

GUJARAT TECHNOLOGICAL UNIVERSITY

DI -2 SEMESTER – OLD PAPER – S22 TO W24 – QUESTION BANK(English)

Subject Name & Code:

Engineering Mechanics (4300008)

Unit 1: Basics of Mechanics

Repeated Questions:

1. **Define scalar and vector quantities with examples.**
 - **Appeared in:** S22 (Q1a, 03 marks), W23 (Q1b, 04 marks), S23 (Q1b, 04 marks), W24 (Q1b, 04 marks)
2. **Differentiate between mass and weight.**
 - **Appeared in:** S22 (Q2a, 03 marks), W23 (Q1b, 04 marks), S24 (Q4a, 03 marks)
3. **State and explain the Law of Parallelogram of Forces.**
 - **Appeared in:** S22 (Q1c, 07 marks), W23 (Q1c, 07 marks), S23 (Q2a, 03 marks), W24 (Q2a, 03 marks), S24 (Q2b, 04 marks)
4. **State and explain the Principle of Transmissibility of Forces.**
 - **Appeared in:** S22 (Q1b, 04 marks), S23 (Q1c OR, 07 marks), W24 (Q2b, 04 marks)
5. **State and explain Lami's theorem.**
 - **Appeared in:** S22 (Q2c, 07 marks), W23 (Q2b, 04 marks), S24 (Q1c, 07 marks), S25 (Q4b, 04 marks)

Other Important Questions:

1. **Define Engineering Mechanics and give the names of Fundamental Principles of Mechanics.** (W23 - Q1a, 03 marks)
2. **Define Force. Explain the characteristics of a Force.** (W25 - Q1a, 03 marks)
3. **Define the following terms: (1) Engineering Mechanics (2) Force (3) Rigid Body.** (S23 - Q1a, 03 marks)
4. **Define force system and explain various force systems.** (S23 - Q1c, 07 marks)
5. **Explain the Principle of Superposition of forces.** (S22 - Q1b, 04 marks), (S23 - Q1c OR, 07 marks)
6. **Explain the Law of Polygon of forces.** (S22 - Q2a OR, 03 marks), (S24 - Q2a, 03 marks), (S25 - Q1b, 03 marks)
7. **Explain the Law of Triangle of forces.** (S24 - Q2a OR, 03 marks), (S25 - Q3a OR, 03 marks)
8. **Explain types of Equilibrium.** (W23 - Q2a, 03 marks), (S24 - Q2b OR, 04 marks)
9. **What are the conditions of equilibrium? Explain types of equilibrium with a neat sketch.** (W24 - Q2c, 07 marks), (S25 - Q1a, 03 marks)
10. **Write characteristics of forces.** (S25 - Q3a, 03 marks)
11. **Separate vector and scalar quantity from the following: Distance, Force, Length, Mass, Velocity, Time.** (S25 - Q3b OR, 04 marks)
12. **If two forces act at an angle of 90° , the resultant is $\sqrt{10}$. If they act at an angle of 60° , the resultant is $\sqrt{13}$. Find the two forces.** (W23 - Q1c OR, 07 marks)
13. **Two forces of magnitude 70 kN each are acting at a right angle to each other. Find out the magnitude and direction of the resultant of these forces.** (S23 - Q2a, 03 marks)
14. **Two forces 100 kN each acting at an angle 45° between them. Find the magnitude and direction of the resultant.** (S22 - Q2b, 04 marks)

Unit 2: Coplanar Concurrent Forces

Repeated Questions:

1. **Find the magnitude and direction of the resultant force for a given system of concurrent forces.**
 - **Appeared in:** S22 (Q2b OR, 04 marks), W23 (Q3b, 04 marks), S23 (Q2c, 07 marks), W24 (Q1f, 03 marks), W24 (Q3c, 07 marks), S25 (Q1c, 04 marks)
2. **Find the tension in strings/forces in members when a weight is suspended by strings/wires.**
 - **Appeared in:** S22 (Q2c OR, 07 marks), W23 (Q3c OR, 07 marks), S23 (Q2c OR, 07 marks), W24 (Q2a OR, 03 marks)

Other Important Questions:

1. **Explain Bow's Notation.** (S23 - Q2b, 04 marks)
2. **Write a short note on a Free Body Diagram.** (S23 - Q2b OR, 04 marks)
3. **State the conditions of equilibrium for coplanar concurrent forces.** (S23 - Q3a, 03 marks)
4. **A body of 30 N is suspended by two strings of length 50 cm and 120 cm attached to two hooks in a horizontal ceiling 130 cm apart. Find the tension in both strings.** (S23 - Q2c OR, 07 marks)
5. **The following forces are acting at a point. Find the magnitude and direction of the resultant force.**
 - **Case 1:** (S23 - Q2c, 07 marks)
 - 500 kN towards North
 - 600 kN towards South West
 - 400 kN towards West
 - 800 kN acting 30° South of East
 - **Case 2:** (S22 - Q2b OR, 04 marks)
 - 4 KN towards North-West
 - 2 KN inclined at 30° North of East
 - 3 KN towards East
 - 5 KN towards South
6. **Buckets of different weights are hooked on a wire as shown in a figure. Find the force developed in the different parts of the wire ABCD.** (S22 - Q2c OR, 07 marks)

Unit 3: Moment of Force and Parallel Forces

Repeated Questions:

1. **Differentiate between a moment of a force and a couple.**
 - **Appeared in:** S22 (Q3a, 03 marks), W24 (Q3a, 04 marks), S24 (Q3a, 03 marks)
2. **Explain different types of supports and beams with sketches.**
 - **Appeared in:** S22 (Q3c, 07 marks), W23 (Q2b, 04 marks), W24 (Q1i, 04 marks), S24 (Q3b OR, 04 marks)
3. **Calculate support reactions for a given beam.**
 - **Appeared in:** W23 (Q2c OR, 07 marks), W23 (Q3b OR, 04 marks), S23 (Q3c OR, 07 marks), W24 (Q1j, 07 marks), W24 (Q1c OR, 07 marks), S24 (Q2c, 07 marks), S24 (Q2c OR, 07 marks), S25 (Q2b, 05 marks)

Other Important Questions:

1. **State and explain Varignon's principle of moments.** (S22 - Q3a OR, 03 marks), (W24 - Q1k, 03 marks)
2. **Explain a couple with an example.** (S24 - Q3a OR, 03 marks), (S25 - Q1e, 03 marks)
3. **A simply supported beam has a span of 5 m. It carries a point load of 200 kN at 2 m from the left-hand support and a point load of 100 kN at 1 m from the right-hand support. Calculate support reactions.** (S22 - Q3b OR, 04 marks)
4. **A beam ABC is 6 m long. The A end is hinged and the B end is a roller. The span of AB is 4 m. Part BC is 2 m long & hanging. A UDL of 5 kN/m is applied to span AB and a point load of 8 kN is applied to point C. Find the reactions at A and B.** (W24 - Q3b OR, 04 marks)
5. **Find the resultant force for the system of forces shown in a figure and locate its distance from point A and the angle at which it acts.** (S22 - Q3c OR, 07 marks)
6. **The side of a regular hexagon ABCDEF is 1 m. Along the sides AB, BC, CD, DE, EF, and FA, forces of 1, 3, 2, 4, 5, and 6 kN are acting respectively. Find the algebraic sum of the moments of all forces about point A.** (S23 - Q3c, 07 marks)

Unit 4: Centroid and Centre of Gravity

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Repeated Questions:

1. **Differentiate between Centroid and Centre of Gravity.**
 - **Appeared in:** W24 (Q1d, 04 marks), S23 (Q4a, 03 marks), S24 (Q4a, 03 marks), S25 (Q5a, 03 marks)
2. **Calculate the centroid/Centre of Gravity for standard sections like Angle section (ISA), T-section, Channel section, or a given lamina/area.**
 - **Appeared in:** W24 (Q1e, 07 marks), S22 (Q4b, 04 marks), S22 (Q4c OR, 07 marks), S23 (Q3b, 04 marks), S23 (Q3b OR, 04 marks), W24 (Q3c OR, 07 marks), S24 (Q3c, 07 marks), S24 (Q3c OR, 07 marks), S25 (Q3c, 07 marks), S25 (Q4c, 07 marks)

Other Important Questions:

1. **Define the following terms: (i) Centroid (ii) Centre of Gravity (iii) Axis of symmetry.** (W23 - Q3a, 03 marks)
2. **Explain Axis of Reference and Axis of Symmetry.** (W24 - Q2h, 04 marks), (S24 - Q4a OR, 03 marks)
3. **Find the centroid of a plate/area as shown in a figure.** (W24 - Q4c OR, 07 marks)
4. **A T-section having flange 20 x 2 cm and web 2 x 30 cm. Find the Centroid of the T-section.** (W24 - Q4a OR, 03 marks)
5. **ABCD is a square piece of paper whose side is 100 mm. E and F are the midpoints of AB and AD respectively. If triangle AEF is cut off, find the Centroid of the remaining segment.** (W24 - Q3c OR, 07 marks)

Unit 5: Friction

Repeated Questions:

1. **Define/Explain: Angle of Friction, Coefficient of Friction, and Angle of Repose.**
 - **Appeared in:** W23 (Q4a, 03 marks), W24 (Q4b, 04 marks), S24 (Q4b OR, 04 marks)
2. **State and prove that the Angle of Repose is equal to the Angle of Friction.**
 - **Appeared in:** W23 (Q4b OR, 04 marks), S23 (Q4b, 04 marks), W24 (Q4c, 07 marks), S24 (Q4b OR, 04 marks)
3. **State the advantages and disadvantages of friction.**
 - **Appeared in:** W23 (Q4b, 04 marks), W24 (Q4b, 04 marks)
4. **Calculate the force required to move a block on a horizontal or inclined plane (either to initiate motion or to prevent sliding).**
 - **Appeared in:** W24 (Q4c, 07 marks), S22 (Q4b OR, 04 marks), S23 (Q4c, 07 marks), S23 (Q4c OR, 07 marks), S24 (Q4c, 07 marks), S24 (Q4c OR, 07 marks), S25 (Q5b, 04 marks)

Other Important Questions:

1. **Define Static Friction, Rolling Friction, and Sliding Friction.** (S25 - Q4a OR, 03 marks)
2. **Explain the types of friction.** (W24 - Q3b, 04 marks), (S23 - Q4b OR, 04 marks)
3. **State any three laws of static friction.** (W23 - Q4a OR, 03 marks)
4. **Explain the law of friction.** (S24 - Q4b, 04 marks)
5. **A block weighing 5 kN is lying on a rough plane inclined at 25° with the horizontal. The angle of friction is 20° . Find the minimum force required parallel to the plane just to support the body.** (W23 - Q4c, 07 marks)
6. **A ladder weighing 400 N is 10 m long. Its end 'A' is resting on a smooth vertical wall and the lower end 'B' is resting on a rough horizontal floor with a coefficient of friction of 0.4. The ladder makes an angle of 45° with the horizontal. The ladder is about to slip when a man weighing 600 N is standing at the mid-length of the ladder. Find reactions at supports A and B and the limiting friction at the floor.** (W23 - Q4c OR, 07 marks)

Unit 6: Simple Lifting Machines

Repeated Questions:

1. **Define Mechanical Advantage (M.A.), Velocity Ratio (V.R.), and Efficiency of a machine.**
 - **Appeared in:** S22 (Q5a, 03 marks), W23 (Q5a OR, 03 marks), S23 (Q5a, 03 marks), S24 (Q5a, 03 marks), S25 (Q4a, 03 marks)
2. **State and explain the Law of a Machine.**
 - **Appeared in:** W23 (Q5b, 04 marks), S23 (Q5b OR, 04 marks), S24 (Q5b, 04 marks), S25 (Q4b OR, 04 marks)
3. **Explain Reversible and Irreversible (Non-reversible) Machines.**
 - **Appeared in:** W24 (Q5b, 04 marks), S22 (Q5b OR, 04 marks), S23 (Q5a OR, 03 marks)
4. **For a simple wheel and axle, given diameters and efficiency, find the effort required to lift a given load.**
 - **Appeared in:** W24 (Q5c, 07 marks), W23 (Q5c, 07 marks), S22 (Q5c OR, 07 marks)

Other Important Questions:

1. **Draw a line sketch of the 1st system of pulleys.** (W23 - Q5a, 03 marks)
2. **Explain the effort lost in friction with an example.** (S23 - Q5b, 04 marks)
3. **Differentiate between reversible and irreversible machines.** (S23 - Q5a, 03 marks)
4. **Prove that for a reversible machine, efficiency is greater than 50%.** (W23 - Q5b OR, 04 marks)
5. **In a lifting machine, an effort of 90 N raised a load of 950 N and an effort of 450 N raised a load of 5700 N. Find the effort required to lift a load of 10 kN.** (W24 - Q5b OR, 04 marks)
6. **In a lifting machine, an effort of 2 kN raised a load of 60 kN and an effort of 3 kN raised a load of 100 kN. The velocity ratio of the machine is 50. Calculate: (1) Effort to lift 160 kN (2) Max Efficiency (3) State if the machine is reversible or self-locking.** (S22 - Q5c, 07 marks)
7. **A weight of 450 N is to be raised by means of a wheel and axle. The axle is 100 mm in diameter and the wheel is 500 mm in diameter. If a force of 120 N has to be applied to the wheel, find (i) M.A., (ii) V.R., (iii) Efficiency.** (S22 - Q5c OR, 07 marks)
8. **A simple lifting machine has a velocity ratio of 20. Find the values in the table and state whether the machine is reversible or not?** (W24 - Q5c OR, 07 marks)

Load in KN	Effort in KN	Efficiency in %
100	9.82	(a) ?
600	49.82	(b) ?
1000	(c) ?	(d) ?
