RAMA UNIVERSITY

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FACULTY OF ENGINEERING AND TECHNOLOGY

Lecture
Introducton to Automobile engineering

- Power Unit and Gear Box: Principles of Design of main components. Valve mechanism. Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort. Gear Box. Gear ratio determination.

- UNIT-II
- Transmission System: Requirements. Clutches. Torque converters. Over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber & Toe-in, Toe-out etc..Steering geometry.Ackerman mechanism, Understeer and Oversteer.

- UNIT-III
- Braking System: General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes.Vacuum and air brakes.
- Suspension System: Need of Suspension System, Types of Suspension; factors influencing ride comfort, Suspension Spring; leaf springs, various suspension systems. 8 Hous
- UNIT-IV
- Electrical System: Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc.
- Fuel Supply System: Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburetor etc. MPFI. 8 Hours
- UNIT-V
- Automobile Air Conditioning: Requirements, Cooling & heating systems.
- Cooling & Lubrication System: Different type of cooling system and lubrication system
- Maintenance system: Preventive maintenance, break down maintenance and over hauling. 8 Hours

1.6. PERFORMANCE OF AN AUTOMOBILE

When the fuel burns in the cylinder, *pressures* are developed. These pressures are transmitted to the crankshaft by the piston and connecting rod and torque is produced which sets the crankshaft in motion. *The torque produced by the engine is transmitted through the drive line to the road wheels to propel the vehicle* (The crankshaft is *coupled to the driving road wheels through clutch, gearbox, propeller shaft, differential and axle shafts*).

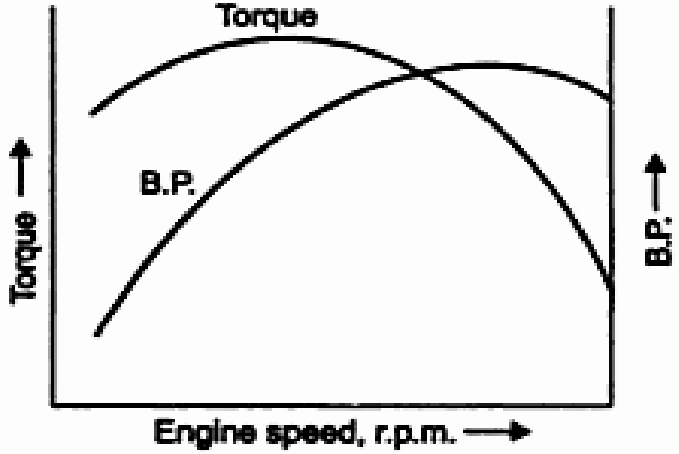
The torque is measured in Nm (SI units) ; the actual power delivered by the engine is known as Brake Power (B.P.) and is measured by dynamometer or prony brake.

$$\text{B.P.} = \frac{2\pi NT}{60 \times 1000} \text{ kW} \qquad \ldots(1.1)$$

where, T = Torque, Nm, and

N = Speed in r.p.m. (revolutions per minute).

— The torque increases with the increase in engine speed upto a certain point after which it starts to fall down even though the engine speed continues to increase. The number of r.p.m. at which the torque begins to decrease, depends upon *engine design*. At higher speeds, engine vacuum falls down and less fuel enters the cylinders resulting in lesser force available at the piston and hence the fall in torque as shown in Fig. 1.3.



The torque available at the contact between driving wheels and road is referred to as *tractive effort*. *Gear box and final drive at differential act as leverage to multiply torque which is inversely proportional to speed*. If the gear speed is lowered, the torque shall be increased in the same ratio and

vice versa.

Fig. 1.3. Typical curves of torque and B.P. with speed of an engine.

Let, T_w = Torque at driving wheels,
G = Gear box ratio,
η_t = Overall transmission efficiency,
T_E = Engine torque (Nm), and
N = r.p.m. of the crankshaft.

Then, $T_w = G \times \eta_t \times T_E$ ...(1.2)

Engine torque, $T_E = \dfrac{B.P. \times 60 \times 1000}{2\pi N}$ Nm, ...(1.3)

where B.P. is in kW.

Tractive effort, $F = \dfrac{T_w}{R_w}$ ...(1.4)

where, R_w = Radius of the driving wheel.

The ratio between engine r.p.m. and vehicle speed depends upon overall gear ratio. A vehicle having four speed gear box shall have four different speeds and ratio between engine r.p.m. and vehicle speed shall be different.

R.P.M. of driving wheel = $\dfrac{V}{2\pi R_w}$

where, V = Vehicle speed in metres/min., and
R_w = Radius of wheel in metres.

Vehicle speed = Wheel circumference $\times \dfrac{N}{G}$

or, $V = \dfrac{2\pi R_w N}{G}$ m/min ...(1.5)

$\therefore$ Engine r.p.m., $N = \dfrac{V \times G}{2\pi R_w}$ ...[1.5(*a*)]

Vehicle speed, $\dfrac{V \times 1000}{60} = \dfrac{2\pi R_w N}{G}$

where V is in km/h.

$\therefore$ The *ratio between engine r.p.m.* (N) and vehicle speed (V)

or, $\dfrac{N}{V} = \dfrac{1000 \times G}{2\pi R_w \times 60} = 2.65\left(\dfrac{G}{R_w}\right)$ ...(1.6)

Also, $V = \frac{2\pi R_w N}{G}$ m/min [Eqn. (1.5) as above]

$\therefore$ $G = \frac{2\pi R_w N}{V}$ ...(1.7)

- The engine torque (T_E) can be *increased by reduction gearing*. The torque transmitted by the engine through gearbox and propeller shaft to the final drive is *increased in every gear speed except in top (direct) and overdrive.*
- The torque transmitted by propeller shaft is further increased by means of gear reduction of final drive (drive piston and ring gear at differential). The *torque of final drive, provided a differential is fitted, is always equally divided between each axle shaft irrespective of speed of road vehicles although it does not apply to limited-slip type of differential.*
- *The speed of propeller shaft is always less than the engine speed except in top gear or when overdrive is engaged.*
- *The speeds of axle shafts are always less than the speed of propeller shaft owing to final drive gear reduction.*

Power at Driving Wheels :

The power available at the driving wheels to drive the vehicle ranges from about 60 to 75%. The various power losses which take place between engine and the driving wheels are :