Rajasthan Institute of Engineering & Technology, Jaipur

I Mid Term Examination, Feb-2018

Session: 2017-18

B.Tech. MECHANICAL Engg. I Year IISem

Basic Mechanical Engineering (ME102)

Set: A

 Time: 2 Hrs. [Maximum Marks: -20]

Solution 1

The First Law of Thermodynamics

The first law of thermodynamics, also known as Law of Conservation of Energy, states that energy can neither be created nor destroyed; energy can only be transferred or changed from one form to another. For example, turning on a light would seem to produce energy; however, it is electrical energy that is converted.

A way of expressing the first law of thermodynamics is that any change in the internal energy (∆E) of a system is given by the sum of the heat (q) that flows across its boundaries and the work (w) done on the system by the surroundings:

ΔE=q+wΔE=q+w

This law says that there are two kinds of processes, heat and work, that can lead to a change in the internal energy of a system. Since both heat and work can be measured and quantified, this is the same as saying that any change in the energy of a system must result in a corresponding change in the energy of the surroundings outside the system. In other words, energy cannot be created or destroyed. If heat flows into a system or the surroundings do work on it, the internal energy increases and the sign of q and w are positive. Conversely, heat flow out of the system or work done by the system (on the surroundings) will be at the expense of the internal energy, and q and w will therefore be negative.

The Second Law of Thermodynamics

The second law of thermodynamics says that the entropy of any isolated system always increases. Isolated systems spontaneously evolve towards thermal equilibrium—the state of maximum entropy of the system. More simply put: the entropy of the universe (the ultimate isolated system) only increases and never decreases.

A simple way to think of the second law of thermodynamics is that a room, if not cleaned and tidied, will invariably become more messy and disorderly with time – regardless of how careful one is to keep it clean. When the room is cleaned, its entropy decreases, but the effort to clean it has resulted in an increase in entropy outside the room that exceeds the entropy lost.

OR

Activities of industrial engineering

* Industrial engineers determine the most effective ways to use the basic factors of production — people, machines, materials, information, and energy — to make a product or to provide a service.
* They are the bridge between management goals and operational performance.
* They are more concerned with increasing productivity through the management of people, methods of business organization, and technology than are engineers in other specialties, who generally work more with products or processes.

Most important activities of industrial engineering are:

* Development of time standards, costing and performance standards.
* Selection of processes and assembling methods.
* Selection and design of tools and equipment.
* Design of facilities including plant location, layout of building, machines and equipment, material handling system raw materials and finished goods storage facilities.
* Design and improvement of planning and control systems for production, inventory, quality and plant maintenance and distribution systems.
* Cost control systems.
* Development and installation of job evaluation systems.
* Installation of wage incentive schemes.
* Design and installation of value engineering and analysis system.
* Operation research.
* Mathematical and statistical analysis.
* Performance evaluation.
* Organization and methods.
* Supplier selection and evaluation

Solution 2

|  |
| --- |
| 2. StressesStress is defined as the internal resistance set up by a body when it is deformed. It is measured in N/m2 and this unit is specifically called Pascal (Pa). A bigger unit of stress is the mega Pascal (MPa). 1 Pa = 1N/m2, 1MPa = 106 N/m2 =1N/mm2.2.1. Three Basic Types of StressesBasically three different types of stresses can be identified. These are related to the nature of the deforming force applied on the body. That is, whether they are tensile, compressive or shearing. |
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|  |
| 2.1.1. Tensile StressTensile StressConsider a uniform bar of cross sectional area A subjected to an axial tensile force P. The stress at any section x-x normal to the line of action of the tensile force P is specifically called tensile stress pt . Since internal resistance R at x-x is equal to the applied force P, we have, pt = (internal resistance at x-x)/(resisting area at x-x)=R/A=P/A. Under tensile stress the bar suffers stretching or elongation. |
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|   |
| 2.1.2. Compressive StressIf the bar is subjected to axial compression instead of axial tension, the stress developed at x-x is specifically called compressive stress pc. pc =R/A = P/A.Compressive StressUnder compressive stress the bar suffers shortening. |
|   |
| 2.1.3. Shear StressConsider the section x-x of the rivet forming joint between two plates subjected to a tensile force P as shown in figure.Shear Stress |
|   |
| The stresses set up at the section x-x acts along the surface of the section, that is, along a direction tangential to the section. It is specifically called shear or tangential stress at the section and is denoted by q.q =R/A=P/A. |

OR

Stress concentration is localization of high stresses mainly due to discontinuities in continuum, abrupt changes in cross section and due to contact stresses. To study the effect of stress concentration and magnitude of localized stresses, a dimensionless factor called Stress Concentration Factor (SCF), Kt as defined by Eq. (1) is used. Kt = σ max / σnom (1) where ζmax is maximum stress at the discontinuity and ζnom is nominal or background stress. A rectangular isotropic or orthotropic plate with circular hole under different types of loading have found wide application in various fields of engineering like in automobiles, marine, aerospace and in other engineering structures. In these plates SCF is affected by many parameters viz. plate length, diameter of holes, dimensions of discontinuity, thickness of plate, elastic constants and many more. For design of such plates with holes/singularities, knowledge of deflection, stresses and stress concentration are required.

Solution 3

|  |  |
| --- | --- |
| Cold working  |  Hot working |
|  1 |  It is done at a temperature below the recrystallization temperature. |  Hot working is done at a temperature above recrystallization temperature. |
|  2. |  It is done below recrystallization temperature so it is accomplished by strain hardening. |  Hardening due to plastic deformation is completely eliminated. |
|  3. |  Cold working decreases mechanical properties of metal like elongation, reduction of area and impact values. |  It increases mechanical properties. |
|  4. |  Crystallization does not take place. |  Crystallization takes place. |
|  5. |  Material is not uniform after this working. |  Material is uniform thought. |
|  6. |  There is more risk of cracks. |  There is less risk of cracks. |
|  7. |  Cold working increases ultimate tensile strength, yield point hardness and fatigue strength but decreases resistance to corrosion. |  In hot working, ultimate tensile strength, yield point, corrosion resistance are unaffected. |
|  8. |  Internal and residual stresses are produced. |  Internal and residual stresses are not produced.  |
|  9. | Cold working required more energy for plastic deformation. | It requires less energy for plastic deformation because at higher temperature metal become more ductile and soft. |
|  10. | More stress is required. | Less stress required. |
|  11. | It does not require pickling because no oxidation of metal takes place. | Heavy oxidation occurs during hot working so pickling is required to remove oxide. |
|  12. | Embrittlement does not occur in cold working due to no reaction with oxygen at lower temperature. | There is chance of embrittlement by oxygen in hot working hence metal working is done at inert atmosphere for reactive metals. |

OR

ccording to the World Steel Association, there are over 3,500 different grades of [steel](https://www.thebalance.com/metal-profile-steel-2340175), encompassing unique physical, chemical, and environmental properties.

In essence, steel is composed of iron and carbon, although it is the amount of carbon, as well as the level of impurities and additional alloying elements that determine the properties of each steel grade.

The carbon content in steel can range from 0.1-1.5%, but the most widely used grades of steel contain only 0.1-0.25% carbon.

Elements such as [manganese](https://www.thebalance.com/metal-profile-manganese-2340143), phosphorus, and sulfur are found in all grades of steel, but, whereas manganese provides beneficial effects, phosphorus and sulfur are deleterious to steel's strength and durability.

Different types of steel are produced according to the properties required for their application, and various grading systems are used to distinguish steels based on these properties. According to the [American Iron and Steel Institute](http://www.steel.org/) (AISI), steel can be broadly categorized into four groups based on their chemical compositions:

1. Carbon Steels
2. Alloy Steels
3. [Stainless Steels](https://www.thebalance.com/metal-profile-austenitic-stainless-2340126)
4. Tool Steels

### Carbon Steels

Carbon steelscontain trace amounts of alloying elements and account for 90% of total steel production. Carbon steels can be further categorized into three groups depending on their carbon content:

* Low Carbon Steels/Mild Steels contain up to 0.3% carbon
* Medium Carbon Steels contain 0.3 – 0.6% carbon
* High Carbon Steels contain more than 0.6% carbon

### Alloy Steels

[Alloy steels](https://www.thebalance.com/common-steel-alloying-agents-properties-and-effects-2340004) contain alloying elements (e.g. manganese, silicon, [nickel](https://www.thebalance.com/metal-profile-nickel-2340147), [titanium](https://www.thebalance.com/metal-profile-titanium-2340158), [copper](https://www.thebalance.com/what-is-copper-2340037), [chromium](https://www.thebalance.com/metal-profile-chromium-2340130), and [aluminum](https://www.thebalance.com/metal-profile-aluminum-2340124)) in varying proportions in order to manipulate the steel's properties, such as its [hardenability](https://www.thebalance.com/precipitation-hardening-2340019), [corrosion](https://www.thebalance.com/what-is-corrosion-2339700) resistance, [strength](https://www.thebalance.com/strength-in-metallurgy-2340023), formability, weldability or ductility.

Applications for alloys steel include pipelines, auto parts, transformers, power generators and electric motors.

### Stainless Steels

Stainless steelsgenerally contain between 10-20% chromium as the main alloying element and are valued for high corrosion resistance. With over 11% chromium, steel is about 200 times more resistant to corrosion than mild steel. These steels can be divided into three groups based on their crystalline structure:

* Austenitic: Austenitic steels are non-magnetic and non heat-treatable, and generally contain 18% chromium, 8% nickel and less than 0.8% carbon. [Austenitic steels](https://www.thebalance.com/metal-profile-austenitic-stainless-2340126) form the largest portion of the global stainless steel market and are often used in food processing equipment, kitchen utensils, and piping.
* Ferritic: [Ferritic steels](https://www.thebalance.com/metal-profile-ferritic-stainless-steel-2340133) contain trace amounts of nickel, 12-17% chromium, less than 0.1% carbon, along with other alloying elements, such as [molybdenum](https://www.thebalance.com/metal-profile-molybdenum-2340145), aluminum or titanium. These magnetic steels cannot be hardened by [heat treatment](https://www.thebalance.com/what-happens-when-metals-undergo-heat-treatment-2340016) but can be strengthened by [cold working](https://www.thebalance.com/what-is-cold-working-2340011).
* Martensitic: Martensitic steels contain 11-17% chromium, less than 0.4% nickel, and up to 1.2% carbon. These magnetic and heat-treatable steels are used in knives, cutting tools, as well as dental and surgical equipment.

### Tool Steels

Tool steels contain [tungsten](https://www.thebalance.com/metal-profile-tungsten-2340159), molybdenum, [cobalt](https://www.thebalance.com/metal-profile-cobalt-2340131) and vanadium in varying quantities to increase heat resistance and durability, making them ideal for cutting and drilling equipment.

[Steel products](https://www.thebalance.com/steel-production-2340173) can also be divided by their shapes and related applications:

* Long/Tubular Products include bars and rods, rails, wires, angles, pipes, and shapes and sections. These products are commonly used in the automotive and construction sectors.
* Flat Products include plates, sheets, coils, and strips. These materials are mainly used in automotive parts, appliances, packaging, shipbuilding, and construction.
* Other Products include valves, fittings, and flanges and are mainly used as piping materials.

Solution 4

Pumps are the mechanical devices that convert mechanical energy into hydraulic energy. They are generally used to raise the water or other fluids from lower elevation to higher elevation. So pumps are generally classified into centrifugal pump and positive displacement pump. Centrifugal pumps are non- positive displacement pumps. They work on the principle of centrifugal action.



**Centrifugal pump** works on the principle that a fluid of mass is given a force it is thrown outward radially. The main parts of the centrifugal pump include
• Suction eye
• Vanes
• Impeller
• Casing
• Suction pipe
• Discharge pipe

The suction pipe is connected to the sump or a ground level tank from where the fluid has to be pumped. The suction pipe at the sump is connected with strainer thus restricting any foreign particles entering into the pump. Generally as the length of the suction pipe is less the friction loss also will be less.

The other end of the suction pipe is connected to the suction eye of the pump. The suction eye is the first point of entry of water into pump. The discharge pipe is connected to the above level where the fluid has to be delivered.

Since the length of the discharge pipe is long the friction loss will also be higher at the discharge end.
The casing of the pump is designed of gradually increasing cross sectional area. It means that velocity of the fluid is decreased inorder to attain pressure energy. So the casing does the work of reducing the velocity of the fluid.

## Types of impeller in centrifugal pump

The impeller rotates to create a pressure drop in the suction side. The pressure drop is much below the atmospheric pressure and hence the water gets into the pump. In the pump the impeller provides the centrifugal action to the fluid. So this impeller can be of various types depending on the fluid on which it is operated. The types of impeller are
• Open impeller
• Closed impeller
• Semi-closed impeller

Open **impeller** is used for pumping of solid waste or sewage from water treatment plants. Semi closed impeller is also used for water and other fluid applications. In case of pumping any corrosive or hazardous material closed type impeller can be used.

## Centrifugal pump and it's casing

So the pump casing can also be differed in different ways
• Volute casing
• Vortex casing
• Volute casing with diffuser

In order to increase the performance of the pump a small chamber called vortex is provided around the impeller. This helps in increasing the static pressure energy of the fluid thus increase in pressure.
**Diffuser** is a set of stationary vanes surrounding the impeller. The function of the diffuser is to increase the efficiency by gradual increase in annular space hence reducing velocity and thus increasing pressure.
OR

Diesel engine, also known as compression ignition (C.I.) engine is widely used in automobile industries. Big vehicles such as truck, bus, locomotive engine etc. used diesel engine as the power unit because of its higher torque and greater mileage than petrol engine.

The ignition temperature of diesel is lower than petrol so the working of diesel engine is slightly different than petrol engine.

Working of a four stroke Diesel engine

Power generation in four stroke is divided into four parts namely suction stroke, compression stroke, expansion stroke (power stroke) and exhaust stroke.

Suction stroke:

In the suction stroke of diesel engine the piston start moves from Top Dead Centre (TDC) of the cylinder to Bottom Dead Centre (BDC) of the cylinder and simultaneously inlet valve opens. At this time air at atmospheric pressure drawn inside the cylinder through the inlet valve due to the suction created. The inlet valve remains open until the piston reaches the BDC of cylinder (not practically but theoretically.).

Pls note: All the images shows a spark plug but that is not present in Compression ignition Engine.

Compression stroke:

After the piston passes BDC of the cylinder, it starts moving up. Both valves are closed and hence the cylinder is sealed. The piston moves upward. This movement of piston compresses the air into a small space between the piston and TDC of cylinder . The air is compressed into 1/22 (compression ratio: 22, varies from engine to engine) or less of its original volume. Due to this compression a high pressure and temperature is generated inside the cylinder. Both the inlet and exhaust valves do not open during any part of this stroke. At the end of compression stroke the piston is at TDC the cylinder.

Power stroke:

At the end of the compression stroke when the piston is at TDC a pre metered quantity of diesel is injected into the cylinder by the injector. The temperature inside the cylinder is very high which is sufficient to ignite the fuel injected and this generates tremendous energy which is in the form of high pressure which pushes down the piston. The connection rod carries this force to the crankshaft which turns to move the vehicle. At the end of power stroke the piston reaches the BDC.

Exhaust stroke:

When the piston reaches the BDC after the power stroke, the exhaust valve opens. The pressure of the burnt gases is higher than atmospheric pressure. This pressure difference allows burnt gases to escape through the exhaust port and the piston move through the TDC. At the end of exhaust all burn gases escape (theoretically) and exhaust valve is closed.

The cycle repeats…

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Basic Mechanical Engineering (ME102)

Set: B

 Time: 2 Hrs. [Maximum Marks: -20]

Solution 1

1 State: When all the properties of system have a definite value, then the system is in a definite state. Whenever there is change in anyone of the property, then the system is said to have a change of state.

2 Path: If all the change of states of system are plotted and all the points are conned, then the line joining the change of states of the system is called the path.

3 Process: When the path connecting the change of states of the system is specified, then this path is called Process. Example: constant pressure process, constant volume process etc.

4 Cycle:  When a system goes through different change of states and return backs to the original state, i.e., all the properties are identical to the original state, then the system is said have gone through a thermodynamic cycle.

OR

Most important activities of industrial engineering are:

* Development of time standards, costing and performance standards.
* Selection of processes and assembling methods.
* Selection and design of tools and equipment.
* Design of facilities including plant location, layout of building, machines and equipment, material handling system raw materials and finished goods storage facilities.
* Design and improvement of planning and control systems for production, inventory, quality and plant maintenance and distribution systems.
* Cost control systems.
* Development and installation of job evaluation systems.
* Installation of wage incentive schemes.
* Design and installation of value engineering and analysis system.
* Operation research.
* Mathematical and statistical analysis.
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Solution 2

Stress concentration is localization of high stresses mainly due to discontinuities in continuum, abrupt changes in cross section and due to contact stresses. To study the effect of stress concentration and magnitude of localized stresses, a dimensionless factor called Stress Concentration Factor (SCF), Kt as defined by Eq. (1) is used. Kt = σ max / σnom (1) where ζmax is maximum stress at the discontinuity and ζnom is nominal or background stress. A rectangular isotropic or orthotropic plate with circular hole under different types of loading have found wide application in various fields of engineering like in automobiles, marine, aerospace and in other engineering structures. In these plates SCF is affected by many parameters viz. plate length, diameter of holes, dimensions of discontinuity, thickness of plate, elastic constants and many more. For design of such plates with holes/singularities, knowledge of deflection, stresses and stress concentration are required.

OR

Definition: It is defined as the ratio of tensile
[stress](http://www.mechanicalbooster.com/2016/09/what-is-stress.html) or [compressive stress](http://www.mechanicalbooster.com/2016/09/types-of-stress.html) to the corresponding [strain](http://www.mechanicalbooster.com/2015/07/what-is-strain.html) within elastic limit. It
is denoted by symbol E. It is also known as modulus of elasticity or elastic modulus.



Where

E = Young’s Modulus

σ = Tensile or compressive stress

e = Tensile or compressive strain

* The SI unit of Youngs modulus is N/mm2.

Modulus of Rigidity

Definition: It is defined as the ratio of shear stress to
corresponding shear strain within [elastic limit](http://www.mechanicalbooster.com/2016/09/what-is-elasticity-elastic-limit-youngs-modulus-modulus-of-rigidity.html). It is also known as shear modulus. It
is represented by C or G or N.



Where

τ = Shear stress

ɸ = Shear strain

* The SI unit of C is N/mm2

Bulk Modulus

Definition: It is defined as the ratio of direct stress to the
corresponding volumetric strain within elastic limit. It is denoted by K.



σ = Direct stress

(dV/V) = Volumetric strain

* The SI unit of C is N/mm2

Difference Between Young’s Modulus, Modulus of Rigidity and Bulk
Modulus.

|  |  |  |  |
| --- | --- | --- | --- |
| S.no | Young’s Modulus | Modulus of Rigidity | Bulk Modulus |
| 1. | It is the ratio of tensile or compressive stress to the correspondingstrain within elastic limit. | It is the ratio of shear stress to the corresponding shear strain withinelastic limit. | It is the ratio of directstress to the corresponding volumetric strain within elastic limit. |
| 2. | It is denoted by E. | It is denoted by C or G or N. | It is denoted by K. |
| 3. | E = stress/ strain | C = shear stress/shear strain | K = direct stress/ volumetric strain. |

This is all about the Elastic constant – Young’s modulus, modulus

Solution 3

Types of Heat Treatment and Their Effect on Metal Properties

The properties of steel or other ferrous metals are mainly altered by heating the metals. The effect of heating the metals to a particular temperature level like the lower critical limit temperature or the higher critical temperature tends to alter various qualities of the material. Parameters like toughness, tensile strength, wear resistance, etc. are greatly improved due to the heat treatment process. The only criterion that plays an important role in heat treatment is the presence of carbon in steels and other ferrous metals. The amount of carbon present in the steel determines the type of heat treatment that can be carried out on it.

There are various processes of heat treatment which are mainly used depending on the applications that the metal is subjected to. Processes like annealing are used to improve the machinability of the steel.

1. Processes like stress relieving and annealing are used reduce the internal stress developed in the material during its course of manufacture like forging, welding, etc. Further, the [annealing process](http://www.brighthubengineering.com/manufacturing-technology/30476-what-is-heat-treatment/) tends to improve the machinability of the material to a very great extent.

* [Annealing - The various methods and their areas of application](http://www.brighthubengineering.com/manufacturing-technology/50523-heat-treatment-of-steels-annealing/)

2. Case hardening and through-hardening tend to improve the hardness of the material to a great extent, thereby increasing the material's wear-resistance property. The two methods are dependent on the amount of carbon present in the steel. Low carbon steel can only be case hardened. Medium and high carbon steels can be through-hardened and surface hardened by using surface hardening methods.

* [Basics of Case Hardening](http://www.brighthubengineering.com/manufacturing-technology/65167-case-hardening-steel-and-metals/)
* [Method of Case Hardening of Low Carbon Steels](http://www.brighthubengineering.com/manufacturing-technology/119103-low-carbon-steel-case-hardening-process/)

3. Tempering is an important process in heat treatment that eliminates the brittleness in the material after other heat treatment processes and provides a uniform grain structure of the material. The process tends to improve the toughness of the material to a very great extent.

* [Process of Tempering](http://www.brighthubengineering.com/manufacturing-technology/74097-heat-treatment-annealing-and-tempering/)

4. Carburizing is a method of increasing the carbon content in a material by inducing carbon into it. This process in particular enhances the hardenability of the case of the material.

* [Carburization and its Types](http://www.brighthubengineering.com/manufacturing-technology/65175-carburizing-techniques-what-is-carburization/)

5. Nitriding is a process of improving the wear resistance of the material, which can be done even after the completed machining process of the component. Cementation is another process for improving the surface hardness of the material thermo-chemically, though it is not used much these days. Here are some articles that will explain in detail on each of the above processes.

OR

Basically **Engineering Materials** Can be classified into two categories-

1. **Metals**
2. **Non-Metals**

### Metals

**Metals** are polycrystalline bodies which are having number of differentially oriented fine crystals. Normally major metals are in solid states at normal temperature. However, some metals such as mercury are also in liquid state at normal temperature. All metals are having high thermal and [electrical conductivity](https://www.electrical4u.com/electrical-conductivity-of-metal-semiconductor-and-insulator/). All metals are having positive temperature coefficient of resistance. Means resistance of metals increase with increase of temperature. Examples of metals – Silver, Copper, Gold, Aluminum, Iron, Zinc, Lead, Tin etc. Metals can be further divided into two groups-

1. Ferrous Metals – All ferrous metals are having iron as common element. All ferrous materials are having very high permeability which makes these materials suitable for construction of core of electrical machines. Examples: Cast Iron, Wrought Iron, Steel, Silicon Steel, High Speed Steel, Spring Steel etc.
2. Non-Ferrous Metals - All non-ferrous metals are having very low permeability. Example: Silver, Copper, Gold, Aluminum etc.
3. Non-Metals
4. Non-Metal materials are non-crystalline in nature. These exists in amorphic or mesomorphic forms. These are in both solid & gases forms at normal temperature. Normally all non-metals are bad conductor of heat and electricity. Examples: Plastics, Rubber, Leathers, Asbestos etc. As these non-metals are having very high [resistivity](https://www.electrical4u.com/electrical-resistance-and-laws-of-resistance/) which makes them suitable for insulation purpose in electrical machines.

Solution 4

Working Principles of 2-Stroke petrol engine

The working principle of 2-Stroke petrol engine is discussed below:-

1) 1st Stroke: To start with let us assume the piston to be at its B.D.C. position. The arrangement of the ports is such that the piston performs two jobs simultaneously.

As the piston starts rising from its B.D.C. position it closes the transfer port and the exhaust port. The charge (mixture, of the air and petrol) which is already there in the cylinder, as the result of the previous running of the engine is compressed at the same time with the upward movement of the piston vacuum is created in the crank case (which is gas tight). As son as the inlet port is uncovered; the fresh change in sucked in the crank case. The charging is continued until the crank case and the space in the cylinder beneath the piston is filled with the charge. As the end of third stroke, the piston reached the T.D.C. position.

2) 2nd Stroke: Slightly before the completion of the compression stroke, the compressed charge is ignited by means of a spark produced at the spark plug.



**Figure of Two stroke SI Engine**

Pressure is exerted on the crank of the piston due to the combustion of the piston is pushed in the downward direction producing some useful power. The downward movement of the will first close the inlet port and then it will compress the charge already sucked in the crank case.

Just the end of power stroke, the piston uncovered the exhaust port and the transfer port simultaneously the expanded gases start escaping through the exhaust port and the same time the fresh charge which is already compressed in the crank case, rushed into the cylinder through the transfer port and thus the cycle is repeated again.

OR

**DIAGRAM:**



**CONTRUCTION DETAILS OF A RECIPROCATIN PUMP:**

Components of reciprocating pumps:-

a) Piston or plunger: – a piston or plunger that reciprocates in a closely fitted cylinder.

b) Crank and Connecting rod: – crank and connecting rod mechanism operated by a power source. Power source gives rotary motion to crank. With the help of connecting rod we translate reciprocating motion to piston in the cylinder.

c) Suction pipe: – one end of suction pipe remains dip in the liquid and other end attached to the inlet of the cylinder.

d) Delivery pipe: – one end of delivery pipe attached with delivery part and other end at discharge point.

e) Suction and Delivery value: – suction and delivery values are provided at the suction end and delivery end respectively. These values are non-return values.

**WORKING OF RECIPROCATING PUMP**

Operation of reciprocating motion is done by the power source (i.e. electric motor or i.c engine, etc). Power source gives rotary motion to crank; with the help of connecting rod we translate reciprocating motion to piston in the cylinder (i.e. intermediate link between connecting rod and piston). When crank moves from inner dead centre to outer dead centre vacuum will create in the cylinder. When piston moves outer dead centre to inner dead centre and piston force the water at outlet or delivery value.