GURU GOBIND SINGH POLYTECHNIC, NASHIK

Basic Mechanical Engineering (22207)

QUESTION BANK CLASS TEST -1 (Mechatronics Engineering)

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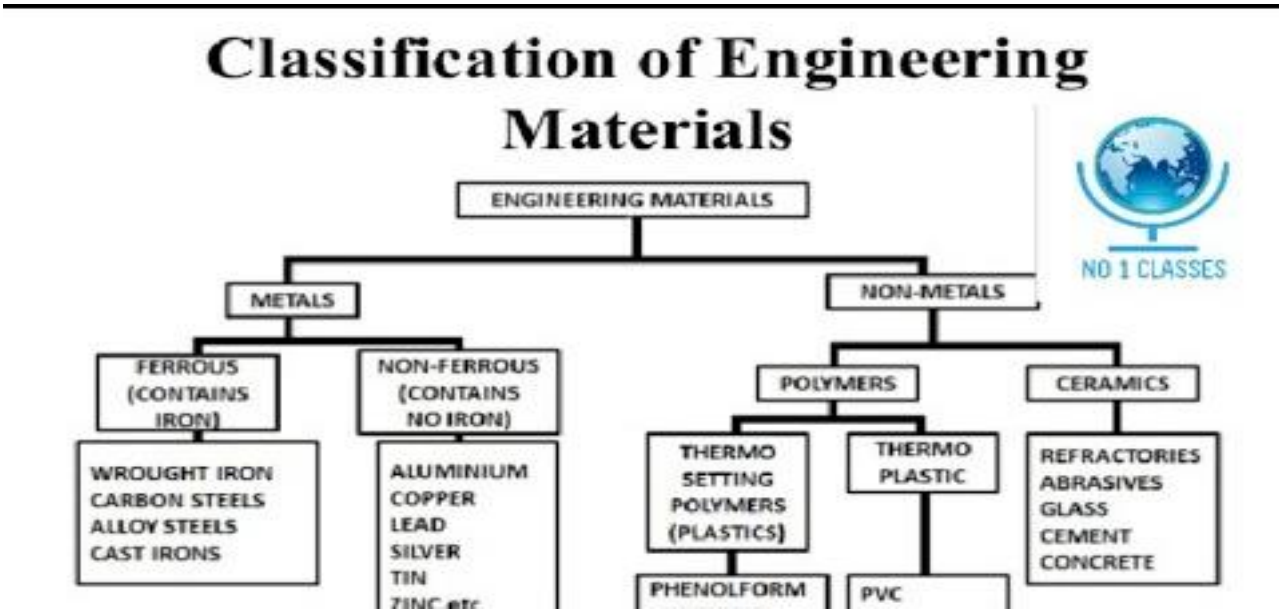
4 Marks Question.

Q1.What is the classification of engineering materials?

Solution-



Q2. What are the various types of Steel ?

Solution-

1. Plain-carbon steel-

Composition:- carbon. (Up to 2.1 wt.%)

Manganese- (1.65% max),

silicon- (0.60% max), and

copper -(0.60% max).

Properties:- good formability and weldeability, higher strength etc.

Application:- used in making nuts, bolts, sheets, tubes .

2. Alloy steel-

Composition:- carbon. (Up to 2.1 wt.%)

Properties:- strength, hardness, toughness, wear resistance, corrosion .

Application:- military vehicles, construction equipment, ships, pipelines, pressure vessels oil drilling platforms and in structural components.

3.Tool Steel-

Composition:- carbon content between 0.5% and 1.5%,

Properties:- Toughness ,Wear resistance, hardness, Heat resistance

Application:- Forming, stamping, cutting and shearing of plastics and metals

4.Stainless steel-

Composition:- at least 10.5% chromium, less than 1.2% carbon

Properties:- Corrosion resistant, High tensile strength, Very durable, Temperature resistant, Easy formability and fabrication.

Application: - Culinary uses. Kitchen sinks; Cutlery; Cookware; Surgical tools and medical equipment.

Q3.Explain Cast iron with its types-

Solution- 1 Grey Cast Iron.

Composition- Carbon (C) 2.5 to 4 wt%

Properties of Grey Cast iron- Resistance to Oxidation, High Compressive Strength, Low Melting Point.

Applications - heavy-duty machine tools, high pressure hydraulic part

2 White Cast Iron.

Composition- C 3.4%, Si 0.7%, Mn 0.6%

Properties - high compressive strength and retains good hardness and strength at higher temperatures

Application- abrasion-resistant part, extrusion nozzles, pipe fittings

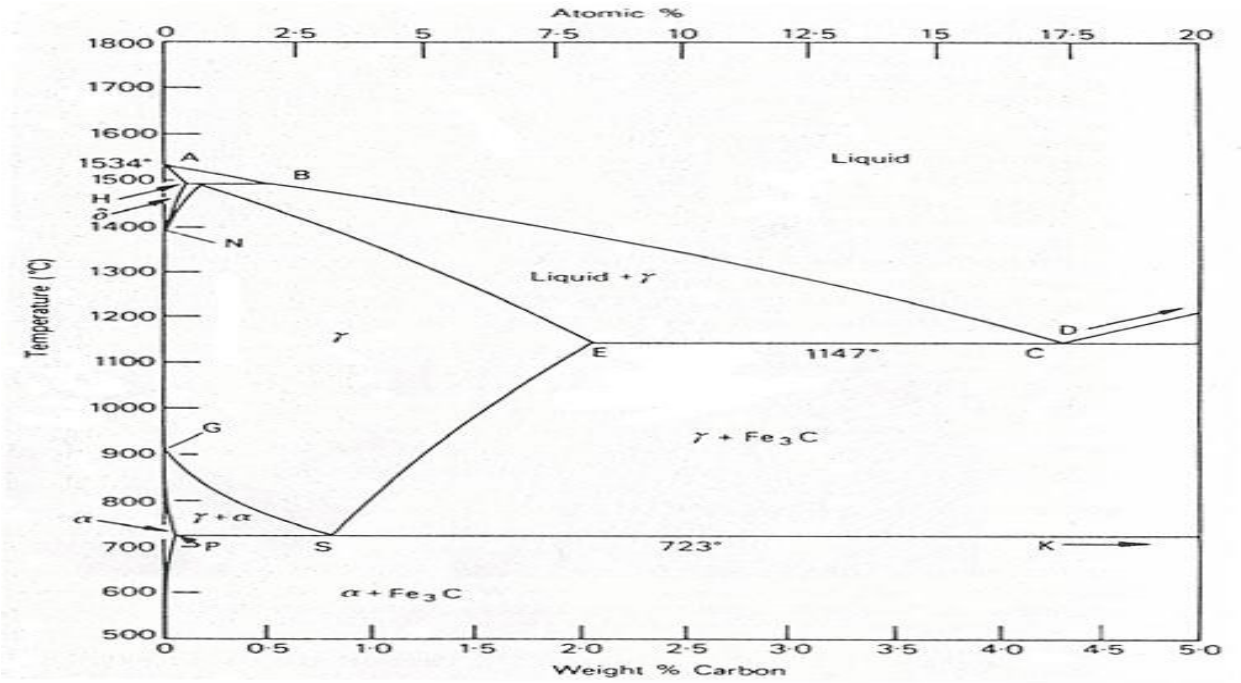
3 Malleable Cast Iron.

Properties - considerable ductility and toughness

Composition -Carbon - 2.16 – 2.90 Silicon- 0.90 – 1.90

Application :-electrical fittings, hand tools, pipe fittings, washers, brackets, fence fittings

Q4.Draw iron carbon equilibrium Diagram.



Q5.What are applications of Tool Steel and Stainless steel?

Application of Tool Steel-

- Forming, stamping, cutting and shearing of plastics and metals.
- Extrusion of plastic sections e.g vinyl window frames and pipes.
- Stamping of computer parts from metal sheets.
- Slitting of steel coils into strips

Application of Stainless Steel-

- Culinary **uses**. Kitchen sinks; Cutlery; Cookware ; Surgical tools and medical equipment

Q6.Explain the Brass and Bronze?

Brass- Properties- Higher malleability than zinc or copper. Low melting point (900 c); flows when melted. Combinations of iron, aluminum, silicon & manganese make brass corrosion resistant. Susceptible to stress cracking when exposed to ammonia. Not as hard as steel

Composition-	Brass is any alloy of copper and zinc.
Uses	Decorative; Low-friction applications (locks, gears, doorknobs, ammunition, valves); Plumbing/electronics

Bronze :- **Properties** -Hard and brittle. Melts at 950 centigrade but depends on amount of tin present. Bronze resists corrosion (especially seawater corrosion) and metal fatigue more than steel and is also a better conductor of heat and electricity than most steels.

Composition- Bronze is a metal alloy consisting primarily of copper, usually with tin as the main additive, but sometimes with other elements such as phosphorus, manganese, aluminum, or silicon

Uses -Used in boat and ship fittings, propellers and submerged bearings because of resistance to salt water corrosion.

Q7.What are the different properties of materials?

1. Strength- It is the property of a material which opposes the deformation or breakdown of material in presence of external forces or load.

2. Toughness-It is the ability of a material to absorb the energy and gets plastically deformed without fracturing

3. Hardness-It is the ability of a material to resist to permanent shape change due to external stress.

4. Malleability-is a property of solid materials which indicates that how easily a material gets deformed under compressive stress

5. Ductility-Ductility is a property of a solid material which indicates that how easily a material gets deformed under tensile stress

Q8.State the properties and applications of Thermoplastic and Thermosetting plastics.

Difference Between Thermoplastic and Thermosetting Plastic	
Thermoplastic	**Thermosetting Plastic**
Thermoplastic can be synthesized by the process called addition polymerization.	Thermosetting plastics are synthesized by condensation polymerization.
Thermoplastic is processed by injection moulding, extrusion process, blow moulding, thermoforming process, and rotational moulding.	Thermosetting Plastic is processed by compression moulding, reaction injection moulding.

Thermoplastics have secondary bonds between molecular chains.	Thermosetting plastics have primary bonds between molecular chains and held together by strong cross-links.
Thermoplastics have low melting points and low tensile strength.	Thermosetting plastics have high melting points and tensile strength.
Thermoplastic is lower in molecular weight, compared to thermosetting plastic.	Thermosetting Plastic is high in molecular weight.

Q9.Difference between Elastomers and polymers?

Property	**Elastomers**	**Polymer**
Definition	It is a polymer with very weak intermolecular forces and Viscoelasticity. Thus, they are famously known as elastic polymers.	Is a macromolecule or large molecule made up of clusters of subunits.
Physical property	They inherit the unique property of elasticity.	They inherit diverse properties based on the category.
Morphology	They are amorphous structure	They vary from crystalline form to amorphous form.
Flexibility	They are elastic in nature. They are capable of configuring the right	They are mostly brittle/ hard/rigid in nature except for

	distribution of applied pressure to retain their original size and shape	elastomers. Application of force can result in permanent deformation

Q10.Enlist some uses of Rubbers.

1.Rubber moulded products are widely used industrially (and in some household applications) in the form of rubber goods and appliances.

2.Rubber is used in garden hoses and pipes for small scale gardening applications.

3.Most of the tyres and tubes used in automobiles are made of rubber. Therefore, rubber plays a very important role in the automobile industry and the transportation industry.

4.Rubber products are also employed in matting and flooring applications.

5.Rubber is frequently used in the manufacture of protective gear for medical professionals, including medical gloves.

6.Vulcanised rubber, a special type of rubber prepared by cross-linking the polymer chains with disulfide bonds, is widely used in protective equipment in the sports industry. For example, the pads and guards used in the popular sport of cricket are made up of vulcanised rubber.

7.Uncured rubber is known for its applications in adhesives and cement, making it a product of choice for the construction industry

Q11.Write the uses of-

a)ABS b)Acrylics c)Nylons d)Epoxides .

Answer-a) ABS- Refrigeration Industry.

-3D Building Materials.

-Machine Prototype Construction.

-Pipes.

-Fittings.

-Vacuum Construction.

-Keyboard Keys.

-Power-Tool Housing.

b)Acrylics- Aquariums,

-Military Use,

-Water Resistant Paint,

-Fiber Optic Cabling,

-Artistic Sculpting,

-Fluorescent Light Lenses

c) Nylons

-Clothing – Shirts, Foundation garments, lingerie, raincoats, underwear, swimwear and cycle wear.

-Industrial uses – Conveyer and seat belts, parachutes, airbags, nets and ropes, tarpaulins, thread, and tents.

-It is used to make a fishnet.

-It is used as plastic in manufacturing machine parts.

d)Epoxides

- Ethylene epoxide has many uses including the generation of surfactants and detergents.

- Epoxy glues and structural materials are a result of epoxide's reaction with amines.
- It is used as a stabilizer in materials like PVC. They are also used in the manufacture of Epoxy resists that have low viscosity and without compromising strength and physical properties.

Q12.What are various properties of ceramics?

Properties of Ceramics

1. Ceramics have high hardness.

2. They are brittle and have poor toughness.

3. They have a high melting point.

4. They have poor electrical and thermal conductivity.

5. They have low ductility.

6. They have a high modulus of elasticity.

7. They have high compression strength.

8. They show optical transparency to a variety of wavelengths.

Q13.Write the TYPES OF SMART MATERIALS

Answer- **Piezoelectric materials-** They can convert mechanical energy into electrical energy and vice versa. For example, they change their shape in response to an electrical impulse or produce an electrical charge in response to an applied mechanical stress

Shape memory materials- They change colour when subjected to a certain variation in temperature, light, pressure, etc. Nowadays, they are used in sectors such as optics, among others.

Magnetorheological materials- They change their properties when exposed to a magnetic field. For example, they are currently used in shock absorbers to prevent seismic vibrations in bridges or skyscrapers.

- Applications- **Synthetic spider web.** This material is not only five times stronger than steel, but also has great elasticity. Its potential uses include: bulletproof clothing, artificial skin for burns or waterproof adhesives.
- **Shrilk.** Its main component is chitin, a carbohydrate found in krill shells. It was created by researchers from Harvard University and is considered the ideal substitute for plastic — since its decomposition time is only two weeks and it also works as a stimulant for plant growth —.
- **Graphene.** Its potential uses are almost unlimited: batteries with more autonomy, cheaper photovoltaic solar cells faster computers, flexible electronic devices, more resistant buildings, bionic limbs, etc. All this is possible thanks to their multiple properties.

Q14.What are different types of constrained motion?

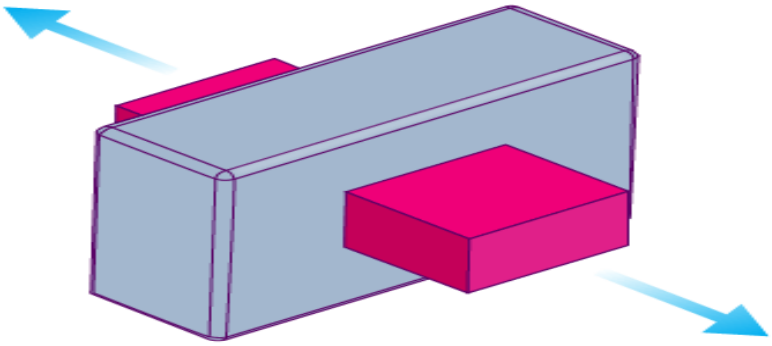
Answer- Types of Constrained Motion

There are three types of constrained motion:

1. Completely constrained motion
2. Partially or successfully constrained motion
3. Incompletely constrained motion

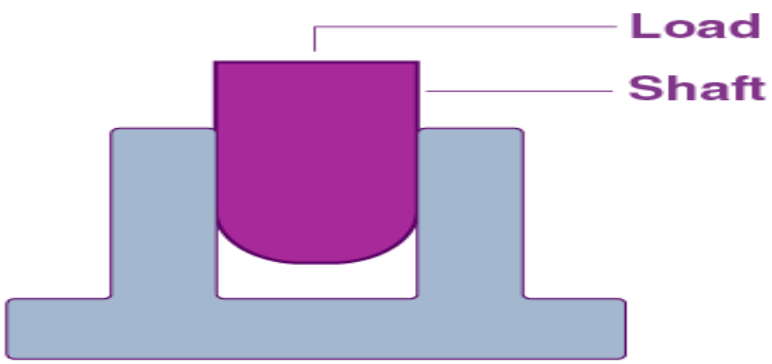
1.Completely Constrained Motion

Completely constrained motion is when the motion of the pair is limited to one direction, irrespective of the direction of the applied force. For example, a rectangular shaft moving in one direction in a rectangular hole is a completely constrained motion. The shaft cannot rotate or move in any other direction.



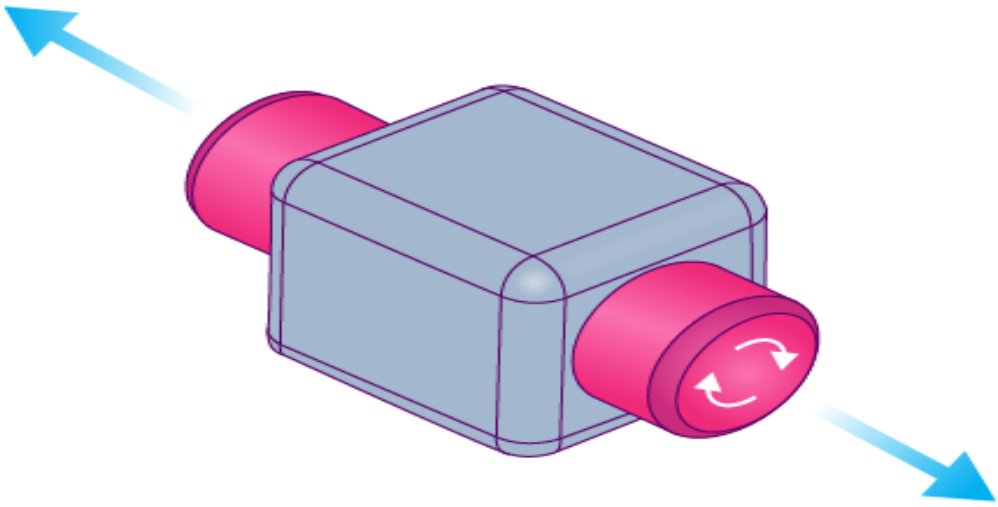
2.Partially or Successfully Constrained Motion

In partially constrained motion, when there is no external force applied the motion will be in more than one direction, but when an external force is applied the motion is restricted to a single direction. Partially constrained motion is also called successfully constrained motion. The footstep bearing moving in only one direction when an external force is applied is an example of partially constrained motion.



3.Incompletely Constrained Motion

In an incompletely constrained motion, the motion between the pair can take place in more than one direction. A circular shaft moving in a circular hole is an example of incompletely constrained motion.

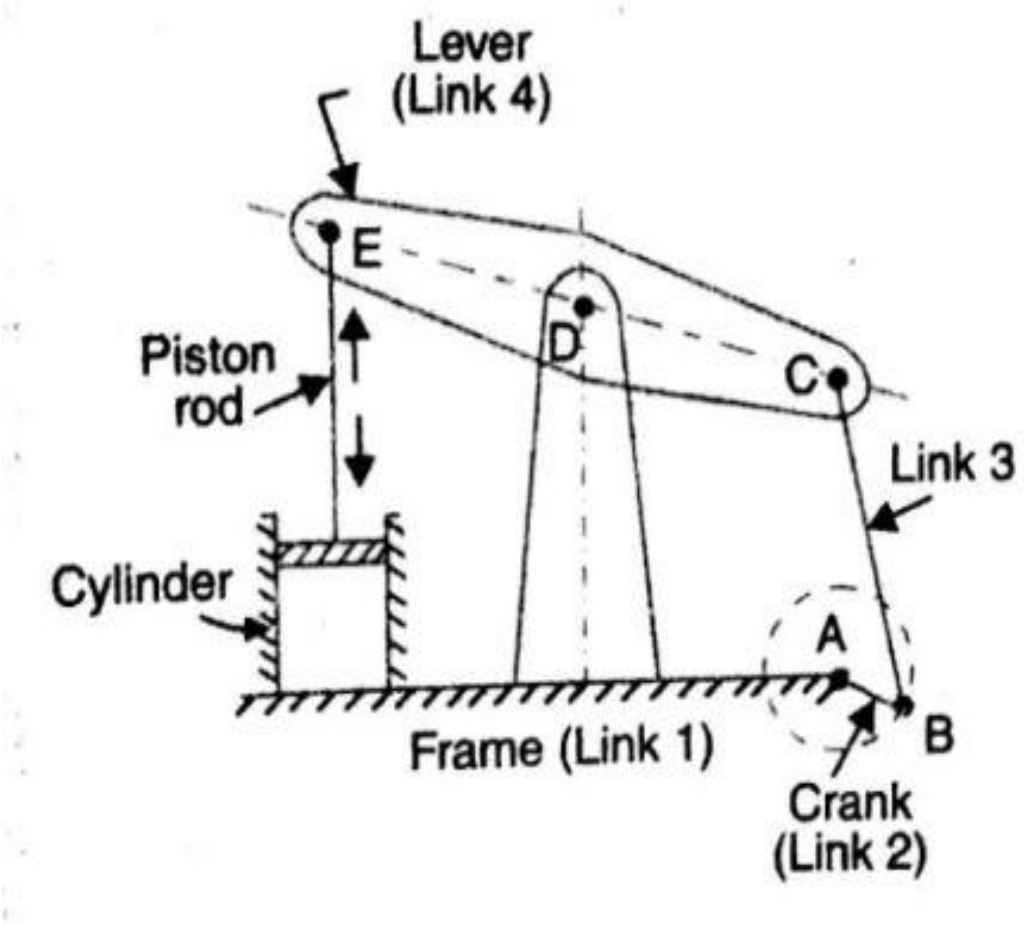


Q15. What are the the different inversions of 4 bar chain?

ANSWER-

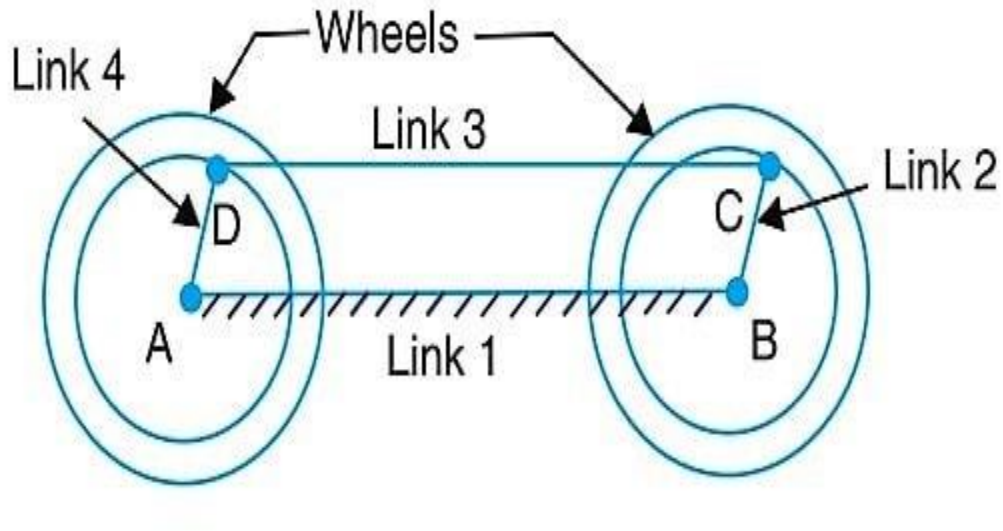
1) BEAM ENGINE(CRANK AND LIVER MECHANISM)

The main purpose of Beam engine is used to convert the rotary motion in to reciprocating motion. It is a part of the mechanism of a beam engine this is also known as Crank and liver mechanism, which consist of four links, in this mechanism when the Crank rotates about a fixed center A , the liver oscillates about a fixed center D the end E of the liver CDE is connected to the position rod which reciprocates due to the rotation of the crank. .



2) COUPLING ROD OF A LOCOMOTIVE

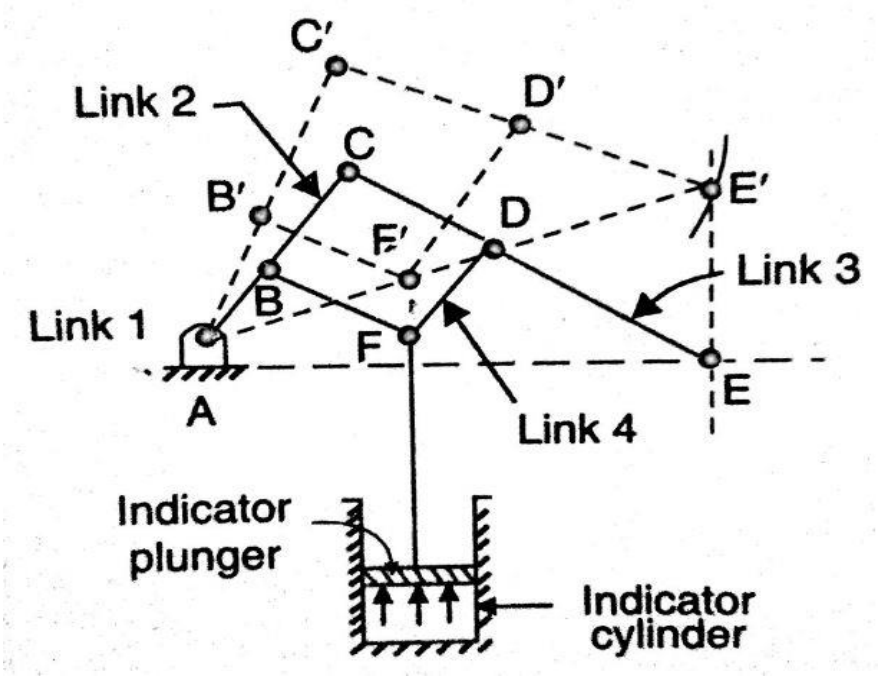
The mechanism of a locomotive/double crank contains four links which are AB, BC, CD and AD. In this links AB link is a fixed one, both AB and BC links acts as Crank. and Link CD acts as Coupling rod. Fixed link of AB maintains constant distance from one center of circle to next center of circle. This type of mechanism is used to transfer the motion from one wheel to the next wheel, the motion transfer one wheel to another wheel is a rotary motion, which helps in moving the vehicle.



3) Watt's indicator mechanism:

A Watt's indicator mechanism also known as Double lever mechanism that consists of four links, is shown in figure 17. The four links are: fixed link 1, link AC with link CE and link BFD. It is noted that BF and FD form one link because these two parts have no relative motion among them. The link of CE and BFD act as lever. The displacement vector of the link BFD is directly proportional to the pressure of gas that acts on the indicator plunger. On any small displacement of the mechanism, the tracing point of E at end of link CE trace out approximately straight line.

The initial position of the mechanism is shown in figure 17 by full lines where the dotted line indicate the position of the mechanism when the gas acts on the indicator plunger

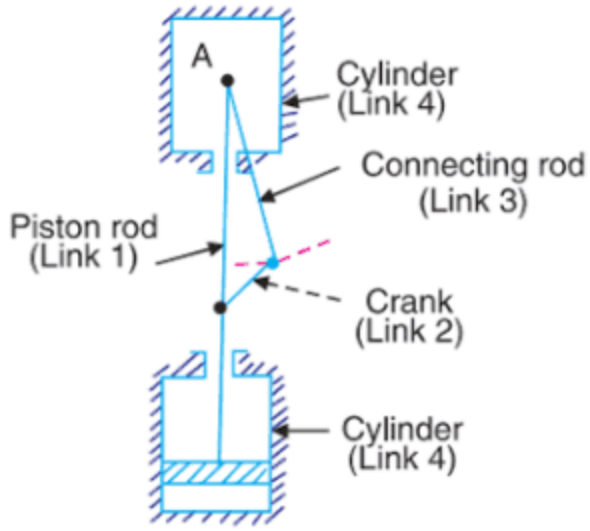


Q 16. What are inversions of single slider crank mechanism?

ANSWER-

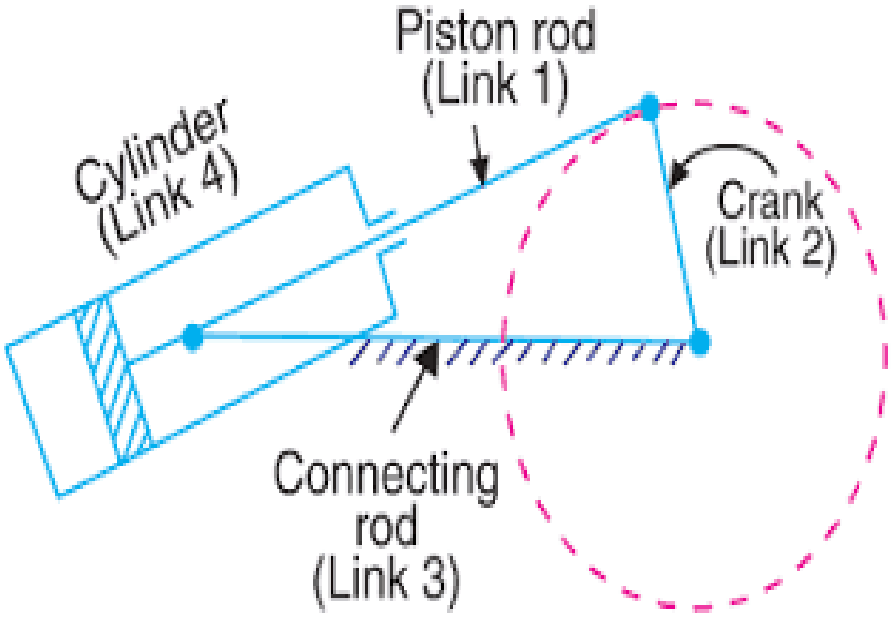
1) <u>pendulum engine:</u>

In this mechanism, the inversion is obtained by fixing the cylinder or link 4 (i.e. sliding pair), as shown in Fig. In this case, when the crank (link 2) rotates, the connecting rod (link 3) oscillates about a pin pivoted to the fixed link 4 at A and the piston attached to the piston rod (link 1) reciprocates. The duplex pump which is used to supply feed water to boilers have two pistons attached to link 1, as shown in Fig.



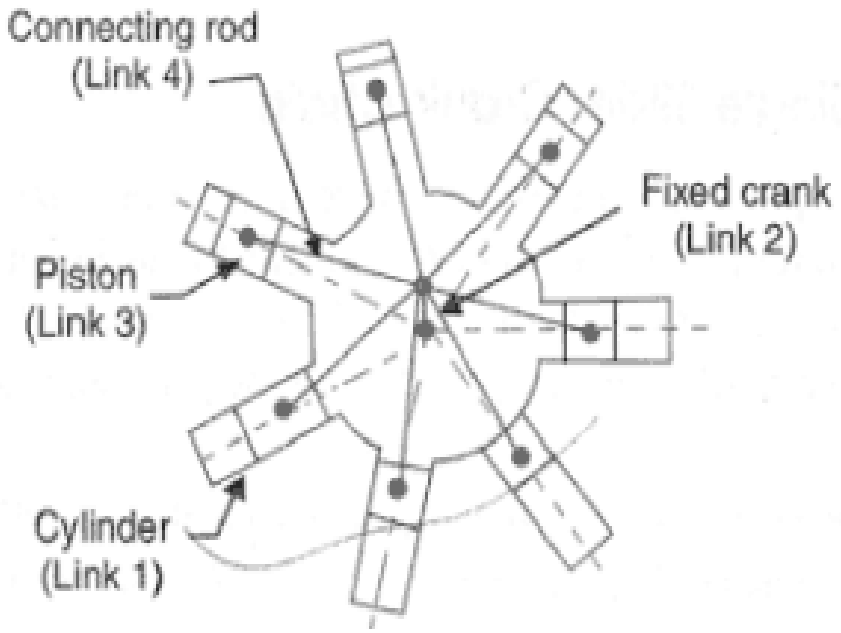
2) Oscillating Cylinder Engine;

The arrangement of oscillating cylinder engine mechanism, as shown in Fig. is used to convert reciprocating motion into rotary motion. In this mechanism, the link 3 forming the turning pair is fixed. Link 3 corresponds to the connecting rod of a reciprocating steam engine mechanism. When the crank (link 2) rotates, the piston attached to the piston rod (link 1) reciprocates and the cylinder (link 4) oscillates about a pin pivoted to the fixed link at A.



3) Rotary Engine :

Sometimes back, rotary internal combustion engines were used in aviation. But nowadays gas turbines are used in its place. It consists of seven cylinders in one plane and all revolves about fixed center D, as shown in Fig. while the crank (link 2) is fixed. In this mechanism, when the connecting rod (link 4) rotates, the piston (link 3) reciprocates inside the cylinders forming link 1.



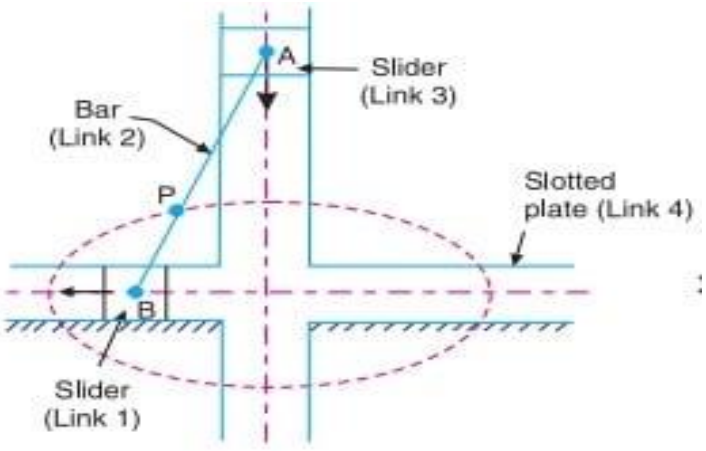
Q.17. What are different inversions of double slider chain mechanism?

ANSWER-

1) Elliptical trammels:

It is an instrument used for drawing ellipses. This inversion is obtained by fixing the slotted plate (link 4). The fixed plate or link 4 has two straight grooves cut in it, at right angles to each other. The link 1 and link 3, are known as sliders and form

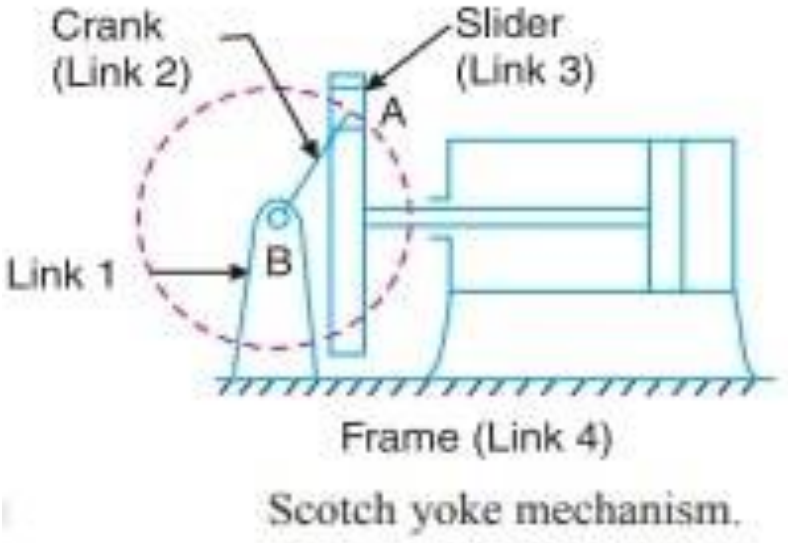
sliding pairs with link 4. The link A B (link 2) is a bar that forms a turning pair with links 1 and 3.



Elliptical trammels.

2) Scotch yoke mechanism:

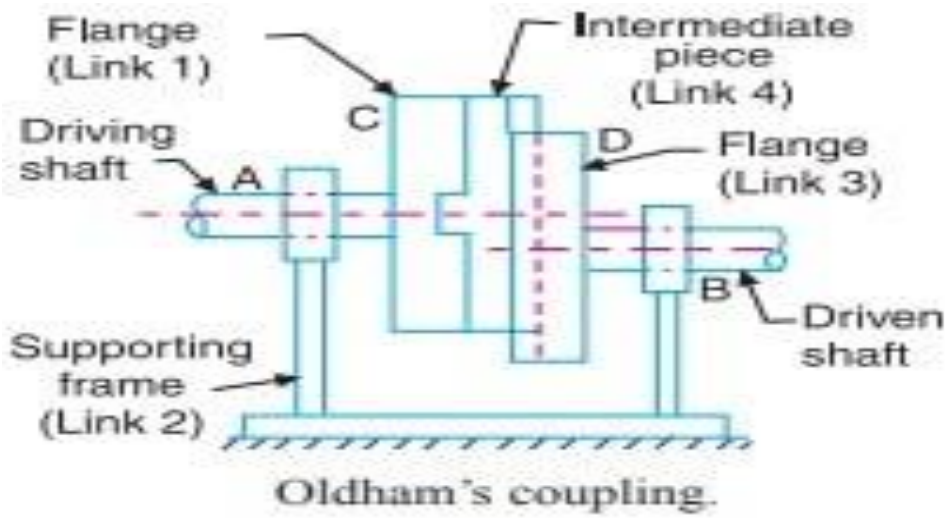
This mechanism is used for converting rotary motion into a reciprocating motion. The inversion is obtained by fixing either the link 1 or link 3. In this, link 1 is fixed. When the link 2 (which corresponds to crank) rotates about B as center, the link 4 (which corresponds to a frame) reciprocates. The fixed link 1 guides the frame.



Scotch yoke mechanism.

3) Oldham's coupling:

An Oldham's coupling is used for connecting two parallel shafts whose axes are at a small distance apart. The shafts are coupled in such a way that if one shaft rotates, the other shaft also rotates at the same speed. This inversion is obtained by fixing the link 2, the shafts to be connected have two flanges (link 1 and link 3) rigidly fastened at their ends by forging.



Oldham's coupling.

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