

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

AUTOMOBILE POLLUTION CONTROL ENGINEERING (Code:3330205)

Diploma Programme in which this course is offered	Semester in which offered
Automobile Engineering	3 rd Semester

1. RATIONALE

Automobiles burn different kinds of fuels to generate mechanical power. Fuel burning also generates exhaust emissions, which pollutes the atmosphere. Increase in number of automobiles has resulted in atmospheric pollution beyond permissible limits in cities. Thus automobile emissions have become a social concern and engineers are supposed to reduce it. Emission standards are therefore set in every country to control this problem. These standards specify maximum amount of pollutants that can be released into the environment by different types of vehicles. The students should therefore have knowledge about the pollutants produced by automobiles and ways to reduce the pollution by the use of the various Emission control devices. This course will provide knowledge about reasons for automobile pollutants and means to reduce them. This course will also provide opportunity to develop skills in measuring pollutions and maintain Emission control devices. It is an important course since the diploma graduates are required to maintain level of pollutants in emissions of various kinds of automobiles.

2. COMPETENCIES (Programme Outcomes according to NBA terminology)

The course content should be taught and with the aim to develop different types of skills so that students are able to acquire following competencies:

- i. Use appropriate Emission Control Device & Systems as per country prevailing emission-norms.
- ii. Test and analyse various Emission Control Devices to reduce air pollutant.
- iii. Select suitable alternative fuels for controlling pollution.

3. 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	
3	0	2	5	70	30	20	30	150

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

4. DETAILED COURSE CONTENTS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Introduction to automotive pollution.	1a. Explain different kind of pollutant produced by automobiles. 1b. Explain Noise pollution, its effects on human & ways to reduce noise pollution.	1.1 The atmosphere 1.2 Air pollutants. 1.3 Pollutants produced by automobiles. 1.4 Emission control norms- International & Indian norms. 1.5 Noise and sound pressure. 1.6 Measurement of noise. 1.7 Causes of automobile noise and its reduction.
Unit – II Principle of production of exhaust gases.	2a. Describe various pollutants produced under different driving conditions.	2.1 Theoretical air-fuel ratio. 2.2 Carbon monoxide (CO) gas. 2.3 Hydro Carbon (HC) gas. 2.4 Oxides of Nitrogen (NO _x). 2.5 Driving conditions and exhaust gases.
Unit– III Emission control systems.	3a. Describe various system used for emission control. 3b. Explain construction & working of different Emission control systems.	3.1 Emission control components layout and drawing. 3.2 Necessity and operation of Positive Crankcase Ventilation (PCV) system. 3.3 Necessity and operation of fuel evaporative emission control (EVAP) system for Carburetted & MPFI engines. 3.4 Operation of Charcoal Canisters. 3.5 Necessity and operation of Throttle Positioner (TP) system & Throttle Positioner sensor. 3.6 Catalytic converters. 3.7 Oxygen (O ₂) sensor. 3.8 Necessity and operation of High Altitude Compensation (HAC) system. 3.9 Manifold Absolute Pressure Sensor (MAPS). 3.10 Spark timing emission control systems. 3.11 Knock (Detonation) sensor. 3.12 Exhaust gas re-circulation (EGR) system. 3.13 ECM controlled EGR valves. 3.14 Necessity and operation of Mixture Control (MC) system.
Unit– IV Principle methods of exhaust gas analysis.	4a. Describe method of measuring various pollutants. 4b. Describe automotive emission control norms in India.	4.1. Measuring CO and CO ₂ concentrations. 4.2. Measuring HC concentrations. 4.3. Measuring NO _x concentrations. 4.4. Prevalent Automotive emission control norms in India. 4.5 Construction & working of Exhaust Gas analyser. 4.6 Construction & working of Diesel Smoke meter.

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit– V LPG and CNG conversion.	5a. Describe conversion, installation & maintenance of LPG & CNG kit	5.1 Merits of LPG's. 5.2 LPG conversion kit. 5.3 LPG kit installation. 5.4 Maintenance of LPG kit components. 5.5 Merits of CNG's. 5.6 CNG conversion kit. 5.7 CNG kit installation. 5.8 Maintenance of CNG kit components. 5.9 Performance features of Petrol, LPG and CNG vis-à-vis.

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

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total
1.	Introduction to automotive pollution.	05	3	2	2	07
2.	Principle of production of exhaust gases.	06	3	2	2	07
3.	Emission control systems.	20	7	21	7	35
4.	Principle methods of exhaust gas analysis.	04	3	2	2	07
5.	LPG and CNG conversion.	07	3	7	4	14
	Total	42	19	34	17	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised 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.

6. SUGGESTED LIST OF PRACTICAL/EXERCISES

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills (**Course Outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only Course Outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

S. No.	Unit No.	Experiment (Any Seven) (Course Outcomes in Psychomotor Domain according to NBA terminology)	Approx. Hrs. Required
1	II	Measure CO, HC emission from petrol engines on exhaust gas analysis	4
2	II	Measure diesel exhaust smoke of diesel engine on diesel smoke meter	4
3	III	Service Positive Crankcase ventilation system.	4
4	III	Test Spark timing control system.	4
5	III	Service muffler.	4
6	III	Service Catalytic converter.	4
7	III	Demonstrate Exhaust gas re-circulation (EGR) system	4
8	V	Study of LPG kit inspection, testing and setting.	4
9	V	Study of CNG kit inspection, testing and setting.	4
Total			36

7. SUGGESTED LIST OF PROPOSED STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

- i. Seminars using power point presentations to get understanding of different phenomenon of pollutants such as NO_x, CO, HC etc.
- ii. Group discussion on severity of atmospheric pollution. Internet based assignments & teacher guided self learning activities.

8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- i. Video films using animations for showing various effects of pollutants on atmosphere, component and system to reduce the pollution.
- ii. Chart and Cut section model showing how they work to reduce the pollution.

9. SUGGESTED LEARNING RESOURCES

A. List of Books

S. No.	Author	Title of Books	Publication
1	Anil Chhikara	Automobile Engineering (Vol- I)	Satya Prakashan, New Delhi
2	William H. Carouse Donald L. Anglin	Automotive Mechanics	Tata McGraw-Hill Co., Ltd., New Delhi
3	William H. Carouse Donald L. Anglina	Automotive Emission Control	Tata McGraw-Hill Co., Ltd., New Delhi
4	James D. Halderman, James Linder	Automotive Fuel and Emissions Control Systems	Prentice Hall,
5	Richard K. DuPuy, Steven D. Schaefer, William E. Renke	Fuel systems and emission controls	Chek-Chart Publications

S. No.	Author	Title of Books	Publication
6	Tom Denton	Automobile Electrical & Electronics System	Arnold Publishers

B. List of Major Equipment/ Instrument

- i. Smoke meter
- ii. Exhaust gas analyzer
- iii. Catalytic converter
- iv. LPG & CNG kit
- v. Different types of muffler.
- vi. Emission control devices (e.g PCV valve, EGR valve, Charcoal Canister)

C. List of Software/Learning Websites- Google and other search engines could be used to get information on internet.

- i. <http://www.youtube.com/watch?v=qB7h7ftdsQA>
(How to install LPG on your car)
- ii. <http://www.youtube.com/watch?v=1zH22Qpe2GA>
(Understanding Catalytic Converters and How They Work)
- iii. [http://nc-ti.org/Program%20Area/Automotive/Emission%20Controls\[1\].ppt](http://nc-ti.org/Program%20Area/Automotive/Emission%20Controls[1].ppt)
(Emission Controls.ppt)
- iv. http://academic.cengage.com/resource_uploads/downloads/1111128618_2767 27.
ppt (Emission Controls.ppt)
- v. <http://grewal.wikispaces.com/file/view/Emission+Control.ppt> (Emission Controls.ppt)

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. D. A. Dave**, Head Automobile Engineering Department. Sir Bhavsinhji Polytechnic Inst., Bhavnagar.
- **Prof. A. C. Suthar**, Lecturer, Automobile Engineering Department. M.L.Institute of Diploma Studies, Bhandu.
- **Prof. D. J. Gohel**, Lecturer, Automobile Engineering Department. C.U.Shah Polytechnic, Surendranagar.
- **Prof. Sanjay Kumar Ghaiye**, Head Automobile Engineering Department, Kalaniketan Polytechnic, Jabalpur (MP).

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. K. K. Jain**, Professor, Department of Mechanical Engineering
- **Dr. C. K. Chugh**, Professor, Department of Electronic Media