1. STATICS OF PARTICLES

Part A

1. Define force?
2. Classification of forces?
3. What is coplanar force?
4. What resultant of forces?
5. What is free body diagram?
6. What is equilibrium of a particle?
7. What are support and its types?
8. Define cone of friction.
9. Define coefficient of friction.
10. Define rigid body.

Part B

11. State parallelogram law of forces?
12. State triangle law of forces?
13. State the principle of transmissibility of forces?
14. State varignon's theorem?
15. What are the differences between static and dynamic friction?
16. What is limiting and angle friction?
17. Explain about law of static friction.
18. Explain about internal and external forces?
19. What are the difference between moment and couple?
20. Explain polygon law of forces

Part C

21. State Parallelogram law of force and prove it.
22. State principle of equilibrium. Explain limiting friction.
23. Explain polygon law of forces
24. Explain about types of support.
25. State laws of static and dynamic friction.
26. Find the resultant of the following three concurrent forces.
    1. 12N acting towards east.
    2. 16N acting towards 45^0 north of west.
    3. 10N acting towards southeast.
27. Describe the parallelogram law of forces and triangle law of forces
28. State angel of friction and Cone of friction and co efficient of friction.
29. Find the resultant of the following three concurrent forces.

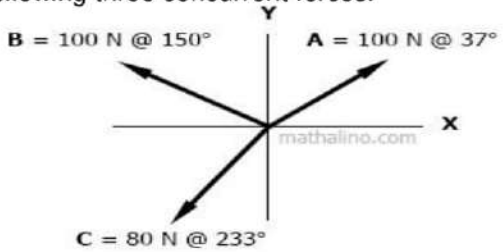

Figure P-013

30. Find the value of P by equilibrium of force figure shown in below (5)

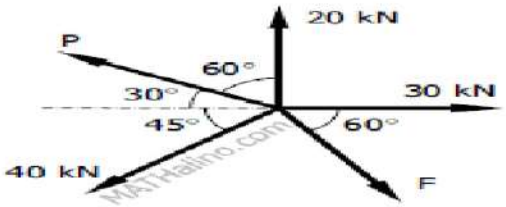

Figure P-314

2. DEFORMATIONS OF METALS

Part A

1. What is creep?
2. What is temperature creep?
3. Define hardness?
4. What is elastic limit?
5. What is factor of safety?
6. Define passion ratio?
7. Define proof resilience?
8. Define modulus of resilience?
9. What are the types of elastic constant?
10. Define stress and strain.
11. Define fatigue.
12. Define malleability.

Part B

13. Explain any five properties of materials.
14. State Hooke's law?
15. Explain about bulk modulus?
16. Explain stress strain diagram.
17. Explain about modulus of rigidity?
18. Explain about composite bar and its conditions.
19. Explain about difference between factor of safety and load factor?
20. Explain about difference between linear and lateral strain?

Part C

21. A cast iron of 200mm external diameter and 160mm internal diameter is filled with concrete. Determine the stresses in cast iron and concrete when an axial compressive load of 50kN is applied. Determine the change in length if $E_{CI}= 1.2 \times 10^5$ N/mm^2 and $E_c=1 \times 10^5$ N/mm^2
22. When a certain material 40mm square is subjected to an axial pull of 160000N, the extension on a gauge length of 200mm is 0.1mm and decrease in sides are 0.005mm. Calculate the E, 1/m, N, K of material
23. A steel bar 400mm long 60mm wide and 15mm thick is subjected to an axial tension of 100 KN. Find the final dimension and change in volume of the bar.
24. Steel Specimen 150mm^2 in cross section stretches by 0.05mm over a 50mm gauge length under an axial load of 30kN.Find the strain energy stored in the specimen at this stage if the load at the elastic limit for the specimen is 50kN. Calculate the elongation at elastic limit and the proof resilience when a load of 50kN is applied.
25. Determine the greatest weight that can be dropped from a height of 200mm onto collar a thin lower end of vertical bar 20mm diameter 2.5m long without elastic limit stress 300 N/mm^2 calculate instantaneous elongation. E= 2×10^5 N/mm^2
26. A steel rod 2m long and 20mm diameter is subjected to an axial pull of 20 KN. Find the change in dimensions of the rod. Poisson ratio is 0.3 and E= 2×10^5 N/mm^2
27. Two vertical wires each 3mm diameter and 3m long support a load 2kN. One is of steel and the other is of aluminum. If the wire stretches elastically 3mm, find the load taken by each and the value of Young's modulus for aluminum. Given E for steel is 0.2X10^{6}N/mm^2.
28. A weight of 9.8 KN is dropped on to a collar at the lower end of a vertical bar 3m long and 32mm diameter. Calculate the height of drop, if the maximum instantaneous stress is not to exceed 240 N/mm^2. What is the corresponding instantaneous elongation?
29. A bar of steel 28mm diameter and 250mm long is subjected to an axial load of 80 KN. It is found that the diameter has contracted by 0.0042mm.if the modulus of rigidity is 0.8×10^5 N/mm^2. Calculate poison's ratio, young's modulus and bulk modulus.

30. A steel rod 20mm diameter and 6m long is connected to two grips one at each end at a temperature of 180^0C. find the pull exerted when the temperature falls to 40^0C. (1). If the ends do not yield. (2). If the end yield by 1.1 mm. take E = 0.2×10^6 N/mm^2, $\alpha = 12 \times 10^{-6}$ per ^{0}C

3. GEOMETRICAL PROPERTIES OF SECTIONS AND THIN SHELLS

Part A

1. Define centre of gravity.
2. Define centroid.
3. Define axis of reference.
4. Explain about moment of inertia.
5. Define radius of gyration.
6. State perpendicular axis theorem.
7. State parallel axis theorem.
8. Define polar moment of inertia.
9. What are the differences between thin and thick cylinder.
10. Define hoop stress.
11. What are the stresses formed in a thin shell due to internal pressure?
12. Define thin cylinder.
13. Define thick cylinder.
14. Define axis of symmetry.
15. State the application of thin cylinder.
16. State the application of thick cylinder.

3 Marks:

14. What is main frame?
15. What is chain drive?
16. Write few advantages of torsion bar?
17. What is the main purpose of shock absorber?
18. Name the controls available on the handle bar?
19. Name the different types of brake drum shoes?
20. What are the components of major frame?
21. What is the principle of clutch?
22. What is the function (or) purpose of clutch?
23. What are the types of shock absorber?

5 and 10 Marks:

24. Determine the I_{xx} and I_{yy} and I_{ZZ} of a T section of flange 150mm x 50mm and web 150x 50mm about an axis passing through.
25. A cylindrical shell 800mm in diameter and 3m long is having 10mm metal thickness. If the shell is subjected to an internal pressure of 2.5 N/mm^2 determine the change in volume. Given $E = 2 \times 10^5$ N/mm^2 and 1/m = 0.25
26. A) Find the moment of inertia of the T- section with flange 100 X 40mm and web 100 X 10mm about XX and YY axis.
27. A cylindrical shell 3m long 500mm in dia is made u of 20mm thick plate. If the cylinder is subjected to an internal pressure of 5 N/mm^2, find the resulting hoop stress, longitudinal stress, change in diameter, change in length and change in volume. Take Poisson's ratio as 0.3 and $E= 2X10^5 N/mm^2$.
28. Determine the I_{xx} and I_{yy} and I_{ZZ} of an L section of flange 150mm x 50mm and web 150x 50mm about an axis passing through.
29. A cylindrical shell 500mm in diameter and 3m long is having 20mm metal thickness. If the shell is subjected to an internal pressure of 5 N/mm^2 determine the change in volume. Given $E = 2 \times 10^5$ N/mm^2 and 1/m =0. 3
30. Determine the centroid of channel section of 300x200x20mm.

4. SF AND BM DIAGRAMS OF BEAMS AND THEORY OF BENDING

Part A

1. What is a beam?
2. What are the different types of beams?
3. Define simply supported beam?
4. Define cantilever beam?
5. Define fixed beam?
6. Define uniformly varying load?
7. Mention different types of loading?
8. What is point load and uniformly distributed load?
9. Define is shear force?
10. Define is bending moment?
11. Define shear force diagram?
12. Define bending moment diagram?
13. Write sign conventions for shear force and bending moment?

Part B

14. What is point of contra flexure?
15. Write down the relationship between load, shear force and bending moment?
16. Define the term bending stress?
17. Define neutral axis?
18. State the assumptions made in the theory of simple bending?
19. Define pure bending?
20. Define moment of resistance of a beam?
21. Define section modulus?

Part C

22. A simply supported beam of 5m span carries a udl of 2kN/m over the entire span. In addition the beam carries a point load of 4kN at a distance of 2m from the left support. Draw SFD and BMD.
23. A simply supported beam of rectangular cross section carries a central load of 25kN over a span of 6m. The bending stress should not exceed 7.5 N/m^{m2}. The depth of the section is 400mm. calculate the necessary width of the section.
24. A beam 8m long is simply supported at its ends. It carries udl of 1kN/m run over the length of left half of its span, together with concentrated loads of 2, 3, and 2 KN situated at 2, 4, and 6m respectively from the left hand support. Sketch the S.F and B.M diagrams for this beam and find out the magnitude and position of maximum BM.
25. A test beam 25mm square in section is broken by a load of 750N applied at the center of span of 1m. Using a factor of safety of 8, calculate the safe UDL for a beam 120mm wide and 300mm deep freely supported over a span of 5m.
26. A beam 6m long is simply supported at its ends. It carries udl of 20kN/m run over the length throughout, a point load at 30KN at 2m from right support. Sketch the S.F and B.M diagrams for this beam and find out the magnitude and position of maximum BM.
27. A cast iron water pipe 450mm bore 19mm thick is supported over a span 9m apart. Find the maximum stress in the metal. When the pipe is running full. Density of cat iron 78KN/m^3. Density of water 10KN/m^3.
28. A wooden beam of rectangular section 100X200mm is ssb over a span of 6m. Determine the udl it may carry if the bending stress is not exceeding 7.5 N/mm^2. Estimate the concentrated load.
29. A cantilever beam of span 3m fixed at right end carries an udl of 10KN/m for a length of 2m from fixed end .it carries two points loads of 15KN and 10KN at 2m and 3m respectively from the fixed end. Draw SFD and BMD.

30. A beam 8m long is ssb carries of 1KN/m over length of the left half of its span together with point load 2KN, 3KN, 2KN situated at 2m, 4m and 6m from the left hand support. Sketch the SFD and BMD.

5. TORSION AND SPRINGS

Part A

1. Write the torsion equation?
2. Write the strength equation of the shaft?
3. Write the stiffness equation of the shaft?
4. Define polar modulus?
5. Write the formula for torsional strength of a hollow shaft?
6. State the application of springs?
7. Give the application of leaf springs?
8. List the application of coiled springs?
9. What is the formula for resilience?
10. What the formula for deflection of spring?
11. Write the formula for stiffness of spring?

Part B

12. What is a mean by stiffness of a spring?
13. Define torsional rigidity?
14. What are the assumptions made in the theory of pure torsional?
15. What are the advantages of hollow shaft over a solid shaft?
16. What is a spring?
17. What is the primary function of a spring?
18. Write down the various types of springs?
19. What is laminated spring? List of applications?
20. What is a compression spring?
21. What is a torsion spring?
22. What is open coil helical spring?
23. What is closed coil helical spring?
24. Mention the advantages of helical springs?
25. What is a bending spring?

Part C

26. A hollow shaft of 300mm outer diameter and 250mm inner diameter runs at 120 rpm. The max. Torque exceeds the mean by 30% and the max. Permitted shear stress is 60N/mm^2. Calculate the power transmitted and the angle of twist in length of 3m. C = 9x 10^4 N/mm^2
27. A truck weighing 30kN and moving at 5km/hr, has to be brought to be rest by a buffer. Find how many springs each of 18 coils will be required to store the energy of motion during a compression of 200mm. The spring is made out of 25mm diameter steel rod coiled to a mean diameter of 240mm. Take C = 8 x 10^4 N/mm^2.
28. A solid steel shaft 100mm diameter transmit 100kW at 180 rpm. Calculate the maximum intensity of shear stress induced and the angle of twist in degrees for a length of 10m. C= 0.8X10^{5}N/mm^2.
29. Design a closely coiled spring of stiffness 20 N/mm deflection. The maximum shear stress in the spring metal is not to exceed 80N/mm^2 under a load of 600N. The diameter of the coil is to be 10 times the diameter of the wire. Take the modulus of rigidity as 85kN/mm^2.
30. A hollow shaft having inner diameter 0.7 times the outer diameter is to replace a solid shaft of the same materials 500 KW at 200 rpm. The permissible shear stress is 80 N/mm^2. Calculate the diameter of solid and hollow shafts. Calculate the percentage of saving materials.