

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

course curriculum

**AUTOMOBILE ENGINES
(Code:3330201)**

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

1. RATIONALE

All automotive vehicles are powered by automobile engines. Hence the fundamental knowledge of automobile engine is most essential for an auto technician. This course will help the students in manufacturing, inspection, operation, servicing and maintenance of various types of engines, and their different associative systems like lubricating systems, cooling systems, fuel systems, etc. Knowledge of this course will also be helpful to the polytechnic pass outs in diagnosis and testing of engine and other associative systems

2. COMPETENCY (Programme Outcomes (POs) 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 competency:

- **Maintain petrol and diesel automotive engines**

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			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 I.C. Engine.	1a. Describe automotive systems. 1b. Describe Engines types. 1c. Differentiate Petrol v/s 1d. Diesel Engine. 1e. Explain Otto and Diesel Cycle. 1f. Compare single & multi cylinder engines.	1.1 Automobile Vehicles-history, arrangement & different systems. 1.2 Types of Engines. 1.3 Principles of I.C. engines for automobiles 1.4 Mechanism of piston type engine and related terms 1.5 Two and four stroke Otto cycle, Two stroke and four stroke diesel cycle 1.6 Merits and demerits of single and multi cylinder engines.
Unit – II Constructional and functional details of components of I.C. Engines	2a. Describe construction & working of different components, systems, subassemblies, of IC engines. 2b. Differentiate components of petrol and diesel engine. 2c. Explain Engine ignition timing, firing order balancing	2.1 Construction of I.C. Engines- Major, minor components, sub-assemblies, systems, etc. 2.2 Functions of I.C. Engine- Major, minor components, subassemblies. 2.3 Engine ignition timing, firing order balancing.
Unit– III Types of combustion chamber	3a. Identify constructional difference between combustion chambers of S. I. Engines. 3b. Identify constructional difference between combustion chambers Of C.I. Engines.	3.1 Different types of combustion chamber used in S.I. engine with their relative advantages. 3.2 Different types of combustion chamber used in C.I. engine with their relative advantages.
Unit– IV Fuel systems for petrol engine	4a. Describe petrol fuel systems with advantages of each system. 4b. Explain construction & working of fuel carburetion system. 4c. Explain construction & working of fuel injection systems. 4d. Explain working of various modern fuel	4.1 Fuel systems of petrol engines.- Description & advantages. 4.2 Carburetion and mixture quality for engine. 4.2 Construction and function of simple Carburetor. 4.3 Types of inlet manifolds and methods of Vaporization. 4.4 Working of air cleaner. 4.5 Gasoline Fuel Injection System. 4.6 Classification of Fuel Injection System. 4.7 Fuel Injection Requirements. Throttle

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	injection systems for Petrol engine.	Body Injection (TBI) System. Port Fuel Injection (PFI) System. 4.8 Construction & Functions of electronic Injectors.
Unit– V Fuel systems for diesel engine	5a. Describe various diesel fuel injection systems. 5b. Explain construction and working of various fuel systems. 5c. Explain working of various modern fuel injection systems for diesel engine. 5d. Describe construction & working of Common Rail Direct Injection .	5.1 Fuel flow diagram.- brief descriptions. 5.2 Construction and working of Different diesel fuel injection system- Unitary type, of mechanically operated fuel injection system, mechanically operated & electronically controlled fuel injection system. 5.3 Construction & Functions of Common Rail Direct Injection (CRDI). 5.4 Details of different types of injectors. 5.5 Various types of governors. 5.6 Types of diesel filters. 5.7 Working of fuel feed pump for diesel engine. 5.8 Diesel electronic control system (DECS).
Unit– VI Cooling system of I. C. Engines	6a. Explain need of Cooling system. 6b. Explain construction & working of various cooling Systems. 6c. Describe attributes & effects of coolants.	6.1 Necessity of cooling system in I.C. engines. 6.2 Types of cooling system. 6.3 Construction & working of cooling system. 6.4 Types & Characteristics of a Coolant , and their effect on performance of cooling and engine
Unit– VII Lubricating system of I.C. engines	7a. Explain need of lubricating system. 7b. Explain elements & working of lubricating systems. 7c. Describe properties of engine oils and their effects.	7.1 Necessity of lubricating system in Engine. 7.2 Properties of engine oils, & effect on performance of lubricating of engines. 7.3 Types of a lubricating system, 7.4 Elements & working of lubricating system.
Unit– VIII Super charging of I.C. engine	8a. Explain purpose of supercharger with its merits and demerits. 8b. Describe various types of superchargers 8c. Explain construction & working of superchargers, Turbocharger, Intercoolers.	8.1 The purpose of super charging, 8.2 Merits & limitations of super charger, 8.3 Types & construction of super charger, 8.4 Principle & Construction of Turbocharger, Intercoolers.

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 I.C. Engine.	08	03	07	04	14
2.	Constructional and functional details of components of I.C. engines	11	04	07	03	14
3.	Types of combustion chamber	04	00	03	04	07
4.	Fuel systems for petrol engine	04	03	04	00	07
5.	Fuel systems for diesel engine	04	03	04	00	07
6.	Cooling system of I.C. Engine	04	03	04	00	07
7.	Lubricating system of I.C. engines	04	03	04	00	07
8.	Super charging of I.C. engine	03	00	03	04	07
	Total	42	19	36	15	70

Legends: R = Remember; U= Understand; A= Apply 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.

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.	Practical Exercise (Any Seven) (Course Outcomes in Psychomotor Domain according to NBA terminology)	Apprx. Hrs. Required
1	I	Demonstrate working of two & four stroke S.I. engines.	04
2	I	Demonstrate working of two & four stroke C.I. engines.	04
3	II	Demonstrate constructional details of piston, connecting rod & crank shaft.	04
4	II	Demonstrate construction & working of valve gear mechanism (Camshaft, Timing gear).	04
5	IV	Demonstrate construction & function of carburetor.	04
6	IV	Demonstrate construction of Gasoline Fuel Injection System.	04
7	VII	Observe construction & operation of fuel injector, its nozzle & fuel filters.	04
8	V	Demonstrate construction of fuel injection pump and governors.	04
9	VI	Demonstrate construction & function of cooling system and its components.	04
10	X	Observe construction & function of various lubricating system & its components.	04
11	XI	Observe construction & working of Turbocharger and Supercharger.	04
Total			28

7. SUGGESTED LIST OF PROPOSED STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

- a. Seminar by Students on construction & operation of various components of engine, associate systems like cooling system, lubricating system etc.
- b. Prepare Display Board such as fuel injection system etc., & Chart like 2 & 4 Stroke engine, various cycles.
- c. Prepare Cut section model of S.I & C.I engine.
- d. Assembly and disassembly of Engine components, fuel, cooling and lubricating systems, turbochargers, superchargers, water pump, etc.
- e. Teacher guided self learning activities to prepare report as an assignment from industrial survey/internet/library/or group discussion on any of the automobile transmission mechanisms.

8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- a. Lectures cum Discussion using Chart (such as fuel injection system for Petrol & Diesel engine), Cut Section Model (such as 2 & 4 stroke S.I & C.I. engine, super charger), Display board (such as cooling system, lubricating system).
- b. Visit of authorized workshop of two wheeler and four wheeler.
- c. Use of animation or video clips.

9. SUGGESTED LEARNING RESOURCES

(A) List of Books

S. No.	Author	Title of Books	Publication
1	R. B. Gupta	Automobile Engineering	Satya Prakashan, New Delhi
2	Anil Chhikara	Automobile Engineering vol-I	Satya Prakashan, New Delhi
3	K. M. Gupta	Automobile Engineering	Umesh Publication
4	W.H.Crouse & D.L. Anglin	Automotive Mechanics	Tata Mc-Graw Hill Publishing Co. Ltd.
5	Jain K.K., Asthana R.B.	Automobile Engineering	Tata Mc-Graw Hill Publishing Co. Ltd.
6	Ganeshan V.	Internal Combustion Engines	Tata Mc-Graw Hill Publishing Co. Ltd.
7	Mathur M.L. Sharma R.P.	Course in Internal Combustion Engines	Dhanpat Rai & Co. (P) Ltd
8	R. K. Rajput	A Textbook of Internal Combustion Engines	Laxmi Publication Ltd.
9	H.N.Gupta	Fundamentals of Internal Combustion Engines	Prentice Hall of India Pvt. Ltd. New Delhi
10	S. Srinivasan	Automotive Mechanics	Tata McGraw-Hill Education
11	C.P. Nakra	Basic Automobile Engineering	Dhanpat Rai Publication Co. (P) Ltd.
12	Singh Kirpal	Automobile Engineering: In a nutshell (Part-I)	Standard Publishers Distributors

(B) List of Major Equipment/ Instruments

- a. Charts for Otto & Diesel Cycles, Components of I.C Engines, Fuel Systems (Circuits) of Petrol/ Diesel/ LPG/ CNG powered Engines, Lubricating System and Cooling Systems.
- b. Models of various components of I.C. Engine.
 - Cut Section model showing Two Stroke Petrol/ Diesel Engine.
 - Cut Section model showing Four Stroke Petrol/ Diesel Engine.
 - Cut Section model showing Fuel Systems (Circuits) for various fuels.
 - Cut Section model showing Lubricating System.
 - Cut Section model showing cooling System.

(C)List of Software/Learning Websites

1. <http://auto.indiamart.com/auto-technology/auto-tech-engine.html>
2. <http://inventors.about.com/library/weekly/aacarsgasa.htm>
3. Howstuffworks.com
4. <http://www.nextgreencar.com/lpg-cng.php>
5. <http://www.air-quality.org.uk/26.php>
6. <http://www.engineering.com/Videos/VideoPlayer/tabid/4627/VideoId/573/Internal-Combustion-Engine.aspx>
7. <http://www.youtube.com/watch?v=uB2cmkWbCMI>
8. <http://www.animatedengines.com>
9. http://en.wikipedia.org/wiki/Internal_combustion_engine

10.COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. D.A.Dave**, Head Automobile Engineering Department, Sir Bhavsinhji Polytechnic Inst., Bhavnagar
- **Prof. M. N. Vibhakar**, Lecturer, Automobile Engineering Department, Dr. S. & S. S. Ghandhy College of Engineering and Technology, Surat.
- **Prof. S. V. Trivedi**, Lecturer, Automobile Engineering Department, Parul Institute of Engineering & Technology, Vadodara.

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

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

AUTOMOBILE TRANSMISSION & MECHANISMS (Code: 3330202)

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

1. RATIONALE

Any automobile apart from engine is made of transmission system and other systems like brakes, steering, suspension systems, wheel and tyres. This course provides knowledge about these systems. This course will also help the students during inspection, installation, operation and maintenance of transmission, steering and suspension systems of automobiles. This course is therefore a core course for automobile engineers and they should develop mastery over it.

COMPETENCIES (Programme Outcomes (POs) 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:

- **Install and test automobile power transmission, brakes, steering and suspension system during manufacturing**
- **Maintain automobile power transmission, brakes, steering and suspension system during service**

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	150
4	0	2	6	70	30	20	30	

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 Automobile Transmission System	1a. Describe power transmission systems. 1b. Draw different layout of chassis. 1c. Explain construction of frames.	1.1 Flow of power transmitted in front wheel drive, rear wheel drive and four wheel drive. 1.2 Different layout of chassis. 1.3 Lubrication of chassis. 1.4 Different types of frame. 1.5 Frame less chassis
Unit – II Clutch	2a. List different types of clutches. 2b. Explain operation of Clutch, Clutch actuating Mechanism. 2c. Describe Construction and working of fluid coupling.	2.1 Necessity Types of clutches. 2.2 Construction and functions of different types of clutches, clutch actuating mechanism. 2.3 Construction and functions of fluid coupling.
Unit – III Gear box	3a. Describe different types of gears and gear boxes. 3b. Describe operation of Gear shifting mechanisms with line diagram of motion flow. 3c. Explain construction & working of overdrive & torque convertor.	3.1 Necessity Types of gearboxes. 3.2 Construction and functions of Sliding mesh, Constant mesh, Synchromesh, Epicyclical train & automatic transmission. 3.3 Gear shifting mechanism, 3.4 Torque converter and overdrive- construction & working.
Unit– IV Propeller shaft & universal joint	4a. Explain need & construction of various types of propeller shafts. 4b. Explain construction & functions of various types of universal joints.	4.1 Need of propeller shaft, universal joint and slip joint. 4.2 Construction & functions of various types of propeller shafts. 4.3 Construction & functions of various types of universal joints.
Unit– V Rear axle assembly	5a. Identify components of final drive assembly. 5b. Describe construction and operation of differential and different types of rear axles. 5c. Describe construction and operation of different types of axle housings.	5.1 Necessity of final drive, Types of final drive. 5.2 Construction & functions of final drive. 5.3 Necessity of differential, Construction & functions of differential, differential locks. 5.4 Types of axle housing, Function of axle housing and different types of axle mounting.
Unit– VI Front axle and steering mechanism	6a. Explain steering geometry. 6b. Describe various steering mechanisms with is need and importance. 6c. Identify various linkages of steering mechanisms, steering gears. 6d. Explain power steering	6.1 Necessity of steering geometry. 6.2 Kingpin inclination, camber, caster, Toe-in Toe-out and other terminology. 6.3 Types of front axle. 6.4 Types of steering linkages and Types of steering gears. 6.5 Effect of under steer and over steering. 6.6 Steering lock and turning circle radius. 6.7 Power steering systems- hydraulic,

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	systems .	electronics controlled electrical.
Unit– VII Brakes	7a. List types of brakes. 7b. Explain construction and operation of various braking mechanisms. 7c. Explain need, construction & working of Anti lock brakes.	7.1 Necessity & Types of brake. 7.2 Construction and functions of braking system, Braking Mechanism, Brake setting. 7.3 Anti lock brake systems- purpose, arrangement and function of different parts.
Unit– VIII Suspension system	8a. Explain importance of suspension system. 8b. Describe construction and working of front & rear suspension systems and shock absorbers. 8c. Differentiate functions of springs and shock absorbers.	8.1 Necessity of suspension system. 8.2 Types of front & rear suspension systems. 8.3 Types of springs. 8.4 Construction and functions of various types of suspension system. 8.5 Necessity of shock absorber. 8.6 Construction and functions of shock absorber.
Unit– IX Wheels and tyres	9a. Describe construction of various types of wheels and tyres. 9b. Factors affecting life of tyre, & Tyre rotation. 9c. Describe tyre rating & specifications. 9d. Explain Hot & cold tyre retreading procedures.	9.1 Various types of wheels. 9.2 Salient features of wheels. 9.3 Salient features of different types of rims. 9.4 Types of tyres. 9.5 Constructional details of tube and tubeless tyres. 9.6 Hot & cold tyre retreading procedure. 9.7 Rating of tyre. 9.8 Factors affecting life of tyre. 9.9 Tyre rotation and Tyre specification.

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 automobile transmission system	04	04	03	00	07
2.	Clutch	07	02	03	02	07
3.	Gear box	09	03	04	03	10
4.	Propeller shaft & universal joint	05	02	03	02	07
5.	Rear axle assembly	04	02	03	02	07
6.	Front axle and steering mechanism	07	02	03	02	07
7.	Brakes	10	03	04	04	11
8.	Suspension system	05	02	03	02	07
9.	Wheels and tyres	05	02	03	02	07
	Total	56	22	29	19	70

Legends: R = Remember; U= Understand; A= Apply 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.

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.

Sr. No.	Unit No.	Practical Exercise (Any Seven) (Course Outcomes in Psychomotor Domain according to NBA terminology)	Apprx. Hrs. Required
1	II	Demonstrate construction and working of different types of clutch.	4
2	III	Demonstrate construction and working of different types of gear boxes.	4
3	III	Study working principal of overdrive mechanism.	4
4	IV	Demonstrate functions of propeller shaft and universal joint.	4
5	V	Demonstrate working of differential.	4
6	VII	Demonstrate operation of brake mechanisms and brakes (Hydraulic, Mechanical, Air brake).	4
7	VI	Demonstrate construction and operation of steering mechanism.	4
8	V	Demonstrate construction and operation of power steering.	4
9	VIII	Demonstrate of different types of suspension systems and shock absorbers.	4
10	IX	Study of different types of wheels and tyres.	4
Total			28

7. SUGGESTED LIST OF PROPOSED STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- a. Seminar by students on various automobile transmission mechanisms like clutch, gear, brakes actuating mechanisms etc.
- b. Preparation of display boards or charts for steering mechanism, suspension system, different types of brakes, wheels and tyres etc.
- c. Assembly and disassembly of clutch actuating mechanism, gear box, differential, steering mechanisms, brake actuating mechanism, steering, suspension systems, etc.
- d. Individual or group-based projects to prepare working model of various mechanisms such as brake operating mechanism, different clutch operating mechanism, steering mechanism, model of differential etc.
- e. Teacher guided self learning activities to prepare report as an assignment from industrial survey/internet/library/or group discussion on any of the automobile transmission mechanisms.

8. SUGGESTED INSTRUCTIONAL STRATEGIES (If Any)

- a. Lecture cum discussion using demonstration of charts, cut section models, animation and videos.
- b. Visit of authorized workshop of two wheeler and four wheeler or transmission component manufacturers.
- c. Group discussion on any of the automobile transmission and mechanisms.

9. SUGGESTED LEARNING RESOURCES

A. List of Books

S.No.	Author	Title of Books	Publication
1	R. B. Gupta	Automobile Engineering	SatyaPrakashan, New Delhi
2	Anil Chhikara	Automobile Engineering vol-II	SatyaPrakashan, New Delhi
3	K. M. Gupta	Automobile Engineering	Umesh Publication
4	Jain K.K., Asthana R.B.	Automobile Engineering	Tata Mc-Graw Hill Publishing Co. Ltd.
5	G. B. S. Narang	Automobile Engineering	Khanna Publishers
6	A. W. Judge	Motor Manual	London, 1925
7	W.H.Crouse & D.L. Anglin	Transmission and power Train	Tata Mc-Graw Hill Publishing Co. Ltd.
8	Singh Kirpal	Automobile Engineering: (Vol-II)	Standard Publishers Distributors
9	S. Srinivasan	Automotive Mechanics	Tata McGraw-Hill Education

S.No.	Author	Title of Books	Publication
10	N. K. Giri	Automobile Technology	Khanna Publishers
11	C.P. Nakra	Basic Automobile Engineering	DhanpatRai Publication Co. (P) Ltd.

B. List of Major Equipment/ Instrument

- a. Cut Sectioned working model of various types of clutches, gear boxes, fluid coupling/ torque convertor.
- b. Cut sectioned working model of various brake systems, differential.
- c. Display board of various steering gear mechanisms, power steering.
- d. Display board of various types of suspension system and shock absorbers.
- e. Charts for various types of chassis and frames, wheels and tyres.

C. List of Software/Learning Websites

- a. http://www.youtube.com/watch?v=H7Iay0Ke_t4
- b. <http://www.youtube.com/watch?v=OQ9eI7mEmxw>
- c. <http://www.youtube.com/watch?v=FfjGohWy-OU>
- d. <http://www.youtube.com/watch?v=IKywZ730JFs>
- e. <http://www.youtube.com/watch?v=eKKfJAaVBJE>
- f. <http://www.youtube.com/watch?v=aUIS25r3XY0>
- g. <http://www.youtube.com/watch?v=VcFQZ8NiF4o>
- h. <http://www.youtube.com/watch?v=17FG-GzVJyI>
- i. <http://www.youtube.com/watch?v=1-ksUrWmBo4>
- j. http://www.ehow.com/video_2327738_overview-shocks-suspension-system.html
- k. Howstuffworks.com
- l. Wikipedia.com

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. D.A. Dave**, H.O.D., Automobile Engineering Department, Sir Bhavsinhji Polytechnic Institute, Bhavnagar.
- **Prof. M.N. Vibhakar**, Lecturer, Automobile Engineering Department, Dr. S&S Gandhi Polytechnic, Surat.
- **Prof. S.V. Trivedi**, Lecturer, Automobile Engineering Department, Parul Institute of Engineering and Technology, Vadodara.
- **Prof. Sanjay Kumar Ghaiye**, Head Automobile Engineering Department, Kalaniketan Govt. Polytechnic, Jabalpur (MP).

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GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

AUTOMOBILE ELECTRICAL SYSTEM (Code: 3330203)

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

1. RATIONALE

Modern automobiles have many instruments for indicating different quantities such as speed, level of fuel, temperature and automatic control systems for doors/windows etc. Ignition system and lighting system also require power. It is therefore essential for automobile engineers to have the fundamental knowledge of automobile electrical systems. This course tries to develop this knowledge and skills in the students, which would help them in installation of various electrical components, operation and maintenance of automobile electrical system. Understanding of this course will also be helpful for diagnosis and testing of electrical system.

2. COMPETENCY (Programme Outcome 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 competency.

- **Install, inspect and maintain auto electrical systems.**

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	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

4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Electricity, Magnetism And Automobile Wiring	1a. Describe current, voltage, Magnetism, conductors, semi-conductors, Insulators & automobile wiring system. 1b. Explain Ohm's law, series and parallel circuits. 1c. Use various instruments for measuring current, voltage & resistance. 1d. Describe wiring harness, symbols for wiring.	1.1 A short history of auto-electrical system, constructional and functional details of conductors, semi-conductors and insulators. 1.2 Ohm's Law, EMF, potential difference and voltage drop, Series and parallel circuits, Effect of electric current, Measurement of DC-Current, Voltage, & resistance, 1.3 Application & principle of Multimeters, 1.4 Meaning of magnetism and law of magnetism, 1.5 Symbols used in wiring, Types of wiring system, wiring harness, Different electrical system
Unit – II Automobile Battery	2a. Explain principle and construction of lead acid battery. 2b. Describe characteristics of battery, rating, capacity and efficiency of batteries. 2c. Describe Charging methods & Battery maintenance.	2.1 Types of battery (dry & wet batteries.), Construction of battery, Function of lead acid battery, 2.2 Various charging processes, Maintenance of battery. 2.3 Modern developments in battery, Procedure of commissioning of new Battery in vehicle. The various battery rating, Battery performance.
Unit – III Ignition System	3a. Explain wiring diagram of various Ignition System. 3b. Describe construction & working of different types of Ignition system. 3c. Describe various spark advance mechanism. 3d. Describe Principal of Hall effect switch.	3.1 Types of ignition system and its layouts, wiring diagram. 3.2 Coil, Magneto & Capacitor discharge ignition system: construction and working. Comparison of systems. 3.3 H.T. Coil & Distributor: - Types, construction and working. 3.4 Distributor less electronic & direct ignition system, mechanical & electronic spark advance mechanism. Hall Effect switch. 3.5 Spark plug: -construction, function, types.
Unit – IV Starting System	4a. Describe construction & working of Starter motor. 4b. Describe different types of Starting units & starter switch.	4.1. Principal of starter motor, 4.2. Constructional and functional details of starter, 4.3. Torque characteristic of starter, Starter drive mechanism: its types

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
		(bendix, and folothru & over running Clutch Drives, axial drive), construction, function and comparison of different drive mechanism. 4.4. Solenoid switch.
Unit – V Charging System	5a. Describe necessity, construction & working of various charging system. 5b. Describe voltage & current regulatory system.	5.1 Necessity of charging system, 5.2 Introduction & basic principle of generators, Function, Circuit arrangement, 5.3 Working Principle of Alternator Charging System, Differences between Generator & Alternator, and Advantages of alternator over DC generator. 5.4 Advanced charging system technology & new developments , 5.5 Requirement of regulating current & voltage in alternator.
Unit– VI Lighting System & Automobile Auxiliaries	6a. Explain functioning of various lighting and Auxiliaries units of automotive vehicle.	6.1 Lighting Fundamentals, Lighting Circuits, Gas discharge & LED lighting, types of lamps. 6.2 Meaning of auxiliaries, Construction, function & circuit arrangement of various auxiliary units such as :- Horn, Wiper, Flashers, fuel gauge, temp gauge, oil pressure gauge, warning lights, Mechanical & digital Speedometer & odometer, Electrical Fan for cooling system, Wind shield washer & Defogger, car stereo. 6.3 Power window, central locking with remote control & without remote control, key less entry.

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

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Electricity, Magnetism And Automobile Wiring	07	3	5	2	10
2	Automobile Battery	08	4	6	4	14
3	Ignition System	08	3	8	3	14
4	Starting Systems	06	2	4	3	09
5	Charging System	06	4	4	4	12
6	Lighting System & Automobile Auxiliaries	07	2	5	4	11
Total		42	18	32	20	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.	Practical Exercise (Any seven) (Course Outcomes in Psychomotor Domain according to NBA terminology)	Approx. Hrs. Required
1	I	Demonstrate cable size, color code, wiring and symbols used in auto wiring.	4
2	II	Demonstrate construction and working of automobile batteries.	4
3	III	Demonstrate construction and working of different types of ignition systems.	4
4	IV	Demonstrate construction and working of different types of	4

S. No.	Unit No.	Practical Exercise (Any seven) (Course Outcomes in Psychomotor Domain according to NBA terminology)	Approx. Hrs. Required
		starter, motor, its drive and switches.	
5	V	Study of working principle of D.C. generator.	4
6	V	Demonstrate working principle of A.C. generator and its regulators.	4
7	VII	Demonstrate automobile bulbs and lights.	4
8	VII	Demonstrate various instruments & gauges (Dash board units).	4
9	VII	Demonstrate construction of various electrical accessories e.g. horn, wiper & flashers etc.	4
Total			28

7. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- a. Seminar by Students on construction & operation of various electrical components & associate systems like charging system, starting system etc.
- b. Prepare Display Board such as ignition system etc., & Chart like hall effect switch, parallel & series circuit.
- c. Internet Base Assignment, Teacher guided self learning activity etc.
(These could be Individual or group base.)

8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- a. Lectures cum discussion using Chart (such as distributor less ignition system, Principle of magnetism), Cut Section Model (such as alternator & starter motor), and Display board (such as ignition system).
- b. Use of animations, video or power point presentation.

9. SUGGESTED LEARNING RESOURCES

(A) List of Books:

S. No.	Title of Books	Author	Publication
1	P. L. Kholi	Automobile Electrical Equipments	Tata McGraw-Hill Co., Ltd., New Delhi,.
2	R. B. Gupta	Automobile Engineering	Satya Prakashan
3	K.M.Gupta	Automobile Engineering	Umesh Publication
4	Dr. Kirpal Singh	Automobile Engineering	Strandard Publishers
5	Jain K.K., Asthana R.B.	Automobile Engineering	Tata Mc-Graw Hill Publishing Co. Ltd.
6	H. M. Sheti	Automobile Technology	Tata McGraw-Hill Co., Ltd., New Delhi
7	W.H.Crouse & D.L. Anglin	Automotive Mechanics	Tata McGraw-Hill Co., Ltd., New Delhi

(B) List of Major Equipment/Materials

- a. Measuring instruments.
- b. Battery with cut section.
- c. Various component of electrical & electronic ignition system.
- d. Various starters with drive & its cut section.
- e. Alternator (its component) & d.c. generator & its cut section.
- f. Various accessories like Flasher unit, Speedo meter etc..

(C) List of Software/Learning Websites

1. http://www.youtube.com/watch?v=a_nsgzlrZGU
2. <http://www.youtube.com/watch?v=RzDqEorOXxk>
3. <http://www.youtube.com/watch?v=XDWGtWmB1D0>
4. http://mail.faribault.k12.mn.us/~Mark_Lessman/S00CF9F37.4/STARTING%20SYSTEM.ppt
5. Howstuffworks.com
6. Wikipedia.com

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. M. J. Pathak**, Head of Automobile Engineering Department, Sir Bhavsinhji Polytechnic Inst., Bhavnagar.
- **Prof. A. C. Desai**, Lecturer, Automobile Engineering Department, Shree N. M. Gopani Polytechnic, Ranpur.
- **Prof. A. C. Suthar**, Lecturer, Automobile Engineering Department, M.L. Institute of Diploma Studies, Bhandu.
- **Prof. Sanjay Kumar Ghaiye**, Head of 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

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

FUELS & LUBRICANTS (Code: 3330204)

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

1. RATIONALE

Fuels are the energy sources for any vehicle and lubricants are used to reduce energy losses due to friction. Both are available in very wide range but only some of them have found their application in vehicle because of their some desirable properties. Their use not only affects the engine performance and vehicle life but also affect the environment. Due to different chemical composition different fuels behave differently during combustion process. Also their end products are different for different combination of parameters, like pressure, temperature, air etc. To justify the selection of proper fuel and lubricants for particular vehicle and particular assembly students of automobile engineering must have knowledge of fuels and lubricants. This course enables students of automobile engineering to understand the fuels and lubricants with reference to vehicle performance.

2. COMPETENCIES: (Programme Outcomes (POs) 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 competency:

Select proper fuel and lubricant depending upon application for better performance and maintenance of automobiles.

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. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Introduction to Fuels	1a. Describe the term fuels its types & uses 1b. Describe the term lubricants its types & uses. 1c. Explain the origin and manufacturing of fuel & lubricants.	1.1 Basic requirements of a fuel & lubricant. 1.2 Types of fuels & lubricants its uses & sources 1.3 Theory of origin and accumulation of crude oil 1.4 Methods of searching crude oil 1.5 Recovery of crude oil 1.6 Classification of crude oil 1.7 Classification of hydrocarbon 1.8 Structure of various hydrocarbon 1.9 Fractional distillation and classification of refinery products 1.10 Various refining processes 1.11 Blending and treatment of gasoline
Unit – II Properties and Additives of Fuel	2a. Explain the properties of fuels and their effect on engine performance 2b. Explain the various additives used to enhance performance of fuels	2.1 Various desirable properties of SI engine fuels 2.2 Their effect on engine performance 2.3 Additives of gasoline 2.4 Various desirable properties of CI engine fuels 2.5 Their effect on engine performance 2.6 Additives of diesel
Unit – III Combustion Process and Rating of Fuels	3a. Describe the phenomenon of combustion in SI and CI engine 3b. Appreciate the terminologies involved in combustion and their effect 3c. Explain the qualities of fuels	3.1 Combustion in SI engine 3.11 (i) Normal and abnormal combustion 3.12 (ii) Factors affecting normal combustion 3.13 (iii) Ignition Lag and factors affecting it 3.14 (iv) Pre-ignition and its effects 3.15 (v) Detonation, its effects and factors affecting it and prevention 3.2 Combustion in CI engine 3.21 (i) Phases of combustion in CI engine 3.22 (ii) Factors affecting combustion in CI engine 3.23 (iii) Ignition Lag and factors affecting it 3.24 (iv) Diesel knock, its effects and factors affecting it and prevention 3.3 Rating of Fuel 3.31 (i) Octane number, merits and demerits of higher octane fuel and normal octane fuel 3.32 (ii) Cetane number
Unit – IV Introduction to Engine Friction and Lubricants	4a. Explain various frictional losses 4b. Explain the phenomenon of lubricant 4c. Describe the importance	4.1 Engine frictional losses 4.2 Factors affecting frictional losses 4.3 Boundary lubrication 4.4 Hydro dynamic lubrication 4.5 Classification and types of lubricating oil

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	of lubricant and types of lubricants 4d. Describe the manufacturing of lubricants 4e. Explain the term grease	(based on crude oil, synthetic oil) 4.6 Basic requirements of lubricants 4.7 Distillation process to get lubricating oil from crude oil 4.8 Various treatment given to the lubricating oil 4.9 Types of grease and its characteristics
Unit – V Properties, Gradation and Additives of Lubricants	5a. Explain various properties of lubricating oil 5b. Describe gradation of lubricating oil 5c. Explain requirement of additives	5.1 various properties of lubricating oil 5.2 Gradation of lubricating oil 5.3 Introduction of ISO Cleanliness code. 5.4 Function and type of additives of lubricating oil
Unit- VI Alternative Fuel	6a. Describe alternative fuels	6.1. Alternative fuels and their economics-like, Alcohol, Ethanol, Methanol, Hydrogen, LPG, CNG, Bio Gas, Bio diesel
Unit-VII Measurement of Various Properties of Fuels & Lubricant	7a. Describe various instruments used for measuring various properties of fuels & lubricants. 7b. Describe the experimental procedures.	7.1 Measurement of various properties of fuels & lubricants. 7.2 Safety precautions while measuring properties of fuels & lubricants.

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

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Fuels	7	7	7	0	14
II	Properties and Additives of Fuel	7	3	4	0	7
III	Combustion Process and Rating of Fuels	6	0	7	7	14
IV	Introduction to Engine Friction and Lubricants	6	3	7	4	14
V	Properties, Gradation and Additives of Lubricants	6	3	4	0	7
VI	Alternative Fuel	6	0	3	4	7
VII	Measurement of Various Properties of Fuels & Lubricant	4	3	4	0	7
Total		42	19	36	15	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.

Sr. No.	UnitNo.	Practical Exercise(Any Seven) (Course Outcomes in Cognitive Domain according to NBA terminology)	Apprx. Hrs. Required
1	I	Draw the chart & Describe distillation process of crude oil.	4
2	II	Determination of viscosity of given sample of fuel using u-tube viscometer..	4
3	V	Determination of viscosity of lubricating oil at different temperature.	4
4	II	Determination of flash and fire point of given sample of fuel.	4
5	II	Determination of specific gravity of given sample of fuel by westphal Balance	4
6	V	Determination of carbon residue of lubricating oil	4
7	III	Study of CFR engine and knock meter.	4
8	II	Study of measuring API gravity of fuel.	4
9	V	Determination of cloud and pour point of given sample of oil.	4
Total			28

7. SUGGESTED LIST OF STUDENT ACTIVITIES

- a. Internet based assignment related to crude oil and refinery work.
- b. Visit of fuel station and collect data about instrument they used to check the properties of fuel and norms and precautions they are following
- c. Internet based assignment/literature survey for types of lubricants with their specific use
- d. Market survey to find out the specification of different types and brands of fuels and lubricants and their relative cost
- e. Internet based assignment to check the use of alternative fuels along with advantages of using them and problem encountered by using them

8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- a. Visit to a fuel station
- b. Use of animation or video clips
- c. Chart (such as combustion phenomenon of SI and CI engine, distillation process)

9. SUGGESTED LEARNING RESOURCES

A. List of Books

S.No.	Author	Title of Books	Publication
1	V.M. Domkundwar	Internal combustion engines	Dhanpat Rai Publishing Company (P) Ltd
2	K. M. Gupta	Automobile Engineering	Umesh Publication
3	C.P.Nakra,	Basic Automobile Engg.	Dhanpat Rai Publishing Company (P) Ltd
4	M.Popovich and Haring	Fuels and Lubricants	John Wiley & Sons, Inc
5	R.L.Bechtold	Alternative Fuels Guidebook	SAE Publication.
6	R. K. Rajput	Internal Combustion Engine	Laxmi Publication

B. List of Major Equipment/ Instrument

- a. Red wood viscometer
- b. Flash and fire point apparatus
- c. Fuel distillation plant
- d. Cloud and pour point apparatus
- e. Carbon residue tester
- f. CFR test engine
- g. U tube viscometer
- h. Westphal balance

C. List of Software/Learning Websites

1. http://www.youtube.com/watch?v=_hwzJUDWIQQ
2. http://www.youtube.com/watch?v=vscX_zawdQw
3. http://www.youtube.com/watch?v=Nd_pybvUgC
4. <http://www.youtube.com/watch?v=Cg9E112wMIU>
5. <http://www.youtube.com/watch?v=RSBs7PRo-fA>
6. <http://www.youtube.com/watch?v=9Py8-Xy9MKo>
7. <http://www.youtube.com/watch?v=NXYESrwhcPY>
8. <http://www.youtube.com/watch?v=h7GVHPEfpU4>
9. <http://www.youtube.com/watch?v=G33gfWg9a7k>
10. <http://www.youtube.com/watch?v=vundAm8q9Rw>
11. <http://www.youtube.com/watch?v=OIr-D-tIPyo>
12. <http://www.youtube.com/watch?v=agtYALodDcg>
13. <http://www.youtube.com/watch?v=suce6QNkVRI>
14. <http://www.youtube.com/watch?v=3Q1342fTH7A>
15. <http://www.youtube.com/watch?v=Qns7eXe4B4c>
16. <http://www.youtube.com/watch?v=R0g4RYMdAsI>
17. <http://www.youtube.com/watch?v=hk7NvgmvwnM>
18. http://www2.tech.purdue.edu/at/courses/at403/Lubrication_systems.ppt
19. <http://lubricantspecialist.files.wordpress.com/2011/10/basic-of-lubricants-lubrication.ppt>
20. http://mustafaozcanli.com/wp-content/uploads/2012/05/FAL_1.ppt

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

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Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. C. K. Chugh**, Professor, Department of Electronic Media
- **Dr. (Mrs.) Vandana Somkuwar**, Associate Professor, Department of Mechanical Engineering.

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

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GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

AUTOMOBILE COMPONENT DESIGN (Code: 3330206)

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

1. RATIONALE

The day to day functions carried out in the design and drawing department of automobile Industries are multifarious. Some of these functions are planning, selecting materials, deciding specification, determining design factors, computing and providing dimensions, coordinating with production, designing job fixtures and tools, specifying materials, evaluating design etc.

The technicians should possess some cognitive skill to assist the designers in performing the above referred job function. This course therefore provides such experiences to the students where they can apply their knowledge from various courses. This course also aims at developing the ability to analyze the given problem, weight alternatives and find the suitable solution. This course would also reinforce the understanding of the basic features of different automobile components since designing would help them in better appreciation of relations between different parameters of components.

2. COMPETENCY (Programme Outcomes (POs) 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:

- **Design (basic design) various automobile components including selection of proper material for them.**

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	150
4	0	2	6	70	30	20	30	

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 design.	1a. Explain general considerations and factors affecting the design of automobile components. 1b. Describe factors affecting the selection of materials. 1c. Explain basic terminologies used in design of automobile parts.	1.1 Design and its types, General consideration, factors affecting the design. 1.2 General procedure in Machine Design. 1.3 Material Selection for manufacturing various components of automobile. 1.4 Standardisation and its Importance, Various Standards and I.S codes. 1.5 S. I. units and definitions of various fundamental and derived quantities 1.6 Mass, Weight, Inertia, Force, Couple, Moment of Inertia, Torque, Power, Work, Energy, Stress, Strain, Young Modulus, Shear Modulus, Bearing Stress, Factor of Safety, Limit, Fit and Tolerances. 1.7 Types of loads, stress and strain. 1.8 Column and Strut, different end conditions, Rankin's and Euler's Formulae. 1.9 Stress concentration and how it can be reduced, Concept of fluctuating load and endurance limit.
Unit– II Design of piston.	2a. Explain nomenclature of piston. 2b. Select proper material of piston. 2c. Design different parts of piston.	2.1 Piston nomenclature. 2.2 Function of Piston. 2.3 Design considerations for Piston. 2.4 Materials for Piston. 2.5 Design of Piston head, rings, pin, skirt and barrel.
Unit– III Design of connecting rod.	3a. State nomenclature of connecting rod. 3b. Select proper material of connecting rod. 3c. Design different parts of connecting rod.	3.1 Connecting rod nomenclature. 3.2 Function of Connecting rod. 3.3 Shape of Connecting rod. 3.4 Length of Connecting rod. 3.5 Forces on Connecting rod. 3.6 Material for Connecting rod. 3.7 Design considerations for Connecting rod. 3.8 Design of cross-section of Connecting rod: I-section & Circular. 3.9 Design of Crank pin. 3.10 Design of Big end cap & bolts.
Unit–IV Design consideration for crank shaft and valve.	4a. State nomenclature of crank shaft and valve. 4b. Select proper material of crank shaft. 4c. Describe the factors affecting design of crank shaft and valve.	Crankshaft nomenclature. 4.1. Function of crankshaft. 4.2. Types of crankshaft. 4.3. Materials and manufacturing processes for crankshaft. 4.4. Bearing pressure and stresses in

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
		crankshaft. 4.5. Design considerations for crankshaft. 4.6. Design consideration for valve.
Unit– V Design of flywheel.	5a. Explain terminology related to flywheel. 5b. Describe design considerations for flywheel. 5c. Design of flywheel rim.	5.1 Function of flywheel. 5.2 Turning Moment Diagram. 5.3 Fluctuation of speed. 5.4 Fluctuation of energy. 5.5 Energy stored in flywheel. 5.6 Weight of the flywheel. 5.7 Design of flywheel Rim.
Unit– VI Design of clutch.	6a. Explain material selection for friction lining of clutch. 6b. Describe design considerations for friction clutch. 6c. Design Single plate and Multiplate clutch.	6.1 Function of clutch. 6.2 Types of clutch. 6.3 Materials for friction surfaces. 6.4 Design considerations for friction clutch. 6.5 Design of disc clutch: (i) Single plate; (ii) Multiplate.
Unit– VII Design of propeller shafts and axles.	7a. Describe design considerations for shaft and axle.	7.1 Calculation for finding diameter of Propeller shaft and Section of Dead Axle. 7.2 Bearing load on front axle. 7.3 Bearing load on rear axle.
Unit– VIII Design considerations for gear.	8a. State terminology related to gears, 8b. Describe design considerations for gear drive. 8c. Compute the gear teeth, speed and torque.	8.1 Gear terminology. 8.2 Types of gears. 8.3 Design consideration for gear drive. 8.4 Relation between number of teeth, speed and torque in meshing gears. 8.5 Calculation of number of teeth and torque transmitted.

Note: - All Equation /Units/ mathematically derivation and Examples based on SI system only.

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
I.	Introduction to Design.	14	4	6	4	14
II.	Design of Piston.	06	2	2	3	07
III.	Design of Connecting Rod	06	3	3	5	11
IV.	Design Consideration for Crank Shaft and Valve.	06	3	3	4	10
V.	Design of Flywheel.	06	2	2	3	07
VI.	Design of Clutch.	06	2	2	3	07
VII.	Design of Propeller Shafts and Axles.	06	2	2	3	07
VIII.	Design Considerations for Gear.	06	2	2	3	07
	Total	56	20	22	28	70

Legends: R = Remember; U= Understand; A= Apply 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.

6. SUGGESTED LIST OF TUTORIAL WORK:

Sr. No.	Unit No.	TUTORIAL WORK	Apprx. Hrs. Required
1.	I	Report writing on general considerations of design.	02
2.	II	Basic Design of Piston.	04
3.	III	Basic Design of Connecting rod.	04
4.	IV	Basic Design considerations for crank shaft and valve.	04
5.	V	Basic Design of Flywheel rim.	02
6.	VI	Basic Design of propeller shafts and axles.	04
7.	VII	Basic Design of clutches.	04
8.	VIII	Basic Design considerations for gear drive to compute the gear teeth, speed and torque.	04
		Total	28

7. SUGGESTED LIST OF PROPOSED STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

- Seminars using power point presentations to get understanding of different phenomenon of design such as stress concentration, endurance limit, limit, fit, tolerances, various I.S. codes etc.
- Group discussion on severity of forces responsible for designing various components of automobile to design dimensions for effective area. Internet based assignments, teacher guided self learning activities, course/library/internet/lab based mini-projects etc. These could be individual or group-based.
- Case studies from real life problems of failure for piston, connecting rod, crank shaft, clutch plate etc.

8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- Power point presentation showing various nomenclature of different components of engine and transmission system to design various dimensions.
- Chart showing various nomenclatures of different components of engine and transmission system.
- Assignments during tutorials for basic design of different components of engine and transmission system (individual attention to be provided to students so solve their difficulties and clear their doubts)

9. SUGGESTED LEARNING RESOURCES

A. List of Books (with SI system)

S.No	Author	Title of Books	Publication
1	B.C.Punamia, Arun Kr. Jain	Strength (Mechanics) of Materials	Firewall Media, 2002
2	S. Ramamurtham	Strength of Materials	Dhanpat Rai Publishing Co., New Delhi.
3	R.S.Khurmi	Strength of Materials	S. Chand Limited, 2007
4	P.C. Sharma; D.K. Aggrawal	Machine Design: Mechanical Engineering Design	S. K. Kataria and Sons
5	R. K. Jain	Machine Design	Khanna Publishers, Delhi
6	R S Khurmi J K Gupta	A Text Book of Machine Design	S Chand & Co., Delhi
7	Dr Sadhu Singh	Machine Design	Khanna Publishers, Delhi
8	Pandya & Shah	Machine Design	Charotar Publishing House
9	K. M. Agrawal	Automobile Design Problems	Satya Prakashan, New Delhi

B. List of Major Equipment/ Instrument:

- a. Charts of Pistons, Connecting Rods, Crank shafts, Clutch Plates, Different types of Flywheels, Gears and Gear Boxes for better understanding of various terminologies related to automobile components.
- b. Models of Pistons, Connecting Rods, Crank shafts, Clutch Plates of different vehicles, different types of gears etc.

C. List of Software/Learning Websites

- a. http://courses.washington.edu/engr100/Section_Wei/engine/UofWindsorManual/Piston%20Design.htm
- b. http://confident-instruments.com/Piston_Study.htm
- c. <http://www.youtube.com/watch?v=gfNR4kGhChs>
- d. http://en.wikipedia.org/wiki/Connecting_rod
- e. <http://www.youtube.com/watch?v=M8TF11Y2T-4>
- f. <http://en.wikipedia.org/wiki/Crankshaft>
- g. <http://en.wikipedia.org/wiki/Flywheel>
- h. <http://www.youtube.com/watch?v=1wDmsevZsRY>

10. COURSE CURRICULUM DEVELOPMENT**COMMITTEE Faculty Members from Polytechnics**

- **Prof. M. J. Pathak**, H.O.D., Automobile Engineering Department, Sir Bhavsinhji Polytechnic Institute, Bhavnagar.
- **Prof. (Mrs) M. N. Vibhakar**, Lecturer, Automobile Engineering Department, Dr. S. & S. S. Ghandhy College of Engineering and Technology, Surat.
- **Prof. S.V. Trivedi**, Lecturer, Automobile Engineering Department, Parul Institute of Engineering & Technology, Vadodara.

Coordinator and Faculty Members from NITTTR Bhopal

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