Lok Nayak Jai Prakash Institute of Technology

Chapra, Bihar

Course File

Of

Automotive Mechanics

Faculty Name:

Bharti Kumari

Assistant Professor

Department of Mechanical Engineering

CONTENTS

Vision of Mechanical Engineering Department

The Mechanical Engineering department visions to be known globally in the field of technical education and to overcome the issues of industry and society.

Mission of Mechanical Engineering Department

1. To deliver outcome based education to undergraduate students
2. To establish an environment for students where they can build professional and personal integrity to pursue long productive career.
3. To maintaining state of the art research facilities to provide collaborative environment that stimulates faculty, staff and students with opportunities to create, analyze, apply and disseminate knowledge.
4. To equip students with good academic, corporate and entrepreneurship skills as well as create global awareness in them required by engineering profession

Program Educational Objectives

1. To prepare the students for successful career in industries, entrepreneurship or in higher studies.(Preparation)
2. To inculcate engineering attitude to analyze, design and solve real life engineering problems.(Core knowledge)
3. To promote the students for continuous learning, with strong professionals, ethical and moral values.(Learning Environment)

Program Specific Outcomes

The graduates of Bachelor of Engineering in Mechanical Engineering Programme will be able to:

1. Design and develop mechanical as well as inter disciplinary components by experimental, numerical and analytical techniques
2. Apply their knowledge from field of mathematics and science fields to solve problems related to mechanical engineering.

Program Outcomes

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Objectives & Course Outcomes

Course Objectives

The student will be made to learn:

1. The anatomy of the automobile in general
2. The location and importance of each part
3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels
4. Suspension, frame, springs and other connections
5. Emissions, ignition, controls, electrical systems and ventilation

Course Outcomes

The student will be able to

1. Acquire fundamental knowledge of the various systems of an automobile.
2. Explain the working of various parts like engine, transmission, clutch, brakes.
3. Describe how the steering and the suspension systems operate.
4. Understand the environmental implications of automobile emissions.
5. Develop a strong base for understanding future developments in the automobile industry.

Mapping of CO's with PO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	1	1	-	-	-	1	3
CO2	3	2	3	3	3	2	1	1	1	1	1	3
CO3	3	2	3	3	3	2	1	-	-	-	-	3
CO4	3	3	3	3	3	3	3	3	2	2	2	3
CO5	3	3	3	3	3	3	2	2	3	3	2	3

CO	PSO1	PSO2
CO1	3	3
CO2	3	3
CO3	2	2
CO4	1	1
CO5	2	2

SYLLABUS

02 1x24 AUTOMOTIVE MECHANICS L-T-P: 3-1-0 Credit : 4

1. Description of power unit: Fuel supply system and engine lubrication. Lecture: 6

2. Transmission requirements, Fluid and automatic transmission system along with their performance requirements, tractive resistance. Lecture: 5

3. Different types of steering systems and performance requirements, Stability of vehicles on level road and curve path. Lecture : 4

4. General braking requirements, weight transfer during braking, different types of brakes. Lecture : 5

5. General consideration of strength and stiffness of vehicle frame, various suspension systems, shock absorber and engine mountage, Tyre pavement interaction forces, tyre wear & SAE terminology. Lecture : 6

6. Various types of ignition systems with wiring diagram Lecture : 4

7. Testing of vehicles and handling characteristics. Lecture : 4

8. Preventive maintenance, trouble shooting & tuning of power unit Lecture : 4

9. Pollution due to vehicles emission, Effect of design and operating condition on pollution. Lecture : 4

Text Book: 1. Automative Mechanics by Crouse 2. Automobile Engineering by KM Gupta

Reference Books: 1. Automobile Engineering by Newton & Steeds

LOKNAYAK JAYPRAKASH INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
Academic Session: 2020-21
TIME-TABLE

SEMESTER: VII **CLASS: ME**

Period, Time & Days	I 10:00-10:50	II 10:50-11:40	III 11:40-12:30	IV 12:30-13:20	13:20-14:00	V- VII 14:.00-16:30	VIII 16.30-17.00
Monday	AM	IC	CAD	OR	L U N C H	RAC LAB (M-1)	PROJECT
Tuesday	RAC	AM	AM (T)	CLASS TEST/EXTRA CLASS		IC LAB (M-2)	PROJECT
Wednesday	OR(T)	IC	PROJECT			CAD LAB (M-1)	PROJECT
Thursday	AM	RAC	CAD	OR		IC LAB (M-1)	PROJECT
Friday	OR	IC	PROJECT			RAC LAB (M-2)	PROJECT
Saturday	CAD	RAC	PROJECT			CAD LAB (M-2)	PROJECT

	SUBJECT NAME	FACULTY NAME
RAC	Refrigeration & Air Conditioning (3-0-3)	Prof. PIYUSH KUMAR PANDEY
IC	Internal Combustion Engine (3-0-3)	Prof. AJIT KUMAR CHAUHAN
AM	Automotive Mechanics (3-1-0)	Prof. BHARTI KUMARI
OR	Operation Research (3-1-0)	Prof. RAHUL CHAURASIA
CAD	CAD –CAM (3-0-3)	Prof. SACHINDRA KUMAR
Training	Training	Prof. KUMAR JYOTIRADITYA

Chandan Kumar 15/07/2020
Time Table Coordinator
MECH. Dept.

HOD ME
LNJPIT CHAPRA
HOD
Dept. of Mech. Engg.
LNJPIT, Chapra

ACADEMIC IN-CHARGE
LNJPIT CHAPRA
15/07/2020

PRINCIPAL
LNJPIT CHAPRA
15/7/2020

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2	ARPIT KUMAR	17102117002
3	AYUSH KUMAR	17102117003
4	SHIVCHARAN KUMAR	17102117004
5	FAIZ AHMAD	17102117005
6	MD REZAUR RAHMAN	17102117006
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9	GITESH KR SHARMA	17102117009
10	DEEPAK KUMAR	17102117010
11	VIKKI KUMAR	17102117011
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15	ASMITA ARYA	17102117015
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18	ARYAN RAJ	17102117018
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21	SHRINARAYAN PRASAD	17102117021
22	MD ATIQULLAH KHAN	17102117022
23	SUDISH KUMAR	17102117023
24	MITHILESH KUMAR	17102117024
25	SUMIT KUMAR SHARMA	17102117025
26	AVINASH KUMAR	17102117026
27	MUKESH KUMAR SINGH	17102117028
28	SAURABH KR RAUSHAN	17102117029
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30	PAPPU KUMAR	17102117031
31	AVINASH CHAUDHARY	17102117032
32	SATISH KUMAR	17102117033
33	PAWAN KUMAR	17102117034
34	CHANDAN KUMAR	17102117035
35	MD RAHBER REYAZ	17102117036
36	VINAY RANJAN	17102117037
37	MANISH KUMAR	17102117038
38	RAJ KUMAR	17102117039
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44	**MD TARIQUE ANWAR**	**17102117045**
45	**PRASHANT KR CHOUDHARY**	**17102117046**
46	**KARTIKESHWAR SAH**	**17102117047**
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50	**SURAJ KUMAR**	**17102117051**
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53	**AMRENDRA KR SHARMA**	**17102117054**
54	**MD SAZID ANSARI**	**17102117055**
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56	**RAUSHAN KUMAR**	**17102117057**
57	**SUMIT KUMAR**	**17102117058**
58	**RAHUL PRASAD**	**17102117059**
59	**ADITYA SUMAN**	**17102117060**
60	**AMAN KUMAR**	**17102117061**
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66	**Rashmi Kumari**	**18102117905**
67	**Krishna kumar**	**18102117906**
68	**Diwakar singh**	**18102117907**
69	**Jitendra kumar**	**18102117908**
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Lecture Plan

Lecture 1	Description of power unit
Lecture 2	Description of power unit
Lecture 3	Fuel supply system
Lecture 4	Fuel supply system
Lecture 5	Engine lubrication
Lecture 6	Engine lubrication
Lecture 7	Transmission requirements
Lecture 8	Transmission requirements
Lecture 9	Fluid and automatic transmission system along with their performance requirements
Lecture 10	Fluid and automatic transmission system along with their performance requirements
Lecture 11	Tractive resistance
Lecture 12	Different types of steering systems and performance requirements
Lecture 13	Different types of steering systems and performance requirements
Lecture 14	Stability of vehicles on level road and curve path
Lecture 15	Stability of vehicles on level road and curve path
Lecture 16	General braking requirements
Lecture 17	General braking requirements
Lecture 18	Weight transfer during braking
Lecture 19	Different types of brakes
Lecture 20	Different types of brakes
Lecture 21	General consideration of strength and stiffness of vehicle frame

Lecture Plan

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Lecture 23	Shock absorber and engine mountage
Lecture 24	Tyre pavement interaction forces
Lecture 25	Tyre wear
Lecture 26	SAE terminology
Lecture 27	Various types of ignition systems with wiring diagram
Lecture 28	Various types of ignition systems with wiring diagram
Lecture 29	Various types of ignition systems with wiring diagram
Lecture 30	Various types of ignition systems with wiring diagram
Lecture 31	Testing of vehicles
Lecture 32	Testing of vehicles
Lecture 33	Handling characteristics
Lecture 34	Handling characteristics
Lecture 35	Preventive maintenance
Lecture 36	Preventive maintenance
Lecture 37	Trouble shooting
Lecture 38	Tuning of power unit
Lecture 39	Pollution due to vehicles emission
Lecture 40	Pollution due to vehicles emission
Lecture 41	Effect of design and operating condition on pollution
Lecture 42	Effect of design and operating condition on pollution

Lecture Plan

DESCRIPTION OF POWER UNIT: FUEL SUPPLY SYSTEM AND ENGINE LUBRICATION

Automobile

Automobile is a self- propelled vehicle which is used for transportation of passengers and goods on the ground.

Examples: Car, jeep, bus, truck, scooter, etc.

A self-propelled vehicle is that in which power is produced within itself for its propulsion.

Automobile is a vehicle driven by an internal combustion engine.

Classification of Automobiles

Automobiles can be classified on different bases as given below:

1. On the Basis of Load:

(a) Heavy transport vehicle (HTV) or heavy motor vehicle (HMV),

e.g. trucks, buses, etc.

(B) Light motor vehicle (LMV),

e.g. cars, jeeps, etc.

2. On the Basis of Wheels:

(a) Two wheeler vehicle, for example: Scooter, motorcycle, scooty, etc.

(b) Three wheeler vehicle, for example: Auto rickshaw, three wheeler scooter and tempo, etc.

(c) Four wheeler vehicle, for example: Car, jeep, trucks, buses, etc.

(d) Six wheeler vehicle, for example: Big trucks with two gear axles each having four wheels.

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(e) Eight or more wheeler vehicle, for example: Special transporting vehicles (trailers)

3. On the Basis of Fuel Used

(a) Petrol vehicle,

e.g. motorcycle, scooter, cars, etc.

(b) Diesel vehicle,

e.g. trucks, buses, etc.

(c) Electric vehicle,

e.g. battery drive

(d) Gas vehicle,

e.g. LPG and CNG vehicles, where LPG is liquefied petroleum gas and CNG is compressed natural gas.

4. On the Basis of Transmission

(a) Conventional vehicles with manual transmission, e.g. car with 5 gears.

(b) Semi-automatic

(c) Automatic: In automatic transmission, gears are not required to be changed manually. It is automatically changes as per speed of the automobile.

Power Unit

In automotive vehicles, the power unit comprises the main components that generate power and deliver that power to provide driving force.

So, this includes a prime move. It will also include the drive train or drive line which essentially consists of the clutch and the gearbox.

Existing power units which are typically called as conventional power units include the prime mover which in conventional vehicle is an internal combustion engine typically abbreviated as an IC engine. In electric hybrid vehicles, the power unit is

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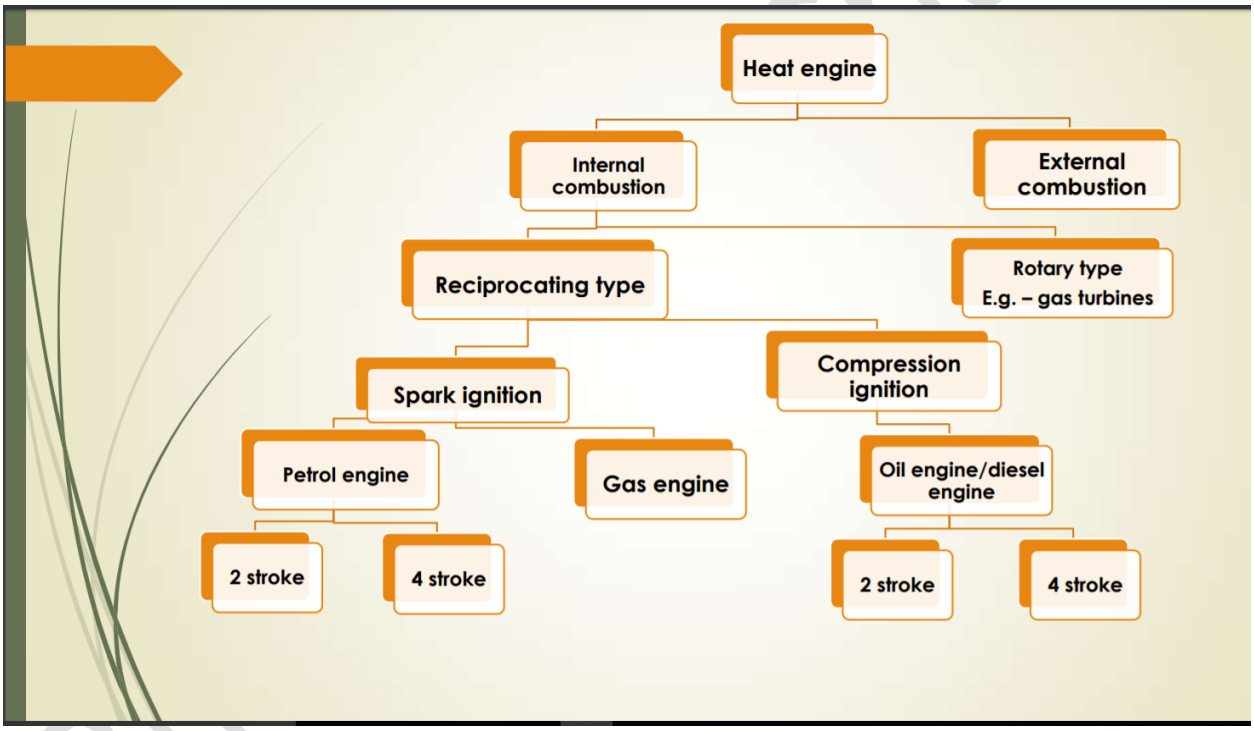
an electric motor which may supplement the IC engine and in a pure electric vehicle, an electric motor which will do the prime movers job is the power unit.

Heat Engine

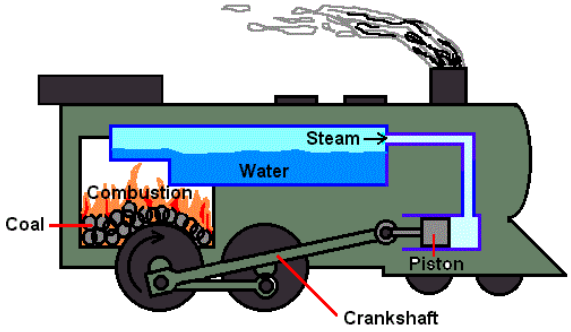
A heat engine is a device which transforms the chemical energy of a fuel into thermal energy and uses this energy to produce mechanical work. So, as far as automobiles are concerned, the chemical energy stored in fuels is first converted to thermal energy by the process of combustion and then this thermal energy is converted to kinetic energy by using appropriate mechanisms and this kinetic energy is used to propel the vehicle.



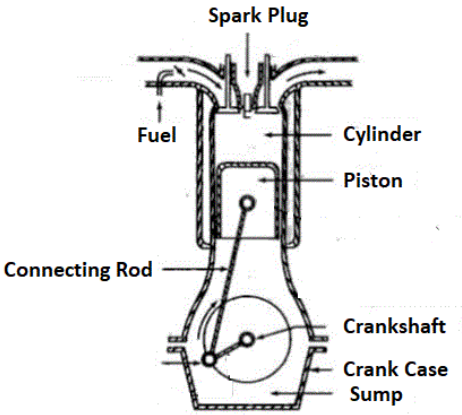
Heat engine is classified into two types-

(a) External combustion engine

(b) Internal combustion engine



External Combustion Engine



Internal Combustion Engine

(a) External Combustion Engines

In external combustion engine, combustion of fuel occurs outside the engine. In this engine, the products of combustion of air and fuel transfer heat to a second fluid which is the working fluid of the cycle.

In a steam engine, we convert water to steam in a boiler by burning some fuel and then the steam is transported from the boiler to a steam turbine, and there the terminology of the steam is converted to kinetic energy. These two energy conversion processes happen in different locations. So, that is an external combustion engine.

(b) Internal Combustion Engines

This process includes the combustion of a fuel that takes place within the system. In this engine, the combustion of air and fuels take place inside the cylinder and are used as the direct motive force.

In an internal combustion engine, the two energy conversion processes take place in the same chamber. Example: petrol and diesel engines.

Internal combustion engines can be classified into the following types:

1. According to the basic engine design-

(a) Reciprocating engine (Use of cylinder piston arrangement),

If an IC engine uses reciprocating motion to convert the thermal energy into kinetic energy, then it is called a reciprocating engine. Example: Petrol and Diesel Engine

(b) Rotary engine (Use of turbine)

If an IC engine uses rotational motion to convert the thermal energy into kinetic energy, then it is called rotary engine. Example: Wankel Engine

2. According to the type of fuel used-

(a) Petrol engine

(b) Diesel engine

(c) Gas engine (CNG, LPG)

3. According to the number of strokes per cycle-

(a) Four stroke engine

A 4 stroke engine is an engine where we need 4 strokes of the piston to complete one operating cycle of the engine. Today 4 stroke engines are universally used in road vehicle applications.

(b) Two stroke engine

A 2 stroke engine is one where one operating cycle of the engine is completed in 2 strokes of the piston. 2 stroke engines are on the way out due to emission issues.

4. According to the method of igniting of the fuel-

(a) Spark ignition (SI) engine

As the name indicates in a spark ignition engine (SI) engine a high voltage spark is used to ignite or to initiate the combustion process. Combustion is the process in which fuel and air are mixed together and ignited in an engine to convert the chemical energy of the fuel to thermal energy, and it is the first energy conversion process. For combustion we need:

- fuel which are typically hydrocarbons
- air mainly oxygen in air, because it is an oxidation reaction chemically
- a mechanism for initiating combustion.

So these are the requirements to have combustion. We need fuel and air in the correct proportion for effective combustion. In an ideal combustion process, hydrocarbon (HC) in the fuel should be completely oxidized to water vapor H_2O and carbon should be completely oxidized into CO_2. After introducing fuel and air in the combustion chamber in the correct ratio we need a mechanism for initiating

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combustion. In a spark ignition engine, we use a high voltage spark to ignite the fuel air mixture. Example: Petrol engines

(b) Compression ignition engine

In compression ignition (CI) engine, we push the engine operating conditions to such a level that the fuel ignites on its own. Every fuel will have its self-ignition temperature and when we take the fuel to that temperature, it ignites on its own. So, here, fuel self ignites. Example: Diesel engines

5. According to the working cycle-

(a) Otto cycle (constant volume cycle) engine,

(b) Diesel cycle (constant pressure cycle) engine,

(c) Dual combustion cycle (semi diesel cycle) engine.

6. According to the fuel supply and mixture preparation-

(a) Carburetted type (fuel supplied through the carburettor),

(b) Injection type (fuel injected into inlet ports or inlet manifold, fuel injected into the cylinder just before ignition).

7. According to the mechanism of charging

Charging is a process by which fuel air mixture is taken from fuel tank and atmosphere respectively and brought into the combustion chamber of an internal combustion engine and prepared for combustion.

(a) Naturally aspirated engines

In a naturally aspirated engine, either the air or the fuel air mixture is introduced into the combustion chamber at near atmospheric pressure.

(b) Supercharged engines

In a supercharged engine, air or sometimes even fuel is introduced at a pressure higher than the atmospheric pressure.

For example, most of the diesel powered car today are called turbocharged vehicles. So, a turbocharger is a device which will essentially compress air and

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introduce that air into the combustion chamber of a diesel engine at pressures higher than atmospheric pressure.

Fuel

Fuel is a substance consumed by the engine to produce energy. The common fuels for internal combustion engines are: 1. Petrol 2. Power kerosene 3. High speed diesel oil 4. Light diesel oil.

Components of Fuel Supply System

1. Fuel tank

The fuel tank is used to store the fuel for the engine. It is made of steel or aluminum or synthetic rubber compounds and fiber reinforced plastics which are flame resistant. And these tanks are coated with lead-tin alloy to protect the tank from the corrosion effect.

This tank is placed in any suitable position of a vehicle. For front engine vehicle, the fuel tank is in the underside of a luggage compartment at the rear end or directly above the rear axle, and for rear engines, the fuel tank is placed in the front behind the compartment.

There are a couple of baffle plates inside the fuel tanks because of when brakes are applied to the vehicle the fuel surge inside the vehicle or when a car turn around then also fuel surge inside the tank so this baffle plate helps to reduce the surge of fuel inside the tank. These plates divide the tank in a number of the compartment which is interconnected through a pipe.

Petrol is filled by the small opening cap. A filter is placed at the tank end of the fuel line and a small hole is provided for venting to the atmosphere A drain plug is fitted at the bottom of the tank to remove sediments and the fuel tank is also provided with a fuel gauge sensing unit for checking of fuel level inside the tank.

2. Fuel filters

A filter is used to remove the dirt and solid particles from the fuel to ensure trouble free fuel supply to the pump.

For this, chamois leather is used which only allows passing of petrol into it and water and fine particles cannot pass through it.

Usually there are two filters in diesel engine: (1) Primary filter and (2) Secondary filter. The primary filter removes water and coarse particle of dirt from the fuel. The secondary filter removes fine sediments from the fuel.

3. Fuel pump

The fuel pump is used to deliver the fuel from the fuel tank to the carburetor.

4. Fuel lines:

These tubes are used to connect the fuel tank with the pump and pump to the carburetor. These pipeline helps to deliver the fuel from the fuel tank to the pump and from the pump to the carburetor. Generally, these tubes are made of Copper or Steel.

The two joints of the tubes are made flexible because flexible joints help the fuel tank and the pump to move back or front with the body.

5. Carburetor:

A perfect air-fuel mixture is necessary for a petrol engine to run. So, therefore, we use a carburetor. The process of preparing an air-fuel mixture away from the cylinders of an engine is called carburetion and the device in which this process take place is called carburetor.

Function of carburetor: The main functions of the carburetor are:

(i) To mix the air and fuel thoroughly
(ii) To atomize the fuel
(iii) To regulate the air-fuel ratio at different speeds and loads and
(iv) To supply correct amount of mixture at different speeds and loads.

There are two chambers in carburetor one is float chamber which is used to maintain the fuel level with the help of needle valve and another one is mixing chamber where the mixture of air-fuel takes place.

6. Air cleaner:

It is very necessary for an engine to get fresh air, otherwise, the polluted air causes several damages to the engine chamber particularly piston, piston chamber, piston ring, and valves. And if the polluted air enters the crankcase where engine oil is stored then that can damage the lubrication parts like bearings. Therefore we need to install an air filter which purifies the air before entering the engine cylinder.

This can also act as a silencer for the carburation system and also as a flame arrester when the engine has backfired.

The air filter should be cleaned regularly. If it is not cleaned, it can cause much fuel consumption and reduce the engine efficiency.

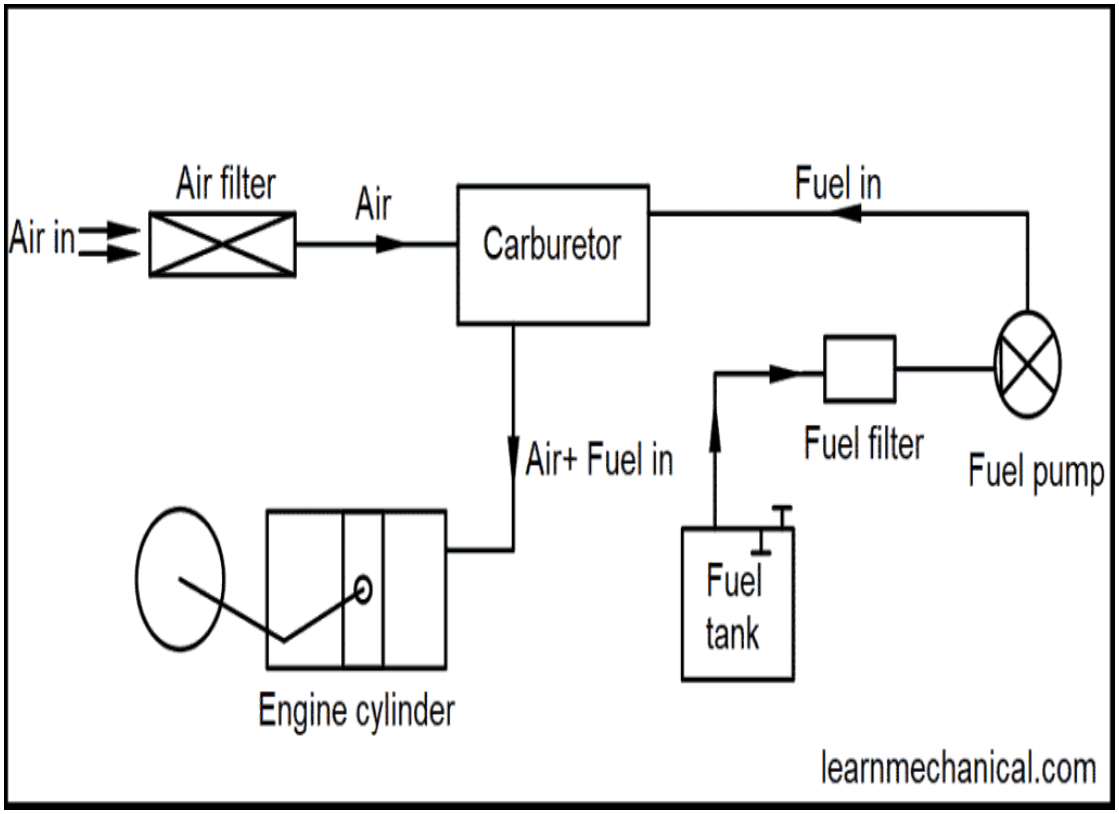
7. Fuel gauge unit:

A fuel gauge is an instrument which is fitted to the dashboard of the vehicle so that driver can know the amount of fuel inside the fuel tank. It indicates the fuel level in the tank.

8. Combustion Chamber

A combustion chamber is a space inside the engine, where the combustion of fuel takes place. In diesel engine, the fuel is atomized, vaporized and burnt inside combustion chamber, whereas in spark ignition engine, atomization of fuel takes place in the carburetor and vaporization occurs in carburetor as well as the inlet manifold. Combustion chamber is classified as: (a) Direct injection chamber (b) Indirect injection chamber

Layout of the Fuel Supply System



In some spark ignition engine, the fuel tank is placed above the level of the carburetor. The fuel flows from the fuel tank to the carburetor under the action of gravity. There are one or two filters between the fuel tank and the carburetor. A transparent sediment bowl is also provided to hold the dust and dirt of the fuel. If the tank is below the level of the carburetor, a lift pump is provided in between the tank and the carburetor for forcing fuel from the tank to the carburetor of the engine. The fuel comes from the fuel tank to the sediment bowl and then to the lift pump. From there the fuel goes to the carburetor through suitable pipe. From the carburetor, the fuel goes to the engine cylinder, through the inlet manifold of the engine.

Types of Fuel Feed System

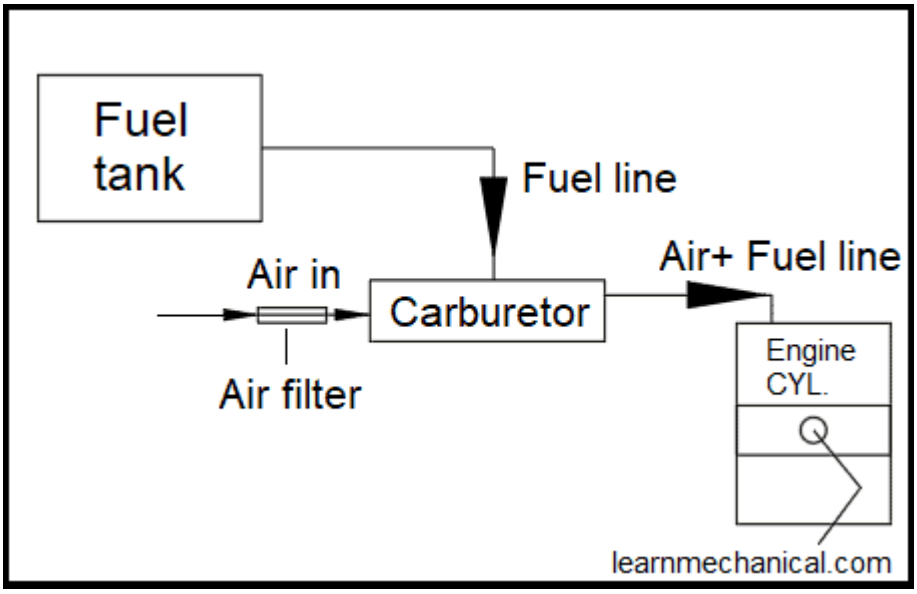
The main purpose of the fuel feed system is to control the fuel supply to the engine. For the supply of fuel from fuel tank to engine cylinder following fuel feed systems are used:

1. Gravity Fuel Feed System
2. Air Pressure Feed System
3. Vacuum Feed System (Suction and Gravity System)
4. Pump Feed System
5. Fuel Injection System

First four out of these fuel feed systems work with carburetor while the fuel injection system uses an injector to supply the fuel to the engine cylinders.

1. Gravity Fuel Feed System

In this system, the fuel tank is mounted at the highest position. This system is quite simple and cheap as the fuel drops into the float Chamber of the carburetor under Gravity. It is used in a small engine having low fuel consumption as sufficient head is not developed for large engine.



2. Air Pressure Feed System

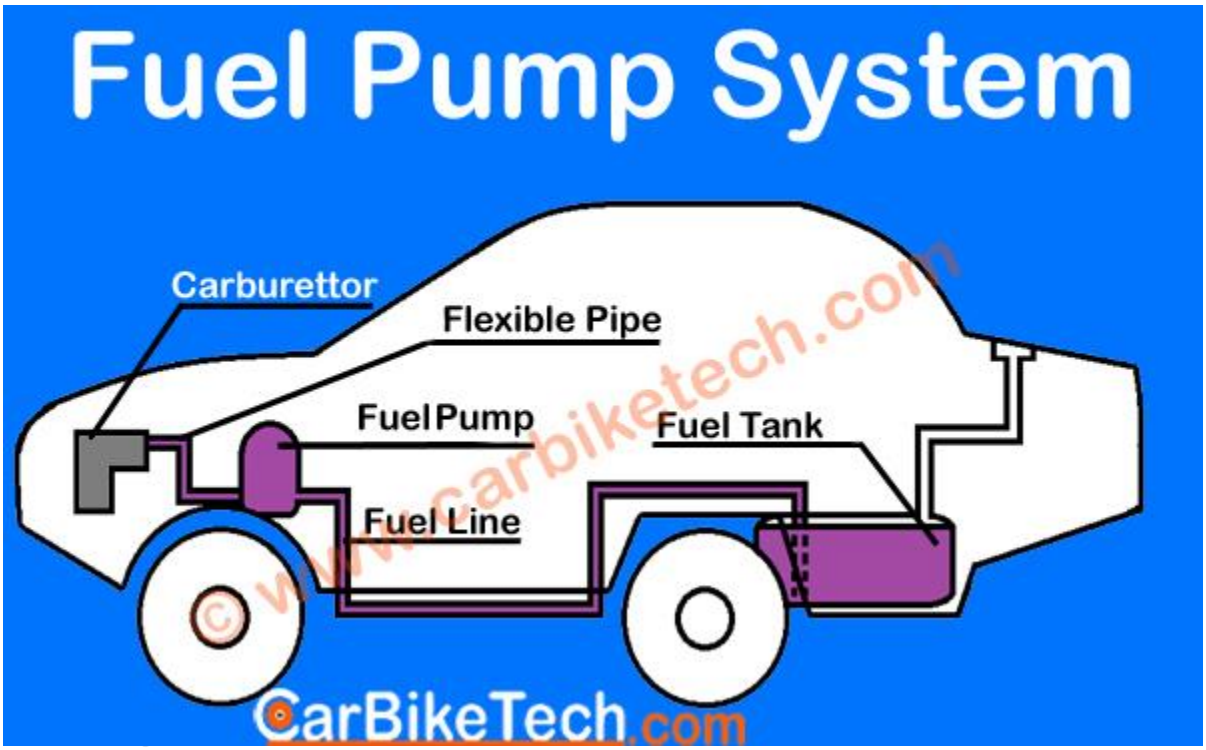
In this system, an airtight fuel tank is used and is placed under the seat or near the engine. The hand operated pump or mechanically operated pump supplies the high-pressure air to the fuel tank to supply the fuel to the carburetor.

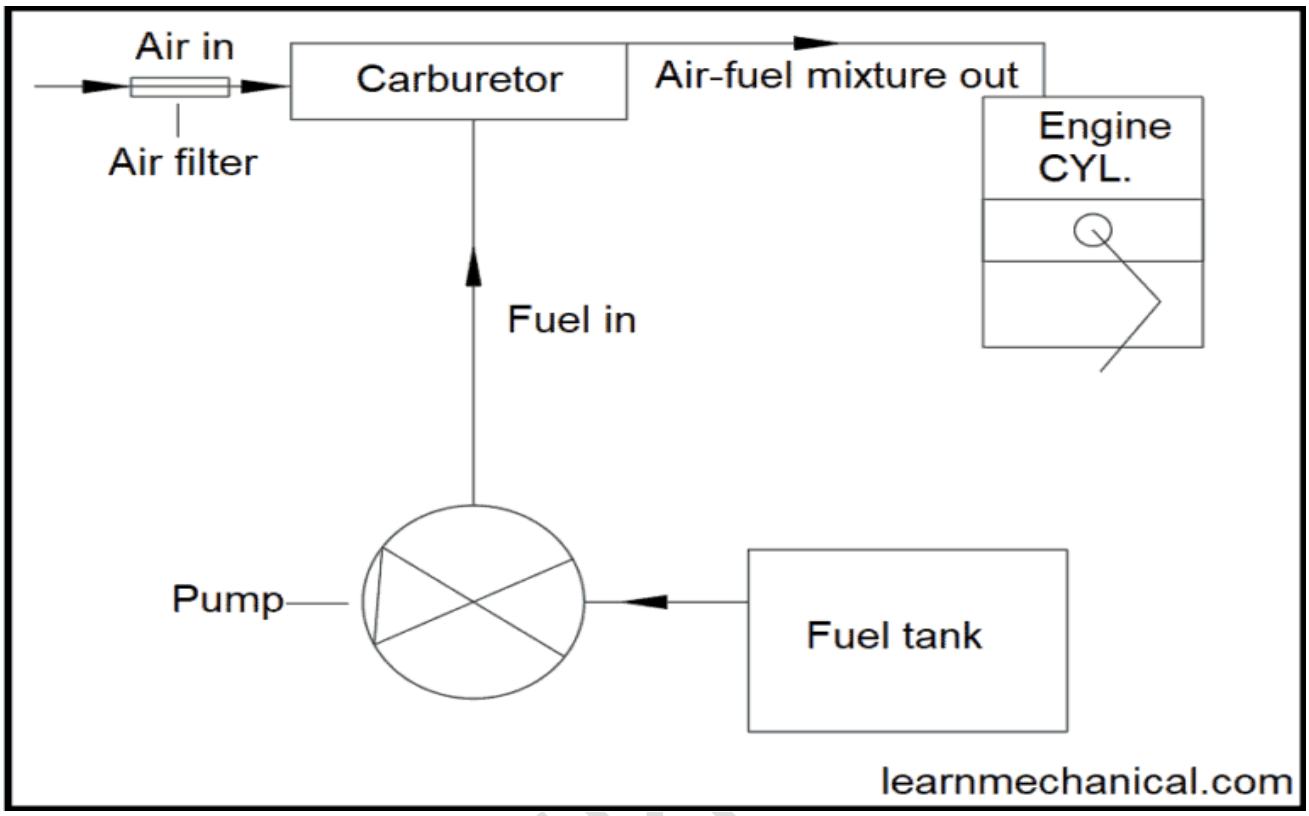
3. Vacuum Feed System (Suction and Gravity System)

This system uses engine suction pressure to suck the fuel from the main tank to an auxiliary tank. From there, the fuel flows to the carburetor float chamber by gravity. This system is now obsolete.

4. Pump Feed System

Most present-day cars use this system. This system uses a steel pipe to supply the petrol to the fuel pump which then pumps it into the carburetor float chamber through flexible pipe. Here we use a mechanical or electrical or a diaphragm pump which supplies the fuel from the fuel tank. Fuel tank is placed at any suitable location and is vented to the atmosphere.





5. Fuel Injection System

Modern/present-day vehicles use petrol injection system which replaced the carburetor. The injector nozzle atomizes the fuel and forces it into the air stream. Newer generation engines use separate injector for each cylinder. The air-fuel mixture for different load and speed conditions is controlled either mechanically or electronically. Hence, this makes the fuel system more accurate.

Engine Lubrication System

When two metallic surfaces under direct contact move over each other, they create friction which generates heat. This causes excessive wear and tear of those moving parts. However, when a film of lubricating matter separates them from each other, they do not come in physical contact with each other. Thus, lubrication is a process that separates the moving parts by supplying a flow of a lubricating substance between them. The lubricant could be liquid, gas or solid. However, engine lubrication system mainly uses liquid lubricants.

Purpose of Engine Lubrication System

1. Minimizes power loss by reducing the friction between the moving parts.
2. Reduces the wear and tear of the moving parts.
3. Provides cooling effect to the hot engine parts.
4. Absorbs shock by providing cushioning effect against vibrations caused when heavy loads are imposed on the bearings.
5. As it circulates through the engine, the oil picks up metal particles and carbon, and brings them back down to the pan and thus carries out the internal cleaning of the engine.
6. Helps form a seal between piston rings and cylinder walls and thus reduces internal oil leak (blow- by) which will result in blue smoke at the tail pipe.

Components of Engine Lubrication System

1. Oil Sump
2. Engine oil filter
3. Piston cooling nozzles
4. Oil Pump
5. The Oil Galleries
6. Oil Cooler
7. The Oil pressure indicator/light

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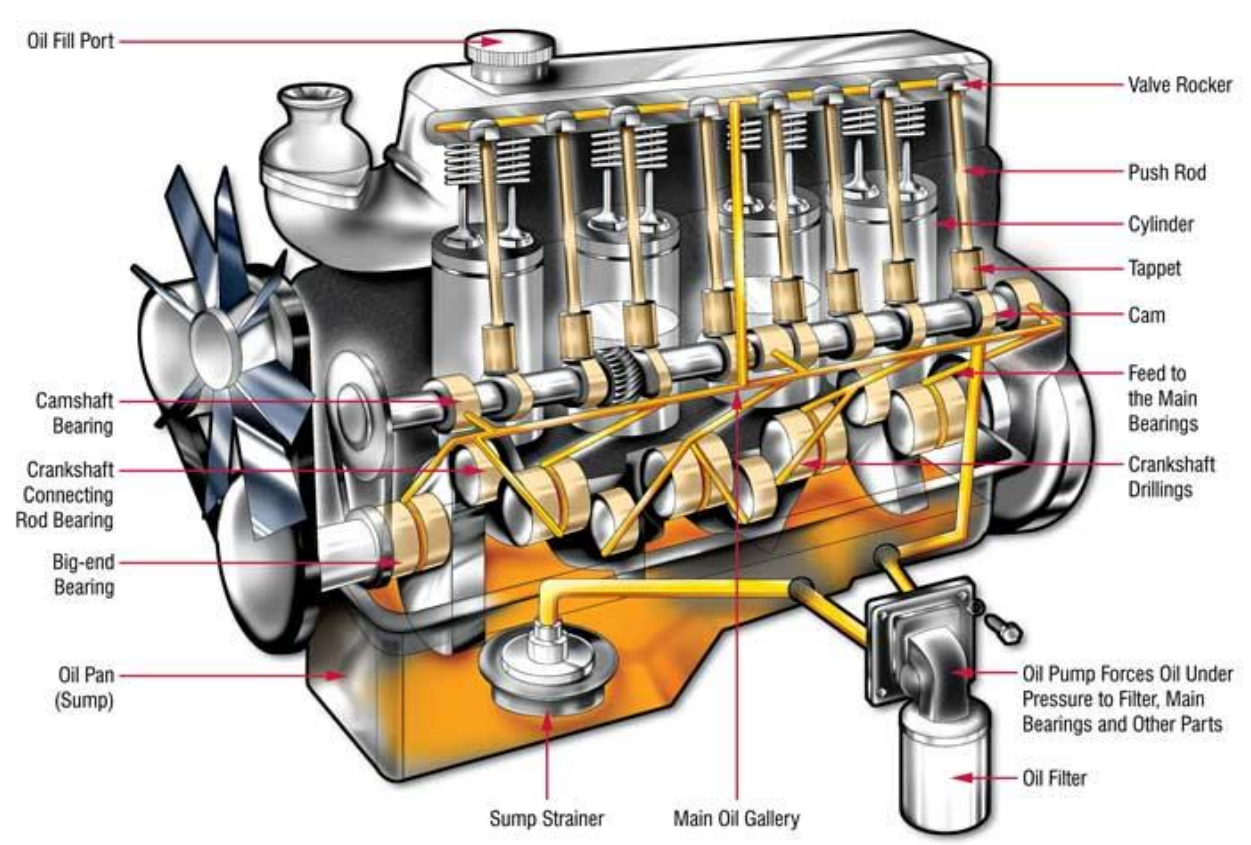


Oil Pan / Sump:

An Oil Pan / Sump is just a bowl-shaped reservoir. It is made of Sheet Metal with baffle plates inside. It stores the engine oil and then circulates it within the engine. Oil sump sits below the crankcase and stores the engine oil when the engine is not running. It is located at the bottom of the engine in order to collect and store the engine oil. The oil returns to the sump by pressure/gravity when the engine is not in use.

Bad road conditions could cause damage to the Oil Pan / Sump. So, the manufacturers provide a stone guard/sump guard underneath the sump. The sump guard absorbs the hit from the uneven road and protects the sump from any damage.

Oil Pump:

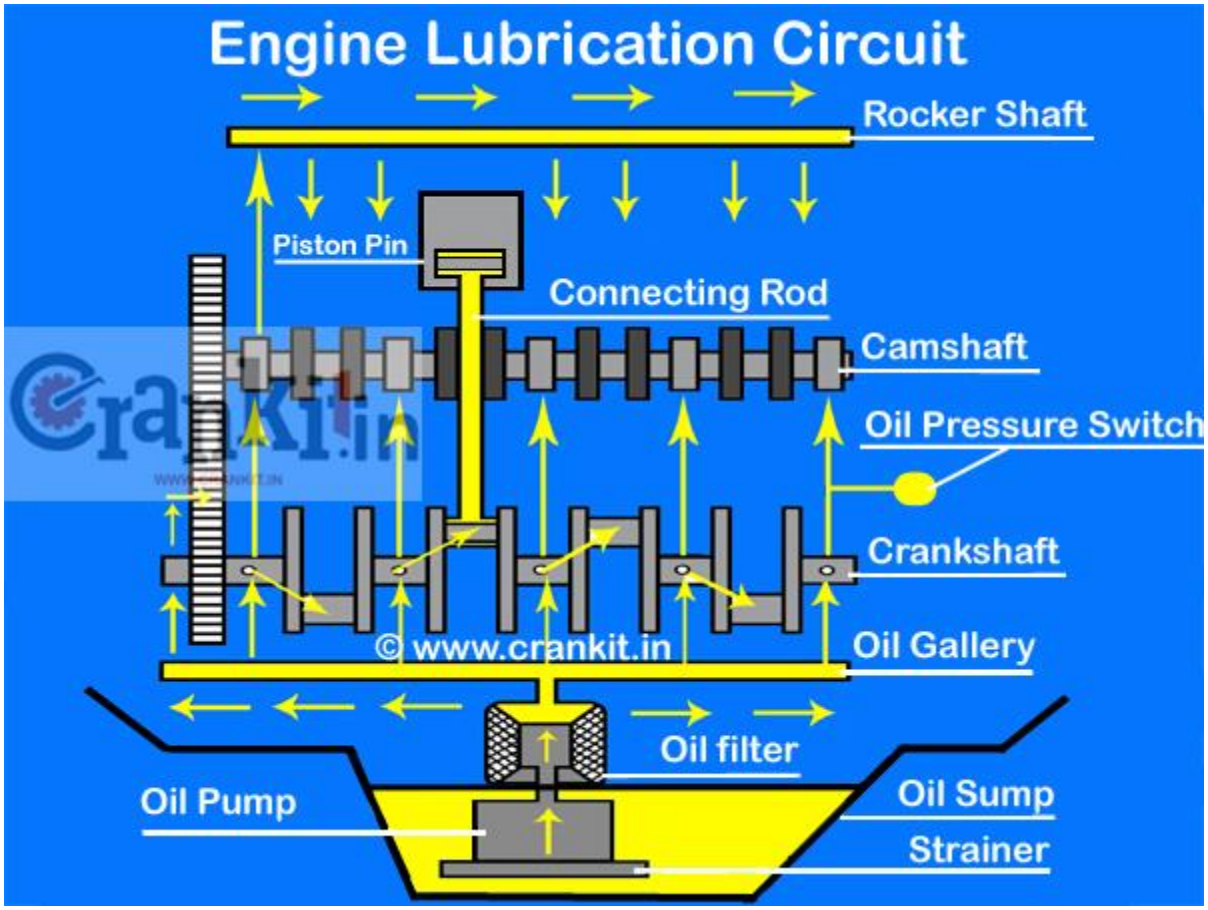
An Oil Pump is a device which helps to circulate the lubricant oil to all the moving parts inside the engine. These parts include crankshaft & camshaft bearings as well as valve lifters. It is generally located at the bottom of the crankcase, close to the

oil sump. The oil pump supplies the oil to oil filter which filters and sends it onward. The oil then reaches different moving parts of the engine through oil galleries.

Even, small particles can choke the oil pump and galleries. If oil pump gets blocked, then it can cause the severe damage to the engine or even complete seizure of the engine. To avoid it, the oil pump consists of a strainer and a by-pass valve. Hence, it is necessary to change the engine oil and filter at regular intervals as recommended by the manufacturers.

Oil Galleries:

In order to get better performance and longer engine life, it is essential that the engine oil quickly reaches the moving parts of the engine. For this purpose, manufacturers provide oil galleries within the engine. The Oil Galleries are nothing but series of interconnected passages which supply the oil to the remotest parts of the engine.



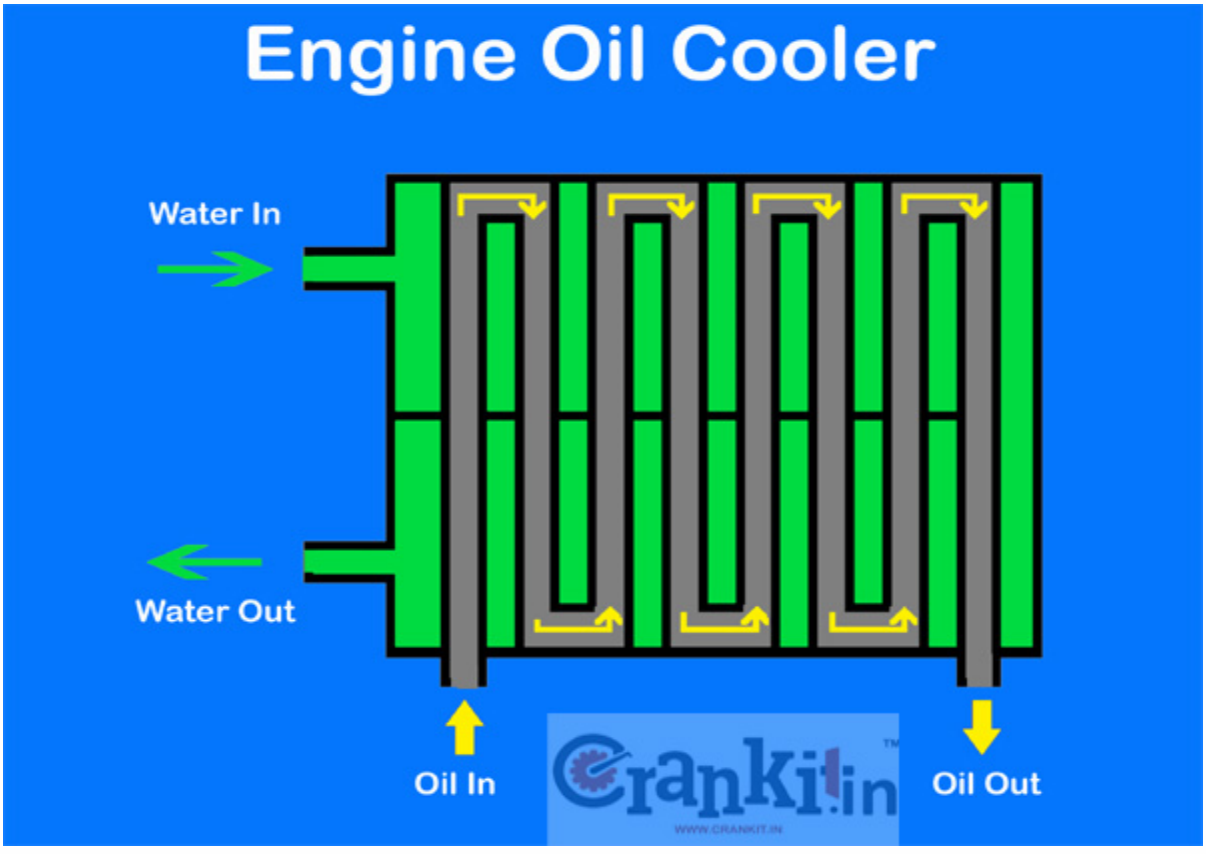
Engine Lubrication System: Oil Galleries

Oil galleries consist of big and small passages drilled inside the cylinder block. The bigger passages connect to the smaller passages and supply the engine oil upto the cylinder head and overhead camshafts. The oil galleries also supply the oil to the crankshaft, crankshaft bearings and camshaft bearings thru holes drilled in them as well as to valve lifters/tappets.

Oil Cooler:

The Oil Cooler is a device which works just like a radiator. It cools down the engine oil which becomes very hot. Oil cooler transfers the heat from the engine oil to the engine coolant through its fins. Initially, manufacturers used the oil cooler only in the racing/high-performance vehicles. However today, most vehicles use oil cooler system for better engine performance.

Oil cooler which helps to maintain the engine oil temperature also keeps its viscosity under control. Additionally, it retains the lubricant quality, prevents the engine from overheating and thereby saving it from wear and tear.



Engine Lubrication System: Oil Cooler

Types of Engine Lubrication System

There are mainly following types of lubrication systems used in automotive engines which are:

1. Petroil or Mist Lubrication (Petrol and Oil Premix) System
2. Splash Lubrication System
3. Pressure Lubrication System
4. Dry-Sump **Lubrication** System
5. **Wet-Sump Lubrication System**

1. Petroil or Mist lubrication (Petrol and Oil Premix) System

The first and the foremost type of engine lubrication system is the mist lubrication system. Under this system a proportionate amount of lubricating oil, 2 to 3%, and the fuel, preferably gasoline is mixed. The mixture of the oil and the fuel is inducted through the carburetor. Fuel is vaporized and the oil in the form of mist goes via the crankcase into the cylinder. The oil which strikes the crankcase walls lubricates the main and connecting rod bearings and the rest of oil lubricate the piston, piston rings and the cylinder.

Advantages:

- Simplicity
- Low cost as it does not require an oil pump, filter, etc.

Disadvantages:

- Cause heavy exhaust smoke due to burning of lubricating oil
- Forms deposit on piston crown and exhaust port which affect engine efficiency.
- Requires a thorough mixing for effective lubrication. This requires either separate mixing prior to use or use of some additive to give the oil good mixing characteristics.
- During closed throttle operation (as in the case of vehicle moving down the hill), the engine suffers from insufficient lubrication as the supply of fuel is less. This is an important limitation of system

2. Splash Lubrication System

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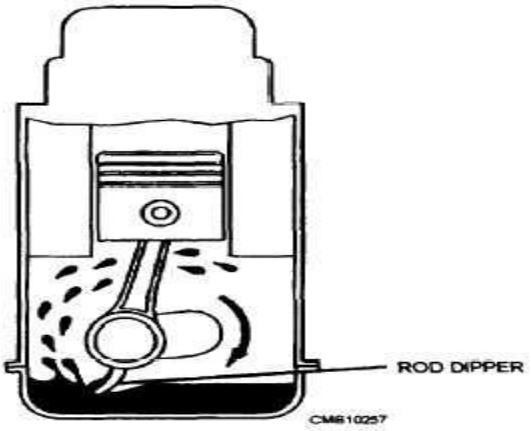
The splash system is no longer used in automotive engines. It is widely used in small four-cycle engines for lawn mowers, outboard marine operation, and so on.

Lubricating oil is stored at the bottom of engine crankcase and maintained at a predetermined level. The oil is drawn by the pump and delivered through a distributing pipe into the splash trough located under the big end of all the connecting rods. These troughs are provided with overflows and oil in the trough is therefore kept at a constant level. A splasher or dipper is provided under each connecting rod cap which dips into the oil in the trough. Each time they rotate, the dippers pass through an oil-filled trough. After running through the oil trough, the dippers splash oil onto the cylinders and pistons to lubricate them. The oil dripping from the cylinder is collected in the sump where it is cooled by the air flowing around. The cooled oil is then recirculated.

While splash lubrication is effective for smaller engines and pumps, it's not a precise process. Parts of the pump may be insufficiently oiled or oiled too much. The amount of oil in the trough is vital for proper operation. If there is not enough oil, wear between critical components may occur, and too much oil will cause excessive lubrication, which can lead to hydraulic lock.

The type of oil used and its viscosity is also important in a splash lube system. The oil must be thick enough to provide sufficient lubrication and cling to the dippers, but not so viscous that it heats up as it is churned about in the oil trough. Oil purity is also critical; oil should be filtered regularly and replenished when necessary.



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3. Pressure Lubrication System

Pressure lubrication is used to lubricate piston compressors. It is a more technically advanced and usually more costly method, but it results in longer life for a compressor.

Pressure lubrication is a process where an oil pump precisely distributes oil to key areas of the pump. Oil is drawn from the sump and pumped by an oil pump through an oil strainer. The strainer is a fine mesh screen which prevents foreign particles from entering the oil circulating system. The oil is transported to the key area by use of an oil pump. A pressure relief valve is provided which automatically keep the delivery pressure constant and can be set to any value. When the oil pressure exceed that for which the valve is set, the valve open and allow some of the oil to return to the sump thereby reliving the oil pressure in the system.

4. Dry Sump Lubrication **System**

This system uses a pump to force oil through the engine parts and a pump to return the oil to the oil tank. The oil tank usually is located above the engine. Oil flows by gravity into the high-pressure pump. The pump forces oil through the engine parts for lubrication. The lubricating oil runs down into the bottom of the engine. The area where the oil is collected is called a sump. A scavenger pump pulls the oil out of the sump and returns it to the oil tank. Since there is never very much oil in the sump, the system is called a dry sump. The advantage of this system is that more oil is available for the engine in the tank than could be stored in the engine itself. The dry sump lubrication system is actually used for heavy-duty commercial vehicles.

5. **Wet-Sump Lubrication System**

- In wet-sump lubrication system, oil is stored in a crankcase or sump which also serves as an oil supply or oil storage tank, and oil cooler.
- Oil is drawn from the sump by a low pressure oil pump through an oil strainer and delivered to various components of engine.
- The oil pump, under this system, is operated by the camshaft.
- Oil then gradually returns back by gravity to the sump after serving the purpose.

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