**OBJECTIVES**

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

## PART – A (Short Answer Questions)

| Q. No | Questions | Blooms Taxonomy Level | Course Outcome |
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| | **Unit-I** | | |
| 1 | Define Longitudinal strain and lateral strain. | Knowledge | 1 |
| 2 | State Hooke's law | Knowledge | 2 |
| 3 | Define Modular ratio, Poisson's ratio | Knowledge | 4 |
| 4 | What is modulus of elasticity? | Understand | 1 |
| 5 | Explain lateral strain with a neat sketch | Understand | 1 |
| 6 | Write the relationship between bulk modulus, rigidity modulus and Poisson's Ratio | Create | 2 |
| 7 | Draw the stress-strain diagram for mild steel, brittle material and a ductile material and indicate the sailent points | Apply | 2 |
| 8 | What is Principle of Superposition? | Understand | 2 |
| 9 | What is the procedure for finding the thermal stresses in a composite bar? | Understand | 2 |
| 10 | Define Factor of Safety, working stress and allowable stress. | Knowledge | 3 |
| | **Unit-II** | | |
| 1 | Explain shear force in a beam with neat sketches | Understand | 1 |
| 2 | What are the different types of beams? Differentiate between a point load and a uniformly distributed load. | Knowledge | 2 |
| 3 | What is the maximum bending moment for a simply supported beam subjected to uniformly distributed load and where it occurs? | Knowledge | 2 |
| 4 | Write the relation between bending moment, shear force and the applied load. | Create | 2 |
| 5 | Define point of contra flexure. | Knowledge | 1 |
| 6 | Define moment of resistance of a beam | Knowledge | 3 |
| 7 | What do you mean by thrust Diagram? | Understand | 4 |

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| 8 | How many points of Contraflexure you will have for a simply supported beam overhanging at one end only? | Knowledge | 4 |
| 9 | What are the sign conventions for shear force and bending moment in general? | Understand | 2 |
| | UNIT-III | | |
| 1 | Define the terms: bending stress, neutral axis | Knowledge | 2 |
| 2 | What do you mean by simple bending | understand | 3 |
| 3 | What do you mean by pure bending | Understand | 1 |
| 4 | What is the meaning of strength of section | Understand | 1 |
| 5 | Define the terms : modular ratio, equivalent section | Knowledge | 1 |
| 6 | Define the terms: section modulus, flitched beams. | knowledge | 1 |
| | UNIT-IV | | |
| 1 | Define terms of principle plane and principle Stress | knowledge | 2 |
| 2 | Define the term obliquity and how it is determined | knowledge | 2 |
| 3 | Write a note on mohr's circle of stress | create | 2 |
| 4 | Derive the expression for the stresses on an oblique plane of a rectangular body When the body is subjected to to simple shear stress | Evaluate | 2 |
| 5 | Discuss about about theories of failure | understand | 3 |
| | UNIT-V | | |
| 1 | Define the term thin cylinders | understand | 1 |
| 2 | Name the stresses set up in thin cylinders subjected to internal fluid pressure | Knowledg | 2 |
| 3 | Write the expressions for circumferential stress and longitudinal stress for a | Create | 2 |
| 4 | Write an expression for change in volume of athin cylindrical shell subjected to | Create | 2 |
| 5 | Define the term efficiency of a joint and write the equation | Understan | 4 |
| 6 | What is hoop stress and explain why hoop stress is required. | understand | 2 |
| 7 | Define the terms torsion, torsional rigidity and polar moment of inertia. | understand | 3 |
| 8 | Derive an expression for shear stress produced in circular shaft which is subjected to torsion. What are assumptions made in derivation? | evaluate | 3 |

## PART – B (Long Answer Questions)

| Q. No | Questions | Blooms Taxonomy Level | Course Outcome |
|---|---|---|---|
| | **UNIT – I** | | |
| 1 | Three sections of a bar are having different lengths and different diameters. The bar is subjected to an axial load P. Determine the total change in length of the bar. Take Young's modulus of different sections as same. | Knowledge | 1 |
| 2 | Prove that the total extension of a uniformly tapering rod of diameters $D_1$ & $D_2$, when the rod is subjected to an axial load P is given by $dL = 4PL/(\pi E D_1 D_2)$ where L is total Length of the rod. | Knowledge | 2 |
| 3 | Find an expression for the total elongation of a bar due to its own weight, when the bar is fixed at its upper end and hanging freely at the lower end. | Knowledge | 2 |
| 4 | Find an expression for the total elongation of a uniformly tapering rectangular bar when it is subjected to an axial load P. | Understand | 2 |
| 5 | Derive the relation between three elastic modulii. | Understand | 2 |
| 6 | Define Volumetric Strain. Prove that the volumetric strain for a rectangular bar subjected to an axial load P in the direction of its length is given by $\varepsilon_V = (\delta l/l)(1-2\mu)$ where $\mu$= Poisson's Ratio and $\delta l/l$ = longitudinal strain. | Knowledge | 2 |
| 7 | Derive an expression between modulus of elasticity and modulus of rigidity. | Understand | 2 |

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| 8 | Prove that the stress induced in the body when the load is applied with the impact is given by, $\sigma = \frac{P}{A}\left(1+\sqrt{1+\frac{2AEh}{P.L}}\right)$ A=cross-section area of the body H=height through which load falls E= modulus of rigidity L=length of the body | Understand | 2 |
| 9 | Prove that the maximum stress induced in a body due to suddenly applied load is twice the stress induced when the same load is applied gradually. | Understand | 2 |
| 10 | If the extension produced in a rod due to impact load is very small in comparison with the height through which the load falls, then the maximum stress induced in the body is given by $\sigma = \sqrt{\frac{2E.P.h}{A.L}}$ | Knowledge | 3 |
| | **UNIT – II** | | |
| 1 | Draw the shear force and bending moment diagrams for a cantilever of length L carrying a point load W at Free end. | Knowledge | 8 |
| 2 | Draw the shear force and bending moment diagrams for a simply supported beam of length L carrying a point load W at its middle point. | Knowledge | 8 |
| 3 | Draw the shear force and bending moment diagrams for a simply supported beam of length L which is subjected to a clockwise couple at the centre of the beam. | Apply | 2 |
| 4 | Draw the shear force and bending moment diagrams for a cantilever of length L carrying a uniformly distributed load w per unit length over its entire length. Also calculate maximum bending moment. | Apply | 2 |
| 5 | Draw the shear force and bending moment diagrams for a simply supported beam of length L carrying a uniformly distributed load w per unit length over its entire length. | Apply | 2 |
| 6 | Derive the relation between Load, shear force and bending moment. | Apply | 3 |
| 7 | Draw the shear force and bending moment diagrams for a cantilever of length L carrying a uniformly varying load zero at free end to w per unit length at the fixed end. | Apply | 3 |
| 8 | Draw the shear force and bending moment diagrams for a simply supported beam of length L carrying a uniformly varying load zero at each end to w per unit length at the centre. | Apply | 2 |
| 9 | How will you draw the S.F and B.M diagrams for a beam which is subjected to inclined loads? | Apply | 1 |
| | **UNIT – III** | | |
| 1 | Derive an expression for bending stress | Knowledge | 3 |
| 2 | Show that for a rectangular section the max shear stress is 1.5 times the average | Knowledge | 4 |
| 3 | The shear stress is not maximum at the neutral axis in case of a triangular | Knowledge | 2 |
| 4 | A rectangular beam 100mm wideand 150mm deep is subjected to a shear force of | Apply | 1 |
| 5 | Derive bending equation M/I=f/y=E/R. | Knowledge | 2 |
| 6 | Discuss the assumptions involved in the theory of simple bending | Knowledge | 3 |
| 7 | Draw and explain shear stress distribution across I section | Knowledge | 2 |
| 8 | Draw and explain shear stress distribution acrossTsection. | Knowledge | 2 |
| 9 | Draw and explain shear stress distribution across Circular section. | Knowledge | 2 |
| | **UNIT – IV** | | |
| 2 | **Derive** equations of static equilibrium for a three dimensional elastic body. | Knowledge | 3 |
| 3 | **Derive** the equations for stresses acting on inclined planes and deduce stress equations for principal planes. | Knowledge | 4 |

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| 4 | **Determine** graphically state of stress on inclined plane for a deformable body. | Knowledge | 1 |
| 5 | **Derive** the strain equations for three mutually perpendicular line elements in terms | Knowledge | 2 |
| 6 | **Derive** equations for stains on inclined planes and deduce strain for principal planes. | Knowledge | 2 |
| 7 | **Draw** the Mohr's Circle to determine stains on inclined plane. | Knowledge | 1 |
| | **UNIT – V** | | |
| 1 | Prove that the torque transmitted by the solid shaft when subjected to torsion is given by $$T = \frac{\pi}{16} \tau D^3$$ | Apply | 1 |
| 2 | Derive the relation for a circular shaft when subjected to torsion as given below $$\frac{T}{J} = \frac{\tau}{R} = \frac{C\theta}{L}$$ | Apply | 2 |
| 3 | Find the expression for strain energy stored in a body due to torsion. | Apply | 2 |
| 4 | A hollow shaft of external diameter D and internal diameter d is subjected to torsion. Prove that the strain energy stored is given by $$U = \frac{\tau^2}{4CD^2}(D^2 + d^2) \times V$$ | Apply | 2 |

## PART – C (Problem Solving and Critical Thinking )

| Q. No | Questions | Blooms Taxonomy Level | Course Outcome |
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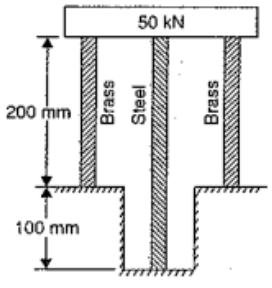
| | **UNIT – I** | | |
| 1 | Find the minimum diameter of a steel wire with which a load of 3500N can be raised so that the stress in the wire may not exceed 130N/mm$^2$. For the size and the length of the middle portion if the stress there is 140N/mm$^2$ and the total extension of the bar is 0.14mm. take E= $2\times10^5$ N/mm$^2$. | Analyze | 3 |
| 2 | A copper rod 5mm in diameter when subjected to a pull of 750 N extends by 0.125mm over a gauge length of 327mm. find the Young's Modulus for copper. | Analyze | 2 |
| 3 | A steel punch can operate at a maximum compressive stress of 75N/mm$^2$. Find the minimum diameter of the hole which can be punched through a 10mm thick steel plate. Take the ultimate shearing strength as 375N/mm$^2$ | Analyze | 2 |
| 4 | A steel rod of cross-sectional area 1600mm$^2$ and two brass rods each of cross-sectional area of 1000mm$^2$ together support a load of 50KN as shown in figure. Find the stresses in the rods. Take E for steel $2\times10^5$ N/mm$^2$ and E for brass $1\times10^5$ N/mm$^2$   | Analyze | 2 |

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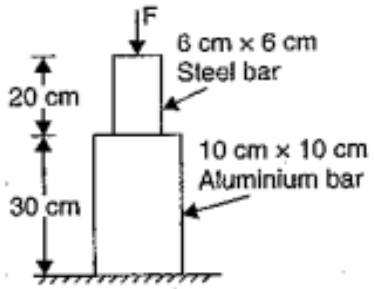
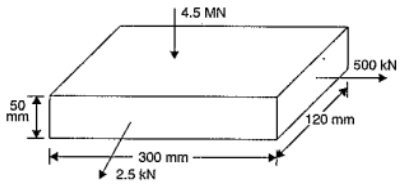
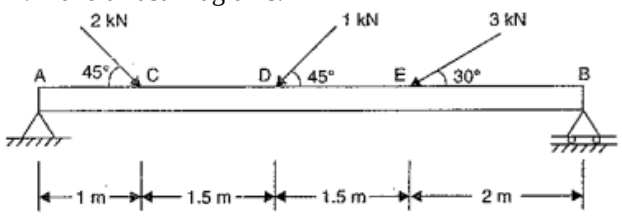
| 5 | A steel rod 5 cm diameter and 6 m long is connected to two grips and the rod is maintained at a temperature of $100^0$C. determine the stress and pull exerted when the temperature falls to $20^0$C if<br>(i) The ends do not yield<br>(ii) The ends yield by 0.15cm<br>Take E = $2 \times 10^5$ N/mm$^2$ and $\alpha = 12 \times 10^{-6}$/$^o$C | Analyze | 1 |
| 6 | The extension in a rectangular steel bar of length 800mm and of thickness 20mm is found to be 0.21mm. The bar tapers uniformly in width from 80mm to 40mm. if E for the bar is $2 \times 10^5$ N/mm$^2$. Determine the axial tensile load on the bar. | Analyze | 3 |
| 7 | A member formed by connecting a steel bar and an aluminium bar is shown in the figure. Assuming that the bars are prevented from buckling sideways, calculate the magnitude of force P, that will cause the total length of the member to decrease 0.30mm. the values of elastic modulus for steel and aluminium are $2 \times 10^5$ N/mm$^2$ and $6.5 \times 10^4$ N/mm$^2$<br>  | Explain | 1 |
| 8 | A metallic bar 300mm×120mm×50mm is loaded as shown in figure. Find the change in volume. Take E=$2 \times 10^5$ N/mm$^2$. And poisson's ratio =0.25<br>  | Explain | 1 |
| 9 | The shear stress in a material at a point is given as 45N/mm$^2$. Determine the local strain energy per unit volume stored in the material due to shear stress. Take C= $8 \times 10^4$ N/mm$^2$ | Analyze | 1 |
| 10 | A vertical compound tie member fixed rigidly at its upper end, consists of a steel rod 3m long and 20mm diameter, placed within an equally long brass tube 20mm internal diameter and 20 mm external diameter. The rod and the tube are fixed together at the ends. The compound member is then suddenly loaded in the tesion by a weight of 1200 Kgf falling through a height of 5mm on to a flange fixed to its lower end. Calculate the maximum in steel and brass. | Analyze | 1 |
| | UNIT-II | | |
| 1 | A beam is loaded as shown in following figure. Find the reactions at A and B, also draw the S.F, B.M and thrust Diagrams.<br>  | Analyze | 2 |

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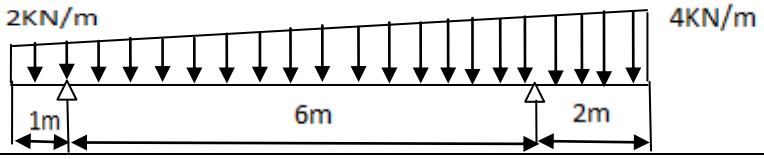
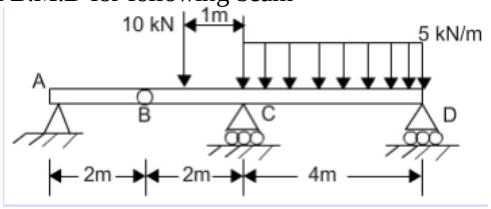
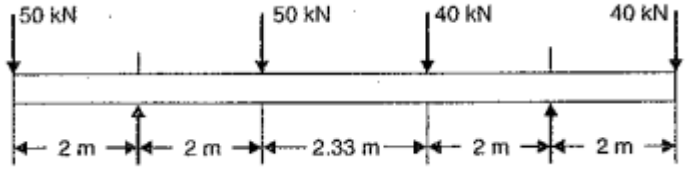
| 2 | A simply supported beam of length 5m, carries a uniformly distributed load of 100N/m extending from the left end to a point 2m away. There is also a clockwise couple of 1500Nm applied at the centre of the beam. Draw the S.F and B.M diagrams for the beam and find the maximum bending moment. | Analyze | 2 |
| 3 | Draw the S.F and B.M diagrams for the beam carrying the loading shown in the figure.<br>  | Analyze | 4 |
| 4 | A beam of length L is simply supported on two intermediate supports, movable along the length, with equal overhangs on either side. The supports are so adjusted that the maximum B.M is the minimum possible. Determine the position of the supports and draw the B.M and S.F diagrams for this position. The beam carries a uniformly distributed load of w per unit length over the entire length. | Analyze | 2 |
| 5 | A beam of uniform section 10m long carries a udl of 10KN/m over the whole length and a concentrated load of 10KN at the right end. If the beam is freely supported at the left end, find the position of the second support so that maximum bending moment for the beam shall be as small as possible. Find also the maximum bending moment for this case. Draw also SF and BM diagrams. | Analyze | 3 |
| 6 | Draw the S.F.D and B.M.D for following beam<br>  | Analyze | 2 |
| 7 | A beam 10m long and simply supported at each end, has a uniformly distributed load of 1000N/m extending from the left end upto the centre of the beam. There is also an anti-clockwise couple of 15kN/m at a distance of 2.5m from the right end. Draw the S.F and B.M diagrams. | Analyze | 2 |
| 8 | A simply supported beam of length 8m rests on supports 6m apart, the right hand end is overhanging by 2m. The beam carries a udl of 1500N/m over the entire length. Draw S.F.D and B.M.D | Analyze | 2 |
| 9 | A cantilever of length 2m carries a udl of 2KN/m run over the length of 1m from the free end. It also carries a point load of 4KN at a distance of 0.5m from the free end. Draw the S.F.D and B.M.D. | Analyze | 1 |
| 10 | A beam is loaded as shown in the figure. Draw S.F.D and B.M.D and find<br>a) Maximum Shear Force<br>b) Maximum Bending Moment<br>c) Point of inflexion<br>  | Analyze | 1 |
| | **UNIT – III** | | |
| 1 | A steel plate of width 60mm and thickness 10mm is bent into a circular arc of radius 10m. Determine the max stress induced and the bending moment which will produce the max stress. Take E= $2x10^5$ $N/mm^2$. | Analyze | 1 |

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| 2 | Calculate the max stress induced in a cast iron pipe of external diameter 40mm of internal diameter 20mm and of length 4m when the pipe is supported at its ends and carries a point load of 80N at the center. | Analyze | 4 |
| 3 | Derive an expression for bending stress | Analyze | 3 |
| 4 | Show that for a rectangular section the max shear stress is 1.5 times the average | Analyze | 3 |
| 5 | The shear stress is not maximum at the neutral axis in case of a triangular section. Prove this statement. | Analyze | 3 |
| 6 | A rectangular beam 100mm wide and 150mm deep is subjected to a shear force of 30kN. Determine the average stress, max shear stress | Analyze | 2 |
| | **UNIT – IV** | | |
| 1 | A structural member supports loads which produce, at a particular point, a direct tensile stress of 80N/mm² and a shear stress of 45N/mm² on the same plane .calculate the values and directions Of the principal stresses at the point and also the maximum stress, stating on which planes this will act. | Analyze | 3 |
| 2 | A solid shaft of circular cross-section supports a torque of 50KNm and a bending moment of 25KNm. If the diameter of the shaft is 150mm calculate the values of the principal stresses and their directions at a point on the surface of the shaft? | Analyze | 3 |
| 3 | A shear stress $\tau_{xy}$ acts in a two-dimensional field in which the maximum allowable shear stress is denoted by $\tau_{max}$ and the major principal stress by $\sigma_1$. Derive using the geometry of Mohr's circle of stress, expressions for the maximum values of direct stress which may be applied to the x and y planes in terms of three parameters given above. | Analyze | 3 |
| | **UNIT-V** | | 3 |
| 1 | A solid shaft of 20cm diameter is used to transmit torque. Find the maximum shaft transmitted by the torque if the maximum shear stresses induced in the shaft is 50N/mm$^2$ | Analyze | 2 |
| 2 | The shearing stress in a solid shaft is not to exceed 45N/mm$^2$ when the torque transmitted 40000N-m. Determine the minimum diameter of the shaft. | Analyze | 2 |
| 3 | Two shafts of same material and of same lengths are subjected to the same torque if the first shaft is of a solid circular section and the second shaft is of hollow circular section whose internal diameter is 0.7 times the outside diameter and the maximum shear stress developed in each shaft is same compare the weights of the shafts. | Analyze | 1 |
| 4 | Find the maximum shear stress induced in a solid circular shaft of diameter 20cm when shaft transmit 187.5KW at 2000 r.p.m. | Analyze | 2 |
| 5 | A solid shaft has to transmit 12.5KW at 250 r.p.m taking allowable shear stress as 70N/mm$^2$. Find suitable diameter for the shaft if maximum torque transmitted at each revolution exceeds the main by 20%. | Analyze | 1 |
| 6 | A cylindrical pipe of diameter 2m and thickness 2cm is subjected to an internal fluid pressure of 1.5N/mm$^2$. Determine longitudinal stress and circumferential stress developed in the pipe material. | Analyze | 2 |
| 7 | A cylinder of internal diameter 0.60m contains air at a pressure of 7.5N/mm$^2$ (gauge). If the maximum permissible stress induced in the material is 75N/mm$^2$ find the thickness of the material. | Analyze | 2 |