**Question Bank**

**Q. 1: - (10, 10 marks)**

A) Define the following

* Construction engineering
* Elastic limit:
* Modulus of rigidity or shear modulus;
* Residual Soils.

B) Fill in the following blanks with appropriate words or phrases

1. Engineering is application of ---------------and -------------------knowledge and rational thinking to improve living standards
2. Soil mechanics is a discipline that applies the principles of ------------------ to soils to predict the ------------------------- of soil.
3. Main areas of environmental engineering are -------------- collection and treatment ---------------- waste management ------------------- management
4. The job of a construction manager is to: Provide ------------------and ensure project is -------------- and within -----------------.

**Q. 2: - (10, 10 marks)**

Answer the following questions

1. Derive relations between Elastic, Shear and Bulk modulus's (E, G and K)
2. What is a permanent set? Explain it during the loading of materials.

**Q. 3: (20 marks)**

Briefly write about shallow foundation types, and illustrate your answer by sketches

**Q. 4: (10, 10 marks)**

1. What are the differences between Newtonian and non-Newtonian fluids? Give an example for each type and illustrate your answer with a figure
2. Determine the force required to reduce a given volume of water 1.5%. If $E=2060\*10^{6}$ N/m2 and loading area is 100 mm2

**Q. 5: (20 marks)**

The following observations were made using a 15 mm diameter steel rod:

 Gauge length = 250 mm

 Extension under the load of 20 kN = 0.20 mm

 Load at yield point = 30 kN

 Ultimate load = 55 kN

 Breaking load = 45 kN

 Length between the gauge marks after failure = 264 mm

 Diameter at the neck = 12 mm

 Evaluate

1. Young’s modulus

2. Yield stress, ultimate stress, nominal and true stresses at breaking point

3. Percentage elongation

4. Percentage reduction in area

**Q. 6: - (8,12 marks)**

A) Define the following

Structural engineering, Geotechnical engineering, Transportation engineering, Construction engineering

B) Fill in the following blanks with appropriate words or phrases

1. The word **engineer** originates from the **Latin term** ……….…………. that means ‘………………. ….’ in Latin
2. Criteria of Foundation Design are ……………………., …………………, and ………………….
3. Generally, that part of the structure above the foundation and extending above the ground level is referred to as the ……………………….
4. Environmental engineering is the application of science and engineering principles to improve the natural environment ……………, ……………., and/or ……………………….,
5. Poisson’s Ratio When a body is subjected to axial load or direct stress, besides the axial strain or longitudinal strain, there will be lateral strain of opposite nature in all directions at right angles. The ratio of the lateral strain to the axial strain is a constant known as ……………………. and it is denoted by ……………. or $…………..$.

**Q. 7: - (6, 7, 7 marks)**

A) Write briefly about composite member? Illustrate your answer by a figure

B) In general, write about fluid viscosity? Then compare between liquid and gas viscosity

C) Transported soils may be classified into several groups, list the name of these soils and explain their modes of transportation and deposition

**Q. 8: (6, 6, 8 marks)**

Answer the following questions

1. Classify Bridges Based on purpose
2. Classify dams based on Size
3. What are the Components of dam? Illustrate them by a figure.

**Q. 9: (10, 10 marks)**

1. Derive a relationship between Young’s modulus (e) and bulk modulus (k) Consider a cube subjected to three mutually perpendicular tensile stresses of equal intensity ‘f’ as shown in **Fig. 1**

**Fig. 1** Relationship between E and K

1. Determine the pressure to reduce a given volume of water 2%. If $E=2068\*10^{6}$ N/m2

**Q. 10: (20 marks)**

An axial load of 50 kN is applied over a metal tube of external diameter 30 mm and internal diameter of 25 mm. The extension observed over a gauge length of 75 mm was 0.08 mm. The decrease in the outer diameter was 0.008 mm. Determine the values of E, Poisson’s ratio and change in volume if length of the tube is 500 mm.

**Q. 11: - (10,8,7 marks)**

1. Define the following
* Bulk modulus of elasticity
* - Soil Definition: Soil is the relatively loose mass of mineral and organic
* - Sieve analysis: Sieve analysis consists of shaking the soil sample through a
1. All structures are founded on ground. What involve interaction between soil and structure. List these structures. That involves
2. List Scope of different fields of Civil Engineering

**Q. 12: - (25 marks)**

What is Strain? What are their types? Explain them by figures and equation.

**Q. 13: (25 marks)**

A bar of certain material of size 50 mm × 50 mm is subjected to an axial pull of 200 kN. The extension observed over a gauge length of 150 mm is 0.10 mm and the decrease in each side is 0.01 mm. Determine the Young’s modulus, Poisson’s ratio, rigidity modulus and bulk modulus.

**Q. 14: (25 marks)**

Briefly write about Clay Minerals. Illustrate basic units with figures and \draw the structures of the three main minerals

**Q. 15: - (10, 15, 15 marks)**

A) Civil Engineer is one who improves the quality of life through the production of Infrastructure, list these Infrastructure.

B) Geotechnical Engineering involves several subjects, list these subjects and draw a freehand (only one) sketch for each one.

C) In general, write about Combined footings and illustrate your answer by figures.

**Q. 16: (30 marks).**

Calculate the power transmitted by a shaft of 120 mm diameter running at

300 rpm, if the shear stress in the shaft material is not to exceed 80 N/mm2.

**Q17: (30 marks)**

A cylinder of 0.41 ft radius rotates concentrically inside of fixed cylinder of 0.43 ft radius. Both cylinders are 1.0 ft long. Determine the viscosity of the liquid that fills the space between the cylinders if a torque of 0.70 Ib.ft is required to maintain an angular velocity of 70 rpm.

Q18. How are loads classified according to the manner of application?

 Q19. How are loads classified according to the duration of their action on the

structure?

 Q20. How are loads classified with respect to area on which they are distributed?

 Q21. What are the types of strains?

 Q22. What is meant by volumetric strain?

 Q23. What is meant by superficial strain?

 Q24. Define working stress.

 Q25 Differentiate between external and internal forces.

 Q26. Define

1. Elasticity (b) Elastic limit

Q27. Differentiate between a compound member and composite member.

Q28. Basic Civil Engineering

 Q29. Define modular ratio.

 Q30. What do you mean by pure torsion?

 Q31. List the assumptions made in the theory of torsion.

 Q32. Write down the torsion equation.

 Q33. Give the expression for the power transmitted by the shaft.

 Q34. Define maximum torque.

 Q35. (a) Define stress, strain and Young’s modulus.

 (b) A steel rod of 15 mm diameter and 0.8 m length is subjected to an axial pull of

40 kN. Calculate the stress, strain and elongation of the rod. Take E = 2.1 × 105

N/mm2.

 Q36. (a) State and explain the different types of stresses.

 (b) Show that the elongation of a bar of uniform cross-section under axial load is Pl/

AE.

 Q37 (a) State Hooke’s law.

 (b) A steel rod of 30 mm diameter and 100 mm length is subjected to a compressive

load of 130 kN. The change in length due to compression was 0.2 mm. Calculate

the Young’s modulus of the rod material.

 Q38. Draw neatly the stress – strain diagram for a mild steel specimen indicating the

salient points in it. Explain them briefly.

 Q39. The following observations were made in a tension test with a 25 mm diameter

steel specimen:

 Gauge length = 200 mm

 Extension under a working load of 25 kN = 0.25 mm

 Yield load = 30 kN

 Ultimate load = 60 kN

 Breaking load = 50 kN

 Length of specimen after failure = 240 mm

 Diameter after failure = 16 mm

 Compute

 (a) Modulus of elasticity

 (b) Yield stress

 (c) Ultimate stress

 (d) Nominal and true stresses at breaking point

 (e) Percentage elongation and percentage reduction in area.

Q40. (a) What do you mean by factor of safety?

 (b) A hollow steel column is subjected to a working load of 1200 kN. If the internal

diameter is 0.6 times the external diameter and the ultimate stress is 400 N/

mm2, determine the external and internal diameters. Take factor of safety = 4.

 Q41. Define the following:

 (a) Poisson’s ratio

 (b) Bulk modulus

 (c) Rigidity modulus

Q42. Derive the relationship between the elastic constants using first principles.

 Q43. A bar of 80 mm × 80 mm size is subjected to an axial pull of 250 kN. The extension of the bar is 0.20 mm and the gauge length is 200 mm. Determine the Young’s

modulus, Poisson’s ratio, rigidity modulus and bulk modulus, if the change in

dimension of each side is 0.010 mm.

 Q44 Evaluate the bulk modulus and Poisson’s ratio of a material having E = 2.1 × 105

N/mm2 and N = 0.8 × 105 N/mm2.

 Q45. A bar of certain material that is 150 mm wide, 20 mm thick and 2 m long is subjected

to a pull of 160 kN. Find the extension in length and change in volume of the bar.

E = 250 kN/mm2, 1/m = 0.28.

 Q46. A tensile test was carried out on a mild steel specimen and the following results

were recorded:

 Original diameter of test piece = 30 mm

 Original gauge length = 240 mm

 Load at elastic limit = 65 kN

 Elongation at elastic limit = 0.16 mm

 Maximum load reached = 150 kN

 Load at fracture = 85 kN

 Calculate

 (a) Modulus of elasticity

 (b) Ultimate stress

 (c) Stress at fracture

 (d) Working stress for a factor of safety 3.

Q47. Calculate the force required to punch a hole of 30 mm diameter in a metal plate of

thickness 18 mm. The permissible shear stress in the material is 3400 N/mm2.

 Q48. A circular bar of 25 mm diameter and 200 mm length is subjected to a tensile force

of 60 kN and the elongation is 0.20 mm. Calculate modulus of elasticity and rigidity

modulus.

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 Q49. A cable consists of 6 aluminium wires, each 3 mm in diameter stranded together.

Compute the elongation of 14 m length of this cable under an axial pull of 800 N.

For aluminium, E = 80 kN/mm2.

 16. A weight of 300 kN is supported by a short concrete column of dimension

250 × 250 mm. The column is strengthened by 4 steel bars in the corners of total

cross-sectional area 6000 mm2. If the modulus of elasticity for steel is 15 times that

for concrete, find the stresses developed in steel and concrete.

 Q50. A wire strand consists of a steel wire of 2.7 mm diameter, covered by 6 bronze

wires each of 2.5 mm diameter. The tensile modulus of steel is 2 × 105 N/mm2

and it is 8 × 104 N/mm2 for bronze. If the working stress for bronze is 65 N/mm2,

calculate the strength of the strand.

 Q51. Two vertical rods, one made of steel and the other of copper are each rigidly fixed

at the top and are 50 cm apart. Diameter and lengths of each rod are 2 cm and 4 cm

respectively. A cross-bar fixed to the rods at the lower ends carries a load of 5 kN

such that cross-bar remains horizontal even after loading. Find the stress in each

rod. Take E for steel = 200 GPa and E for copper = 100 GPa.

 Q52. A 100 cm long solid aluminium shaft having 5 cm diameter is to be replaced by a

tubular steel shaft of the same length and same outside diameter so that either of

the shafts could carry the same torque and have same angle of twist over the total

length. What must be the inner diameter of the tubular steel shaft? Modulus of

rigidity of steel = 0.85 × 105 N/mm2 and that of aluminium = 0.28 × 105 N/mm2.

 Q53. The internal diameter of a hollow shaft is 2/3 of its external diameter. Compare its

resistance to torsion with that of a solid shaft of the same weight and material.

 21. What diameter of a shaft will be required to transmit 80 HP at 60 rpm if the

maximum torque is 30 per cent greater than the mean and the limit of torsional

stress is to be 56 N/mm2? If the modulus of rigidity is 0.84 × 105 N/mm2, what is

the maximum angle of twist in 3 metre length?

 Q54. A hollow shaft with a diameter ratio of 3/5 is required to transmit 800 HP at 110

rpm, the maximum torque being 20 per cent greater than the mean. The shear stress

is not to exceed 63 N/mm2 and the twist in a length of 3 metres is not to exceed

1.4°. Calculate the minimum external diameter satisfying these conditions: C = 0.84

× 105 N/mm2.

 Q55. A hollow shaft is of 5 cm external diameter and 3 cm internal diameter. An applied

torque of 1600 Nm is found to produce an angular twist of 0.4° measured on a length

of 20 cm of the shaft. Calculate the value of modulus of rigidity. Also, calculate the

maximum horse power which could be transmitted by the shaft at 2000 rpm if the

maximum shear stress is 65 N/mm2.

 Q56. Compare the weight of solid shaft with that of a hollow one to transmit a given horse

power at a given speed with a given maximum shear stress, the inside diameter of

the hollow shaft being 2/3 of its outside diameter.

Q59 The following are the results of a sieve analysis:

|  |  |
| --- | --- |
| U.S. sieve No. | Mass of soil retained on each sieve (g) |
| 4 | 0 |
| 10 | 21.6 |
| 20 | 49.5 |
| 40 | 102.6 |
| 60 | 89.1 |
| 100 | 95.6 |
| 200 | 60.4 |
| Pan | 31.2 |

* 1. Perform the necessary calculations and plot a grain-size distribution curve.
	2. Determine D10, D30, and D60 from the grain-size distribution curve.
	3. Calculate the uniformity coeffi­cient, Cu.
	4. Calculate the coef­ficient of gradation, Cc.

**Q60**

For a saturated soil, show that

$$γ\_{sat}=\left(\frac{1+ω\_{sat}}{1+ω\_{sat}G\_{s}}\right)G\_{s}γ\_{w}$$

**Q61** For a moist soil sample, the following are given.

Total volume: V = 1.2 m3

Total mass: M = 2350 kg

Moisture content: w = 8.6%

Specifi­c gravity of soil solids: Gs = 2.71

**Determine the following.**

a. Moist density

b. Dry density

c. Void ratio

d. Porosity

e. Degree of saturation

f. Volume of water in the soil sample

**Q62** The following data are given for a soil:

Porosity: n = 0.4

Speci­c gravity of the soil solids: Gs = 2.68

Moisture content: $ω$ = 12%

Determine the mass of water to be added to 10 m3 of soil for full saturation.

**Q63** A saturated soil has a dry unit weight of 103 lb/ft3. Its moisture content is 23%.

Determine:

a. Saturated unit weight, ­$γ\_{sat}$

b. Speci­c gravity, Gs

c. Void ratio, e

**Q64** The dry density of a sand with a porosity of 0.387 is 1600 kg/m3. Determine the void ratio of the soil and the spesifi­c gravity of soil solids.

QFigure 3.8 shows the cross section of an embankment to be constructed. For the embankment, ­ $γ=$ 110 lb/ft3. The soil for the embankment has to be brought from a borrow pit. The soil at the borrow pit has the following: e = 0.68, Gs = 2.68, and $ω=$ 10%. Determine the volume of soil from the borrow pit that will be required to construct the embankment 1000 ft long.



**Q65** Determine *moisture content*, *void ratio*, *porosity* and *degree of saturation* of a soil core sample. Also determine the dry unit weight, γd

**Data**:

Weight of soil sample = 1013g

Vol. of soil sample = 585.0 cm3

Specific Gravity, Gs = 2.65

Dry weight of soil = 904.0g

**Q66** The bulk density of a soil sample was found to be 1.90 g/ml and the moisture content 12%.

1. Determine the **dry density**, **void ratio** and **degree of saturation** if the particle specific gravity was 2.68.
2. What would the **moisture content** be if the soil were completely saturated at the same void ratio?

**Q.67** A sample of saturated clay has a volume of 245 ml and, after oven drying, has a mass of 453g. If the particle specific gravity of the soil is 2.75, determine the **dry** and **saturated unit weights** of the soil in its natural state.

**Q68** A saturated soil has a dry unit weight of 16.2 kN/m3. Its moisture content is 20%.

Determine:

1. $γ\_{sat}$
2. $G\_{s}$
3. $e$

Q69

Draw AOA- diagram of a small project involving activities, durations, and precedence given below.

Calculate ES, EF, LS, LF, TF, and FF and show critical path

|  |  |  |  |
| --- | --- | --- | --- |
| Activity | Duration (days) | Preceding activity | Following (succeeding) activity |
| A | 4 | - | D, E |
| B | 5 | - | E |
| D | 6 | A | - |
| E | 8 | A ,B | - |

Q70 Draw AOA- diagram of a small project involving activities, durations, and precedence given below.

Calculate ES, EF, LS, LF, TF, and FF and show critical path

|  |  |  |  |
| --- | --- | --- | --- |
| Activity  | Duration (days) | Preceding activity | Following (succeeding) activity |
| A  | 4 | - | D, C  |
| B  | 5 | - | E  |
| C  | 3 | A  | E  |
| D  | 6 | A  | - |
| E  | 8 | B, C | - |

Q71 Prepare an arrow (AOA) diagram showing critical path and calculate ES, EF, LS, LF, LF, TF and FF for a project involving following activities and durations.

|  |  |  |  |
| --- | --- | --- | --- |
| Activity  | Code | Duration (days)  | Activity  |
| Precedence  | following |
| Foundation works | A  | 7 | - | B |
| Brickwork above DPC  | B | 8 | A | C |
| Roofing | C | 20 | B | D, E, F |
| Plastering  | D | 15 | C | G |
| Electrical  | E | 5 | C | H |
| Plumbing  | F | 7 | C | I |
| Glass tiling | G | 10 | D | H |
| Gypsum works | H | 5 | G, E | I |
| Doors and window fixing | I | 5 | H, F | - |

Q72

Draw bar (Gantt) diagram for the following project.

Q73 A plate with area (0.1 m2) is needed to be moved over another fixed plate with speed of 0.3 m/s. there is a fluid with depth (0.1 cm) and viscosity of (0.001 N. s/m2), between the two plates. Find the force and power to remove the plates

Q74 Determine the pressure to reduce a given volume of water 2%. If $E=2068\*10^{6}$ N/m2

Q75 determine the height of capillary rise of water in a glass tube with a diameter of 0.5 mm at 50 oF, $σ \left(surface tension\right)=0.07\frac{N}{m}$ $∅ \left(water and glass\right)=0$

Q76 The specific gravity of ethyl alcohol is 0.79. Calculate its specific weight (in both pounds per cubic foot and kilonewtons per cubic meter) and mass density (in both slug per cubic foot and kilogram per cubic meter)

Q77 A cylinder of 0.4 ft radius rotates concentrically inside of fixed cylinder of 0.42 ft radius. Both cylinders are 1.0 ft long. Determine the viscosity of the liquid that fills the space between the cylinders if a torque of 0.650 Ib.ft is required to maintain an angular velocity of 60 rpm.

Q78 The following observations were made in a tension test with a 25 mm diameter

steel specimen:

 Gauge length = 300 mm

 Extension under a working load of 25 kN = 0.30 mm

 Yield load = 30 kN

 Ultimate load = 60 kN

 Breaking load = 50 kN

 Length of specimen after failure = 360 mm

 Diameter after failure = 16 mm

 Compute

 (a) Modulus of elasticity

 (b) Yield stress

 (c) Ultimate stress

 (d) Nominal and true stresses at breaking point

 (e) Percentage elongation and percentage reduction in area.

Q79 A hollow shaft having inner diameter 0.6 times the outer diameter is to replace a solid shaft of the same material to transmit 550 kW at 220 rpm. The permissible shear stress is 80 N/mm2. Calculate the diameters of the hollow and solid shafts. Also, calculate the percentage saving in material.

**Q80** How the solution to soil engineering problems could be done?

**Q81**

* define foundation engineering
* list types of foundation settlement

Q82. Define the following: (2,2)

1. Poisson’s ratio
2. Rigidity modulus

**Q82**

A 100 cm long solid aluminum shaft having 5 cm diameter is to be replaced by a tubular steel shaft of the same length and same outside diameter so that either of the shafts could carry the same torque and have same angle of twist over the total length. What must be the inner diameter of the tubular steel shaft? Modulus of rigidity of steel = 0.85 × 105 N/mm2 and that of aluminum = 0.28 × 105 N/mm2.