V.S.B. Engineering College, Karur

Department of Civil Engineering

ACADEMIC YEAR: 2017-2018 (EVEN Semester)

CE6401-CONSTRUCTION MATERIALS
UNIT I
STONES – BRICKS – CONCRETE BLOCKS

1. Write short notes on stone as a building material.

Stone is an important building material and use in the construction of stone masonry for foundation, stone work for dam, wing walls for bridges, culverts and other important structural works.

2. What are the uses of stone?

- For masonry work
- For lintels and vertical columns
- For covering floors and buildings
- For paving of roads and footpaths
- As an aggregate in cement as well as lime concretes.

3. What are the various tests for stones?

1. Smith's test 6. Microscopic examination
2. Freezing and thawing test 7. Impact test
3. Frost action test 8. Attrition test
4. Acid test 9. Crushing test
5. Water absorption test 10. Hardness test

4. What are the causes for deterioration of stones?

1. Temperature variation 6. Vegetable growth
2. Wetting and drying of stone 7. Rain water
3. Frost action 8. Wind
4. Polluted atmosphere 9. Water
5. Living organisms 10. Chemicals

5. What is an artificial stone?

Cast stone or artificial stone is nothing, but hardened plain cement concrete, moulded in suitable shape and size. Artificial stone consists of 1.5 parts of coarse aggregate ofsize 3mm to 6mm and 1.5 parts of coarse aggregate of size less than 3mm.

6. Explain the factors influencing the selection of preservatives.

- Type of the stone
- Durability of the preservative.
- Colour of the preservative.
- Environmental conditions.
- Cost factors etc.
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7. What are Kilns? State its types.

Kilns are the permanent structures or arrangements, used for large scale unit in the manufacturing process of bricks, for burning process of bricks, for burning purposes. Kilns are classified as,1)Intermittent Kilns 2)Continuous Kiln

8. What is meant by stone quarrying?

The site from where stones are excavated is known as quarry or quarry site. The process of taking out stones from quarry is known as quarrying of stone.

9. What are the methods of quarrying stones?

1. Digging or excavating
2. Heating
3. Wedging
4. Blasting

10. What is the purpose of preservation of stones?

Preservation of stones is the preventing process of stones from deterioration by external agencies. Preservatives are used for this purpose and following are the important preservatives 1) Coal tar 2) Linseed oil 3) Paint 4) Paraffin 5) Alum soap solution.

11. Write short notes on bricks and its ingredients.

Bricks are lightweight rectangular blocks used as important building materials having uniform size, and obtained by burning and drying of clay in moulding. A good brick earth mainly consists of silica (sand), alumina (clay), lime, oxide of ironand magnesia.

12. State the steps carried out in the manufacturing process of bricks.

Bricks are manufactured by moulding clay in rectangular moulds of uniform size and then drying and burning these blocks.1) Preparation of clay 2) Moulding 3) Drying 4) Burning

13. What are the classifications of bricks?

1. First class bricks
2. Second class bricks
3. Third class bricks
4. over burnt or Jhama bricks
5. Under burnt or pilla bricks

14. List the tests for bricks.

1) Absorption test 2) Shape and size test 3) Crushing strength test 4) Soundness test
5) Hardness test .6) Test for presence of soluble salts.

15. Define the term Efflorescence.

If soluble present in the bricks, it will cause efflorescence on the surface of the bricks. In this test, the brick is immersed in water for 24 hours. It is taken out and allowed to dry in shade. The presence of grey and white deposits on bricks surface indicates the presence soluble salts.

16. Explain the factors affecting the quality of bricks.

1) Composition of brick earth 2) Preparation of Clay and blending 3) Type of the moulding
4) Process of drying and stacking 5) Type of the kiln used 6) Burning and cooling methods.

17. What are refractory bricks and its types?

Refractory bricks (fire clay bricks) are manufactured from fire-clay and the process is same as that of ordinary bricks.Fireclay bricks are white or yellowish in colour. The weight of a fire-brick is about 30N to 35N.Following are the types of refractory bricks.1) Acidic bricks 2) Basic bricks 3) Neutral bricks.

18. What are Concrete blocks and state its uses?

Concrete blocks are the solid cement concrete bricks made up of cement, aggregates and water. Concrete blocks are used in the construction of wall for larger scale for mass housings, industrial structure, foundations of heavy structures and power plants etc.

19. What is meant by lightweight concrete and its advantages?

Lightweight concrete blocks are made by replacing the sand and gravel with expanded clay, shale or slate. Expanded clay, shale and slate are produced by crushing the raw materials and heating them to about 2000˚c.It has following advantages light in weight, high thermal insulation, high fire protection, high sound insulation and low water absorption.

20. List the applications of lightweight blocks.

1. Blocks, panels and ceiling panels
2. Pre-cast Exterior walls
3. Void Filling
4. Roof Insulation
5. Floors
6. Road Construction
7. Low cast housing etc.

UNIT II
LIME – CEMENT – AGGREGATES – MORTAR

1. Define Lime.

Lime is a locally available binding material and it is used as an alternative for cementing material.

2. Define Calcinations of lime.

Calcinations are defined as the process of heating the lime to redness in contact with air. Calcinations remove the moisture content and carbon-di-oxide from hydrated lime.

$$CaCO_3 \longrightarrow Cao \text{ (quick lime)} + CO_2$$

3. What is meant by slaking?

Slaking is defined as the process of chemical combination of quick lime with sufficient quantity of water for reducing the heat and, to get the powder form of lime.

$$CaO + H2O \longrightarrow Ca(OH)_2 + Heat$$

4. Define slaked lime and Quick lime.

The product obtained by slaking of quick lime is known as slaked lime or hydrated lime.

The lime obtained from the calcinations of pure limestone is known as quick lime

5. What are the constituents of Lime Stone?

Clay, soluble silica, carbonate of magnesia, alkalis and metallic oxides and sulphate.

6. What are the classifications of lime?

1. Fat lime
2. Hydraulic lime
3. Poor lime

7. What is Lime mortar?

Lime mortar is the mix of lime and sand with water. In this, only pure water is used for making mortar and it should be free from any organic and other impurities. It is prepared by the following two methods a) Pounding b) Grinding

8. What is meant by cement and it types?

Cement is the binding material, obtained by burning and crushing of clay stones containing Calcium Carbonate and Magnesium Carbonate. ($CaCO_3$ and $MgCO_3$).Cement can be classified as 1.Natural cement 2.Artificial cement.

9. List the important ingredients of cement?

1. Lime 2.Silica 3.Alumina 4.Calcium Sulphate 5.Iron Oxide 6.Magnesia 7.Sulphur

10. What is the function of manufacturing of cement?

Three important processes are carried out in the manufacturing of ordinary cement.1).Mixing of raw materials 2).Burning 3).Grinding

11. What is known as clinker?

Artificial cement is manufactured by burning approximately proportioned mixture of calcareous and argillaceous materials at a very high temperature and then grinding the resulting burnt mixture to a fine powder. The burnt mixture of calcareous and argillaceous matter is known as clinker.

12. Define hydration of cement?

The chemical reaction takes place between cement and water is called hydration of cement. When water is added to the cement, various ingredients of cement react chemically with various complicated chemical compounds.

13. List the types and grades of cement?

Types of cement: 1. High alumina cement 2.Low heat cement 3.White cement 4.Coloured cement 5.Expanding cement 6.Quick setting cement.

Grades of cement: The grades are classified depending upon the compressive strength of the cement.1) Grade 33 2) Grade 43 3) Grade 53.

14. What are the properties of cement?

1. High strength to masonry 2.Easy hardening 3.High plasticity 4.Good building material 5.High workability 6.High moisture resistant

15. Define Cement mortar.

The mortar is a paste like substance prepared by adding required amount of water to a dry mixture of sand or fine aggregate with some binding material like clay, lime or cement.

16. List the properties of cement mortar.

1. Cement mortar has good workability **2**.It binds the bricks; stones etc.**3**.It has low water permeability **4**.It can withstand the stresses developed.

17. What are the different type's tests for cement?

1. Compressive strength test **2.**Tensile strength test **3.**Fineness test **4.**Soundness test **5.**Consistency test**6**.Setting time.

18. Write short notes on setting time of cement.

Setting time is used to detect the initial and final setting time of the cement under various climatic conditions. This test also is used to detect the deterioration of cement due to storage. The test is carried out to find out initial setting time and final setting time of cement.

19. Define Fly ash:

Fly ash is one of the by-products generated in combustion, contains fine particles that rise with the flue gases. Fly ash is classified into two types 1) Class F fly ash 2) Class C fly ash.

20. What are Aggregates?

Aggregates are defined as inert, granular and inorganic materials that normally consist of stone or stone-like solids.

21. What is meant by grading of aggregates?

1. Dense Graded Aggregate **2.**Gap-Graded Aggregate**3**.Uniformly Graded Aggregate **4**.Well Graded Aggregate **5**.Open Graded Aggregate.

22. Explain the testing of aggregates.

1. Crushing strength test **2.**Impact strength test **3.**Abrasion resistance test**4.**Flakiness Index and Elongation Index test.

23. State Flakiness Index test and Elongation test.

Flakiness index is defined as the percentage by weight of particles whose least thickness is less than $3/5^{th}$ of their mean dimension. Thickness gauge is used to find out the flakiness index.

Elongation index is the percentage by weight of particles whose greatest length is greater than $4/5^{th}$ 1.8 times their mean dimension.

24. What is known as bulking of sand?

Bulking of sand is defined as the volume increase of sand due to presence of moisture content. Fine sand bulks more as compared to coarse sand. Fine aggregate do not show any bulking when it is absolutely dry or completely saturated.

UNIT III

CONCRETE

1. Define Concrete.

Concrete is defined as the solid-composite material and made up of suitable proportions of binding material, fine aggregate, coarse aggregate and water. Some special chemicals may be used to change the properties of concrete.

2. What are the various ingredients of concrete?

The various ingredients of concrete are **1**.Binding Material **2**.Fine aggregate **3**.Coarse aggregate **4**.Water.

3. What are the various stages of preparation of concrete?

1. Batching of ingredients 2.Mixing of materials 3. Transporting 4.Placing 5.Compacting
6. Finishing 7.Curing.

4. Define Ready Mixed Concrete.

Concrete prepared at plant or in trick mixers and transported and delivered to the construction site is called Ready Mix Concrete or Pre-Mixed Concrete. It has low cost and high durability.

5. Define bleeding.

Bleeding is defined as the type of segregation, in which sum of the water leaves out from the concrete and float on the surface of the concrete. It is sometimes referred as water gain.

6. What are the steps adopted to control bleeding.

- By adding more cement

- By using more finely ground cement
- By using little air entraining agent
- By increasing finer part of fine aggregate
- By properly designing the mix and using minimum quantity of water.

7. Define Segregation.

The disintegration of ingredients of concrete mix, so that the mix is no longer in a homogeneous and stable condition is called segregations.

8. What are the methods adopted to avoid segregation of concrete.

1. Addition of little air entraining agents in the mix.
2. Restricting the amount of water to the smallest possible amount.
3. Concrete should not be allowed to fall from larger heights**.**

9. Define workability.

Workability is that property of concrete which determines the amount of internal worknecessary to produce full compaction. It is a measure with which concrete can be handledfrom the mixer stage to its final fully compacted stage.

10. What are the factors affecting workability.

1. Water-Cement ratio.
2. Mix proportions
3. Size of the aggregates.
4. Shape of the aggregates
5. Nature of the work and climatic conditions

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11. List the types of tests for concrete.

1. Slump test 2.Compaction test 3.Flow test 4.Kelly ball test 5.Vee-Bee consistometer test

12. Define compaction Factor.

The Compaction factor is defined as the ratio of the weight of partially compacted concrete to the weight of fully compacted concrete.

13. List the properties of hardened concrete.

Following are the important properties of hardened concrete. 1).Strength 2).Durability 3).Permeability

14. Define Modulus of rupture.

The Flexural Tensile Strength is expressed as modulus of rupture (MR)in psi (Mpa)and is determined by standard test methods ASTM C78 or ASTM C 293.It is a measure of an unreinforced concrete beam or slab to resist failure in bending.

15. Define mixing of concrete.

The process of mixing cement, water, fine aggregate and coarse aggregate in suitable proportion is known as mixing of concrete.

16. What are the methods of consolidation or compaction of concrete?

1. Hand compaction
2. Machine compaction – i) Internal vibrators
   ii) Form vibrators
   iii) Surface vibrators

17. Define curing of concrete.

Curing is the operation by which moist conditions are maintained on finished concrete surface, to promote continued hydration of cement.

18. What are admixtures?

Admixtures are ingredients other than cement, fine aggregate and coarse aggregate toimprove the quality of concrete. The addition of an admixture may improve the concrete with respect to its strength, hardness, workability, water resisting power etc.

19. Write short notes on Mix Proportioning.

Mix proportioning is the process of measuring the various ingredients of concrete of the required strength, quality and durability, and which is prepared by using the available materials.

20. Define Grades of Cement.

Grade of concrete is defined as the designation of concrete based on its characteristic compressive strength (fck) value.

21. Define BIS Method.

The BIS, recommends procedure for designing the mix for concrete. The mix design procedures are given in IS: 10262:1982. The procedure given in the BIS standards are based on various researches carried out at national laboratories.

22. Define High Strength Concrete.

High Strength concrete having the compressive strength of more than 35 Mpa.It is used instructors that must resist high compressive loads, HSC is used in high-rise buildings and long bridges.

23. Define High Performance Concrete.

High performance concrete is defined as the concrete, which possesses high strength, high workability, high modulus of elasticity, high density, high dimensional stability, high resistance to chemical attacks and low permeability.

24. Define Self Compacting Concrete.

Self-compacting concrete has evolved as an innovative method. In this, no vibration is required for the concrete, which can flow around obstructions, reinforcement and fill the formwork completely under its own self weight.

25. What are the types of concrete used?

Plum concrete, light weight concrete, air-entrained concrete, no-fines concrete, vacuumconcrete, water-proof concrete, reinforced cement concrete, pre-stressed concrete, cellular or aerated concrete, foamed concrete, pre-cast concrete.

26. Write short notes on durability of concrete.

Durability of concrete is defined as the ability of concrete to withstand the weathering action of chemical attack, abrasion or any other process of deterioration.

UNIT IV
TIMBER AND OTHER MATERIALS

1. What is timber?

Timber is defined as the wood suitable for building purposes and it is applied to the trees measuring not less than 0.6 m in circumference or girth of the trunk.

2. What is Structural timber and converted timber?

Structural timber is the timber, used in forming and load bearing structures. When roughly converted timber is further sawn and converted into commercial sizes such as planks, logs, battens, posts, beams, etc, it is called converted timber.

3. Define seasoning of timber?

Seasoning is defined as the process of drying the timber to reduce the moisture content and thus to prevent the timber from possible fermentation and making it suitable for use.

4. What are the methods of seasoning of timber?

- Natural seasoning
- Artificial seasoning – Water seasoning, boiling seasoning, kiln seasoning, chemical Seasoning, electrical seasoning.

5. Define Industrial timber.

Industrial Timber is defined as the timber prepared in a factory with specification and having shape, appearance, strength etc.

6. Name of the some industrial timber.

1. Veneers 2.Plywoods 3.Fibre Boards 4.Thermacole 5.Panels of laminates.

7. Define veneers.

Veneers are thin sheets or slices of wood of superior quality and its thickness varies from 0.4mm to 0.6mm.The maximum thickness of the veneer is limited to 1mm.Depending on the cutting process, the veneers are classified as 1.Rotary veneers 2.Sliced veneers.

8. Define plywood.

An odd number of layers of wood or veneers are arranged and glued by using glues under pressure is called plywood.

9. Define thermacole.

Thermal insulation is the process of restricting the transfer of heat from warmer to cooler areas. It is a light and cellular plastic material used for sound and heat insulation.

10. What are the panels of laminates?

Laminated boards have a core of strips, each not exceeding 7mm in thickness. The edges are glued together to form a solid sheet, which is then glued between two or more outer veneers.

11. What is Steel?

The steel is a ferrous material containing a maximum of 1.5% of carbon in its composition.Steel is harder and tougher than iron, because its carbon chemically combines with complete iron, exist in its free state.

12. Explain the process of manufacturing of steel.

1. Bessemer process 2.Open Hearth process 3.Crucible process 4.Duplex process 5.Cementation process 6.Electric smelting process 7.Lintz and Donawitz process.

13. What is heat treatment of steel?

Heat treatment of steel is the process of changing the properties of steel based on the requirement by heating and cooling under controlled conditions.

14. List the types of defects of steel.

1. Checks 2.Segregation 3.Blow Holes 4.Cold Shortness

15. What are the processes involved in the heat treatment?

1. Annealing 2.Cementing 3.Hardening 4.Normalising 5.Tempering 6.Case Hardening.

16. Define annealing.

Annealing is the process of heating and slow cooling of metal, glass or any other material, which has developed strain due to rapid cooling.

17. Name of the market forms of steel.

1. Angle section 2.Channel section 3.T-section 4.I-section 5.Plates 6.Tor steel.7.Expanded metal.

18. Define Aluminium.

Aluminium is a silvery white, soft, ductile metal and it is the third most important metal in the earth crust. It has low density and high ability to resist corrosion.

19. What is meant by aluminium alloy?

An alloy is a homogeneous mixture of two or more metals. Aluminium alloys are manufactured from copper, silicon, magnesium, manganese, iron and other metals, to improve its mechanical properties.

20. Define paint.

Paint is a surface coating liquid used to protect, colour or to provide texture to objects. Paint can be made in many colours and in many different types, such as water colours, artificial etc.

21. What are the components of paint and types of paints?

Components: 1. Vehicle or binder 2.Pigments 3.Solvents or Thinners 4.Plasticizers 5.Adultrants.

Types: 1. Oil paints 2.Bituminous paints 3.Water paints 4.Cement Paints 5.Special paints

22. What is meant by varnish?

Varnish is a solution of some resinous substance in alcohol, oil or turpentine. The process of covering the surface with varnish is known as varnishing. Varnishing is done on wooden surface.

23. List the constituents and types of the varnish?

Constituents: 1. Resinous material2. Driers3. Solvents

Types: 1.Oil varnish 2.Spar varnish 3.Flat varnish 4.Spirit varnish 5.Asphalt varnish.

24. What is meant by distempering?

Distemper is the mixture of pigment, suspended in a liquid used as a protective or decorative coating of surface it dries to form a hard coating. It is made with base as white chalk and thinner as water.

25. Define Bitumen.

Bitumen is oil based, high viscous, semi-solid material produced by removing the lighter materials from heavy crude oil during the refining process.

UNIT V
MODERN MATERIALS

1. What is Glass?

Glass is a hard, brittle, amorphous, transparent inorganic material, which is mad from the pure iron fine quartz sand or crushed quartzite rock.

2. State the Composition of Glass.

Glass is not a single material and which is formed by various constituents. The general formula of glass is as follows.

$aX_2O,bYO.6SiO2$

Where,

1) a and **b –** Number of molecules**.**
2) X-alkali metal atom (Na, K, etc),
3) Y-bivalent metal atom (ca, Pb, etc).

3. State the types of glass.

Glasses are classified based on the properties and uses and are as follows.

1. Soda-Lime Glass
2. Potash-Lime Glass
3. Potash-Lime Glass
4. Boro-Silicate Glass
5. Common Glass.

4. Explain the procedure adopted in the manufacture of glass.

1. Raw materials collection
2. Batch Preparation
3. Melting
4. Fabrication
5. Annealing

5. Name the colouring agents (decolourisers) used in the manufacturing of glass.

1. Antimony oxide
2. Arsenic oxide
3. Manganese Dioxide
4. Cobalt Oxide
5. Nickel Oxide

6. Define Batch or Frit.

The raw materials, cullet and decolourises are weighed, and mixed in correct proportions and finely powdered in grinding units. The uniform mixture of the raw materials of glass is called **Batch** or **Frit**.

7. What is fabrication in glass manufacturing?

Fabrication is carried out to shape (to form) the glass from the molten glass, operated manually or mechanically. **Manual Fabrication** (Hand Fabrication) is employed for small scale production and **Mechanical Fabrication** (Machine Fabrication) is employed for large scale production, various methods of fabrication of glass1. Blowing 2. Casting 3.Drawing 4. Pressing 5. Rolling 6. Spinning 7.Annealing.

8. Name the treatment process given to glass.

The glass may be given any of the following treatment:

1. Blending
2. Cutting

3. Opaque making
4. Silvering.

9. What are the characteristics of good sealant?

1. It should be always in shear in lap joints.
2. It should not be affected by temperature.
3. It should be cheap in cost.
4. It should be always in tension.

10. What are ceramics?

Ceramics are defined as the products or articles or materials, which are produced from the products of heating the earthly materials. Following are the general classification of ceramics as follows. **1. Clay products 2.Refractories 3. Glass**

11. What are clay tiles?

Clay tiles are thin slabs of low melting clays, used for various purposes in engineering constructions. These give a very pleasing appearance and good service properties. Roofing tiles, flooring tiles, wall tiles and partition tiles are some of the examples.

12. State the properties of a good clay brick.

1. Uniform texture
2. Accurate size and shape
3. Free from defects like flaws, cracks
4. Less water absorption
5. High Resistant to atmosphere
6. High Durability

13. What are the types of fire-clay bricks?

a) Acid Refractory Bricks
b) Basic Refractory Bricks
c) Neutral Refractory Bricks

14. Define refractory.

Refractory are the materials that can with stand high temperatures and used in high temperature furnaces. In the use of refractory materials, there are two important principles involved, 1.Thermal **insulation 2.Heat conduction**

15. Define FRP

Fibre glass reinforced plastic (FRP) is defined as the composite material formed by two different materials having different properties. **FRP** is sometimes referred as **GRP**(Glass Fibre Reinforced Plastics) and in the FRP, the glass fibre provides the strength and rigidity and the resin provides a matrix to transfer the load to the fibres.

16. What are the methods of fabrication of FRP?

1) Filaments winding
2) Hand lay-up
3) Pultrusion
4) Resin transfer moulding
5) Spray-up

17. Define Composite materials.

Composite materials are defined as the combination of two or more material having the different properties, differ from those of the individual materials of the composite. The properties of composite materials are always better than any one of the individual materials of the composite.

21. What is Fibre Reinforced Composite?

Fibre Reinforced Composites are high strength, low-density, fibre and matrix materials and in which the disperse phase is in the form of the fibre.

22. What are Laminar Composites?

Laminar Composites are defined as the composite materials. In which the layers of two dimensional sheets or panels cemented together, such that the orientation of the high strength direction varies with each successive layer.

23. Define Fibre textiles.

It is defined as the hair like substances that are very small in diameter in relation to their length. It is the important raw material to produce various types of finished textile products.

24. What is Geomembrane?

A **Geomembrane** is very low permeability-synthetic membrane liner which is used with any geotechnical engineering material, in order to control fluid migration in a man-made project, structure or system.

25. What are the applications of Geotextiles for earth reinforcement?

Geotextiles are employed in the following civil Engineering works. **1**. Road works **2**.Railway works **3**.Rivr canals and coastal works **4**.Drainage **5**.Sports field construction.

13 MARK QUESTIONS

UNIT – I
STONE-BRICKS-CONCRETE BLOCKS

1. Explain in detail about the manufacturing process of bricks.
2. Briefly discuss the defects and preservation of stones.
3. List the various tests to be performed on stones.
4. Explain the process of manufacturing of Bricks.
5. Describe the various tests on bricks.
6. Explain the recent advancements refractory bricks.
7. What are concrete blocks? Explain about the manufacturing of concrete blocks.
8. Explain in detail about the manufacturing of light weight concrete blocks.

UNIT- 2
LIME-CEMENT-AGGREGATES-MORTAR

1. Explain in detail about the manufacturing process of lime.
2. Enumerate the requirements and preparation of lime mortar.
3. Briefly describe the manufacturing process of cement.
4. Describe the wet and dry process of mixing of raw material for cement.
5. Give a detailed account of types and grades of cement.
6. Explain the preparation, properties and uses of cement mortar.
7. List the various field and laboratory tests for cement.
8. Explain detail about

i) Consistency test on cement.
ii) Soundness of cement.
iii) Crushing strength of aggregate.
iv) Impact strength of aggregate

9. Explain with codal provision for testing of conventional coarse aggregates.

UNIT 3
CONCRETE

1. Explain in detail about preparation of concrete.
2. With sketches explain in detail about different flow properties of concrete.
3. List the various tests to be performed on hardened concrete.
4. Briefly explain about mix proportion and mix design methods.
5. With sketches explain the various specifications for self-compacting concrete.
6. Briefly explain about the high strength and high performance concrete.

7. Write in detail about
   i) Ready Mixed Concrete
   ii) Durability of concrete
   iii) Curing
8. What is durability of concrete? Explain the factors affecting durability and requirement for durability.

UNIT 4
TIMBER AND OTHER MATERIALS

1. Define timber. Explain the classification and advantages of timber.
2. Define Seasoning of timber. Explain various methods of seasoning of timber.
3. Explain the defects and market forms of timber.
4. Explain in detail about
   i) Plywood
   ii) Veneer
   iii) Thermacole
   iv) Panels of laminates
5. Explain the important advantages and disadvantages of timbers and timber construction.
6. Describe the manufacturing process and civil Engineering applications of steel.
7. List the various mechanical and heat treatment of steel.
8. Explain in detail about aluminium composite panel and its advantages.
9. Explain the important properties and advantages of aluminium.
10. Write in detail about
    i) Paints
    ii) Varnishes
    iii) Distempers
    iv) Bitumen

UNIT-5
MODERN MATERIALS

1. Explain the various types and manufacturing process of glass.
2. What is fabrication? Explain the various methods for fabrication of glass.
3. Define Ceramics. Explain the advantages and disadvantages of ceramics.
4. Explain in detail about
   i) Sealants for joins
   ii) Ceramics

5. Explain in detail about clay products and refractories.
6. Write short notes on
   i) Laminar Composites
   ii) Fibre glass reinforced plastic
   iii) Fibre textile
7. Define laminar composites and explain its applications.
8. Explain in detail about the composite materials.
9. Discuss about the types of textile fibre and properties of textile fibre
10. Describe the various applications of i) Geomembrane ii) Geotextile

CE6402 STRENGTH OF MATERAILS
PART A

UNIT : I

1. Define: Strain Energy

When an elastic body is under the action of external forces the body deforms and work is done by these forces. If a strained, perfectly elastic body is allowed to recover slowly to its unstrained state. It is capable of giving back all the work done by these external forces. This work done in straining such a body may be regarded as energy stored in a body and is called strain energy or resilience.

2. Define: Proof Resilience.

The maximum energy stored in the body within the elastic limit is called Proof Resilience.

3. Write the formula to calculate the strain energy due to axial loads (tension).

$$U = \int_{0}^{L} \frac{P^2}{2AE} dx$$

Where,

P = Applied tensile load.
L = Length of the member
A = Area of the member
E = Young's modulus.

4. Write the formula to calculate the strain energy due to bending.

$$U = \int_{0}^{L} \frac{M^2}{2EI} dx$$

Where,

M = Bending moment due to applied loads.
E = Young's modulus
I = Moment of inertia

5. Write the formula to calculate the strain energy due to torsion

$$U = \int_{0}^{L} \frac{T^2}{2GJ} dx$$

T = Applied Torsion

Where,

G = Shear modulus or Modulus of rigidity

J = Polar moment of inertia

6. Write the formula to calculate the strain energy due to pure shear

$$U = K \int_{0}^{L} \frac{V^2}{2GA} dx$$

limit 0 to L

Where, V= Shear load

G = Shear modulus or Modulus of rigidity

A = Area of cross section.

K = Constant depends upon shape of cross section.

7. Write down the formula to calculate the strain energy due to pure shear, if shear stress is given.

$$U = \frac{\tau^2 V}{2G}$$

Where, τ = Shear Stress

G = Shear modulus or Modulus of rigidity V = Volume of the material.

8. Write down the formula to calculate the strain energy, if the moment value is given

$$U = \frac{M^2 L}{2EI}$$

Where, M = Bending moment

L = Length of the beam

E = Young's modulus

I = Moment of inertia

9. Write down the formula to calculate the strain energy , if the torsion moment value is given.

$$U = \frac{T^2 L}{2GJ}$$

Where, T = Applied Torsion

L = Length of the beam

G = Shear modulus or Modulus of rigidity J = Polar moment of inertia

10. Write down the formula to calculate the strain energy, if the applied tension load is given.

$$U = \frac{P^2 L}{2AE}$$

Where,

P = Applied tensile load.

L = Length of the member

A = Area of the member

E = Young's modulus.

UNIT II

1. Explain with examples the statically indeterminate structures.

If the forces on the members of a structure cannot be determined by using conditions of equilibrium ($\sum Fx = 0, \sum Fy = 0, \sum M = 0$), it is called statically indeterminate structures.

Example: Fixed beam, continuous beam.

2. Define: Continuous beam.

A Continuous beam is one, which is supported on more than two supports. For usual loading on the beam hogging (- ive) moments causing convexity upwards at the supports and sagging (+ ve) moments causing concavity upwards occur at mid span.

3. What are the advantages of Continuous beam over simply supported beam?

1. The maximum bending moment in case of continuous beam is much less than in case of simply supported beam of same span carrying same loads.
2. In case of continuous beam, the average bending moment is lesser and hence lighter materials of construction can be used to resist the bending moment

4. Give the procedure for analyzing the continuous beams with fixed ends using three moment equations?

The three moment equations, for the fixed end of the beam, can be modified by imagining a span of length l_0 and moment of inertia, beyond the support the and applying the theorem of three moments as usual.

5. Define Flexural Rigidity of Beams.

The product of young's modulus (E) and moment of inertia (I) is called Flexural Rigidity (EI) of Beams. The unit is $N\ mm^2$.

6. What is a fixed beam?

A beam whose both ends are fixed is known as a fixed beam. Fixed beam is also called as built-in or encaster beam. Incase of fixed beam both its ends are rigidly fixed and the slope and deflection at the fixed ends are zero.

7. What are the advantages of fixed beams?

(i) For the same loading, the maximum deflection of a fixed beam is less than that of a simply supported beam.
(ii) For the same loading, the fixed beam is subjected to lesser maximum bending moment.
(iii) The slope at both ends of a fixed beam is zero.
(iv) The beam is more stable and stronger.

8. What are the disadvantages of a fixed beam?

(v) Large stresses are set up by temperature changes.
(vi) Special care has to be taken in aligning supports accurately at the same level.
(vii) Large stresses are set if a little sinking of one support takes place.
(viii) Frequent fluctuations in loading render the degree of fixity at the ends very uncertain.

UNIT III

1. Define: Column and strut.

A column is a long vertical slender bar or vertical member, subjected to an axial compressive load and fixed rigidly at both ends.

A strut is a slender bar or a member in any position other than vertical, subjected to a compressive load and fixed rigidly or hinged or pin jointed at one or both the ends.

2. What are the types of column failure?

1. Crushing failure:

The column will reach a stage, when it will be subjected to the ultimate crushing stress, beyond this the column will fail by crushing The load corresponding to the crushing stress is called crushing load. This type of failure occurs in short column.

2. Buckling failure:

This kind of failure is due to lateral deflection of the column. The load at which the column just buckles is called buckling load or crippling load or critical load. This type of failure occurs in long column.

3. What is slenderness ratio (buckling factor)? What is its relevance in column?

It is the ratio of effective length of column to the least radius of gyration of the cross sectional ends of the column.

Slenderness ratio = l eff / r

l eff = effective length of column r = least radius of gyration

Slenderness ratio is used to differentiate the type of column. Strength of the column depends upon the slenderness ratio, it is increased the compressive strength of the column decrease as the tendency to buckle is increased.

4. What are the factors affect the strength column? 1.Slenderness ratio

Strength of the column depends upon the slenderness ratio, it is increased the compressive strength of the column decrease as the tendency to buckle is increased.

2. End conditions: Strength of the column depends upon the end conditions also.

5. Define: Equivalent length of the column.

The distance between adjacent points of inflection is called equivalent length of the column. A point of inflection is found at every column end, that is free to rotate and every point where there is a change of the axis. ie, there is no moment in the inflection points. (Or)

The equivalent length of the given column with given end conditions, is the length of an equivalent column of the same material and cross section with hinged ends , and having the value of the crippling load equal to that of the given column.

6. What are the uses of south well plot? (column curve).

The relation between the buckling load and slenderness ratio of various column is known as south well plot.

UNIT IV

1. What are the types of failures?
    1. Brittle failure:
        Failure of a material represents direct separation of particles from each other, accompanied by considerable deformation.
    2. Ductile failure:
        Slipping of particles accompanied, by considerable plastic deformations.

2. List out different theories of failure
    1. Maximum Principal Stress Theory. (Rakine's theory)
    2. Maximum Principal Strain Theory. (St. Venant's theory)
    3. Maximum Shear Stress Theory. (Tresca's theory or Guest's theory)
    4. Maximum Shear Strain Theory. (Von –Mises- Hencky theory or Distortion energy theory)
    5. Maximum Strain Energy Theory. (Beltrami Theory or Haigh's theory)

3. Define: Maximum Principal Stress Theory. (Rakine's theory)
    According to this theory, the failure of the material is assumed to take place when the value of the maximum Principal Stress (σ_1) reaches a value to that of the elastic limit stress(f_y) of the material. $\sigma_1 = f_y$.

4. Define: Maximum Principal Strain Theory. (St. Venant's theory)
    According to this theory, the failure of the material is assumed to take place when the value of the maximum Principal Stain (e_1) reaches a value to that of the elastic limit strain(f_y / E) of the material.
5. Define : Maximum Shear Stress Theory. (Tresca's theory)
    According to this theory, the failure of the material is assumed to take place when the maximum shear stress equal determined from the simple tensile test.
6. Define: Maximum Strain Energy Theory (Beltrami Theory)
    According to this theory, the failure of the material is assumed to take place when the maximum strain energy exceeds the strain energy determined from the simple tensile test.
7. What are the theories used for ductile failures?
    1. Maximum Principal Strain Theory. (St. Venant's theory)
    2. Maximum Shear Stress Theory. (Tresca's theory)
    3. Maximum Shear Strain Theory. (Von –Mises- Hencky theory or Distortion energy theory)

8. Write the limitations of Maximum Principal Stress Theory. (Rakine's theory)
    1. This theory disregards the effect of other principal stresses and effect of shearing stresses on other planes through the element.
    2. Material in tension test piece slips along 45^0 to the axis of the test piece, where normal stress is neither maximum nor minimum, but the shear stress is maximum.
    3.Failure is not a brittle, but it is a cleavage failure.

9. Write the limitations of Maximum Shear Stress Theory. (Tresca's theory).
    This theory does not give the accurate results for the state of stress of pure shear in which the maximum amount of shear is developed (in torsion test).

10.Write the limitations of Maximum Shear Strain Theory.(Von –Mises- Hencky theory or Distortion energy theory).
    It cannot be applied for the materials under hydrostatic pressure.

UNIT V

1. What are the assumptions made in the analysis of curved bars?
   1.Plane sections remain plane during bending.
   2.The material obeys Hooke's law.
   3.Radial strain is negligible.
   4.The fibres are free to expand or contract without any constraining effect from the adjacent fibres.

2. Define unsymmetrical bending.

If the plane of loading or that of bending, does not lie in (or parallel to) a plane that contains the principal centroidal axis of the cross-section, the bending is called unsymmetrical bending.

3. What are the reasons for unsymmetrical bending?
   1.The section is symmetrical but the load line is inclined to both the principal axes.
   2.The section itself is unsymmetrical and the load line is along the centroidal axis.

4. How will you calculate the resultant stress in a curved bar subjected to direct stress and bending stress.

$$\nabla_r = \nabla_o + \nabla_b$$

where ∇_o = Direct stress = P/A

∇_b = Bending stress

5. What is shear centre or angle of twist?

The shear centre for any transverse section of the beam is the point of intersection of the bending axis and the plane of the transverse section.

6. Who postulated the theory of curved beam?

Winkler-Bach postulated the theory of curved beam.

7. What is the shape of distribution of bending stress in a curved beam?

The distribution of bending stress is hyperbolic in a curved beam.

8. Where does the neutral axis lie in a curved beam?

The neutral axis does not coincide with the geometric axis

PART B

UNIT – 1

ENERGY PRINCIPLES

1. A beam of 4 m length is simply supported at the ends and carries a uniformly distributed load of 6 kN/m length. Determine the strain energy stored in the beam. Take E = 200 GPa and I = 1440 cm4.
2. A beam simply supported over a span of 3 m carries an UDLof 20 kN/m over the entire span. The flexural rigidity EI = 2.25 MNm2 Using Castigliano"s theorem, determine the deflection at the centre of the beam.
3. A cantilever beam of span 3 m carries a UDL of 5 kN/m for the entire span in addition to a concentrated load of 20 kN at the free end. Using energy principle, calculate the deflection under the concentrated load. Assume EI = 2 x 104 kNmm2.
4. A simply supported beam of span 8 m carries two concentrated loads of 32 kN and 48 kN at 3 m and 6 m from left support. Calculate the deflection at the centre by strain energy principle.
5. A cantilever beam of span 3 m is carrying a point load of 50 kN at its free end. Compute the strain energy in the beam due to bending and hence deflection under the load. Assum e EI = 2 x 105 kNm2.

6. A simply supported beam AB of span 5 m carries a UDL of 25 kN/m throughout its entire span. Calculate the strain energy due to bending and deflection at its mid span. Assume EI = 2 x 104 kNm2.

7. A simply supported beam of 10 m span carries a uniformly distributed load of 2 kN/m over the half of the span. Find the deflection at Mid-span using principle of virtual work. Take EI = 30000 kNm2.

8. A beam of span 8 m carries UDL of 20 kN/m for a length of 4 m from left end. Find the deflection and slope at the centre of the beam by strain energy method. EI is constant.

9. Calculate the strain energy stored in a cantilever beam of 4 m span, carrying a point load of 10 kN at free end. Take EI = 25000 kNm2.

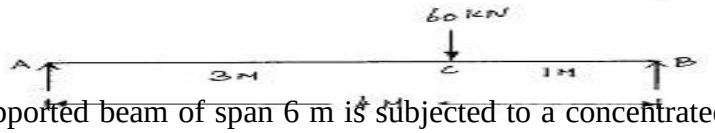
10. Find the deflection at mid span of a simply supported beam carrying a uniformly distributed load of 2 kN/m over the entire span using principle of virtual work. Take span = 5 m; EI = 20000 kNm2.

11. A mild steel specimen of gauge length 50 mm has a cross sectional area of 145 mm2. When it is subjected to a axial pull of 32 kN, it stretches by 0.054 mm. Calculate the strain energy stored in the specimen. If the load at the elastic limit of the specimen is 58 kN, calculate the elongation at elastic limit and proof resilience.

12. A rectangular beam of cross section 100 x 200 mm and length 2 m is simply supported at its ends and carries a central load. If the maximum bending stress is 120 N/mm2. Find the strain energy stored in the beam due to bending. Take E = 2X105N/mm2

13. Using castigliano‟s theorem, obtain the deflection at the free end of a cantilever of length 2.5 m carrying a udl of 16.4 kN/m over the whole span. Assume uniform flexural rigidity.

14. Using castigliano‟s theorem, obtain the deflection under a single concentrated load applied to a simply supported beam shown in fig. Take EI = 2.2 MNm2.



15. A simply supported beam of span 6 m is subjected to a concentrated load of 45 kN at 2 m from the left support. Calculate the deflection under the load point.
Take E =200 x 106 kN/m2and I = 14 x10-6 m4.

UNIT – 2 INDETERMINATE BEAMS

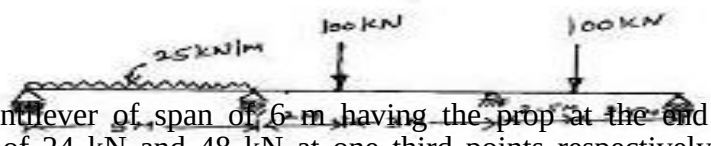
1. A fixed beam of 6 m span is loaded with point loads of 150 kN at a distance of 2 m from each support. Draw the shear force and bending moment diagram. Also find the maximum deflection. Take E = 200 GPa and I = 8 x 108 mm4.

2. A continuous beam consists of three successive spans of 6 m, 12 m and 4 m carries loads of 2 kN/m, 1kN/m and 3 kN/m respectively on the spans. Draw the bending moment diagram and shear force diagram for the continuous beam.

3. A fixed beam of 8 m span carries a uniformly distributed load of 40 kN/m run over 4 m length starting from left end and a concentrated load of 80 kN at a distance of 6 m from the left end. Find (i) Moments at the supports (ii)Deflection at centre of the beam. Take EI = 15000 kNm2.

4. A cantilever AB of span 6 m is fixed at the end „A‟ and propped at the end B. It carries a point load of 50 kN at the mid span. Level of the prop is the same as that of the fixed end. (i) Determine reaction at the prop.(ii) Draw the S.F and B.M diagrams.

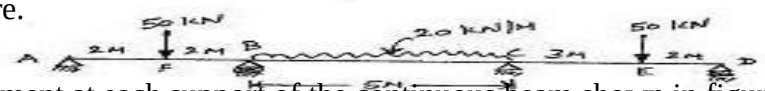
5. Compute the moment and reaction developed at each support of the continuous beam shown in figure.



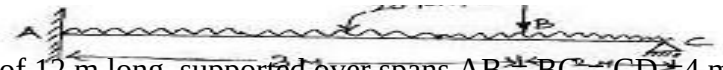
6. A propped cantilever of span of 6 m having the prop at the end is subjected to two concentrated loads of 24 kN and 48 kN at one third points respectively from left fixed end support. Draw shear force and bending moment diagram with salient points.

7. A continuous beam ABC has fixed end at A and is simply supported at B and C. AB = 4 m BC =5 m. Span AB carries a load of 20 kN at 3 m from A. Span BC carries two concentrated loads of 10 kN and 20 kN at 2 m and 3 m from right support C. Draw shear force and bending moment diagrams.

8. Draw the shear force and bending moment diagrams for the propped cantilever beam shown in figure.



9. Compute the moment at each support of the continuous beam shown in figure.



10. A continuous beam of 12 m long, supported over spans AB = BC = CD = 4 m, carries a UDL of 3 kN/m over the span AB, a concentrated load of 4 kN at a distance of 1 m from support B on the span BC, and a concentrated load of 3 kN at the centre of the span CD. Determine moments and reactions developed at each support.

11. A fixed beam of ACB of span 6 m is carrying a uniformly distributed load of 4 kN/m over the left half of the span AC. Find the fixing moments and support reactions.

12. Analyse the beam shown in fig. EI = constant. Draw the bending moment diagram.

13. A continuous beam ABC consists of two consecutive spans AB and BC 4 m each and carrying an UDL of 60 kN/m. The end A is fixed and C is simply supported.Find the support moments by using three moment equation.

UNIT – 3

COLUMNS

1. A 1.5 m long cast iron has a circular cross section of 50 mm diameter. One end of the column is fixed in direction and position and the other is free. Taking factor of safety as 3, calculate the safe load using Rankine-Gordan formula. Take yield stress as 560 MPa and constant $\alpha = 1/1600$.

2. A pipe of 200 mm internal diameter and 50 mm thickness carries a fluid at a pressure of 10 MPa. Calculate the maximum and minimum intensities of circumferential stress across the section. Also sketch the radial stress distribution and circumferential stress distribution across the section.

3. Find the greatest length of a mild steel rod of 30 mm x 30 mm which can be used as a compressive member with one end fixed and the other end hinged. It carries a working load of 40 kN. Factor of safety = 4, $\alpha = 1/7500$ and $\sigma c = 300$ N/mm2. Compare the result with Euler. Take E = 2 x 105 N/mm2.

4. A column with one end hinged and the other end fixed has a length of 5 m and a hollow circular cross section of outer dia 100 mm and wall thickness 10 mm. If E = 1.60 x 105 N/mm2 and crushing stress σc = 350 N/mm2, find the load that the column may carry with a factor of safety of 2.5 according to Euler theory and Rankine-Gordon theory.

5. A solid round bar 4 m long and 60 mm in diameter is used as a strut. Determine the Euler's crippling load under the following end conditions: (i)Both ends hinged. (ii) One end fixed and the other end free. (iii)Both ends are fixed and (iv) One end is fixed and the other end is hinged.Assume the modulus of elasticity of the material of the bar as 200 kN/mm2.

6. Find the Rankine's critical load for a column of 150 mm internal diameter, 15 mm thick and of length 5.2 m hinged at both ends. E= 200 kN/mm2. Assume fc = 500 MN/m2 and $\alpha = 1/1600$.

7. A hollow cast iron column whose outside diameter is 150 mm and has a wall thickness of 25 mm respectively. It is 3 m long and is fixed at both ends. Using Rankine-Gordan formula, find the critical load. Take Rankine constants as $\alpha = 1/1600$ and $\sigma c = 567$ N/mm2.

8. A T-section 150 mm x 120 mm x 20 mm is used as a strut of 4 m long with hinged at its both ends. Calculate the crippling load, if young's modulus for the material will be 200 GPa.

9. A hollow cast iron strut 150 mm outer and 100 mm inner diameter and 8 m long, one end pin jointed and other end rigidly fixed, is subjected to the axial compressive load. Taking a factor of safety of 5 and Rankine's constants, α = 1/1600 and σc = 550 N/mm2respectively. Using Rankine's formula, calculate the safe load.

10. Find the Euler's critical load for a cast iron hollow column of external diameter 200 mm diameter, 25 mm thick and of length 6 m hinged at both ends. E = 0.8 x 104 N/mm2. Compare Euler's load with Rankine's critical load. Assume fc = 550 N/mm2 and α = 1/1600. Find the length of column at which both critical loads are equal.

11. A pipe of 400 mm internal diameter and 100 mm thick contains a fluid at a pressure of 10 N/mm2. Find the maximum and minimum hoop stress across the section. Also sketch the stress distribution.

12. Find the thickness of steel cylindrical shell of internal diameter 200 mm to withstand an internal pressure of 35 N/mm2.Maximum hoop stress in the section not to exceed 120 N/mm2.

13. Find the greatest length of mild steel bar 25 mm x 25 mm in cross-section which can be used as compression member with one end fixed and the other end free to carry a working load of 35 kN. Allow a factor of safety of 4. Take α = 1/1600 and fc = 320 N/mm2.

14. A hollow cylindrical cast iron column is 4 m long and fixed at the ends. Design the column to carry an axial load of 250 kN. Use Rankine's formula and adopt a factor of safety of 5. The internal diameter may be taken as 0.8 times the externaldiameter. Take fc = 550 N/mm2and Rankine's constant is 1/1600.

UNIT – 4
STATE OF STRESS IN THREE DIMENSIONS

1. The rectangular stress components of a point in three dimensional stress system are defined as σx = 20 MPa, σy = -40 MPa, σz = 80 MPa, τxy = 40 MPa, τyz = -60 MPa and τzx = 20 MPa. Determine the principal stresses at the given point.

2. A steel shaft is subjected to an end thrust produces a stress of 90 MPa and the maximum shearing stress on the surface arising from torsion is 60 MPa. The yield point of the material in simple tension was found to be 300 MPa. Calculate the factor of safety of the shaft according to (i) Maximum shear stress theory and (ii) Maximum distortion energy theory.

3. Two mutually perpendicular planes of an element of a material are subjected to direct stresses of 10.5 MN/m2 (tensile); and 3.5 MN/m2 (compressive) and shear stress of 7 MN/m2. Find (i) The magnitude and direction of principal stresses.
(ii) The magnitude of the normal and shear stresses on a plane on which the shear Stress is maximum.

4. At a point in a strained material there is a tensile stress of 80 N/mm2 upon a horizontal plane and a compressive stress of 40 N/mm2 upon a vertical plane. There is also a shear stress of 48 N/mm2 upon each of these planes. Determine the planes of maximum shear stress at the point. Determine also the resultant stress on the planes of maximum shear stress.

5. A solid circular shaft is subjected to a bending moment of 40 kN.m and a torque of 10 kN.m. Design the diameter of shaft according to (i) Maximum principal stress theory (ii) Maximum shear stress theory (iii) Maximum strain energy theory. Take μ = 0.25, stress at elastic limit = 200 N/mm2 and factor of safety = 2.

6. A solid circular shaft is subjected to a bending moment of 40 kN.m and a torque of 10 kN.m. Design the diameter of the shaft according to

(i) Maximum principal stress theory (ii) Maximum shear stress theory

(iii) Maximum strain energy theory.

7. The normal stress in two mutually perpendicular directions are 600 N/mm2 and 300 N/mm2 both tensile. The complimentary shear stresses in these directions are of intensity 450 N/mm2. Find the normal and tangential stresses in the two planes which are equally inclined to the planes carrying the normal stresses mentioned above.

8. The state of stress (N/mm2), at a point is given by

$$\begin{matrix} 40 \\ 20 \\ 30 \end{matrix}\begin{pmatrix} 20 & 30 \\ 60 & 10 \\ 10 & 50 \end{pmatrix}$$

Determine the principal stresses and the orientation of any one of the principal plane.9. At a point in a strained material, the major principal stress is 200 N/mm2 tensile and the minor principal stress. If the yield stress of the material is 250 N/mm2, find the value of the minor principal stress at which yielding commence, according to (i) Maximum principal stress theory (ii) Maximum shear stress theory and (iii) Total strain energy theory. Assume Poisson's ratio as 0.28.

10. At the central point in a strained material the principal stresses (MPa) are 60 (tensile), 40 (tensile) and 40 (compressive) respectively. Calculate

(i) The total strain energy per unit volume (ii) Volumetric strain energy per unit volume (iii) Shear strain energy per unit volume. Assume the modulus of elasticity and Poisson's ratio for the material as 120 kN/mm2.

11. In a triaxial stress system, the six components of the stress at a point are given below: σx= 6 MN/m2, σy = 5 MN/m2, σz = 4 MN/m2, $\tau xy = \tau yx$ 1 MN/m2, $\tau yz = \tau zy$ 3 MN/m2 and $\tau zx = \tau xz$ 2 MN/m2. Find the magnitude of the three principal stresses.

12. The stress tensor at a point is given by

$$\begin{pmatrix} 20 & 15 & 0 \\ 15 & 10 & 5 \\ 0 & 5 & 5 \end{pmatrix}$$ N/mm2.

Calculate the minimum principal stress.

13. A bolt is under an axial thrust of 9.6 kN together with a transverse force of 4.8 kN. Calculate its diameter according to maximum principal stress theory and maximum shear stress theory. Assume the following, yield strength of material of bolt = 270 N/mm2, factor of safety = 3.0.

14. The state of stress at a point is given by MPa.

$$\begin{matrix} 4 \\ 2 \\ 3 \end{matrix}\begin{pmatrix} 2 & 3 \\ 6 & 1 \\ 1 & 5 \end{pmatrix}$$ Determine the principal stresses.

15. Explain any two theories of failure.

16. In a material the principal stresses are 40 MN/m2, 48 MN/m2 and -30 MN/m2. Calculate

(i) Total strain energy per unit volume

(ii) Shear strain energy per unit volume.

(iii) Volumetric strain energy per unit volume and

(iv) Factor of safety on the total strain energy criterion if the material yields at 110 MN/m2. Poisson's ratio = 0.3, E = 200 x 109 N/m2.

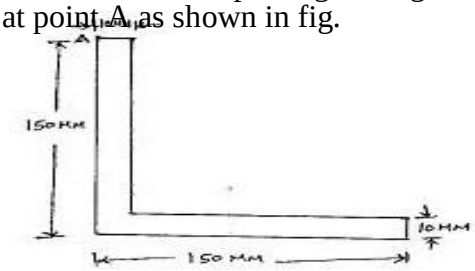
17. The state of stress at a point is given by

$$\begin{pmatrix} 9 & 6 & 3 \\ 6 & 5 & 2 \\ 3 & 2 & 4 \end{pmatrix}$$ MPa. Determine the principal stresses.

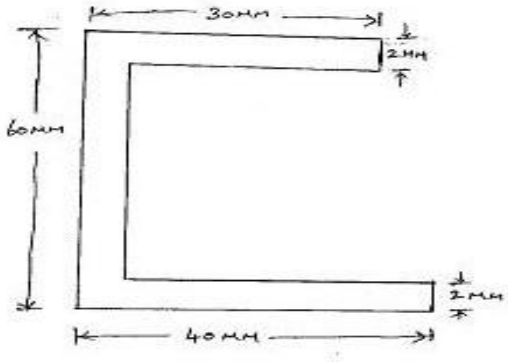
UNIT – 5 ADVANCED TOPICS IN BENDING OF BEAMS

1. Find the centroidal principal moments of inertia of an equal angle section 30 mm x 30 mm x 10 mm.
2. A compound tube is composed of 250 mm internal diameter and 25 mm thick shrunk on tube of 250 mm external diameter and 25 mm thick. The radial pressure at the junction is 8 N/mm^2. Find the variation of hoop stress over the wall of the compound tube.
3. Calculate the thickness of metal necessary for a steel cylindrical shell of internal diameter 100 mm to withstand an internal pressure of 40 N/mm^2, if the allowable tensile stress is 120 N/mm^2.

4. Explain with figure the conduct of Fatigue test for a material in the laboratory.
5. Find the thickness of metal necessary for a steel cylinder of internal diameter 200 mm to withstand an internal pressure of 50 N/mm^2. The maximum hoop stress in the section is not to exceed 150 N/mm^2. Assume thick cylinder.
6. An equal angle section 150 mm x 150 mm x 10 mm is used as a simply supported beam of 4 m length is subjected to a vertical load passing through the centroid. Determine bending stress at point A as shown in fig.



7. Find the principal moment of inertia of angle section 60 mm x 40 mm x 6 mm.
8. Find the thickness of metal necessary for a cylindrical shell of internal diameter 150 mm to withstand an internal pressure of 50 N/mm^2. The maximum hoop stress in the section is not to exceed 150 N/mm^2.
9. Determine the principal moment of inertia for an unequal angle section 60 mm x40 mm x 6mm.
10. Find the principal moment of inertia of channel section shown in fig.



11. A beam of Tee section having flange of 100 mm x 20 mm and web of 150 mm x 10mm and 3 m long is simply supported at its ends. It carries 4 kN at 30 ° to vertical and passing through the centroid of the section. Calculate the maximum tensile stresses and maximum compressive stresses. E = 200 kN/mm^2.
12. Determine the principal moment of inertia for an angle section 80 mm x80 mm x 10 mm

13. A 80 x 80 x 10 mm angle is used as a simply supported beam over a span of 2.4 m. It carries a load of 400 kN along the vertical axis passing through the centroid of the section. Determine the resulting bending stress on the outer corners of the section along the middle section of the beam.

over entire span using principle of virtual work method.

Or

(b) A crane is shown in fig. Q. 11(b) the cross sectional area of the member AC is 3000 mm² and that of member BC is 7000 mm². Determine the vertical deflection of the joint C. Take E = 2.0 × 10⁵ N/mm². Use Williot diagram method.

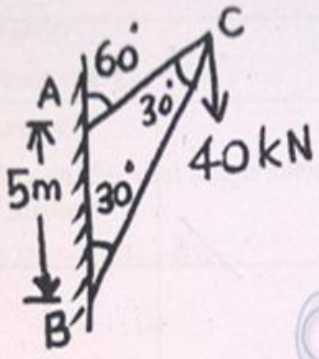


Fig. Q. 11(b)

12. (a) A fixed beam ACB of span 6 m is carrying a concentrated clockwise couple of 150 kN.m applied at a section 4 m from the left end. Find the

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DEPARTMENT OF CIVIL ENGINEERING
CE 6403 - APPLIED HYDRAULICS ENGINEERING
TWO MARKS QUESTION AND ANSWES

UNIT - I
UNIFORM FLOW

1. Define sub critical flow:

   If the Froude number is less than one then the flow is said to be sub critical flow.

2. Define critical flow:

   If the froude number is less equal to one it is called as critical flow.

3. Define supercritical flow:

   If the Froude number is greater than one it is called as super critical flow

4. What are the possible types of flow in open channel with respect to space and time?

   A, steady and unsteady flow

   B, uniform and non uniform flow

5. What do you know about uniform and non uniform flow?

Uniform flow: If the given length of the channel, depth, velocity, the rate of flow, cross section is constant.

Non Uniform flow: If the given length of the channel, depth, velocity, the rate of flow, cross section is not constant.

6. Define specific energy:

It is defined as energy per unit weight of the liquid with respect to the bottom of the channel.

7. What do you mean by open channel flow?

1. Open channel flow has a free surface which is subjected to atmospheric pressure.
2. In open channel flow the cross section is irregular.

8. What do you mean by pipe flow?

1. Pipe flow has no free surface and subjected to hydraulic pressure only.
2. The cross section of the flow is fixed

9. List the instrument used to measure open channel flow

1. pitot tube
2. Ultrasonic flow instrument.
3. Dropper instrument
4. Gurley instrument.

10. What do you know about laminar and turbulent flow?

Laminar flow:

The flow in open channel is said to be laminar if the Reynolds number (Re) is less than 500

Turbulent flow:

If the Reynolds number is greater than 2000 it is called turbulent flow.

11. What do you mean by specific energy curve?

It is defined as the curve which shows the variation of specific energy with respect to depth of flow.

12. What are the classifications of flow in channels?

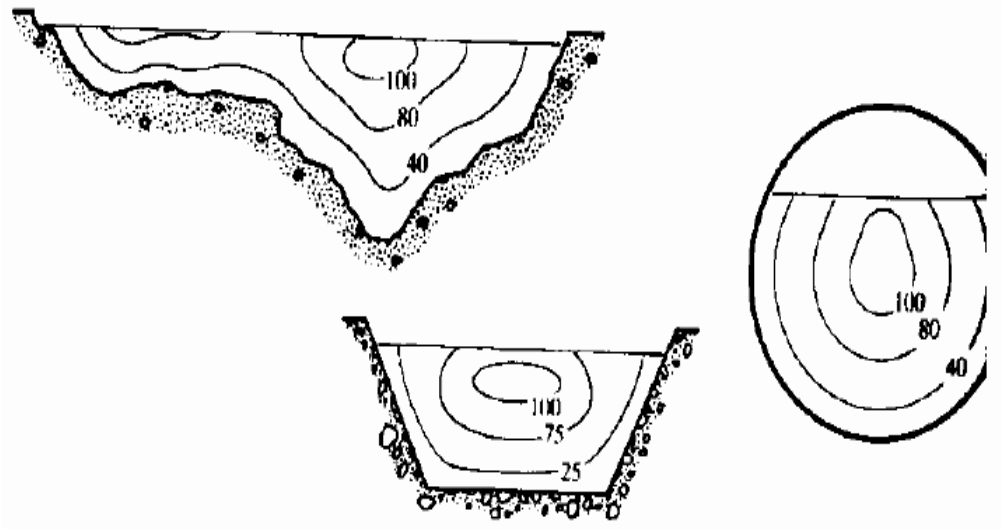
1. Steady flow and Un steady flow.
2. Uniform flow and non uniform flow.
3. Laminar flow and turbulent flow and
4. Sub critical, critical and super critical flow.

13. What are the types of Non uniform flow?

(i)Rapidly Varied Flow (R.V.F)

(ii)Gradually Varied Flow (G.V.F)

14. Sketch the velocity distribution of a trapezoidal channel section.



15. Explain specific force (Fc).

Specific force is the sum of the pressure force (F) and momentum force due to flow (M) per unit weight of the liquid at a section.

16. What are the possible types of flow in open channel with respect to space and time?

Based on space:

(i) Uniform flow

(ii) Non-uniform flow

Based on time:

(i) Steady flow

(ii) Unsteady flow

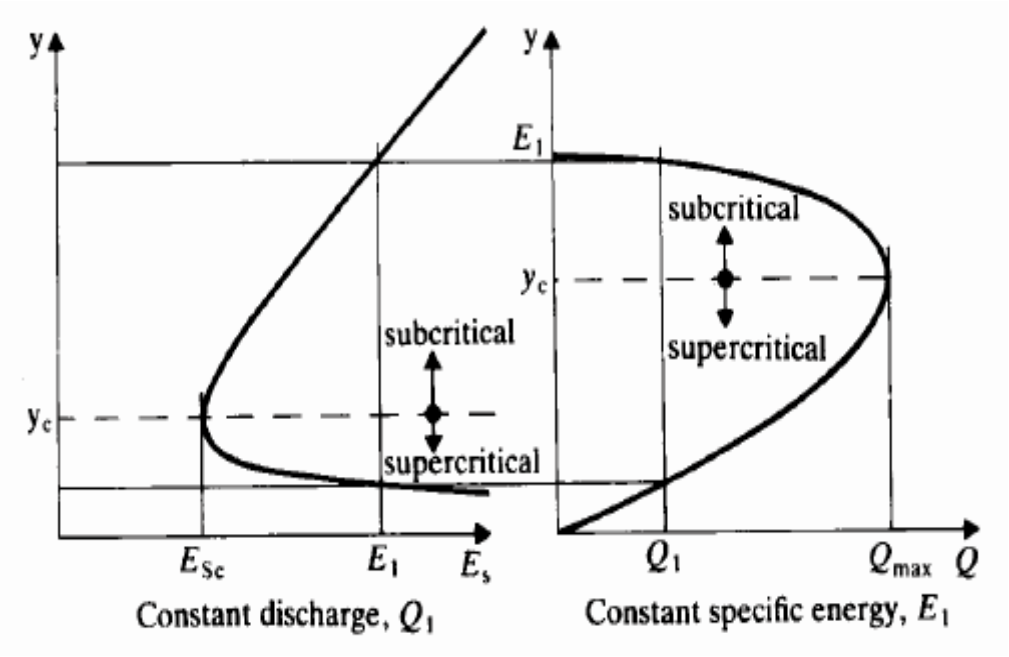
17. Differentiate closed conduit flow and open channel flow.

Sl.No.	Closed conduit flow	Open channel flow
1.	Water does not have	Water flows with a free surface
2.	Water does not contact with atmosphere pressure but it has only hydraulic pressure.	Water contacts with atmospheric pressure.
3.	Flowmay be due to either by pump pressur or by gravity flow	Flow is obtained only by gravity

18. Define alternate depths.

From the curve ABC, the point B corresponds to the minimum specific energy (Emin) and the depth of flow at B is called critical depth.

For any other value of specific energy, there are two depths called alternate depths.



19. Differentaite between prismatic and non-prismatic channels.

Sl.No	Prismatic channel	Non-prismatic channel
1.	Geometric dimensions of the channel such as cross section and bottom slope are constant throughout the length of the channel is called prismatic channel.(eg) channels such as circular and rectangular channels.	Geometric dimensions of the channel such as cross section and bottom slope are not constant throughout the length of the channel is called non-prismatic channel.(eg) all natural channels such as river,stream

20. Distinguish between steady uniform flow and unsteady non-uniform flow.

Sl.No	Steady uniform flow	Unsteady non-uniform flow.
1.	If the flow properties such as depth and velocity of the flow remains constant along the length of the channel over a long time interval is called steady uniform flow.	If the flow properties such as depth and velocity of the flow does not constant along the length of the channel over a long time interval is called unsteady non-uniform flow.

UNIT-II
GRADUALLY VARIED FLOW

1. What is meant by wetted perimeter?

The wetted perimeter (p) is the length of the line of intersection of the channel wetted surface with the cross section plan normal to the direction of flow.

2. Define critical depth:

It is defined as the depth of flow of water at which the specific energy is minimum.

3. Define critical velocity:

The velocity of flow at the critical depth is known as critical velocity.

4. Define the term most economical section of the channel:

A section of the channel is said to be most economical when the cost of construction of the channel is minimum. But the cost of construction depend up on the excavation and lining to keep the cost minimum The wetted perimeter for a given discharge should be minimum.

5. Differntiate pitot tube and pitot static tube.

Sl.No	Pitot Tube	Pitot Static Tube
1.	Pitot tube gives kinetic head of moving liquid	Pitot static tube is an instrument which records static pressure and stagnation

6. How can current meter be classified?

Current meters are classified, on the basis of revolving element, as

1. Cup type current meter
2. Screw or propeller type current meter.

7. What is cup type current meter?

In this type, series of conical cups called revolving element are mounted on a spindle vertically at right angles to the direction of flow.

8. What is screw or propeller type current meter?

In a screw or propeller type current meter, the revolving element has of a shaft with its axis parallel to the direction of flow. It has a number of curved vanes or propeller blades mounted around the periphery of the shaft.

9. What is the working principle of float as a velocity measuring device?

It is operated on the principle that the times taken by the float to traverse for the known distance is measured to compute velocity. Here, the mean velocity of flow is about 0.8 to 0.95 times the surface velocity. The approximate value of mean velocity of flow is determined from the known value of the surface. Floats are used to measure the velocity of flow of water in rivers and channels.

10. What are the pros and cons of laser Doppler anemometer?

It measures only the velocity.

1. Volume of sensing part is very small
2. There is no addition of physical object to avoid disturbances.
3. It has very high accuracy.
4. It has a high frequency response.

11. List the factors affecting manning's roughness coefficient.

The following factors affecting manning's roughness coefficient are:

1. Surface roughness
2. Vegetation growth
3. Channel irregularities
4. Sitting and scouring
5. Stage(water surface elevation) and discharge

12. Give some application of laser Doppler anemometer.

1. It is used for the flow between blades of a turbine.
2. It is used fin combustion and flame phenomena in gas turbine.
3. It is used in jet propulsion systems.
4. It is used for measuring the blood flow.
5. In remote sensing of wind velocities.

13. What are the factors considered for the derivation of chezy's equation?

1. Force resisting the flow per unit of wetted area is proportional to the square of the velocity.
2. Force causing the flow must be equal to the force of resistance.

14. What is the condition for most economical rectangular channel section?

Hence the most economical cross section of a rectangular channel giving maximum discharge would be when

(a) Depth of cross section is half of the width($Y=b/2$) or

(b) Hydraulic radius is half the depth($R=y/2$)

15. On what condition most economical trapezoidal channel section is derived?

The most economical section of a trapezoidal channel is

(a) Sloping side of cross section is equal to half the top width.

(b) Angle of channel sides make with horizontal is 600

(c) Hydraulic radius is equal to half the depth of water.

16. What are the condition for obtaining most economical circular channel section for maximum velocity and discharge?

(i) Depth of flow is 0.81 times the diameter of the circular channel.

(ii) Hydraulic radius is equal to 03 times the diameter of channel.

(iii)Angle subtended by water surface from the centre,2Θ=257º30”

17. Define non-erodible channels.

Channels which are constructed from materials, such as concrete,masonry and metal can withstand erosion under all including most extreme conditions are called as non-erodible channels.

18. What are the factors considered while designing non-erodible channels?

1. Manning”s constant n value of the material.
2. Channel slope
3. Free board

19. What is the significance of most economical section?

The most economical cross section of a channel is one which gives the maximum discharge with constant cross sections.

20. Define hydraulic mean radius.

R=Wetted area/Wetted perimeter=A/P

UNIT - III
RAPIDLY VARIED FLOW

1. Define gradually varying flow

If the change in depth in a varying flow is gradual so that the curvature of the streaming line is not excessive such flow is called gradually varying flow.

2. Define rapidly varying flow

If the curvature in a varied flow is large and depth changes appreciably over short length it is called rapidly varying flow.

3. Define affux.

The maximum increase in water level due to obstruction in the path of flow is known as affux.

4. Define length of backwater curve

The distance along the bed of the channel between the sections where water starts raising to the section where water is having maximum height is known as the length of the back water curve

5. Define back water

The profile of the raising water on the upstream side of the dam is called as back water curve.

6. Define hydraulic jump

The raise of water level which takes place due to the transformation of the unstable shooting flow (super critical flow) to the stable Streaming flow
(Sub critical flow) is called hydraulic jump.

7. Write down the expression for energy loss due to hydraulic jump?

$H_L = (d_2-d_1)^3 / (4d_1d_2)$

Where

H_L – energy loss due to hydraulic jump

D_2 - depth of flow after the jump

D_1 -- depth of flow before the jump

8. What are the assumptions of gradually varying flow profile?

1. Pressure distribution at any section is assumed to be hydrostatic.
2. The velocity distribution at the channel section is fixed
3. The channel is prismatic
4. The roughness coefficient is independent of the depth of flow.

9. What the two cases where distance of the normal depth of flow does not exit? (a) When the channel bed is horizontal

(b) When the channel bed has a adverse slope.

10. What are the methods used for finding gradually varying flow profile?

1. Direct integration method
2. Numerical method
3. Graphical representation method.

11. What do mean by M_1 profile?

The most common of all gradually varying flow is of M_1 type which is a subcritical flow condition obstruction to flow such as wiers, dams etc…which produce M_1profile.

12. What are the types of flow profile?

- Mild slope profile
- Steep slope profile
- Critical slope profile
- Horizontal bed profile
- Adverse slope profile

13. What do you mean by M_2 profile?

The M2 profile occurs at a sudden drop in the bed of the channel in to the ponds or pools or lakes.

14. What is transition in open channel?

Transition means a change of channel cross section.

(i) Provision of a hump or depression along a depth and

(ii) Contraction or expansion of channel width in any combination.

15. What is hydraulic jump in horizontal bed channel?

The rise of water level which takes place due to the transformation of the shooting to the streaming flow is known as hydraulic jump.

16. Explain the classification of hydraulic jumps.

(a) Undulation jump: The froude number ranges from 1 to 1.7 and the liquid surface does not rise shortly but having undulations of gradually decreasing size.

(b) Week jump: The froude number ranges from 1.7 to 2.5 and the liquid surface remains smooth.

17. Define the term backwater curve.

The profile of the rising water on the upstream side of the dam is called back water curve. The distance along the bed of the channel between sections where water is having maximum height is known as length of back water curve.

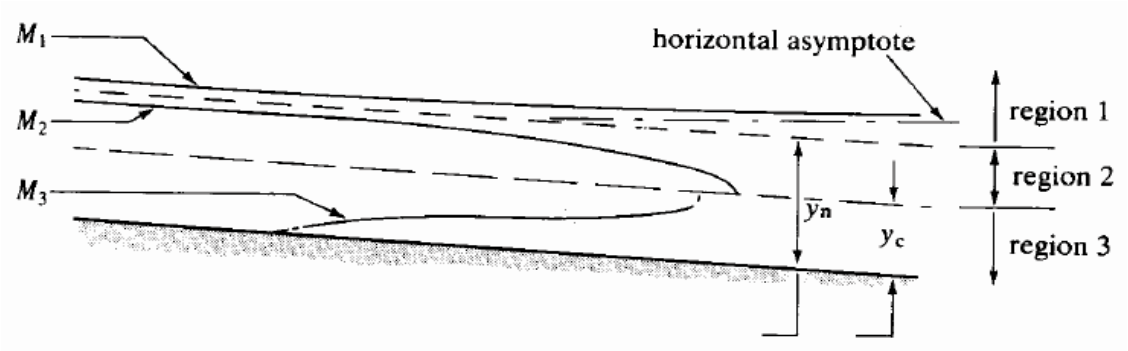
18. State the uses of hydraulic jump.

The kinetic energy of flow after hydraulic jump is greatly reduces, which may prevent erosion of the channel boundaries of downstream side.

19. What are the flow profiles possible in mild sloped channels?

1) Flow behind an overflow weir
2) Flow over a free over fall
3) Flow downstream of a sluice gate

20. Draw the schematic diagram for back water curve.



UNIT- IV
TURBINES

1. Explain Reaction turbine

If at the inlet of the turbine the water possesses kinetic energy as well as pressure energy the turbine is known as reaction turbine.

2. Explian tangential flow turbine

If the water flows along the tangent of the runner, the turbine is known as the tangential flow turbine.

3. Expain radial flow turbine

If the water flows in the radial direction through the runner the turbine is called radial flow turbine.

4. Explain inward flow radial turbine

If the water flows from outwards to inwards radially the turbine is called radial flow turbine.

5. Explain outward flow radial turbine

If the water flows radially from inwards to outwards the turbine is known sa outward radial flow turbine.

6. Define axial flow turbine

If the water flows through the runner along the direction parallel to the axis of rotation of the runner the turbine is called axial flow turbine.

7. What is Pelton wheel?

Pelton wheel or Pelton turbine is a tangential flow impulse turbine. The water strikes the bucket along the tangent of the runner. The energy available at the inlet of the Turbine is only kinetic energy. This turbine is used for high heads.

8. What is breaking jet?

When the nozzle is completely closed, the amount of water striking the runner reduces to zero but the runner due to inertia goes on revolving for a long time to stop the runner in a short time a small nozzle is provided which direct the jet of water on the back of vanes .This jet of water is called breaking jet.

9. What is jet ratio?

It is the ratio of pitch diameter (D) to the diameter of jet (d).

10. What is Draft tube?

A tube or pipe of gradually increasing area is used for discharging water from the exit of the turbine to the tail race is called draft tube.

11. Define Degree of Reaction (R)

It is defined as the ratio of change of pressure energy inside the runner to the change of total energy outside the runner.

12. What is radial discharge?

This means the angle made by absolute velocity with the tangent on the wheel is 90 and the component of whirl velocity is zero.

13. Define Francis turbine:

Inward flow reaction turbine having radial discharge at outlet is known as francis turbine

14. Define propeller turbine:

This is an example of axial flow reaction turbine. Here the vanes are fixed to the hub and are not adjustable.

15. Define Kaplan turbine:

This is an example of axial flow reaction turbine. Here the vanes are not fixed to the hub and are adjustable.

16. What is the use of draft tube?

1. The net head on the turbine increases.
2. Due to increase in net head the power and efficiency of the turbine also increases.
3. The large amount of rejected kinetic energy is converted in to useful pressure energy

17. What are types of draft tube?

1. Conical draft tube
2. Simple elbow tube
3. Moody spreading tube
4. Draft tube with circular inlet and rectangular outlet.

18. Define cavitations

cavitations is defined as phenomenon of formation of vapour bubbles in a region of a flowing liquid where the pressure in the liquid is falls below than vapour pressure and sudden collapsing of these vapour bubbles in a region of higher pressure.

19. What is known by governing of a turbine?

Governing of a turbine is defined as the operation by which the speed of the turbine is kept constant under all conditions of working. It is done by oil pressure generator.

20. Explain net head

It is defined as the head available at the inlet of turbine .If Hf is the loss due to friction between water and penstock then net head

21. Define Hydraulic Efficiency:

It is defined as the ratio of power delivered to the runner to the power supplied at the inlet.

22. Define mechanical efficiency

It is defined as the ratio of power at the shaft of the turbine to the power delivered by the water to runner.

23. Define volumetric efficiency

It is defined as the ratio of volume of water actually striking the runner to the Volume of water supplied to the runner.

24. Define overall efficiency

It is defined as the ratio of shaft power by water power.

UNIT-V
PUMPS

1. Define pump:

It is defined as the hydraulic machine which converts mechanical energy in to hydraulic energy

2. What is Net Positive Suction Head (NPSH)?

NPSH is defined as the total head required making liquid flow through suction pipe to pipe impeller.

3. Define slip of a reciprocating pump and negative slip:

Slip is defined as the difference between theoretical discharge and actual discharge.

If actual discharge is greater than theoretical discharge negative value is found this negative value is called negative slip.

4. What do you know coefficient of discharge?

It is defined as the ratio of actual discharge by theoretical discharge. It is denoted by $C_{d.}$

5. What do you know Drop down curve?

The water surface has a convex profile upwards this curve is called drop down curve.

6. What is separation of reciprocating pump?

If the pressure in the cylinder is below the vapour pressure, dissolved gasses will be liberated from the liquid and cavitations will takes place. The continuous flow of liquid will not exit which means separation of liquid takes place. The pressure at which separation takes place is

called separation pressure and head corresponding to the separation pressure is called separation pressure head.

7. What is an indicator diagram?

Indicator diagram is the graph between the pressure head and distance traveled by the piston from inner dead center for one complete revolution.

8. What is Air vessel?

Air vessel is a closed chamber containing compressed air in the top portion and liquid at the bottom of the chamber. It is used to obtain a continuous supply of water at uniform rate to save a considerable amount of work and to run the pump at high speed with out separation.

9. Write the manometric efficiency of the pump?

Manometric efficiency $= (gHm)/(V_{w2}U_2)$

Where

Hm –manometric head

10. Write the expression for over all efficiency?

Overall efficiency = $(\vartheta g\ QHm)/(1000 \times P)$ Where

Hm – manometric head

P - Power

11. What is the minimum speed for starting the centrifugal pump?

$N=(120\ \eta_{man} V_{w2}\ D_)/(\pi(D_2^2-D^{\ 2})$ 1

Where

η_{man} – efficiency

manom

etric V_{w2} _- Whirl at out let of the turbine

D_2 - diameter of impeller at out let

12. Write down the use of centrifugal pump?

1. Used in deep sump and basement
2. The high discharge capacity
3. It is driven by electric motors

13. What is centrifugal pump?

The hydraulic machine which convert mechanical energy in to pressure energy by means of centrifugal force is called centrifugal pump.It acts a reverse of inward radial flow turbine.

14. What are the main parts of centrifugal pump?

1. Suction pipe with foot valve and strainer

2. Impeller

3. Casing

4. Delivery pipe

15. Define multistage pump:

If centrifugal pump consists of two or more impellers the pump is called multistage pump. To produce a high head impellers are connected in series .To produce high discharge impellers are connected in parallel.

16. What is the purpose of an air vessel fitted in the pump?

1. To obtain a continuous supply of liquid at a uniform rate.

2. To save a considerable amount of work in overcoming the frictional resistance in the suction and delivery pipes, and3. To run the pump at a high speed without separation.

17. What is the work saved by fitting a air vessel in a single acting, double acting pump?

Work saved by fitting air vessels in a single acting pump is 84.87%, In a double acting pump the work saved is 39.2%.

18. What is Discharge through a Reciprocating Pump in per sec?

For Single acting

Discharge (Q)=ALN/60

Where

A=Area of the Cylinder in m^2

L=Length of Stroke in m.

N=Speed of Crank in RPM

For Double acting

Q=2ALN/60

19. What is the Workdone by Reciprocating Pump Per sec.?

Workdone = $\rho gALN(h_s+h_d)/60$ (for single acting)

For Double acting:

Work done= $2\rho gALN (h_s+h_d)/60$

Where

ρ=Density of Water in kg/m^3

A=Area of the Cylinder in m^2

L=Length of Stroke in m

N=Speed in rpm

Hs, hd=Suction and Delivery head in m

20. What is the Mean Velocity of Single acting reciprocating pump?

$v=A\omega r/3.14a$

Where

ω =Angular velocity in rad/sec

r =Radius of the crank in m

A and a =Area of cylinder and Pipe in m^2

CE 6403 - APPLIED HYDRAULICS ENGINEERING

UNIT – I: UNIFORM FLOW

1. How do you classify open channels? Explain in detail. Also explain the velocity distribution in open channel.
2. Write short notes on the following:
(i) Critical flow and its computations
(ii) Channel Transition
3. (i) Define specific energy. How would you express the specific energy for a wide rectangular channel with depth of flow 'D' and velocity of flow 'V'? Draw the typical specific energy diagram and explain its features.
(ii) Calculate the specific energy, critical depth and velocity for the flow of 10m3/s in a cement lined rectangular channel 0.5m wide with 2m depth of water. Is the given flow subcritical or supercritical?
4. (i) Define Froude number FR. Describe the flow for FR = , FR < and FR >1. Represent a discharge versus depth curve for a constant specific energy and explain its features.
(ii) A trapezoidal channel has a bottom width of 6.1m and side slopes of 2H: 1V. When the depth of flow is 1.07 m, the flow is 10.47 m3/s? What is the specific energy of flow? Is the flow tranquil or rapid?
5. A trapezoidal channel with side slopes of 2 horizontal: 3 vertical has to carry 20 m3/sec. Find the slope of the channel when the bottom width of the channel is m and the depth of the water is 3 m. Take Manning's n = 0.03.
6. Calculate the specific energy of 12m3/sec of water flowing with a velocity of 1.5 m/s in a rectangular channel 7.5m wide. Find the depth of water in the channel when the specific energy would be minimum. What would be the value of critical velocity as well as minimum specific energy?
7. (i) How are the flows classified under specific energy concepts?
(ii) A 8m wide channel conveys 15 cumecs of water at a depth of 1.2m. Determine
(1) Specific Energy of the flowing water (2) Critical depth, critical velocity and minimum specific energy (3) Froude number and state whether the flow is subcritical or supercritical.
8. (i) Explain the salient features of Specific Energy curve.
(ii) Determine the critical depth for a specific energy of 1.5 m in the following channels
(1) Rectangular channel
(2) Triangular channel
(3) Trapezoidal channel.

9. (i) Find the critical depth for a specific energy of 1.5 m in: (1) Rectangular channel of bottom width 2m (2)Triangular channel of side slope 1:1.5 (3)Trapezoidal channel of bottom width 2m and side slope 1:1?

(ii) What are the different types and states of flow in open channel?

10. (i) Prove that for critical flow specific is minimum.

(ii) Calculate the width of a rectangular channel required to carry a discharge 15m3/s as critical flow at a depth of 1.2m.

UNIT – II: GRADUALLY VARIED FLOW

1. A channel is designed to carry a discharge of 20 m3/s with Manning's n = 0.015 and bed slope of 1 in 1000 (for trapezoidal channel side slope M = 1√3). Find the channel dimensions of the most efficient section if the channel is (i) trapezoidal (ii) rectangular.

2. Explain the computation of uniform flow using Manning's and Chezy's method.

3. (i) A V – shaped open channel of included angle 90º conveys a discharge of 0.05 m3/s when the depth of flow at the center is 0.225 m. Assuming that C = 50 m1/2/s in the Chezy's equation, calculate the slope of the channel.

(ii) Calculate the dimensions of the rectangular cross-section of an open channel which requires minimum area to convey 10 m3/s. The slope being in 1500. Take the Manning's 'N' as 0.013.

4. Derive the expressions for the most economical depths of flow of water in terms of the diameter of the channel of circular cross-section:

(i) For maximum velocity and (ii) For maximum discharge.

5. (i) Derive the Chezy's equation for steady uniform flow.

(ii) Derive the relationship for most economical trapezoidal channel

6. A power canal of trapezoidal section has to be excavated through hard clay at the least cost. Determine the dimensions of the channel given, discharge equal to 14 m3/s, bed slope 1/2500, Manning's n = 0.02.

7. (i) Show that the hydraulic radius is half the flow depth for the most economical trapezoidal channel section.

(ii) Determine the most economical section of rectangular channel carrying water at the rate

of 0.6 cumecs. The bed slope is 1 in 2000. Assume Chezy's constant C = 50.

8. (i) How do you determine velocity of flow in open channel?

(ii)The bed width of a trapezoidal channel section is 40 m and the side slope is 2 horizontal to 1 vertical. The discharge in the canal is 60 cumecs. The Manning's 'n' is 0.015 and the bed slope is 1 in 5000. Determine the normal depth

9. Derive the geometrical properties of a most economical triangular channel section.

10. (i) A rectangular channel of width 15m has abed slope of 0.00075 and Manning's n = 0.016. Compute the normal depth to carry a discharge of 50m3/s? (ii)Explain the graphical method of determination of normal depth for a trapezoidal channel.

UNIT – III: RAPIDLY VARIED FLOW

1. How do you classify surface profiles? Briefly explain the various salient features of various profiles. Also write a note on hydraulic jump.

2. A 50 m long laboratory flume has a rectangular section with a width of 2m and ends in a free overall. The channel is made of glass and the bed drops by 5 cm in the entire length. At a certain discharge, it was seen that the depth near the channel entrance was more or less constant at 0.5 m. Use the direct step method to obtain the length of profile. Use two equal depth increments.

3. (i) In a given channel, Yo and Yc are two fixed depths if Q, N and So are fixed. Also, there are three possible relation between Yo and Yc. Further, there are two cases where You does not exist. Based on these, how the channels are classified?
(ii)A river 100 m wide and 3m deep has an average bed slope of 0.0005. Estimate the length of the GVF profile produced by a low weir which raises the water surface just upstream of it by 1.5 m. Assume N = 0.035. Use direct step method with three steps.
4. (i) Explain the classification of hydraulic jumps.
(ii) A spillway discharges a flood flow at a rate of 7.75 m3/s per meter width. At the downstream horizontal apron the depth of flow was found to be 0.5 m. What tail water depth is needed to form a hydraulic jump? If a jump is formed, find its type, length, head loss and energy loss as a percentage of the initial energy.
5. In a rectangular channel of 0.5 m width, a hydraulic jump occurs at a point where depth of water flow is 0.15 m and Froude number is 0.5. Determine
(i) The specific energy
(ii) The critical and subsequent depths
(iii) Loss of head and
(iv) Energy dissipated.
6. A river of 45 m wide has a normal depth of flow of 3 m and an average bed slope of in 10,000.A weir is build across the river raising the water surface level at the weir site to 5 m above the bottom of the river. Assuming that the back water curve is an arc of circle; calculate the approximate length of the curve. Manning's n = 0.025
7. (i) What are the assumptions made in the analysis of gradually varied flow? (ii)The bed width of a rectangular channel is 24 m and the depth of flow is 6m. The discharge in the canal is 86 cumecs. The bed slope of the channel is 1 in 4000. Assume Chezy's constant C = 60. Determine the slope of the free water surface.
8. (i)What are the conditions for the formation of hydraulic jump?
(ii)In a rectangular channel of bed width 0.5 m, a hydraulic jump occurs at a point where depth of flow is 0.15 m and Froude's number is 2.5. Determine
(1) The specific energy (2) The critical depth (3) The subsequent depths (4) Loss of head (5) Energy dissipated.
9. (i) A rectangular channel carries a flow with a velocity of 0.65m/s and depth of 1.4m. If the discharge is abruptly increased three fold by sudden lifting of a gate on the upstream

side, estimate the velocity and height of the resulting surge?
(ii)With neat diagrams explain different types of channel transitions.
10. (i)Write the gradually varied flow equation in an open channel flow. Deduce the equation for a wide rectangular channel using Manning's and Chezy's equation.
(ii)Explain with a neat diagram the surges produced when (i) a sluice gate is suddenly raised (ii) sluice gate is suddenly lowered.

UNIT – IV: TURBINES

1. A Pelton wheel operates with a jet of jet of 150 mm diameter under the head of 500 m, its mean runner diameter is 0.25 m and it rates with a speed of 375 rpm. The angle of bucket tip at outlet as 15º, coefficient of velocity is 0.98, mechanical losses equal to 3% of power supplied and the reduction in relative velocity of water while passing through bucket is 15%. Find (i) the force of jet on the bucket (ii) the power developed (iii) bucket efficiency and (iv) overall efficiency.
2. Derive the equation for power and work done for the impact of jets on moving curved vanes. Explain the classification of turbines.

3. (i) Classify the turbines based on : (1) Action of water on turbine blades. (2) Head on turbine. (3) Direction of flow through turbine runner. (4) Specific speed. (5) Disposition of turbines shaft.

(ii) A Pelton turbine is required to develop 9000 kW when working under a head of 300 m. The runner may rotate at 500 rpm. Assuming the jet ratio as 10, speed ratio as 0.46 and overall efficiency as 85%, determine the following: (1) Quantity of water required (2) Diameter of the wheel (3) Number of jets (4) Number of buckets.

4. (i) Draw the characteristics curves of turbines and explain.

(ii) An inward flow reaction turbine operates under a head of 25 m running at 200 rpm. The peripheral velocity at the runner is 20 m/s and the radial velocity at the runner exit is 5 m/s. If the hydraulic losses are 20% of the available head, calculate: (1) The guide-vane exit angle (2) The runner-vane angle (3) The runner diameter (4) The specific speed, if the width of the runner at the periphery is 30 cm and (5) The power produced by the turbine.

5. A Pelton wheel generates 8000 kW under a net head of 130 m at a speed of 200 rpm. Assuming the coefficient of velocity for the nozzle 0.98, hydraulic efficiency 87%, speed ratio 0.46 and jet diameter to wheel diameter ratio 1/9, Determine, (i) Discharge required (ii) Diameter of the wheel (iii) Diameter and number of jets required and (iv) Specific speed of the turbine. Take Mechanical efficiency is 75%.

6. In an inward flow reaction turbine, head on turbine is 32 m. The external an internal diameters are 0.44 m and 0.72 m respectively. The velocity of flow through the runner is constant and equal to 3 m/s. The guide blade angle is 10^{o} and runner vanes are rigid at inlet. If the discharge at outlet is radial, determine (i) The speed of the turbine (ii) The vane angle at outlet of the runner and (iii) Hydraulic efficiency.

7. (i) Distinguish between impulse and reaction turbines.

(ii) A Pelton wheel is required to develop 8825 kW when working under the head of 300 m. The speed of the pelton wheel is 540 rpm. The coefficient of velocity is 0.98 and the speed ratio is 0.46. Assuming jet ratio as 10 and overall efficiency as 84%. Determine: (1) The number of jets (2) The diameter of the wheel (3) The quantity of water required

8. (i) What are the various types of draft tube?

(ii) A Francis turbine is to be designed to develop 360 kW under a head of 70 m and a speed of 750 rpm. The ratio of width of runner to diameter of runner 'n' is 0.1. The inner diameter of the runner is half the outer diameter. The flow ratio is 0.15. The hydraulic efficiency is 95% and the mechanical efficiency is 84%. Four percent of the circumferential area of runner is to be occupied by the thickness of the vanes. The velocity of flow is constant and the discharge is radial at exit. Determine: (1) The diameter of the wheel (2) The quantity of water supplied (3) The guide vane angle at inlet and (4) Runner vane angles at inlet and exit.

UNIT – V: PUMPS

1. A single acting reciprocating pump having a cylinder diameter of 150 mm and stroke of 300 mm is used to raise the water through a height of 20 m. Its crank rotates at 60 rpm. Find the theoretical power required to run the pump and the theoretical discharge. If actual discharge is 5 lit/s find the percentage of slip. If delivery pipe is 100 mm in diameter and is 15 m long, find the acceleration head at the beginning of the stroke.

2. Discuss in detail the working of Centrifugal pump. Also write a note on working of jet pump.

3. (i) With the help of neat sketches, explain the features of a volute type and a diffusion type centrifugal pump

(ii)A centrifugal pump delivers salt water against a head of 15 m at a speed of 100 rpm. The vanes are curved backward at 30º with the periphery. Obtain the discharge for an impeller diameter of 30 cm and outlet width of 5 cm at a manometric efficiency of 90%.

4. (i) Draw the indicator diagram of a reciprocating pump for the following cases : (1) Without air vessels on both suction and delivery sides.(2) With air vessel only on suction side.

(ii) For a hydraulic machine installed between A and B, the following data is available: At A At B Diameter 20cm 30cm Elevation 105m 100m Pressure 100 kPa 200 kPa. The direction of flow is from A to B and the discharge is 200 litres per second. Is the machine a pump or a turbine?

5. The impeller of a centrifugal pump having external and internal diameters 500 mm and 250 mm respectively, width at outlet 50 mm and running at 1200rpm. Works against a head of 48 m. The velocity of flow through the impeller is constant and equal to 3 m/s. The vanes are set back at an angle of 40º at outlet. Determine

(i) Inlet Vane angle

(ii) Work –done by the impeller and Manometric efficiency.

6. A three throw pump has cylinders of 250 mm diameter and stroke of 500 mm each. The pump is required to deliver 0.1 m3/sec at a head of 100 m. Friction losses are estimated to be m in the suction pipe and 19 m in delivery pipe. Velocity of water in delivery pipe is m/s, overall efficiency is 85% and the slip is 3% Determine

(i) Speed of the pump and

(ii) Power required for running the pump.

7. (i) Define

(1) Manometric efficiency (2) Volumetric efficiency (3) Mechanical efficiency

(4) Overall Efficiency of Centrifugal pump.

(ii) The impeller of a centrifugal pump has an external diameter of 450 mm and internal diameter of 200 mm. The speed of the pump is 1440 rpm. Assuming a constant radial flow through the impeller at 2.5 m/s and that the vanes at exit are set back at an angle of 25º, Determine:

(1) The inlet vane angle

(2) The angle, the absolute velocity of water at exit makes with the tangent and

(3) The work done per unit weight.

8. (i) Explain the working principle of double acting reciprocating pump with a neat sketch.

(ii) Length of 350 mm. The speed of the pump is 60 rpm and the discharge is 0.02cumecs of water. Determine (1) The theoretical discharge (2) Coefficient of discharge (3) Percentage slip.

9. (i) Compare and contrast Centrifugal pump and reciprocating pump.

(ii)The cross sectional area of a plunger of reciprocating pump equals 1.5 times that of a delivery pipe. The delivery pipe is 60m long and it rises upward at a slope of 1 in 6. If the plunger has an acceleration of 2.4m/s2 at the end of the stroke and separation pressure is 2.5m of water find whether separation will take place.

10. (i)Explain the different types of Reciprocating pumps? (ii)Differentiate pumps and turbines.

CE6404 SURVEYING II

TWO MARKS WITH ANSWERS

UNIT I

1. **Define Tacheometry**

   Tacheometry is a branch of angular surveying in which the horizontal and vertical distances (or) points are obtained by optional means as opposed to the ordinary slower process of measurements by chain (or) tape.

2. **Define Tacheometer.**

   It is an ordinary transit theodolite fitted with an extra lens called analytic lens. The purpose of fitting the analytic lens is to reduce the additive constant to zero.

3. **Define Analytic lens.**

   Analytic lens is an additional lens placed between the diaphragm and the objective at a fixed distance from the objective. This lens will be fitted in ordinary transit theodolite. After fitting this additional lens the telescope is called as external focusing analytic telescope. The purpose of fitting the analytic lens is to reduce the additive constant to zero.

4. **Define Substance bar:**

   A Substance bar is manufactured by Mr. Kern. The length of the substance bar is 2m (6ft) for measurement of comparatively short distance in a traverse. A Substance bar may be used as a substance base. The length of the bar is made equal to the distance between the two targets.

5. **What are the merits and demerits of movable hair method?**

   Merits:

   Long sights can be taken with greater accuracy than stadia method.
   The error obtained is minimum.

   Demerits:

   The computations are not quicker.
   Careful observation is essential.

6. **What is the objective of geodetic surveying?**

   Geodetic surveying is also called as trigonometrical surveying which deals with long distances and larger areas. The objects of geodetic survey is to establish absolute and relative positions of a number of widely separated points on the earth`s surface.

7. **Distinguish between triangulation and trilateration.**

   Triangulation is a survey by which position of several stations are fixed very accurately on the surface of the earth at large intervals which serve as basis or reference points.

   Trilateration is based on the principle that a triangle can be solved by knowing its three sides; Instruments like geodimeter and tellurometer are employed. In geodetic survey this method is extensively used and the accuracy of the results is comparable to that of triangulation.

8. **What are the different classifications of triangulation system?**

   Classification of a triangulation system is based on the accuracy with which the length and angle of a line of a triangulation are determined. The following are the classification based on the order of grades:

   (i) First order or primary triangulation.
   (ii) Second order or secondary triangulation.

(iii) Third order or tertiary triangulation.

9. What is meant by phase of a signal?

When a cylindrical signal is partly illuminated and partly in shade, the observer sees only the illuminated portion and bisects it. The error of bisection thus introduced is called phase. It is the apparent displacement of the centre of the signal.

10. List out corrections for tape.

(i) **Correction for temperature**: This correction may be positive or negative depending on the temperature at the time of measurement (T_m) and the standard temperature (T_0).

(ii) **Correction of pull**: Correction for pull will be positive or negative depending on the applied pull (P_m) is greater or less than standard pull (P_0).

(iii) **Correction for slope**.

(iv) **Correction for sag**.

11. What is a base net?

Some site conditions may not be favourable to get the required length of a base line. In such a situation a short base line is selected and the same is then extended. Such group of triangles which are meant for extending the base is known as base net.

12. What are the different kinds of bench marks?

GTS bench marks: These bench-marks are established all over the country at large interval by the survey of India Department.

Permanent bench marks: These are fixed points or marks set up by different Govt. Department. The reduced levels of these points are determined with references to GTS bench marks.

Arbitrary bench marks: When reduced levels of some fixed points are assumed they are called as arbitrary bench marks. These are adopted in small survey operations.

Temporary bench marks: When bench marks are set up temporarily at the end of a day`s work, they are referred to as temporary bench-marks.

13. What do you understand by the term Traversing?

A traverse is a multi-sided figure consisting of a series of connected lines. The lengths are measured by chain or tape and the directions are identified by angle measuring instruments.

Closed traverse is one in which the last survey line is joined back to the first station point forming a polygon. Open traverse, called as unclosed transverse, when it does not return back to the first station point and form a closed polygon.

14. What is called axis signal correction?

At the stations, signals are erected at different heights. The signals may or may not be of the same height as that of the instrument. If the height of the signal is not the same as that of the height of the instrument axis above the station, a correction known as the axis signal correction or eye and object correction is to be applied.

15. Define base line.

Base line forms the basis for the entire computations of triangulation system. The length of base line to be adopted depends on the magnitude of triangulation work, i.e., the grade of the triangulation.

16. Define Satellite Station.

In order to form well conditioned triangles of triangulation and also to have better visibility objects such as church spirals, towers of temples, flag poles, etc are selected. But the instrument cannot be set up over these true stations for the measurements of angles and a subsidiary station called as satellite station or eccentric station or false station.

17. Define reduction to centre.

Angles taken from satellite are corrected and reduced to what they would have been if the true station was occupied. This operation of applying corrections to the observed angles due to the eccentricity of the station is termed as Reduction to centre.

18. What are the Methods used to measure baseline.

The field work for the base line measurements is carried out by two parties,

(i) Setting out party

This party consists of two surveyors and a number of porters. The duty of the porters is to place the measuring tripods., at correct intervals, in alignment in advance.

(ii) Measuring Party

This party consists of two observers, recorder, leveller and staff man for actual measurements.

19. **Mention the Two types of trigonometrically leveling.**

Trigonometrical levelling may be grouped as

(i) Observations to find small elevations and short distances.

(ii) Observations to find higher elevations and large distances.

20. Define Control Surveying.

- A survey that provides coordinates (H&V) of points to which supplementary survey are adjusted.
- A survey which is performed to achieve higher than normal accuracies.

UNIT II

1. Explain the terms true error and most probable error.

A true error is the difference between the true value of a quality and its observed value. Most probable error is defined as that quantity which is added to, or subtracted from, the most probable value which fixes the limits. By these limits there is an even chance the true of the measured quantity may lie.

2. Distinguish between true error and residual error.

- A true error is the different between the true value of a quantity and its observed value.
- A residual error is the difference between the most probable value of a quantity and its observed value.

3. State the principle of method of least squares.

In observations of equal precision the most probable values of the observed quantities are those that render the sum of the squares of the residual errors a minimum.

4. What are the kinds of errors possible in survey work?

Error made on an observation may be due to some reason. Error may be classified in a more general form as (i) mistakes, (ii) systematic error and (iii) accidental error. Value of an error is also assigned as true, most probable and residual.

5. What is the weight of an observation?

Weight of an observation is a measure of its relative worth which may be indicated by a number. Thus if a certain observation is said to have weight age 5, it is meant to say that it is five times as much as an observation of weight 1.

6. How are normal equations formed in theory of errors?

A normal equation is an equation of condition by means of which the most probable value of any unknown quantity may be determined corresponding to a set of values assigned to other unknown quantities. Therefore normal equations have to be formed for each of the unknown, to determine their values.

7. What is method of correlates?

- Correlates are the unknown multiples or independent constants employed for finding the most portable values of unknowns.
- In this method of correlates all the condition equations are collected. One more equation of condition, i.e., the sum of the residual errors should be minimum, is added.

8. Define normal equation.

A normal equation is an equation of condition by means of which the most probable value of any unknown quantity may be determined.

9. Distinguish between the observed value and the most probable value of a quantity.

- An observed value is the numerical value of a measured quantity. This may be a direct observation or an indirect observation.
- Most probable value of a quantity is the value which is more likely to be the true value that any other value. It is the one which is deduced from the several measurements or which it is based.

10. Distinguish between true value and most probable value.

- True value of a quantity is the value which is absolutely free from all the errors. It is indeterminate since the true error is never known.
- Most probable value of a quantity is the value which is more likely to be the true value than any other value.

11. What do you mean by figure adjustments in triangulation?

Figure adjustment is the determination of the most probable values of the angles involved in any geometric figure so as to fulfil, the geometric requirements. It invariably involves one or more conditional equations. Conditional equations may be framed by the method of normal equation or by the method of correlated.

12. What is single angle adjustment?

In general single angle is measured several times. Corrections to be applied are inversely proportional to the weight and directly proportional to the square of probable errors.

In case of equal weighted measurements the most probable value is equal to the arithmetic mean of the observations. In case of unequally weighted observations, the most probable value of the angle is equal to the weighted arithmetic mean of the observed angles.

13. Why figure adjustment is made?

Figure adjustment is needed so as fulfil the geometric conditions of nay geometrical figures. The figure adjustment, therefore involves one or more condition equations.

14. State Gauss`s rule.

It is applied when the weights of the observations are not directly known. If the residual error of each observation is known the weights can be calculated by Gauss`s rule.

15. What is called spherical excess?

In a spherical triangle the sum of the three angles of the triangles always exceeds 180^0 by an amount known as spherical excess. Spherical excess depends on the area of a triangle. It may be taken approximately equivalent to 1'' for every 196.75sq.km.

16. Explain level net.

A level net is an interconnecting net work of level circuits formed by level lines interconnecting three or more bench marks. In adjusting a level net, the method of least squares may be adopted.

17. Define systematic error.

A systematic error is one which occurs under a given condition and be of same size and sign. Such errors generally add up to make the results too great or too small. That is why it is also called as cumulative error. Such error follows some definite mathematical or physical law and hence a correction can be applied.

18. Define Accidental error.

It occurs by a combination of reasons beyond the ability of the observer to control. They sometimes occur in one direction and some times in the other side. Thus they are likely to make the apparent result too large or too small.

19. What is mean by single angle adjustment?

In case of equal weighted measurements the most probable value is equal to the arithmetic mean of the observations. In case of unequally we8ighted observations, the most probable value of the angle is equal to the weighted arithmetic mean of the observed angles.

20. Define Figure adjustments?

It is the determination of the most probable values of the angles involved in any geometrical figure so as to fulfil the geometric requirements. Conditioned

equations may be framed by the method of normal equation or by the method of correlates.

UNIT III

1. What is a Total Station?

A Total Station or an Electronic Tachometer is a combination of an Electronic Theodolite, an Electronic Distance Measuring Device (EDM) and a microprocessor with memory unit. With this device are can determine angles (both horizontal and vertical) and distance from the instrument to the points to be surveyed.

2. What is a carrier wave?

EDMs consist of a transmitter set up at one end of the lengths to be measured, sending out a continuous wave to the receiver at the other end. This wave, termed the carrier wave, is then modulated and the length determined.

3. List the components of an Electro-optical EDM system.

Main components of Electro-optical EDM instruments are:

- Visible light produced by a tungsten lamp, xenon flash tube or laser light or infra-red light.
- Optical parts for transmitting and receiving the modulated light.
- Photomultiplier.
- Phase meter and
- A read out unit.
- A light source.

4. What is called trilateration in Modern positioning system?

It is basically a technique of triangulation and no angular measurement are made. The three sides of the triangles are measured precisely using electronic distance measuring equipment or a total station. It is useful when measurement is difficult or impossible due to any reason.

5. What is a microwave system?

Microwave system held an important position in land surveying because they were used to measure distances varying from 50m to 50km. The introduction of GPS has diminished that importance.

6. Compare the microwave and the electro-optical systems adopted in total station.

Electro-optical instruments are more accurate than the microwave instruments, because the shorter the carrier wave length, the better is the accuracy of the total station. In bad atmospheric conditions and for long distance measurements, microwave instruments may be utilized for better penetration through fog and haze.

7. What are the salient parameters of a total station?

A total station comprises of an electronic theodolite with an EDM and a microprocessor. The theodolite measures the horizontal angle (Hz) and the vertical angle (V) of the line of sight from the centre of the total station to the centre of a target on point to measure. The intersection of the rotation of the axis of the horizontal and vertical circles in the centre of the station.

8. What is meant by EDM?

The total station or electronic tacheometer is a combination of an electronic theodolite, an electronic distance measuring device (EDM) and a

microprocessor with memory unit. With this device one can determine angles and distances from the instrument to the points to be surveyed.

9. What are the software applications can be done by total station?

The software applications available on may total stations include the following:

- Slope correction and reduced orientation.
- Horizontal circle orientation.
- Co-ordinate measurement.
- Traverse measurements.
- Resection.
- Remote elevation measurement.

10. List out the sources of error in total station.

- Horizontal collimation or line of sight error.
- Tilting axis error.
- Compensator index error.
- Vertical collimation or vertical axis error.

11. List out the different types of Total stations.

- Manual total station.
- Semi-automatic total station.
- Automatic total station.
- Servo-driven total station.

12. Explain the parts of total station?

- Telescope.
- Plate level.
- Keyboard and display window.
- Tribrach.
- Vertical tangent screw.
- Power switch.
- Vertical Motion clamp.
- Horizontal screw.
- Horizontal motion clamp and inbuilt EDM.

13. Explain the sources of error in total stations.

- Horizontal collimation or Line of sight error.
- Tilting axis error.
- Compensator index error.
- Vertical collimation or Vertical index error.
- Calibration procedure of total stations.
- General equipment maintenance.

14. List the disadvantages of a total station.

- Hard copies of field notes are not provided.
- During the process of surveyor to look over and check the work.
- For an overall check of the survey, it is to be done in the office using appropriate software.
- It cannot be used routinely for observations of the sun, unless special filter are used.

15. Explain the use of target prisms.

Prisms are used to reflect transmitted signals. A single reflector is a cube corner prism that has the characteristics of reflecting light rays precisely back to the existing instrument.

16. Explain basic principles of Total station.

Total station one can determine angles and distances from the instruments to the points to be surveyed. With the application of trigonometry the angles and distances may be used to compute the actual positions of surveyed points in absolute terms.

17. Mention the function of carrier frequency in three distinct EDM categories.

- Low-frequency radio systems,
- Microwave radio systems.
- Visible and infra-red light system.

18. Explain the pulse method adopted in EDM.

Pulse method is essentially based on the simple concept that the distance is a product of velocity and time. Here, a short but intense pulse of radiation id transmitted to a reflector target, which is transmitted back to the receiver along a parallel path. The measured distance is obtained from the product of velocity of the signal and the complete time taken fir the travel.

19. How horizontal angle is measured in a total station?

Horizontal angle is measured from the zero direction on the horizontal circle. Choice of the zero direction is generally made as instrument north. Instead one may set zero in the direction of the long axis of the map area or choose to orient the instrument approximately to true, magnetic or Grid North. Most total station can measure angle to at least 5 seconds or 0.0013888^{o}.

20. Explain Tilting Axis error.

This axial error occurs when the tilting axis of the total station is not perpendicular to its vertical axis. This has no effect on sightings taken when the telescope is horizontal, but introduces errors into horizontal circle readings when the telescope is tilted, especially for steep sighting.

UNIT IV

1. What is GPS?

Global Positioning System (GPS) is a space-based all weather radio navigation system that provides quickly, accurately and in-expensively the time, position and velocity of the object anywhere on the globe at any time.

2. List the advantage of GPS surveys.

- Three dimensional.
- Site intervisibility not needed.
- Weather independent.
- Day or night operation.
- Common reference system.
- Rapid data processing with quality control.
- High precision.

3. Mention any three aims of GPS.

- To explain how GPS can be used to take code and place measurements to determine position and be able to explain the different between these.
- To identify the various sources of error in GPS and explain how each of these affects the accuracy obtained.
- To understand the reasons why differential and relative methods are essential for high precision surveying with GPS.

4. What is space segment?

Space segment consists of a group of earth-orbiting satellites. GPS uses a system of 24 satellites, arranged in six orbital planes, inclined at 55^{o} to the equator

at altitudes of about 20000km with orbital periods of about 12hours. Each satellite has a microprocessor on board for self-monitoring and data processing.

5. Explain user segment.

User segment is the total user and supplier community, both civilian and military. It consists of all earth-based GPD receivers, which vary greatly in size and complexity. The typical receiver comprises of an antenna and a pre amplifier, radio signal micro processor, control and display device, data recording unit and power supply.

6. Explain absolute positioning.

This type is based on single receiver station. As ranging is carried out strictly between the satellite and the receiver station it is also called as stand- alone type. Thus the positions are subjected to errors inherent in satellite positioning. The accuracy is in the range of 50 to 100m.

7. What are the satellite-related errors?

GPS satellites are provided with accurate atomic clocks. Although they are accurate they may not be perfect. Because of slight inaccuracies in the time keeping may lead to inaccuracies in position measurements.

The satellite position in space is also important equally because it is stacking point of all of the GPS calculations. Although GPS satellites are placed into very high orbits, they are still drift slightly from their predicted orbits contributing to the errors.

8. Why GPS signal is so complicated?

- The signal is so complicated that it almost looks like random electrical noise and name it as "Pseudo-Random."
- Distance to a satellite is determined by measuring how long a radio signal takes to reach us from that satellite.
- To make the measurement we assume that both the satellite and our receiver are generating the same pseudo-random codes at exactly the same time.

9. Define Geocoding.

Geocoding" is the process of converting street addresses or other locations (ZIP codes, postal codes, city & state, airport IATA/ICAO codes, etc.) to latitude and longitude, which can be entered into a GPS device or geographical software. GPS Visualizer offers several options for geocoding your information.

10. Write the principles of GPS.

GPS is a satellite based navigation system. It uses a digital signal at about 1.5 GHz from each satellite to send data to the receiver. The receiver can then deduce its exact range from the satellite, as well as the geographic position (GP) of the satellite. The GP is the location on the Earth directly below the satellite. This establishes a line of position (LOP) on the Earth.

11. Explain static technique of surveying with GPS.

Static technique of surveying was the first high precision method developed for GPS and is the standard GPS method for determining the length of baselines that are longer than 20km.

Using this method, the reference receiver is located at a known control point and a rover, that is set up at a point whose location is to be determined.

12. What are satellite-related errors?

- GPS satellite is provided with very accurate atomic clocks. Although they are accurate they may not be perfect. Because of slight inaccuracies in position measurements.

- The satellite position in space is also important equally because it is stacking point of all of the GPS calculations. Although GPS satellites are placed into very high orbits, they are still drift slightly from their predicted orbits contributing to the errors.

13. What is multipath error?

As the signal arrives at the surface of the earth it may get reflected by local obstructions and goes to the receiver's antenna through more than one path. This type of error is called multiple error as the signal is getting to the antenna by multiple paths.

14. What is meant by hand held GPS?

A handheld GPS is a device that uses the Global Positioning System, combining modern geographic technology with a portable, user-friendly device for everyday use. Features on some models may also provide information on geographic locations like national and historic landmarks. The device is often used by outdoors enthusiasts to pinpoint the coordinates of a certain location for future reference.

15. Define GPS navigation.

GPS, which stands for Global Positioning System, is a radio navigation system that allows land, sea, and airborne users to determine their exact location, velocity, and time 24 hours a day, in all weather conditions, anywhere in the world.

16. What are the sources of error in GPS?

- Satellite-related errors.
- Propagation-medium related errors.
- Receiver-related errors.
- Selective availability (S/A).

17. Mention the components of GPS?

- Satellite constellation called space segment.
- Ground control/monitoring network called operational control segment.
- User receiving equipment called user equipment segment.

18. Define Satellite.

An artificial body placed in orbit around the earth or moon or another planet in order to collect information or for communication. An object launched to orbit Earth or another celestial body, as a device for reflecting or relaying radio signals or for capturing images.

19. Explain Rapid-static Technique.

GPS is now the preferred method for control surveys on large construction sites. For these surveys, the static method previously described but the GPS receiver needs to be left for shorter occupation times of 10 to 30 min.

20. Define Kinematic Technique.

It is used when a lot of points are to be surveyed in a relatively small area and where the accuracy required is not as high for static surveys. These include detail surveying (mapping) and construction measurements.

UNIT V

1. Distinguish between a compound curve and a reverse curve.

- A compound curve consists of a combination of two circular of different radius with a common junction. The different of change of curvature is on the same side.

- A reverse curve is basically a compound curve with a common tangent at the junction. It consists of two circular arcs turning in opposite directions with the common at the junction.

2. What is super elevation?

In order to counter balance the centrifugal force the outer edge of the road is raised which is known as the super-elevation or cant or banking. This traverse slope is provided throughout the length of the horizontal curve. The super elevation is expressed as the ratio of the height of the outer edge with respect to the horizontal width.

3. What is a transition curve?

Transition curve is also called as an basement curve which is an arc introduced between a straight and a circular curve or between two arcs of a compound curve. The radius of a transition curve varies from infinity to a fixed value.

4. Write down the requirements of an ideal transition curve.

- The transition should be tangential to the straight.
- The curvature of the transition curve should be zero at the origin of the straight.
- The exact amount of super elevation should be attained at the junction with the circular curve.
- The curvature of the transition curve should increase at the same rate as that of the super elevation

5. What is a summit curve and how it occurs.

A vertical curve with convexity upwards is called a summit curve.

- An ascending of gradient meets another ascending gradient.
- An ascending gradient intersects a descending gradient.
- A descending gradient meets another descending gradient.
- An ascending gradient meets a horizontal.

6. What is a route survey? What is its purpose?

Route surveying is applied to the surveys required to establish the horizontal and vertical alignments for transport facilities. The transport facilities may be highways, railway, aqua ducts, canals, water pipeline oil and gas lines, cableways, waterways, power, telephone and waste water disposal.

7. What is Reconnaissance survey?

Preliminary inspection of an area to be surveys is called reconnaissance or a reconnoitre. During the survey a proper planning should be done such that the work will be better and effectively executed.

8. What are lunar and solar tides?

- The periodical variations in natural water level are called as tides. The resultant force between the earth and moon causes lunar tides. Lunar tides may be super lunar tide or inferior lunar tides depending on the moon`s transit.
- The phenomenon of production of solar tides is due to force of attraction between earth and sun which is similar to the lunar tides. Thus there will be superior solar tide or inferior solar tide.

9. What is meant by sounding?

The measurements of depths below the water surface are called soundings. This is synonymous to the depth measurement in land with reference to a datum. The aim in making soundings is to determine the configuration of the subaqueous source.

10. What are three point problems in hydro graphic surveying?

If a sounding is located by two angles from the boat by observations to three known points on the shore, the plotting can be done adopting three-point problem. The three point problem may be solved by mechanical, graphical or analytical methods.

11. What is a great circle?

If the earth is considered as a sphere any plane passing through its centre traces out upon the surface a circle called great circle. For example equator is a great circle.

12. What is meant by celestial sphere?

For an observer upon the earth the fixed starts seem to be studded over the surface of a vast sphere, known as the celestial sphere at the centre of which the earth is approximately situated.

Because of the real rotation of the earth about its polar axis every twenty four hours, the celestial sphere appears to rotate about the same axis during that time. The centre sphere the earth may be taken as the centre of the celestial sphere.

13. Name the properties of spherical triangle.

- Any angle is less than two right angles or π.
- Sum of the three angles is less than six right angles or 3 π and greater than two right angles or π.
- Sum of any two sides is greater than the third.
- If the sum of any two angles is equal to two right angles or π, the sum of the angles opposite them is equal to two right angles.
- The smaller angle is opposite the smaller side and vice-versa.

14. What are the corrections to be applied to the observed altitude of sun?

The corrections to be applied are

- Instrumental corrections and
- Observational corrections.

Instrumental corrections are Index Error and Bubble Error corrections. Observational corrections are the following: Correction for parallax, correction for refraction, correction for dip of the horizon and correction for semi-diameter.

15. Explain the term sidereal time.

The sidereal time at any instant is the hour angle of the first point of Aries reckoned westward from 0 h to 24 h. The right ascension (R.A.) of the meridian of a place is known as the local sidereal time (L.S.T)

L.S.T = (R.A. of a star) + (westerly hour angle of a star)

16. What is meant by Mean Solar Time?

In order to circumvent the non-uniformity of apparent solar time, a fictitious body called the mean sun is introduced.

17. What is Photogrammetry?

- Photographic surveying or photogrammetry is the art of producing plans or maps from photographs. Here the photographs are taken from a suitable camera position.
- Photographic surveying, in principles, is very similar to that of plane table surveying, with the difference that most of the work, which the latter instrument is executed in the field, is here done in the office.

18. List the uses of photogrammetry.

- Construction of planimetric and topographic maps.
- Mountains and hilly areas with less number of trees can be very satisfactorily surveyed.
- Aerial surveying is most suitable for reconnaissance.
- Acquisition of military intelligence.
- Interpretation of geology and soil details.

19. What is meant by scale of photograph?

Scale of a photograph is obtained from the ratio of the distance of any two points on the photograph and the distance between the corresponding points on the ground. The two points chosen for scaling should lie nearly equidistant on either side of the principal point.

20. Differentiate between Tilted photograph and oblique photograph.

- A tilted photograph is an aerial photograph made with the camera axis unintentionally. The tilt from the vertical axis is usually less than 3^o.
- An oblique photograph is the one made in an aerial photograph intentionally between the horizontal and the vertical.

IMPORTANT 16 MARK QUESTIONS

UNIT 1

1. What are the different corrections to be applied while measuring baseline in geodetic Surveying?
2. A steel tape 30m long, standardized at 10 o c with a pull of 100N was used for measuring abaseline. Find the correction per tape length, if the temperature at the time of measurementwas 20oc and pull applied was 150 N. Density of steel = 3000 kg/m3. Weight of tape=5.88N.
3. What is meant by a "satellite station"? Explain briefly.
4. In a trignometrical measurement of the difference in level of two stations P and Q, 10480 m

   apart, the following data were obtained.
   - Instrument at P, angle of elevation of Q = 0"15"
   - Instrument at Q, angle of depression of P = 3" 33"
   - Height of instrument at P = 1.42 m.
   - Height of instrument at Q = 1.45 m.
   - Height of signal at P = 3.95 m.
   - Height of signal at Q = 3.92 m.

   Find the difference in level between P and Q and the curvature and refraction correction.
5. From an eccentric Station S, 12.25 meters to the west of the main station B, the followingangles were measured BSC = 760251; CSA = 540321 2011. The stations S and C are to theopposite sides of the line AB. Calculate the correct angle ABC if the lengths AB and BC are5286.5 and 4932.2m respectively.

6. What are the methods of measurement of the base line and explain any two with neat sketch.
7. A steel tape is 30 m long at a temp of 15ºc when lying horizontal on the ground. Its c/s area is0.08 cm2 and weight of 18.kg (18N) and. Co-efficient of expansion is 117 x10-7/ºc. The tapeis stretched over 3 supports which are at the same level and at equal intervals. Calculate theactual length between the end graduations under the following conditions. Temp = 25ºc, Pull-180 kg, E = 2.1 x 10^5 N/cm^2.
8. Explain in detail about Horizontal control & its methods and Vertical Control & its Methods.
9. State the factors to be considered while selecting base line and also explain with neat sketches how to extend the base line in the field.
10. Explain in detail about the Classification of triangulation system.
11. What is mean by triangulation adjustment? Explain the different conditions and cases with sketches.
12. Write short notes on: (1) selection of site for base line
(2) Satellite station
13. What are the different methods by which the difference in elevation could be determined? Name the corrections to be applied.

UNIT II

1. What are the temporary adjustments of dumpy level? How is it done?
2. What is reciprocal leveling and why is it employed? What errors will be eliminated by this?
3. Enumerate the principle of least squares as applied to observations of equal weight and tothose for which different weights are assigned
4. Explain the methods of correlates.
5. What do you mean by station adjustment? Explain.
6. The following are the three angles α β and γ observed at a station P closing the horizon,alongwith their probable errors of measurement. Determine their corrected valuesα = 78o 12‟ 12” ± 2” β = 136o 48‟ 30” ± 4” γ = 144o 59‟ 08” ± 5”
7. What do you mean by figure adjustment? Explain.
8. Find the most probable values of the angles A, B and C from the following observations at a station P using method of differences.
   a. A = 38o 25‟ 20” wt.1
   b. B = 32o 36‟ 12” wt.1
   c. A +B = 71o 01‟ 29” wt .2
   d. A + B+ C = 119 o 10‟ 43” wt.1
   e. B + C = 80o 45‟ 28 wt.2
9. Form the normal equation for x, y, z in the following equations.
   a. 3X+3Y+Z-4=0
   b. X+2Y+2Z-6=0
   c. 5X+Y+4Z-21=0
10. Also form the normal equation, if weights of the equations are 2, 3 and 1 respectively.
11. The following angles were measured at a station O so as to close the horizon
    a. A=8304212811.75 wt.3
    b. B=10201514311.26 wt.2
    c. C=9403812711.22 wt.4
    d. D=7902312311.77 wt.2
12. Adjust the angles by method of correlates.
13. Explain in detail about errors sources and error classification.

14. What are the precautions and correction can be applied in error reduction.
15. How are normal equations formed in theory of errors?
16. List three types of errors occur in measurement.

UNIT III

1. Explain in detail about Electromagnetic Spectrum and its applications.
2. Explain in detail about the properties of electromagnetic waves. How are they useful in measuring of distances?
3. Explain in detail about the different types of EDM.
4. Explain the working principle of EDM.
5. Why phase comparison and modulation is preferred over time measurement in EDM?
6. Explain the working principle of "Tellurometer".
7. Explain the working principle of "Geodimeter".
8. Explain the working principle of "Wild Distomats".

9. Explain in detail about the sources of errors in Total station and EDM.
10. How is Traversing and Trilateration done using Total station?
11. Explain in detail about the fundamental measurements of the Total Station.

UNIT IV

1. What are the space, control and user segments of GPS and their functions?
2. Explain the history of GPS and technical specifications of its orbits.
3. How is co-ordinates determined using GPS?
4. Explain in detail about the signal structure of GPS.
5. Explain in detail Anti-spoofing and Selective availability.
6. Explain the requirements of GPS signals.
7. What are the types of GPS receivers? Explain in detail.
8. Distinguish between single frequency receivers and Double frequency receivers.
9. How the traversing and triangulation is to be done using GPS?
10. Explain the main components of GPS receiver.
11. What is SAASM? Explain.
12. Explain the Characteristics of GPS Navigation and Satellite navigation.

UNIT V

1. Explain briefly components of hydrographic survey?
2. Comparison between Aerial photographs and maps.
3. List the different methods of locating soundings. Explain any two methods.
4. Define stereoscope and list out the types of stereoscopes?
5. State the equipment used for soundings and explain them.
6. State stereoscope and explain briefly the basic types of stereoscopes.
7. Explain briefly about the Electro-Magnetic Distance measurement.
8. What is a three point problem in hydrographic surveying? What are the various solution for the Problems? Explain any one method.
9. Explain briefly the different methods of prediction of tides.

CE 6405- SOIL MECHANICS
UNIT I
SOIL CLASSIFICATION AND COMPACTION

1. Define: Water Content (w)

Water content is defined as the ratio of weight of water to the weight of solids in a given mass of soil.

2. Density of Soil: Define

Density of soil is defined as the mass the soil per unit volume.

3. Bulk Density: Define ($\triangle$)

Bulk density is the total mass M of the soil per unit of its total volume.

4. Dry Density: Define ($\triangle_d$)

The dry density is mass of soils per unit of total volume of the soil mass.

5. Define: Saturated Density ($\triangle_{sat}$)

When the soil mass is saturated, is bulk density is called saturated density

6. Define: Submerged Density ($\triangle'$)

The submerged density is the submerged mass of the soil solids per unit of total volume of the soil mass.

7. Define: Unit Weight of Soil Mass

The unit mass weight of a soil mass is defined as it s weight per unit volume.

8. Bulk Unit Weight: Define ($\rightarrow$)

The bulk weight is the total weight of a soil mass per unit of its total volume.

9. Dry Unit Weight: Define ($\rightarrow_d$)

The dry unit weight ifs ht weight of solids per unit of its total volume of the soil mass.

10. Unit Weight of Solids: Define ($\rightarrow_s$) .

The unit weight of soil solids is the weight of soil solids per unit volume of solids.

11. What Is Submerged Unit Weight ($\rightarrow'$)

The submerged unit weight is the submerged weight of soil solids per unit of the total volume of soils.

12. What Is Saturated Unit Weight ($\rightarrow_{sat}$)

Saturated unit weight is the ratio of the total weight of a saturated soil sample to its total sample.

13. What Is Void Ratio? (e)

Void ratio of a given soil sample is the ratio of the volume of soil solids in the given soil mass.

14. What is Porosity? (n)

The porosity of a given soil sample is the ratio of the volume of voids to the total volume of the given soil mass.

15. Degree of saturation: Define (Sr)

The degree of saturation is defined as the ratio of the volume of water present in a given soil mass to the total volume of voids on it.

16. Define: percentage of air voids (n_a)

Percentage of air voids is defined as the ratio of the volume of air voids to the total volume of soil mass.

17. Air content: Define (a_c)

The air content is defined as the ratio of volume of air void to the volume of voids.

18 .Define: Density Index (I_D) or Relative Compactive

The density index is defined as the ratio of the differences between the voids ratio of the soil in the loosest state and its natural voids ratio ratio & to the differences between voids ratio in the loosest and densest states.

19. What is compaction?

Compaction is a process by which the soil particles are artificially rearranged and packed together into a closer strata of contact by mechanical means in order to decrease the porosity (or voids ratio) of the soil and thus increase its dry density.

20. Aim of the compaction

To increase the shear strength soil
To improve stability and bearing capacity

To reduce the compressibility
To reduce the permeability of the soil.

21. What are the methods available for sieve analysis?

a) Dry sieve Analysis
b) Wet sieve analysis

22.Atterberg limits: define

The limit at which the soil, changes from one state to another state, is termed as atterberg limits.

23. Liquid limit: define

Is the water content at which the soil, changes from liquid to plastic state liquid.

24. What is plastic limit?

The maximum water content at which, soil changes from plastic to semi-solid state.

25. Define: percentage of air voids (n_a)

Percentage of air voids is defined as the ratio of the volume of air voids to the total volume of soil mass.

UNIT II
SOIL WATER AND WATER FLOW

1. Define soil water.

Water present in the voids of a soil mass is called soil water.

2. State the types of soil water.

i. Free water (or) Gravitational water
ii. Held water
   a. Structural water
   b. Absorbed water
   c. Capillary water.

3. Define free water and held water.

Free water:

Water that is free to move through a soil mass under the influence of gravity is known as free water.

Held water:

Held water is the part of water held in soil pores by some forces existing within the pores: such water therefore is not free to move under gravitational forces.

4. Define structural, Adsorbed and capillary water. Structural water:

Structural water is the water chemically combined in the crystal structure of the soil mineral and can be removed only by breaking the structure.

Adsorbed water:

Adsorbed water, also termed as the hygroscopic water (or) the contact moisture (or) surface bound moisture. It is the part which the soil particles freely adsorb from atmosphere by the physical forces of attraction and is hold by the force of adhesion.

Capillary water:

Water held in the interstices of soil due to capillary forces is called capillary water.

5. Draw the diagrammatic representation of water molecules.

The soil particles carry a net negative charge. Due to this charge, they attract water. The water in the soil system that is not under significant forces of attraction from the soil particle is pore water.

6. Define capillary action (or) capillarity:

It is the phenomenon of movement of water in the interstices of a soil due to capillary forces. The capillary forces depend upon various factors depend upon various factors such as surface tension of water, pressure in water in relation to atmospheric pressure and thee size and conformation of soil pores.

7. Define contact moisture.

Water can also be held by surface tension round the point of contact of two particles (spheres) capillary water in this form is known as contact moisture (or) contact capillary water.

8. Compute the maximum capillary tension for a tube 0.05 mm in diameter.

Solution:

The maximum capillary height at 4^{o} C is given by

$$hc_{max} = \frac{0.3084}{61.7cm} = \frac{0.3084}{0.617m} \quad d\ 0.005$$

Capillary tension = $(hc)_{max}$ = 0.617 x 9.81

1 6.05 x KN/m^3

9.Compute the height of capillary rise in a soil whose D_{10} is 0.1 mm and voids ratio is 0.60. Solution:

Let the average size of the void be d mm.

Volume of each sphere of solids maybe assumed proportional to D_{10}^3. Since the voids ratio is 0.6, the volume of rods space, corresponding to the unit of volume of solids, will be proportional to 0.60 D_{10}^3 . But volume of each void space is also proportional to d^3.

Hence $d^3 = 0.60\ D_{10}^3$

$$d = 0.60^{1/3} D_{10}$$

= 0.845 x D_{10}

= 0.845 x 0.1

d = 0.0845 mm = 0.00845 cm

$$hc = \frac{0.3084}{d}\ cm \quad \text{at } 4^{o} \text{ C.}$$

$$hc = \frac{0.3084}{0.00845} = 36.5cm$$

10.Define Permeability.

Permeability is defined as the property of a porous material which permits the passage of water (or) other fluids through its interconnecting voids.

A material having continuous voids is called permeable. Grovels are highly permeable while stiff clay is a least permeable, and hence clay may be formed impermeable.

11.Define laminar and turbulent flow.

In laminar flow, each fluid particle travels along a definite path which never crosses the path of any other particle.

In Turbulent flow, the paths are irregular and twisting, crossing and recrossing at random.

12.What are the importances for the study of seepage of water?

1. Determination of rate of settlement of a saturated compressible soil layer.
2. Calculation of seepage through the body of earth dams, and stability of slopes.
3. Calculation of uplift pressure under hydraulic structure and there safety against piping.
4. Ground water flow towards well and drainage of soil

13.Define coefficient of permeability (or) permeability.

It is defined as the average velocity of flow that will occur through the total cross-sectional are of soil under unit hydraulic gradient. The coefficient of permeability is denoted as K. It is usually expressed as cm/sec (or) m/day (or) feet/day.

14.Define seepage velocity (or) Actual velocity.

The actual velocity (or) seepage velocity is defined as the rate of discharge of percolating water per unit cross-sectional area of voids perpendicular to the direction of flow.

15.State the factors affecting permeability.

i. Grain size
ii. Properties of the pore fluid
iii. Voids ratio of the soil
iv. Structural arrangement of the soil particle
v. Entrapped air and foreign-matter.
vi. Adsorbed water in clayey soils.

16.Mention the methods to determine the coefficient of permeability.

Laboratory methods
- Constant head permeability test
- Falling head permeability test

Field methods
- Pumping – out tests
- Pumping –in tests

Indirect methods
- Computation from grain size (or) specific surface

UNIT III
STRESS DISTRIBUTION AND SETTLEMENT

1.Write about the Pressure Distribution Diagrams Types.

By means of Boussinesq's stress distribution theory, the following vertical pressure distribution diagrams can be prepared.

1. Stress isobar (or) isobar diagram
2. Vertical pressure distribution on a horizontal plane
3. Vertical pressure distribution on a vertical line.

2. What Is Iso-Bar?

An Isobar is a curve or counter connecting all points below the ground surface of equal vertical pressure on a given horizontal plane is the some in all directions at points located at equal radial distances around the axis of loading

3. Define the pressure bulb..

The some in a loaded soil mass bounded by on isobar of given vertical pressure. intensity is called a "pressure bulb".

4. Define Contact Pressure?

Contact pressure defined as the vertical pressure acting at the the surface of contact between the base of footing and the underlying soil mass.

5. What Is Compressibility?

When the compressive load is applied to soil mass, a decrease in its volume takes places. The decrease in the volume of soil mass under stress is known as compression and the property of soil mass compressibility.

6. What is consolidation?

Every process involving a decrease in the water content of a saturated soil without replacement of the water by air is called process of consolidation.

7. Define the Co-efficient of Compressibility.(a_v)

The co-efficient of compressibility is defined as the decrease in voids per unit increase of pressure.

$$a_v = \frac{\Delta e}{\Delta \sigma_1} = \frac{e_0 - e}{\sigma_1 - \sigma_0}$$

8. Define of volume change (m_v)

The co-efficient of volume change or the co-efficient of volume compressibility is defined as the change in volume of a soil mass per unit of initial volume due to a given increase in the pressure.

9. Write short notes on consolidation of undisturbed specimen?

Soil deposits may be divided into three classes as regards to the consolidation history; pre consolidation normally consolidated and under consolidated. Clay is said to be pre compressed pre consolidated or over consolidated.

If it has ever been subjected to a pressure in excess of it present overburden pressure the temporary overburden pressure to which a soil has been subjected and under which it got consolidated is known as pre-consolidation pressure.

A soil may have been subjected during metal away by other geologic over burden and structural level which to longer exist now. A soil which is not fully consolidated existing over burden called an under consolidation.

10. How do you determine the pre-consolidation pressure?

To find the pre consolidation pressure on disturbed sample of clay is consolidated in the laboratory and the pressure voids ratio relationship is plotted on a semi-log plot.

The initial portion of the curve is that and assembles the recompression curve of a remoulded specimen. The lower portion of the curve which is a straight line is the laboratory.

The approximate value of the pre-consolidation pressure may be determined by the following empirical method of A casagrande. The point A of maximum curvature selected and horizontal line AB: is drawn. A tangent AC is drawn to the curve and bisector AD, bisecting angle BAC is drawn.

11. What are the assumption are made in the Terzaghi's theory of one-dimensional consolidation.

1 soil homogenous and fully saturated
2 Soil particles and water are incompressible.
3 Deformation of the soil is due entirely to change in volume
4 Darcy's law for the velocity of flow of water thorough soil is perfectly valid.
5 Coefficient of permeability is constant during consolidation
6 Load is applied deformation occurs only in direction
7 The change in thickness of the layer during consolidation is insignificant.

12. What type of soil undergoes larger consolidation?

Clay soil will undergo larger consolidation.

13. Define pre-consolidation pressure.

The pre-consolidation stress is defined to be the max effective stress experienced by the soil. This stress is identified in comparison with the effective stress in its present state.

14. What is the principal behind the construction of new marks influence chart?

The chart consists of number of circles and radiating lines is so prepared that the influence of each area unit is the same at the centre of the circle.

15. Find the ultimate consolidation settlement undergo two way drainage?

The magnitude of the settlement is not influenced by the drainage condition. Hence the ultimate consolidation for both the single and double drainage is 100mm only.

16. Define stress tensor.

The total stress field at appoint within a soil mass loaded at its boundary consist of nine stress components are given by group of square matrix of stresses are the components of a mathematical entity called stress tensor.

UNIT IV
SHEAR STRENGTH

1. What is cohesive strength of soil? Name the soil which has the maximum cohesive strength.

Shear strength equation $S = c + \sigma \tan\varphi$

Where, C = cohesive strength of the soil clay has the maximum cohesive strength.

Φ = angle of internal friction.

2. Define angle of internal friction.

$S = c + \sigma \tan\varphi$ When two soil particles are in contact with each other, the frictional resistance available is deponent upon the normal force between the two and an intrinsic property.

3. What is meant by progressive shear strength failure?

In which test does it occur? The stress conditions across the soil sample are very complex. The distribution of normal stresses over the potential surface of sliding is not uniform. The stress is more at the edges and less in the center. Due to this there is progressive failure of specimen.

4. What are the factors influencing the shear strength of soil?

The structural resistance to displacement of ther soil because of the♠ interlocking of particles. The frictional resistance to translocation between the individual soil particles♠ at their contact points. Cohesion or adhesion between the surface of the soil particles.

5. When the field and laboratory vane shear tests are preferred?

The vane shear test is particularly suited for softy clays and sensitive clays for which

cylindrical specimens cannot be easily prepared. It is a quick test used either in the lab or in the field to determine the undrained shear strength of cohesive soil.

6. How will you find the shear strength of cohesive soil?

From the un confined compression test the sear strength of the cohesive soil can be determined from the given relation. $\sigma 1 = 2c \tan (45° + \varphi/2)$ From triaxial test $\sigma 1 = \sigma 3 \tan 2 \alpha + 2c \tan\alpha$

7. What are the advantages of Triaxial compression test?

The stress distribution on the failure plane is much more uniform than it is in♠ direct shear test Precise measurement of pore water pressure and volume changes during the♠ test are possible Complete control the drainage conditions is possible with the Triaxial♠ compression test, this would enable one to simulate the field conditions better.

8. What is stress path?

A stress Path is a curve or straight line which is the locus of a series of stress points depicting the changes in stress in a test soecimen or in a soil element in-situ, during loading or unloading, engineered as in a triaxial test in the former case or caused by forces of nature .

9. How liquefaction of sands can be prevented.

The prevention of liquefaction is acjived by installing gravel drains in sand deposits to dissipate excess pore water pressure.

10. List the merits and demerits of tri axial test.

Merits: The stess distribution on the failure plane is much more uniform than it is in♠ the direct shear test Precise measurement of pore water and volume changes during the test are♠ possible Complete control of the drainage conditions is possible with the triaxial♠ compression test, this would enable to simulate the field conditions better. Demerits The apparatus is elaborate, costly and bulky.♠ The drain test takes longer period as compared with that in a direct shear test.

11. Enumerate the type of laboratory tri axial test you would specify to be carried out in connection with field problem of initial stability of a footing on saturated clay.

A footing on saturated clay will initially increase the pore pressure of the clay and only gradually, as consolidation occurs, will the effective stresses increase. The appropriate in this case, therefore, would be an un consolidated undrained triaxial test.

12. On which type of soil unconfined compression test is conducted?

Explain with the help of Mohr circle how shear strength are determined in this type of test. The unconfined compression test is used to measure the shearing resistance of cohesive soils which may be undisturbed or remoulded specimens. The unconfined compression test is applicable only to coherent material such as saturated clays or cemented soil retain intrinsic after removal of confining pressure.

13. Define shear strength of soil state different type of shear failure.

The shear strength of a soil is its resistance to shear stresses. It is a measure of the soil resistance to deformation by continuous of its individual soil particles. Shear strength in soil depends primarily on interactions between particles. Shear failure occurs when the stresses between the particles are such that they slide or roll past each other.

14. For what type of soil vane shear test will be conducted and write the advantages of test.

For undisturbed or remoulded soil vane shear test will be preferred. Advantages: Vane shear is use full method to measuring the shear strength of clay. It is cheaper and quick method.

15. Write down advantages of direct shear test.

Test is simple and convenient.♠ Sample preparation is easy.♠ Apparatus is relatively cheap.♠ Thickness is small.

16. Write down the expression to determine the shear strength of soil by vane shear test.

Shear strength at failure along the cylindrical surface = πd H Cu = T Πd2 ((H/2) + (d/b))

17. Why triaxial shear test is considered better tha direct shear test?

Stress distribution on the failure plane is uniform.♠ Complete control of the drainage condition is possible.♠ Special tests such as extension test are also possible to be conducted in it the♠ triaxial testing machine.

UNIT V
SLOPE STABILITY

1. Find the factor of safety of an infinite slope having an angle of 30°.

The slope consists of cohesion less soil with angle of friction 30°.

FOS= tanφ/tani = 1.00

2. What are the three critical conditions for which the stability analysis of an earth dam is carried out?

Steady seepage.♠ Sudden drawdown.♠ Immediately after construction.

3. What are the types of slope failure?

It is broadly classified into Base failure.♠ Slope failure.♠ Face failure &Toe failure.

4. Why the FOS of an infinite slope made of sandy soil is independent of the height of the embankment?

Because it depends on the angle of internal friction and slope angle

5. Explain Finite and Infinite slope.

If a slope represent the boundary surface of semi infinite soil mass and the soil properties for all identical depths below the surface are constant it is called an infinite slope. If the slope is of limited extent it is called a finite slope.

6. Write down the expression foe factor of safety of an infinite slope in case of cohesionless soils.

For dry and submerged slope FOS= tanφ/tani For steady seepage FOS= γ/ γ2

7. What are the different types of failure surfaces?

Planar failure surface.♠ Circular failure surface.♠ Non circular failure surface.

8. State some of the slope production measures.

Providing stone pitching♠ Turfing♠ Providing tail drains♠ Soil nailing♠ Anchoring and grouting♠ Using geotextiles.

9. What are the limitations of culmann's method of stability analysis?

It is only suitable for steep slopes.♠ For planar failure surface.♠ Slope homogeneous soil.

10. State the situations under which modified Bishop's method of slope stability analysis is more suitable?

Consider the forces acting on the vertical sides of the slice♠ For effective stress analysis

11. What are the different types of slopes?

Infinite slope.♠ Finite slope.

12.What is meant by base failure? When does it occur?

If the soil beneath the toe of the slope is weak the failure occurs along a surface that passes at some distance below the toe of the slope, such a type of failure is called base failure.

13. State the two basic types of failure occurring in finite slope

Rotational failure.♠ Translation failure.

14. Write down the Taylor's stability number.

A dimensionless parameter called stability number is often useful for analysis of slope of C-Φ soil.

CE6504- Soil Mechanics
Sixteen Marks Questions

1. Writes notes on nature of soil?
2. Explain the problems related to soils.
3. A soil sample has a porosity of 40% .the specific gravity of solids 2.70, Calculate
    a. Void ratio
    b. Dry density
    c. Unit weight if the soil is 50% saturated
    d. Unit weight if the soil is completely saturated
4. An undisturbed sample of soil has a volume of 100 cm^3 and mass of 190.g. On oven drying for 24 hrs, the mass is reduced to 160 g. If the specific gravity grain is 2.68, determine the water content, voids ratio and degree of saturation of the soil.
5. The in-situ density of an embankment, compacted at a water content of 12 % was determined with the help of core cutter. The empty mass of the cutter was 1286 g and the cutter full of soil had a mass of 3195 g, the volume of the cutter being 1000 cm3. Determine the bulk density, dry density and the degree of saturation of the embankment. If the embankment becomes fully saturated during rains, what would be its water content and saturated unit weight / assume no volume change in soil on saturation. Take the specific gravity of the soil as 2.70.
6. The in-situ percentage voids a sand deposit is 34 percent .for determining the density index , dried sand from the stratum was first filled loosely in a 1000 cm^3 mould and was then vibrated to give a maximum density . The loose dry mass in the mould was m1610 g and dense dry mass at maximum compaction was found to be 1980 g. Determine the density index if the specific gravity of the sand particles 2.67
7. The mass specific gravity (apparent gravity) of a soil equals 1.64. The specific gravity of solids is 2.70. Determine the voids ratio under assumption that the soil is perfectly dry. What would be the voids ratio, if the sample is assumed to have a water content of 8 percent?
8. A natural soil deposit has a bilk unit weight of 18.44 KN/ m^3 , water content of 5 % .calculate the amount of water required to the added to 1 m^3 of soil to raise the water content to 15 %. Assume the void ratio to remain content .What will then be the degree of saturation? Assume G= 2.67.
9. Calculate the unit weighs and specific gravities of solids of (a) soil composed of pure quartz and (b) a soil composed of 60 % quartz, 25% mica, and 15% iron oxide. Assume that both soils are saturated and have voids 0f 0.63. Take average and for iron oxide = 3.8
10. A soil has a bulk unit weight of 20.22 KN/ m^3 and water content of 15%. Calculate the water content if the soil partially dries to a unit weight of 19.42 KN/ m^3 and voids ratio remains unchanged.
11. A cube of dried clay having sides 4 cm long has a mass of 110 g. The same cubes of soil, when saturated at unchanged volume, has mass of 135 g. Draw the soil element showing the volumes and weights of the constituents, and then determine the specific gravity of soil solids and voids ratio.
12. a. Explain Dry sieve analysis

b. Explain wet sieve Analysis.

13. Explain the analysis of sedimentation by pipette method.
14. What are the limitations of sedimentation analysis?
15. Explain the soil classification
16. Explain the BIS classification for soil system
17. Different between consolidation and compaction
18. What are the factors affecting compaction? Explain in brief?
19. What are the different methods of compaction adopted in the field?

UNIT – II- SOIL WATER AND WATER FLOW.

1. Explain capillary rise?
2. Explain capillary tension, capillary potential and soil suction.
3. Define Non-uniform meniscus and explain stress condition in soil.
4. The water table in a certain area is at a depth of 4m below the ground surface. To a depth of 12m, the soil consists of every fine sand having an average voids ratio of 0.7. Above the water table the sand has an average degree of saturation of 50%. Calculate the effective pressure on a horizontal plane at a depth 10 meters hollow the ground surface. What will be the increase in the effective pressure if the soil gets saturated by capillarity up to a height of 1m above the water table? Assume G = 2.65
5. A 10m thick bed of sand is underlain by a layer of clay of 6 m thickness. The water table witch was originally at the ground surface is lowered by drainage to a depth of 4m , where upon the degree of saturation above the lowered water table reduces to 20%. Determine the increase in the magnitude of the vertical effective pressure at the middle of the day layer due to lowering of water table, the saturated unit weights of sand and clay are respectively 20.6 KN/m^3 and 17.6 KN/m^3 and the dry unit weight of sand is 16.7 KN/m^3.
6. The water table in a deposit of sand 8 m thick is at a depth of 3m below the surface. Above the water table, the sand is saturated with capillary water. The bulk density of sand is 19.62 KN/m^3. Calculate the effective pressure of 1m, 3m and 8m below the surface. Hence plot the variation of total pressure, neutral pressure and effective pressure over the depth of 8 m.
7. Describe Poiseuille's Law of flow through capillary tube.
8. Calculate the co-efficient of permeability of a soil sample, 6 cm in height and 50 cm^2 in cross-sectional area, if a quantity of water equal to 430 ml passed down under an effective constant head of 40 cm. On oven-drying, the test specimen has mass of 498 g. Take the specific gravity of soil solids as 2.65. calculate the seepage velocity of water during the test.
9. In a falling head permeameter test, the initial head (t = 0) is 40 cm. The head drops by 5 cm in 10 minutes. Calculate the time required to run the test for the final head to be at 20cm. If the sample is 6 cm is height and 50 cm^2 in cross-sectional area, calculate the coefficient of permeability, taking area of stand pipe = 0.5 cm^2
10. a) What is seepage force or seepage pressure?
    b) What is upward flow or Quick condition? Explain in brief?
11. Explain the Laplace equation for two dimensional flow.
12. a) Explain properties of flow nets.
    b) Explain flow net By Electrical analogy.
13. Applications of flow net: Explain in brief

    i. Determination of seepage
    ii. Determination of hydrostatic pressure
    iii. Determination of seepage pressure
    iv. Determination of exit gradient

UNIT –III - STRESS DISTRIBUTION AND SETTLEMENT

1. Explain the Stresses Due To Self Weight of soil.
2. Explain The Concentrated Force By Boussinesq Equations:.
3. Write Notes on Iso-Bars:
4. Explain Vertical Pressure Distribution On A Horizontal Plane:
5. Explain The Vertical Pressure Distribution On Vertical Line:
6.Find the intensity of vertical pressure and horizontal shear stress at point 4m directly below a 20 KN point load acting at a horizontal ground surface what will be vertical pressure and shear stress at a point 2m horizontal away from the axis of loading but at the same depth of 4m.
7.Prove the maximum vertical stress n a vertical line at a constant radial distance r from the axis of a vertical load is induced at the pint of intersection of the vertical line with a radial line at □ = 39^o 15' from the point of application of concentrated load. What will be the value of shear stress at the hence or otherwise find the maximum vertical stress on a line situated at r = 2 m from the axis of a concentrates load of value 20 KN.
8. Explain the Vertical Pressure under a uniformly loaded circular Area
9. Explain the Vertical Pressure Due To a Line Load.
10. Explain the Vertical Pressure under Strip Load.
11. Explain The Vertical Pressure Under A Uniformly Loaded Rectangular Area:
12. a. Explain the Equivalent Point Load Method
    b Explain the Newmark's influence chart
13. A rectangular area 2m x 4m carries a uniform load of 80 KN/m^2 at the ground surface find the vertical pressures at 5m below the centre and corner of the loaded area.
14. A rectangular area 2m x 4m carries a uniform load of 80 KN/m^2 at the ground surface find the vertical pressures at 5m below the centre and corner of the loaded area.. Solve the problem by the equivalent load method.
15. A rectangular area 2m x 4m carries a uniform load of 80 KN/m^2 at the ground surface find the vertical pressures at 5m below the centre and corner of the loaded area. Using Newmark's influence chart.
16. Explain the Westergaard's Analysis?
17. Explain the Contact Pressure?
18. a. Explain The One Dimensional Consolidation:
    b. Explain The Consolidation Process : Spring analogy
19. Explain the Consolidation of Laterally Confined Soil?
20. Explain the Terzaghi's Theory of One Dimensional Consolidation?
21. Explain The Solution Of The Consolidation Equation:
22. Explain the Laboratory Consolidation Test.

UNIT IV - SHEAR STRINGTH

1. Explain the mohr's stress circle
2. Explain the Mohr-coulomb failure theory
3. Explain the effective stress principle
4. Explain the direct shear test.
5. Explain the tri-axial compression test
6. Explain the Stress conditions in soil specimen during tri-axial testing.
7. Explain the un-confined compression test
8. a. Table, gives observations for normal load and maximum shear force for the specimens of sandy clay tested in the shear box, 36 cm^2 in area under un-drained

conditions. Plot the failure envelope for the soil and determine the value of apparent angles of shearing resistance and the apparent cohesion.

Normal load (N)	Maximum shear force (N)
100	110
200	152
300	193
400	235

8.b. Samples of compacted, clean dry sand were tested in a shear box, 6 cm x 6 cm and the following results were
obtained:

Normal load (N)	:	100	200	300	400
Peak shear load (N)	:	90	181	270	362
Ultimate shear load (N)	:	55	152	277	300

Determine the angle of shearing resistance of the sand in (a) the dense, and (b) the loose
state.

9. A cylindrical specimen of saturated clay, 4 cm in diameter and 9 cm in over all length is tested in an unconfined compression tester. The specimen has coned ends and its length between the apices of cones is 8 cm. Find the unconfined compressive strength of clay, if the specimen fails under an axial load of 46.5 N. The change in the length of specimen at failure is 1 cm.

10. A cylinder of soil fails under an axial vertical stress of 160 kN/m^2, when it is laterally unconfined. The failure plane makes an angle of 50° with the horizontal. Calculate the value of cohesion and the angle of internal friction of the soil.

11. Two identical specimens, 4 cm in diameter and 8 cm high, of partly saturated compacted soil is tested in a triaxial cell under un-drained conditions. The first specimen failed at an additional axial load (i.e. deviator load) of 720 N under a cell pressure of 100 kN/m^2. The second specimen failed at an additional axial load of 915 N under a cell pressure of 200 kN/m^2. The increase in volume of the first specimen at failure is 1.2 ml and it shortens by 0.6 cm, at failure. The increase in volume of the second specimen at failure is 1.6 ml, and it shortens by 0.8 cm at failure. Determine the value if apparent cohesion and the angle of shearing resistance (a) analytically, (b) graphically by Mohr's circle.

12.A saturated specimen of cohesion-less sand was tested in triaxial compression and the sample failed at a deviator stress of 482 kN/m^2 when the cell pressure was 100 kN/m^2, under the drained conditions. Find the effective angle of shearing resistance of sand. What would be the deviator stress and the major principal stress at failure for another identical specimen of sand, if it is tested under cell pressure of 200 kN/m^2?

13. Following are the results of un-drained tri-axial compression test on two identical soil specimens, at failure:

Lateral pressure □3 (kN/m^2)	100	300
Total vertical pressure □1(kN/m^2)	440	760
Pore water pressure u (kN/m^2)	- 20	60

Determine the cohesion and angle of shearing resistance (a) referred to total stress, (b) referred to effective stress.

14. Un-drained triaxial tests are carried out on four identical specimens of silt clay, and the following results are obtained:

Cell pressure (kN/m^2)	50	100	150	200
Deviator stress at failure (kN/m^2)	350	440	530	610
Pore pressure (kN/m^2)	5	10	12	18

Determine the value of the effective angles opf shearing resistance and the cohesion intercept by plotting (a) conventional failure envelope from Mohr circles, (b) modified failure envelope.

UNIT V- SLOPE STABILITY

1. Write a detailed note on direct shear test.
2. Write a detailed note on Tri axial shear test.
3. What are the factors that influence the compaction of a soil mass?
4. What are the factors that affect the permeability of a soil mass.
5. Explain vane shear test
6. Explain UCC test.
7. Explain the Swedish Circle method of Analysis of slopes.
8. Explain the friction Circle method of analysis of stability of slopes.