

UNIT I

Introduction of Layout of Automobile or Vehicle:

1. Introduction to Automobile

Definition

An automobile is a self-propelled vehicle that moves on roads and is used for transporting passengers or goods. It obtains power from an internal combustion (IC) engine, electric motor, or other power sources.

History of Automobile

- The word automobile is derived from:
 - **Auto** = Self
 - **Mobile** = Moving
- Early automobiles were powered by steam engines.
- Modern automobiles mainly use petrol, diesel, CNG, LPG, and electric power.

Functions of an Automobile

1. Transportation of passengers.
2. Transportation of goods.
3. Providing comfort and safety.
4. Reducing travel time.
5. Increasing mobility and convenience.

Types of Automobile:

The automobiles are classified by the following ways,

1. *On the Basis of Load:*

- Heavy transport vehicle (HTV) or heavy motor vehicle (HMV),
- Light transport vehicle (LTV), Light motor vehicle (LMV),

2. *On the Basis of Wheels:*

- Two wheeler vehicle, for example: Scooter, motorcycle, scooty, etc.
- Three wheeler vehicle, for example : Autorickshaw,
- Three wheeler scooter for handicaps and tempo, etc.

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- Four wheeler vehicle, for example: Car, jeep, trucks, buses, etc.
- Six wheeler vehicle, for example: Big trucks with two gear axles.

3. *On the basis of Fuel Used:*

- Petrol vehicle, e.g. motorcycle, scooter, cars, etc.
- Diesel vehicle, e.g. trucks, buses, etc.
- Electric vehicle which use battery to drive.
- Steam vehicle, e.g. an engine which uses steam engine.
- Gas vehicle, e.g. LPG and CNG vehicles, where LPG is liquefied

4. *On the basis of body style:*

- Sedan Hatchback car.
- Coupe car Station wagon Convertible.
- Van Special purpose vehicle, e.g. ambulance, milk van, etc.

5. *On the basis of Transmission:*

- Conventional vehicles with manual transmission, e.g. car with 5 gears.

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9. On the basis of body style:

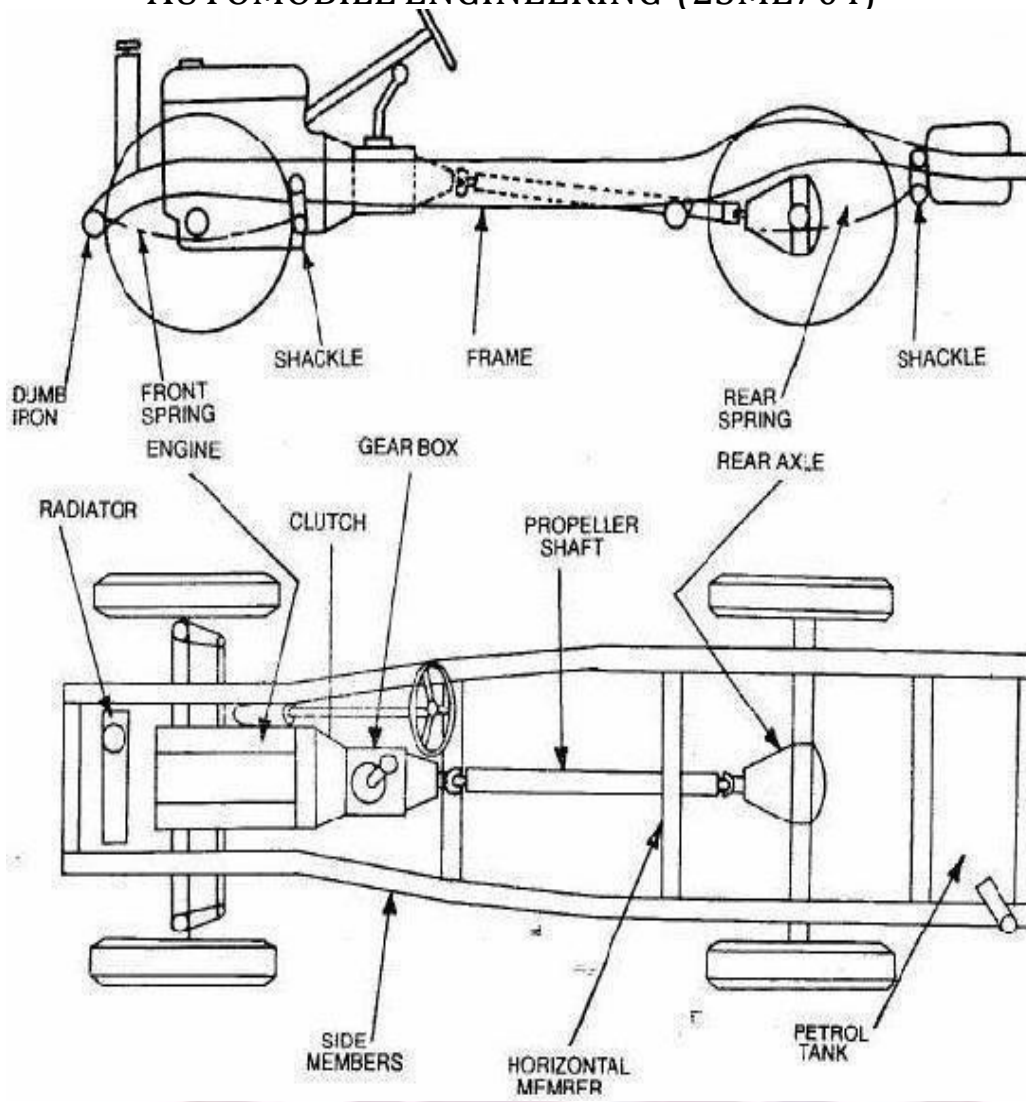
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The logo for NIRGM (National Institute of Research in Glass and Ceramics) is centered on the page. It features a stylized tree with a purple trunk and branches, and a canopy of colorful leaves in shades of yellow, orange, and red. Below the tree, the acronym 'NIRGM' is written in large, bold, purple capital letters.

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Frame:

The frame is the skeleton of the vehicle. It serves as a main foundation and base for alignment for the chassis.

Types;

- Conventional frame,
- Semi integral frame;
- Integral or unitized frame.

Conventional Frame

- Most of the heavy vehicles.
- Made up of steel section.
- 2 long side members & 5 to 6 cross members joined rivets or bolts.
- Cross members increased strength.
- Front – inswept (narrow): Steering lock, pivoting & swinging of the front wheels.
- Rear – upswept (Board): vertical movement of the rear axles, road bumps & inequalities.

Fig.1 Cross section of ladder chassis



Fig. 1(a)

Intergal Frame

- In this type of construction, there is no frame. It is also called unitized frame-body construction.
- All the assembly units are attached to the body and all the functions of the frame carried out by the body itself.
- Here the body shell and underbody are welded into single unit. The underbody is made of floor plates and channel and box sections welded into single unit. This assembly replaces the frame.
- This frame is used now days in most of the cars. Due to elimination of long frame it is cheaper and due to less weight most economical also.
- The main disadvantage is repairing

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Semi Integral Frame

- In some vehicles half frame is fixed in the front end on which engine gear box and front suspension is mounted.
- In this case the rubber mountings used in conventional frame between frame and suspension are replaced by more stiff mountings.
- Because of this some of the vehicle load is shared by the frame also. This type of frame is heavier in construction.
- It has the advantage when the vehicle is met with accident the front frame can be taken easily to replace the damaged chassis frame.
- This type of frame is used in some of the European and American cars.



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Types of Chassis

- i. Ladder Chassis
- ii. Tubular Chassis
- iii. Monocoque Chassis

Ladder Chassis

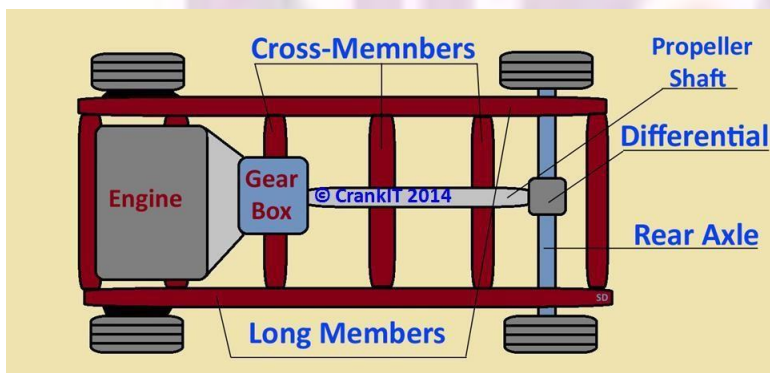
The ladder-frame chassis is one of the oldest chassis types. This chassis is characterised by two long heavy beams that are supported by two smaller ones. Its quality of being easily manufactured not only made it contemporarily popular but also eased the way for its massproduction. Since ladder frame chassis is significantly heavy it's usually used for vehicles that transport heavy material.

Benefits

- Easy to manufacture and easy assembling of the car over it.
- Heavy and strong tensile strength.

Drawbacks

- Poor cornering ability due to weak torsional rigidity
- Its heaviness doesn't make it suitable for performance cars and hatchbacks



Tubular Chassis

- Tubular space frame chassis employs dozens of circular-section tubes (some may use square-section tubes for easier connection to the body panels, though circular

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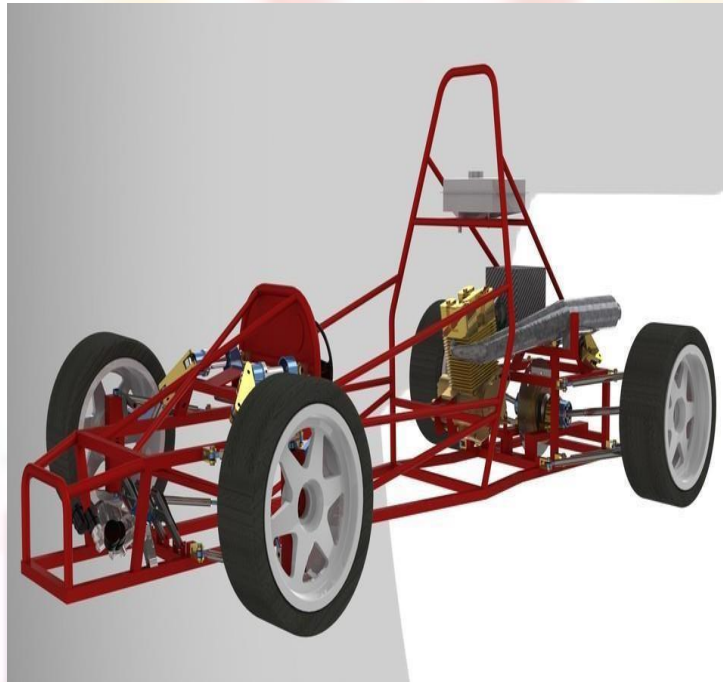
Benefits

- Its crafting allows better contact between the half axle and ground making it preferable for off-roading.
- A cylindrical tube covering the driveshaft saves it from any damage while off-roading.
- The structure's torsional toughness is relatively more supple than ladder chassis.

Drawbacks

- In case the driveshaft fails, the whole chassis needs to be dismantled as the driveshaft is covered with the cylindrical tube of the chassis.

The manufacture of backbone chassis is costly and increases the overall cost of the car.



Monocoque Chassis

- The construction of a monocoque chassis is quite simple in the sense that the entire structure is one big construction.
- All components or mechanical parts constitute the frame, foundation and body of the car.
- The engine, gearbox, suspension, seats and exterior body panels are simply attached to the construction. This means that the overall construction is very lightweight and compact. There is quite a lot of safety element to it.
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- The applications include all sorts of everyday vehicles ranging from small and compact hatchbacks to large and heavy SUVs. It must be noted that modern SUVs are using monocoque construction quite a bit which was not always the case in the past

Benefits

- It's safer than both the other chassis due to its cage-like construction.
- The chassis is easy to repair as well.
- It has superior torsional rigidity.

Drawbacks

- The chassis is obviously heavy as it's both the frame and chassis as one single entity.
- Producing it in small quantities is not financially feasible and thus it cannot be used for cars that are not mass-produced.

Body:

- Body is the super-structure for all vehicles. It may either be constructed separately and bolted to the chassis or manufactured integral with the chassis (i.e. Frameless construction).
- The chassis and the body make the complete vehicle.
- A body consists of windows and doors, engine cover, roof, luggage cover etc. The electrical system in the body is connected to the chassis electrical units so that the battery and the generator/alternator can furnish the required electrical energy to the system.

Types;

- Car, Truck, Tractor, Delivery Van, Ambulance, jeep, Bus, etc.,

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Description of an Automobile

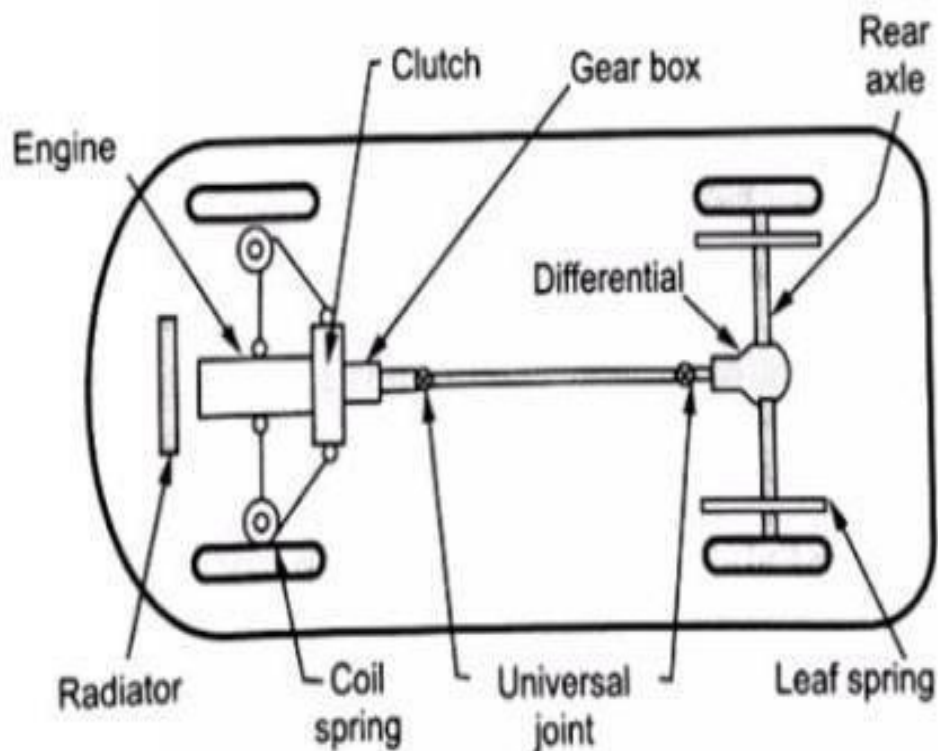
- **Type:** Motor Cycle, Car, Bus, truck, etc.,
- **Capacity:** Tonnage and no. of seats
- **Make:** Manufacturer of the vehicle and Engine Capacity
- **Drive:** Left hand Drive or Right hand Drive, 2, 4, 6 wheel drive
- **Model:** Year of Manufacturing

Layouts of an Automobile

The different layouts of an automobile are as follows

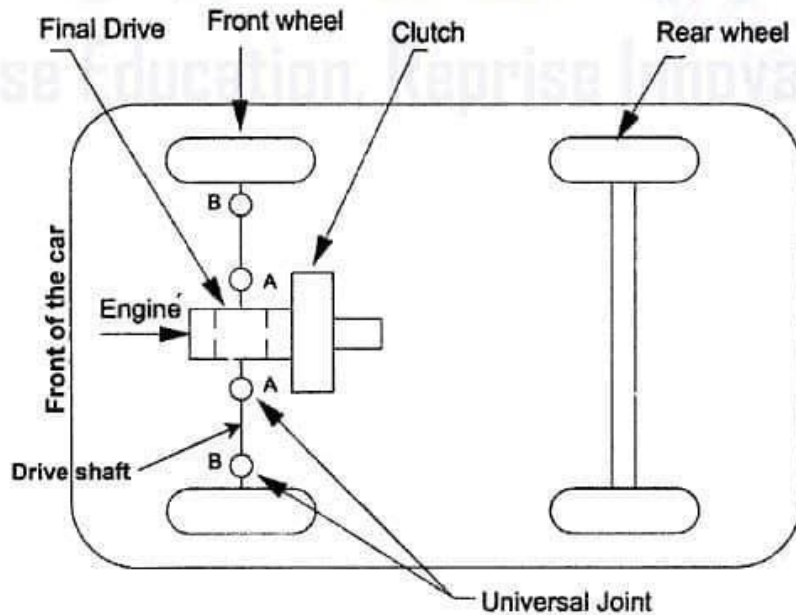
- Front Engine Rear Wheel Drive
- Front Engine Front Wheel Drive
- Rear Engine Rear Wheel Drive
- Four Wheel Drive (All Wheel Drive)

1. Front Engine Rear Wheel Drive



Layout, the engine is fitted at the front

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1. In this type of chassis layout the engine is fitted at front and drive is also given to the front wheel. No propeller shaft is used in this layout and differential are included in the same assembly.
2. This layout provides optimum body luggage space and flat floor line. However, due to all assemblies at front, it makes very difficult to accommodate the steering mechanism.

Advantages

1. Due to more weight placed on driving front wheel, the vehicle has more adhesion on road. Hence good road holding capacity even on the curves and slippery roads.
2. This layout provides low floor, since no propeller shaft and the differential placed at front instead of rear.
3. The clutch, gearbox, and final drive usually made as one unit thereby cost of vehicle are reducing.
4. The wheel does not take to sharply turn into the curve due to tendency of understeering. The understeer conditions generally preferred by many drivers are promoted by this type of chassis.
5. Either a transverse or longitudinally engine position can be used. In case of transverse mounted engine, as the engine crankshaft and wheels already rotate in the parallel planes, therefore, they do not require their drive to be turned through 90° as in case of conventional longitudinally mounted engines.

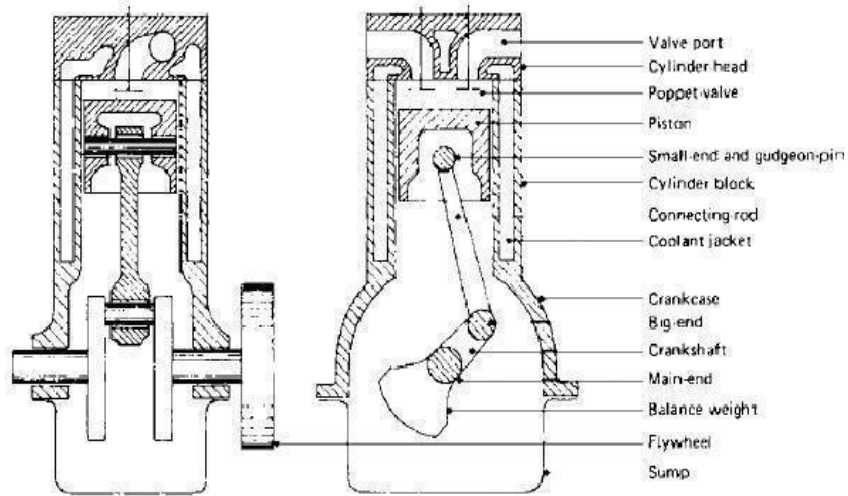
Dis Advantages

1. The weight on the driving front wheels is reduced during acceleration and climbing of steep gradient due to weight of the vehicle shifting to the rear wheels. Hence, result in decreased tractive effort which makes slippery gradient

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Definition of 'Engine'

An engine is a device, which transforms one form of energy into another form. Normally, most of the engines convert thermal energy into mechanical work and therefore they are called 'heat engines'.



Basic Parts of the Gasoline Engine:

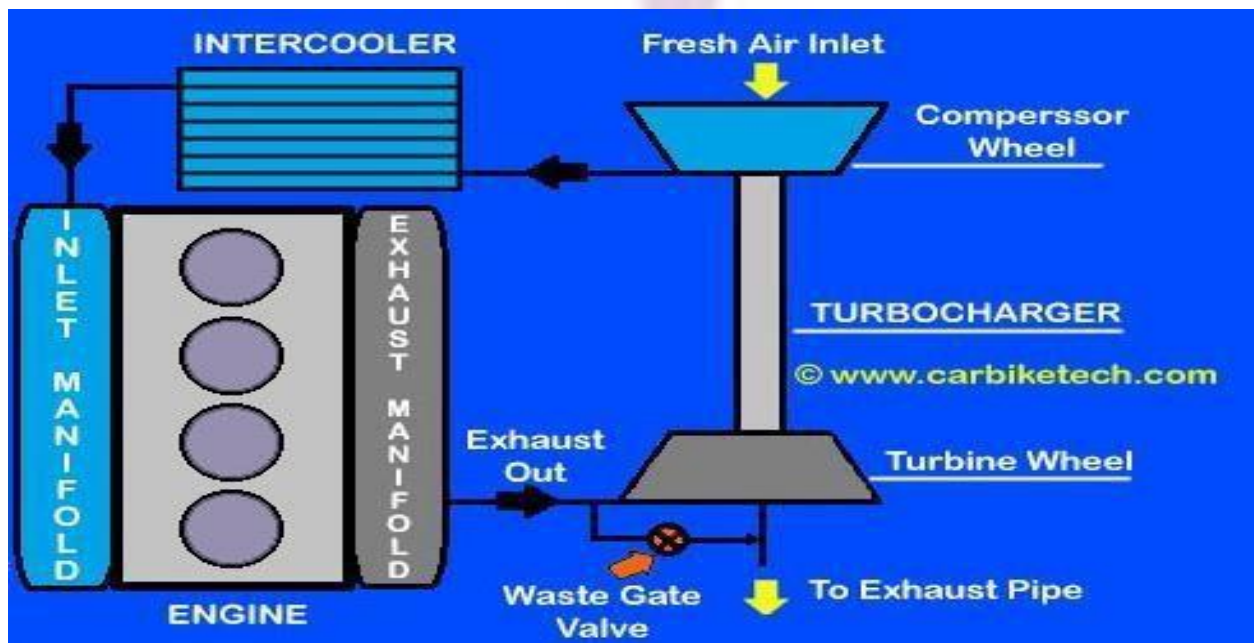
Basic Parts of the Gasoline Engine are listed below;

- Cylinder block
- Piston
- Piston rings
- Piston pin
- Connecting rod
- Crankshaft
- Cylinder head
- Intake valve
- Exhaust valve

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- The turbo charger utilizes the wasted heat energy in the exhaust system, to run a compressor which compresses the intake air. Compressed intake air has more density and hence more fuel can be injected increasing the power of the engine. Turbo charging is an ideal way to increase the engine power without increasing the engine size.
- It is a turbine-driven forced induction device that increases an engine's efficiency and power by forcing extra air into the combustion chamber. This improvement over a naturally aspirated engine's output results because the turbine can force more air, and proportionately more fuel, into the combustion chamber than atmospheric pressure alone.
- Turbochargers are commonly used on truck, car, train, aircraft, and construction equipment engines. They are most often used with Otto cycle and Diesel cycle internal combustion engines. They have also been found useful in automotive fuel cells.

The waste-gate regulates the pressure of the relief valve. It, in turn, limits the boost pressure in the turbocharger system. This is helpful in preventing the engine from potential mechanical damages caused by the high pressure. Furthermore, the system automatically opens the waste-gate valve when the pressure reaches the pre-set levels. Then, it allows all the high-pressure exhaust gases to escape the turbine wheel and enter into the downstream/outlet. Thus, it prevents the exhaust gas pressure from rising more than required.



Advantages

- Needs a smaller space to fit.
- Reduces turbo lag to some extent.
- Installation of compact and simple external exhaust pipe system. Thus, reducing the engine weight.
- Delivers optimum engine performance at all times.