GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering
Level: Diploma
Branch: Automobile Engineering
Subject Code: DI05002021
Subject Name: Automotive Heating & Air Conditioning

w. e. f. Academic Year:	2026-27
Semester:	5th
Category of the Course:	PCC

Prerequisite:	Basics of Thermodynamics
Rationale:	Automotive air conditioning and HVAC systems play a vital role in vehicle comfort, safety, and energy efficiency, especially under varying climatic conditions. This course is designed to provide diploma students with a comprehensive understanding of the fundamentals, components, controls, and servicing practices of automotive air conditioning and heating systems. The course enables students to understand basic air-conditioning principles, refrigeration cycles, refrigerants, and environmental considerations, which form the foundation for learning automotive cooling systems. It further develops the ability to understand the construction, working, and troubleshooting of automotive cooling, heating, and HVAC ventilation system, essential for diagnosing system performance issues in real vehicles. The course also introduces control devices, sensors, and automatic climate control systems, aligning students with modern automotive technologies. Finally, the course emphasizes practical skills in inspection, maintenance, servicing, charging, and repair of automotive HVAC systems with safety practices, preparing students for industry-ready roles such as service technicians, maintenance engineers, and workshop supervisors. Overall, the course bridges theory with hands-on application, supporting employability and meeting the requirements of the automotive service and manufacturing sectors.

Course Outcome:
After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Explain the fundamentals, terminology, refrigerants, and environmental aspects of automotive air conditioning systems.	R & U
02	Describe the working cycle, components, contaminants, and troubleshooting of automotive cooling (air-conditioning) systems with safety.	U & A
03	Explain the construction, working, air distribution, types, and troubleshooting of automotive heating and HVAC ventilation systems with safety.	U & A
04	Explain various HVAC controls and automatic climate control system.	R & U
05	Perform inspection, leak detection, servicing, charging, and repair of automotive HVAC systems following safety procedures.	U & A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE(V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
Unit I Fundamental of Air conditioning System.	1.1 Requirement and use of Air conditioning system in Automotive Vehicles. 1.2 Air conditioning system basic terminology. 1.2.1 Modes of heat transfer 1.2.2 Refrigeration, Air Conditioning 1.2.3 Cooling Load, Cooling Capacity, 1 Ton of refrigerant 1.2.4 Humidity (Absolute & Relative), Dry bulb Temperature, Wet Bulb Temperature and Dew point temperature. 1.2.5 Dry Air, Moist air, saturated air and unsaturated air. 1.2.6 Sensible heat, Latent heat Evaporation Latent Heat of Condensation 1.3 Types and properties of Refrigerant and Refrigerant Oil. 1.4 Effect of air conditioning refrigerants on the environment. 1.5 Concept of ecofriendly refrigerants.	05	16%
Unit II Automotive Cooling System.	2.1 Basic working cycle of Automotive cooling system (Vapour Compression Refrigeration cycle) 2.2 Major components Automotive cooling system 2.2.1 Magnetic clutch. 2.2.2 Types of compressors. 2.2.3 Condensers 2.2.4 Receiver Drier and Filter. 2.2.5 Accumulator. 2.2.6 Expansion valves and heat sensing tube, Orifice tube. 2.2.7 Evaporator 2.3 Trouble shooting of automotive cooling system.	10	21%

	2.3.1 Based on complain 2.3.2 Based on component defect. 2.4 Various Contaminant and their effects.		
Unit III Automotive Heating & HVAC Ventilation System.	3.1 Various Automotive Heating Methods 3.2 Major components Automotive heating system. 3.2.1 Engine Radiator 3.2.2 Heater Core 3.2.3 Heater Hoses 3.2.4 Heater Control Valve 3.2.5 HVAC Control Panel 3.3 Working of electric heating system. 3.4 Ventilation of Automotive AC System. 3.4.1 Air Distribution system. 3.4.2 Duct System. 3.4.3 Different Outlets and Grills/vents 3.4.4 Blower 3.4.5 Air Filters 3.5 Types of Air Conditioning Unit – Based on its working 1) Heater Cooler Independent System 2) Reheat Air Conditioning System 3) Semi-air mixed type Air Conditioning System 4) .Full air mixed type Air Conditioning System – Based on its location. 1) Dash type air condition system 2) Boot type air conditioning system 3) Dual air conditioning system 3.6 Trouble shooting of Automotive Heating System. 3.7 Trouble shooting of Air Distribution Unit	10	21%
Unit IV Various controls and Automatic climate control.	4.1 Controls of Automotive AC system 4.1.1 Pressure Switch 4.1.2 Evaporator Pressure Regulator 4.1.3 Humidifier and Dehumidifier 4.1.4 Thermistor Switch 4.1.5 Vacuum operated device 4.2 Semi-Automatic Temperature Control (SATC) and its Input Sensors.	10	21%

	4.3 Automatic Temperature Control (ATC) and its Input Sensors. 4.4 Automatic climate control. 4.5 Safety while working with Automotive AC system.		
Unit V HVAC Maintenance, Servicing and Repairing.	5.1 Inspection of A.C system –Visually and with the help of sight glass. 5.2 leak test of refrigerant 5.1.1 Electronic leak detector unit 5.1.2 Soap Bubble method 5.1.3 Water Immersion method 5.1.4 Fluorescent dye and Ultra violate rays method 5.3 Periodic service (Routine Service) of Automotive AC System. 5.4 Automotive charging and discharging methods: 5.4.1 Discharging A.C system and Evacuating A.C system. 5.4.2 Charging A.C system using various methods. (Liquid Charging, Vapour charging, top up cane charging, Charging with recovery unit) 5.4.3 Adding oil in Automotive A.C system. 5.5 Servicing steps/procedure of following components: 5.5.1 Compressor and Magnetic clutch and shaft seal replacement 5.5.2 Hose pipe fitting and connection checking. 5.5.3 Evaporator, condenser, Heater core.	10	21%
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**40**	**40**	**-**	**-**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Automotive Air Conditioning and Climate control Systems.	Steven Daly	Butterworth-Heinemann publications, ISBN-13: 978-0-7506-6955-9
2	Automobile Engineering (Volume – VI)	Anil Chhikara	Satya Prakashan. ISBN-10 : 1870186718 ISBN-13 : 871 -1870186718
3	Automotive Airconditioning	William H. Carouse & Donald L. Anglin	Tata McGraw-Hill Co., Ltd., New Delhi ISBN : 0-07-014591-1
4	Automotive Airconditioning	Clifford L.Samuels	Prentice Hall Int. ISBN-10 : 6806880688 ISBN-13 : 871 -6806880680
5	Automotive heating and air conditioning	Mark Schnubel	Cengage Publication ISBN-10 : 8800687880 ISBN-13 : 871 -8800687888
6	Basic Refrigeration and Air conditioning	Ananthanarayanan, P.N	McGraw Hill Education; New Delhi n(2013) ISBN-10: 9781259062704
7	Refrigeration and Air-Conditioning	Arora; Domkundwar	Dhanpatrai & Son's, New Delhi, ISBN: 9780000229663

(b) Open source software and website:

a) https://www.howacarworks.com
b) https://swayam.gov.in
c) http://nptel.ac.in/courses/112105129/pdf/R&AC
d) https://tinyurl.com/57mv2hct for video link
e) https://tinyurl.com/yysu44b6 for web link

Suggested Course Practical List:

Sr. No	Practical Outcomes (PrOs)		Unit No.	Approx. Hrs. required
1	Interpret Vapour Compression cycle using cut-section of Automotive Air Conditioning System.	Any One	I	04
2	Prepare list of different refrigerants, discuss major characteristics and property.		I	04

Sr. No	Practical Outcomes (PrOs)		Unit No.	Approx. Hrs. required
3	Identify components of Automotive air conditioning system and Explain Function of each Components.	Any Two	II	04
4	Trouble Shooting Of Automotive Air-Conditioner System with the help of pressure gage manifold set.		II	04
5	Trouble Shooting Of Automotive Air-Conditioner System with the help of touch, see and hear diagnostic.		II	04
6	Identify and Explain components of Automotive Heating System.	Any One	III	04
7	Trouble Shooting Of Car Heating System.		III	04
8	Locate and Explain parts of ventilation system of Automotive Air Conditioning.		III	04
9	Identify and Explain various controls of Automotive Air Conditioning.	Any One	IV	04
10	Compare various control systems of given any two Automotive Air Conditioning.		IV	04
11	Interpret working of Automatic Climate Control system of the given vehicle.		IV	04
12	Perform Discharge & Evacuation of refrigerant in A.C System with safety.	Any One	V	04
13	Perform Lubrication & Recharging of refrigerant in A.C System with safety.		V	04
14	Perform Leak Detection Test of A.C System with safety.		V	04
15	Perform Servicing Of Air Conditioning System with safety.	Any One	V	06
16	Perform servicing of AC compressor and magnetic clutch assembly with safety.		V	06
17	Perform servicing of Car Heating System with safety.		V	06
	Total Hrs.			**30**

List of Laboratory/Learning Resources Required:

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Cut Section of whole assembly of Automotive air conditioning system. – Cut Section of Condenser. – Cut Section of Compressor. – Cut Section of Receiver. – Cut Section of Evaporator. – Cut Section of Expansion Valve	1,2,3
2	Working model of Automobile HVAC system of any Car model – Make: car manufacturer in India – Power supply: 220 V AC 50 Hz 110 V AC 60 Hz – Compressor wobble plate type – Condenser parallel flow type suitable for car – Evaporator serpentine type with a thermostatic expansion valve, blower motor, and grill. – Receiver with sight glass and other accessories. – All ideal controls and safety controls for car ac. – Single phase electric motor 2 HP – Suitable 12volt battery to run condenser fan, evaporator fan and to operate magnetic clutch of the compressor. – Battery Charger to recharge Battery	1,2,3,8,9,10,11
3	Air Conditioning & Heater Service Tool Kit.	4,5,7,15.16,17
4	HFC Halogen Gas refrigerant leak Detector in automobile air conditioning for R-134a.	14
5	Electric refrigerant leak Detector in automobile air conditioning for R-134a.	14
6	Car Heater with Blower Assembly	6,7
7	Refrigerant Recovery, Recycling and Recharging Machine – Power supply: 220 V AC 50 Hz 110 V AC 60 Hz – Evacuating air speed of vacuum pump. 4.6 CFM – Compressor Power. 4/9 HP – Accuracy of electronic scale: 5 g – Maximum Wight of the electronic scale: 50 Kg – Drying filter: 500 cc, 3/8 connecting port – Capacity of refrigerant tank: 23.5 L 13.6 L – Maximum Working pressure. 17.5 bar – Maximum recovery speed: 0.5 kg/min – Maximum recharging speed: 2 kg/min	12,13

8	Digital Temperature Gauge	9,10,11
9	Pneumatic Gun. – Nozzle Size:- 0.3 mm – 0.5 mm – Body Material;- Mild Steel Color:- any – Air Pressure:- 30 PSI – 90 PSI	15,16,17
10	Pressure Gauge Manifold Set.(R 134a)	4,12,13,14,15

Suggested Project List:

1	Visit any AC Service workshop and prepare report on procedure of troubleshooting, Diagnosis, Testing and Servicing including AC recovery and evacuating.
2	Prepare a chart showing the layout and construction details of all the components of automobile air conditioning system.
3	Make a model/project on a basic Automotive AC system.
4	Prepare Power point presentation for explaining various trouble shooting of air conditioning and heating system.
5	Prepare color printed poster for showing importance of safety at lab/garage/workshop.
6	Prepare a chart on aggregates of Automatic Climate control System of Car air condition system.
7	Perform Market Survey for different types of Refrigerant available in the market.
8	Prepare report on Refrigerants.
9	Prepare videos of component dismantling and assembling.
10	Select any one Electric Automotive air conditioning system, search information from websites and prepare report for the same.
11	Collect the data of different types of control system and writes a report on it.

Suggested Activities for Students: If any

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of each activity. They should also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Charts can be prepared.
b) Small report on any topic given by concern faculty.
c) Small groups of students can be formed for assigned work. Assigned work should be such that it covers market survey, team work, presentation, time management, quality development.

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