B.Tech I Year

Regular Course Handbook

Subject Name: Fund. Of Mechanical Engineering (Unit-2)

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B.Tech First Year: Regular Course Lecture Plan Session 2022-23

Subject Name	Fundamental of Mechanical Engineering

Unit No.	Unit Name	Syllabus Topics	Lecture No
1	Introduction to mechanics of solids	Force system, moment and couple, Principle of transmissibility,	1
		Varignon's Theorem, Resultant of forces,	2
		Types of supports and loads, equilibirium equation and support reactions.	3
		Free body diagram, numericals	4
		Normal and shear Stress, strain, Hooke's' law, Poisson's ratio.	5
		Various types of Elastic constants and their relationship	6
		Stress-strain diagram for ductile and brittle materials, factor of safety.	7
		Basic Numerical problems on stress, strain and elastic constant.	8
2	Introduction to IC-engines and Electric Vehicles	Introduction to IC and EC engines, Classification of IC Engine and its components .	9
		IC Engine terminology, Construction and Working of four stroke SI & CI engine, Differentiate SI and CI engines.	10
		Construction and Working of two stroke SI & CI engine,Scavenging process, Differentiate 2 stroke and 4 stroke IC engine	11
		Introduction to electric vehicles, advantages and disadvantages	12
		EV Batteries and chargers	13
		EV Drives, Transmission and power device	14
		Introduction to Hybrid electric vehicles(HEV), HEV drive train, advantages and disadvantages, comparision	15
3	Introduction to RAC	Refrigeration : meaning and its applications, unit of refrigeration, methods of refrigeration.	16
		VCRS method	17
		Concept of Refrigerator and Heat pump, Coefficient of performance.	18
		Construction and Working of domestic refrigerator.	19
		Formula based numerical problems on cooling load.	20
		Air-Conditioning : meaning and applications, Atmospheric air, Dry Air ,Wet air.	21
		Specific and relative humidity, Psychrometry : dry bulb, wet bulb, and dew point temperatures.	22
		Construction and working of window air conditioner, Comfort conditions	23

Unit-II

Objective of Lecture-10

In this lecture we will discuss the following:

1) Definition of engine
2) Two general classes of Combustion engine i.e. Internal and External Combustion engine along with their principle
3) Differences between internal and external Combustion engines.
4) Advantages of I.C.E over E.C.E.
5) Classification of internal Combustion engines i.e. two stroke and four stroke engines.
6) Basic Components of an I.C. engine and their functions.
7) Now a days in most of engines four-stroke engines are used.

Q.1 Name the two general classes of combustion engine and state how do they differ in principle?

Ans:→ Engine is a device which converts one form of energy into another useful form.

Based on Combustion engines are classified into:→

1) Internal Combustion engines (I.C. Engines)

2) External Combustion engines (E.C. Engines)

1) In internal Combustion engines burning or Combustion of fuel takes place inside the cylinder and power is developed in the same cylinder.

Examples: Automobile engines (Petrol and Diesel engines)

2) In external Combustion engine the burning or Combustion of the fuel takes place outside the engine.

Examples: Steam engine, closed gas turbine etc.

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Q.2 Discuss the relative advantages and disadvantages of internal and external Combustion engine. [AKTU: 2020-21]

Ans: These are the following differences between ICE and ECE.

S.N.	E.C. Engines	I.C. Engines.
1)	Combustion of fuel takes place outside the engine	1) Combustion of fuel takes place inside the engine.
2)	Bulky due to presence of boiler, Condensers etc.	2) It is light and Compact.

3) Ratio of weight to power is high	3) Low
4) It can use cheaper fuels including solid fuels.	4) High grade fuels are used with proper filtration
5) Lower efficiency about 15-20%	5) Higher efficiency about 35-40%
6) High requirement of water for dissipation of heat	6) Lesser requirement of water. for dissipation of heat.

Q.3 What are the two basic types of internal combustion engines? What are fundamental differences between the two?

Ans: Two basic types of internal Combustion engines are.

1.) Two Stroke engines
2.) Four Stroke engines

1.) In Case of two Stroke engine cycle operation (Intake, Compression, Expansion and exhaust) Completed in two Strokes of the piston or one revolution (360°) of the Crank.

The two Stroke engine may be SI or C.I.

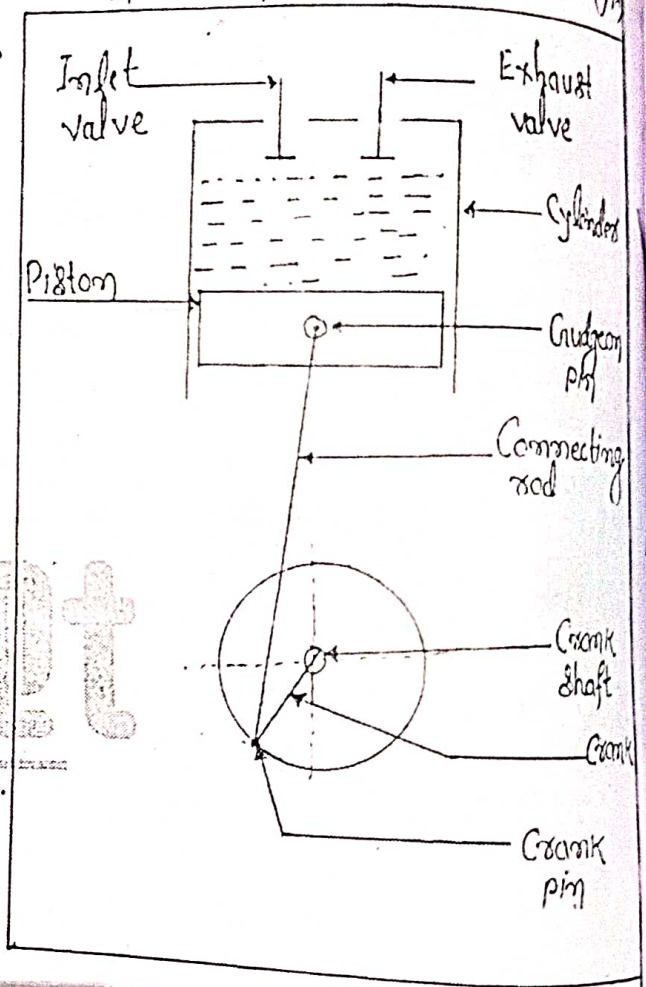
2.) In Case of four Stroke engine cycle operations (Intake, Compression, expansion and exhaust) Completed in four Strokes of the piston or two revolution (720°) of the Crank.

Four Stroke engines may be S.I. or C.I.

spark ignition engine
compression ignition engine

Q.4 What are the basic Components of an I.C. Engine & Also explain their function.

Ans. The basic Components of an I.C. engine are cylinder block, cylinder piston, piston rings, Connecting rod, Crank / Crank shaft, Cam / Camshaft, inlet and exhaust valve, flywheel etc.



Cylinder block:

It is main body of the engine

This is main supporting structure which holds the other Components together.

Cylinder block is manufactured by Casting.

It is made of iron or Aluminium.

Cylinder:

It is a cylindrical vessel supported by the cylinder block in which the piston makes reciprocating motion.

Piston:

Piston is a tubular Component that fitted into engine cylinder

Its motion is restricted to one dimension only.

It reciprocates inside the cylinder from TDC to BDC or from BDC to TDC

It also acts as a link in transmitting gas forces to rotary motion of output shaft.

Piston rings:

Piston rings are provided on the piston to provide a gas tight seal between piston and cylinder wall.

Connecting rod:

It is a metal rod which connects the piston and the crank shaft.

It transmits the power of piston to the crank shaft.

Crank / Crankshaft:

It is a component which enclosed in the crank case and converts the reciprocating motion of piston to the rotary motion of output shaft.

Bearings are used to crankshaft

Cam / Cam shaft:

Cams and camshaft are the parts of engine which controls the opening and closing of inlet and exhaust valves.

Cam and camshaft are driven by crankshaft by using the timing gears.

Inlet and Exhaust valves:-

These are the valves provided in the cylinder head to regulate the flow of working fluid into the cylinder and expelling of

Combustion products to the atmosphere.

Flywheel:

It is a inertia wheel used in a machine acts as a energy reservoir, which stores energy when it is more than required for an operation and releases the stored energy when the supply power does not adequate as needs.

LECTURE - 11

In this lecture we will discuss about:

→ Terminology of I.C. engine:
- (a) TDC & BDC
- (b) Stroke
- (c) Bore
- (d) Swept volume
- (e) Clearance volume
- (f) Compression ratio.

→ Working of four stroke S.I. engine

→ Working of four stroke C.I. engine.

→ Suction stroke

→ Compression stroke

→ Working stroke (Expansion stroke)

→ Exhaust stroke

→ Difference between S.I. and C.I. engines.

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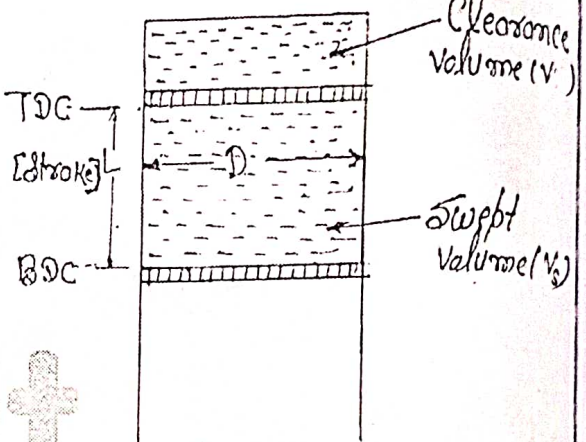
Q.5 Explain the following terms as applied to I.C.E.
<a> TDC and BDC <b> Stroke <c> Bore <d> Swept Volume
<e> Clearance Volume <f> Compression ratio.

Ans: <a> TDC (Top-dead-Center) :-

It is the position of the piston when it is farthest from the Crank Shaft.

BDC (Bottom dead Center) :-

It is the position of the piston when it is nearest to the Crank Shaft.



b) Stroke:

When piston moves from TDC to BDC or BDC to TDC is known as stroke.

→ Distance travelled by the piston from TDC to BDC is called stroke length (L).

<c> Bore (D):

It is inner diameter of the Cylinder or diameter of the piston face.

<d> Swept volume (V_s):

It is the volume displaced by the piston as it travels through one stroke.

$$V_s = \frac{\pi}{4} D^2 L$$

(6) Clearance Volume (V_c):

It is the volume of the cylinder when piston is at TDC. Therefore it is minimum volume.

(7) Compression ratio (r):

It is defined as the ratio of volume before compression to the volume of after compression.

Volume before Compression $\rightarrow V_c + V_s$

Volume after Compression $\rightarrow V_c$

$$r = \frac{V_c + V_s}{V_c}$$

Note: Range of r for S.I. engines $\rightarrow$ 6 to 10

V. Imp. Range of r for C.I. engines $\rightarrow$ 16 to 22

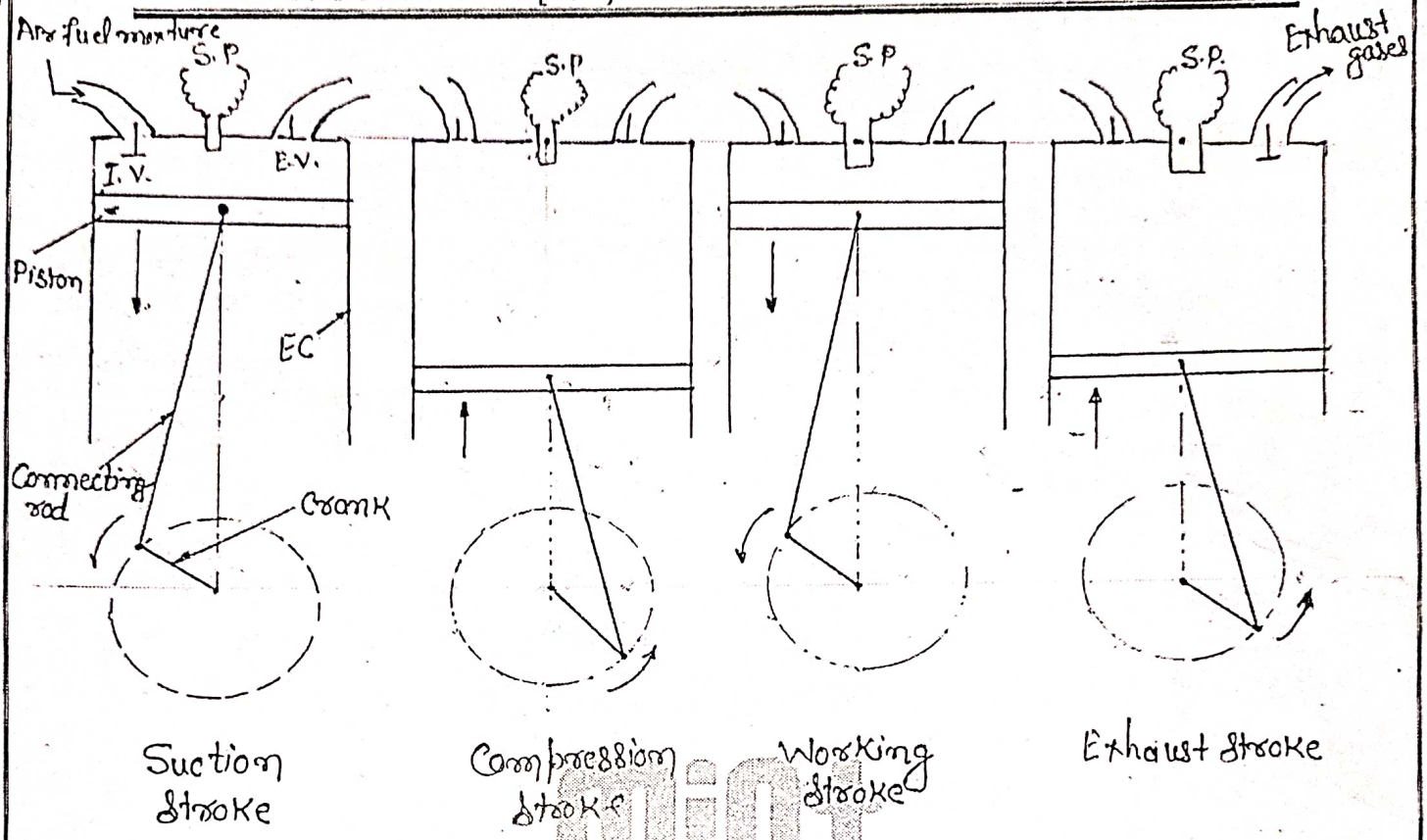
Q.6 Explain with suitable sketches the working of four stroke S.I. engine.

Ans.

Suction stroke :-

→ Piston moves down from TDC to BDC
→ Inlet valve is opened and Exhaust valve is closed
→ Pressure inside the cylinder reduced below the atmosphere pressure.
→ The mixture of air-fuel is sucked into the cylinder.

Note: S.P - Spark plug E.V. - Exit valve
I.V. - Inlet valve E.C. - Engine Cylinder



Compression stroke:

→ Piston moves up from BDC to TDC

→ Both inlet and exhaust valves are closed.

→ Temperature and pressure increased due to compression of air-fuel mixture in the cylinder.

Power or Expansion stroke:

→ The burning gases expands rapidly.

→ Gases exert force on the piston.

→ The piston is pushed from TDC to BDC

→ This reciprocating motion of the piston is converted into rotary motion of the crank shaft through connecting rod.

→ Both inlet and exhaust valves are closed.

Exhaust stroke

→ Piston moves upward from BDC to TDC.
→ Exhaust valve is opened and inlet valve is closed.
→ The burnt gases are forced out to the atmosphere.
→ The inlet valve is opened and the cylinder is ready to receive fresh charge for new cycle.

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Q.1 Explain with suitable sketches the working of a four-stroke C.I. engine [AKTU-2020-21].

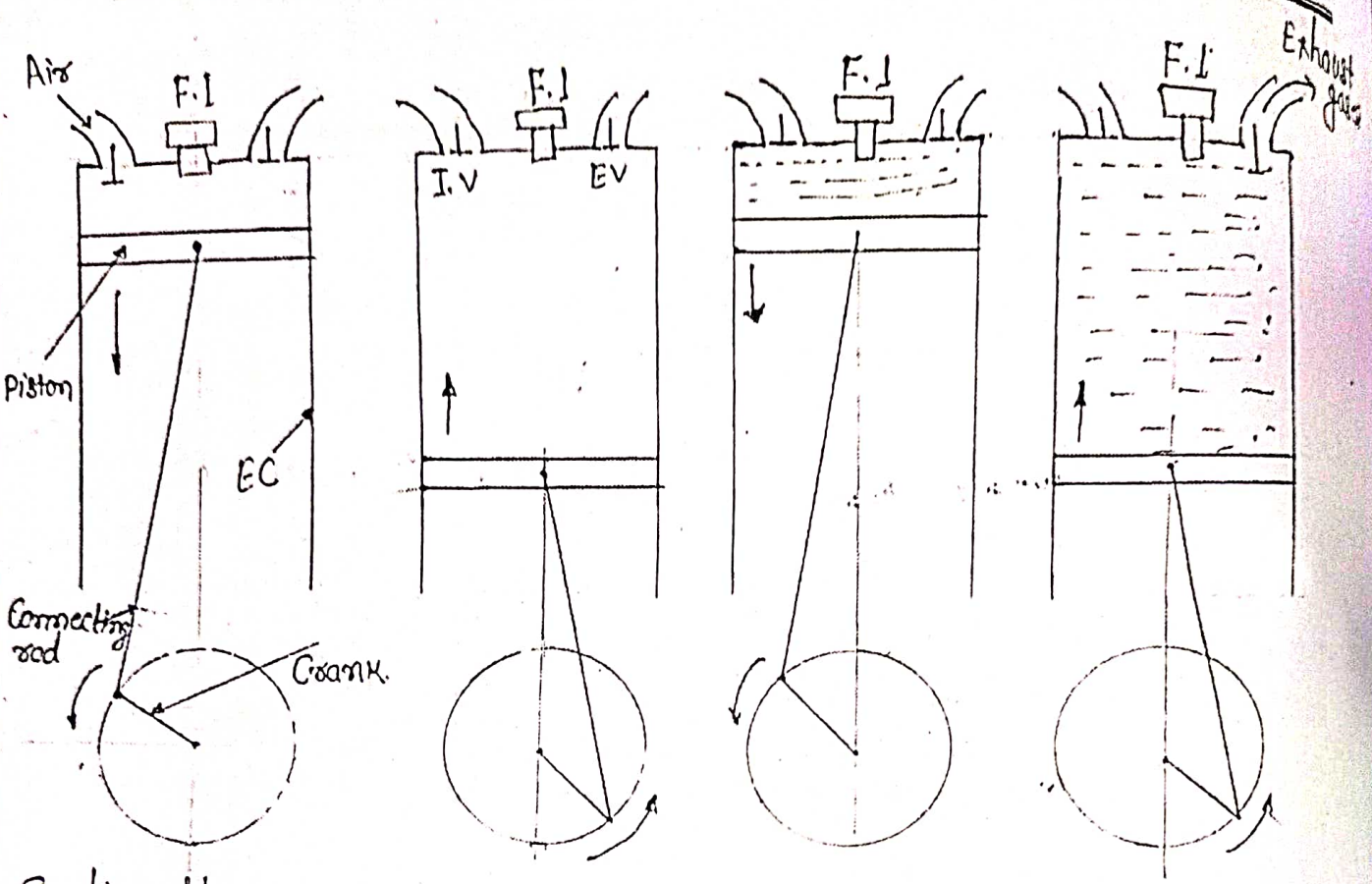
Ans:

Suction stroke:

→ Piston moves from TDC to BDC
→ Inlet valve is opened and exhaust valve is closed.
→ The pressure inside the cylinder is reduced below the atmospheric pressure.
→ Fresh air from the atmosphere is sucked into the engine cylinder.

Compression stroke

→ Piston moves from BDC to TDC
→ Both inlet and exhaust valves are closed.
→ The air only is drawn during suction stroke is compressed to a high pressure and temperature.



Suction Stroke | Compression Stroke | Working Stroke | Exhaust Stroke.

Power or expansion Stroke.

→ Fuel (diesel) is injected inside the cylinder with the help of injector.

→ The burning gases expand rapidly and push the piston from TDC to BDC.

→ This movement of the piston is converted into rotary motion of the crank shaft through connecting rod.

→ both inlet & exhaust valves are closed.

Exhaust Stroke

→ Piston moves from BDC to TDC
→ Exhaust valve is opened and inlet valve is closed.
→ The burnt gases are forced out to the atmosphere through the exhaust valve.
→ The inlet valve opens and the cylinder is ready to receive fresh air to start a new cycle.

Q.8 Compare the relative advantages and disadvantages of S.I and C.I. engines.

Ans: These are the following differences between S.I. and C.I. engines.

S.I. Engines	C.I. Engines
1) It works on otto cycle	1) It works on Diesel cycle.
2) During suction stroke air and fuel are used	2) Only air is used.
3) Petrol is used as a fuel	3) Diesel is used as a fuel.
4) The fuel is supplied by Carburetor.	4) The fuel is supplied by injector
5) The Compression ratio is 6 to 10	5) The Compression ratio is 16 to 22
6) Lower thermal effficiency	6) High thermal efficiency

Lecture No: 14

7)	It produces less noise	Produces high noise.
8)	Maintenance cost is low	High.
9)	Used in small vehicles.	used in heavy vehicles
10)	Starting of the engine is easy	Difficult.

Q.3. Explain with suitable sketches the working of two-stroke S.I. engine [AKTU:- 2020-21]

Ans:

Suction and Compression:

→ The piston moves from BDC to TDC

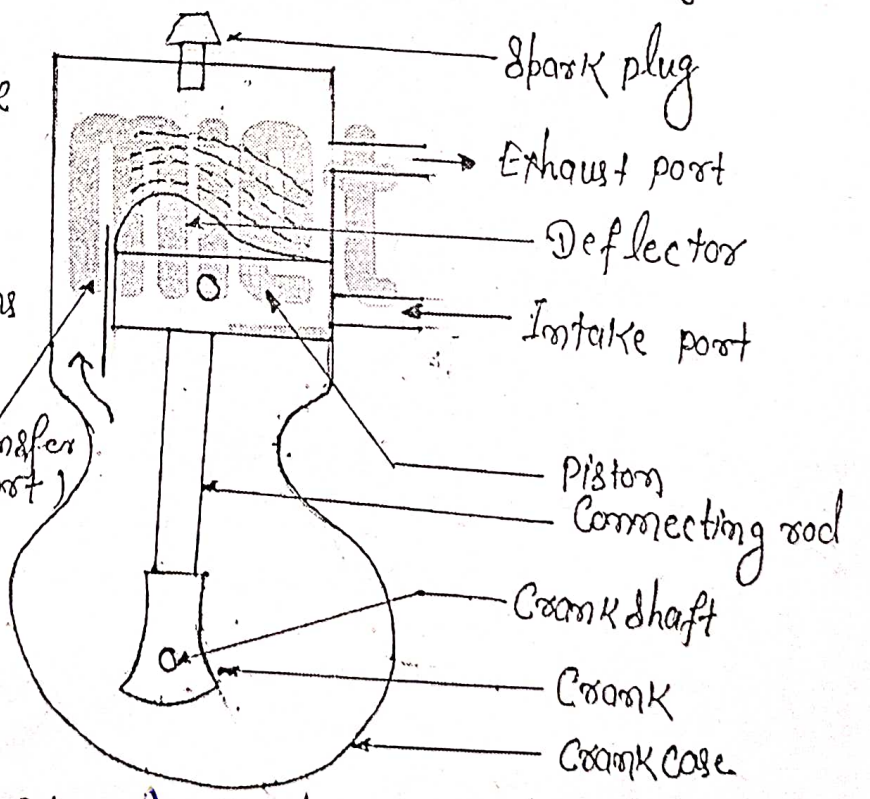
→ Both transfer and exhaust port are covered by the piston

→ Air-fuel mixture is compressed inside the cylinder by moving the piston.

→ The pressure and temperature increase inside the cylinder.

→ As piston almost reaches the TDC. The air-fuel mixture inside the cylinder is ignited by means of electric spark produced by a spark plug.

→ At the same time, the inlet port is uncovered by the piston. Fresh air-fuel mixture enters the crank case through the inlet port.



LECTURE - 12.

In this lecture we will discuss:

→ Working of two-stroke S.I. engine.

→ Working of two-stroke C.I. engine.

→ Differences between Two-Stroke and four Stroke engines

→ Scavenging Process.

→ After discussing this we are able to understand how a two S.I. engine (Petrol) and two stroke C.I. engine (diesel) will work and what is the difference exist between them, moreover we also discuss the problem of scavenging which is going to take place in a two stroke engine & the process to eliminate or reduce this type of problem.

Expansion and Exhaust :-

→ The burning gases expand inside the cylinder.

→ The burning gases forced the piston to move down and useful work is obtained.

→ when piston moves down, the air-fuel mixture in the crankcase is partially compressed.

→ At the end of expansion, (piston moved down to BDC) exhaust port is uncovered. (opened)

→ Burnt gases escape to the atmosphere. Transfer port is also opened.

Q.10 Explain with suitable sketches the working of two-stroke C.I. engines :

Ans

Suction and Compression:

→ The piston moves upward from BDC to TDC.

→ Both transfer and exhaust ports are covered.

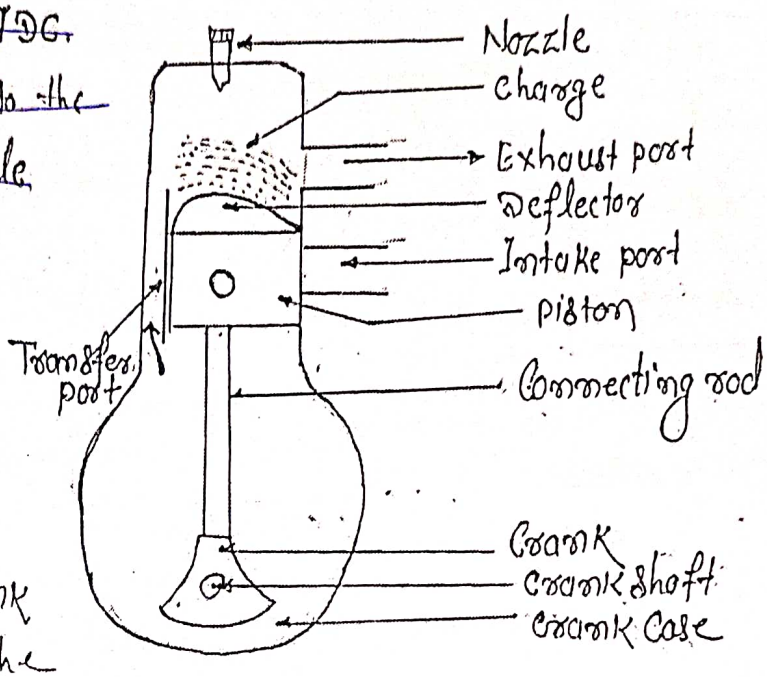
→ Air which is already transferred into the cylinder, Compressed by moving the piston.

→ The pressure and temperature of air increases.

→ As piston reaches the TDC. The fuel is injected into the hot Compressed air inside the cylinder.

→ The fuel mixed with hot air and burns.

→ The admission of fresh air into the Crank Case Continues till the piston reaches the T.D.C.



Expansion and Exhaust :

→ The burning gasses expands in the cylinder.

→ Burning gasses forced the piston to move down and useful work is obtained.

→ At the same time, the air in the Crank Case is Compressed by the movement of the piston from TDC to BDC.

→ At the end of expansion, the exhaust port is uncovered.

→ The burnt gasses escape to the atmosphere through the exhaust port

Q.11 Compare the relative advantages and disadvantages of four-stroke and two-stroke engines.

Ans: These are the following differences between four-stroke and two-stroke engines.

4-Stroke engine	2-Stroke engine
1) Four-strokes of the piston and two revolution of the Crankshaft	1) Two-strokes of the piston or one revolution of the Crank shaft.
2) One power stroke in every two revolution of Crank shaft	2) One power stroke in each revolution of Crank shaft.
3) Power produces is less	3) Theoretically twice power.
4) Heavy flywheel is used	4) Lighter flywheel.
5) Contains valve and valve mechanism	5) Contains ports arrangement
6) Thermal 'η_{th}' is high	6) Thermal 'η_{th}' is low
7) Mechanical 'η_{mech}' is low	7) Mechanical 'η_{mech}' is high
8) Heavy and bulky	8) Lighter and Compact.

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Q-12 What is the Scavenging Process? [AKTU: 2020-21]

Ans: Scavenging is a process of pushing exhaust gases out of the cylinder.

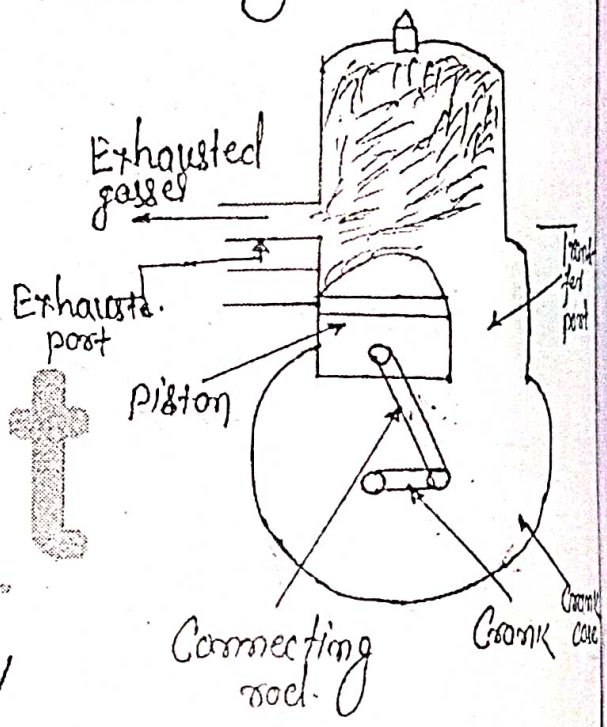
→ This action takes place in two stroke engines

→ The charge (air & fuel mixture or air) enters the engine cylinder from the crank case at a pressure higher than the exhaust gases.

→ This fresh charge forces the burnt gases to the atmosphere through the exhaust port.

→ During this period both the transfer and exhaust ports are kept open for a short period

→ Hence there is a possibility of the fresh charge escaping out with the burnt gases.



LECTURE - 13

In this lecture we will discuss about electric vehicles.

Electric vehicles are future, and each year we have seen automakers and more EVs to their line Up.

→ Most of the automobile Company are working on the Technology of electric vehicles.

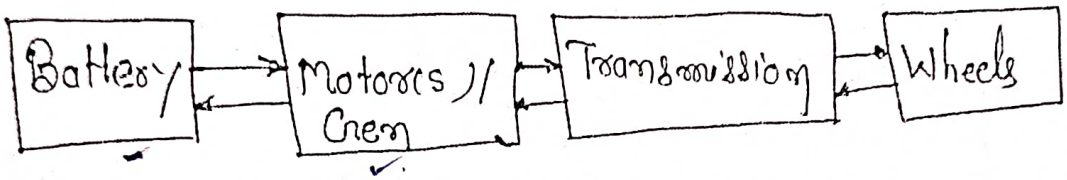
→ we will be in detail:

- Concept of electric vehicles
- Main parts of electric vehicles.
- Hybrid electric vehicles with their types
- Advantages and disadvantages of electric and hybrid electric vehicles

→ Comparision between electric, hybrid electric and I.C. Engine.

Q.13 What is electric Vehicle? What are the main Components of electric Vehicles?

Ans: An electric vehicle (EVs) is a vehicle that uses one or more electric motor for propulsion.

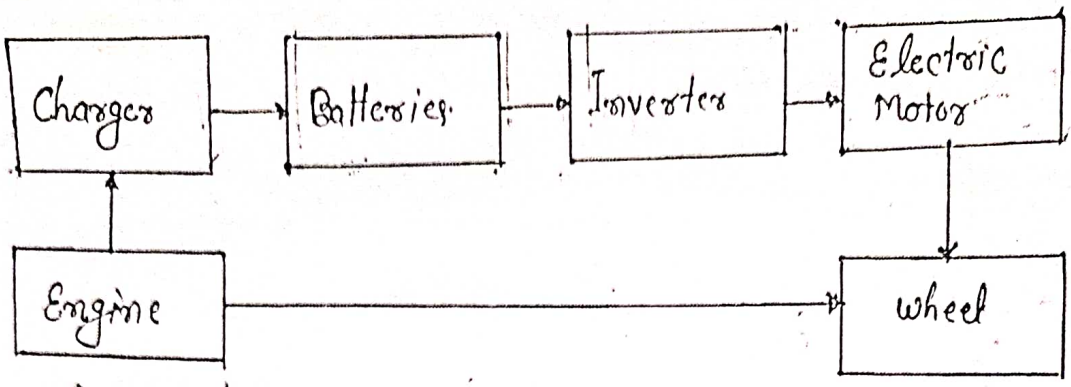


→ Motoring
← Regenerative braking

→ Main Components of electric vehicles are:
- Battery
- Electric motor
- Battery charger
- Power electric Converter

Q.14 What is hybrid vehicle? Give the classification of hybrid vehicles.

Ans: A hybrid electric vehicle (HEV) Combines a Conventional internal Combustion engine (ICE) System with an electric propulsion System.



Types of hybrid electric vehicles:

Parallel Hybrid : Toyota Camry, Honda, Accord, etc.

Series Hybrid: BMW i3, Kia optima, Ford fusion etc.

Plug-in Hybrid: BMW 330e, Volvo XC40

Mild Hybrid: Maruti Suzuki Ertiga, Ciaz, Baleno etc.

Q.15 Compare the relative advantages and disadvantages among I.C. Engine, electric and hybrid electric vehicles.

Ans

	Electric Vehicle	Hybrid Electric Vehicle	I.C. Engine
i) Power fuel source	Electricity through battery pack	Electricity and fossil fuel (Petrol & Diesel)	Fossil fuel (Petrol or Diesel etc.)
2) Engine	Electric motor(s)	ICE + Motor(s)	I.C. Engine.

	Electric Vehicle	Hybrid Electric Vehicle	I.C. Engine
3) Emission level	Lower Compared to ICE and hybrid	Higher Compared to electric vehicle and lower than I.C.E	High
4) Price range	High.	Similar to I.C.E	Lower as Comp. are to EVs
5) Charging	Required.	Not required.	Not required

Types of Batteries for EV:

* Lithium-ion battery: These batteries are currently used in most portable consumer electronics such as cellphones & laptops because of their high energy per unit mass relative to other electrical energy storage systems.

- These batteries are designed to discharged upto 90% of total capacity. Also these battery parts are recyclable so it is good option regarding the environmental aspects.
- Some of the other advantages of using these batteries are as follows:
  - → High power to weight ratio. (Great charge holding capacity even at smaller size)
  - → High energy efficiency.
  - → Good high temperature performance.
  - → Low self discharge. (Very good at holding charge even if kept idle for longer period of time.)

* Lead-acid battery: Lead-acid batteries are the oldest rechargable batteries and still are in the development phase. These are much cheaper to manufacture, but are still usually heavy and have a faster discharge rate.

- These batteries can be designed to be high power & are inexpansive, safe and reliable. However low specific energy, poor cold temperature, performance, and short Calender & the lifecycle impede their use.
- About 95% of the Content of the battery can be reused, which is better for the environment. These batteries do not discharge more than 30-40%, which typically go on to damage the battery.

* Nickel-Metal Hydride Battery: Nickle-Metal hydride batteries, used routinely in computer and medical equipment offer reasonable specific energy and specific power capabilities. These batteries have a much longer life cycle than lead-acid batteries and are safe. These batteries are widely used in HEVs. It is usually slower to charge and discharge the battery & it contains less power per weight so it takes longer time to charge the battery.

•) The main challenges with nickel-metal hydride batteries are their high cost, high self discharge & heat generation at high temperatures, and the need to control hydrogen loss.

* Nickel-Cadmium Battery: These batteries have high power & energy density, high efficiency of charge/discharge, and a low cycle life. The primary demerit of Ni-cd batteries is relatively high cost because the manufacturing process is expensive. In contrast, Cadmium (Cd) is a toxic heavy metal, hence posing issues associated with the disposal of Ni-cd batteries. "Ni-cd" batteries also suffer from 'memory effect', where the batteries only take a full charge after a series of full discharge.

* Solid State Batteries (S.S.B): Solid state batteries are primarily Li-ion batteries except for the fact that they use solid electrolytes, not liquid electrolyte solutions. And so, there is a lower risk of catching fire. Also they have a higher energy density and longer life span than Li-ion batteries, which makes them perfect to use in EVs. Nonetheless, the solid state is still at the laboratory prototype stage.

IF CHARGERS: (for EV)

•) There are mainly three types of EV-chargers.

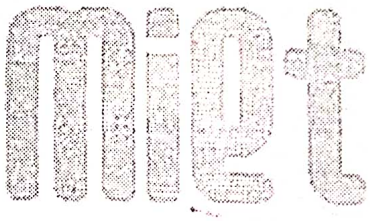
1.) Rapid Chargers: These are the fastest chargers for an EV, usually located at locations close to main route in the country. The devices provide high power direct current (D.C.) or alternating current (AC) to recharge a car as rapidly as attainable. These rapid chargers can be used only with vehicles with rapid charging capabilities.

Types: i.) Rapid DC → Provides power at 50kW (125A)

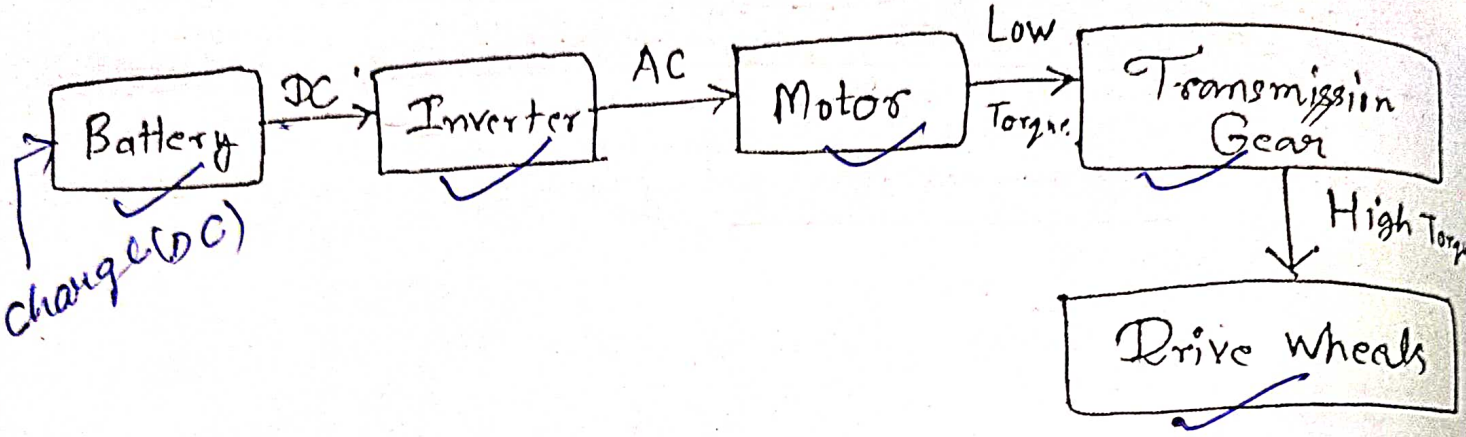
ii.) Ultra Rapid DC → Provide power mostly either 100kW, 150kW or 350kW.

2.) FAST CHARGERS: These are Type-2 AC chargers. Fast chargers are rated at either 7kW or 22 kW (Single or three phase - 32A) Fast chargers tend to be found at locations such as Car parks, Shops, Supermarkets, or leisure centres, where people likely to be park their vehicles for an hour or more.

3.) Slow Chargers: These are the most commonly available chargers in the indian market. Power output is 3kW - 6 kW and the Car will be charged between 8-12 hours. People/ Customers will have to keep their Car overnight to be in full charge.



Electric Vehicle Drives —



Block Diagram of EV Drive.

EV Drive includes the following components :—

1) Battery. (It stores electrical energy).
2) Inverter (It converts DC Power to AC Power)
3) Motor (It converts EE into ME).
4) Transmission Gear System (Provides enhanced torque).
5) Drive Wheels (Provides final motion to vehicle).

Electric Vehicle Transmission :-

Transmission refers to the transfer of power from motor to the wheels of the vehicle.

There are two types of EV transmissions :-

1). Single Speed Transmission :-

Only 1 pair of reduction gear is used.

Advantages :-
1. It has direct drive.
2. Its operation is very smooth.
3. It generates instant torque when coupled with motor.
4. No complex gear system is required.
5. It occupies less space.

Limitation :-
1. It has a fixed gear ratio.

2). Multi Speed Transmission :-

(Mostly 2-Speed Transmission).

A compound planetary gear system is used, that provides two degrees of freedom.

Advantages :-
1. Two different gear ratios can be achived.
2. Top speed of vehicle can be achived.

Disadvantages :-
1. These are heavy & large.
2. High cost.

Electric Vehicle Power Devices :—

The main devices of power electronics required in an electric vehicle are :—

1). Rectifiers
2). Power Converters
3). Controllers & Sensors
4). Inverters

Rectifiers →

→ A rectifier is an electronic device {Electronic device} that converts an AC into a DC by using one or more P-N junction diodes.

→ A diode behaves as a one-way valve that allows current to flow in a single direction.

→ The conversion of AC current into DC current through rectifier is known as rectification.

→ The rectifiers are used in AC-DC conversion stages of Plug-in EVs, where the grid electricity is firstly met with this device.

Power Converters →

→ Power converters are classified according to their input & output types namely DC-DC converters & AC-AC Cyclo-converters.

→ These devices increase or decrease the input voltage to obtain the desired output voltage.

→ Buck converter (Step-down converter) decreases the voltage, while Boost converter (Step-up converter) increases the voltage.

→ The cyclo-converters are used to convert input power at one frequency to output power at a different frequency. This can also be achived by an inverter.

Controllers →

→ The required control signals are generated by Microcontrollers & commutate power electronic devices with switches to provide fixed speed.

Inverters →

→ In EVs, Inverters are used for DC-AC conversions.

→ Inverters are used to provide the required AC voltage & current to AC motors.

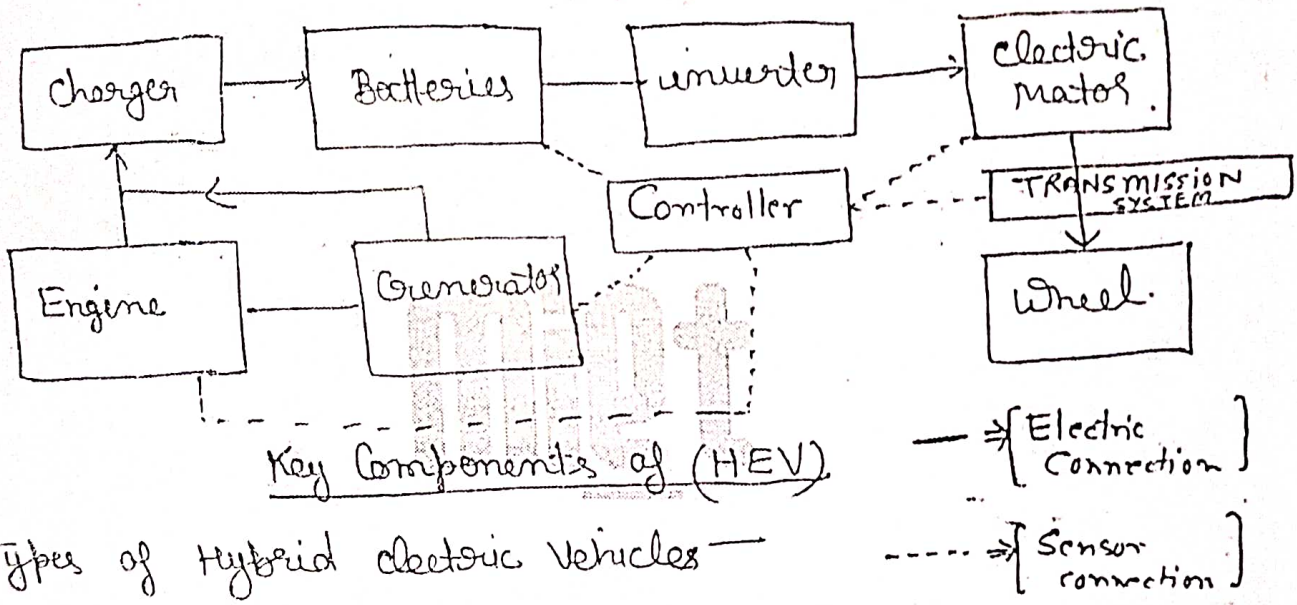
Sensors —

→ These are the devices, which sense a change in input & sends signal to controller.

(HEV) Hybrid electric Vehicle

A hybrid electric Vehicle (HEV) Combines a Conventional internal Combustion engine (ICE) System with an electric propulsion System.

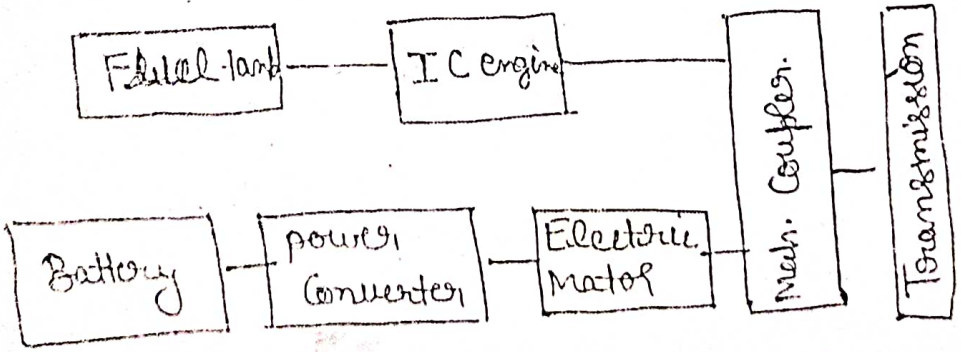
Drive train Components of HEV physically integrate the ICE power source & electric drive.



Key Components of (HEV)

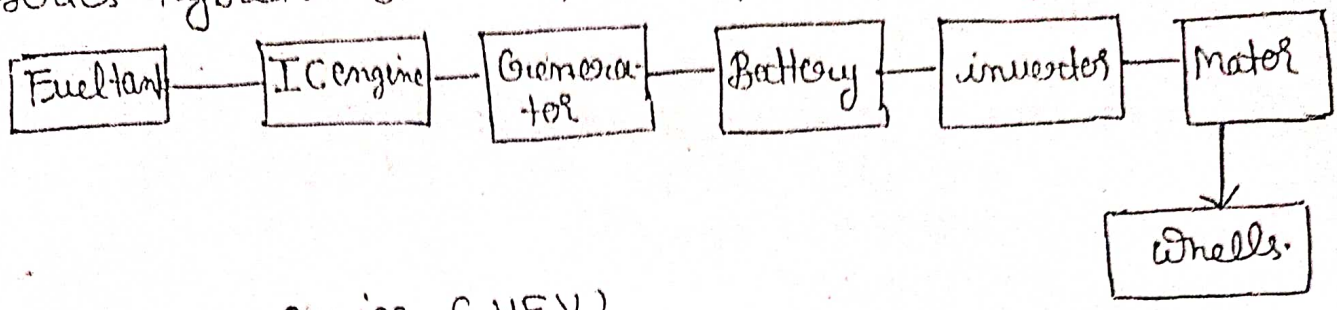
Types of Hybrid electric Vehicles —

1. parallel Hybrid : Toyota Camry, Honda Accord etc.



In this mode both the engine and electric motor are Coupled to the Wheels to propel the Vehicle

2. Series Hybrid :- BMW i3, Kia Optima, Ford fusion etc.



Series C HEV)

3. plug in Hybrid :- PHEVs use batteries to power an electric motor. PHEV batteries can be charged using a wall outlet or charging equipment, by IGE, or through regenerative braking. example:- BMD 330e, Volvo XC40

4. Mild Hybrid :- Maruti Suzuki Ertiga, Ciaz, Baleno etc.

Advantages of HEV —

1. Less dependency on fossil fuel.
2. Less emissions
3. Smaller & fuel-efficient engine.

Disadvantages of HEV —

1. Lower speeds & Accelerations.
2. Expensive to buy.
3. High maintenance cost..

5 Year's

University Paper Questions

(AKTU Question Bank)

20/3/23 - Chemistry ✓

22/3/23 - Electronics ✓

24/3/23 - mechanical

28/3/23 - maths

31/3/23 - Soft skill.

B. Tech I Year [Subject Name: Fund. Of Mechanical Engineering]

5 Years AKTU University Examination Questions		Unit-2	
S. No	Questions	Session	Lecture No
1	Name the two general classes of combustion engines and state how do they basically differ in principle?		
2	Discuss the relative advantages and disadvantages of internal combustion and external combustion engines.	2020-21	
3	What are the two basic types of internal combustion engines? What are the fundamental differences between the two?		
4	Explain the following component of I.C. engines with sketch: Cylinder, Cylinder head, Piston & Piston rings, Connecting rod, Crank, Crankshaft and Flywheel.		
5	Explain the following terms as applied to I.C. engines : Bore, stroke, T.D.C., B.D.C., clearance volume, swept volume, compression ratio.		
6	Explain with suitable sketches the working of a four-stroke SI engine.		
7	Explain with suitable sketches the working of a four-stroke CI engine.	2020-21	
8	Explain with suitable sketches the working of a Two-stroke SJ engine.	2020-21	
9	Explain with suitable sketches the working of a Two-stroke CI engine.		
10	Compare the relative advantages and disadvantages of four-stroke and two-stroke cycle engines.		
11	Compare the relative advantages and disadvantages of S.I. and C.I. engines.		
12	What is the scavenging process?	2020-21	
13	Draw p-v and T-S diagram for Otto and diesel cycles.		
14	What is electric vehicle? What are the main components of electric vehicle?		
15	Write the advantages and disadvantages of Electric Vehicles.		
16	Compare the relative advantages and disadvantages among IC engine, Electric vehicle and Hybrid vehicles.		
17	Explain different types of batteries and chargers required for a electric vehicle.		
18	Write short notes on- (i) EV Transmission system (ii) EV Power devices		
19	What are hybrid electric vehicles (HEV)? Explain different drive train components of HEV..		
20	Suppose the displacement volume of a v6 engine is 2700m^3 while its clearance volume is 300 m^3, calculate the compression ratio.		