

Automotive Fourth Year

Module 2 Makina Klasika! Engine Classification

What this module is about

Hello, my friend! I'm here again. I would like to ask you one question. Would you like to add more learning skills through this module? Believe me, learning is a continuous process. If I were you, continue going on with this new module.

This module helps you understand the operating principles of an engine, its types, parts and the function of each part. Doing some exercises will help you a lot in your quest for knowledge and productivity.

After going through this module, you are expected to do these:

1. Identify the types, parts and functions of each part of an engine and the operating principles of engines.
2. Perform practical exercises in:
 - a. Determining the four-stroke cycle of engine operation.
 - b. Identify the rotating, reciprocating and oscillating parts of engines.
3. Appreciate the aesthetic value of engine parts and their contribution to the rest of the parts of an engine.

Your performance shall be assessed by giving you a test after going through this module. For your performance to be considered acceptable, you are expected to:

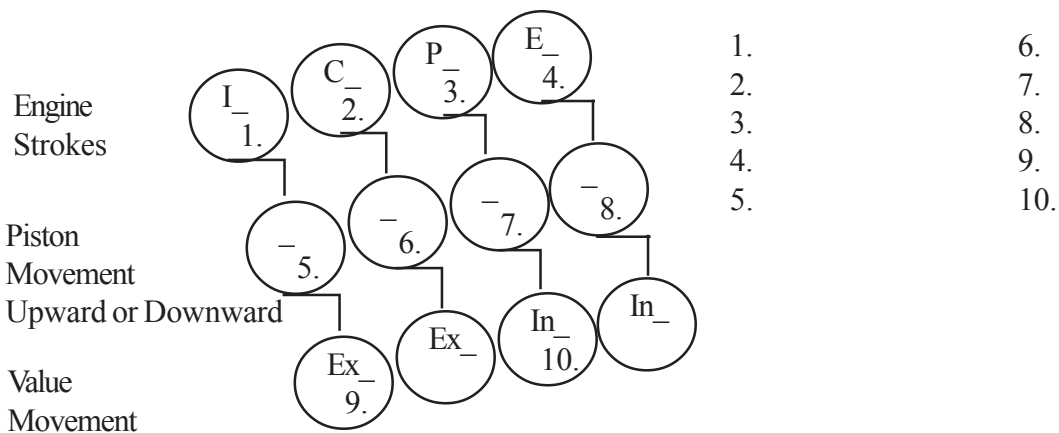
1. Answer correctly at least 80% of the test items.

PRETEST

Directions: Below is a set of questions for you to answer. This is not a graded test. It will just test your level of knowledge about engine classification. So feel free to answer all the items in this test.

Test I

Directions: Fill in the space provided in the chain of events. Write your answer on the blank on the right.



TEST II

Directions: Rearrange the word or group of words to find the correct answer to the question.

1. A type of engine that uses diesel fuel as a medium of combination is called ENILOSAG engine.
2. An engine that uses diesel fuel as a medium of combination is called LESEID engine.
3. In-line engine is an engine where cylinders are arranged in a GHTIARTS line.
4. I-head valve arrangements is also called LAVEV-NI-DEHA.
5. When a vehicle is equipped with a radiator, cooling fan and water pump, of engine is RETAW-OOCLED.

TEST III

Directions: Find at least 10 engine parts by highlighting or encircling the square blocks-six horizontal and four vertical answers. Write your answers on the right space provided on your answer sheet.

E	N	G	I	N	E	B	L	O	C	K
N	A	E	B	B	I	O	U	L	A	A
G	E	A	E	Y	O	N	G	S	M	M
I	G	G	A	S	K	E	Y	S	S	M
N	E	A	R	O	U	R	I	R	C	H
E	A	B	I	C	D	E	F	G	A	H
C	R	A	N	K	C	A	S	E	F	F
Y	C	O	G	E	O	F	G	H	T	I
L	M	N	S	T	N	O	P	Q	R	S
N	P	U	S	H	R	O	D	E	F	G
D	E	F	G	H	O	I	L	P	A	N
E	F	G	H	I	D	E	F	G	H	I
R	O	C	K	E	R	A	R	M	N	O

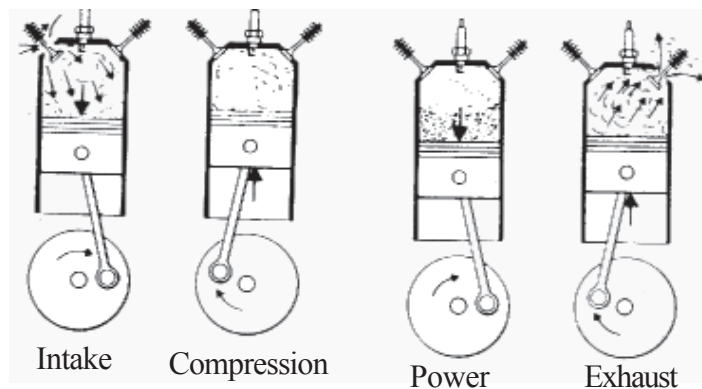
Lesson 1

The Four Stroke Cycle

Automotive engines must be compact and light and capable of producing high power. These requirements must meet the modern era of engine production. But, even though how powerful and modern engines are. The basic and elementary principles should not be ignored because it remains the same.

However, for a clearer and more elaborate understanding of this lesson, the four operating principles of engines are as follows:

1. Intake Stroke - During this operation, the piston moves downward inside the engine cylinder. (This is initially done by the cranking motor which is electrically operated by a battery) The intake valve opens to admit a fresh air and fuel mixture into the engine cylinder. The exhaust valve is closed during this period.
2. Compression Stroke - As the starter motor continues to crank the engine, the piston moves upward, compressing the air and fuel mixture inside the cylinder. In this period, the intake valve is closed and the exhaust valve remains closed during this entire period.



3. Power Stroke - Several degrees before the piston reaches the top of the engine cylinder (TDC-top dead center), an electric spark from the spark plug ignites the highly compressed air and fuel mixture, thus producing a very high expansion of burned gases. This expansion of burned gases forces the piston to move downward. The intake and exhaust valves at this time are closed. The engine now produces its own power and the initial cranking of the motor has now regenerated.
4. Exhaust Stroke - Due to the great momentum produced to force the piston downward, the engine is now self-energized, the piston moves upward again the exhaust valve opens to give way for the burned gases to be expelled out from the engine cylinder, through the exhaust part, exhaust, manifold, tail pipe and muffler. During this period, the intake valve is closed.

Lesson 2

Classification of Engines

A. Types of Engines

1. Gasoline Engine – An engine that uses gasoline as fuel and as medium of combustion. The gasoline engine uses an ignition coil for delivering high tension voltage to the spark plug to ignite the air-fuel mixtures inside the engine cylinder.
2. Diesel Engine – An engine that uses diesel fuel as medium of combustion. It uses injectors instead of spark plugs which spray diesel fuel only inside the engine cylinder. It also uses an injection pump instead of an ignition coil and distributor in distributing pressurized diesel fuel to the engine cylinder via an injector.

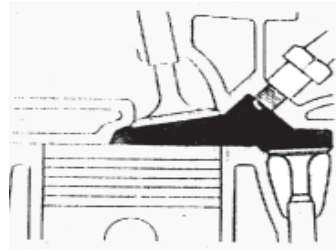
B. According to Cylinder Arrangements

Common cylinder arrangements are the in-line, V-type and horizontally opposed type.

1. In-line - In this arrangement, cylinders are arranged in a straight line in a single cylinder block. It can be vertical in-line or inclined in line. In-line cylinder arrangement can be from one up to 8 cylinder engines.
2. V-type cylinders - these are made in two bank – two in-line V-shaped or slanted from each other at a 90 degree angle. The most common is the eight-cylinder type with four cylinders at each bank.
3. Horizontally opposed - In this type of engine, cylinders are arranged horizontally and opposed to each other. The advantage of horizontally opposed engines is the extremely low overall height and its air-cooled system.

C. According to Valve Arrangements

1. L-Head – In the L-head type of valve arrangement, both the intake and exhaust valves are located at one side of the cylinder block. The valve operation mechanism is located in the crankcase under the valves.
2. I-Head – In the I-head or valve-in-head type of valve arrangement, both the intake and exhaust valves are placed in an inverted position in the cylinder head, directly above the cylinders. The valve operating mechanism is located on one side and on top of the cylinder head.
3. F-Head – The F-head type of valve arrangement has one valve at the cylinder in the cylinder block as in L-head engines, and the other in the cylinder head, as in the I-head engine.

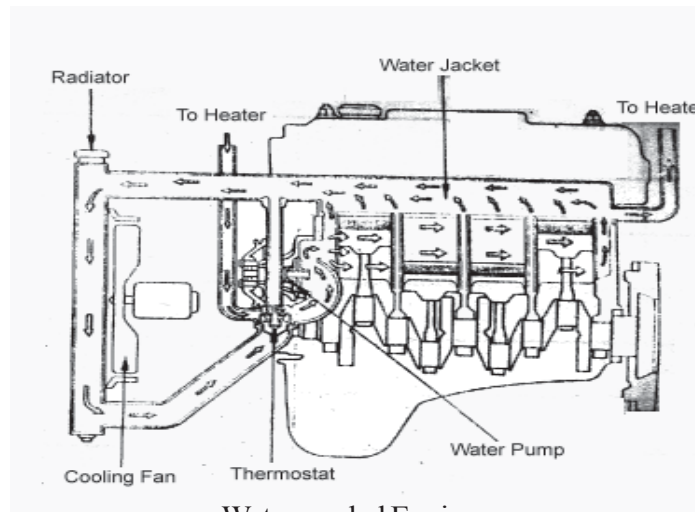


F-Head

4. T-Head - In the T-head type of valve arrangement, the intake valves are on one side of the cylinder, and the exhaust valve on the other, both in the cylinder block.

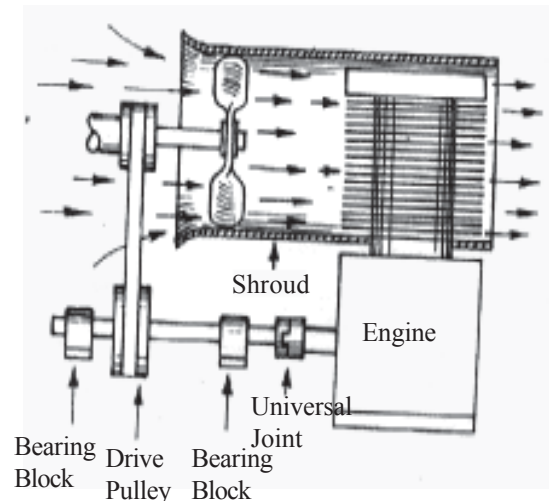
D. According to Methods of Cooling

1. Water Cooled Engine - In water cooled engines, the water passes through the cylinder block and head. This is made possible by the water jacket. The water jacket allows the passage of water outside the cylinder walls, valve seats, valve guides and combustion chamber. The presence of radiator acts as a water reserve and the cooling fan for air-circulation around the outside surface of the engine compartment.



Water-cooled Engine

2. Air-cooled engine - In air-cooled engines, air is the primary medium for maintaining the normal operating temperature of the engine. Generally the air-cooled engine warms up more quickly and operates at a high temperature than a water cooled engine. Hence, engines of this type are equipped with cooling fans to force the air around the engine. Usually, air-cooled engines are made of aluminum, consisting of cooling fins around the head and the block.



Activity 2

- a. Discussion - After reading this lesson, report to your teacher for further clarification on the classification of engines.
- b. Investigation - Go to the nearest automotive shops in your community and investigate the following;
-Which of the following type of cylinder arrangements are commonly serviced? Why? Please check:
 - In-line
 - V-Type
 - Horizontally opposed

Write your investigation in ½ sheet of pad paper and submit to your teacher for further discussion.

- c. Inspection - Inspect the different types of engines according to valve arrangement. Describe and compare the differences and similarities or valve arrangement.

Self-check:

Directions: Rearrange the word to find the correct answer to each statement.

1. A type of engine that uses gasoline fuel as medium of combustion is ENILOSAG engine.
2. An engine that uses diesel fuel as medium of combustion is known as LESEID engine.
3. In line engine is an engine the cylinders of which are arranged in a GHTIARTS line.
4. I-head valve arrangement is also called LAVEV-NI-DEHA.
5. When a vehicle is equipped with a radiator or cooling fan, the engine of this vehicle is a RETAW-OOCLED engine.

For the correct answers, turn to the key to correction at the end of this module. Review the items not correctly answered and find out what your problem is.

Lesson 3

Engine Parts

While types of engine vary as to size, design and horsepower developed, there may have some added parts but, generally, certain parts common in engine designs perform similar functions. The different parts of the engine and their functions are as follows:

1. Cylinder Block - It is the basic framework of the engine. It provides the smooth cylindrical bores which guide the pistons. It is usually made of cast iron. Some modern engines are made of aluminum alloy to improve heat radiation and reduce weight. The cylinder block is provided with holes or passage separately designed for water circulation as well as for oil passage.

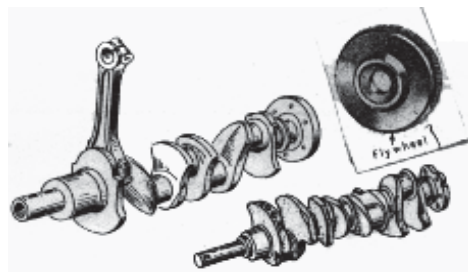
The cylinder block has many sub-components such as the following:

- a. Engine cylinder - It is a long cylindrical bore where the piston slides up and down.
- b. Piston - This is a round cylindrical shape, close at the top which slides up and down the cylinder. It is attached to the connecting rod, and when the fuel charge is fired, transfers force of explosion to the connecting rod and then to crankshaft.



Piston Assembly

- c. Crankshaft -It converts the up and down motion of the piston to a rotary motion to drive the wheels via the power trains. Connected at the rear-end of it is the flywheel, a circular solid metal disc that provides inertia to keep the crankshaft turn smoothly when power impulses are applied. The flywheel also forms a base for starter ring gear and attachments for clutch assembly.



Crankshaft with Fly Wheel

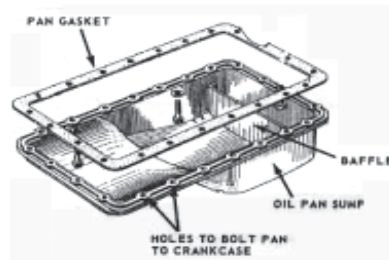
2. Crankcase – A part of the engine, this is located at the lower part of the cylinder block. It allows the installation of the upper halves of crankshaft main bearings.

- a. Bearings are made of soft metal alloy known as babbitt metal, a combination of lead, tin and antimony. Bearings offer relatively little friction when contracted by the revolving crankshaft. Bearings used in connecting rod are called conrod bearing and other bearings used in the crankshaft main journals are called main journal bearings.



Connecting Rod Bearings

- b. Oil pan – It is part bolted at the cover portion of the crankcase of the engine block with a gasket inserted in between them.



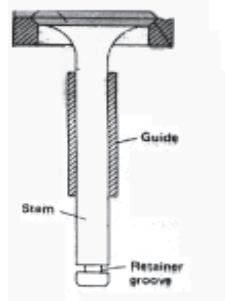
Oil Pan

3. Cylinder head – This is the top covering of the cylinders bolted to the upper portion of the engine block with a cylinder head gasket placed in between. The cylinder side of the cylinder head comprise the combustion chamber – a space for the burning of air and fuel mixture during power stroke and a separate hole for water passage and other holes for passage of lubrication oil for valve mechanism.
4. Valve Mechanism – These are series of parts working together to open and close valves proper intervals or at the right time.

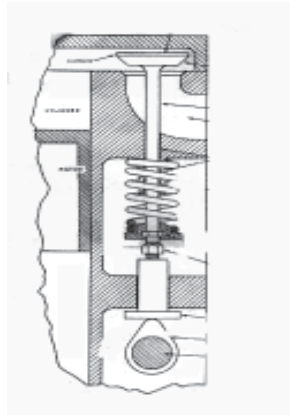


It has the following parts:

- a. Camshaft - An engine camshaft is a long, solid tubular shaft equipped with cams which is responsible for the opening and closing of the valves.
- b. Valves - These are generally designed for the purpose of giving way to the incoming air fuel mixture (intake valve opens) during intake strokes and the outgoing of burned gases. (Exhaust valve opens) on the exhaust stroke. They are also generally designed to close (intake and exhaust valves) during compression and power stroke.



- c. Valve spring - These are made to close the valve. The valve spring is coil type and should be strong enough to withstand vibration pressure.



- d. Valve seat – This refers to an area where the face of valve seats when closed two common angles for this seat are 45° and 30°.
- e. Valve guide – It is a hole through which the stem of the valve passes. It is designed to keep the valve properly aligned.
- f. Valve lifter or cam follower – This refers to a unit that contacts the end of valve stem and camshaft. The valve lifter rides on the camshaft and when the cam lobes move it upward, it opens the valve.
- g. Push rod - In an I-head type of valve arrangement, it is a rod that connects, this valve lifter to the rocker arm.
- h. Rocker arm – It is an arm used to direct the upward motion of the push rod to a downward or opening motion of the valve stem.
- i. Camshaft drive – It is the opening and closing of the valves which must be timed with the crankshaft rotation. It is accomplished by the timing gears or chain driven by the crankshaft and mounted at the front part of engine.

Activity 3

- a. Report to your teacher for a review of the different parts of an engine and this function of each part. You may ask your teacher for any clarification on lesson you have not well understood.
- b. Reidentify the parts and the function of each. Clear every engine part that has not been properly identified.

Self-check:

Directions: Find out at least 10 engine parts by highlighting or encircling the square block.

E	N	G	I	N	E	B	L	O	C	K
N	A	E	B	B	I	O	U	L	A	A
G	E	A	E	Y	O	N	G	S	M	M
I	G	G	A	S	K	E	T	S	S	M
N	E	A	R	A	U	O	I	R	C	H
E	A	B	I	C	D	E	F	G	A	H
C	R	A	N	K	C	A	S	E	I	F
Y	C	D	G	E	O	F	G	H	T	I
L	M	N	S	T	N	O	P	Q	R	S
K	J	K	L	M	N	O	P	Q	R	S
N	P	U	S	H	R	O	D	E	F	G
D	E	F	G	H	O	I	L	P	A	N
E	F	G	H	I	D	E	F	G	H	I
R	O	C	K	E	R	A	R	M	N	O

For the correct answers, turn to the key to correction at the end of this module. Review the items not correctly identified and find out what your problem is.

LET'S SUMMARIZE

- The two types of engines are the gasoline and diesel engines.
- Engine types are according to valve arrangements such as L, I, F and T valve arrangements.
- Engine block is the basic framework of engine parts. It is where all engine component parts are attached.

POSTTEST

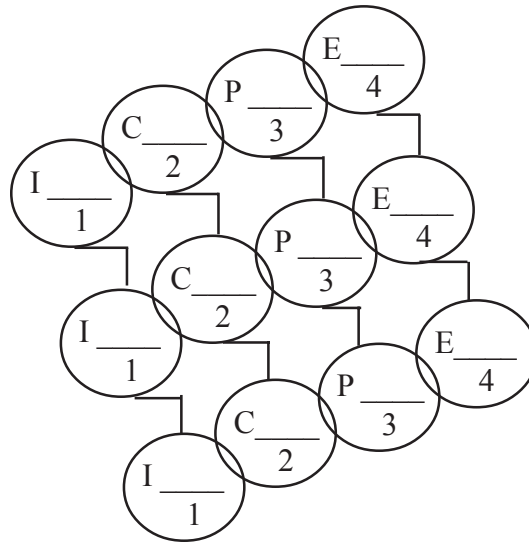
Directions: In this section, you will be given a test which will help you find out if you have understood what you have read or done.

Test I

Directions: Fill in the space provided in the chain of events. Write your answer on the left space provided on your answer sheet.

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

Engine Stroke
 Piston Movement (up or down)
 Valve Movement (open or closed)



TEST II

Directions: Find at least 10 engine parts by highlighting or encircling the square blocks – six horizontal and five vertical. Write your answers on the right space provided on your answer sheets in any order.

E	N	G	I	N	E	B	L	O	C	K
N	A	E	B	B	I	O	U	L	A	A
G	E	A	E	Y	O	N	G	S	M	M
I	G	G	A	S	K	E	Y	S	S	M
N	E	A	R	O	U	R	I	R	C	H
E	A	B	I	C	D	E	F	G	A	H
C	R	A	N	K	C	A	S	E	F	F
Y	C	O	G	E	O	F	G	H	T	I
L	M	N	S	T	N	O	P	Q	R	S
N	P	U	S	H	R	O	D	E	F	G
D	E	F	G	H	O	I	L	P	A	N
E	F	G	H	I	D	E	F	G	H	I
R	O	C	K	E	R	A	R	M	N	O

TEST III

Directions: Rearrange the word or group of words to find the correct answer to the questions.

1. A line engine is one in which cylinders are arranged in a GHTIARTS line.
2. When a vehicle is equipped with a radiator, cooling fans and water pump the engine of this vehicle is a RETAW-OOCLED engine.
3. An engine that uses diesel fuel as medium of combustion is called LESEID engine.
4. The head valve arrangement is also called LAVEV-NI-DEHA.
5. A type of engine that uses gasoline fuel as medium of combustion is called ENILOSAG engine.

For the correct answers, turn to the key to correction at the end of the module. Review the items not correctly answered and find out what your problem is. Identify to which bracket in the scorecard you belong after correcting your own paper.

Suggested Activities:

1. Read the following supplementary reading materials.
 - a. Automotive mechanics by William H. Crouse
 - b. Aklat Pang-Automekaniko by Felizardo Francisco
 - c. Automotive Fundamentals by Ray F. Kuns
 - d. Audel's Gas Engine Manual
2. Cut out clippings from newspapers or magazines about record trends in automotive.
3. Visit nearby automotive repair shops and observe the following:
Types of engine repaired or serviced as to:
 - * Types of fuel used
 - * Methods of cooling
 - * Valve arrangements
 - * Parts repaired or replaced.

KEY TO CORRECTION

Pretest

Test I

1. Intake
2. Compression
3. Power
4. Exhaust
5. Downward
6. Upward
7. Downward
8. Upward
9. Closed
10. Closed

Test II

1. Gasoline
2. Diesel
3. Straight
4. Valve-in-head
5. Water-cooled

Test III

1. Engine block
2. Gasket
3. Crankcase
4. Push rod
5. Oil pan
6. Rocker arm
7. Engine cylinder
8. Bearings
9. Camshaft
10. Connrod

Lesson 1: Self-check

1. intake
2. compression
3. power
4. exhaust
5. downward
6. upward
7. downward
8. upward
9. closed
10. closed

Lesson 2: Self-check

1. Gasoline
2. Diesel
3. Straight
4. Valve-in-head
5. Water - cooled

Lesson 3: Self-check

1. Engine block
2. Gasket
3. Crankcase
4. Push rod
5. Oil pan
6. Rocker arm

7. Engine cylinder
8. Bearings
9. Camshaft
10. Connrod

Posttest

Test I

1. Intake
2. Compression
3. Power
4. Exhaust
5. Downward
6. Upward
7. Downward
8. Upward
9. Closed
10. Closed

Test II

1. Engine block
2. Gasket
3. Crankcase
4. Push rod
5. Oil pan
6. Rocker arm
7. Engine cylinder
8. Bearings
9. Camshaft
10. Connrod

Test III

1. Straight
2. Water-cooled
3. Diesel
4. Valve-in-head
5. Gasoline

Scorecard

- | | |
|-------|-------------------|
| 21-25 | Excellent |
| 16-20 | Very Good |
| 11-15 | Good |
| 6-10 | Needs Improvement |
| 0-5 | Poor |

If your score is 21 and above, congratulations, you are an excellent learner. If you did not do well, review the questions you missed. I believe you can do next time.