## 1. Briefly explain scope of different fields in civil engineering

**1. SURVEYING**:

It is the art of determining the relative position of points on the earth's surface by measuring the horizontal between them. Levelling is the process of determining the position of points in a vertical plane

Surveying are of two types

1) Geodetic survey: the survey in which the shape of the earth is taken in to account is called geodetic surveying

2) Plane survey: the survey in which the shape (or) curvature of earth is not taken in to account is called plane surveying

The scope of surveying and levelling are:

a) To prepare plan and map which help in project implementation (setting out the alignment for a road or railway track or canal, deciding the location for a dam or airport or harbour)

b) To determine the dimensions and contours of any part of the earth surface

c) To establish boundaries of land

d) To measure the areas and volume of land

e) To select suitable site for an engineering project

f) To conduct engineering survey, topographical survey, military survey, mine survey, geological survey, archaeological survey, hydro graphic survey, environmental survey etc..

The Knowledge of surveying is essential in many phases for every engineering project such as buildings, roadways, railways, dams, bridges, tunnels, harbours, mines, water supply and sanitation, pipe line laying, airports etc..

**2. BUILDING MATERIALS**:

Any engineering structure requires a wide range of materials known as building materials. The building materials chosen should have such properties that are safe, economical, eco-friendly and serviceable for the purpose for which they are used

The building materials can be broadly divided into following categories

a. **Traditional materials**: stones, timber, bricks, lime, cement, tar, bitumen, mortar, ferrous and non-ferrous metals etc

b. **Alternative building materials**: mud blocks, concrete blocks, glass, aluminium, paint, flyash etc.

c. **Composite materials:** RCC, fibre reinforced concrete, ferro-cement, composite laminated doors, asbestos sheets, fibre reinforced glass etc.

**3. CONSTRUCTION TECHNOLOGY**:

As land cost is going up there is a demand for tall structures in urban areas, while in rural areas need for low cost construction, one has to develop technology using locally available materials Construction technology comprises of different techniques of construction for different materials under site different condition. The study of construction machinery comes under its purview. The management or organization of men (labour), material, method in relation to site, money and time is the backbone of construction management. It involves almost every branch of engineering, commerce and economics, for; its ultimate aim is to 'achieve the desired construction in the most economical way. A clear knowledge of following points is necessary for reliable construction and its management.

a) Money, Materials, Machines, Manpower, Methodologies,

b) Maintenance, Modernization, Monitoring, Motivations,

c) Managements of all types.

**4. GEO-TECHNICAL ENGINEERING (Soil Mechanics)**:

The load from the structure is to be safely transferred to soil, for this safe bearing capacity of soil is to be properly assessed. This branch of study in civil engineering is called geotechnical engineering, which deals with the study of the properties , behaviour and use of earth materials (soil and rocks) in engineering works

Geotechnical engineering has much wider scope that:

a) It is concerned with the properties of earth materials

b) To investigate the soil and bed rocks below the structure and study the soil structure interaction

c) To select the type of foundation earth works for particular structure

d) To design foundation of building, dams, retaining walls, bridges, road pavement, railway lines etc.

e) To design foundation for underground structure like tunnels, power houses etc.

f) To design foundation for machines such as turbines, compressors etc. to transmit vibrations to foundation soil

g) To study the effect of soil as a medium for blasts during mining, earthquake, landslides and nuclear explosions

h) They include various types of foundations like shallow foundation, deep foundations. Pile foundation, well foundation etc.

**5. STRUCTURAL ENGINEERING :**

A building or a bridge or a dam consists of various elements like foundations, columns, beams, slabs etc. These components are always subjected to forces. Depending upon the materials available the components of the building should be safely and economically designed. A structural engineer is involved in such a designing activity

Scope of structural engineering:

a) The structural engineering plays a vital role in planning, designing and building the structure

b) The structural analysis and structural design are the components of structural engineering

c) The structural engineering should take the responsibility about the safety and serviceability of the structure for its life time

d) The structural engineer should be prepared for to accept the natural calamities like earthquake, wind, landslide etc. and provide remedial measures

**6. HYDRAULICS ENGINEERING :**

Water is an important need for all living beings, study of mechanics of water and its flow characteristics is another important field in civil engineering and its known as hydraulics

Hydraulics mainly deals with the practical problems of flow of water. The concept of fluid pressure, fluid statics, and flow pattern helps in engineering to design the structures like dams, reservoirs, bridges, culverts, sewage system etc. this concept is also used for flow through pipes, pumps, turbines, hydraulic machines etc. Hydroelectric power generation facilities are also included under this aspect.

**7. WATER RESOURCES AND IRRIGATION ENGINEERING :**

Water is to be supplied to agricultural fields and for drinking purposes, hence suitable water resources are to be identified and water is to be stored. Identifying, planning and building water retaining structures like tanks and dams and carrying stored water to agricultural fields through irrigation channels is known as water resources and irrigation engineering

Scope of water resources and irrigation engineering:

a) It facilitates to control, regulate and utilize water to serve wide variety of purposes

b) It gives scope for utilization of water in beneficial purpose by providing water supply, irrigation, hydroelectric power development and navigational improvement

c) Water quality management

d) Scope for recreational use of water resources

e) To protect fish and wild life

f) India being an agricultural country, irrigation will definitely help in the overall development of our country, citizen and improve the civilization

**8. TRANSPORTATION ENGINEERING:**

Transportation means the movement of the men and goods from one point to another. It is as old as civilization

The Transportation system includes road ways, railways, airways and water ways, design, construction and maintenance of railway lines, signal system are part of the transportation engineering.

Scope of water resources and transportation engineering:

a) It contributes to the economic, industrial. Social and cultural development of any country

b) To optimise the transportation cost, maintenance and administrative overheads

c) Planning the transport process with respect to survey and analysis of existing condition and forecasting the future condition

d) It involves accident study for safe and comfort transport system

e) For traffic performance and control

**9. ENVIRONMENTAL ENGINEERING :**

People in every village, town & city need potable water. The water available (surface water & ground water) may not be fit for direct consumption. In such cases, the water should be purified and then supplied to the public. For water purification, sedimentation tanks, filter beds, etc. should be designed. If the treatment plants are for away from the town or city, suitable pipelines for conveying water & distributing it should also be designed.

In a town or city, a part of the water supplied returns as sewage. This sewage should be systematically collected and then disposed into the natural environment after providing suitable treatment. The solid waste that is generated in a town or locality should be systematically collected and disposed of suitably. Before disposal, segregation of materials should be done so that any material can be recycled & we can conserve our natural resources.

Scope of environmental engineering:

a) The study of importance of protection and conservation of our environment

b) The proper distribution of water supply with water treatment facility

c) Solution of problems of environment sanitation with waste water treatment

d) The proper disposal of / recycle of waste water and solid waste

e) Adequate drainage of urban, rural and recreational areas

f) Control of air pollution and provide healthy environment to public

**2. Briefly explain role of civil engineering in infrastructural development on socio economic development of country.**

Infrastructure may be divided into economic infrastructure and social infrastructure

1. **ECONOMIC INFRASTRUCTURE**:

It includes the progressive growth of the country and its economic condition in generating revenue

a) Well-developed cities, towns and village:

The master plan of cities and towns are prepared by civil engineers by using town planning procedures. The plans for each house will be planned by civil engineering and it will be constructed under the supervision of civil engineers.

b) Transportation facilities: transportation facility play a crucial role in the economic and commercial progress of a country by the effort of civil engineers like

i. Providing road ways and railways connecting every corner of a country

ii. Providing airways, where enormous time can be saved

iii. Providing water ways for transporting ores, petroleum products food, grains etc.

c) Water supply and drainage systems: providing a good and assured water supply scheme for drinking, industries, agriculture and other purpose and also an efficient drainage system by collecting the waste treating it properly and final disposal in the form liquid with the help of civil engineering technique

d) Power supply: it is an essential factor for development of country. It includes power plants, solar energy, wind energy, etc. all these can be managed and constructed by civil engineers

e) Irrigation facilities: The economy of the country depends on the agricultural output. Agriculture depends upon the water supply and power. Irrigation includes construction of dams, proper distribution of water through canals and distributaries etc.

2. **SOCIAL INFRASTRUCTURE:**

It includes provides

a) Good health can by providing primary health centres, hospitals with sophisticated instruments and veterinary hospitals for animals health

b) Education facilities: it includes providing education at primary, higher college and professional courses, and technical courses with interdisciplinary education as a new concept

c) Other facilities: wild life conservation, agriculture, industries, communication, agriculture, fire stations for emergency and safety purpose are constructed by the effort of civil engineering Thus the civil engineers play a vital role in contributing the socio-economic development of the country.

**3. Briefly explain the role of civil engineers in infrastructural development of a country.**

The role of Civil Engineers lies in planning the work meticulously and carrying out the designed works systematically to achieve the most optimal and efficient output that help the common people to lead a satisfactory life. They are also responsible for the regular maintenance of the works carried out by them. Following illustrations explain the complexities involved in the works to be carried out by a civil engineer. Civil Engineering constructions vary from very simple routine works to very complicated, huge structures. Everything depends upon the prevailing site conditions which may or may not be favourable for the construction. Environmental conditions, location of the site, site & soil conditions and the like may contribute to all kinds of problems, in addition to unforeseen circumstances which may suddenly creep in. A civil engineer has to think calmly and take judicious and practicable decisions, considering all alternates and their pros and cons.

Civil engineering is much more than erecting skyscrapers or bridges. The civil engineers must have a thorough understanding of the interaction among the various units of construction, among the various structural elements, between the structure and the complex environment. Since constructing a large building or public-works project can involve elaborate planning, civil engineers can be outstanding project managers. They sometimes manage thousands of workers. They also develop advanced computerization and planning policies.

In addition, many civil engineers are also involved with preserving, protecting, or restoring the environment. A growing number of civil engineers are involved in many sensitive and hazardous projects involving huge money such as cleaning up toxic industrial or municipal wastes at abandoned dump sites, reclamation of unsuitable sites for construction, rehabilitation of old / heritage structures, maintaining national forest parks, and restoring the land around mines, oil wells, or factories.

In total, a civil engineer has to perform the role of a planner, a builder, an architect, a management expert, and also an arbitrator.

**4. Briefly explain the impact of infrastructural development?**

The overall development of any country is directly dependent on the infrastructural facilities made available to the people of the country. The positive impact of developing good infrastructural facilities can be summarised as indicated below.

- Self sufficiency in food sector can be achieved
- Foreign exchange can be saved
- Export of surplus food products industrial products is possible.
- Unemployment can be reduced through increased job opportunities
- Prevention of unhealthy urbanisation can be prevented, which in turn solves many problems such as urban congestion, acute housing shortage, traffic problems, crimes, pollution etc.
- Per capita income is increased.
- The living standards of people can be enhanced.
- Public health can be improved

Inflation can be reduced.

- Draught and flood related problems can be controlled / minimised
- Pollution can be controlled
- Literacy level of people can be increased
- Public awareness gets improved

On the other hand, ill planned, ill executed and ill maintained infrastructure development projects have negative impact on the society. Some of them are listed below.

- Small scale industries, handicrafts industries and rural industries are adversely affected.
- Fuel consumption is increased, which has direct impact on foreign exchange.
- Environmental pollution (air, water and ground pollution) continues to increase.
- The culture of the society can be adversely get affected.
- Literacy level of people will come down.
- Health related problems can be on the rise.
- Labour problems will increase.
- Inflation will increase.

If the infrastructure developments are urban centered, then that will lead to uncontrolled urbanisation. This will aggravate the urban housing problems, water supply and sanitation problems and urban traffic congestion. This may also result in an increase in the

crime rate.

If the infrastructural facilities provided are rich people oriented, then the gap between the rich and poor will continue to widen. This results in an unhealthy society, full of crimes and unrest.

**5. What is a force? What are the characteristics or elements of a force?**

**Force:** According to Newton‘s I law, force is defined as an action or agent, which changes or tends to change the state of rest or of uniform motion of a body in a straight line.

**Characteristics of a force**

These are ones, which help in understanding a force completely, representing a force and a lso distinguishing one force from one another.

A force is a vector quantity. It has four important characteristics, which can be listed as follows.

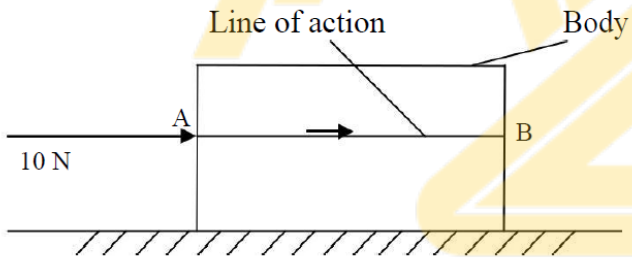
1) **Magnitude**: It can be denoted as 10 kgf or 100 N.

2) **Point of application**: It indicates the point on the body on which the force acts.

3) **Line of action**: The arrowhead placed on the line representing the direction represents it.

4) **Direction**: It is represented by a co-ordinate or cardinal system.

Ex.1: Consider a body being pushed by a force of 10 N as shown in figure below.




The characteristics of the force acting on the body are

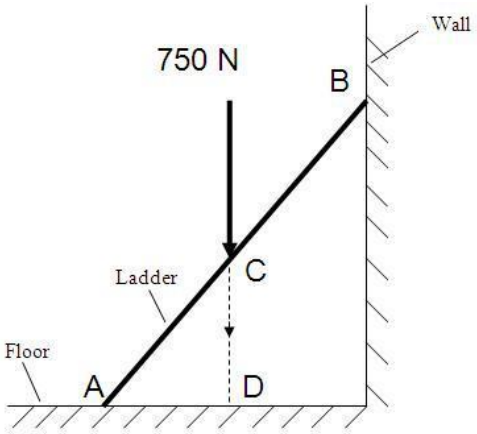
1) Magnitude is 10 N.

2) Point of application is A.

3) Line of action is A to B or AB.

4) Direction is horizontally to right.

Ex.2: Consider a ladder AB resting on a floor and leaning against a wall, on which a person weighing 750 N stands on the ladder at a point C on the ladder.




The characteristics of the force acting on the ladder are

1) Magnitude is 750 N.

2) Point of application is C.

3) Line of action is C to D or CD.

4) Direction is vertically downward

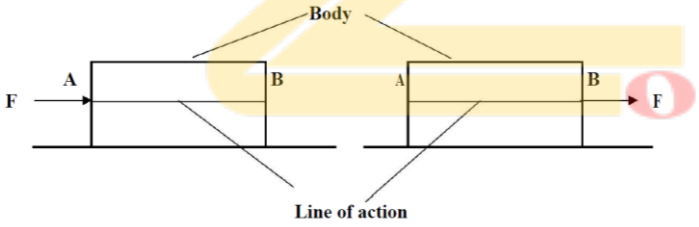
6. **Explain briefly**

**i. principle of transmissiblity of force**

**ii. Law of physical independence of force**

**iii. Law of superposition of force**.

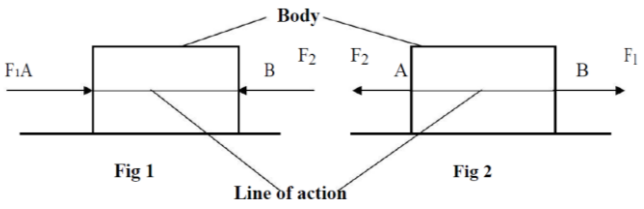
**Principle or Law of transmissibility of forces**: It states, ―The state of rest or of Uniform motion of a rigid body is unaltered if the point of application of the force is Transmitted to any other point along the line of action of the force."




From the above two figures we see that the effect of the force F on the body remains the same when the force is transmitted through any other point on the line of action of the force.

This law has a limitation that it is applicable to rigid bodies only.

**Explanation of limitation:**




In the example if the body considered is deformable, we see that the effect of the two forces

on the body are not the same when they are shifted by principle of transmissibility. In the first case the body tends to compress and in the second case it tends to elongate. Thus principle of transmissibility is not applicable to deformable bodies or it is applicable to rigid bodies only.

**ii. Law of physical independence of force**

This principle states that 'the action of a force on a body is not affected by the action of any other force on the body'.

**iii. Law of superposition of force**

This principle states that the net effect of a system of forces on a body is same as that of the combined effect of individual forces on the body.

## 7. Explain briefly with sketches resolution and composition of force.

**Resolution of a force** : The process of splitting of a force into its two rectangular components (horizontal and vertical) is known as resolution of the force, as shown in Figure 1. In this figure, *F* is the force which makes an angle Θ with the horizontal axis, and has been resolved into two components, namely *Fx* and *Fy*, along the *x*-axis and *y*-axis respectively.

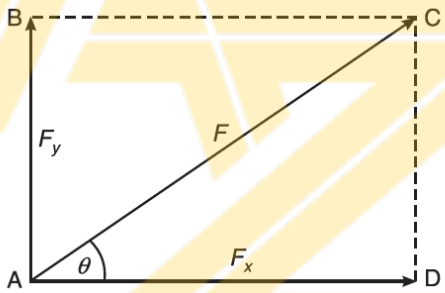



Fig. 1 Resolution of a force

In Δ CAD,

$$\cos\theta = \frac{F_x}{F} \quad \Rightarrow \quad F_x = F\cos\theta$$

$$\sin\theta = \frac{F_y}{F} \quad \Rightarrow \quad F_y = F\sin\theta$$

If, on the other hand, $\theta$ is the angle made by the force $F$ with the vertical axis, then

$$F_y = F\cos\theta\,; \quad F_x = F\sin\theta$$

**Note:** If the force $F$ makes an angle of $\theta$ with the horizontal, the horizontal component of the force is $F\cos\theta$.

Composition of a force : It is the process of combining a number of forces into a single force such that the net effect produced by the single force is equal to the algebraic sum of the effects produced by the individual forces. The single force in this case is called the **resultant force** which produces the same effect on the body as that produced by the individual forces acting together. For example in fig 2,

$\Sigma F_x$ = algebraic sum of the components of the forces along the $x$-axis

i.e. $\Sigma F_x = F_4 + F_1 \cos\theta_1 - F_3 \sin\theta_2$

and $\Sigma F_y$ = algebraic sum of the components of the forces along the $y$-axis

i.e. $\Sigma F_y = -F_2 - F_1 \sin\theta_1 - F_3 \cos\theta_2$

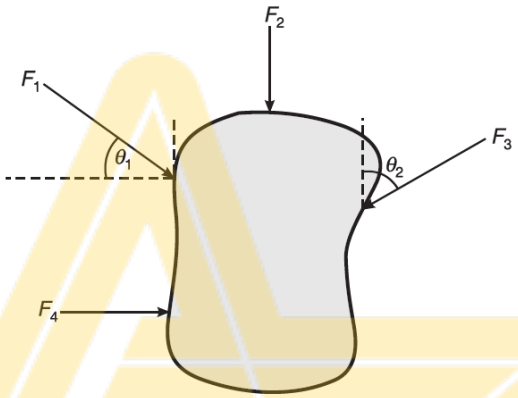



Fig. 2 A body acted upon by number of forces

**8. State and prove parallelogram law of forces**

If two forces are acting simultaneously on a particle and away from the particle, with the two adjacent sides of the parallelogram representing both the magnitude and direction of forces, the magnitude and direction of the resultant can be represented by the diagonal of the parallelogram starting from the common point of the two forces. See fig 3

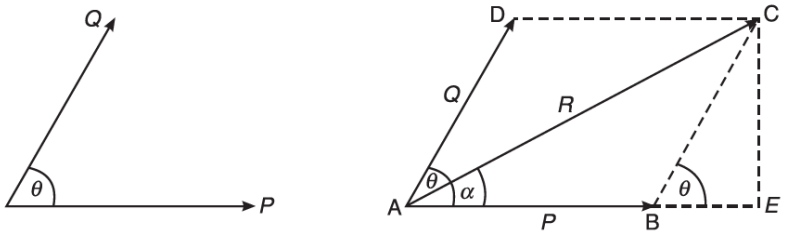



Fig. 3 Parallelogram law of forces

Let $P$ and $Q$ be the two forces, represented by the sides AB and AD of the parallelogram, the resultant can then be represented by AC as shown below:

To find the magnitude $R$ of the resultant, consider the Δ CAE, where

$$AC^2 = AE^2 + CE^2$$
$$= (AB + BE)^2 + (CE)^2$$

Consider the Δ CBE, where

$$CE = Q \sin \theta$$
$$BE = Q \cos \theta$$

$\therefore$ $$AC^2 = AB^2 + 2AB \cdot BE + BE^2 + CE^2$$

or $$R^2 = P^2 + 2 \cdot P \cdot Q \cos \theta + Q^2 \cos^2 \theta + Q^2 \sin^2 \theta$$
$$= P^2 + Q^2 + 2PQ \cos \theta$$

i.e. $$R = \sqrt{P^2 + Q^2 + 2PQ \cos \theta}$$

To find the direction $\alpha$ of the resultant, consider the Δ CAE, where

$$\tan \alpha = \frac{CE}{AB + BE}$$
$$= \frac{Q \sin \theta}{P + Q \cos \theta}$$

$\therefore$ $$\alpha = \tan^{-1}\left(\frac{Q \sin \theta}{P + Q \cos \theta}\right)$$

**9. Briefly explain different types of force systems with Sketches.**

If two or more forces are acting on a body or a particle, then it is said to be a force system, such as that shown in Fig 4

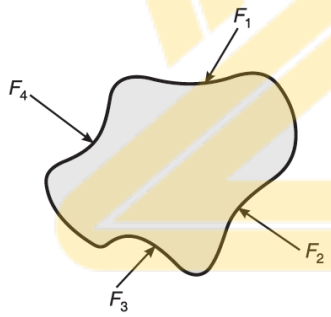



Fig. 4 A force system

## Types of Force System

The types of force system are:

1. Coplanar force system
2. Non-coplanar force system
3. Collinear force system.

### Coplanar force system

If two or more forces are acting in a single plane, then it is said to be a coplanar force system. The types of coplanar force system are:

(i) Coplanar concurrent force system

(ii) Coplanar non-concurrent force system

(iii) Coplanar parallel force system.

If two or more forces are acting in a single plane and their lines of action pass through a single point, then it is said to be a **coplanar concurrent force system**. See Fig 5

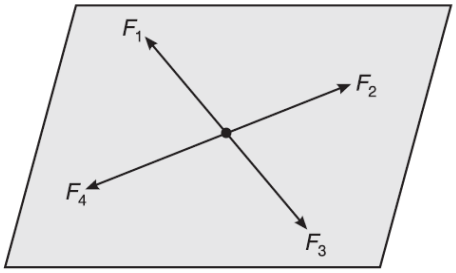



Fig. 5 Coplanar concurent force systems

If two or more forces are acting in a single plane and their lines of action do not meet at a common point, then the forces constitute a **coplanar non-concurrent force system.** See Figure 6.

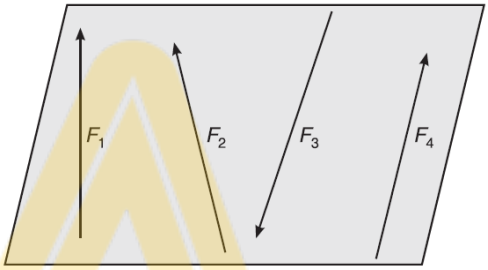



Fig 6. **coplanar non-concurrent force system**

If two or more forces are acting in a single plane with their lines of action parallel to one another, then it is said to be a **coplanar parallel force system**.

The coplanar parallel force system is of two types:

(i) **Like parallel force system:** All the forces act parallel to one another and are in the same direction, as shown in Figure 7

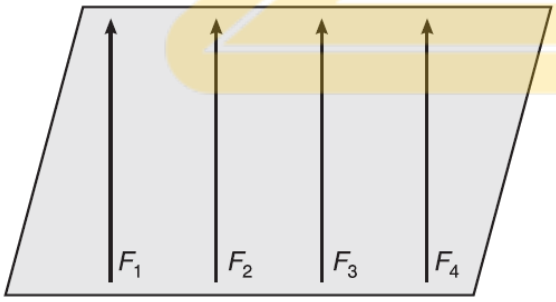



Fig 7. Like parallel force systems

(ii) **Unlike parallel force system:** The forces act parallel to another, but some of the forces have their line of action in opposite directions, as shown in Figure 8

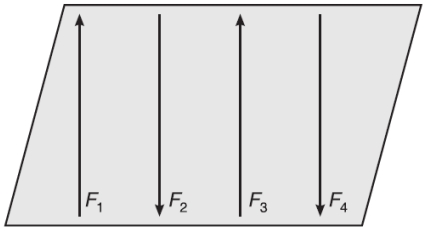



**Figure 2.8** Unlike parallel force system.

**10. Explain triangular and polygonal law of forces.**

**Triangle law:** If two forces acting simultaneously on a particle can be represented both in magnitude and direction by the two sides of a triangle taken in order, then the magnitude and direction of the resultant can be represented by the third side of a triangle, taken in opposite order. This is illustrated in Figure below

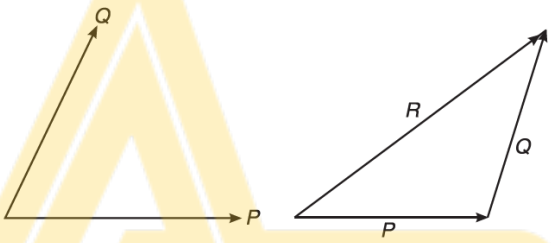



**Figure 2.19** Triangle law of forces.

**Polygon law:** If a number of forces acting on a particle can be represented in both magnitude and direction by the sides of the polygon taken in order, then the resultant can be represented in magnitude and direction by the closing side of the polygon taken in the opposite order. This is illustrated in Figure below

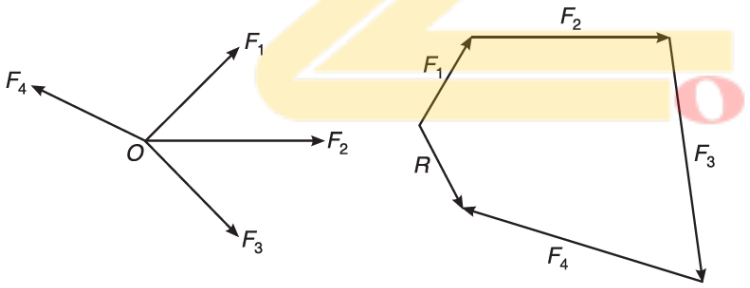



**Figure 2.20** Polygon law of forces.

11. Explain moment of a force and its types.

The turning effect produced by a force on a body is known as the moment of the force. The magnitude of the moment is given by the product of the magnitude of the force and the perpendicular distance between the line of action of the force and the point or axis of rotation. This is shown in Figure 2.21(a).

**Types of moments**

(i) If the tendency of a force is to rotate the body in the clockwise direction, it is said to be a clockwise moment and is taken positive, as shown in Figure 2.21(b).

(ii) If the tendency of a force is to rotate the body in the anticlockwise direction, it is said to be anticlockwise moment and is taken negative as shown in Figure 2.21(c).

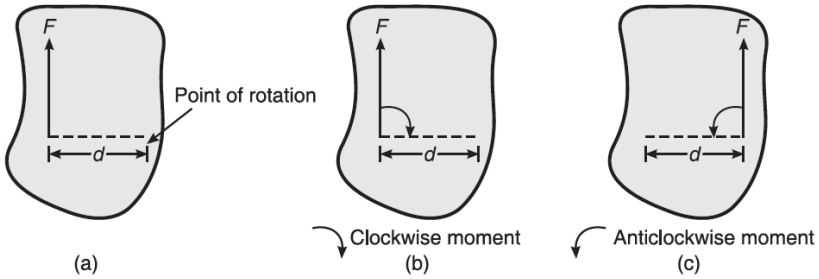



**Figure 2.21** Moment of a force.