

Program Name : Diploma in Automobile Engineering
Program Code : AE
Semester : Third
Course Title : Automobile Engines
Course Code : 22308

1. RATIONALE

This is a core technology course. All automotive vehicles are powered by engines. Hence the fundamental knowledge of automobile engine is most essential for an auto technologist. This course will help in understanding the procedure of inspection, diagnosis and testing of various types of engines and other systems. This course also forms the basis for the Advanced Automobile Engine and vehicle maintenance.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Check the functioning of the 2-wheeler and passenger car engine components.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Interpret the IC engine specifications.
- Identify various petrol and diesel engine components.
- Troubleshoot petrol and diesel fuel supply system.
- Check ignition systems.
- Use service manual for routine maintenance of cooling and lubrication systems.
- Estimate I.C. engine performance.

4. TEACHING AND EXAMINATION SCHEME

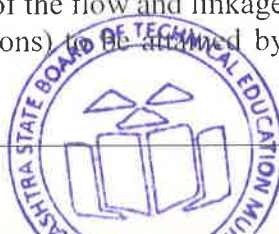
Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	--	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; T- Tutorial/Teacher Guided Theory Practice; P - Practical; C - Credit, ESE - End Semester Examination; PA - Progressive Assessment

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the



course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

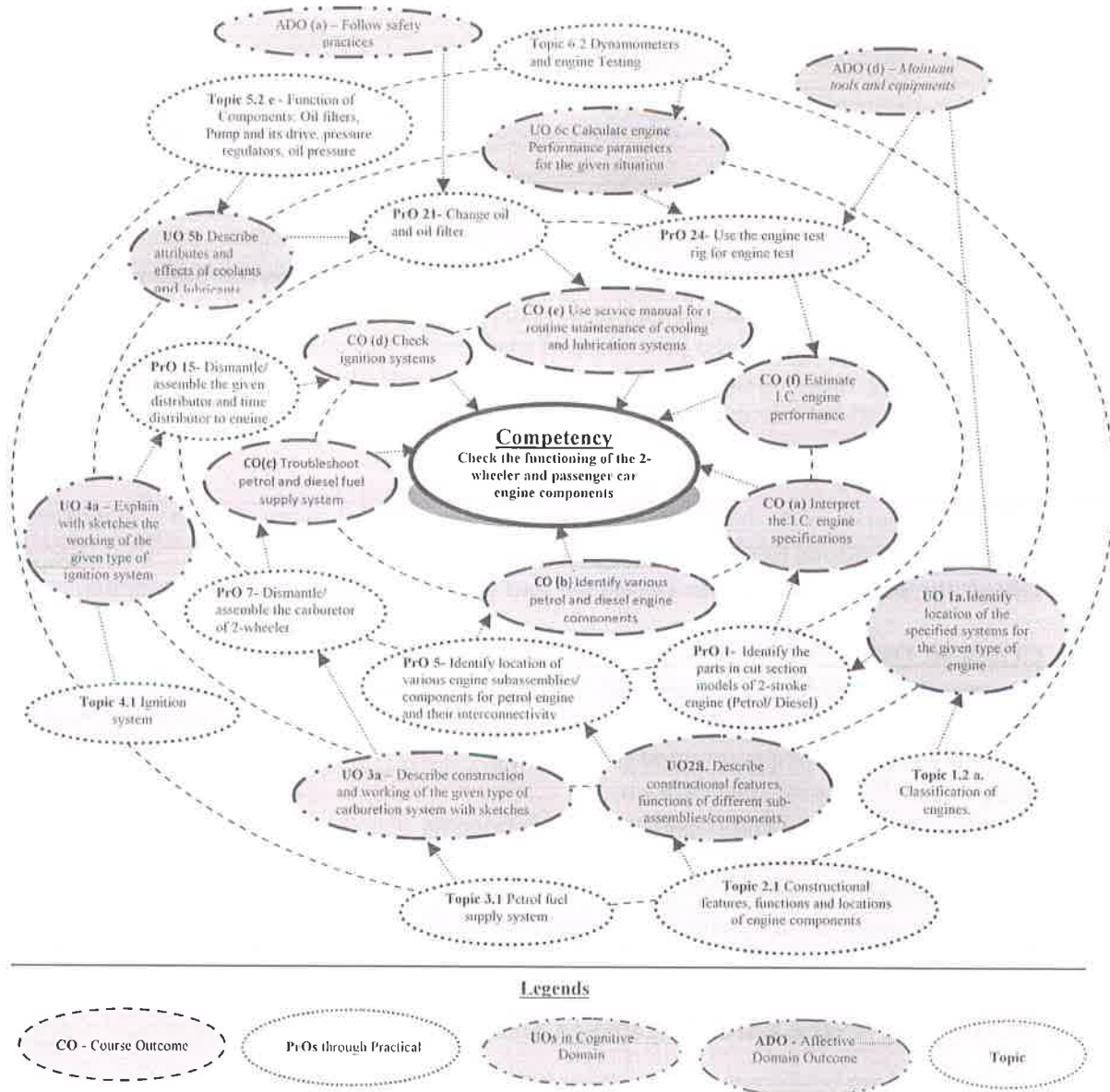


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Identify the parts in cut section models of 2-stroke engine (petrol/ diesel).	I	02*
2.	Identify the parts in cut section models of 4-stroke engine (petrol/ diesel).	I	02
3.	Use special tools in dismantling 2-stroke engine.	I	02
4.	Use special tools in assembling 4-stroke engine.	I	02*



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
5.	Identify location of various engine subassemblies/ components for petrol engine and their interconnectivity. Part - I	II	02
6.	Identify location of various engine subassemblies/ components for diesel engine and their interconnectivity. Part - II	II	02*
7.	Dismantle/ assemble the carburetor of 2-wheeler. Part - I	III	02*
8.	Dismantle/ assemble the carburetor of 2-wheeler. Part - II	III	02
9.	Trace induction and fuel supply system of a diesel engine	III	02*
10.	Dismantle/assemble fuel injector of a diesel engine	III	02*
11.	Dismantle/ assemble Single element Fuel injection pump of a diesel engine.	III	02*
12.	Trace ignition system of a 2-wheeler engine.	IV	02*
13.	Trace ignition system of a 4-wheeler engine.	IV	02
14.	Carry out maintenance of Spark Plug, ignition coil and HT cords.	IV	02
15.	Dismantle/ assemble the given distributor and time distributor to engine. Part - I	IV	02
16.	Dismantle/ assemble the given distributor and time distributor to engine. Part - II	IV	02
17.	Check 4-wheeler engine cooling system.	V	02
18.	Test Thermostat Valve and Electric Cooling Fan Thermo-switch.	V	02
19.	Replace/replenish coolant of an engine after checking.	V	02
20.	Check lubrication system of a passenger car engine.	V	02
21.	Change oil and oil filter.	V	02*
22.	Service oil pump of passenger car engine.	V	02
23.	Perform the servicing of Oil Pressure Relief Valve	V	02
24.	Use the engine test rig for engine test. Part I	VI	02*
25.	Use the engine test rig for engine test. Part II	VI	02
26.	Use the engine test rig for engine test. Part II	VI	02
27.	Conduct Morse Test on multi-cylinder petrol engine. Part I	VI	02*
28.	Conduct Morse Test on multi-cylinder petrol engine. Part II	VI	02
29.	Dismantle/ Assemble a multi-cylinder diesel engine. Part - I	VI	02*
30.	Dismantle/ Assemble a multi-cylinder diesel engine. Part - II	VI	02
31.	Dismantle/ Assemble a multi-cylinder petrol engine. Part - I	VI	02*
32.	Dismantle/ Assemble a multi-cylinder petrol engine. Part - II	VI	02
	Total		64

Note

- i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 24 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1.	Follow safety rules and adopt standard practices for handling	20



S. No.	Performance Indicators	Weightage in %
	tools	
2.	Refer workshop manual and include relevant data in the journal.	20
3.	Sketching layouts, components and conclusion	30
4.	Answer to simple questions	20
5.	Timely completion of the task and term-work.	10
Total		100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- a. Follow safety practices.
- b. Practice good housekeeping.
- c. Demonstrate working as a leader/a team member.
- d. Maintain tools and equipments.
- e. Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- a. 'Valuing Level' in 1st year
- b. 'Organizing Level' in 2nd year
- c. 'Characterizing Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	General purpose tools (Spanners, ring spanner and socket)- 6mm to 32 mm	All
2	Special purpose tools (Piston ring expander, Piston ring compressor, Valve lifter, Torque wrench)- Torque wrench range- 10 Nm to 200Nm.	
3	Two stroke engine cut-section model- single cylinder (motorized/ manual)	
4	Four stroke engine cut-section model- single cylinder (motorized/ manual)	
5	Two stroke engine (Single cylinder) Petrol / Diesel	
6	Four stroke engine (Single / Multi-cylinder)	
7	Fuel Supply system (Petrol)- including carburettor, fuel pump and fuel filter of two wheeler/ four wheeler	
8	Fuel Supply system (Diesel) - Fuel Injection pump, primary filter, secondary filter, Injectors.- Single cylinder/ multi-cylinder engine FIP unit .	
9	Magneto coil ignition system- including Magneto, Ignition coil, Spark plug and battery.	
10	Distributor	
11	Four stroke multi-cylinder diesel/ petrol engine with water cooling system	
12	Four stroke diesel / petrol engine with cooling system.	



S. No.	Equipment Name with Broad Specifications	PrO. No.
13	Single cylinder/ multi-cylinder Engine test rig with dynamometer.	
14	Four stroke CI and SI engines	
15	Engine dismantling and assembly tools	
16	Consumables (cotton waste, fuel and lubricants), Water supply provision, Electrical supply provision, Exhaust gas outlet, Wooden blocks, safety equipment, fire extinguisher	

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Introducti on to I.C. Engine.	1a. Identify location of the specified systems for the given type of engine. 1b. Explain with sketches the working principle of the given type of engine. 1c. Identify the engines from the given specifications with justification. 1d. Interpret the specifications of the given type of engine.	1.1 Definition of I C engine, Engine nomenclature. 1.2 Classification a. Classification of engine on the basis of: Cycle of operation, Fuel, Method of Charging, Ignition, Cooling, Cylinder arrangement, Camshaft, layout, b. Vertical and horizontal engines and its Merits and Demerits 1.3 Types of Engines a. Four-Stroke Spark Ignition and Four-Stroke Compression Ignition Engine. b. Two-Stroke and Four-Stroke engine scavenging 1.4 Engine Specifications and applications a. Engine Specifications - Two Wheelers, Light Motor Vehicle, Medium Motor Vehicle and Heavy Motor Vehicle. b. Applications of IC Engines.
Unit – II Constructi onal Features of Engine Componen ts.	2a. Describe constructional features, functions and materials of the given systems/sub-assemblies/ components of the given I.C. engines with sketches. 2b. Differentiate the working/materials between the given types of engine component. 2c. Compare the salient features of the given types of valves and cams arrangement.	2.1 Constructional features, functions, locations and materials of engine components. a. Cylinder block, Cylinder liners – Dry and Wet, Cylinder head, Inlet and Exhaust manifold, Tappet cover, Timing cover, Crank case. Oil Sump. b. Crank Mechanism: Piston and piston rings, Piston pin, Connecting rod, Crank Shaft, Cam shaft, Flywheel, Bearings, Oil seals, Gaskets. c. Valve and Valve Operating Mechanisms: Overhead Valve and Overhead Cam arrangements; Valve Cooling. 2.2 Camshaft Drives and Valve Timing Camshaft drives: Timing Gears, Chain and



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2d. Identify relative position of crankshaft and camshaft in the given situation with justification.	Belt drive. b. Relation between speed of camshaft and crank Shaft. Valve timing Diagram.
Unit– III Fuel and Air feed System	3a. Describe construction and working of the given type of carburetion system with sketches. 3b. Explain with sketches the construction and working of the given type of fuel injection systems. 3c. Describe with sketches the working of the given type of governor in the given type of engine. 3d. Select relevant lubrication system for the given situation with justification. 3e. Choose the relevant fuel supply system components for the given situation with justification.	3.1 Petrol fuel supply system. a. Pump feed :Layout, Function of Components and location; Construction and working of components: Fuel Tank. Fuel Filter, S. U. Electrical Fuel Pump b. Air cleaners – dry type and oil wetted types. c. Working Principle of Simple Carburettor, Air Fuel ratio requirements, Circuits in Two-wheeler carburettor. 3.2 Diesel fuel supply system a. Diesel Engine: Need and requirements of Fuel Injection Systems; Layout of Fuel Injection systems Individual pump, Unit injector system, Distributor system and Common rail system. b. Fuel Injector and types of nozzles. c. Fuel metering in Fuel Injection Pump (Inline pump and Distributor pump) 3.3 Working of Mechanical Governor in Fuel Injection Pump.
Unit– IV Ignition and Exhaust System	4a. Explain with sketches the working of the given type of ignition system. 4b. Explain with sketches the firing order for the given type of engine. 4c. Explain with sketches the construction and working of the given type of exhaust system 4d. Select the relevant type of silencer/Mufflers for the given engine with justification.	4.1 Ignition System a. Requirements of ignition system. b. Magneto and Battery Ignition systems c. Firing order used in 3,4 and 6 cylinder engines 4.2 Exhaust system a. Function of Exhaust manifold. b. Types of silencer / Mufflers (Construction and Working).
Unit– V Cooling and Lubricatio n system	5a. Describe layout, construction and working of the given cooling System with sketches. 5b. Describe attributes and effects of the given type	5.1 Engine cooling system: a. Need of cooling system and limitations of cooling system. b. Types: Air, Water/ Liquid cooling system (Layout and Function of Components) c. Properties of coolants and coolant additives



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	<p>of coolant and lubricant.</p> <p>5c. Describe with sketches properties of the given type of engine oil and their effects.</p> <p>5d. Select the relevant coolant, lubricant and engine oil for the given situation with justification.</p>	<p>5.2 Cooling system components:</p> <p>a. Construction and working of: Thermostat valve, Water expansion tank, Temperature Indicators, Pressure cap, Water pump, Fan and fan belt, Electrically driven Fan circuit.</p> <p>b. Radiator: Construction and type of radiator cores.</p> <p>c. Types and Characteristics of a Coolant , and their effect on performance of engine cooling; Lubrication system: Need, Properties and additives of lubricating oil, Parts to be lubricated</p> <p>d. Classification of Lubricating Oils on the basis of Viscosity (SAE) and Load (API) Severity rating; Types of lubrication system: Splash, Pressure – wet sump and dry sump</p> <p>e. Function of Components: Oil filters, Pump and its drive, pressure regulator, oil pressure gauge.</p>
Unit– VI I.C. Engine Performan ce.	<p>6a. Interpret the given engine performance parameters and their implications.</p> <p>6b. Explain with sketches the working principle of the given type of dynamometer.</p> <p>6c. Calculate engine Performance parameters for the given situation.</p> <p>6d. Prepare heat balance sheet for the given situation.</p>	<p>6.1 Performance parameters.</p> <p>a. Definitions: Indicated Power, Brake Power and Frictional Power.</p> <p>b. Efficiencies - Air standard, Mechanical, Brake Thermal, Indicated Thermal, Volumetric and Relative.</p> <p>6.2 Dynamometers and engine testing:</p> <p>a. Working Principle and types of Dynamometers: Hydraulic and Eddy current.</p> <p>b. Engine Testing: Morse Test, Willian’s line Method for finding Frictional Power.</p> <p>c. Heat balance sheet and Method of calculating Volumetric Efficiency and Fuel Consumption.</p>

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to I.C. engines	08	04	02	04	10
II	Constructional features of engine components.	08	04	04	04	12



Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
III	Fuel and air feed system	10	04	04	06	14
IV	Ignition and exhaust system	04	02	02	04	8
V	Cooling and lubrication system	10	02	04	06	12
VI	I.C. Engine performance	08	02	06	06	14
Total		48	18	22	30	70

Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Prepare journal of practicals.
- Undertake micro-projects.
- List down the specifications of a bike engine.
- Compare engine specifications of two bikes of different manufacturers.
- Record the specifications of diesel engine of a electric generator.
- Visit an auto parts shop and list down the salient features of three lubricating oils and three coolants.
- Compare engines of petrol and diesel version of same car of a manufacturer on the basis of Power, Torque, RPM, noise, pollution, maintenance etc.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Guide student(s) in undertaking micro-projects.
- Demonstrate students thoroughly before they start doing the practice.
- Encourage students to refer different websites to have deeper understanding of the subject.
- Observe continuously and monitor the performance of students in Lab.

12. SUGGESTED MICRO-PROJECTS



Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

- Choose a modern engine. Search information on any one system from website. Prepare a report for the same.
- Make a few engine components/ their models using suitable material like thermocol/ wood/ plastic.
- Prepare a CAD production drawing of the same. Suitable technique like 3D printing may be used.
- Investigate valve timing diagram of a four stroke engine. Verify result with manufacturer's specification.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Automobile Engg. Vol.-2	Singh, Kirpal	Standard Publishers, New Delhi, 2015; ISBN: 9788180142062
2	Automobile Engineering	Jain K. K. and Asthana	Tata McGraw Hill Publishers, 2010, New Delhi ISBN : 007044529X
3	Automobile Engineering Vol.1	Chhikara, Anil	Satya Prakashan, New Delhi, 2009, ISBN: 9788176843515
4	Automobile Engineering	Gupta, R.B.	Satya Prakashan, New Delhi, 2011, ISBN: 9788176843799
5	Automobile Engineering	Ramlingam, K.K.	Scitech Publications, New Delhi, 2008, ISBN-9788183715744
6	Internal Combustion Engine Fundamentals	Heywood, John B.	McGraw-Hill International Edition New Delhi, 2010, ISBN: 9781259002076
7	Internal Combustion Engine	Newton and Steeds	Butterworth Publishers, NY, 2000 ISBN: 9780750644495

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

- <http://nptel.ac.in>
- <https://www.youtube.com/watch?v=bLXDPS7UrXs> for I.C. engine working principle
- www.Learnengineering.org
- <https://www.youtube.com/watch?v=Rlw7Z4ksFgg> for time an engine without timing marks
- <https://www.youtube.com/watch?v=juuQHKMc0> for engine lubrication system



- f. <https://www.youtube.com/watch?v=vErfnY5bPrY> and <https://www.youtube.com/watch?v=9BYm0HnLGRU> for carburettor working animation
- g. <https://www.youtube.com/watch?v=EhwK2KWDH1Y> for fuel filter animation
- h. <https://www.youtube.com/watch?v=JSymXTP8HTg> for Distributor type FIP animation
- i. <https://www.youtube.com/watch?v=ljXnbFVJKRY> for Jerk type FIP animation

