



Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Automobile Engineering	Semester	IV
Course Code	20AT44P	Type of Course	Programme Core
Course Name	Fuels and Pollution Control	Contact Hours	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	Credits	6
CIE Marks	60	SEE Marks	40

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 maintain level of pollutants in emissions of various kinds of automobiles.

2. Course Outcomes/Skill Sets: At the end of the course the student will be able to:

CO-01	Differentiate between petroleum and alternative fuels and analyse emission performance of an engine using alternative fuels.
CO-02	Test and troubleshoot or service a fuel feed system, supercharger, turbocharger and Micro-Hybrid Vehicle.
CO-03	Explain the formation of pollutants, its measurement techniques and list the appropriate methods to be used to control pollutions from vehicles.
CO-04	List emission standards & the regulations applicable to vehicles manufactured in India and carry out emission tests to record emission levels as per each standard.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1	5	1. Petroleum fuels. Refining process. 2. Properties of liquid and gaseous fuels. Types – merits – demerits. 3. Alternative fuels –Methanol – properties merits- demerits -storage emissions.	Refer Table 1	1. Determination of flash point, fire point and viscosity of petrol fuel. 2. Determination of flash point, fire point and viscosity of Diesel fuel.
2	1	5	1. Ethanol – properties merits- demerits -storage emissions. 2. Biodiesel - properties merits- demerits -storage emissions- Biodiesel production processes.	Refer Table 1	1. Determination of Calorific value of methanol and Ethanol using Bomb's calorimeter.

			3. Hydrogen - properties merits- demerits -storage emissions. CNG - properties merits- demerits -storage emissions- CNG fuel feed system layout.		2.a) Installation CNG kit to the car, setting and maintenance. b) Determination of Calorific value of CNG using Junker's calorimeter.
3	2	1,5	1. Fuel feed system in SI engine- Requirements-types- Layout - Working of 2-wheeler carburetor. 2. Fuel feed system in CI engine- requirements-types- Layout- Inline and distributor system. 3. Governor- need- types- working of mechanical governor. single cylinder fuel injector pump. Multi hole fuel injector.	Refer Table 1	1. Servicing of 2-wheeler fuel feed system. 2.a) Servicing of typical CI engine fuel feed system. b) Trouble shooting of fuel feed systems
4	2	1,5	1. Stratified engine -Need- types. 2. Supercharging- need. Supercharger-types. 3. Turbocharging- need- types construction - working of turbocharger.	Refer Table 1	1. Servicing of super charger. 2. Servicing of a turbocharger.
5	3	4,5	1. Pollutants from an automobile – Sources of pollutants in SI engine & Diesel engine 2. Formation of Particulate emission in Diesel engine. 3. Mechanism of nitrogen oxide, carbon monoxide and unburnt hydro carbon in SI engine.	Refer Table 1	1. Measurement of HC, CO, CO ₂ , O ₂ using exhaust gas analyzer. 2. Measurement of smoke of Diesel engine using Smoke meter.
6	3	5	1. Methods of controlling pollution: Crankcase ventilation system- need- layout. Exhaust gas recirculation-need- layout.	Refer Table 1	1. Servicing of PCV and EGR system 2. Servicing of catalytic converter.

			<p>2. Catalytic converters -need-types - construction and working of 3-way catalytic converter.</p> <p>3. SCR and Particulate filters to control particulate emission of diesel engine.</p>		
7	3	4,5	<p>1. Electronic fuel injection- Advantage. Construction and working -single point-multipoint fuel injectors. Variable valve timing-need-types.</p> <p>2. Multipoint direct injection system- operating modes of direct injection. construction and working-petrol injectors. Variable length intake system-need.</p> <p>3. CI Engine Electronic Fuel injection- types-construction and working- Electronic Diesel Control.</p>	Refer Table 1	<p>1. Service and troubleshoot single point injection system.</p> <p>2. Service and troubleshoot multipoint injection systems.</p>
8	3	4,5	<p>1. In line- Distributor pumps, construction and working.</p> <p>2. Unit Injector-Common rail injection System</p> <p>3. Electrohydraulic injector of CRDI system.</p>	Refer Table 1	<p>1. Servicing, calibrating and troubleshooting of Inline fuel pump system.</p> <p>2. Servicing and troubleshooting of CRDI system.</p>
9	3	4,5	<p>1. Battery operated vehicle-working principle -regenerative braking-working principle.</p> <p>2. Fuel cells-types- construction and working of polymer electrolyte membrane type.</p> <p>3. Hybrid vehicles-types- layouts of series and parallel.</p>	Refer Table 1	<p>1.Servicing and maintenance of battery-operated two-wheeler.</p> <p>2. Servicing and maintenance of micro hybrid vehicles</p>

10	4	5	<ol style="list-style-type: none"> 1. Emission norms-need- different emission standards for different engines in India. Driving cycles-need- types. 2. Bharath stage emission standards and norms. 3. Comparison of Bharath stage with European standards. 	Refer Table 1	<ol style="list-style-type: none"> 1. Case study on implantation of BS VI norms. 2. Test fuel consumption of a vehicle under different driving cycles.
11	4	4,5,7	<ol style="list-style-type: none"> 1. ARAI- Formation- functions. 2. Formulation of standards. Central Motor vehicle rules. Automotive pollution – air pollution & human health 3. Exhaust manifold- function, Exhaust manifold components, Muffler, Electronic muffler, Exhaust manifold reactor. 	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	<ol style="list-style-type: none"> 1. Case study on standardization/ Formulation/ Certification. 2. Case study on effects of exhaust gas and advancement in exhaust manifold to control exhaust emission level.
12	4	4,5,7	<ol style="list-style-type: none"> 1. Performance of SI engine using different blends of ethanol- modifications to engine and fuel feed system. 2. Performance of SI engine using different blends of methanol. modifications to engine and fuel feed system. 3. Comparison of above emissions (1 & 2). 	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	<ol style="list-style-type: none"> 1. Measure ethanol & methanol emission on a SI engine. 2. Conduct an experiment to measure various performance parameters of a SI engine using ethanol blend.
13	4	4,5,7	<ol style="list-style-type: none"> 1. Performance of Diesel engine using CNG- Modifications to engine and fuel feed system. 2. Performance of Diesel engine using biofuel- Modifications to engine and fuel feed system. 3. Comparison of above emissions (1 & 2). 	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these	<ol style="list-style-type: none"> 1. Measure CNG emission on CI engine. 2. Conduct an experiment to measure various performance parameters of a CI engine using biofuel blend.

				changes on industry.	
Total in hours			39	13	52

*** PO= Program Outcome as listed and defined in year 1 curriculum and PO – CO mapping with strength (Low/Medium/High) has to be mapped by the course coordinator. (Above only suggestive)**

Table 1: Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl. No.	Week	Suggested Activity
1	1	Study the benefits of different alternative fuels and submit the report on the best alternative fuel for transit buses with proper justification.
2	2	Study the characteristics of alcohol fuels and justify why methanol is used as a racing fuel and submit a report as an assignment.
3	3	List the properties of hydrogen and prepare a presentation on hydrogen fuel cell vehicles.
4	4	Discuss and present why a turbocharger/supercharger is an essential requirement for an aircraft engine.
5	5	Take a survey on the effects of vehicular pollution on human health and present the effects of pollution on human health.
6	6	Refer any one journal paper and present on mechanism of pollutant formation in an IC engine.
7	7	Study and present on motor cycle crankcase ventilation.
8	8	Study and present on passive SCR.
9	9	Study and document the effect of Diesel particulate trap on efficiency of the engine and submit as an assignment.
10	10	Document the impact of BS VI norms on vehicle pollution as an assignment.
11	11	Study and present the central motor vehicle rules 1989 and its amendment.
12	12	Make a group of students, ask them to collect the information on methanol and ethanol blends. Run the engine with any one blend measure the emission.
13	13	Refer any one journal on future of CNG in India and present the collected information.

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3.	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill tests 20
5.	CIE-5 Skill Test-Practice	12	180	100	
6.	CIE-6 Portfolio continuous evaluation of Activity through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40
Total Marks					100

5. a) Format for CIE written Test

Course Name	Fuels and Pollution Control	Test	I/II/III	Sem	III/IV
Course Code	20AT44P	Duration	80 Min	Marks	30
Note: Answer any one full question from each section. Each full question carries 10 marks.					
Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks	
I	1				
	2				
II	3				
	4				
III	5				
	6				
Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.					

5. b) CIE Skill Test-I Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	1	One Question on "fuels". a) Determining the fire point/flash point/ calorific value/ Servicing -15m b) Calculation -10m	25
2	2	One skill- oriented question on fuel feed system/supercharger/ turbocharger /stratified engine. a) Identification of the problem - 5m b) Servicing -20m	25
3	3	One question on measurement of the pollutants from automobile a) Measurements - 15 m b) Tabulation - 05 m	20
4	3	One question on "pollution control". a) Servicing -20m	20
5	1,2,3	Portfolio evaluation of practical sessions (1-6 week)	10
Total Marks			100

5. c) CIE Skill Test-II Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	3	One question on "methods of Pollution control" a) Servicing - 25 m	25
2	4	One question on "Emission standards" based on given case (case study). a) Identification of the key facts in the case - 05m b) Identification of the key issues - 05m	25

		c) Evaluate and recommend the course of action -15m	
3	4	One question on "performance of engine". a) Finding the performance parameter/fuel consumption - 25 m b) Tabulation -05 m	30
4	3,4	Portfolio evaluation of practical sessions (7-12 week)	10
5	3,4	Viva-voce	10
Total Marks			100

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
Average Marks= (8+6+2+2)/4=4.5							5

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. Reference:

Sl. No.	Description
1	Alternative fuels, Thipse, Jaico publications.
2	Alternative Fuels & the Environment, Frances S. Sterrett, Hardback Publications.
3	Alternative fuels, V.Ganeshan, McGraw Hill Education (India) Private Limited, New Delhi
4	Internal combustion Engine, M.L. Mathur and R.P. Sharma, Dhanpat Rai Publications.
5	SAE Transactions, "Vehicle Emission", 3 volumes, 1982
6	Automobiles and Pollution SAE Transaction, 1995.
7	Engine Emissions: pollution Formation and advances in control technology by B.P. Pundir.

8. SEE Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	1,2	One Question on "fuels". a) Tabular column -5 m b) Determining the fire point/flash point/ calorific value/ Servicing -15m c) Calculation - 10 m Or One skill- oriented question on fuel feed system/supercharger/ turbocharger /stratified engine. a) Identification of problem - 05m b) Measurements - 25 m c) Accuracy -05 m	35

2	3,4	One question on "pollutants and control method" a) Identification of problem - 10 m b) Servicing- 25m Or One question on "Emission standards and testing procedures". a) Finding the performance parameter/fuel consumption - 25 m b) Tabulation -10m	35
4	1,2,3,4	Viva-voce	20
5	1,2,3,4	Portfolio evaluation of practical sessions (1-13 week)	10
Total Marks			100

NOTE: Use same format of evaluation for CIE skill test. Portfolio evaluation of practical session should be considered from "Week 1-6" for 1st CIE and "Week 7-12" for 2nd CIE each 10 marks.

9. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1	Pensky Martin Flash and Fire point Equipment		2
2	Redwood and Saybolt Viscometer		1
3	Bomb Calorimeter		1
4	Junker's gas Calorimeter		1
5	CNG kit		1
6	2-wheeler fuel feed system		4
7	Diesel engine with all accessories.		2
8	Single cylinder FIP		4
9	Multi hole diesel injector		6
10	MPFI petrol engine with all accessories (PCV, EGR, Catalytic convertor)		2
11	CRDI diesel engine with all accessories (PCV, EGR, Catalytic convertor, SCR/Particulate filter)		2
12	Turbochargers and Superchargers		2 each
13	MPFI engine injector tester		1
14	Diesel engine injector tester		2

15	FIP Calibrating machine		1
16	Four gas latest make exhaust gas analyser		2
17	Smoke meter		2
18	Catalytic Converter		2
19	Battery operated 2-wheeler		1
20	Vehicle with micro hybrid system		1