UNIT I

Lecture Hour 1: *INTRODUCTION*

Heat engine is a machine for converting heat, developed by burning fuel into useful work. It can be said that heat engine is equipment which generates thermal energy and transforms it into mechanical energy.

CLASSIFICATION OF HEAT ENGINES

1. Based on combustion of fuel:

(i) External combustion engine

(ii) Internal combustion engine.

External combustion engine

Here, the working medium, the steam, is generated in a boiler, located out side the engine and allowed in to the cylinder to operate the piston to do mechanical work.

Internal combustion engine

In internal combustion engine, the combustion of fuel takes place inside the engine cylinder and heat is generated within the cylinder. This heat is added to the air inside the cylinder and thus the pressure of the air is increased tremendously. This high pressure air moves the piston which rotates the crank shaft and thus mechanical work is done

2. Based on fuel used

1. Diesel engine 2. Petrol engine 3. Gas engine Diesel

engine – Diesel is used as fuel Petrol engine –

Petrol is used as fuel

Gas engines – propane, butane or methane gases are used

3. Based ignition of fuel

1. Spark ignition engine (Carburetor type engines)

2. Compression ignition engine (injector type engines)

Spark ignition engine – a mixture of air and fuel is drawn in to the engine cylinder. Ignition of fuel is done by using a spark plug. The spark plug produces a spark and ignites the air- fuel mixture. Such combustion is called constant volume combustion (C.V.C.).

Compression ignition engine – In compression ignition engines air is compressed in to the engine cylinder,. Due to this the temperature of the compressed air rises to 700-900 C. At this stage diesel is sprayed in to the cylinder in fine particles. Due to a very high temperature, the fuel gets ignited. This type of combustion is called constant pressure combustion (CP.C.) because the pressure inside the cylinder is almost constant when combustion is taking

place.

4. Based on working cycle

1. Four stroke cycle engine - When the cycle is completed in two revolutions of the crankshaft, it is called four stroke cycle engine.

2. Two stroke cycle engine. - When the cycle is completed in one revolution of the crankshaft, it is called two stroke cycle engine

Internal combustion engines (ICE) are the most common form of heat engines, as they are used in vehicles, boats, ships, airplanes, and trains. They are named as such because the fuel is ignited in order to do work inside the engine. The same fuel and air mixture is then emitted as exhaust. This can be done using a piston (called a reciprocating engine), or with a turbine

Combustion, also known as burning, is the basic chemical process of releasing energy from a fuel and air mixture. In an internal combustion engine (ICE), the ignition and combustion of the fuel occurs within the engine itself. The engine then partially converts the energy from the combustion to work. The engine consists of a fixed cylinder and a moving piston. The expanding combustion gases push the piston, which in turn rotates the crankshaft. Ultimately, through a system of gears in the power train, this motion drives the vehicle's wheels.

There are two kinds of internal combustion engines currently in production: the spark ignition gasoline engine and the compression ignition diesel engine. Most of these are four-stroke cycle engines, meaning four piston strokes are needed to complete a cycle. The cycle includes four distinct processes: intake, compression, combustion and power stroke, and exhaust.

Spark ignition gasoline and compression ignition diesel engines differ in how they supply and ignite the fuel. In a spark ignition engine, the fuel is mixed with air and then inducted into the cylinder during the intake process. After the piston compresses the fuel-air mixture, the spark ignites it, causing combustion. The expansion of the combustion gases pushes the piston during the power stroke. In a diesel engine, only air is inducted into the engine and then compressed. Diesel engines then spray the fuel into the hot compressed air at a suitable, measured rate, causing it to ignite.

Working of steam engine

Steam engine is a device which converts heat energy into mechanical energy and heat is supplied into the engine through the medium of steam. This is a machine where steam is used as a working substance. Steam engine works on the principle of first law of thermodynamics where work and heat are mutually convertible. This is a very basic definition of steam engine.

In a steam engine there is a cylinder fitted with a piston. Then steam from the boiler enters to the engine cylinder and the cylinder is made act on the piston which thereby reciprocates to and fro motion of the piston. So heat energy in the steam is converted into mechanical work, thus, it is called Reciprocating steam engine.

Advantages of the Steam Engine over Wind-Mills and Water-Mills: 1. A steam engine (or external combustion engine) could be located anywhere because water is heated in a separate boiler to produce steam. The steam engine, with its boiler, could be taken to any place of work. Steam engines were used in all sorts of applications including factories, mines, locomotives, and steamboats. Steam engines use hot steam from boiling water to drive a piston (or pistons) back and forth. There are four different parts in a steam engine:

A fire where the coal burns.

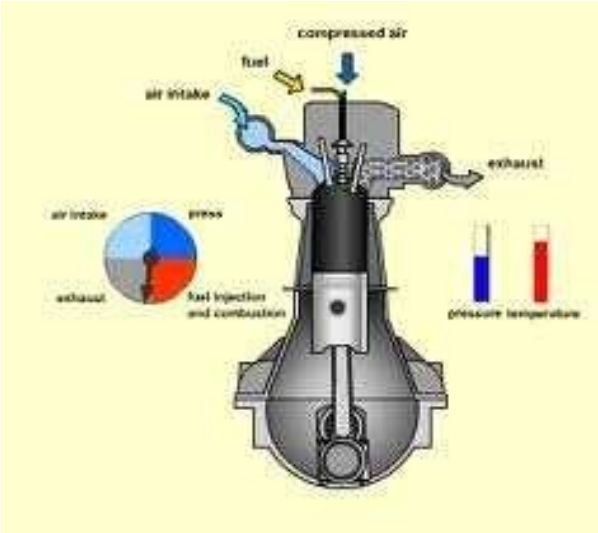
A boiler full of water that the fire heats up to make steam.
A cylinder and piston, rather like a bicycle pump but much bigger. ...
A machine attached to the piston.
Steam engines and turbines operate on the Rankine cycle which has a maximum Carnot efficiency of 63% for practical engines, with steam turbine power plants able to achieve efficiency in the mid 40% range. In earliest steam engines the boiler was considered part of the engine.

Differentiate Between I.C. Engines and Steam Engines.

Internal Combustion Engine	**Steam Engine**
In I.C. engines, the combustion of fuel takes place inside the cylinder.	In steam engine , the combustion of fuel takes place outside the cylinder.
The working temperature and pressure in I.C. engine is higher.	The working temperature and pressure in Steam engine is lower.
I.C. engines are lighter and cheaper.	Steam engines are heavier and costlier.
I.C. engines are easy and quick to start and stop.	Steam engines takes time to lightening the fire and generating the steam.
I.C. engines have higher efficiency	Steam engines have lower efficiency
Due to Higher temperature and pressure, materials having better resistance is been used.	Due to Higher temperature and pressure , materials having normal resistance is been used.
I.C. engines require only a small tank to store fuel ; and there is no steam condenser in it.	Steam engines require a big boiler to store water for converting it into the steam and a condenser to condense exhaust steam into water.
I.C. engines are single acting, piston is directly connected to connecting rod.	In steam engine there is no piston and hence it has no stuffing box.

CONSTRUCTION OF AN IC ENGINE

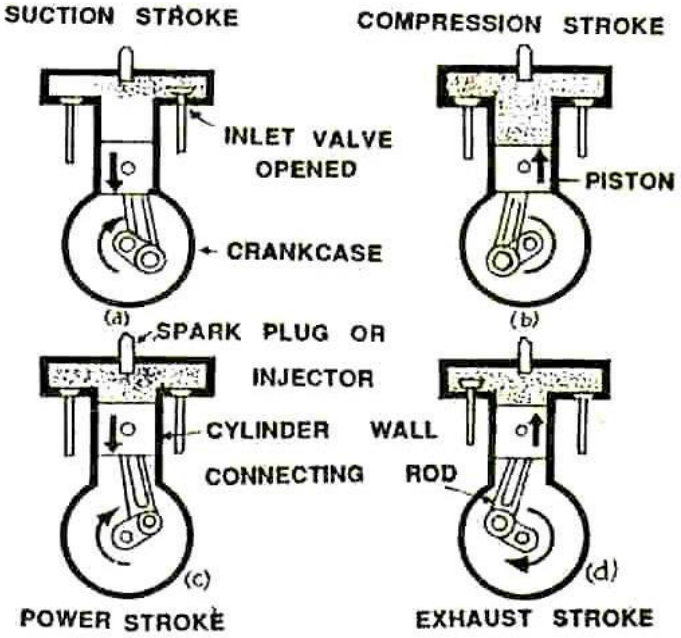
I.C. engine converts the reciprocating motion of piston into rotary motion of the crankshaft by means of a connecting rod. The piston which reciprocating in the cylinder is very close fit in the cylinder. Rings are inserted in the circumferential grooves of the piston to prevent leakage of gases from sides of the piston. Usually a cylinder is bored in a cylinder block and a gasket, made of copper sheet or asbestos is inserted between the cylinder and the cylinder head to avoid ant leakage. The combustion space is provided at the top of the cylinder head where combustion takes place.



The connecting rod connects the piston and the crankshaft. The end of the connecting rod connecting the piston is called small end. A pin called gudgeon pin or wrist pin is provided for connecting the piston and the connecting rod at the small end. . The other end of the connecting rod connecting the crank shaft is called big end. When piston is moved up and down, the motion is transmitted to the crank shaft by the connecting *FOUR STROKE ENGINE* rod and the crank shaft makes rotary motion. The crankshaft rotates in main bearings which are fitted the crankcase. A flywheel is provided at one end of the crankshaft for smoothing the uneven torque produced by the engine. There is an oil sump at the bottom of the engine which contains lubricating oil for lubricating different parts of the engine.

Lecture Hour 2: FOUR STROKE ENGINE

A four-stroke engine (also known as four-cycle) is an internal combustion engine in which the piston completes four separate strokes which comprise a single thermodynamic cycle. A stroke refers to the full travel of the piston along the cylinder, in either direction. While risqué slang among some automotive enthusiasts names these respectively the "suck," "squeeze," "bang" and "blow" strokes, they are more commonly termed

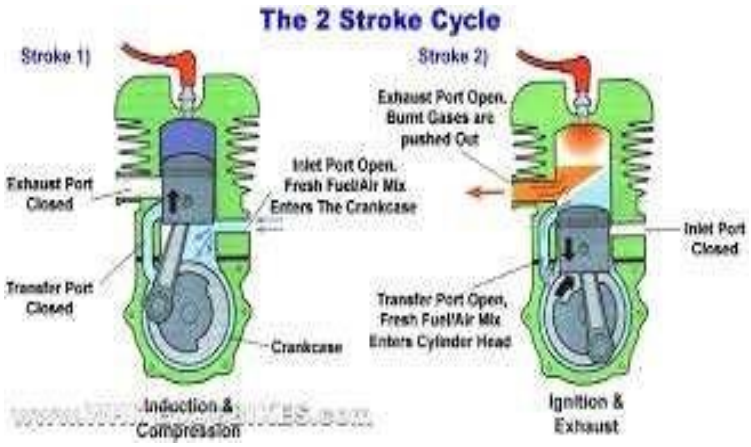


INTAKE: this stroke of the piston begins at top dead center. The piston descends from the top of the cylinder to the bottom of the cylinder, increasing the volume of the cylinder. A mixture of fuel and air is forced by atmospheric (or greater) pressure into the cylinder through the intake port.

COMPRESSION: with both intake and exhaust valves closed, the piston returns to the top of the cylinder compressing the air or fuel-air mixture into the cylinder head.

POWER: this is the start of the second revolution of the cycle. While the piston is close to Top Dead Centre, the compressed air–fuel mixture in a gasoline engine is ignited, by a spark plug in gasoline engines, or which ignites due to the heat generated by compression in a diesel engine. The resulting pressure from the combustion of the compressed fuel-air mixture forces the piston back down toward bottom dead centre.
EXHAUST: during the exhaust stroke, the piston once again returns to top dead centre while the exhaust valve is open. This action expels the spent fuel-a mixture through the exhaust valve(s).

Lecture Hour 3: Two Stroke Engine



In two stroke cycle engines, the whole sequence of events i.e., suction, compression, power and exhaust are completed in two strokes of the piston i.e. One revolution of the crankshaft. There is no valve in this type of engine. Gas movement takes place through holes called ports in the cylinder. The crankcase of the engine is air tight in which the crankshaft rotates.

Upward stroke of the piston (Suction + Compression)

When the piston moves upward it covers two of the ports, the exhaust port and transfer port, which are normally almost opposite to each other. This traps the charge of air- fuel mixture drawn already in to the cylinder. Further upward movement of the piston compresses the charge and also uncovers the suction port. Now fresh mixture is drawn through this port into the crankcase. Just before the end of this stroke, the mixture in the cylinder is ignited by a spark plug (Fig 2 c &d). Thus, during this stroke both suction and compression events are completed.

Downward stroke (Power + Exhaust)

Burning of the fuel rises the temperature and pressure of the gases which forces the piston to move down the cylinder. When the piston moves down, it closes the suction port, trapping the fresh charge drawn into the crankcase during the previous upward stroke. Further downward movement of the piston uncovers first the exhaust port and then the transfer port. Now fresh charge in the crankcase moves in to the cylinder through the transfer port driving out the burnt gases through the exhaust port. Special shaped piston crown deflect the incoming mixture up around the cylinder so that it can help in driving out the exhaust gases . During the downward stroke of the piston power and exhaust events are completed.

Lecture 4: Various types of two wheelers, three wheelers and four wheelers.

Two Wheelers-

A two-wheeler is a vehicle that runs on two wheels. The two wheels may be arranged in tandem, one behind the other, as with single track vehicles, or arranged side by side, on the same axle. If on the same axle, the vehicle may have no other support, as with dicycles, or have additional support, which is often also the source of motive power.

Wheeled single track vehicles include: Dandy horses, Bicycle, a pedal powered two-wheeler. Motorcycles, a motor-powered two-wheeler.

Dicycles include: Self balancing scooters, also known as hover boards. Segway PTs, a brand of self-balancing personal transporters.

Two-wheelers to be used with additional support, which is also the source of motive power include: cabs or hansoms on two wheels and hand trucks.

Two-wheelers to be used with additional support, which is not the source of motive power, include: two-wheel tractors.

Three-wheelers-

A three-wheeler is a vehicle with three wheels. Some are motorized tricycles, which may be legally classed as motorcycles, while others are tricycles without a motor, some of which are human-powered vehicles and animal-powered vehicles. Three wheelers can have one wheel at back and two at front or one at front and two at back.

Three-wheelers including some cycle cars, bubble cars and micro cars, are built for economic and legal reasons. Three-wheeler transport vehicles known as auto rikshaws are a common means of public transportation in many countries in the world, and are an essential form of urban transport in many developing countries such as india.

Four-wheelers-

A four-wheeler is a vehicle which runs on four on four wheels. This type of engines mostly run on engines and some of them are also human powered vehicles. The most common four-wheeler vehicle is car which is the most common means of private transport for the public. Four wheeler vehicles include cars, mini buses which are a good means of transportations, small trucks which are used for transportation of goods, horse carts which is a human powered four wheeler vehicle.

Lecture:5 History of the automobile

The early history of the automobile can be divided into a number of eras, based on the prevalent means of propulsion. Later periods were defined by trends in exterior styling, size, and utility preferences.

17th and 18th centuries

Ferdinand Verbiest, a member of a Jesuit mission in China, built a steam-powered vehicle around 1672 as a toy for the Kangxi Emperor. It was small-scale and could not carry a driver but it was, quite possibly, the first working steam-powered vehicle ('auto-mobile') Steam-powered self-propelled vehicles large enough to transport people and cargo were first devised in the late 18thcentury. Nicolas-Joseph Cugnot demonstrated his fardier à vapeur ("steamdray"),an experimental steam-driven

Artillery tractor, in 1770 and 1771. Ascugnot's design proved to be impractical,his invention was not developed in his native France. The center of innovation shifted to Great Britain. By 1784, William Murdoch had built a working model of a steam carriage in Redruth and in 1801richardtrevithick was running a full-sized Vehicle on the roads in

Camborne. The first automobile patent in the United States was granted to Oliver Evans in 1789.

19th century

During the 19th century attempts were made to introduce practical steam powered vehicles. Innovations such as Hand brakes, multi-speed transmissions and better steering developed. Some commercially successful vehicles provided Mass transit until a backlash against these large vehicles resulted in the passage of legislation such as the United Kingdom Locomotive Act (1865), which required many self-propelled vehicles on public roads to be preceded by a man on foot Waving a red flag and blowing a horn. This effectively halted road auto development in the UK for most of the rest of the 19th Century; inventors and engineers shifted their efforts to improvements in railway locomotives. The law was not repeale duntil 1896,although the need for the red Flag was removed in 1878.In 1816, a professor at Prague Polytechnic,Josef Bozek, built an oil-fired steam Car. Walter Hancock, builder andoperator of London steam buses, in 1838built a 2 seated car phaeton. In 1867, Canadian jeweller Henry sethtaylor demonstrated his 4-wheeled "steam Buggy" at the Stanstead Fair in Stanstead, Quebec and again the following year. The basis of the buggy, which he began Building in 1865, was a high-wheeled carriage with bracing to support a two-cylinder steam engine mounted on the Floor. One of the first "real" automobiles wasproduced in 1873 by Frenchman amédéebollée in Le Mans, who built self-propelled Steam road vehicles to transport groups of passengers. The first carriage-sized automobile suitable for use on existing wagon roads in the United States was a steam-powered Vehicle invented in 1871 by Dr. J.W.Carhart, a minister of the method is tepiscopal Church, in Racine, Wisconsin. It induced the State of Wisconsin in1875 to offer a $10,000 award to the first to produce a practical substitute for the Use of horses and other animals. They stipulated that the vehicle would have tomaintain an average speed of more than 5 Miles per hour (8.0 km/h) over a 200-mile(320 km) course. The offer led to the first city to city automobile race in the United States, starting on 16 July 1878 in green bay, Wisconsin, and ending in Madison,Wisconsin, via Appleton,Oshkosh,Waupun, Watertown, Fort Atkinson, and janes ville. While seven vehicles were registered, only two started to compete the entries from Green Bay and Oshkosh. The vehicle from Green Bay was faster, but broke down before completing the race. The Oshkosh finished the 201-mile(323 km) course in 33 hours and 27minutes, and posted an average speed of six miles per hour. In 1879, the legislature awarded half the prize.

20th century

Pre WWII1924Doble Model esteam-powered road vehicles, both cars and wagons, reached the peak of their development in the early 1930s with fast steaming lightweight boilers and efficient Engine designs. Internal combustion engines also developed greatly during wwi, becoming simpler to operate and More reliable. The development of the high-speed diesel engine from 1930 began to replace them for wagons, accelerated in The UK by tax changes making steam wagons uneconomic overnight. Although a few designers continued to advocate Steam power, no significant developments in production steam cars took place after doble in 1931.