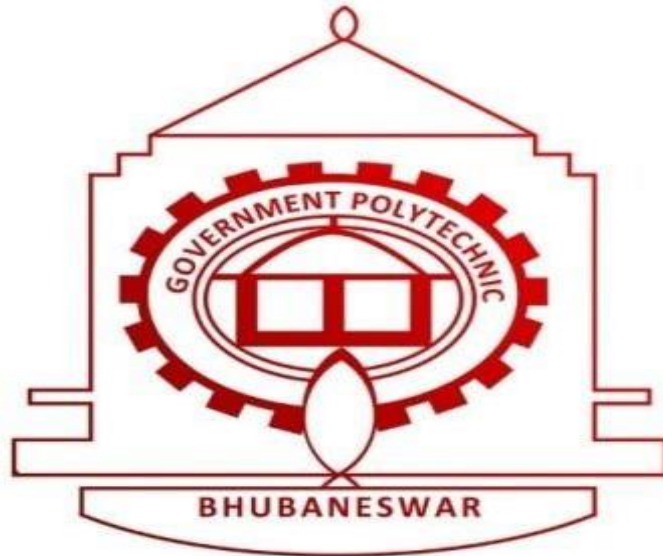


GOVERNMENT POLYTECHNIC, BHUBANESWAR

ସରକାରୀ ପଲିଟେକ୍ନିକ ଭୁବନେଶ୍ୱର



ENGINEERING MECHANICS

QUESTION BANK

**Previous year Question
2024 to 2020**

PREPARED BY

ER. RAJKUMAR PRADHAN [RAJ SIR]

Answer any four Questions including Q No.1 & 2.
Figures in the right hand margin indicates marks

1. Answer All questions

2 x 10

- Define Force. Write its SI unit.
- Differentiate between scalar quantity and vector quantity.
- Illustrate Free Body Diagram.
- Differentiate between hinged support and roller support.
- Define angle of friction. Write the relation between 'angle of friction' and 'co-efficient of friction'.
- Differentiate between static and dynamic friction.
- Define rigid body and flexible body.
- Define Simple lifting machine.
- State law of Polygon of forces.
- Define Centroid.

2. Answer Any Six Questions

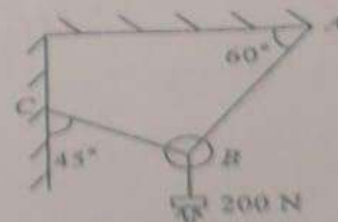
5 X 6

- The following forces act at a point
 - 40N inclined at 40° towards north of east
 - 30N towards north-west
 - 15N towards south
 Calculate the magnitude and direction of the resultant force.

- Define centre of gravity.
 - Calculate the centre of gravity of a cuboid of length 15m, width 8m and height 4m.

2+3

- An electric light fixture of weight 200N is supported as shown in the figure. Determine the tensile forces in the wires BA & BC.



- Explain Laws of friction.
- Derive the relation between mechanical advantage, velocity ratio and efficiency of a simple lifting machine.

f. Find out the angle between two equal forces of magnitude 'P' when the resultant of the two forces is also equal to the forces and has a magnitude 'P'.

g. A single purchase crab winch has 300mm long handle and 120mm diameter drum. Number of teeth on the pinion is 25 and that on wheel is 130. If an effort of 20N lifts a load of 300N then calculate the MA, VR and efficiency of the crab winch.

Answer Any Two Questions

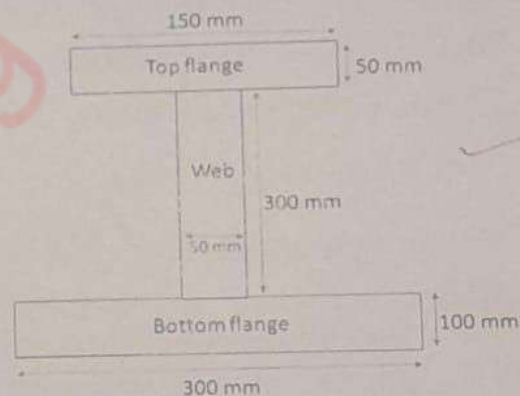
3. A simply supported beam having a length of 10m has UDL of 25KN/m throughout its length. Point loads of 80KN and 120KN are acting at 3m and 8m from the left support. Calculate the support reactions. 10

4. In a lifting machine, a load of 15KN is raised by an effort of 350N. On the same machine a load of 35KN is raised by an effort of 600N. Find the law of machine. Also calculate the effort required to lift a load of 50KN. 10

5. An I-section has the following dimensions in mm units 10

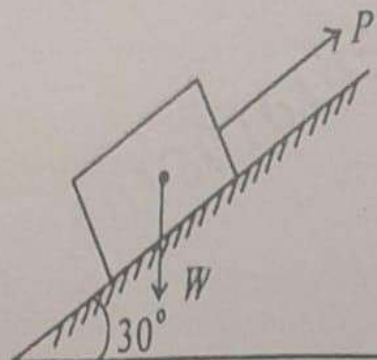
Bottom flange = 300 x 100
Top flange = 150 x 50
Web = 300 x 50

Determine the Centroid of the given section



6. a) Define Limiting friction. 2+8

b) A body of weight 600 N is placed on a plane inclined at an angle 30° . It is supported by an effort "P" parallel to the plane as shown in figure. Determine the minimum & maximum values of "P" for which equilibrium can exist. Take the co-efficient of friction as 0.35. =10



1ST SEM./ COMMON / 2022(W)

TH-4 ENGINEERING MECHANICS

Full Marks: 80

Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10
 - a. Define elasticity.
 - b. Define force, write down its SI units.
 - c. What do you mean by kinematics.
 - d. Define coplanar and collinear forces.
 - e. Define couple.
 - f. State perpendicular axis theorem.
 - g. What is self locking machine.
 - h. Define centroid.
 - i. Define Coefficient of Restitution.
 - j. What is De -Alembert's principle.

2. Answer **Any six** Questions. 6 x 5
 - a. State and prove Lami's theorem.
 - b. Find the angle between two equal forces of magnitude p , when their resultant is (i) p and (ii) $p/2$.
 - c. Derive velocity ratio of a compound gear train.
 - d. Derive the relation between mechanical advantage, velocity ratio and efficiency of a machine.
 - e. A body of weight 50N is pulled along a rough horizontal plane by a force of 18N acting an angle of 14° with horizontal. Find the coefficient of friction.
 - f. Find the position of centroid of I-section having following dimensions:
Bottom flange = 300mm x 50mm
Top flange = 150mm x 50mm
Web = 300mm x 50mm
 - g. A ball of mass 2 kg moving with a velocity of 2 m/s hits directly on a ball of mass 4 kg at rest. The first ball, after impinging, comes to rest. Find the velocity of the second ball after the impact and the coefficient of restitution.

3. Find the moment of inertia of a T-section having flange and web both 120 mm x 30 mm about X-X axis passing through the centre of gravity of the section. 10

- 4 A uniform ladder 'AB' 3m long weighs 200N. It is placed against a wall making an angle of 60° with the floor. The coefficient of friction between the wall and the ladder is 0.25 and that between the floor and ladder is 0.35. The ladder in addition to its own weight, support a man of 1000N at its top at B. Calculate the horizontal force 'P' to be applied to the ladder at the floor level to prevent slipping. 10
- 5 A simple screw jack has a thread of pitch 12 mm. Find the load that can be lifted by an effort of 20 N applied at the end of handle 500 mm long. Take efficiency of the machine as 50%. 10
- 6 Prove that the moment of inertia of a rectangular section having width 'b' and depth 'd' about x-x axis is $bd^3/12$. 10
- 7 The forces 20N, 30N, 40N, 50N & 60N are acting at one of the angular points of a regular hexagon towards the other five angular points taken in order. Find the magnitude and direction of resultant force. 10

Total Pages— 3

II— Sem/COMMON/2019(S)(New)

ENGINEERING MECHANICS

(Theory : 4)

Full Marks : 80

Time : 3 hours

Answer any five questions including Q. Nos. 1 & 2

Figures in the right-hand margin indicate marks

1. Answer the following :

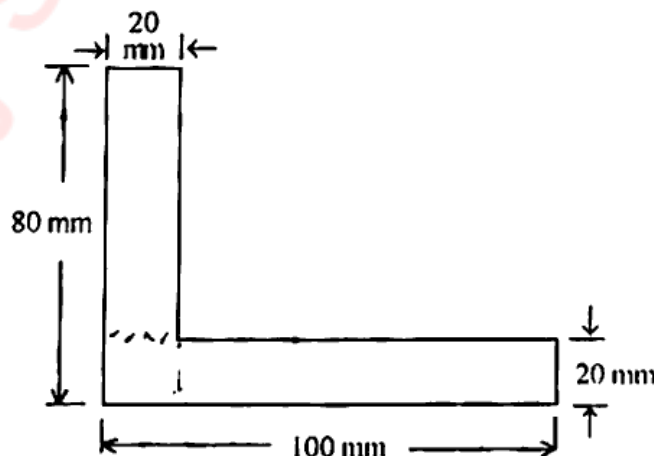
2 × 10

- (a) What is free body diagram ?
- (b) State polygon law of forces.
- (c) State the condition of equilibrium.
- (d) Define angle of friction.
- (e) What do you mean by centroid of a lamina ?
- (f) Write any two disadvantages of friction.
- (g) State the relation between M.A., VR and efficiency of a simple lifting machine.
- (h) State law of machine.
- (i) Define power and write down its S.I. unit.
- (j) State Newton's 2nd law of motion.

2. Answer any six questions :

5 × 6

- (a) A particle is acted on by three forces 2, $2\sqrt{2}$ and 1 kN. The first force is horizontal and towards the right, the second acts at 45° to the horizontal and inclined right upward and the third is vertical. Determine the resultant of the given forces.
- (b) Derive the condition for reversibility of a machine.
- (c) Derive velocity ratio of a compound gear train.
- (d) A body of weight 50 N is pulled along a rough horizontal plane by a force of 18 N acting at an angle of 14° with the horizontal. Find the coefficient of friction.
- (e) Find the position of centroid of a L section as shown in the figure below :



(Turn Over)

(2)

- (f) A constant force acting on a body of mass 20 kg changes its speed from 2.5 m/sec to 10 m/sec in 15 seconds. What is the magnitude of the force ?
- (g) State and explain d'Alembert's principle.
- (h) State and explain law of conservation of energy.
3. A spherical ball of weight 100 kgf rests on two smooth inclined planes as shown in the figure. Find the reaction of each inclined plane on the ball. 10

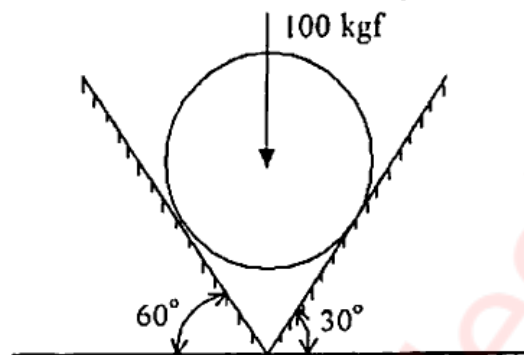
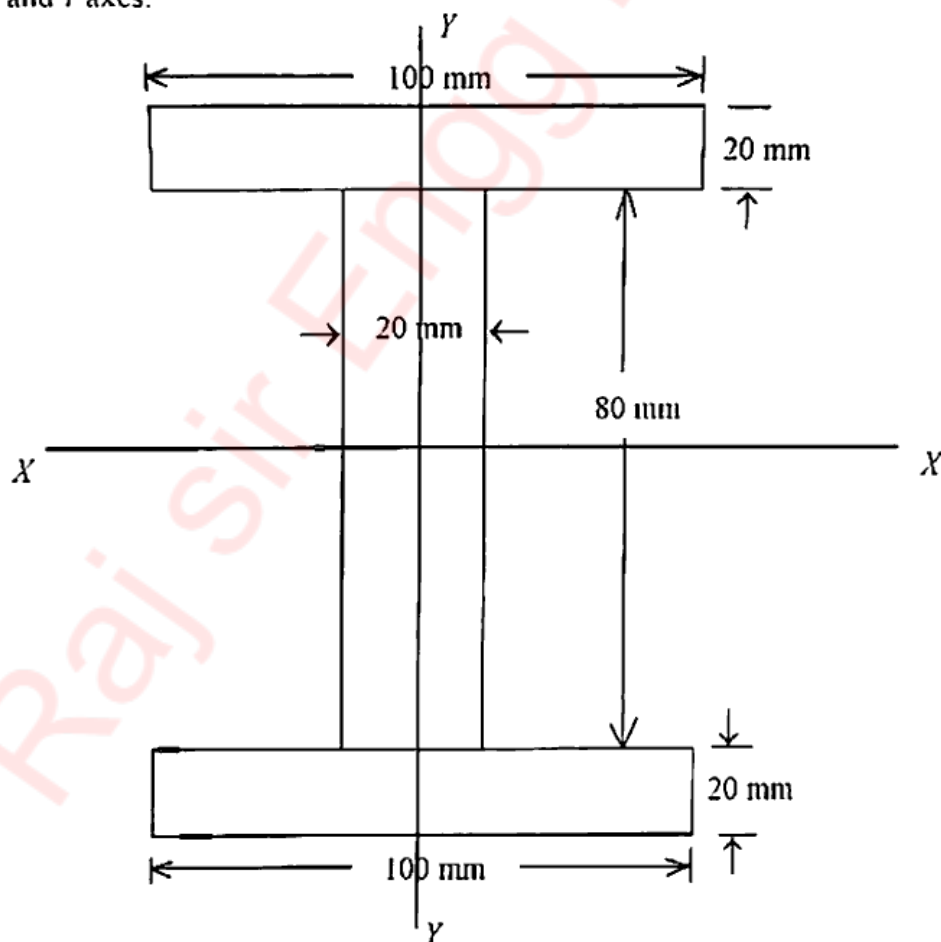


Figure 1

4. Find the moment of inertia of the I-section as shown in the figure 2 about centroidal X and Y axes. 10



5. A ladder 5 meter long rests on a horizontal ground and leans against a smooth vertical wall at an angle of 70° with the horizontal. The weight of the ladder is 900 N and acts at its middle. The ladder is at the point of sliding, when a man weighing 750 N stands on a rung 1.5 m from the bottom of the ladder. Calculate the co-efficient of friction between the ladder and floor. 10
6. In a certain weight lifting machine, an effort of 15 N can lift a load of 300 N and an effort of 20 N can lift a load of 500 N. Find the law of the machine. Also find the effort required to lift a load of 880 N. 10
7. A ball is dropped from a height $h_0 = 1$ m on a smooth floor. Knowing that the height of the first bounce is $h_1 = 81$ cm determine 10
- (a) coefficient of restitution
- (b) expected height h_2 after the second bounce.

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II/SEM/COMMON/2018 (W)/Old
ENGG. MECHANICS

(BET - 103)

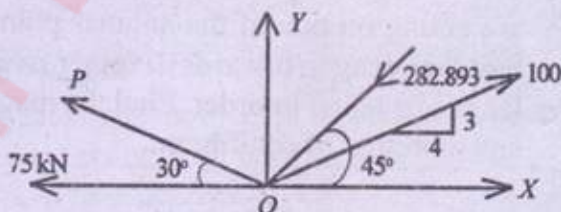
Full Marks : 70

Time : 3 hours

Answer any five questions.

The figures in the right-hand margin indicate marks.

1. (a) Define a scalar quantity. Give two examples. 2
- (b) Write down the parallelogram law of forces. Find out the resultant of two forces P & Q acting at a point with angle θ in between them. 5
- (c) If five forces act on a particle as shown on Figure and the algebraic sum of horizontal component of all these forces is -324.904 kN, calculate the magnitude of p and the resultant of all forces. 7



(Turn Over)

2. (a) What is meant by 'moment of a force'? Show it mathematically. 2
- (b) State and explain polygon law of forces. 5
- (c) A heavy spherical ball of weight 12 kN rests on a V-trench as shown in Figure. Find the reactions assuming the contact surfaces to be smooth. 7



3. (a) What is the meaning and 'three force principle' for equilibrium? 2
- (b) State and prove Lami's theorem. 5
- (c) The forces 16 N, 24 N, 32 N, 40 N and 48 N are acting on one of the angular points of a regular hexagon towards the other five angular points taken in order. Find the magnitude and direction of equilibrant. 7
4. (a) Define 'Angle of Friction'. 2

- (b) Find out the minimum force which will keep the body in equilibrium when it is at the point of sliding downwards on an inclined rough plane. 5
- (c) A ladder 5 m long rests on a horizontal ground and leans against a smooth vertical wall at an angle 70° with the horizontal. The weight of the ladder is 900 N and acts at its middle. The ladder is at the point of sliding, when a man weighting 750 N stands on a rung 1.5 m from the bottom of the ladder. Calculate the coefficient of friction between the ladder and the floor. 7
5. (a) Define 'centre of gravity'. 2
- (b) An I-section has the following dimension in mm :
- Bottom Flange = 300×100
Top Flange = 150×50
Web = 300×50
- Determine mathematically the position of centre of gravity/centroid of the section. 5
- (c) Find out the moment and inertia of a rectangular section with breadth (b) and height (h) about two centroidal axes $X-X$ and $Y-Y$ (from 1st principle). 7

6. (a) What do you mean by 'self-locking machine'? 2
- (b) In a certain weight lifting machine, an effort of 25 N can lift a load of 315 N. If the velocity ratio of the m/c is 14, find the effort lost in friction and the friction load. 5
- (c) Draw the sketch of a single purchase crab winch and find out the efficiency mathematically. 7
7. (a) Define statics and dynamics. 2
- (b) At a certain instant, a body of mass 10 kg falling freely under the force of gravity was found to be falling at the rate of 20 m/s. What force will stop the body in (i) 2 seconds and (ii) 2 metres? 5
- (c) Derive an expression for the maximum height and range of a projectile traversed by a stone thrown with an initial velocity u and an inclination of α . 7
-

Th4. ENGINEERING MECHANICS

Full Marks: 80

Time- 3 Hrs

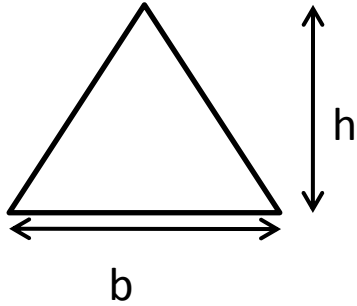
Answer any five Questions including Q No.1& 2

Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10
 - a. What is resultant force?
 - b. Define couple
 - c. Define lateral strain.
 - d. State varignons theorem?
 - e. Define elasticity
 - f. Define impulse
 - g. What is clockwise and anticlockwise moment?
 - h. State lami's theorem
 - i. What is force . Write down its SI units
 - j. Define coplanar and collinear forces

2. Answer **Any Six** Questions 5 x 6
 - a. Find the magnitude and direction of the resultant of concurrent forces of 8N,10N,12N and 14N making angles of 30° , 60° , 120° , and 145° respectively with positive direction of x-axis.
 - b. State and prove perpendicular axis theorem
 - c. Define M.A, V.R. and efficiency of a simple lifting machine and derive the relationship between them.
 - d. A body of weight of 50N is pulled along a rough horizontal plane by a force of 18N acting on angle of 14° with horizontal. Find the coefficient of friction
 - e. Find the position of centroid of I-section having following dimensions:
Bottom flange = 300mm x 50mm
Top flange = 150mm x 50mm
Web = 300mm x 50mm
 - f. Draw the stress-strain curve for ductile material and explain the salient points on it
 - g. Define amplitude , frequency and time period of simple harmonic motion

- 3 Find out I_{xx} and I_{yy} for the isosceles triangle shown in the figure. 10



- 4 State and prove parallelogram law of forces. 10

- 5 In a worm and worm wheel, the number of teeth in the worm wheel is 25. The effort handle is 300mm long and the load drum is 150 mm diameter. Find the efficiency of the machine, if an effort of 30N can lift a load of 345N and the worm is double threaded 10

- 6 Find out the velocity and acceleration of a particle executing simple harmonic motion. 10

- 7 A ball of mass 1 kg moving with a velocity of 2m/sec impinges directly on a ball of mass 2kg at rest. The first ball after impinging comes to rest. Find the velocity of the second ball after impact and the coefficient of restitution. 10

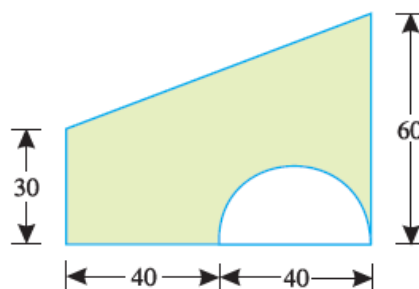
Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10

- a. Define force and state its unit ?
- b. State the principle of transmissibility ?
- c. Define FBD with suitable sketch ?
- d. Define Couple and write its unit ?
- e. Define angle of repose ?
- f. What is coefficient of friction?
- g. Differentiate between Centroid and Centre of Gravity ?
- h. Define Mechanical advantage and Velocity ratio by considering a lifting machine ?
- i. Define momentum and impulse ?
- j. Define coefficient of restitution ?

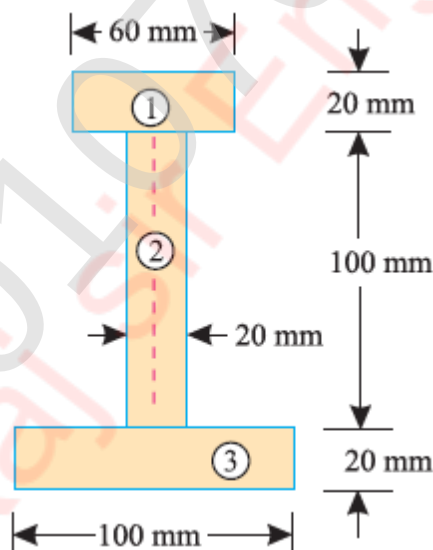
2. Answer **Any Six** Questions 6 x 5

- a. State and prove Lami's theorem.
- b. The resultant of two concurrent forces is perpendicular to the smaller force and angle between the forces is 120° . if the bigger force is 60 N, find the smaller one?
- c. State the laws of static friction ?
- d. A certain weight lifting machine of velocity ratio 40 can lift a load of 2000 N, with the help of 150 N effort. Determine the efficiency of the machine ?
- e. A smooth circular cylinder of radius 1.5 meter is lying in a triangular groove, one side of which makes 15° angle and the other 40° angle with the horizontal. Find the reactions at the surfaces of contact, if there is no friction and the cylinder weights 100 N.
- f. A semicircular area is removed from a trapezium as shown in Fig.(dimensions in mm)



Determine the centroid of the remaining area (shown hatched).

- g A body of mass 40 kg is moving with a constant velocity of 2.5 m/s. Now a force of 100 N is applied on the body in its direction of motion. What will be its velocity after 2 second.
- 3 The following forces act at a point : 10
 (i) 20 N inclined at 30° towards North of East,
 (ii) 25 N towards North,
 (iii) 30 N towards North West, and
 (iv) 35 N inclined at 40° towards South of West.
 Find the magnitude and direction of the resultant force
- 4 A uniform ladder of length 3.25 m and weighing 250 N is placed against a 10
 smooth vertical wall with its lower end 1.25 m from the wall. The coefficient of friction between the ladder and floor is 0.3. What is the frictional force acting on the ladder at the point of contact between the ladder and the floor? Show that the ladder will remain in equilibrium in this position.
- 5 (a) What is reversible machine? State the condition of reversibility. 5
 What load can be lifted by an effort of 120 N, if the velocity ratio is 18 and
 (b) efficiency of the machine at this load is 60% ? Determine the law of the 5
 machine, if it is observed that an effort of 200 N is required to lift a load of 2600 N
- 6 (a) Define Collision .state the law of conservation of linear momentum. 5
 (b) 5
 A ball of mass 1 kg moving with a velocity of 2 m/s impinges directly on a ball of mass 2 kg at rest. The first ball, after impinging, comes to rest. Find the velocity of the second ball after the impact and the coefficient of restitution
- 7 An I-section is made up of three rectangles as shown in Fig. Find the moment of 10
 inertia of the section about the horizontal axis passing through the centre of gravity of the section.



Th4(a) - Engineering Mechanics

Full Marks: 80

Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10
- a. State the Law of Conservation of Linear momentum.
 - b. What is fundamental unit and derived units with examples?
 - c. What is coefficient of friction?
 - d. Write down the expression for Velocity Ratio of a Simple wheel and Axle.
 - e. What is Coplanar Concurrent Forces?
 - f. State Newton's 1st law of motion.
 - g. What is Self Locking machine?
 - h. What is the distance of centroid of a semi circular area from the base?
 - i. Define Force and its unit in S.I system.
 - j. Define Couple and its unit.
2. Answer **Any Six** Questions 6 x 5
- a. Derive the relation between Mechanical Advantage, Velocity Ratio and Efficiency of a Lifting machine.
 - b. In a lifting machine, an effort of 15N can lift a load of 300N and an effort of 20N can lift a load of 500N. Find the law of machine. Also find the effort required to lift a load of 880N.
 - c. What is Gear Train .Derive its velocity ratio of a Simple Gear Train.
 - d. State and Prove the Polygon Law of Forces.
 - e. Find the angle between two equal forces p, when their resultant is equal to (i) p and (ii) p/2
 - f. State and prove Lami's theorem.
 - g. The following forces act at a point
 - (i) 20N inclined at 30° towards North to East.
 - (ii) 25N towards North
 - (iii) 30N towards North west, and
 - (iv) 35N inclined at 40° towards south of west.Find the magnitude and direction of the resultant force.

- 3 State Triangle Law of force and proof Parallelogram Law of Force. 10
- 4 Define Centroid. 10
An I- section has the following dimensions in mm units.
Bottom flange= 300x100
Top flange= 150x50
Web= 300x50
Determine mathematically the position of centre of gravity of the section.
- 5 Define Angle of repose. 10
A body of weight 500N is pulled up an inclined plane, by a force of 350N. The inclination of the plane is 30° to the horizontal and the force is applied parallel to the plane.
Determine the co-efficient of friction.
- 6 A body of weight 70KN is suspended by two strings whose lengths are 6cm and 8cm from two points in the same horizontal level. The horizontal distance between the two points is 10cm. Determine the tensions of the strings. 10
- 7 Define Coefficient of Restitution. What are various types of Impacts? Discuss any one of them. 10