-12-D-12]: analyze and calculate air properties to optimize system performance. **Safety and Compliance** [SLO:HVACR-12-D-13]: apply safety measures during HVAC system work.

Practical Air Distribution Skills [SLO:HVACR-11-D-13]: perform air leak testing techniques in ducts. [SLO:HVACR-11-D-14]: demonstrate the installation of air filters. [SLO:HVACR-11-D-15]: identify various air control and distribution devices.	[SLO:HVACR-12-D-14]: adhere to industry standards and regulations. [SLO:HVACR-12-D-15]: demonstrate awareness of environmental considerations in HVAC practices.

Domain E: **Heat Load Calculation and Thermodynamics**

Standard I: Demonstrate proficiency in thermodynamic principles by describing and calculating quantities of heat in gases, understanding unit conversions, recognizing types of heat (sensible, latent and total) and applying gas laws (Boyle's, Charles's, Gay-Lussac and General gas law).

Grade 9	Grade 10	Grade 11	Grade 12

Benchmark I: Students will apply thermodynamic analysis by accurately calculating and demonstrating psychometric properties, including sensible cooling/heating, dehumidification, air mixing, evaporative cooling (humidification) and summer cooling (dehumidification).

Student Learning Outcomes			
N/A	The students will be able to: [SLO:HVACR-10-E-01]: describe quantity of heat in gases [SLO:HVACR-10-E-02]: explain conversion of different types of units [SLO:HVACR-10-E-03]: describe types of heat (sensible, latent and total heat) [SLO:HVACR-10-E-04]: calculate different types of heat	Students will be able to: [SLO:HVACR-11-E-01]: define thermodynamics [SLO:HVACR-11-E-02]: describe thermodynamics properties of air [SLO:HVACR-11-E-03]: calculate specific heat, constant pressure & volume, enthalpy, internal energy of air and gas, specific gravity, density. [SLO:HVACR-11-E-04]: apply thermodynamics principles on different	

	[SLO:HVACR-10-E-05]: calculate pressure, volume and temperature relationship of gases using the following laws: Boyle's law, Charles's law, Gay-Lussac law and General gas (equation) law [SLO:HVACR-10-E-06]: define properties (energy, density, work, area, volume velocity specific volume, pressure, temperature)of gases [SLO:HVACR-10-E-07]: define heat and cool psychometric processes of air [SLO:HVACR-10-E-08]: describe psychometric properties (sensible cooling & heating, dehumidification and air mixing etc.).	conditions.	

	[SLO:HVACR-10-E-09]: calculate psychometric properties [SLO:HVACR-10-E-10]: calculate evaporative cooling(humidification) [SLO:HVACR-10-E-11]: calculate summer cooling(dehumidification)		

Domain F: Electronics, Electrical Power System Operation and Control

Standard I: Demonstrate proficiency in electricity and electronics by explaining fundamental knowledge, identifying tools and materials, making connections, measuring electric quantities and executing various tasks related to electric circuits, motors, star-delta and other electronic components.

Grade 9	Grade 10	Grade 11	Grade 12
Benchmark I: Students will apply their electrical and electronics skills by successfully identifying electric motors, detecting electrical defects using specified test instruments, checking protective devices, defining electronics components and circuits and executing tasks such as making pin-hole detectors, flame		**Benchmark I:** Students will interpret drawings, identify symbols, abbreviations and specifications and effectively connect various starters, including direct online, star-delta and auto-transformer to ensure optimal machine performance.	

failure controls, DC motor speed control circuits, AC power control circuits and time delay circuits.			
Student Learning Outcomes			
The students will be able to: [SLO:HVACR-09-F-01]: explain fundamental knowledge of electricity and electronics [SLO:HVACR-09-F-02]: identify & collect tools and material as per job. [SLO:HVACR-09-F-03]: identify electric meters [SLO:HVACR-09-F-04]: make connections of electric meters [SLO:HVACR-09-F-05]: measure different electric quantities	The students will be able to: [SLO:HVACR-10-F-01]: identify the type of electric motors [SLO:HVACR-10-F-02]: check the motor by using specified test instruments to detect electrical defects such as loose/or burnt electrical connections, defective capacitors, burnt windings, low insulation resistance etc. [SLO:HVACR-10-F-03]: check the tripping of a protective device using specified test	Students will be able to: [SLO:HVACR-11-F-01]: Interpret drawings [SLO:HVACR-11-F-02]: Identify Signs and symbols [SLO:HVACR-11-F-03]: Identify term and abbreviations [SLO:HVACR-11-F-04]: Interpret specifications [SLO:HVACR-11-F-05]: Interpret circuit diagrams of given drawing	N/A

[SLO:HVACR-09-F-06]: identify & collect tools and material as per job. [SLO:HVACR-09-F-07]: remove and clean the insulation from conductors [SLO:HVACR-09-F-08]: twist and overlay the conductors [SLO:HVACR-09-F-09]: make simple twist joint of pvc [SLO:HVACR-09-F-10]: make married joint of pvc cable [SLO:HVACR-09-F-11]: make "tee" joint of pvc cable [SLO:HVACR-09-F-12]:	instruments, while the motor is running with power supply connected with suitable control) and protective device, the difficulty in starting/ low rpm/unusual noises/ excessive heat/ grounded winding etc. [SLO:HVACR-10-F-04]: define electronics components and circuits [SLO:HVACR-10-F-05]: define opto-coupler devices [SLO:HVACR-10-F-06]: make a pin-hole detector [SLO:HVACR-10-F-07]: make flame failure control [SLO:HVACR-10-F-08]:	[SLO:HVACR-11-F-06]: Draw sign, symbols and abbreviations of given equipment [SLO:HVACR-11-F-07]: Connect Direct online starter, controls and accessories [SLO:HVACR-11-F-08]: Collect and interpret Star-delta starter [SLO:HVACR-11-F-09]: Identify procedure for star connections [SLO:HVACR-11-F-10]: Identify procedure for delta connection [SLO:HVACR-11-F-11]:	

splice the conductors smoothly & properly [SLO:HVACR-09-F-13]: solder the splice in a way so that there is no space remaining between splice conductors. [SLO:HVACR-09-F-14]: insulate the splice [SLO:HVACR-09-F-15]: identify & collect tools and material as per job. [SLO:HVACR-09-F-16]: prepare the lay-out/circuit diagram for making circuit [SLO:HVACR-09-F-17]: connect a lamp with a switch [SLO:HVACR-09-F-18]:	make dc motor speed control circuit. [SLO:HVACR-10-F-09]: make AC power control circuit. [SLO:HVACR-10-F-10]: connect the crocodile [SLO:HVACR-10-F-11]: connect photocell [SLO:HVACR-10-F-12]: verify photocell [SLO:HVACR-10-F-13]: make necessary connections [SLO:HVACR-10-F-14]: operate gates in circuit. [SLO:HVACR-10-F-15]:	Demonstrate techniques for Star-delta starter [SLO:HVACR-11-F-12]: Make Star connections [SLO:HVACR-11-F-13]: Make delta connection [SLO:HVACR-11-F-14]: Connect Star-delta starter [SLO:HVACR-11-F-15]: Demonstrate techniques for Auto-transformer starter [SLO:HVACR-11-F-16]: Check and justify all the connections of each starter, control and accessory [SLO:HVACR-11-F-17]:	

connect two lamps in series circuit & parallel [SLO:HVACR-09-F-19]: make stare case circuit [SLO:HVACR-09-F-20]: prepare test board circuit	perform time delay circuit. [SLO:HVACR-10-F-16]: install and connect the PCB system according to the functional diagram. [SLO:HVACR-10-F-17]: check the inverter ac performance as per requirement	Test & check connection between motor and starters [SLO:HVACR-11-F-18]: Interpret manufacturer's instructional/service manual and machine functional diagram. [SLO:HVACR-11-F-19]: Install and connect the PLC system according to the functional diagram. [SLO:HVACR-11-F-20]: Check the machine performance as per requirement	

Domain G: **Introduction to HVACR Allied Components for Commercial & Industrial Systems**

Standard I: Demonstrate proficiency in HVACR fundamentals including commercial and industrial air conditioning units by defining HVACR, understanding its basic concepts and scope, recognizing the importance of HVACR, comprehending various HVACR sources, identifying tools, equipment and plants and adopting the 5S standard operating procedures.

Grade 9	Grade 10	Grade 11	Grade 12
Benchmark I: Students will apply their HVACR knowledge by describing pipe sizes, defining cutting, flaring, swaging and bending techniques. Additionally, they will showcase an understanding of HVACR societies by defining them, recognizing their role and learning about different types of societies.		**Benchmark I:** Students will demonstrate a comprehensive understanding of commercial and industrial air conditioning units, including their types, components and distinctions.	
Student Learning Outcomes			
The student will be able to: [SLO:HVACR-09-G-01]: define HVACR [SLO:HVACR-09-G-02]: explain the basic concept of HVACR [SLO:HVACR-09-G-03]: define the scope of HVACR [SLO:HVACR-09-G-04]:	N/A	**Students will be able to:** [SLO:HVACR-11-G-01]: Define commercial & Industrial air conditioning units. [SLO:HVACR-11-G-02]: Identify the types of commercial Air conditioning units. [SLO:HVACR-11-G-03]: explain the components of Commercial & Industrial Air Conditioning units.	Students will be able to: [SLO:HVACR-12-G-01]: Select tools, equipment and related accessories according to job requirements. [SLO:HVACR-12-G-02]: Install filter dyer by following manufacturer's specifications [SLO:HVACR-12-G-03]:

comprehend the importance of HVACR [SLO:HVACR-09-G-05]: explain HVACRsources [SLO:HVACR-09-G-06]: elaborate the importance of different HVACR sources [SLO:HVACR-09-G-07]: recognize different HVACR sources [SLO:HVACR-09-G-08]: recognize the tools, equipment & plants(T&P) explain the function of tool & equipment [SLO:HVACR-09-G-09]: adopt the 5S Standard Operating procedures [SLO:HVACR-09-G-10]: define HVACR societies		[SLO:HVACR-11-G-04]: explain the importance of commercial and industrial air Conditioning Units. [SLO:HVACR-11-G-05]: explain the difference between commercial and industrial air Conditioning Units.	Install Side Glass by following manufacturer's specifications [SLO:HVACR-12-G-04]: Install Vibration Absorber by following manufacturer's specifications [SLO:HVACR-12-G-05]: Install Liquid receiver by following manufacturer's specifications [SLO:HVACR-12-G-06]: Install Service Valve by following manufacturer's specifications [SLO:HVACR-12-G-07]: Install Heat Exchanger by following manufacturer's specifications [SLO:HVACR-12-G-08]:

[SLO:HVACR-09-G-11]: identify the role of HVACR societies [SLO:HVACR-09-G-12]: learn types of societies [SLO:HVACR-09-G-13]: describe Pipe Sizes [SLO:HVACR-09-G-14]: define Cutting [SLO:HVACR-09-G-15]: define Flaring [SLO:HVACR-09-G-16]: define Swaging [SLO:HVACR-09-G-17]: describe Bending			Install Heat Solenoid valve by following manufacturer's specifications [SLO:HVACR-12-G-09]: Install Oil Separator by following manufacturer's specifications [SLO:HVACR-12-G-10]: Switch on the unit to check the performance of mechanical components as specified in

Domain H: **Refrigeration Cycle and Refrigerants**

Standard I: Demonstrate a comprehensive understanding of refrigeration systems by defining the refrigeration cycle, explaining its working principle and enlisting the basic components. Define compression, condensation, refrigerant control and evaporation, understanding the types and principles of each component.

Grade 9	**Grade 10**
Benchmark I: Students will define ozone depletion, global warming and the greenhouse effect. They will understand the process of retrofitting and demonstrate knowledge of recovery, reclaiming, recycling and safe handling and storage techniques for refrigerants.	
Student Learning Outcomes	
The students will be able to: [SLO:HVACR-09-H-01]: define cycle [SLO:HVACR-09-H-02]: explain refrigeration cycle [SLO:HVACR-09-H-03]: explain working principle of refrigeration cycle	The students will be able to: [SLO:HVACR-10-H-01]: define retrofitting [SLO:HVACR-10-H-02]: define ozone depletion [SLO:HVACR-10-H-03]: define global warming

[SLO:HVACR-09-H-04]: enlist basic components of refrigeration cycle [SLO:HVACR-09-H-05]: define compression [SLO:HVACR-09-H-06]: define compressor and its types [SLO:HVACR-09-H-07]: explain working principles of compressor [SLO:HVACR-09-H-08]: define condensation [SLO:HVACR-09-H-09]: define condenser and its types [SLO:HVACR-09-H-10]: explain working principle of condenser [SLO:HVACR-09-H-11]:	[SLO:HVACR-10-H-04]: define green house effect [SLO:HVACR-10-H-05]: explain process of retrofitting [SLO:HVACR-10-H-06]: define recovery of refrigerant [SLO:HVACR-10-H-07]: define reclaiming [SLO:HVACR-10-H-08]: describe recycling [SLO:HVACR-10-H-09]: describe techniques of safe handling and storage of refrigerants [SLO:HVACR-10-H-10]: study refrigerants charts for GW and ODP

define refrigerant control. [SLO:HVACR-09-H-12]: define expansion role of expansion in refrigeration cycle [SLO:HVACR-09-H-13]: identify types of refrigerant controls [SLO:HVACR-09-H-14]: define evaporation [SLO:HVACR-09-H-15]: define evaporator and its types [SLO:HVACR-09-H-16]: explain working principle of evaporator [SLO:HVACR-09-H-17]: define refrigerants [SLO:HVACR-09-H-18]: explain types of refrigerants [SLO:HVACR-09-H-19]:	

enlist the properties of refrigerants. [SLO:HVACR-09-H-20]: explain different properties of refrigerant [SLO:HVACR-09-H-21]: classify refrigerants according to application and safety [SLO:HVACR-09-H-22]: differentiate between good and bad refrigerant	

Domain I: **Install Commercial & Industrial Refrigeration Units**

Standard I: Installation of commercial refrigeration systems to provide step-by-step guidance and best practices for professionals to correctly and safely set up commercial refrigeration systems, ensuring optimal performance and efficiency while maintaining compliance with industry standards.

Grade 9	Grade 10	Grade 11	Grade 12
Benchmark I: Students will identify correct size of refrigeration unit on the basis of load calculation and install different refrigeration systems on the basis of requirement.			

Student Learning Outcomes			
	Student will be able to: [SLO:HVACR-10-I-01]: Select tools, equipment and related accessories according to job requirements of Ice Making Machine [SLO:HVACR-10-I-02]: Fix the machine on potable water supply by following manufacturer's specifications [SLO:HVACR-10-I-03]: Measure the clearance on each side to be sure it meets the standards set by the manufacturer [SLO:HVACR-10-I-04]: Make water drain connections in order to empty purged and melt water as per	Student will be able to: [SLO:HVACR-11-I-01]: Select tools, equipment and related accessories according to job requirements of Walk in Cooler / **Freezers / Cooled Room** [SLO:HVACR-11-I-02]: Prepare insulated room for preserving the food on lowest temperature as per drawing and requirements [SLO:HVACR-11-I-03]: Prepare steel / concrete foundation / frame for installation of condensing unit following manufacturer's specifications	Students will be able to: [SLO:HVACR-12-I-01]: Select tools, equipment and related accessories according to job requirements of Chilled Water Tank / Electric Water Cooler [SLO:HVACR-12-I-02]: Fix the cooler / tank on potable water supply by following manufacturer's specifications and client requirements. [SLO:HVACR-12-I-03]: Measure the clearance on each side to be sure it meets the standards set by the

	manual instructions and client requirements [SLO:HVACR-10-I-05]: Install shut of valve on water supply near the machine according to unit specifications [SLO:HVACR-10-I-06]: Make electric supply, switched on and check performance according to machine specification by using specific instruments	[SLO:HVACR-11-I-04]: Prepare the place and level it, to install the evaporator and condensing unit firmly according to manufacturer's specifications [SLO:HVACR-11-I-05]: Layout piping and control wiring from indoor to outdoor unit according to instructional manual [SLO:HVACR-11-I-06]: Perform leak test, evacuation and charge the refrigerant according to unit specifications and standards [SLO:HVACR-11-I-07]: Connect the electric supply and operate the	manufacturer [SLO:HVACR-12-I-04]: Make water drain connections adjacent to the water supply as per manual instructions/location [SLO:HVACR-12-I-05]: Install shut-off valve and no return valve at water supply line. [SLO:HVACR-12-I-06]: Fix minimum water level protection & interlocking with refrigeration unit to prevent empty freezing [SLO:HVACR-12-I-07]:

		unit to check the performance according to unit specifications.	Make power supply as per manual instructions

Domain J: Service & Repair Domestic, Commercial & Industrial Refrigeration Systems.

Standard I: Demonstrate troubleshooting for refrigeration and water cooler systems by checking for obvious problems, selecting appropriate tools and equipment and conducting systematic diagnostic procedures as recommended by manufacturers.

Grade 9	**Grade 10**
Benchmark I: Students will apply their troubleshooting skills in real-world scenarios by selecting tools and equipment based on job requirements, disconnecting appliances safely and following manual instructions for rectification.	
Student Learning Outcomes	
The students will be able to: [SLO:HVACR-09-J-01]: Check for obvious problems to determine which component or system is causing the problem [SLO:HVACR-09-J-02]:	The students will be able to: [SLO:HVACR-10-J-01]: Select tools, equipment and related accessories according to job requirements [SLO:HVACR-10-J-02]: Disconnect the water cooler/dispenser from electric supply and follow the manual instructions for rectification

Select tools, equipment and related accessories according to requirements and standards. [SLO:HVACR-09-J-03]: Check power supply, electric wiring, electric/electronic components as recommended by manufacturer and record the results [SLO:HVACR-09-J-04]: Check different types of heaters as recommended by manufacturer and record the results [SLO:HVACR-09-J-05]: Check refrigerant pressure to determine the exact problem by using AVO meter / Gauge manifold as recommended by manufacturer and record the results [SLO:HVACR-09-J-06]: Diagnose the causes of the problem according to the manufacturers manual and standards. Students will be able to: [SLO:HVACR-09-J-07]:	[SLO:HVACR-10-J-03]: Rectify the faults as per diagnosed, repair /replace the components, as necessary [SLO:HVACR-10-J-04]: Water cooler / Dispenser body / mounts check, wash and restore to the actual condition [SLO:HVACR-10-J-05]: Switch on the water cooler / dispenser to check the performance of electrical/electronic and mechanical components as specified in the manufacturer's manual and record the results

Select tools, equipment and related accessories according to job requirements [SLO:HVACR-09-J-08]: Disconnect the Refrigerator / Freezer from electric supply and follow the manual instructions for rectification [SLO:HVACR-09-J-09]: Rectify the faults as per diagnosed, repair /replace the components, as necessary [SLO:HVACR-09-J-10]: Refrigerator / Freezer body / cabinets check, wash and restore to the actual condition [SLO:HVACR-09-J-11]: Thermostat / Door Gasket / Heaters check, service and replace if necessary for proper functioning [SLO:HVACR-09-J-12]: Switch on the Refrigerator / Freezer to check the performance of electrical/ electronic and mechanical components as specified in the manufacturer's manual and record the results	

Standard II: Students will diagnose faults in commercial and industrial refrigeration systems by employing systematic checks, utilizing appropriate tools and equipment and referencing manufacturer recommendations.

Grade 11	**Grade 12**
Benchmark I: Students will repair commercial and industrial refrigeration systems by selecting suitable tools, executing systematic fault rectification procedures and ensuring optimal performance after repairs. They will extend their expertise to multi-stage, cascade and ultra-low temperature refrigeration systems, demonstrating preventive maintenance, fault diagnosis and effective repairs in complex industrial settings.	
Student Learning Outcomes	
Diagnose **Faults in Commercial & Industrial Refrigeration Systems.** Students will be able to: [SLO:HVACR-11-J-01]: Check for obvious problem to determine which component or system is causing the problem [SLO:HVACR-11-J-02]:	Repair **Multi-Stage, Cascade & Ultra-Low Temperature Refrigeration System** **Students will be able to:** [SLO:HVACR-12-J-01]: Undertake preventive maintenance checks/adjustment on multi- stage, cascade and/or ultra-cold industrial refrigeration systems [SLO:HVACR-12-J-02]:

Select tools, equipment and related accessories according to requirements and standards. [SLO:HVACR-11-J-03]: Check the power supply, electric wiring, electric / electronic components and refrigerant pressure to determine the exact problem by using a flow chart as recommended by manufacturer and record the results [SLO:HVACR-11-J-04]: Diagnose the causes of the problem according to the manufacturers manual and standards Repair **Commercial & Industrial Refrigeration Systems.** Students will be able to: [SLO:HVACR-11-J-05]: Select tools, equipment and related accessories according to requirements and standards	**Coordinate refrigeration system in production of food products** [SLO:HVACR-12-J-03]: **Inspect different parts of unit** [SLO:HVACR-12-J-04]: **Diagnose fault in system** [SLO:HVACR-12-J-05]: **Repair faults** [SLO:HVACR-12-J-06]: **Check & Repair leaks in system** [SLO:HVACR-12-J-07]: **Practice storage methods to avoid food spoilage.** [SLO:HVACR-12-J-08]: **Shut down the system** [SLO:HVACR-12-J-09]:

[SLO:HVACR-11-J-06]: Disconnect the unit from electric supply and follow the manual instructions for rectification [SLO:HVACR-11-J-07]: Rectify the fault as diagnosed with the help of repair / replace the components [SLO:HVACR-11-J-08]: Switch on the unit to check the performance of electrical/ electronic and mechanical components as specified in the manufacturer's manual and record the results	**Replace faulty parts of system**

Domain K: **Installation of Domestic** Commercial & Industrial Building Air Conditioning Systems

Standard I: Demonstrate installation of air conditioning units, selecting tools, marking precise locations, conducting inspections, making necessary openings and adhering to manufacturer specifications for domestic, Commercial & Industrial Building Air Conditioning Systems.

Grade 9	Grade 10	Grade 11	Grade 12
Benchmark I: Students will effectively install window air conditioners, selecting tools, marking locations, creating openings, fixing frames and ensuring compliance with instructional manuals and standards. They will demonstrate proficiency in sealing gaps, installing covers, fixing drain pipes, arranging power supply and achieving optimal performance, meeting specified criteria.		**Benchmark II:** Students will install a commercial and industrial building air conditioning system, demonstrate proficiency in selecting tools, equipment and accessories for the specific job requirements. They will effectively carry out installation tasks, including marking locations, preparing foundations, connecting units with ducts and pipes, insulating joints, establishing power and control connections and ensuring optimal system performance.	
Student Learning Outcomes			
The students will be able to: [SLO:HVACR-09-K-01]: Select tools, equipment and related accessories according to job requirements [SLO:HVACR-09-K-02]: Select and mark the area on the wall where Indoor and Outdoor units are to be installed according to Unit specifications and client requirements.	The students will be able to: [SLO:HVACR-10-K-01]: Select tools, equipment and related accessories according to job requirements [SLO:HVACR-10-K-02]: Mark the location on the wall where Window Air conditioner to be installed according to Unit	**Install Package Unit** **Students will be able to:** [SLO:HVACR-11-K-01]: Select tools, equipment and accessories for the job. [SLO:HVACR-10-K-02]: Mark locations and areas according to layout plans and specifications. [SLO:HVACR-10-K-03]:	**Install Water Chiller** Students will be able to:: [SLO:HVACR-12-K-01]: Select tools, equipment and accessories for the job. [SLO:HVACR-12-K-02]: Mark locations and areas according to layout plans. [SLO:HVACR-12-K-03]:

[SLO:HVACR-09-K-03]: Perform a physical inspection of indoor and outdoor units according to unit specifications. [SLO:HVACR-09-K-04]: Make an opening for the refrigerant pipes, condensate pipe and control wires to pass through [SLO:HVACR-09-K-05]: Mount the Indoor unit wall mounting plate according to manufacturer's specifications and install the indoor unit on it [SLO:HVACR-09-K-06]: Prepare the base for fixing of outdoors according to manufacturer's specifications and fix on it	specifications and client requirements. [SLO:HVACR-10-K-03]: Make an opening at marked area on the wall [SLO:HVACR-10-K-04]: Fix Iron / wooden frame in the opening firmly and Air conditioner cover insert in it according to the instructional manual and standards [SLO:HVACR-10-K-05]: Install the Air conditioner in the framed opening with a standard slope so that condensate water dropped out side. [SLO:HVACR-10-K-06]: Cover / Seal side air gaps of opening with insulation	Prepare foundations, place, adjust and level Package units adhering to safety precautions. [SLO:HVACR-10-K-04]: Connect Package units with ducts, insulate where required and establish power and control connections. [SLO:HVACR-10-K-05]: Switch on the supply and check performance as per manufacturer's instructions and standards. Install Variable Refrigerant Flow (VRF) / Variable Refrigerant Volume (VRV) System Students will be able to: [SLO:HVACR-10-K-06]:	Prepare foundations, place, adjust and level the chiller, considering safety precautions. [SLO:HVACR-12-K-04]: Install Air Handling Units (AHU)/Fan Coil Units (FCU) based on drawings. [SLO:HVACR-12-K-05]: Install high-pressure MS pipes from chiller to AHUs/FCUs inside the building. [SLO:HVACR-12-K-06]: Fabricate and install G.I sheet ducting inside the building. [SLO:HVACR-12-K-07]:

[SLO:HVACR-09-K-07]: Connect the refrigerant pipes amongst both indoor and outdoor units, supply and control wires according to manufacturer's manual [SLO:HVACR-09-K-08]: Add additional refrigerant for additional piping according to manufacturer's recommendations. [SLO:HVACR-09-K-09]: Make oil trap in copper pipe as per site requirement. [SLO:HVACR-09-K-10]: Perform leak test, evacuation procedure, charge refrigerant and open the service valves [SLO:HVACR-09-K-11]:	material [SLO:HVACR-10-K-07]: Fix the fancy wooden border around the Air conditioner grill as per client's requirement [SLO:HVACR-10-K-08]: Fix the Air conditioner condensate drain pipe and put it into main sewerage line. [SLO:HVACR-10-K-09]: Arrange power supply with a circuit breaker near the Air conditioner [SLO:HVACR-10-K-10]: Make sure that all packing materials -including Cardboard, Styrofoam, Tape and Plastic Film have been	Select tools, equipment and accessories for the job. [SLO:HVACR-10-K-07]: Prepare foundations, place, adjust and level outdoor units, ensuring safety precautions. [SLO:HVACR-10-K-08]: Prepare piping, weld and braze according to specifications and layout drawings. [SLO:HVACR-10-K-09]: Install indoor units based on layout diagrams, client requirements and manufacturer's instructions. [SLO:HVACR-10-K-10]:	Install Cooling Tower and water pumps (for water-cooled condenser). [SLO:HVACR-12-K-08]: Establish the electric power supply system for the chiller, AHUs and cooling tower. Carry out Commissioning Students will be able to [SLO:HVACR-12-K-09]: Select tools, equipment and accessories for commissioning. [SLO:HVACR-12-K-10]: Start the condenser and chilled water pump for water circulation. [SLO:HVACR-12-K-11]:

Insulate the joints and refrigerant pipes according to standards [SLO:HVACR-09-K-12]: Make sure that all packing materials including Cardboard, Styrofoam, Tape and Plastic film have been removed [SLO:HVACR-09-K-13]: Switch on the Air conditioner and check performance as per capacity and specifications	removed from the site after installation [SLO:HVACR-10-K-11]: Switch on the Air conditioner and check Air conditioner's performance as per capacity and specifications	Fix shut-off valves with service ports on each indoor unit. [SLO:HVACR-10-K-11]: Check and repair leaks, insulate joints, evacuate the system and charge refrigerant. [SLO:HVACR-10-K-12]: Connect power supply and control wires to central control/Building Management System (BMS). [SLO:HVACR-10-K-13]: Switch on the system and check performance.	Start the chiller, record temperature/pressure parameters and check for unusual vibrations/noises. [SLO:HVACR-12-K-12]: Perform Air Balancing and water balancing to ensure air/water distribution per design. [SLO:HVACR-12-K-13]: Check the system's performance against design criteria.

Domain L: **Service & Repair Domestic, Commercial & Industrial Air Conditioning System**

Standard I: Diagnose air conditioning issues by checking for problems, selecting appropriate tools and evaluating electrical and refrigerant systems for Domestic, Commercial & Industrial Air Conditioning System

Grade 9	Grade 10	Grade 11	Grade 12
Benchmark I: Students will effectively service split-type air conditioners, selecting tools, starting the unit and assessing performance using specified instruments and will also demonstrate competence in pump-down procedures, dismantling units, cleaning components and reinstallation, ensuring proper connection of refrigerant pipes and control wires.		**Benchmark I:** Students will diagnose, repair and maintain Commercial and industrial Air Conditioning Systems, ensuring optimal performance, extended lifespan and superior indoor air quality. This mastery includes diagnosing complex faults, executing advanced repairs and implementing innovative maintenance practices, showcasing a deep understanding of HVAC technology and a commitment to sustainability.	
Student Learning Outcomes			
The students will be able to: [SLO:HVACR-09-L-01]: Check for obvious problems to determine which component or system is causing the problem	The students will be able to: [SLO:HVACR-10-L-01]: Select tools, equipment and related accessories according to job requirements	**Diagnose Fault in Commercial & Industrial Air Conditioning System:** Students will be able to:	**Advanced Diagnostics and Troubleshooting:** Students will be able to: [SLO:HVACR-12-L-01]:

[SLO:HVACR-09-L-02]: Select tools, equipment and related accessories according to requirements and standards. [SLO:HVACR-09-L-03]: Check power supply, electric wiring, electric /electronic components as recommended by manufacturer and record the results [SLO:HVACR-09-L-04]: Check refrigerant pressure to determine the exact problem by using AVO meter / Gauge manifold as recommended by manufacturer and record the results [SLO:HVACR-09-L-05]: Diagnose the causes of the problem according to the manufacturers manual and standards.	[SLO:HVACR-10-L-02]: Disconnect the Air conditioner from electric supply and follow the manual instructions for rectification [SLO:HVACR-10-L-03]: Rectify the faults as per diagnosed, repair /replace the components, as necessary [SLO:HVACR-10-L-04]: Switch on the Air conditioner to check the performance of electrical/ electronic and mechanical components as specified in the **manufacturer's manual and record the results.** [SLO:HVACR-10-L-05]: Select tools, equipment and related accessories according	[SLO:HVACR-11-L-01]: Develop fundamental skills in diagnosing common problems in AC systems. [SLO:HVACR-11-L-02]: Learn to select basic tools and equipment for diagnostic purposes. [SLO:HVACR-11-L-03]: Understand the importance of documentation and record-keeping in fault diagnosis. [SLO:HVACR-11-L-04]: Gain hands-on experience by checking power supply, wiring, components and refrigerant pressure. **Repairing of Chillers / AHU / FCU:**	Specialize in advanced diagnostic techniques for intricate air conditioning systems. [SLO:HVACR-12-L-02]: Focus on interpreting readings of various parameters such as temperature and pressure. [SLO:HVACR-12-L-03]: Learn advanced techniques for testing compressor efficiency and air velocity of cooling coils. **Advanced Repairs and Component Replacement:** [SLO:HVACR-12-L-04]: Acquire advanced skills in replacing and upgrading

	to job requirements. [SLO:HVACR-10-L-06]: Start the Air conditioner, check and record performance by using specified test instruments [SLO:HVACR-10-L-07]: Pump down the split-type Air conditioner and dismantle the both indoor and condensing unit [SLO:HVACR-10-L-08]: Clean the components of Air conditioner with specified cleaning agents/tools & materials. [SLO:HVACR-10-L-09]: Re-install the indoor & in outdoor unit, connect with refrigerant pipes, control wires, evacuation, opening	[SLO:HVACR-11-L-05]: Progress to selecting tools and equipment based on specific repair requirements. [SLO:HVACR-11-L-06]: Advanced skills in system shutdown and rectification procedures. [SLO:HVACR-11-L-07]: Develop proficiency in replacing components, such as Printed Circuit Boards (PCB) and air filters. [SLO:HVACR-11-L-08]: Practice restarting systems and recording post-repair performance. **Repair Pumps and Cooling Tower:**	components, such as motorized actuator valves. [SLO:HVACR-12-L-05]: Explore techniques for dismantling and reassembling complex HVAC units. [SLO:HVACR-12-L-06]: Gain expertise in replacing critical components to optimize system performance. **Specialized Pump and Cooling Tower Maintenance:** [SLO:HVACR-12-L-07]: Develop specialized skills in pump and cooling tower maintenance.

	the service valves and leak testing [SLO:HVACR-10-L-10]: Switch on the Air conditioner, check and record performance	[SLO:HVACR-11-L-09]: Expand skills in selecting tools for more complex tasks related to pumps and cooling towers. [SLO:HVACR-11-L-10]: Deepen understanding of cooling tower components, including fan assemblies, float valves and strainers. [SLO:HVACR-11-L-11]: Explore chemical treatment techniques for preventing sludge/scaling issues. [SLO:HVACR-11-L-12]: Learn advanced procedures for starting, servicing and repairing condenser/chilled water pumps.	[SLO:HVACR-12-L-08]: Focus on intricate tasks such as checking water levels, bearings and motor abnormalities. [SLO:HVACR-12-L-09]: Deepen knowledge of chemical treatments for preventing sludge and scaling issues. [SLO:HVACR-12-L-10]: Specialize in servicing and repairing condenser/chilled water pumps.

Domain M: **Automobile Air Conditioning system**

Standard I: Identify, collect tools and gather materials for automotive air conditioning system inspection and will also handle refrigerants safely, check components, refrigerant levels and detect faults without causing damage, following standard procedures.

Grade 9	**Grade 10**
Benchmark I: Students will check air conditioning system components, ensuring the correct amount of refrigerant per the manual. They will skillfully detect damaged components, assess electric wiring/ECU operating systems and complete tests without causing damage to the workplace or vehicles.	
Student Learning Outcomes	
	The students will be able to: [SLO:HVACR-10-M-01]: identify and collect necessary tools and equipment as per requirement. [SLO:HVACR-10-M-02]: collect materials in accordance with work requirements. [SLO:HVACR-10-M-03]:

	identify and prepare technical and/or calibration requirements for servicing sourced and support equipment [SLO:HVACR-10-M-04]: handle the refrigerants when observed dangers [SLO:HVACR-10-M-05]: check air conditioning system components as per procedure [SLO:HVACR-10-M-06]: check the amount of refrigerant as per instruction manual [SLO:HVACR-10-M-07]: detect damaged components and related electric wiring /ECU operating system according to the standard procedures. [SLO:HVACR-10-M-08]: complete the test without causing damage to any work-place property and vehicle.

	[SLO:HVACR-10-M-09]: identify faults/defects for repairing/servicing action based on checking

Domain N: Fabrication Fundamentals for HVAC Work

Standard I: Demonstrate Proficiency in HVAC Fabrication and Installation Techniques for Commercial & Industrial Buildings..

Grade 11	**Grade 12**
Benchmark I: Students will be able to fabricate, install and insulate HVAC components following industry standards, ensuring optimal system performance, longevity and compliance with ASHRAE or SMACNA guidelines.	
Student Learning Outcomes	
Students will be able to: **Tool and Material Selection:** [SLO:HVACR-11-N-01]: Select tools, machines, sheet materials and accessories per HVAC fabrication requirements and standards.	**The students will be able to:** **Advanced Fabrication Procedures:** [SLO:HVACR-12-N-01]: adhere to international standards (ASHRAE or SMACNA) for fabrication, ensuring compliance with industry benchmarks.

[SLO:HVACR-11-N-02]: Identify and categorize tools, gaining hands-on experience in their use. **Basic Duct Fabrication:** [SLO:HVACR-11-N-03]: take measurements, mark locations and select duct fittings based on layout plans and diagrams. [SLO:HVACR-11-N-04]: practice fabricating basic duct elements, focusing on edges, joints, seams, bends and notches. **Pipe Fabrication Basics:** [SLO:HVACR-11-N-05]: select tools, machines and pipe materials; prepare joints and clean pipe joints for welding or threading.	[SLO:HVACR-12-N-02]: apply advanced fabrication techniques, meeting international HVAC standards and maintaining quality control. **Installation Mastery:** [SLO:HVACR-12-N-03]: mount hangers, angle rails, threaded rods and straps according to industry standards; install ducts and pipes on angle rails. [SLO:HVACR-12-N-04]: execute complex installations, ensuring fabricated ducts and pipes are securely mounted with proper insulation and cladding. **Quality Insulation Practices:** [SLO:HVACR-12-N-05]: select tools, equipment and insulation materials; prepare and apply insulation based on ASHRAE or SMACNA standards.

[SLO:HVACR-11-N-06]: demonstrate proficiency in basic pipe fabrication techniques, emphasizing precision and cleanliness.	[SLO:HVACR-12-N-06]: demonstrate expertise in insulating water and steam pipes, applying vapor barrier paper, cotton cloth wrapping and sheet metal cladding according to specifications.

Domain O: **Perform Preventive Maintenance**

Standard I: Demonstrate proficiency in HVACR system calibration and maintenance, ensuring optimal equipment performance and adherence to industry standards.

Grade 11	**Grade 12**
Benchmark I: Students will be able to calibrate or replace measuring instruments in HVACR systems, showcasing advanced troubleshooting skills and utilizing digital tools. Execute routine maintenance tasks, integrating proactive measures for system efficiency and consistently adhere to HVACR standards throughout the processes.	
Student Learning Outcomes	
Students will be able to: **Calibrate/Replace the Measuring Instruments:** [SLO:HVACR-11-O-01]:	**The students will be able to:** **Calibrate/Replace the Measuring Instruments:** [SLO:HVACR-12-O-01]:

shut down the system when required and safely dismantle measuring instruments. [SLO:HVACR-11-O-02]: select and organize tools, equipment and accessories based on job requirements and the sequence of operations. [SLO:HVACR-11-O-03]: follow manufacturer's instructions to calibrate or replace measuring instruments. [SLO:HVACR-11-O-04]: reinstall measuring instruments, starting the system to ensure the calibrated instrument's performance aligns with the manufacturer's specifications. [SLO:HVACR-11-O-05]: record the output results of measuring instruments for future reference. [SLO:HVACR-11-O-06]:	apply advanced troubleshooting skills to identify the need for instrument calibration or replacement, ensuring optimal system performance. [SLO:HVACR-12-O-02]: integrate digital tools and technologies for precision in calibrating and replacing measuring instruments. [SLO:HVACR-12-O-03]: develop a comprehensive understanding of industry best practices and emerging trends in instrument calibration and replacement. Carry Out Maintenance: [SLO:HVACR-12-O-04]: safely pump down or shut down the system, following standard procedures and safety protocols. [SLO:HVACR-12-O-05]: utilize advanced tools and equipment to perform a thorough check of various machine parameters, including temperature, vibration and noise.

adhere to HVACR standards throughout the calibration or replacement process.	[SLO:HVACR-12-O-06]: implement a proactive approach to weekly, monthly and annual maintenance tasks, ensuring the system operates at design efficiency. [SLO:HVACR-12-O-07]: record and analyze system performance post-maintenance, making adjustments as necessary. [SLO:HVACR-12-O-08]: demonstrate an in-depth understanding of HVACR standards and apply them consistently during maintenance operations.

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