

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: VEHICLE AIR CONDITIONING
(COURSE CODE:3360204)**

Diploma Programme in which this course is offered	Semester in which offered
Automobile Engineering	Sixth

1. RATIONALE

Vehicle air conditioning is the important feature of any modern vehicle. This course is designed to learn the fundamental principles and basic concept of vehicle air conditioner system. Also this will help the students in understanding the troubles occurring in vehicle air conditioner system, its possible causes and required measures. The student will develop the ability to use the instruments and tools to check and service the system.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the following competency:

- **Troubleshoot using standard procedures for maintaining vehicle air conditioning and heating systems.**

3. COURSE OUTCOMES

Students will be able to:

- Identify various components of Vehicle Air conditioning and heating system.
- Apply various concepts related to Air conditioning and heating system.
- Operate manually and automatic Air conditioning and heating system.
- Diagnose various faults in air conditioning system by using suitable tools and instruments.
- Follow safety rules while servicing of Air conditioning and heating system.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
3	0	2	5	70	30	20	30	

Legends: L-Lecture; T – Tutorial/Teacher Guided Student Activity; P - Practical; C – Credit; ESE - End Semester Examination; PA - Progressive Assessment.

5. DETAILED COURSE CONTENTS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I VEHICLE AIR- CONDITI ONING FUNDAM ENTALS.	1a.Explain concepts of air conditioning. 1b.Describe Air Conditioning Cycle. 1c.Describe functions of various components of air-conditioning, & heating system.	1.1 Fundamental principles and various Definitions (i) Heat and Modes of heat transfer. (ii) Latent Heat, Sensible Heat. (iii) Various Refrigerants and its properties. (iv) Air circulation and Humidity. (v) Cooling the air. (vi) Drying and cleaning the air. (vii) Due Point Temperature, Wet bulb/Dry bulb Temperature, Humidity, Relative Humidity. 1.2 Air-conditioning principle with Schematic layout (Vapour Compression Refrigeration cycle) 1.3 Basic Air-conditioning systems and operation of basic components (i) Magnetic clutch. (ii) Types of compressors. (iii) Condensers. (iv) Receiver Drier and Filter. (v) Different types of expansion valves and suction valves. (vi) Evaporator and heat sensing tube. (vii) Thermostats switch, Evaporator Pressure Regulator. (viii) Automotive air-conditioning controls. 1.4 Working of different automotive heaters.
Unit – II VEHICLE AIR- CONDITI ONING AND HEATER SYSTEMS.	2a.Describe various automotive Air-conditioner & Heater systems.	2.1 Manually controlled air-conditioner heater systems. (i) Different types of air-conditioner heater systems. (ii) Working and its operating modes. 2.2 Automatically controlled Air-conditioning systems. (i) Automatic temperature control. (ii) Operating modes. (iii) Different parts of automatic controlled air conditioning system. (iv) Humidity Control (Humidifier and Dehumidifier) 2.3 Field installed air-conditioners. 2.4 Automatic climate control.

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit– III HEATER AND AIR- CONDITI ONER TROUBLE SHOOTIN G.	3a.Explain Diagnosis & Testing of Automotive air-conditioner system. 3b. Describe fire prevention & shop safety.	3.1 Safety in the shop. (i) Fire prevention (ii) Shop safety rules (iii) Air-conditioner service safety rules 3.2 Servicing heating system (i) Car heater system, trouble diagnosis chart 3.3 Causes of Air-conditioner failure 3.4 Trouble shooting the Air-conditioner system. (i) Checking out a trouble (ii) Air-conditioner trouble - diagnosis chart 3.5 Checking the refrigeration system. (i) Checking system with sight glass (ii) Using the Leak detector (iii) Checking pressures with the gauge set
Unit– IV SERVICIN G OF VEHICLE AIR CONDITIO NING SYSTEMS.	4a.Explain Maintenance & service of various components of air-conditioner system. 4b.Explain Charging & Discharging of air- conditioner system.	4.1 Air-conditioner maintenance and service. (i) Periodic maintenance (ii) Vacuum pump service (iii) Discharging the system (iv) Adding oil (v) Evacuating the system (vi) Vapour charging and Liquid charging Methods. (vii) Use of Recovery recharging unit. 4.2 Different types of air-conditioner service. 4.3 Removing and replacing components. (i) O - rings (ii) Hose clamps (iii) Compressor drive belts (iv) Removing and replacing the compressor (v) Removing and replacing other components 4.4 Servicing Air-conditioner compressors. (i) Servicing different types compressors (R-4, R-6, V-type etc.)

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks (Duration – 42 Hours)			
			R Level	U Level	A Level	Total
I.	Vehicle air-conditioning fundamentals.	13	11	10	0	21
II.	Vehicle air-conditioning heater systems.	09	07	07	0	14
III.	Heater and air-conditioner trouble shooting.	10	0	05	12	17
IV.	Servicing of vehicle air conditioning systems.	10	0	05	13	18
	Total	42	18	27	25	70

Legends:

R = Remembrance; U = Understanding; A = Application and above levels (Revised Bloom's taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7. SUGGESTED LIST OF EXPERIMENTS

The tutorial/practical/exercises should be properly designed and implemented with an attempt to develop different types of cognitive and practical skills (**Outcomes in cognitive, psychomotor and affective domain**) so that students are able to acquire the competencies.

Sr. No.	Unit No.	Practical Exercises (Any Seven) (Outcomes' in Psychomotor Domain)	Hours (Total 28 hrs)
1	III	Test the Air Conditioning System for refrigerant leaks.	4
2	IV	Perform Evacuation of the Air-conditioner system	4
3	IV	Perform Recharging the Air-conditioner system	4
4	IV	Perform Air Conditioning system Recharging with Recovery unit.	4
5	III	Trouble shooting the Air-conditioner system	4
6	IV	Service Air-conditioner	4
7	I	Service Air-conditioner compressors	4
8	II	Service Heating systems	4

8. SUGGESTED LIST OF PROPOSED STUDENT ACTIVITIES

Following is the list of proposed student activities like: course/topic based seminars, internet based assignments, teacher guided self learning activities, course/library/internet/lab based mini-projects, Demonstration, Industrial Visits, Transparency, Video collection, Chart or Model preparation by students etc. These could be individual or group-based.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Case studies of typical maintenance/installation problems in ACs for different makes of automobiles and problem based learning
- ii. Arrange expert lectures of executives of different vehicle ACs companies
- iii. Visit of authorized workshop of four wheelers.
- iv. Collection of animation or video clips and presentation using same.
- v. Internet based assignments, teacher guided self learning activities, course/library/internet/lab based mini-projects etc.

10. SUGGESTED LEARNING RESOURCES**A. List of Books**

S.No.	Author	Title of Books	Publication
1	Anil Chhikara	Automobile Engineering (Volume – VI)	Satya Prakashan.
2	William H. Carouse & Donald L. Anglin	Automotive Air-conditioning	Tata McGraw-Hill Co., Ltd., New Delhi
3	Clifford L.Samuels	Automotive Air-conditioning -	Prentice Hall Int.
4	Steven Daly	Automotive Air-conditioning & Climate control system.	Butterworth-Heinemann
5	Mark Schnubel	Automotive heating and air conditioning	Cengage Publication

B. List of Major Equipment/ Instrument

1. Leak Detector
 - (a) Halide Torch complete set (Propane Cylinder, torch, etc)
 - (b) Electric Leak Detector complete set (Detector probe, Amplifier/tester, 12V battery, test liquid, etc)
2. Vacuum pump – Model for demonstration
3. High/Low Pressure (Vacuum) gauge manifold (unit cm of Hg & kg/cm²)
4. Refrigerant container
5. Oil Inducer (A Long tube with connectors at ends and with a Manual valve)
6. Magnetic clutch – Model for demonstration
7. Expansion valve – Model for demonstration
8. Compressor – cut section for demonstration
9. Evaporator Pressure regulator Valve – for demonstration
10. Car Heater Blower Motor and wheel assembly – for demonstration.
11. V.C.R. Cycle – Model for Demonstration
12. Evaporator – Cut section model for demonstration
13. Air conditioning Recovery Recharging Unit

C. List of Software/Learning Websites

Sample Video for Practical:

Sr No.	Topic	Sample Video URL Address	
1	How To Find and Repair AC Leaks EricTheCarGuy	<1>	https://www.youtube.com/watch?v=e31HCvckZAU
		<2>	http://youtu.be/e31HCvckZAU
2	How To Recharge an AC System EricTheCarGuy	<1>	https://www.youtube.com/watch?v=IN55uStu8Xs
		<2>	http://youtu.be/IN55uStu8Xs
3	Using AC Pressure Gauges To Fix Car AC Problems	<1>	https://www.youtube.com/watch?v=PdQGS6mJjQ8
		<2>	http://youtu.be/PdQGS6mJjQ8
4	Quick automotive a c system leak detection using uv dye	<1>	https://www.youtube.com/watch?v=1-R8k0Rf76M
		<2>	http://youtu.be/1-R8k0Rf76M
5	How to Troubleshoot your Car's AC System NBC Consumer Watch Advance Auto Parts	<1>	https://www.youtube.com/watch?v=QsxzcoYFWTk
		<2>	http://youtu.be/QsxzcoYFWTk
6	How to Recharge an Auto A C System Removing Connecting Refrigerant Cans to a Car	<1>	https://www.youtube.com/watch?v=orflU-cvxco
		<2>	http://youtu.be/orflU-cvxco
7	How to test for refrigerant leaks	<1>	https://www.youtube.com/watch?v=2XjAZjqSC-k
		<2>	http://youtu.be/2XjAZjqSC-k
8	How to pull vacuum on an R134a car AC system	<1>	https://www.youtube.com/watch?v=FiHr5V04dnc
		<2>	http://youtu.be/FiHr5V04dnc
9	How to evacuate and pull vacuum on an R134a car AC system	<1>	https://www.youtube.com/watch?v=8Yom2jLiKGA
		<2>	http://youtu.be/8Yom2jLiKGA
10	Evacuate vacuum down your Auto AC system w inexpensive tools	<1>	https://www.youtube.com/watch?v=8kTyLkcu0dA
		<2>	http://youtu.be/8kTyLkcu0dA
11	Air Conditioning Troubleshooting	<1>	https://www.youtube.com/watch?v=WncHNLdU4EA
		<2>	http://youtu.be/WncHNLdU4EA
12	A C Troubleshootingpart 2of 2	<1>	https://www.youtube.com/watch?v=tcQ3HVVHXm4
		<2>	http://youtu.be/tcQ3HVVHXm4
13	A C Troubleshootingpart 1of 2	<1>	https://www.youtube.com/watch?v=15oqzuFNHx4
		<2>	http://youtu.be/15oqzuFNHx4
OR Complete Video Play-list available on below single URL address			
http://www.youtube.com/playlist?list=PLssHEXVflgpF63EPqNhDZhNGewONk8UGs			

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- Mr.D.A.Dave, H.O.D., Automobile Engg. , Sir Bhavsinhji Polytechnic Inst., Bhavnagar.
- Mrs.M.N.Vibhakar, Lecturer, Automobile Engg. DR.S&SS Gandhi Polytechnic, Surat
- Mr.A.K.Nanavati, Lecturer, Automobile Engg. G.P., Ahmadabad
- Mr.V.B.Patel, Lecturer, Automobile Engg. Dr. J.N.Mehta Government Polytechnic, Amreli

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof.K.K.Jain**, Professor, Deptt of Mechanical Engineering, NITTTR Bhopal
- **Dr.C. K. Chugh**, Professor, Deptt of Mechanical Engineering, NITTTR Bhopal