Engineering Mechanics (ME102)

Unit I and II

- 1. State and explain varignon's theorem?
- 2. State and explain force System?
- 3. State and explain Lami's theorem?
- 4. Explain the principle of equilibrium theorem and force law of equilibrium?
- 5. What is resolution and composition of forces?
- 6. State and explain triangle law?
- 7. State and explain polygon law?
- 8. Explain parallelogram forces system?
- 9. The two tugboats apply the forces P and Q to the barge, where P =76 kN and Q =52 kN. Determine the resultant of P and Q.?

6 т

32 m

10. Two forces act on the hook. Determine the magnitude of the resultant force?



12 m

24 m

11. Explain moment and couple?

12.Four forces of magnitude 20 N,40 N, 60 N and 80 N are acting respectively along four sides of a square ABCD as shown in figure. Find the magnitude direction and position of resultant force about point A.



13.A smooth circular cylinder of weight "W" and radius "r" rests in a "V" shaped groove whose sides are inclined at angles α and β to the horizontal as shown in figure. Find the reaction R_A and R_B at point of contact.

(Given $\alpha = 25^{\circ}$ and $\beta = 65^{\circ}$, W= 500N)



14.A bar AB 12 m long rests in horizontal position as shown in Fig.2.2 on two smooth planes. Finddistance x at which a load P = 100 N is to be placed to keep the bar in equilibrium. Neglect weight of bar.



15.Two spheres A and B weighing 100 N and 75 N respectively and with the corresponding radii 75 mm and 50 mm are placed in a container as shown in Fig. 2.3. Determine the support reactions.



16. A wire is fixed at two points A and D as shown in Fig. 2.5(a). Two weights 20 kN and 25 kN are supported at B and C, respectively. When equilibrium is reached it is found that inclination of AB is 30° and that of CD is 60° to the vertical. Determine the tension in the segments AB, BC and CD of the rope and also the inclination of BC to the vertical.



17.Define principle of transmissibility.

18.Differentiate between 'Resultant' and 'Equilibrant'?

19. Find the magnitude of the two forces such that if they act at right angles, their resultant is 3.1622 N. But if they act at 60° their resultant is 3.6055 N.



20. Explain andSketch the different types of loads and supports?

Unit III

- Q. 1. Give difference between centroid and centre of gravity
- Q. 2. How centroid of triangle is obtained
- Q. 3. From first principle show the centroid for quarter circle
- Q. 4. Using integration find the centroid of the parabolic area OAB as shown in the figure below.



Q. 5 Determine, without integration, the centroid of the following figures

a) Semicircle cut out of a rectangle, radius r.

b) Semicircle, cut out of a semicircle, inner and outer r&R.

Q6. Find the centroid of the composite area ABCDEF. A circle of radius 0.5 units has been cut out as shown. A triangle and a quarter circle have been cut out in a similar way.



Q7. A wire has been bent in the following shape. Find out the centroid of the given shape. Given OA and CD are arcs centered at C.



Q8.Find centroid.



Q9.Locate Centroid of following I- section.



- 1.Explain why moment of inertia is called second moment of area.
- 2. Give significance of radius of gyration
- 3.Derive expression of MOI of triangular lamina about its base.

4.Derive expression of MOI of semicircular lamina about its base.

5. State parallel axis and perpendicular axis theorem.

6.Find MOI about centroidal axis



7.Locate x-centroidal moment of inertia.



Ans:- \bar{x} =16.82 cm, \bar{y} =12.57 cm,I_{XX}=14690.88 mm⁴

3.Find MOI about base.



4.Find MOI about axis indicated.



5. Find centroid and MOI about horizontal centroidal axis



Ans:-cg(60,28),169.77*10⁴mm⁴

6. Find MOI and radius of gyration about AB axis



Fig.2.2. 1

Ans:- k_{AB} =8.63 mm , I_{AB} =7.613*10⁴ mm⁴

7.Two blocks A and B weighing 15kN and 3 kN respectively are held in a position against an inclined plane by applying a horizontal force P as shown in fig. Find the least value of P which will induce motion of block A upwards . Angle of friction for all contact surfaces is 12° .



Q.5) Determine the forces in all the members of the truss shown in figure below.



Unit IV

Q.1. A motorcycle is traveling at 20 m/sec, when observes a traffic light is 180 m ahead of him turns red. The traffic light is to stay red for 10 seconds if the motorcyclist wishes to pass the light without stopping just as it turns green determine.

i) Acceleration ii) Speed of the motor as it passes the light

Q. 2. The initial velocity of a body moving writ a retardation of $2m/\sec^2$ is 88 m/sec. find the interval of time in which the body will come to rest and the distance moved in this interval.

Q. 3 A car starts from a station and moves with a constant acceleration. It covers a distance of 19m during 10^{th} seconds of its motion. Find the acceleration and velocities after 9^{th} and 10^{th} second from the start?

Q4. A motor cyclist is travelling at 20m/sec, when he observes a traffic length 180m ahead of him turns red for 10 seconds. If the motor cyclist wish to pass the length without stopping just as it turns green. Determine

- 1. Acceleration
- 2. Speed of motor as it passes the light.

Q.5. A stone is dropped from a height. After falling 5 sec from rest, the stone breaks the glass pane and in breaking the stone is loses 20% of its velocity. Find the distance travelled by the stone in the next seconds.

Q.6A stone, thrown up is caught by the thrower after 6s. How high did it go and where was it 4 s after start? $g = 9.8 \text{ m/s}^2$.

Q. 7. A particle moves along a straight line so that its displacement in m from a fixed point is given by

$$s = t^3 + 3t^2 + 4t + 5$$

Find :- i) Velocity at start and after 4 sec.

ii) Acceleration at start and after 4 sec.

Q.8. A particle moves along a straight line with an acceleration prescribed by the relation $a = (4t^2 - 3t + 2)$. Where a is in m/s²& t is in seconds. The particle has a velocity of 10 m/s at t=3sec & it is located 12m to the right of origin at t=12 sec. determine the position and velocity of the particle after 5 sec.

Q.9.A fly Wheel starts from the rest and after half a minute rotates at 2000 rpm. Calculate the i) angular acceleration and ii) number of revolution made by the wheel within this period.

 $\omega_{\rm o} = 0 \qquad \omega = \frac{2\pi \ x \ 2000}{60}.$

Q.9A rotor of turbine has an initial angular velocity of 1800 rpm. Accelerating uniformly, it doubled its velocity in 12 s. Find the revolution performed by it in this interval.

$$\omega o = \frac{2\pi x N}{60} = \frac{2\pi x 1800}{60}$$

Unit V

Q.1) Determine the horizontal and vertical components of the acceleration of point B on the rim of the flywheel. At the given position, $\omega = 12 \text{rad/s}^2$, both clockwise.

Q.2) Two blocks m1 = 2 kg and m2 = 5 kg ar initially resting on the floor. Find the acceleration of each block and pully if an upward force F applid to the pulley is

(a) 14 N., (b) 70 N. Find thee force required to lift both the blocks.



Q.3) Three blocks m1, m2 and m3 of masses 1.5 kg, 2 kg, 1 kg respectively are shown. If a free P is applied so as to give acceleration of give acceleration of 3 m/s^2 , then what will be the force that m1 will exerts on m2?



Unit VI

Q.1)A trolley of mass 200 kg moves on a level track for a distance of 500 meters. If the resistance of the track is 100N, find the work done in moving the trolley.

Q.2) A horse pulling a cart exerts a steady horizontal pull of 250 N and walks at the rate of 5 kmph. How much work is done by the horse in 7 minutes?

Q.3) A spring is stretched by 50mm by the application of a force. Find the work done. If the force required to stretch 1mm of the spring is 8 N.

Q.4) A force F = 4x + 5 acts on particle. Find the work done by the force during the displacement of the particle from x = 0 m to x = 3 m. given that force is in newton.

Q.5) A small block starts from rest at a point A and slides down the inclined plane shown in Fig. What distance along the horizontal plane will it travel before coming rest? The coefficient of kinetic friction between block of the either plane is 0.3. Assume that the initial velocity with which it starts to move along BC is of the same magnitude as gained in sliding from A to B.

Q.6)Find the power of an engine, which can do a work of 1500 joules in 8 seconds?

Q.7)A constant force of 3 kN pulls a crate along a level floor at a distance of 10m in 50 secs. What is power used?

Q.8)A hoist operated by an electric motor has a mass of 500 kg. It raises a load of 250 kg vertically at a steady speed of 0.2 m/s. Frictional resistance can be taken to be constant at 1200.What is the power required?

Q.9)A trolley of mass 200 kg moves on a level track for a distance of 500 meters. If the resistance of the track is 100 N, find the work done in moving the trolley.

Basic Civil Engineering

Unit I

- 1. Describe the properties of good bricks used in building construction.
- 2. Describe the properties of cement
- 3. Describe the properties of fine aggregate and coarse aggregate
- 4. Write short note on classification of bricks
- 5. Explain various building materials in construction work

Unit II

- 1. Explain various components in building with neat sketch
- 2. Write short note on bearing capacity of soil.
- 3. Explain various types of foundation with neat sketches.
- 4. Explain suitability of foundation for various types of soil condition
- 5. What is stair case? Explain its various components with neat sketches
- 6. Draw and explain various types of doors and windows
- 7. Differentiate between load bearing and framed structures

Unit III

- 1. Explain various principles of planning
- 2. Write criteria for site selection for residential building
- 3. Write short note on
 - a) building bye laws
 - b) loads on structures
 - c) Types of tiles
 - d) Materials used for plastering and painting
- 4. Define following terms,
 - a. Plinth area
 - b. Carpet area

Unit IV

- 1. Explain principles of surveying
- 2. Write short note on
 - a. Triangulation and traversing survey
 - b. GIS
 - c. GPS
 - d. Photogrammetry survey
 - e. Counter and its application
- 3. Define the following terms with sketch wherever necessary
 - a. Ranging
 - b. Offset

Unit V

- 1. Write short note on various modes of transportation
- 2. Explain classification of road by Nagpur road plan
- 3. Differentiate between rigid ad flexible pavement
- 4. Write short note on traffic signal and speed breaker with the help of diagrams
- 5. Draw cross section of road and explain its various components

Unit VI

- 1. Write short note on importance and sources of water
- 2. Enlist various water reservoirs
- 3. Define irrigation. Explain irrigation methods
- 4. What is water shed management. Enlist various water shed management structures
- 5. What is rain water harvesting? Explain detail procedure for rain water harvesting
- 6. Enlist IS specifications for drinking water
- 7. Explain with neat sketch water treatment plant
- 8. Explain with neat sketch water sewage treatment plant
- 9. Write short note on
 - a) Air pollution and sources of air pollution
 - b) Air pollution control measures