GPSC - CIVIL
Previous Year Question

EXAM ACHARYA
EDUCATION REDEFINED

PREFACE

GPSC Previous Year Question Bank, a comprehensive refresher for GPSC, is designed for aspirants who are targeting GPSC and definitely useful for other job oriented technical exams such as RPSC, MPSC, MPPSC, UPSC, RRB JE, SSC JE etc by Exam Acharya. This book provides knowledge of the field and also helpful hints to make the study and understanding easier to the aspirants. Each subject in this book has been meticulously designed by the state PSC's toppers and experienced faculties with the idea of maximizing the potential of an individual in a limited time. Every chapter in the book is logically divided to various sections while ensuring that the content in the book is self-sufficient and requires no cross referencing. Over all the whole content of the book furnishes the students with the knowledge of the subject and paves a confident path for the aspirants to accomplish success in state PSC's.

Key Features:

> ➢ Conforms to the latest syllabus prescribed by GPSC.
> ➢ Contain the previous year question (updated) with detailed solution.

Prepared by

Mukesh Rai

SUBJECT	WEIGHTAGE (approx...)		
	NARMADA	GES CLASS 1 & 2	ROAD
SURVEYING	18	24	22
TRANSPORTATION ENGINEERING	15	24	26
BUILDING MATERIAL AND CONSTRUCTION	30	28	15
STEEL STRUCTURE	16	16	13
RCC	11	14	17
GEOTECH & FOUNDATION ENGINEERING	22	40	28
STRUCTURAL ANALYSIS	10	12	20
FLUID MECHANICS	20	26	17
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ENVIROMENTAL ENGINEERING	0	61	0
CPM	10	10	10
HYDROLOGY & IRRIGATION	30	25	16

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BUILDING MATERIAL AND CONSTRUCTION

GPSC - CIVIL

Building Material and Construction

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

CHAPTER 1: CEMENT

1. The total percentage of dicalcium silicate and tricalcium silicate in all types of Portland cement is around
   (a) 50 %
   (b) 60 %
   (c) 70 %
   (d) 90 %

2. White cement is white in colour due to
   (a) Use of limestone and china clay free from metal oxides
   (b) It is modified manufacturing process
   (c) Specific chemical treatment given to ordinary cement
   (d) None of these

3. The fineness of cement is expressed as
   (a) mm
   (b) m^2 / kg
   (c) grade
   (d) Kg / m^3

4. Soundness test is carried out on cement to determine
   (a) Sound penetration capacity of cement
   (b) The presence of sound material in cement
   (c) The presence of uncombined lime in cement
   (d) None of these

5. The apparatus used for measuring soundness of cement is
   (a) Vicat's apparatus
   (b) Le Chatelier's apparatus
   (c) Briquette apparatus
   (d) Leachate apparatus

6. In Vicat's apparatus, the cross-sectional area of needle used is _____ and time to penetrate… is used to measure initial setting time of cement
   (a) $1 \text{ mm}^2, 33 - 35 \text{ mm}$
   (b) $10 \text{ mm}^2, 20 - 25 \text{ mm}$
   (c) $1 \text{ mm}^2, 0.5 \text{ mm}$
   (d) $5 \text{ mm}^2, 5 \text{ mm}$

7. The main advantage of adding pozzolanas in cement is
   (a) Longer life
   (b) Reduced cost and permeability of concrete
   (c) Slower setting time
   (d) Faster setting time

8. The fineness of cement can be found out by sieve analysis using IS sieve number
   (a) 6
   (b) 9
   (c) 10
   (d) 20

9. What percentage of bound water by weight of cement is required for chemical reaction with Portland cement compounds?
   (a) 15%
   (b) 23%
   (c) 38%
   (d) 40%

10. The minimum compressive strength (MPa) of 53 grade Ordinary Portland Cement after 72 hours should not be less than
    (a) 10
    (b) 15.69
    (c) 27
    (d) 53

22. Gypsum is added to Portland cement during its manufacturing to
    (a) Accelerate the setting time
    (b) Retard the setting time
    (c) Decrease the burning temperature
    (d) Improve grinding

23. Which of the following is the first one to participate in hydration reaction of cement paste?
    (a) Dicalcium silicate
    (b) Tricalcium silicate
    (c) Tricalcium aluminate
    (d) Tetracalcium aluminoferrite

24. The main constituent of cement which is responsible for the initial setting of the cement is
    (a) Tricalcium aluminate
    (b) Dicalcium silicate
    (c) Tricalcium silicate
    (d) Tetracalcium alumina ferrite

25. For getting Green coloured cement, which pigment has to be added during the grinding of the cement clinkers?
    (a) Barium manganate
    (b) Chromium oxide
    (c) Oxides of Iron
    (d) Oxides of Cobalt

26. The most commonly used retarder in cement is
    (a) Gypsum
    (b) Calcium Chloride
    (c) Calcium Carbonate
    (d) Magnesium Chloride

27. Correct match of column I (types of bricks) with Column II (properties or use) is

Column I	Column II
P. Portland pozzolana cement	1. Ordinary Portland cement with less than 5% tricalcium aluminate
Q. Sulphate-resisting Portland cement	2. Contains 25 to 60% slag which offer good sulphate resistance
R. Portland slag cement	3. Grinding the clinkers with oleic acid
S. Hydrophobic cement	4. Requires longer curing time than Ordinary Portland cement

    (a) $P - 4, Q - 1, R - 2, S - 3$
    (b) $P - 1, Q - 4, R - 2, S - 3$
    (c) $P - 3, Q - 1, R - 4, S - 2$
    (d) $P - 2, Q - 1, R - 4, S - 3$

28. …. is responsible for flash set of cement
    (a) Tetracalcium alumino ferrite
    (b) Tetracalcium silicate
    (c) Tri Calcium aluminate
    (d) Dicalcium silicate

Chapter 5: Bricks

1. The Bureau of Indian Standards (BIS) has classified the common burnt clay bricks on the basis of
   (a) Compressive strength
   (b) Size of the brick
   (c) Water absorption capacity
   (d) Efflorescence on brick

2. The process of mixing clay, water and other ingredients to make brick is known as
   (a) Pugging
   (b) Moulding
   (c) Drying
   (d) Kneading

3. The bricks which are extensively used for basic refractories in furnaces are
   (a) Chrome bricks
   (b) Sillimanite bricks
   (c) Magnesite bricks
   (d) Fosterite bricks

4. The minimum compressive strength of first class bricks should be
   (a) 5 N/mm²
   (b) 7.5N/mm²
   (c) 10 N/mm²
   (d) 15 N/mm²

5. Pug mill is used for
   (a) Clay preparation
   (b) Clay moulding
   (c) Brick drying
   (d) Brick burning

6. Load applied during the compressive strength test of brick till its failure is at the rate of ….. kg/cm² per minute.
   (a) 100
   (b) 120
   (c) 140
   (d) 160

7. A first class brick when immersed in cold water for 24 hours should not absorb water more than
   (a) 15%
   (b) 18%
   (c) 20%
   (d) 22%

8. Number of bricks required for one cubic meter of masonry are
   (a) 400
   (b) 450
   (c) 500
   (d) 550

9. A relatively high water absorption of a common burnt clay brick indicates
   (a) High bond strength with mortar
   (b) High shrinkage of brick
   (c) High strength of brick
   (d) Need more mortar for plastering

10. Hoffman's kiln to manufacture bricks is a
    (a) Clamp burning
    (b) Intermittent kiln
    (c) Continuous kiln
    (d) None of the above

11. The wedge shaped bricks forming an arch ring are called
    (a) Soffits
    (b) Voussoirs
    (c) Haunches
    (d) Spandrils

9   The purpose of providing cavity wall is
    (i)   To prevent dampness
    (ii) Heat insulation
    (iii) Sound insulation

    (a)   Only (i)   (b)   Only (ii)
    (c)   (i) and (ii)   (d)   (i), (ii) and (iii)

10 A type of bond in a brick masonry consisting of alternate course of headers and stretchers is called
    (a)   English bond   (b)   Flemish bond
    (c)   Stretcher bond   (d)   Header bond

11 Which of the following features regarding Double Flemish bond is not true?
    (a)   Every course consists of headers   (b)   The facing and backing of the
          and stretchers placed alternately   wall, in each course, have the
                                                     same appearance
    (c)   Queen closers are not required   (d)   Headers of any course are
                                                 supported centrally by the
                                                 stretchers of their underlying
                                                 course.

12 Minimum thickness of wall where Single Flemish bond can be used is
    (a)   Half brick thick   (b)   One brick thick
    (c)   One and a half brick thick   (d)   Two brick thick

13 The maximum slenderness ratio for a load bearing is
    (a)   13   (b)   20
    (c)   27   (d)   37

Chapter 9: Concrete

1   The main disadvantage of concrete blocks used for masonry as compared to bricks is
    (a)   Lower strength   (b)   Higher moisture content
    (c)   More requirement of mortar   (d)   Shrinkage due to moisture
                                                 movement

2   The most undesirable properties of water used for making concrete or mortar are:
    (a)   High concentration of   (b)   High concentration of
          carbonates   bicarbonates
    (c)   High concentrations of sulphate (d)   High concentration of silicates
          and chloride

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Total test   : 80

29 Why is super plasticizer added to concrete?
(i) To reduce the quantity of mixing water
(ii) To increase workability
(iii) To reduce the quantity of cement
(iv) To increase early age strength
(a)   (i) and (iv)   (b)   (i), (ii) and (iv)
(c)   (iii) and (iv)   (d)   (i), (ii), (iii) and (iv)

30 Match List - I (Admixtures) with List II (Chemicals) and select the correct answer using the options given below:

List - I	List – II
P. Water- reducing admixture	1. Sulphonated melanin formaldehyde
Q. Air-entraining agent	2. Calcium chloride
R. Super plasticizer	3. Lignosulphonate
S. Accelerator	4. Neutralized vinsil resin

	P	Q	R	S
(a)	2	4	1	3
(b)	1	3	4	2
(c)	3	4	1	2
(d)	3	4	2	1

Chapter 10: Miscellaneous

1 Which of the following is not the characteristic of green building?
(a)   Use of natural light and ventilation   (b)   Solar PV Panels at roof
(c)   Roof top rainwater harvesting   (d)   Use of material with high thermal conductivity

2 Normally the tensile strength of glass varies between
(a) $28 \ kg/cm^2$ to $56 \ kg/cm^2$ (b) $280 \ kg/cm^2$ to $560 \ kg/cm^2$
(c) $2800 \ kg/cm^2$ to $5600 \ kg/cm^2$ (d) $28000 \ kg/cm^2$ to $56000 \ kg/cm^2$

3 The glass articles, after manufactured, are to be cooled down slowly and gradually. The process of slow and homogeneous cooling of glass articles is known as
(a)   Annealing   (b)   Blowing
(c)   Rolling   (d)   Spinning

4 Following is not the process involved in the fabrication of articles of plastic
(a)   Laminating   (b)   Blowing
(c)   Calendering   (d)   Tempering

5 _____ porcelain contains 70% to 90% silicate of magnesia
(a)   Cordierite   (b)   Zircon
(c)   Carbon and graphite   (d)   Steatic

15 The lower edges of a roof which are resting upon or projecting beyond the supporting wall are known as the
    (a) Gables   (b) Rafters
    (c) Eaves   (d) Wall plates

16 The triangular upper part of a wall formed at the end of pitched roof is known as a
    (a) Hip   (b) Eaves
    (c) Cleats   (d) Gable

17 Shielding glass consists high content of
    (a) Lead oxide   (b) Manganese dioxide
    (c) Tin oxide   (d) Cobalt oxide

18 A temporary structure that is built to support an unsafe structure is called
    (a) Scaffolding   (b) Jacking
    (c) Shoring   (d) Underpinning

19 Which of the following is/are incorrect about a staircase?
    (i)   String is the part of tread which is projecting beyond the face of the riser
    (ii)   Soffit is a sort of additional moulding provided under the nosing or tread to beautify the step in elevation
    (iii)   Baluster is a member supporting the hand rail
    (iv)   Newel post is a vertical member at the ends of flights
    (a) Only (i)   (b) (i) and (ii)
    (c) (i) and (iii)   (d) (ii) and (iv)

20 A good staircase should preferably have the maximum and minimum pitch respectively as
    (a) 90° and 0°   (b) 75° and 15°
    (c) 60° and 30°   (d) 45° and 25°

21 Doglegged stairs are
    (a) Half turn stairs   (b) Quarter turn stairs
    (c) Straight stairs   (d) Three quarter turn stairs

3. (b) Fineness of cement is tested in two ways:-
    (a)   By sieving.
    (b)   By determination of specific surface (total surface area of all the particles in one gram of cement) by air-permeability apparatus. Expressed as cm^2/gm or m^2/kg.

4. (c) The test conducted to identify the excess amount of lime in cement is known as soundness test of cement.

5. (b) The test used for determining soundness of cement is known as "Le chatelier apparatus test."

6. (a) In Vicat's apparatus, the cross-sectional area of needle used is $1\ mm^2$ and time to penetrate 33-35 mm is used to measure initial setting time of cement.

7. (b) Advantages of PPC:-
    (i) In PPC, costly clinker is replaced by cheaper pozzolanic material, hence economical.
    (ii) Reduction in permeability.

8. (b) There are three methods for testing fineness of cement:
    Sieve method using 90 micron (9 No.) sieve, air permeability method and sedimentation method.

9. (c) In Portland cement water needed for chemical reaction is 23% and 15% to fill gel pores. For complete reaction it is 38%.

10. (c) Minimum Compressive Strength at:

Description	Requirement
3 days (72 ± 1 hour)	Not less than 27MPa
7 days (168 ± 2 hour)	Not less than 37MPa
28 days ($6 + 72 \pm 4$ hour)	Not less than 53MPa

11. (b) The rate of hydration is on the order of $C_3A > C_3S > C_4AF > C_2S$

12. (c) About 23% water is required for C_3S in cement for its complete hydration and extra 15% is required to fill the gel pores formed by the reaction between C_3S and H_2O .
    So in overall $0.23 + 0.15 = 0.38$ w/c ratio is required.

13. (d) Lime in excess, causes the cement to expand and disintegrate Magnesium oxide in excess, remains in free state and makes the cement unsound.

14. (b) Dicalcium silicate is responsible for ultimate strength while tricalcium silicate is responsible for early strength of cement.

28. (a) The reaction of pure C_3A with water is very fast and may lead to flash set.

Chapter - 2 Lime

1. (b) Ordinary lime mortar is cured by air.

2. (d) Fat lime if exposed to air, it absorbs moisture and CO_2 from the atmosphere and becomes inert $CaCO_3$

3. (b) Hydraulic lime is obtained by burning limestone containing lot of clay and other substances which develop hydraulicity. Hydraulicity of this lime depends upon the amount of clay and type of clay present in it. This lime has the property of setting under water.

4. (b) One of the main demerits in using lime mortar is that it does not set quickly. Therefore the progress of work while using lime mortar is slow.

5. (d) Fat lime is white in colour, which has high calcium oxide content. This lime can set and become hard only in the presence of carbon dioxide. It is also called high-calcium lime, pure lime, rich lime or white lime.

6. (d) Surkhi performs the same function as sand. But, in addition, it imparts strength and improve hydraulic property of mortar. As it disintegrates under the action of air and humidity, the mortar with surkhi should not be used for external plaster or pointing work. Common functions of sand/surkhi in mortar:-
   (i) It acts as bulk.
   (ii) It absorbs carbon dioxide from fat lime and setting of fat lime occurs effectively.
   (iii) It increases resistance of mortar to crushing.

Chapter - 3 Aggregate

1. (d) Smith's test is performed to find out the presence of soluble matter in a sample of stone. Few chips or pieces of stone are taken and they are placed in a glass tube. The tube is then filled with clear water. After about an hour, the tube is vigorously stirred or shaken. Presence of earthy matter will convert the clear water into dirty water. If water remains clear, stone will be durable and free from any soluble matter.

2. (a) Dorry's testing machine is used for hardness test of stone.

3. (a) **Sandstone:**
   This stone is another form of sedimentary rock formed by the action of mechanical sediments which is used as a road metal work.

4. (d)

Type of sand	Fineness modulus range
Fine sand	$2.2 - 2.6$
Medium sand	$2.6 - 2.9$
Coarse sand	$2.9 - 3.2$

Chapter - 4 Timber

1. (d) A tree's age can be determined by counting the annual growth rings in its trunk.

2. (c) **Scantling:-** This is a timber piece whose breadth and thickness exceed 50mm, but are less than 200 mm in length.

3. (c) The process of drying timber or removing moisture or sap, present in a freshly felled timber, under more or less controlled conditions is called seasoning of timber.

4. (a) **Pith:-** At the very center of the tree is the pith, which is the oldest part of the tree. The pith, together with the tree's first few annual rings, is called juvenile wood. The pith area has a greater tendency to crack than the rest of the wood in a tree.

5. (c) Shisham yields hard wood.

6. (a) The strength of timber is maximum in a direction parallel to the grain.

7. (d) Following are the different form of industrial timber:
   - Veneers
   - Plywood
   - Fiber boards
   - Impreg timbers
   - Compreg timbers
   - Hard boards
   - Glulam
   - Chip board
   - Block board
   - Flush door shutters

8. (c) The process of drying timber or removing moisture or sap, present in a freshly felled timber, under more or less controlled conditions is called seasoning of timber.

9. (a) The dimension of sample to be tested for specific gravity of timber is 6 cm in length and 2×2 cm in cross-section or 15 cm in length and 5×5 cm in cross-section.

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EXAM ACHARYA
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Progress Control

Planning

Document Control

Plant Turnover

Material Control

Quality Control

Construction, Planning and Management

"All Birds find shelter during a rain. But Eagle avoids rain by flying above the Clouds."

A.P.J. Abdul Kalam

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

10. (c) The Hoffmann kiln is a series of batch process kilns. Hoffmann kilns are the most common kiln used in production of bricks and some other ceramic products. Hoffman kiln is a continuous, moving fire kiln in which the fire is always burning and moving forward through the bricks stacked in the circular, elliptical or rectangular shaped closed circuit with arched roof.

11. (b) Voussoirs:- These are wedge-shaped units of masonry, forming an arch.

12. (a) The process of mixing clay, water and other ingredients to make brick is known as kneading.

13. (c) Compressive Strength of Bricks.
   (i) Compressive Strength of first class brick is $105 \frac{kg}{cm^2}$
   (ii) Compressive Strength of 2 nd class brick is $70 \frac{kg}{cm^2}$
   (iii) Compressive Strength of common building brick is $35 \ kg/cm^2$

14. (d) Ground-moulded bricks - Irregular dimensions
   Table-moulded bricks - Also called stock bricks
   Machine-moulded bricks - Also called wire-cut bricks
   Pressed bricks – Used for decorative works

Chapter - 6 Structural Steel

1. (c) According to IS: 1786-2008, Table No.1, maximum carbon content in high strength deformed bars should not be more than 0.3%.

2. (a) The percentage of chromium and nickel in stainless steel respectively are 18% and 8%

3. (b) The normal rails are made of steel containing 0.7% C and 1%Mn, which are called as Carbon Manganese rail steel.

4. (c) Chromium is added to steel to increase resistance to oxidation. This resistance increases as more chromium is added. Stainless Steels have a minimum of 10.5% Chromium (traditionally 11 or 12%). This gives a very marked degree of general corrosion resistance when compared to steels with a lower percentage of Chromium. The corrosion resistance is due to the formation of a self-repairing passive layer of chromium oxide on the surface of the stainless steel.

5. (a) Upper yielding point in a stress-strain curve of structural steel can be avoided by cold working.

6. (a) The coefficient of thermal expansion for steel is taken as 12×10^{-6} / °C.

7. (c) Wrought Iron is the purest form of iron. It contains 0.12 to 0.25% carbon and is thus the purest form of iron.

8. (b) The ratio of Young's modulus of high tensile steel to that of mild steel is about 1.0.

3. (d) For half brick thickness leaves, stretcher bond is provided. And for one brick thickness or more thickness, English bond or Flemish bonds type constructions are provided.

4. (b) The slenderness ratio for masonry walls should not be more than 20.

5. (a) When a brick is cut along its length, making it two equal halves then it is called queen closer. Thus a queen closer is a broken brick portion whose width is half as wide as the original brick.

6. (b) In Dutch bond, the alternate courses are of headers and stretchers, the Quoin of a stretcher course is a three quarter but and a header is introduced next to the three quarter but in every alternate stretcher course.

7. (d) Cavity wall gives better thermal insulation than any other solid wall because space is full of air and reduces heat transmission. They have a heat flow rate that is 50 percent that of a solid wall. Cavity Wall is economically cheaper than other solid walls. Cavity Wall is fire resistant.

8. (c) As per BIS standard
   Size of Brick = $190 \times 90 \times 90$ mm
   Size of Brick with mortar = $200 \times 100 \times 100$ mm
   (10 mm mortar)
   No of bricks in 1 cubic Meter = 1/ volume of bricks.
   = $1/(200 \times 100 \times 100)$ (convert mm into m)
   = $1/(0.2 \times 0.1 \times 0.1) = 500$ nos. (Add 5% as a wastage).

9. (d) Purposes of Cavity wall
   The cavity walls are provided for various purposes
   • Damp prevention • Sound Insulation • Thermal insulation • Economy

10. (a) In English Bond alternate courses consist of headers and stretchers. This is considered to be the strongest bond. Hence it is commonly used bond for the walls of all thicknesses.

11. (c) The bond in which headers and stretchers are laid alternately in each course, both in the face and back of the wall, is called Double Flemish Bond. Headers of any course are supported centrally by the stretchers of their underlying course

12. (c) Minimum thickness required for single Flemish bond is one and a half brick thickness. The main purpose of using single Flemish bond is to provide greater aesthetic appearance on the front surface with required strength in the brickwork with English bond.

13. (c) Maximum slenderness ratio is 27 for cement mortar and 20 for mortar not containing cement.

adversely. The least lateral dimension of flaky aggregate (thickness) should be less than 0.6 times the mean dimension. For example, the mean sieve size for an aggregate piece passing through 50 mm and retained on 40 mm sieve is $(50 + 40)/2 = 45.0$ mm. If the least lateral dimension is less than $0.6 \times 45 = 27.0$ mm, the aggregate is classified as flaky. Elongated aggregate are those aggregate whose length is 1.8 times its mean dimension. Flaky aggregate generally orients in one plane with water and air voids underneath They adversely affect durability and are restricted to maximum of 15 percent.

26. (a) Split tensile strength -modulus of rupture -cylinder strength -cube is the increasing order of stress.

27. (b) For a given environment, the most significant factor that influences the total shrinkage of concrete is total amount of water added at the time of mixing

28. (a) While testing the compressive strength of cement concrete, the correct standard conditions (viz temperature, age, humidity and size of the specimen) to be maintained as per IS are 27 ± 3^0C, 28 days, 90% and 15 cm cube.

29. (d) super plasticizers are added to concrete to:
     (i) reduce the quantity of mixing water
     (ii) increase workability
     (iii) reduce the quantity of cement
     (iv) increase early age strength

30. (c) Water reducing admixture- Lignosulphonate
     Air-entraining agent- Neutralized vinsil resin
     Super plasticizer- Sulphonated melanin formaldehyde
     Accelerator- Calcium chloride

Chapter - 10 Miscellaneous

1. (d) Characteristic of green building are
    (i) Use of natural light and ventilation
    (ii) Solar PV panel at roof
    (iii) Roof top rainwater harvesting.

2. (b) Normally the tensile strength of glass varies between 280 kg/cm^2 to 560 kg/cm^2

3. (a) The process of slow and homogeneous cooling of glass articles is known as the annealing of glass. The annealing of glass is a very important process.

4. (d) Tempering is not the process involved in the fabrication of articles of plastic.

5. (d) Steatic Porcelain contains 70% to 90% silicate of magnesia.

Chapter 1: Properties of Material

1. The ratio of change of dimension of the body to the original dimension is known as
   (a) Strain
   (b) Stress
   (c) Force
   (d) Pressure

2. The stress induced in a body, when subjected to two equal and opposite forces which are acting tangentially across the section is known as
   (a) Compressive stress
   (b) Tensile stress
   (c) Shear stress
   (d) Bending stress

3. The work done to strain a material within elastic limits is known as
   (a) Resistance
   (b) Virtual work
   (c) Resilience
   (d) Work modulus

4. A pull of 20t is suddenly applied to a rod of cross-sectional area $40cm^2$. The stress produced in the rod is equal to
   (a) $0.5 \ t/cm^2$
   (b) $1.0 \ t/cm^2$
   (c) $2.0 \ t/cm^2$
   (d) $4 \ t/cm^2$

5. In a uniaxial tension test on a mild steel bar, the Lueders line will be
   (a) Inclined at 45^0 to the direction of tensile stress applied
   (b) Perpendicular to the direction of tensile stress applied
   (c) Along the direction of tensile stress
   (d) Perpendicular to the resultant compressive stress

6. Brittle materials are characterized by
   (a) No difference between ultimate strength and breaking strength.
   (b) Rupture occurs without any noticeable change in rate of elongation.
   (c) Strain at the time of rupture is very small.
   (d) All of the above

7. Upon loading a mild steel bar beyond proportional limit, increases more rapidly than the force.
   (a) Strength
   (b) Elongation
   (c) Stress
   (d) Resistance

8. When a body is deformed due to force, the work done by force is stored in body as
   (a) Potential energy
   (b) Kinetic Energy
   (c) Heat Energy
   (d) All of the above

9. The property by which a body returns to its original shape after removal of load is called
   (a) Plasticity
   (b) Elasticity
   (c) Deformability
   (d) Ductility

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23. A rod of length L is hanging vertically and carries a load P at the bottom. If the weight per unit length of the rod be w, then the tensile force in the rod at a distance y from the support is given by
    (a) P
    (b) P-wy
    (c) $P + wy$
    (d) $P + w(L - y)$

24. If for a given material $E = 2G$, then the bulk modulus K will be
    (a) E/3
    (b) E/2
    (c) E/4
    (d) E

25. A bar of 80 mm diameter and 800 mm length is subjected to an axial load of 200KN. It elongates by 0.30 mm and the diameter decreases by 0.01 mm. What is the Poisson's ratio of the material of the bar?
    (a) 0.25
    (b) 0.33
    (c) 0.5
    (d) 0.75

26. The principle of superposition is not applicable when
    (i)   The material does not obey Hooke's law
    (ii)   The effect of temperature changes is taken into consideration
    (iii) The structure is being analysed for the effect of support settlement

    Which of these statement(s) is/are correct?
    (a) (i) only
    (b) (i) and (ii)
    (c) (ii) and (iii)
    (d) (i), (ii) and (iii)

27. When a prismatic bar is suspended and loaded with self-weight only, the deformation of the bar is
    (a) Proportional to total weight of bar
    (b) Proportional to quarter of the total weight of the bar
    (c) Proportional to the half of the total weight of the bar
    (d) Proportional to modulus of elasticity of bar

Chapter 3: Shear Force and Bending Moment

1. For the beam of span L, carrying UVL as shown in figure, the maximum bending moment is
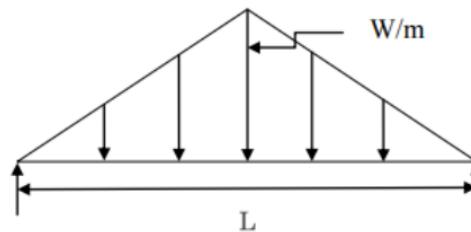
    (a) $\dfrac{WL^2}{8}$
    (b) $\dfrac{WL^2}{12}$
    (c) $\dfrac{WL^2}{10}$
    (d) $\dfrac{WL^2}{4}$

8. A Rectangular section is to be prepared by cutting a Circular log of timber having diameter D. What should be the width of the Strongest Rectangular section to resist the moment?
   (a) D/2
   (b) $D/\sqrt{2}$
   (c) $D/\sqrt{3}$
   (d) D/3

9. Between the point loads the variation of shear is
   (a) Linear
   (b) Constant
   (c) Parabolic
   (d) Cubic

10. Which of the following represents the bending at a section of the beam?
    (a) $EI\frac{d^4y}{dx^4}$
    (b) $EI\frac{d^3y}{dx^3}$
    (c) $EI\frac{d^2y}{dx^2}$
    (d) $EI\frac{dy}{dx}$

11. If the magnitude of shear force is constant, then the magnitude of the slope of bending moment curve is
    (a) Zero
    (b) Increasing
    (c) Decreasing
    (d) Constant

12. If the following figure represents the Shear Force Diagram of a beam, then the loading conditions of the beam would be?
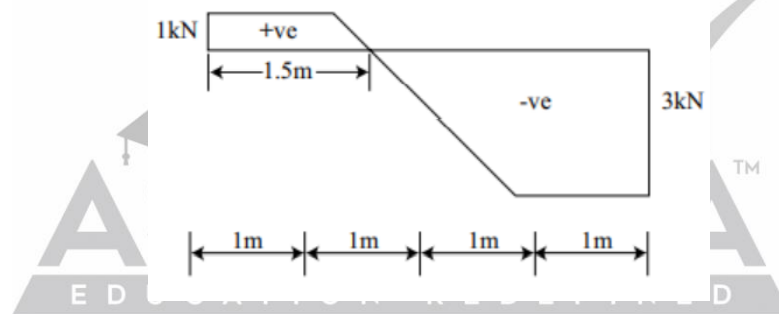
(a)

(b)

(c)

11. Normal stress on an oblique plane inclined at angle 45° to the axis of a bar of square cross- section of side S when acted upon by a tensile force P is
    (a) P/S^2
    (b) $2P/S^2$
    (c) $P/2S^2$
    (d) $P/4S^2$

12. A plane element is subjected to a shearing stresses of 50MPa. The principal stresses existing in this element and the directions of the planes on which they occur would be _____at respectively.
    (a) 50MPa at 45°
    (b) 50MPa at 90°
    (c) 7MPa at 45°
    (d) 7MPa at 90°

13. Two shaft of different diameter d_1 and d_2 are made from same material and are of same length under the action of same torque T the ratio of strain energy V_1/V_2
    (a) $[d_2/d_1]^3$
    (b) $[d_1/d_2]^2$

    (c) $[d_2/d_1]^2$
    (d) $[d_2/d_1]^4$

14. Let the strains produced in length and diameter of the cylindrical rod be α and β respectively. Then the volumetric strain is given by
    (a) $\alpha + 2\beta$
    (b) $\alpha + \beta$
    (c) $\alpha - \beta$
    (d) $\alpha - 2\beta$

15. A beam carries uniformly distributed load throughout its length. In which of the following configuration will the strain energy be maximum?
    (a) Cantilever
    (b) Simply supported beam
    (c) Propped cantilever
    (d) Fixed

Chapter 5 : Bending Stress in Beams

1. The equation of pure bending in usual notation is
   (a) M/R = E/Y = f/I
   (b) M/Y = E/I = f/R
   (c) M/I = E/R = f/Y
   (d) M/R = E/I = f/Y

2. The assumption that the cross section plane before bending remain plane even after bending means
   (a) The strain in the fibres is proportional to their distances from the neutral axis
   (b) The bending moment will be resisted by the central core of the section
   (c) The stresses in the fibres are proportional to their distances from the neutral axis
   (d) The neutral axis lies at mid height

3. A rectangular section 100 mm × 200 mm is subjected to moment of 20kNm. The maximum bending stress is
   (a) $30 \, N/mm^2$
   (b) $5/6 \, N/mm^2$
   (c) $10000 \, N/mm^2$
   (d) $300 \, N/mm^2$

13. Match the List 1 (Cross Section) with List 2 (Shape of the core) to ensure no tension is developed in the cross section:

LIST 1	LIST2
(A) Rectangular	1. Circle
(B) I-section	2. Rhombus
(C) Hollow section	3. Square
(D) Square section	4. Annular

Select the correct choice:

	A	B	C	D
(a)	1	2	3	4
(b)	1	2	4	4
(c)	2	2	4	3
(d)	2	2	1	3

Chapter 7: Torsion

1. If a shaft is subjected to pure twisting moment, an element on the surface is subjected to
    - (a) Normal tensile stress
    - (b) Normal compressive stress
    - (c) Pure shear stress
    - (d) Bending stress

2. The maximum shear stress produced in a shaft is 5 N/mm^2. The shaft is of 40 mm diameter. The value of twisting moment is
    - (a) 628 Nm
    - (b) 62.8 Nm
    - (c) 125.6 Nm
    - (d) 1256 Nm

3. When a shaft of diameter d is subjected to a bending moment M and torque T, the equivalent B. M. is given by
    - (a) $\dfrac{M+\sqrt{M^2+T^2}}{2}$
    - (b) $\dfrac{M-\sqrt{M^2+T^2}}{2}$
    - (c) $\dfrac{16}{\pi d^3}M + \sqrt{M^2 + T^2}$
    - (d) $\dfrac{32}{\pi d^4}M + \sqrt{M^2 + T^2}$

4. A key inserted between a uniform circular shaft and pulley transmitting torsion is subjected to_____
    - (a) Bending stress
    - (b) Axial stress
    - (c) Shear stress
    - (d) None of the above

5. What is the polar moment of inertia (in cm^4) for a solid circular shaft of radius 10 cm?
    - (a) 7850
    - (b) 15700
    - (c) 3925
    - (d) 18500

6. A circular shaft is subjected to a twisting moment T and bending moment M. The ratio of maximum bending stress to maximum shear stress is given by
    - (a) 2M/T
    - (b) M/T
    - (c) 2T/M
    - (d) M2T

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Design of Steel Structures

"Shoot for the Moon. Even if you miss, you will land among the Stars."

Les Brown

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7 The slope deflection method is
    (a)   Deformation method   (b)   Force Method
    (c)   Matrix method   (d)   None of the above

8 In moment distribution method, the unbalanced moment at a joint is distributed to members
    (a)   In proportion to the stiffness of members meeting at joint   (b)   In proportion to stiffness of all the members of structure
    (c)   In proportion to the fixed end moments   (d)   In proportion to ratio of spans

9 In moment distribution method, at simple end support
    (a)   Moments are considered   (b)   Fixed end moments are balanced to zero and no further carry - over moments
    (c)   Procedure is same as fixed end   (d)   Only distribution factors are changed

10 If the actual beam has fixed end, the corresponding condition of Conjugate beam will be
    (a)   Simply supported end   (b)   Free end
    (c)   Fixed end   (d)   Internal hinge

11 In slope deflection method, the equations are expressing the moments at any joint in terms of
    (a)   Beam end moments   (b)   Support moments
    (c)   Fixed end moments   (d)   Rotations and settlements of joints

12 In a cantilever beam loaded by point load at its free end, the slope at free end will be
    (a)   Zero   (b)   Maximum
    (c)   Minimum   (d)   Neither zero nor maximum

13 The first derivative of deflection at any point on a beam defines
    (a)   Slope of the beam   (b)   Bending moment of beam
    (c)   Shear force of the beam   (d)   Load intensity of beam

14. Macaulay's method is particularly suitable for beams subjected to_____ loads.
    (a)   Point   (b)   Distributed
    (c)   Varying   (d)   None of the above

15 The deflection of a point in the real beam numerically equal to the shear force at the corresponding point in the conjugate beam". This theorem is used for analysis of beams in which of the following methods?
    (a)   Castigliano's method   (b)   Moment area method
    (c)   Conjugate beam method   (d)   None of the above

13. (d) A very common type of stress that causes dilation is known as hydrostatic stress

14. (d) SI unit of stress is KN/mm^2

15. (a) Property of material to resist fracture under tensile loading is called tenacity.

Chapter - 2 Hooke's Law

1. (c) Linear strain is strain induced in dimension in the direction of Load. The ratio of axial deformation to the original length of the body is known as linear strain.

2. (b) Poisson's ratio is the ratio of lateral strain to longitudinal strain in direction of Stretching force.
   Here
   compressive deformation considers negative $(-)$
   Tensile deformation considers Positive $(+)$.

3. (d) Orthogonal to each other
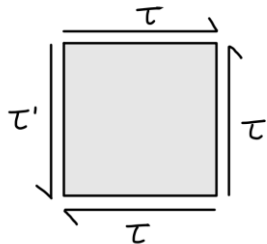
   Consider rectangular block, we consider set of shear strees(τ) of same intensity acting over the rest of two opposite surfaces of rectangular block.

4. (d) Lateral strain α longitudinal strain
   Poisson's ratio $(\mu) = \left| \frac{-(\text{Lateral strain})}{\text{longitudinal strain}} \right|$

5. (a) When a uniform element is subjected to equal stresses in the mutually perpendicular direction then, the ration of direct stress to volumetric strain is called "Bulk Modulus".
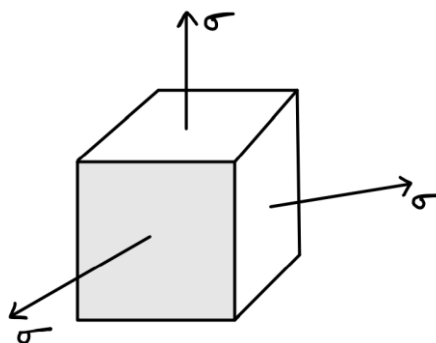
22. (c) Elongation of part-1 $\delta_1 = \dfrac{PL}{A_1 E}$

Elongation of part-2 $\delta_2 = \dfrac{PL}{A_2 E}$
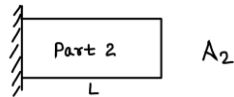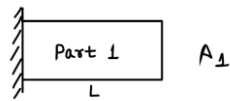
$A_1 = 2A_2$ (given in equation)

$\dfrac{\delta_1}{\delta_2} = \dfrac{PL}{2A_2 E} \Big/ \dfrac{PL}{A_2 E}$

$\dfrac{\delta_1}{\delta_2} = \dfrac{1}{2}$

23. (d) Weight per unit length of rod be $W = mg$

Mass of $(L - Y)$ part $= m(L - Y)$
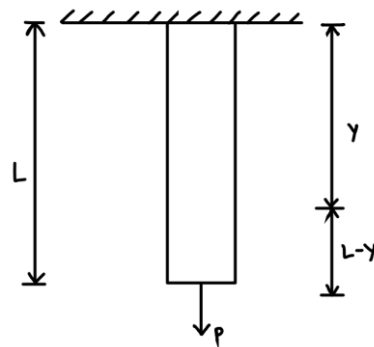
Total force = force due to $(L - Y)$ part + force due to P

$= mg(L - y) + P$

Tensile force $= P + W(L - Y)$

24. (a) Given data

$E = 2G$

using relationship equation

$E = 2G(1 + \mu) \ldots (i)$

Put value E in equation (i)

$\mu = 0$

$E = 3k(1 - 2\mu)$

$k = E/3$

25. (b) Given data

Diameter of bar $= 80$ mm

Length of bar $= 800$ mm

Axial load $= 200$kN

Axial elongation $= 0.30$ mm

Decrease in diameter $= 0.01$ mm

5. (c) Using relationship equation between shear force and bending moment.

$$F = \frac{dm}{dx}$$

rate of change of bending moment will give shear force.

8. (c)
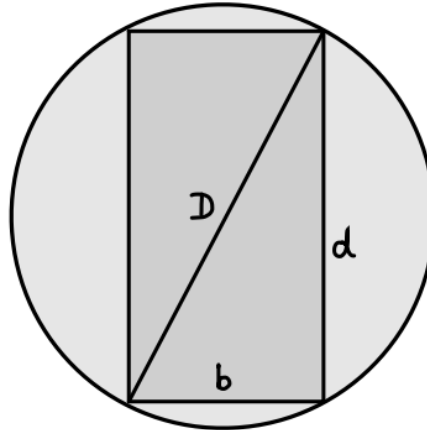
Z circular at NA $= \frac{\pi}{32} d^4$

Z Rectangular at NA $= \frac{(bd^2)}{6}$

For strongest cross section

$Z_{NA} = \frac{1}{6} bd^2$ (here, $D^2 = b^2 + d^2$, $d^2 = D^2 - b^2$)

$\quad = \frac{1}{6} b(D^2 - b^2)$

$\frac{dZ}{db} = 0$

$[1(D^2 - b^2) - 2b \times b]$

$D^2 - b^2 - 2 b^2 = 0$

$D^2 = 3 b^2$

$b = D/\sqrt{3}$

10. (c) Bending equation $\frac{M}{1} = \frac{\sigma}{y} = \frac{E}{R}$

$R = \frac{EI}{M}$

$\frac{1}{R} = \frac{M}{EI}$ ... (i)   where, R = Radius of curvature

$\therefore \frac{1}{R} = \frac{d^2 y}{dx^2}$ .... (ii)

Put equation (ii) in (i)

$\frac{M}{EI} = \frac{d^2y}{dx^2}$

$M = El\dfrac{d^2y}{dx^2}$

11. (a) If magnitude of shear force is constant, then the magnitude of the slope of Bending moment curve is zero.

New Batches are going to start.....

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Test Series Available..

Total weekly test   : 35

Total mid subject test   : 16

Total full length test   : 13

Mock test   : 16

Total test   : 80

17. (d) The neutral axis shift towards the flange of T-beam. Hence the bottom most portion or web is more distant than the top most portion of the flange.

As we know that bending stress given by

$\sigma = \dfrac{M}{I} y$

For particular loading and beam c/s M and I constant

$\therefore \ \sigma \ \alpha \ y$

since y increase of bottom most protion of T beam is more, hence bending stress will be maximum here. It may noted that bottom most portion of T beam will be in compression and top most portion will be in tension

Chapter - 4 Complex Stress & Strain

1. (a) At any Point in a stressed body, the principal planes can be located by identifying set of Orthogonal planes passing through the point and having shear stress on it as zero.

2. (b)
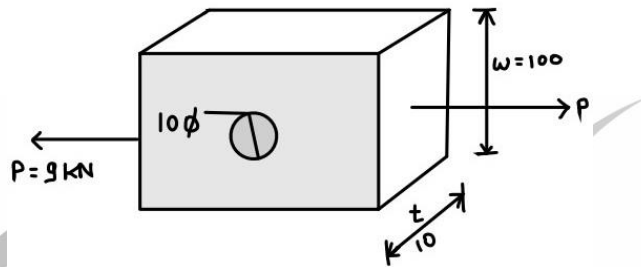
$K_t = \dfrac{\sigma_{max}}{\sigma_{normal}}$

Where,

$K_t = 1 + \dfrac{2a}{b}$

For Circular $a = b$, $K_t = 3$

$3 = \dfrac{\sigma_{max}}{\sigma_{normal}}$

$\sigma_{max} = 3\sigma_{normal}$

$= 3 \times \dfrac{p}{(W-d)t} = \dfrac{3 \times 9 \times 10^3}{(100-10)10} = 30 \ N/mm^2$

3. (b)
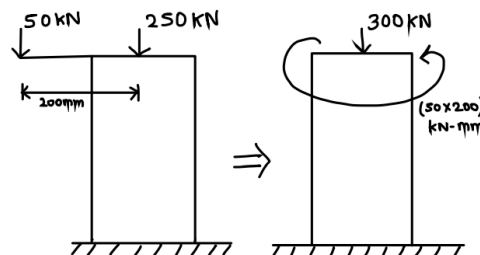
$\sigma_a = \dfrac{P}{A}$

$= \dfrac{300 \times 10^3}{30000}$

Chapter - 5 Bending Stress in Beams

3. (a) 3 Given data
    Cross sectional area $= 100 \times 200 \text{ mm}^2$
    moment $= 20 \text{kNm}$
    Maximum bending stress $\sigma_b = \dfrac{M}{I} y \left(\because \dfrac{I}{y} = \dfrac{bd^2}{6} \right)$
    $= (20 \times 10^3 \times 10^3)/(6 \times 100 \times 200^2)$
    $= 30 \text{ N/mm}^2$

4. (c) Theory of simple bending is derived for the condition when beam is subjected to bending moments only.

5. (c) Maximum bending stress $= 32M/\pi d^3$ ... (i)
    Maximum shear stress $= 16\,T/\pi d^3$ ... (ii)
    Ratio of (i) and (ii) $= \dfrac{2M}{T}$

8. (b) Let $d =$ diameter of circular cross section
    $a =$ side of square
    σ_b for circular c/s,
    $\sigma_b = \dfrac{M}{Z} = \dfrac{32M}{\pi d^2}$
    here $\dfrac{\pi}{4} d^2 = a^2$ (given)
    σ_b for square c/s
    $\sigma_b = \dfrac{M}{Z} = \dfrac{6M}{a^3}$
    $\dfrac{(\sigma_b) \text{ circular cross section}}{(\sigma_b) \text{ square cross section}} = \dfrac{\frac{32M}{\pi d^3}}{\frac{6M}{a^3}}$ ..... (i)
    Put given value in eqution (i)
    σ_b for circular cross section $> \sigma_p$ for square cross section

9. (b) Only the maximum bending stress will remain unaltered.

11. (b) The shape of bending stress diagram across given c/s is linear with maximum values at top and bottom edge.

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6. (a) Max. bending stress $= \frac{32M}{\pi d^3}$ ... (i)

    Max. shear stress $= \frac{16T}{\pi d^3}$ ... (ii)

    Ratio of (i) and (ii) $= \frac{2M}{T}$

7. (a) Angle of twist at A will be equal to twist at B, because there is no torque between A and B.

    $\theta_B = \frac{TL}{2GJ}$

    $\theta_A = \sum \frac{TL}{GJ} = \frac{TL}{2GJ} + 0 = \frac{TL}{2GJ}$

8. (d) **Helicoidal surface:**
    Brittle materials fail in plane $45°$ from axis when subjected to torque because they are weak in tension compare to shear. If ductile material is subjected to torque, then the failure surface will be in plane at $90°$ from the axis of shaft.

9. (a) Maximum normal stress is zero and only shear stress will occur.

Chapter - 8 Theory of Failure

1. (b) According to maximum shear stress theory yielding occur when maximum shear stress just exceeds the shear stress at tensile yield point. At the tensile yield $\sigma_2 = \sigma_3 = 0$ and thus maximum shear stress is $\frac{\sigma_y}{2}$.
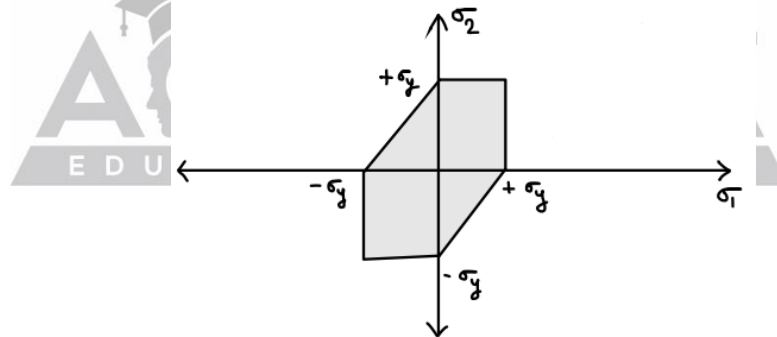
2. (a) For ductile material the most appropriate failure theory is maximum shear stress theory.

Chapter - 9 Thin Cylinder

1 (a) Circumferential stress $(\sigma_h) = \frac{pd}{2t}$

    Longitudinal stress $(\sigma_L) = \frac{pd}{4t}$

    $\sigma_L = \frac{1}{2} \sigma_h$

STRUCTURAL ANALYSIS

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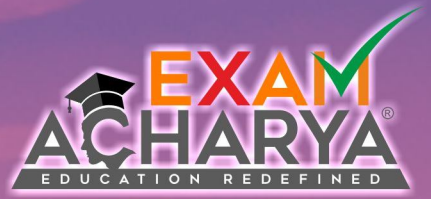
Excellence is a Continuous Process and an Accident.

A.P.J. Abdul Kalam

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5. A statically indeterminate structure is the one which:
    (a) Cannot be analyzed at all   (b) Can be analyzed using equation
                                              of statics only
    (c) Can be analyzed using equations (d) Can be analyzed using equations
        of statics and compatibility   of compatibility only
        equations

6. For a linear elastic structural analysis system, minimization of potential
    energy yields
    (a) Compatibility condition   (b) Constitutive relations
    (c) Equilibrium equations   (d) Strain-displacement relations

Chapter 2: Analysis of Truss

1. If a plane truss satisfies the condition m = 2 j −3, where m is number of
    member and j is number of joints, then it is
    (a) Determinate internally   (b) Determinate externally
    (c) Indeterminate internally   (d) Indeterminate externally

2. If in a Pin jointed plane frame $(m + r) > 2j$, then the frame is
    (a) Stable and statically   (b) Stable and statically determinate
        indeterminate
    (c) Unstable   (d) Unstable and statically
                                              indeterminate

3. Vertical reactions at the supports for the given truss are:
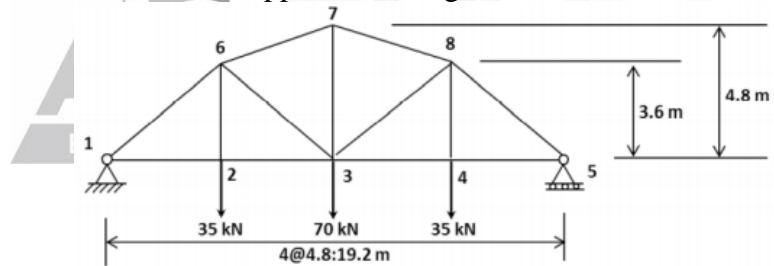
    (a) 35kN, 35kN   (b) 35kN, 70kN
    (c) 70kN, 70kN   (d) 70kN, 35kN

4. The force in member 2 − 5 in the truss show in figure is
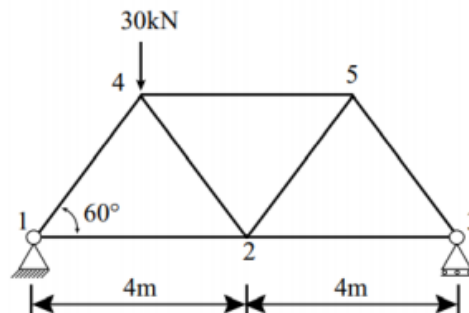
    (a) 22.5kN compression   (b) 7.5kN tension
    (c) 8.66kN compression   (d) 8.66kN tension

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4. Unit load method is based on
    (a) Internal strain energy
    (b) Theorem of minimum potential energy
    (c) Theorem of minimum deflection
    (d) Castigliano's theorem

5. Deflection of simply supported beam at midspan under a concentrated load is
    (a) $\dfrac{WL^3}{48EI}$
    (b) $\dfrac{WL^2}{8EI}$
    (c) $\dfrac{WL^3}{3EI}$
    (d) $\dfrac{WL^3}{96EI}$

6. The Castigliano's second theorem can be used to compute deflections
    (a) In statically determinate structure only
    (b) For any type of structure
    (c) At point load under the load only
    (d) For beam and frames only

7. The ratio of maximum deflection of a cantilever beam of span "l" with
    (i) a load "W" at the free end and
    (ii) a uniformly distributed load over entire length of total "W" is given by
    (a) $\dfrac{8}{5}$
    (b) $\dfrac{8}{3}$
    (c) $\dfrac{3}{8}$
    (d) $\dfrac{5}{8}$

8. The Clapeyron's theorem is used for analysis of_____
    (a) Two hinged arch
    (b) Fixed beam
    (c) Continuous beam
    (d) thin cylinders

9. Which one of the following is a force method of structural analysis?
    (a) Slope deflection method
    (b) Kani's method
    (c) Moment distribution method
    (d) Strain energy method

Chapter 4: Method of Structural Analysis

1. Slope deflection method is suitable for analysis of
    (a) Continuous beam
    (b) Simply supported beam
    (c) Fixed beam
    (d) Cantilever beam

2. For the beam of span L, carrying UVL as shown in figure, the maximum bending moment is
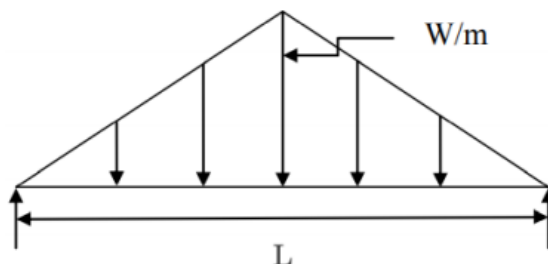
Chapter 6: Influence Line Diagram

1. The maximum bending moment due to a train of wheel loads on a simply supported girder
   (a) Always occurs at centre of span
   (b) Always occurs under a wheel load
   (c) Never occurs under a wheel load
   (d) None of the above

2. Influence line Diagram for redundant structures can be obtained by
   (a) Castigliano's Theorem
   (b) Muller-Breslau Principle
   (c) Unit Load Theorem
   (d) All of the above

3. A single rolling load of 8 kN rolls along a girder of 15 m span. The absolute maximum bending moment will be?
   (a) $8 \text{ kN} - \text{m}$
   (b) $15 \text{ kN} - \text{m}$
   (c) $30 \text{ kN} - \text{m}$
   (d) $60 \text{ kN} - \text{m}$

4. Muller-Breslau principle is applicable to get influence line for which one of the following?
   (a) Reaction at ends of a simple beam
   (b) Bending moment at a section
   (c) Shear force at a section
   (d) Force and moments at any section

Chapter 7: Matrix Method

1. Flexibility method is also called as:
   (1) force method
   (2) compatibility method
   (3) consistent deformation method
   (a) Only 1
   (b) 1 and 2
   (c) 1 and 3
   (d) 1, 2 and 3

2. For a linear elastic frame, if stiffness matrix is double with respect to the existing stiffness matrix, the deflection of the resulting frame will be
   (a) Twice the existing value
   (b) Half the existing value
   (c) The same as existing value
   (d) Indeterminate value

3. Stiffness method is known as
   (a) Equilibrium method
   (b) Compatibility method
   (c) Consistent deformation
   (d) Portal method

Chapter: 3 Energy Theorem

1. (d) In redundant structure, we will not be able to apply Unit load method.

2. (c) Statistically indeterminate beam can be solved by displacement method, energy method, matrix method etc.

3. (c) Maximum deflection at mid-span of a simply supported beam with UDL is $\frac{5WL^4}{384EI}$

4. (a) Unit load method is based on internal strain energy.

5. (a) Deflection of simply supported beam at midspan under a concentrated load is $= \frac{WL^3}{48EI}$

6. (b) The Castigliano's second theorem can be used to compute deflections for any type of structure.

7. (b) $\dfrac{\delta max_{Concentrated\ load}}{\delta max_{UDL}} = \dfrac{\frac{Wl^3}{3EI}}{\frac{Wl^3}{8EI}} = \dfrac{8}{3}$

8. (c) The Clapeyron's theorem is used for analysis of continuous beam.

9. (d) Strain energy method is a force method of structural analysis.

Chapter: 4 Method of Structural Analysis

1. (a) Slope deflection method is suitable for analysis of Continuous beam.

2. (b) For the beam of span L, carrying UVL, the maximum bending moment is $M_{max} = \frac{WL^2}{12}$

3. (a) For a cantilever beam of span L carrying uniformly distributed load, W on its entire span, the maximum bending moment is $M_{max} = \frac{WL^2}{2}$

5. (c) The point of contraflexure occurs in overhanging.
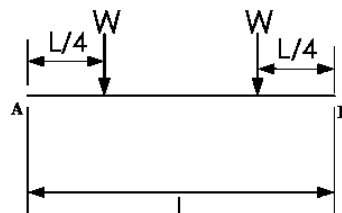
7. (d)

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STEEL STRUCTURE

10. As per IS: 800, the splice connection should be designed for a force of atleast k times the member design capacity in tension. Here the value of k is
    (a) 0.3   (b) 0.4
    (c) 0.5   (d) 0.6

11. What is the partial safety factor for dead load when it contributes to the stability of the structure against overturning?
    (a) 1   (b) 1.5
    (c) 1.2   (d) 0.9

12. Stainless steel resist corrosion due to presence of
    (a) Carbon   (b) Manganese
    (c) Chromium   (d) Sulphur

13 The permissible stress in axial tension in steel member on the net effective area of the section shall not exceed the following value (Note: f_y is the yield stress)
    (a) $0.80f_y$ (b) $0.75f_y$
    (c) $0.60f_y$ (d) $0.50f_y$

14. As per IS 800: 1984, the permissble stress in axial tension in the net effective area of the section shall not exceed_____ (where, f_y is minimum yield stress in steel in N/mm^2)
    (a) $0.85f_y$ (b) 1.15 fy
    (c) 0.65fy   (d) 0.6fy

15. The magnitude of tensile and compressive residual stress in rolled sections may reach
    (a) 0.2fy & 0.8fy   (b) 0.3fy & 0.5fy
    (c) 0.4fy & 0.5fy   (d) 0.3fy & 0.6fy

16. The coefficient of thermal expansion for steel is taken as
    (a) $12 \times 10^{-6}/°C$ (b) $0.12 \times 10^{-6}/°C$
    (c) $1.2 \times 10^{-6}/°C$ (d) $0.012 \times 10^{-6}/°C$

17. ISJB means_____
    (a) Indian standard Joist Beam   (b) Indian Standard Joint beam
    (c) Indian standard Junior Beam   (d) Indian standard Junction Beam

18. A TMT bars has _____ than normal HYSD bars
    (a) Lower ductility   (b) Higher ductility
    (c) Lower toughness   (d) Higher magnesia content

19. Cast iron has
    (a) Good weldability   (b) Good magnetizing characteristics
    (c) High compression resistance but weak in tension   (d) Very high ductility

Chapter - 4 Design of Compression Member

1. In case of industrial steel structure sag rods are designed as_____

    (a) Torsional member   (b) Compression member
    (c) Bending member   (d) Tension member

2. For a tension member, the design shear capacity of bolts carrying shear through packing plate in excess of 6 mm shall be decreased by a factor of (note: t_{pk} is the thickness of the thicker packing plate)
    (a) $1\text{-}0.125t_{pK}$ (b) $1-0.0125\,t_{pK}$
    (c) $1-0.250t_{pK}$ (d) $1-0.0250\,t_{pK}$

3. Which one of the following is not a factor considered for calculating the net effective area of a tension member?
    (a) Ductility factor   (b) Geometry factor
    (c) Shear lag factor   (d) Buckling factor

4. The tension member can fail due to
    (a) Yielding of gross section   (b) Rupture of critical section

    (c) Block shear   (d) All of the above.

5. A tension splice section is designed for
    (a) Maximum factored tensile load   (b) Design strength of the tension member
    (c) Maximum service load   (d) Maximum of factored tensile load and 0.3 times the design strength of tension member

Chapter - 5 Design of Compression Member

1. What is the value of maximum effective slenderness ratio (KL/r) for a compression flange of beam against lateral torsional buckling
    (a) 180   (b) 250
    (c) 300   (d) 350

2. What is the value of maximum effective slenderness ratio (KL/r) for a member carrying compression loads resulting from dead loads and imposed loads only
    (a) 180   (b) 250
    (c) 300   (d) 350

3. What is the Buckling class for hollow cold formed section as per IS: 800-2007?
    (a) Buckling class a   (b) Buckling class b
    (c) Buckling class c   (d) Buckling class d

8. According to IS: 800 − 1994, lacing bars should resist a transverse shear equal to _____ of the axial load in the member.
   (a) 2.5%   (b) 5%
   (c) 7.5%   (d) 10%

Chapter - 7 Design of Battening

1. To account for shear deformation effect in battened columns, the ratio of effective slenderness ratio $(kL/r)_e$ to the maximum actual slenderness ratio $(KL/r)_0$ of column is to be considered as

   (a) More than 1   (b) 1.0
   (c) 0.5   (d) 0.1

2. The thickness of battens shall be
   (a) 1/10 th of effective length of batten   (b) 1/15 th of effective length of batten
   (c) 1/10 th of the distance between the innermost connecting lines of rivets, bolt or welds   (d) 1/15 th of the distance between the innermost connecting lines of rivets, bolt or welds

3. Battens provided for a compression member shall be designed to carry a transverse shear force equal to
   (a) 2.5% of axial force in the member   (b) 5% of axial force in the member
   (c) 10% of axial force in the member   (d) 12.5% of axial force in the member

4. For battened struts the effective lengths will be increased by
   (a) 10%   (b) 12%
   (c) 14%   (d) 8%

Chapter - 8 Design of Purlins

1. In industrial roofs, purlins are designed as
   (a) Axial member   (b) Compression member
   (c) Bending member   (d) Tension member

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Environmental Engineering

18. The problem of web-crippling in beams is significant when
    (i) Web is weak under concentrated loads
    (ii) There is too much flexural moment
    (iii) Compression flange is weak
    (a) Only (i)   (b) Only (ii)
    (c) (i), (ii)   (d) (i), (ii) and (iii)

19. To prevent local buckling in Plate girders, the horizontal stiffeners are provided
    (a) At a distance 0.2 times the depth   (b) At a distance 0.2 times the depth
         of web from compression end   of web from tension end
    (c) At a distance 0.4 times the depth   (d) At a distance 0.4 times the depth
         of web from compression end   of web from tension end

20. Which of the following types of failure is more prone to take place when web of the plate girder is made too thick?
    (a) Local buckling   (b) Shear buckling
    (c) Flexural buckling   (d) Shear yielding

21. Gantry girders are designed for which of the following types of loads?
        (i)   Gravity loads
        (ii)   Lateral Loads
        (iii)   Wind loads
        (iv)   Longitudinal Loads
    (a) (i) and (ii)   (b) (i), (ii) and (iv)
    (c) (i), (iii) and (iv)   (d) (i), (ii), (iii) and (iv)
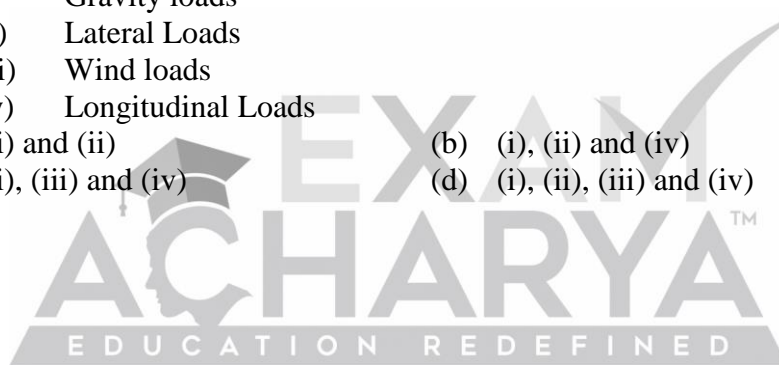
4.   (c)   A beam width a series of regular opening in its web is called castellated beam.

5.   (c)   The prying forces are additional tensile forces due to the flexibility of connected parts leading to deformation.

6.   (c)   Connections subjected to small end moments and large end shear are called light moment connections or clip angle connections.

7.   (c)   To transfer large shear force through connection, sttifened seated connection is suitable.

8.   (b)   The upper yield point in the stress-strain curve in structural steel can be avoided by hot working.

9.   (b)   For a moment resisting frame building without brick infill panels. Ta (fundamental natural period) may be estimated by the empirical expression. $Ta = 0.075\, h^{0.75}$ for RC frame building
$Ta = 0.085\, h^{0.75}$ for steel frame building

10. (a)   As per IS specification splice connection should be designed for a force of at least 0.3 times the member design capacity in tension or the design action, which ever is more.

11. (d)   Partial safety factor for dead load is 0.9, when it contributes to the stability of the structure against overturning.

12. (c)   Chromium

13. (c) $0.60\, F_y$

14. (d) $0.60 F_y$

15. (b)   Magnitude of tensile residual stress $= 0.3 f_y$
Compressive residual stress $= 0.5\, f_y$

16. (a)   The coefficient of thermal expansion for steel is taken as $12 \times 10^{-6}/\,^\circ C$

17. (c)   ISJB: Indian Standard Junior Beam.

18. (b)   Higher Ductility TMT bars have a stronger external layer when compared with HYSD due to ductile microstructure at the centre and hard crystalline outside surface of TMT steel.

19. (c)   Cast iron has higher compressive strength.

20. (c)   2.5% of factored dead load + Vertical imposed load

21. (d)

Nominal diameter of bolt (mm)	Clearance (mm)
12-14	+1
16-24	+2
>24	+3

7. (d) The design compressive stress of axially loaded compression member in IS: 800 is given by Perry Robertson formula.

8. (d) 350

9. (b) The mean compressive stress of buckling is given by
$$f_{cr} = \frac{Pcr}{A} = \frac{\pi^2 EI}{AL^2} = \frac{\pi^2 E}{AL^2} Ar^2 = \frac{\pi^2 E}{(L/r)^2} = \frac{\pi^2 E}{\lambda^2}$$
where, $\lambda = L/r$ slenderness ratio.

10. (d) 2.0L

11. (d) The allowable slenderness ratio of the elements in built up section is 50.

12. (b) Strut is a compression member used in roof truss.

13 (d) IS: $800 - 2007$ limits the values of width to thickness ratio of the elements of a steel section to place a check on local buckling.

19. (b) Compact or class II sections are cross sections which can develop plastic moment resistance, but have inadequate plastic hinge rotation capacity because of local buckling.

20. (c) Flexural buckling

21. (b) The buckling resistance of stiffener is found by considering it as strut.

22. (a) Intermediate transverse web stiffener provided to improve the buckling strength of a slender web due to shear.

24. (d) Splices for a compression member are designed as short column.

Chapter - 6 Design of Lacing

1. (d) The effective slenderness ratio of laced column is taken as 5% more than the actual maximum slenderness ratio. This provision takes care of shear deformation.

3. (c) Lacing bar shall be inclined at an angle which should be between $40^0 - 70°$

6. (b) For single lacing system $t \not< \frac{L}{40}$
For double lacing system $t \not< L/60$

19. (a) To prevent local buckling in plate girders, the horizontal stiffeners are provided at a distance 0.2 times the depth of web from compression end.

21. (b) Gantry girders are designed for
    (i) Gravity loads.
    (ii) Lateral loads.
    (iii) Longitudinal loads.

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Total test   : 80

16. According to IS 456 – 2000, the maximum size of coarse aggregate is_____ times the minimum thickness of the member.
    (a) One fourth
    (b) One half
    (c) One third
    (d) One sixth

17. As per IS 456, if the surface of reinforced concrete member lies in tidal zone, it will be under _____ exposure condition.
    (a) Severe
    (b) Extreme
    (c) Moderate
    (d) Very severe

18. As per IS 456, minimum cement content in reinforced concrete section under mild exposure conditions is
    (a) 200kg per cubic meter
    (b) 250kg per cubic meter
    (c) 300kg per cubic meter
    (d) 350kg per cubic meter

19. The characteristic strength is the strength of material below which not more than_____ of the test result are expected to fall
    (a) 5%
    (b) 10%
    (c) 7%
    (d) 3%

20. The horizontal distance between two parallel main reinforcing bars shall not be less than
    (a) The diameter of bar
    (b) The diameter of larger bar
    (c) 5mm more than maximum size of coarse aggregate
    (d) The greatest of above

21. Which is a correct formula for characteristic strength (F_{ck}) where F_m is mean strength and σ is standard deviation?
    (a) $F_{ck} = F_m + 1.55\sigma$
    (b) $F_{ck} = F_m + 1.65\sigma$
    (c) $F_{ck} = F_m + 1.75\sigma$
    (d) $F_{ck} = F_m + 1.85\sigma$

22. The limiting tensile strain in reinforced concrete is
    (a) 0.0002
    (b) 0.0035
    (c) $0.002 + fy/(1.15Es)$
    (d) $0.0002 + 0.0035$

23. Design compressive stress in concrete, for collapse in flexure, is taken as
    (a) $0.77\ f_{ck}$
    (b) $0.67\ f_{ck}$
    (c) $0.55\ f_{ck}$
    (d) $0.45\ f_{ck}$

24. The factor of safety for flexural compression in case of working stress method is
    (a) 1.5
    (b) 2
    (c) 3
    (d) 3.5

25. In limit state method, the failure criterion for reinforced concrete beam and column is based on
    (a) Maximum principal stress theory
    (b) Maximum principal strain theory
    (c) Maximum shear stress theory
    (d) Maximum normal stress theory

10. Maximum spacing of vertical stirrups permitted in RC beam having depth D is_____

   (a) 0.75D   (b) 2.0D

   (c) 0.5D   (d) 0.25D

Chapter - 4 Slab

1. Minimum percentage of steel reinforcement for HYSD bars in walls, slabs and roofs of water retaining concrete structure as specified by Indian Standards is

   (a) 0.2%   (b) 0.24%

   (c) 0.40%   (d) 0.12%

2. Minimum percentage of steel reinforcement to be provided in design of reinforced concrete slab in terms of cross-sectional area is

   (a) 0.20%   (b) 0.15%

   (c) 0.12%   (d) 0.25%

3. According to IS:456-2000, the minimum diameter of reinforcing bars shall not exceeds

   (a) One-fourth of the total thickness of the slab   (b) One-sixth of total thickness of the slab

   (c) One-eight of the total thickness of the slab   (d) One-tenth of the total thickness of the slab

4. According to IS:456-2000, the HYSD reinforcement in either direction of the slab shall not be less than

   (a) 0.10% of the total cross-sectional area   (b) 0.12% of the total cross-sectional area

   (c) 0.15% of the total cross-sectional area   (d) 0.20% of the total cross-sectional area

Chapter - 5 Footing

1. In design of isolated RC footing, the critical section for two-way shear is considered at a distance of _____from the face of column / pedestal

   (a) d/2   (b) d

   (c) d/3   (d) 2d

2. Two-way shear in a RCC footing is checked at a distance equal to_____of the footing from the face of the column.

   (a) One-fourth of the effective depth   (b) One-half of the effective depth

   (c) Three-fourth of the effective depth   (d) The effective depth

3. The minimum cover prescribed in the code for flexural reinforcement in all footings

   (a) 75mm   (b) 40mm

   (c) 50mm   (d) 60mm

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Very severe	50
Extreme	75

2. (d) For designing purpose the tensile strength of concrete is neglected.

3. (a) In Amendment No. 4 - May 2013, Classificution of concrete has been changed. M60 grade has been shifted to standard concrete and from grades M85 to M100 are added to high strength concrete. In note to M55 is replaced with M60

4. (b) The initial tangent modulus E_C in N/mm^2 is estimated from
$$E_C = 5000\sqrt{f_{ck}}$$
Where f_{ck} = characteristic compressive strength of concrete at 28 days. The initial tangent modulus E_C is also known as short term static modulus of elasticity of concrete in N/mm^2 and is used to calculate the elastic deflections.

5. (d) The lap length of a direct tension reinforcement bar in a RCC beams should be more than twice the development length or 30 times the diameter of the bar.

6. (d) As per IS:456-2000, clause No.26.3.3, The horizontal distance between parallel reinforcement bars provided against shrinkage and temperature shall not be more than five times the effective depth of a solid slab or 450mm, which ever is smaller.

7. (c) As per IS: $456 - 2000$; clause No. 38.1. The mximum strain in concrete at the outermost compression fibre is taken as 0.0035 in bending.

8. (b) As per IS: $456 - 2000$. Table No. 5, states that the minimum grade of concrete for reinforced concrete construction in moderate exposure condition is M25.

9. (b) The structures adjacent to the joint should preferably be supported on separate columns or walls but not necessarily on separate foundation. Expansion joint should be completely clear, reinforcement should not extend across expansion joint. Normally, structures exceeding 45mm in length are designed with one or more expansion joints.

10. (a) As per IS: $456 - 2000$, clause no. 8.2.8, concrete in sea-water or exposed directly along the sea-coast shall be at least M20 grade in the case of plain concrete and M30 in case of reinforced concrete. The use of slag or pozzolana cement is advantageous under such conditions.

11. (a) The maximum compressive strain in concrete in axial compression is taken as 0.002.

12. (b) In LSM, spacing of reinforcement controls primarily cracking. Unequal top and bottom reinforcement in a RCC section leads to creep deflection.

6. (b) As per IS: 456-2000 Clause No. 26.4.2.1, for a longitudinal reinforcing bar in a column nominal cover shall in any case not be less than 40mm or less than the diameter of such bar.

7. (c) As per IS:456-2000, a concrete column may be considered as short when its slenderness ratio is less than 12.

i.e., $\frac{leff}{b} < 12$ for short column

$\frac{leff}{b} > 12$ for long column

Chapter – 7 Prestressed Concrete

1. (a) Loss due to elastic shortening of concrete occurs in pre tensioning.

2. (b) For pre-tensioned $\rightarrow$ M40
    For post-tensioning $\rightarrow$ M30

3. (b) Given, initial stress = 140 N/mm^2
    $E = 2 \times 10^5$ N/mm^2
    Initial strain, $\varepsilon = \frac{\sigma}{E} = \frac{140}{2 \times 10^5} = 0.007$

5. (c) High tensile steel are commonly used in pre stressed concrete members and ultimate strength of high tensile steel is equal to $2100 N/mm^2$.

Chapter – 8 Retaining Wall

1. (b) Minimum reinforcement
    Mild steel bar 0.15%
    HYSD bar 0.12%

2. (b) Normally counter forts in a retaining wall spaced at an interval of $\frac{1}{3}$ to $\frac{1}{2}$ of the height of the wall.

GPSC - CIVIL

Fluid Mechanics
and
Hydraulic Machines

Chapter - 4 Critical Path Method

1. The full form of acronym CPM is:
   (a) Construction Project Method
   (b) Critical Project Method
   (c) Critical Path Method
   (d) Critical Program Method

2. The CPM network analysis is a_____ based method useful for_____
   (a) Activity, research and development projects
   (b) Event, construction projects
   (c) Event, research and development projects
   (d) Activity, construction projects

3. In CPM and PERT methods activities are connected with each other in_____
   (a) finish-to-start manner
   (b) overlapping manner
   (c) partially finish-to-start and partially overlapping manner
   (d) random manner

4. Precedence Network Analysis (PNA) method of network analysis better addresses the real-life situation in a construction project than CPM because
   (a) It is very precise
   (b) It is independent of activities
   (c) It does not allow overlapping of activities
   (d) It allows overlapping of activities

5. The type of float which give an idea about the excess time that exists if the preceding activity ends as late as possible and the succeeding activity starts as early as possible
   (a) Total float
   (b) Free float
   (c) Independent float
   (d) Slack

6. Which one of the following statements is correct for every activity in a network?
   (a) Interference float can never be negative
   (b) Independent float can exceed free float
   (c) Total float can exceed free float
   (d) Interference float and independent float may be equal to each other in magnitude

7. Latest start of an activity is always
   (a) Greater than or equal to latest event time of preceding node
   (b) Less than or equal to latest event time of preceding node
   (c) Equal to latest event time of preceding node
   (d) Less than latest event time of preceding node

8. Float may be defined as the difference between
   (a) Latest start time and the earliest start time
   (b) Latest finish time and the earliest finish time
   (c) Time available and the time required to complete the activity
   (d) All of the above

2. The order of following basic causes of accidents in civil engineering works starting from less severe to more severe is:
(i) persons being trapped or struck by moving objects
(ii) persons/material falling from height
(iii) persons stepping on or striking against objects
(a) i − ii – iii   (b) iii −i − ii
(c) iii - ii – i   (d) ii – i − iii

3. For an earthwork, if B is formation width, s is the side slope, L is the length of the section and d be the height of the embankment, then quantity of earthwork can be given
(a) $(Bd + Sd)L$ (b) $(B + s)dL$
(c) $(B + Sd)dL$ (d) $(B + Sd^2)dL$

4. The cement consumption per 100 sqm area for 12 mm thick plastering with cement mortar proportion of $(1:4)$ is
(a) 18 bags   (b) 15 bags
(c) 12 bags   (d) 9 bags

6. (c) (i) Interference float can be negative.
   (ii) Independent float cannot exceed free float.
   (iii) Total float can exceed free float.
   (iv) Interference float and independent float may not be equals to each other in magnitude.

7. (a) Latest start of an activity is always greater than or equal to latest event time of preceding node.

8. (d) The total amount of time that a schedule activity may be delayed from its early start date without delaying the project finish date, or violating a schedule constraint.

   Total Float $= LF - EF$ (or $LS - ES$)
   Where ES = Early Start
   EF = Early Finish
   LS = Late Start and
   LF = Late Finish

9. (b) Interfering float is the difference between total float and free float.

10. (d) Free float is measured by subtracting the early finish (EF) of the activity from the early start (ES) of the successor activity. Free float represents the amount of time that a schedule activity can be delayed without delaying the early start date of any immediate successor activity within the network path.

Chapter - 5 Crashing

1. (a) Cost slope of the direct cost curve is given by $\dfrac{\text{Crash cost} - \text{Normal cost}}{\text{Normal time} - \text{Crash time}}$

2. (a) In the time-cost optimization using CPM, the crashing of the activities along the critical path is done starting with the activity having least cost slope.

3. (a) Economic saving of time results by crashing cheapest critical activity.

Chapter - 6 Construction Equipments

1. (d) An excavator is defined as a power-operated digging machine and it includes different types like shovels, draglines, clamshells, backhoes, etc. Bulldozer, also called Dozer, powerful machine for pushing earth or rocks, used in road building, farming, construction, and wrecking.

2. (d) Grader is used mainly for finishing, shaping and trimming.

3. (a) Drag line excavator is most suitable for digging under water.

FLUID MECHANICS

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12. In a Newtonian fluid, shear stress is
    - (a) Constant with change in velocity gradient
    - (b) Directly proportional to velocity gradient
    - (c) Inversely proportional to velocity gradient
    - (d) None of the above

Chapter – 2 Pressure Measurement

1. Pascal-second is the unit of
   - (a) Pressure
   - (b) Kinematic viscosity
   - (c) Dynamic viscosity
   - (d) Surface tension

2. Which one of the following pressure units represent the least pressure
   - (a) Millibar
   - (b) mm of Hg
   - (c) N/mm^2
   - (d) Kgf/cm^2

3. Mercury is used in barometers because
   - (a) it is a perfect liquid
   - (b) its volume changes uniformly with temperature
   - (c) it is a liquid metal
   - (d) it gives less height of column for high pressure

4. "The pressure at any point in a fluid at rest has same magnitude in all the directions".This law is called
   - (a) Stokes' law
   - (b) Boyle's law
   - (c) Newtonian fluid law
   - (d) Pascal law

Chapter – 3 Hydrostatic Force and Buoyancy

1. The resultant hydrostatic force on a submerged body acts through a point known as
   - (a) Centre of pressure
   - (b) Centre of gravity
   - (c) Centre of buoyancy
   - (d) Metacentre

2. The point about which a floating body starts oscillating when the body is tilted is called:
   - (a) Centre of buoyancy
   - (b) Centre of gravity
   - (c) Centre of pressure
   - (d) Metacentre

3. For a submerged body, if the centre of buoyancy is above the centre of gravity, the equilibrium is called as
   - (a) Stable equilibrium
   - (b) Unstable equilibrium
   - (c) Neutral equilibrium
   - (d) Restoring equilibrium

4. A flow net analysis cannot be applied to
   (a) Fluid adjacent to boundary
   (b) Straight pipe flow
   (c) Straight channel flow
   (d) Gradually converging flow

5. Boarda's mouthpiece is a
   (a) Convergent mouthpiece
   (b) Divergent mouthpiece
   (c) Convergent-divergent mouthpiece
   (d) Internal mouthpiece

6. If the velocity pressure, density, etc change at a point with respect to time, the flow is called
   (a) uniform
   (b) compressible
   (c) unsteady
   (d) incompressible

7. What will be the circulation around rectangle defined by $x = 0, y = 0, x = 1, y = 1$ for a velocity field $u = x$ and $v = x + y$?
   (a) Infinity
   (b) 0
   (c) 1
   (d) 4

8. The equation of continuity in fluid mechanics
   (a) is a condition of equilibrium in the flow pattern
   (b) is an embodiment of the law of thermodynamics
   (c) is an embodiment of the law of conservation mass
   (d) Relates work and energy

9. In a steady flow, the velocities at points A and B, which were 100 cm apart, were 3 m/s and 6 m/s, respectively. If the velocity varies linearly between A and B, then what would he the convective acceleration at B?
   (a) 18 m/s^2
   (b) 9 m/s^2
   (c) 12 m/s^2
   (d) None of the above

10. At any point in flowing fluid, various flow characteristics which describes the behaviour of fluid in motion, do not change with time, the flow is called
    (a) Uniform flow
    (b) Non-uniform flow
    (c) Steady flow
    (d) Non steady flow

11. In a steady flow, if streamlines are parallel, there will be
    (a) No acceleration
    (b) Convective tangential acceleration
    (c) Convective normal acceleration
    (d) Both convective tangential and normal acceleration

12. A flow net is a graphical representation of stream lines and equipotential lines such that these lines
    (a) Intersect each other orthogonally curvilinear squares
    (b) Intersect each other at various different angles forming irregular-shaped nets
    (c) Indicate the direction and magnitude of vector
    (d) None of above

Chapter – 7 Flow Through Pipe

1. In water hammer in rigid pipe, the velocity of pressure wave in terms of bulk modulus (K) and density (ρ) can be obtained by

    (a) $\sqrt{\dfrac{\rho}{K}}$

    (b) $\dfrac{1}{\pi}\sqrt{\dfrac{\rho}{K}}$

    (c) $\dfrac{1}{\pi}\sqrt{\dfrac{K}{\rho}}$

    (d) $\sqrt{\dfrac{K}{\rho}}$

2. In a long pipeline flowing fluids, which of the followings is causing minor loss?
    (a) Pipe material
    (b) Pipe slope
    (c) Valves and Bends
    (d) D - W Friction factor

3. When the velocity distribution is uniform is over the cross-section, the correction factor for momentum is
    (a) 0
    (b) 1
    (c) 4/3
    (d) 2

4. The hydraulic jump always occurs from
    (a) below critical depth to above critical depth
    (b) above critical depth to below critical depth
    (c) below critical depth to above normal depth
    (d) above normal depth to below normal depth

5. The flow in channels is considered to be in transitional state if the Reynolds number is
    (a) less than 500
    (b) between 500 and 2000
    (c) between 2000 and 4000
    (d) greater than 4000

6. The height of hydraulic jump is equal to the
    (a) initial depth
    (b) conjugate depth
    (c) difference in the alternating depth
    (d) difference in the conjugate depth

7. Darcy Weisbach friction factor for headloss computation can be obtained from
    (a) Moody's diagram
    (b) Strange curve
    (c) specific energy diagram
    (d) Blench's curve

8. The momentum correction factor 'B' is used in account for
    (a) Change in direction of flow
    (b) Change in total energy
    (c) Non-uniform distribution of velocities at inlet and outlet section
    (d) Change in mass rate of flow

9. A line representing sum of pressure head and datum head is called
    (a) Energy grade
    (b) Total energy line
    (c) Hydraulic gradient line
    (d) Phreatic line

4. An irrigation canal has a steady discharge Q at a section where a cross regulation (gate) is provided for control purposes. If the gate of the regulator which is normally fully open is suddenly lowered down to a half open position then a rapidly varied unsteady flow result. In such a case, it would take the form of a
   - (a) +ve surge moving u/s and a -ve surge moving d/s
   - (b) +ve surge moving d/s and a -ve surge moving u/s
   - (c) +ve surge moving u/s and a +ve surge moving d/s
   - (d) -ve surge moving u/s and a -ve surge moving d/s

5. For a flow in channel having depth of flow greater than critical depth, the Froude's number will be
   - (a) Smaller than 1
   - (b) Greater than 1
   - (c) Equal to 1
   - (d) Equal to 0

6. The most economical section of a rectangular section is one which has hydraulic radius equal to
   - (a) One-third the depth of flow
   - (b) Half the depth of flow
   - (c) Two-third the depth of flow
   - (d) Depth of flow

7. If the Froude number of a hydraulic jump is 2.0, the jump can be classified as
   - (a) Undular jump
   - (b) Weak Jump
   - (c) Oscillating jump
   - (d) Steady jump

8. Hygrometer is used for estimating
   - (a) water vapour content of air
   - (b) water content of soil
   - (c) capillary potential of soil water
   - (d) specific gravity of a liquid

9. Type of Jump occurs for froude number F1 = 4.5 to 9.0
   - (a) Steady
   - (b) Strong
   - (c) Undular
   - (d) Oscillating

10. In open channel, the specific energy is
    - (a) The total energy per unit discharge
    - (b) The total energy measured above a horizontal datum
    - (c) The total energy measured with respect to the channel bottom which is taken as datum
    - (d) The kinetic energy plotted above the free surface

11. According to khosla theory, the exit gradient in the absence of downstream cut-off is
    - (a) Zero
    - (b) Unity
    - (c) Infinity
    - (d) Very large

12. The length of the hydraulic jump is found to be
    - (a) 10 to 15 times depth of jump
    - (b) 1 to 2 times depth of jump
    - (c) 5 to 7 times depth of jump
    - (d) Has no relation to the depth of jump

GPSC - CIVIL

Geo-technical and Foundation Engineering

7. Which of the following statement(s) is/are incorrect?
    (i)   A turbine is called impulse turbine if at the inlet of the turbine total energy is only kinetic energy
    (ii) A turbine is called reaction turbine if at the inlet of the turbine the total energy is kinetic energy and pressure energy
    (iii) The inward flow reaction turbine having radial discharge at outlet is known as Kaplan turbine
    (a) Only (i)   (b) Only (iii)
    (c) (i) and (ii)   (d) (ii) and (iii)

8. Governing of a turbine means
    (a) The head is kept constant under all conditions of working   (b) The speed is kept constant under all conditions of working
    (c) The discharge is kept constant under all conditions of working (d) The frictional loss is kept constant under all conditions of working

9. Which of the following pump is suitable for small discharge and high head?
    (a) Centrifugal pump   (b) Reciprocating pump
    (c) Mixed flow pump   (d) Axial flow pump

10. . ……… are those which are capable of working under heads less than 30 m.
    (a) Low head turbine   (b) Medium head turbine
    (c) High head turbine   (d) None of above

11. According to the direction of flow through runner, Pelton turbine is
    (a) Tangential flow impulse turbine (b) Radial flow impulse turbine
    (c) Axial flow impulse turbine   (d) Mixed flow impulse turbine

12. The main function of surge tanks that are connected to the penstocks in the power house is to
    (a) Provide a free water surface near the turbines   (b) Protect penstocks from bursting
    (c) Acts as a reservoir   (d) Provide protection against water hammer.

13. Kaplan turbine is
    (a) An impulse turbine   (b) A radial flow impulse turbine
    (c) An axial flow reaction turbine (d) A radial flow reaction turbine

14. The cavitation and pitting can be prevented by creating which one of the following conditions?
    (a) Reducing the pressure head   (b) Reducing the velocity head
    (c) Increasing the elevation head   (d) Reducing the piezometric head

SOLUTION

Chapter-1 Fluid Properties
1 (d), 2 (a), 3 (c), 4 (c), 5 (d), 6 (c), 7 (b), 8 (c), 9 (d), 10 (a), 11 (c), 12 (b)

Chapter-2 Pressure Measurement
1 (c), 2 (a), 3 (d), 4 (d)

Chapter-3 Hydrostatic Force and Buoyancy
1(a), 2 (d), 3 (a), 4 (c), 5 (b), 6 (a), 7 (c)

Chapter-4 Kinematics of Fluid
1(c), 2 (b), 3 (c), 4 (a), 5 (d), 6 (c), 7 (c), 8 (c), 9 (d), 10 (c), 11 (a), 12 (a)

Chapter-5 Dynamics of Fluid Flow and Measurement
1(a),2 (b),3 (a),4 (d),5 (b),6 (a), 7 (d), 8 (c), 9 (c), 10 (d), 11 (c), 12 (c),
13 (d), 14 (c), 15 (a), 16 (a), 17 (b), 18 (d), 19 (d), 20 (b)

Chapter-6 Laminar Flow
1(c), 2(c), 3 (c), 4 (d), 5 (a),6 (c), 7 (b), 8 (c), 9 (a)

Chapter-7 Flow Through Pipe
1(d), 2(c), 3(c), 4(a), 5 (b), 6(d), 7(a), 8(c), 9(c), 10(d), 11(d), 12 (c),
13 (d), 14 (b), 15 (b), 16 (c),17 (b)

Chapter-8 Turbulent Flow
1 (b), 2(d), 3 (c)

Chapter-9 Boundary Layer
1(c),2(d), 3(b), 4(c), 5(d), 6(a)

Chapter-10 Drag and Lift
1 (c), 2 (d), 3 (c), 4 (d)

Chapter-11 Open Channel Flow
1(b), 2(d), 3(d), 4(a), 5(a), 6(b), 7(b), 8(a), 9(a), 10(c), 11(c), 12(c), 13(c), 14(d),
15(c), 16(a), 17(a), 18(d)

Chapter-12 Dimensional Analysis and Modelling
1(b), 2(a), 3(c), 4(c), 5(c), 6(c), 7(c), 8(c), 9(d), 10(d), 11(a), 12(c)

Chapter-13 Hydraulic Turbine and Pump
1(b), 2(b), 3(c), 4(a), 5(c), 6(d), 7(c), 8(b), 9(b), 10(a), 11(a),12(d),13(c), 14(b),
15(a), 16(b), 17(b), 18(d), 19(c), 20(d)

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7. (c) Given, $u = x, v = x + y$
Circulation = vorticity x area
Vorticity $= 2W_z = \left(\frac{dv}{dx} - \frac{du}{dy}\right) = (1 - 0) = 1$
Area $= 1 \times 1 = 1$ m^2
$\therefore$ Circulation $= (1 \times 1) = 1$

8. (c) Equation of continuity is simply the law of conservation of mass.

9. (d) $u = 3$ m/s, $v = 6$ m/s, $x = 100$ cm
$v^2 = a^2 + 2as$
$36 = 9 + 2 \times a \times \frac{100}{100}$
$\therefore a = 13.5$ m/s^2

10. (c) Property which do not changes with time is steady flow.

11. (a) In a steady flow, If stream lines are parallel than no acceleration exist.

12. (a) Intersect each other orthogonally, making curve linear square

Chapter-5 Dynamic of Fluid Flow and Measurement

1. (a) Pressure is maximum at entry point of convergent section.

2. (b) C_d value for orifice is $(0.61 - 0.65)$

3. (a) Cipolletti weir is a trapezoidal weir.

4. (d) Steady flow

5. (b) Bernoulli's equation can be based on principle of conservation of energy.

6. (a) Venturimeter is a device used for measuring discharge.

7. (d) An orifice is known as large orifice if water head is five times the diameter of the orifice.

8. (c) Stagnation point is that point where velocity of flow reduces zero.

10. (d) C_d Value of mouth pieces depends on length of mouth pieces.

11. (c) $Q = 8/15 \, C_d \sqrt{2g}(H^{5/2})\tan\theta/2$
for Qmax $\quad \theta = 90°$
$\theta/2 = 45°$

12. (c) $Q = 1.418 \, H^{5/2}$
$Q \propto H^{5/2}$

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Chapter – 8 Turbulent Flow

1. (b) Turbulent boundary layer growth at a faster rate.
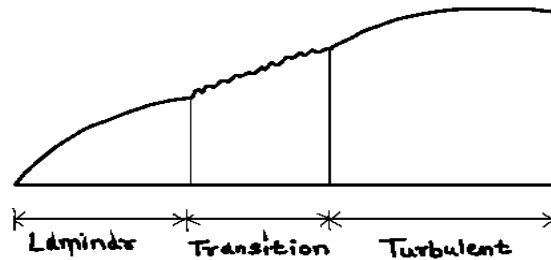
2. (d) $hf = \dfrac{4fLV^2}{2\,gD}$

   $h_f\ \alpha V^2$

3. (c) For smooth pipe,

   friction factor (f) $= \dfrac{0.316}{R_e{}^{1/4}}$

   $= \dfrac{0.316}{(10^4)1/4} = \dfrac{0.316}{10} = 0.0316$

Chapter – 9 Boundary Layer

1. (c) Velocity potential only exist for irrotational flow.

2. (d) Flow separation takes places when pressure gradient is (+ve) i.e. adverse pressure gradient.

3. (b) Bluff body have more pressure drag than stream line body.

4. (c) **Vorticity** exist for rotational flow.
   Velocity potential exist for only irrotational flow.
   Stream function exist for both.

5. (d) Fluid of velocity is equal to 0.99 times the free stream velocity.

6. (a) Boundary layer exist when viscosity is present in fluid i.e., in case of real fluid.

Chapter – 10 Drag and Lift

1. (c) Drag force acts in opposite direction to the relative velocity of flow and lift force acts perpendicular to the relative flow. So, usually, pressure and viscosity of a fluid cause darg and lift.

2. (d) Stoke's law deals with laminar flow in the tubes.

New Batches are going to start.....

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Test Series Available..

Total weekly test : 35

Total mid subject test : 16

Total full length test : 13

Mock test : 16

Total test : 80

HYDROLOGY

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4. Average annual rainfalls in cm at 4 existing rain gauges stations in a basin are 105, 79, 70 and 66. If average depth of rainfall over the basin is to be estimated within 10% error, then additional no. of gauges needed will be.
   (a) 1
   (b) 2
   (c) 3
   (d) 4

5. The method used for estimating missing rainfall is
   (a) Normal ratio method
   (b) Station year method
   (c) Plotting position method
   (d) Rational method

6. How many additional rain gauges are required in a catchment, if the error allowed in estimation of mean rainfall is to be reduced by half than the present one?
   (a) Equal to the present number
   (b) Twice the present number
   (c) Thrice the present number
   (d) Four times the present number

7. The double mass curve is used to
   (a) Check the consistency of rain gauge records
   (b) Determine the reservoir capacity
   (c) Determine the number of rain gauges required
   (d) Determine the maximum probable precipitation

8. According to Indian Meteorological Department, a year is considered a drought year in case the total area affected exceeds
   (a) 10% of the total area of the country
   (b) 20% of the total area of the country
   (c) 53% of the total area of the country
   (d) 75% of the total area of the country

9. The double mass curve analysis is adopted to
   (a) Estimate the missing rainfall data
   (b) Obtain intensities of rainfall at various duration
   (c) Check the consistency of data
   (d) Obtain the amount of storage needed to maintain a demand pattern

10. The variation of rainfall between two sections in isohyetal method is assumed as
    (a) Linear
    (b) Parabolic
    (c) Elliptical
    (d) Quadratic

11. Depth-Area-Duration curves of precipitation are drawn as
    (a) Minimizing envelopes through the appropriate data points
    (b) Maximizing envelopes through the appropriate data points
    (c) Best fit curves through the appropriate data points
    (d) Best fit mean straight lines through the appropriate data points

11. The drainage density is expressed as
    (a) Ratio of shortest length of channel to the total drainage area
    (b) Ratio of total drainage area to the total channel length
    (c) Ratio of total channel length to the total drainage area
    (d) Ratio of longest length of channel to the total drainage area

12. Runoff is equal to
    (a) Surface runoff
    (b) Base flow
    (c) Surface runoff - Base flow
    (d) surface runoff + Base flow

13 The_____ of a drainage basin is the time required by the water to reach the outlet from the most remote point of drainage area.
    (a) Travel time
    (b) Period of runoff
    (c) Period of rise
    (d) Time of concentration

14. Time of concentration is the
    (a) Time of maximum possible precipitation that may concentrate and fall over a given basin.
    (b) Time taken by the rain water to flow to an existing defined drain in a basin.
    (c) Time for which the rain water remains concentrated on the basin.
    (d) Maximum time taken by the rain water to reach the outlet of the basin.

Chapter - 5 Hydrograph

1. Hyetograph is a plot of
   (a) Accumulated rainfall vs. time
   (b) Rainfall intensity vs. time
   (c) Runoff vs. time
   (d) Infiltration intensity vs. time

2. The statement "ordinate of the direct run off hydrographs of a common base period are directly proportional to the volumes of runoff represented by the respective hydrograph" infers
   (a) Principle of linearity
   (b) Principle of time invariance
   (c) Principle of uniformity
   (d) None of these

3. A 3-hour storm hydrograph has 7 units of direct runoff. The 3 -hour unit hydrograph for this storm can be obtained by dividing the ordinates of the storm hydrograph by
   (a) 3
   (b) 7
   (c) 3 / 7
   (d) 7 / 3

4. A unit hydrograph for a watershed is triangular in shape with base period of 20 hours. The area of watershed is 500 ha. What is the peak discharge in m3/hr?
   (a) 4000
   (b) 5000
   (c) 6000
   (d) 7000

9. The quantity of water that can be withdrawn annually and also the rate at which this withdrawal could be made without adversely affecting the inventory of the aquifer is called
   - (a) Annual yield
   - (b) Percent yield
   - (c) Operational yield
   - (d) Monthly yield

10. Resistivity sounding in groundwater exploration estimates:
    - (a) Variation of resistivity with depth
    - (b) Horizontal variation in resistivity
    - (c) Both (A) and (B)
    - (d) None of the above

11. The discharge per unit drawdown at a well is known as
    - (a) Specific yield
    - (b) Specific discharge
    - (c) Specific capacity
    - (d) Specific transmissibility

12. Specific storage refers to
    - (a) Volume of water stored in the unit volume of aquifer
    - (b) Water that a portion of an aquifer releases from storage, per unit mass or volume of aquifer, per unit change in hydraulic head, while remaining fully saturated.
    - (c) Volume of water drained by gravity per unit volume of aquifer
    - (d) The difference between field capacity and evapotranspiration

13. A shallow well is a well
    - (a) Whose depth is less than its width
    - (b) Whose depth is less than 20 feet
    - (c) Which does not rest on a mota formation
    - (d) Which rests on a mota formation

14. If the porosity of an aquifer material is 0.80 and specific retention is 0.30, then the ratio of specific retention to specific yield would be
    - (a) 1.93
    - (b) 0.85
    - (c) 1.67
    - (d) 0.60

15. Artesian well are
    - (a) Shallow wells
    - (b) Deep wells
    - (c) Dry wells
    - (d) Flowing wells

16. Vertical distance between initial water table and lowered water level due to pumping out water is called
    - (a) Reduced level (RL)
    - (b) Radius of influence
    - (c) Drawdown
    - (d) Specific capacity

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Reinforced Cement Concrete

Chapter – 1 Introduction

1. (d) Cyclonic precipitation is caused by the lifting of an air mass because of the pressure difference. If low pressure occurs at an area, air will flow horizontally from the surrounding area, causing the air at the low-pressure area to lift.

2. (c) The Indian standard (IS:4987-1968) recommends the following densities:
   (i) In plain area → 1 station per 520 km^2.
   (ii) In region of average elevation 1000 m → 1 station per 260-390 km^2
   (iii) In predominantly hilly areas with heavy Rainfall → 1 station per 130 km^2

3. (b) A Hyetograph is plot of the intensity of rainfall against the time interval.

4. (b)

Type	Intensity
Light rain	< 2.5
Moderate rain	2.5-7.5
Heavy rain	>7.5

5. (d) Precipitation caused by upward movement and of clouds due to natural barrier like mountain called orographic precipitation.

Chapter - 2 Precipitation & It's Measurements

2. (d) Hydrological drought is indicated by surface water and ground water deficit.

4. (a) Main rainfall $\overline{P} = \frac{P_1+P_2+P_3+P_4}{n} = \frac{105+79+70+66}{4}$

$\overline{P} = 80$

Standard deviation

$\sigma_{n-1} = \sqrt{\frac{(105-80)^2+(79-80)^2+(70-80)^2+(66-80)^2}{4-1}}$

$\sigma_{n-1} = 17.53$

Coefficient of variation (CV) $CV = \frac{\sigma_{n-1}}{\bar{P}} \times 100$

$\frac{17.53}{80} \times 100 = 21.91\%$

The optimal number rain gauge with allowable percentage error.

$N = \left(\frac{CV}{E}\right)^2$

$= \left(\frac{21.91}{10}\right)^2 = 4.80 = 5$

Chapter - 6 Flood

1. (b) A linear reservoir is one in which storage varies linearly with outflow rate.

2. (a) The probability of non-occurrence of a flood in n successive years is
$P_{0,100} = q^{100} = (1 - P)^n$
$= \left(1 - \frac{1}{100}\right)^{100}$ [n = 100 years]
$= 0.3660 \times 100 = 36.60\ \%$

3. (b) Probable maximum flood is largest flood that occur at a particular location.

Chapter-7 Flood Estimation & Flood Routing

1. (b) Probability of 24 hours rainfall equal to or greater than 300 mm eccuring atleast once in 10 years.
$= 1 - \left(1 - \frac{1}{100}\right)^{10}$
$= 1 - (1 - 0.01)^{10}$
$= 1 - (0.99)^{10}$

3. (b) The probability of a 10-year flood to occur at least once in Next 2 years is
$\begin{aligned} P &= 1 - \left(1 - \frac{1}{10}\right)^2 \\ &= 0.19 \\ &= 19\% \end{aligned}$

4. (d) Barrages design flood $\rightarrow$ SPF or T = 100 years
Spillways $\rightarrow$ PMF or T = 1000 years

5. (c) The Muskingum method of flood routing is a Hydrologic channel routing method.

6. (a) The relation between probability (P) and recurrence interval (T) is given by PT = 1.

Chapter - 8 Well Hydraulics

2. (c) The surface joining the static water levels in several wells penetrating a confined aquifer represents cone of depression.

5. (c) Resistivity logging method is used in sub surface investigation of GW.

6. (d) An aquifuge is an impermeable geological formation which is neither porous nor permeable.

6. Irrigation water having Sodium Absorption Ratio (SAR) of 12 is classified as
   (a) Low sodium water
   (b) Medium sodium water
   (c) High sodium water
   (d) Very high sodium water

7. Net irrigation requirement of a crop is equal to
   (a) Consumptive use
   (b) Consumptive use - Effective rainfall
   (c) Consumptive use - Effective rainfall + Leaching and other requirements
   (d) Percolation loss + Effective rainfall

8. Paleo is defined as
   (a) The first watering before the crop is sown
   (b) The first watering after the crop is sown
   (c) The first watering after the application of fertilizers
   (d) The last watering before the harvest

9. Permanent wilting point is
   (a) A characteristic of the plant
   (b) A soil characteristic
   (c) A soil characteristic modified by rainfall intensity
   (d) A soil characteristic modified by solar intensity

10. If the Sodium Adsorption Ratio of the irrigation water is 11, then it is classified as
    (a) Low sodium water
    (b) Medium Sodium Water
    (c) High Sodium Water
    (d) Very High sodium water

11. Which of these does not relate to the zone of aeration in the soil profile?
    (a) Saturation zone
    (b) Capillary zone
    (c) Intermediate zone
    (d) Soil water zone

12. Kor water is the
    (a) First watering before a crop is sown
    (b) First watering after a crop is sown
    (c) First water after a crop is grown
    (d) Water of least depth

13. Permanent wilting point is
    (a) A characteristic of a plant
    (b) A soil characteristic
    (c) A soil characteristics modified by a plant
    (d) Dependent on soil water plant fertilizer interaction

14. Phreatic water is available in
    (a) Capillary water zone
    (b) Aeration zone
    (c) Saturation Zone
    (d) All of the above

15. If the electrical conductivity of water is in the range of 250-750 micro-mhos/cm, then it is classified as
    (a) Low saline water
    (b) Moderate saline water
    (c) High saline water
    (d) Very high saline water

10. The general depth of scour calculated by Lacey's formula in a river represents the depth below the
    (a) maximum flood level in the river
    (b) minimum flood level in the river
    (c) Normal flow water level in the river
    (d) Existing river bed level.

11. According to Kennedy, non-silting and nonscouring velocity is called
    (a) Optimal velocity
    (b) Critical velocity
    (c) Mean velocity
    (d) Average velocity

12. Hydraulic mean depth of a canal is the ratio between
    (a) Area of flow section and top water surface width
    (b) Area of flow section and the wetted perimeter
    (c) Total cross sectional area and top water surface width
    (d) Total cross sectional area and the wetted perimeter

13. Lacey's theory is applicable to flow
    (a) Through pipes
    (b) Over spillways
    (c) In alluvial rivers and canal
    (d) In concrete lined canals

14. According to Khosla theory, the exit gradient in the absence of downstream cut-off is
    (a) Zero
    (b) Unity
    (c) Infinity
    (d) very large

15. Garret's diagram is based on
    (a) Kennedy's Theory
    (b) Lacey's Theory
    (c) Khosla's Theory
    (d) Bligh's Theory

16. Wetted Perimeter of a regime channel for a discharge of 100 cumecs as per Lacey's theory will be
    (a) 47.5 m
    (b) 9.5 m
    (c) 5 m
    (d) 95.0 m

17. Lacey's method of canal design is applicable when
    (a) Discharge in the channel is constant
    (b) Velocity remains constant across depth
    (c) Water pressure remains constant
    (d) Sediment characteristics are variable

CHAPTER – 5 Canal Head Works

1. Pressure relief valves are provided in lined canal when
   (a) Canal is in full cutting
   (b) Canal is in full banking
   (c) Canal is in partial cutting and banking
   (d) Canal is in barrel form in aqueduct

New Batches are going to start.....

Contact: 7622050066

Test Series Available..

Total weekly test   **: 35**

Total mid subject test   **: 16**

Total full length test   **: 13**

Mock test   **: 16**

Total test   **: 80**

CHAPTER – 7 Dams and Reservoirs

1. The ratio of total deposited sediment in reservoir to the total sediment inflow over a period is
   (a) Surcharge
   (b) Bed load factor
   (c) Displacement efficiency
   (d) Trap efficiency

2. We are unlikely to construct a dam when_____
   (a) When the rocks are strong
   (b) When the rocks are impermeable
   (c) When the rocks are porous
   (d) When the rocks are weathered to a certain extent

3. Trap efficiency of a storage reservoir is defined as
   (a) Total annual sediment flow /reservoir capacity
   (b) Total sediment deposited in a given period / Total sediment inflow in that period
   (c) Total annual sediment deposited in the reservoir / Dead storage capacity of the reservoir
   (d) None of these

4. Economical Height of a Dam is that height for which
   (a) Cost per unit of storage is minimum
   (b) Benefit cost ratio is maximum
   (c) Net benefits are maximum
   (d) None of these

5. The force considered for the analysis of an elementary profile of a gravity dam under empty reservoir condition is
   (a) Uplift pressure
   (b) Water pressure
   (c) Self weight
   (d) Earthquake pressure

6. In Gravity dam, _____ the acts in a direction opposite to the acceleration imparted by earthquake forces and is equal to the product of the mass and the acceleration
   (a) Inertia force
   (b) Hydrodynamic force
   (c) Uplift force
   (d) Wave pressure

7. A_____is an irrigation structure constructed across a canal to lower down its water level and destroy the surplus energy liberated from the falling water which may otherwise scour the bed and banks of the canal
   (a) Canal falls
   (b) Head regulator
   (c) Canal escape
   (d) Canal outlets

8. In Gravity dam, the factor of safety against overturning should not be less than
   (a) 1.15
   (b) 1.5
   (c) 1.8
   (d) 2

9. In reservoir, the volume of water below the minimum pool level is known as
   (a) Dead storage
   (b) Surcharge storage
   (c) Valley storage
   (d) Useful storage

Chapter – 2 Water Requirements of Crops and Canal Irrigation

1. (a) Suitability of ground water for irrigation uses is commonly studied by measuring sodium adsorption ratio.

2. (d) 3% of the Earth's water is fresh water.

3. (c)

Classification	EC	ESP	PH
Saline soil or white alkali	>4	<15	≤ 8.5
Alkaline soil or Non saline soil or sodic soil or black alkali	<4	>15	8.5 – 10.0
Saline alkali soil	>4	>15	<8.5

5. (b) Irrigation frequency is a function of soil crop and climate.

6. (b)

0 < SAR <10	Low sodium water (S_1)
10 < SAR < 18	Medium sodium water (S_2)
18 < SAR < 26	High sodium water (S_3)
SAR > 26	Very high sodium water (S_4)

7. (c) NIR = Cu – Re + LR
Where, NIR = Net irrigation Requirement
Cu = consumptive use of water
Re = Effective rainfall during growth period of crop

11. (b & c) Zone of Aeration does not relate capillary zone and intermediate zone.

12. (b) Kor water is the first watering after a crop is sown.

15. (b)

EC < 250 micro-mhos/cm at 25^0C	Low Salinity water (S_1)
250 < EC < 750 micro-mhos/cm at 25^0C	Medium salinity water (S_2)
750 < EC < 2250 Micro-mhos/cm at 25^0C	High salinity water (S_3)
EC $\geq$ 2250 micro-mhos/cm at 25^0C	Very high Salinity water (S_4)

16. (c) Irrigation projects in India.
Major irrigation project: CCA more than 10000 Ha
Medium irrigation project: CCA between 2000 and 10000 Ha
Minor irrigation project: CCA less than 2000 Ha

14. (a) Economical height of a dam is that height for which the cost per unit storage is minimum.

15. (c) The design and construction of free roller gate are difficult as the rollers are not attached to the gate and the guide. Therefore, the rollers are attached to the gate.

17. (c) Levees are used for river training.

Chapter – 8 Canal Regulation Works

1. (c) The earthen embankment constructed parallel to the river banks at some suitable distance for flood control are known as levees and dikes.

2. (b) The ratio of stream length to the valley length is called as Mender ratio.

3. (a) Aggrading rivers are silting rivers.

4. (a) Tortuosity of meandering river is the ratio of curved length along the channel to the direct axial length of the river each.

7. (a) Dikes are flood controlling devices.

13. EDTA titration method of hardness determination of water sample uses an indicator which combines with hardness causing divalent cations and forms a coloured complex. The name of the indicator and the colour of the formed complex respectively are
    (a) Ferroin and Dark blue
    (b) Ferroin and Wine red
    (c) Erichrome Black T and Dark blue
    (d) Erichrome Black T and Wine red

14. Acidity in natural water in surface water bodies is mainly due to
    (a) Oxygen
    (b) BOD
    (c) Carbon dioxide
    (d) Sulfuric and nitric acids

15. Column I lists various impurities in drinking water and Column II lists effects/diseases caused by these impurities.

Column I	Column II
P. Nitrate > 45ppm	1. Minamata disease
Q. Mercury > 0.001ppm	2. Discoloration of teeth
R. Fluoride < 1.0ppm	3. Cavities in teeth
S. Fluoride > 1.5ppm	4. Methemoglobenemia
	5. Pneumoconiosis

    The correct match of the column I with column II is
    (a) P − 4, Q − 5, R − 2, S − 3
    (b) P − 4, Q − 1, R − 3, S − 2
    (c) P − 4, Q − 1, R − 2, S − 3
    (d) P − 5, Q − 4, R − 1, S − 2

16. With reference to Drinking Water Quality, match the Pollutants (List-I) with theirPermissible Limits in the Absence of Alternate sources (List-II)

List-I	List -II
Pollutant	Limits
(i) Chloride (as Cl)	(iv) 1000 mg/lit
(ii) Sulphate (as SO_4)	(v) 400 mg/lit
(iii) Total Alkalinity as $CaCO_3$	(vi) 600 mg/lit

    (a) (i)-(iv), (ii)-(v), (iii)-(vi)
    (b) (i)-(iv), (ii)-(vi), (iii)-(v)
    (c) (i)-(vi), (ii)-(v), (iii)-(iv)
    (d) (i)-(v), (ii)-(iv), (iii)-(vi)

17. As per IS 10500 − 2012, which of the following Pollutant(s) have some relaxation in their Acceptable Limits in the absence of alternate sources of water?
    (i) Aluminium (as Al)
    (ii) Ammonia (as total ammonia-N)
    (iii) Barium (as Ba)
    (iv) Boron (as B)
    (a) Only (i)
    (b) (i) and (iv)
    (c) (iii) and (iv)
    (d) (i) and (ii)

18. Which of the following pairs of Water Quality Parameter and Method of determination is not correctly matched?
    (a) Hardness: EDTA Method
    (b) Dissolved Oxygen: Winkler's Method
    (c) Chlorine: Orthotolidine test
    (d) Chloride: SPADNS Method

GPSC - CIVIL

Solid Mechanics

EXAM ACHARYA
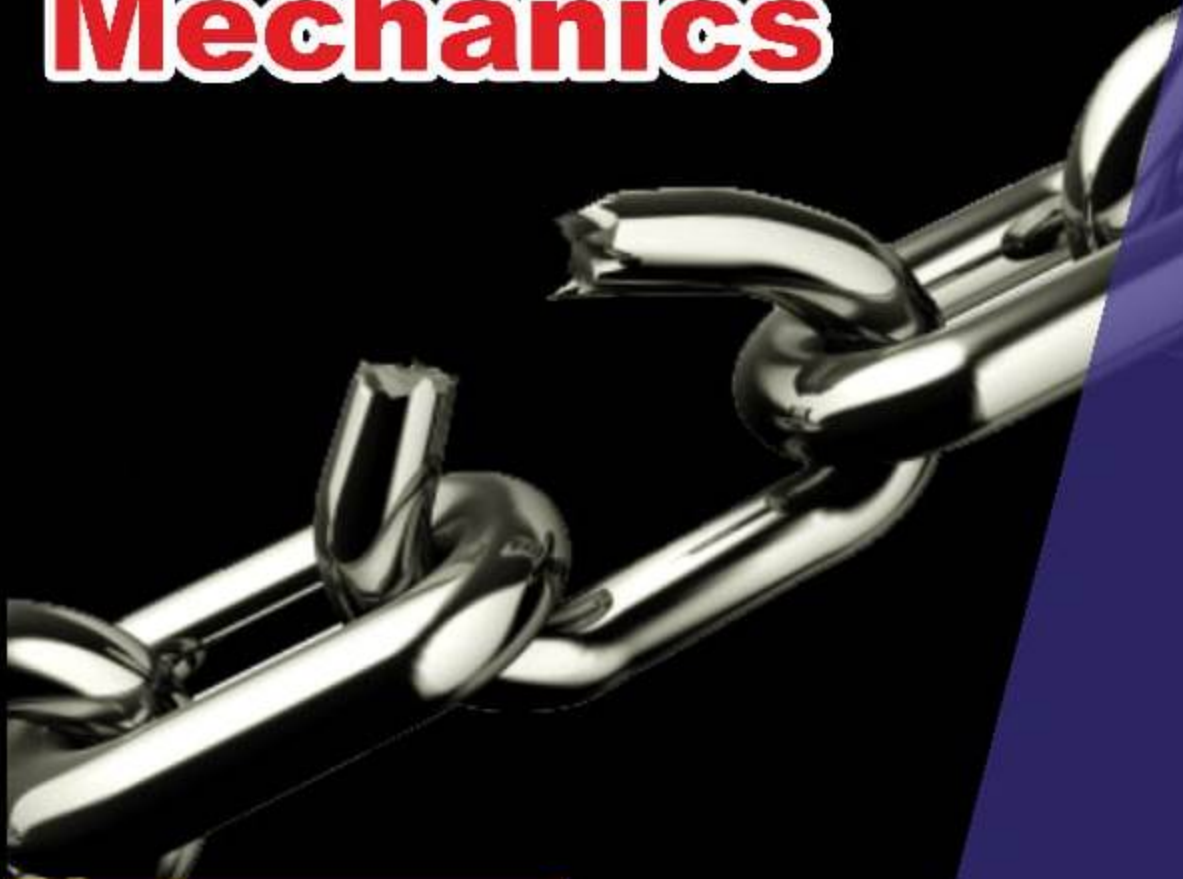
"Education is the most Powerful Weapon which you can use to change the world."

A.P.J. Abdul Kalam

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

9. Which one of the following is the purpose of providing a surge tank in a pipeline carrying water?
   (a) To store water
   (b) To increase pressure throughout the pipeline
   (c) To store overflowing water
   (d) To protect the pipeline against water hammer

10. Which one of the following should be recommended for protected rural water supply project?
    (a) Pressure filter
    (b) Slow sand filter
    (c) Diatomaceous earth filter
    (d) Rapid sand filter

11. In which treatment unit is Schmutzdecke formed?
    (a) Sedimentation tank
    (b) Rapid sand filter
    (c) Coagulation tank
    (d) Slow sand filter

12. What is predominant coagulating mechanism for raw water having high turbidity and high alkalinity
    (a) Ionic layer compression
    (b) Adsorption and charge neutralization
    (c) Sweep coagulation
    (d) Inter particle bridging

13. In a water treatment, the optimum time of flocculation is usually given as 30 minutes. In case the time of flocculation is increased beyond this value, the flocs will
    (a) Become heavy and settle down in the flocculation tank itself
    (b) Entrap air and will float in the sedimentation tank
    (c) Break up and defeat the purpose of flocculation
    (d) Stick to the paddles

14. Ganga water pollution is mainly due to discharge of
    (a) Agricultural runoff
    (b) Wastes from forests
    (c) Industrial and domestic wastewater
    (d) Spillages from mines

15. Consider the following impurities:
    (i) Hydrogen-di-Sulphide
    (ii) Excess alkalinity
    (iii) Suspended Matter
    (iv) Pathogenic Bacteria
    What will be the correct sequence of the removal of these impurities in a water treatment plant?
    (a) (i), (ii), (iii), (iv)
    (b) (i), (iii), (ii), (iv)
    (c) (ii), (i), (iii), (iv)
    (d) (iii), (ii), (iv), (i)

of waste disposal area.

(iii) Provisions for management of leachates including its collection and treatment shall be made.

(a) Only (i)   (b) Only (ii)

(c) (i) and (ii)   (d) (i), (ii) and (iii)

3. As per the Solid Waste Management Rules, 2016, the landfill site shall be
   (i) 100 meter away from river.
   (ii) 200 meter away from a pond.
   (iii) 200 meter away from Highways, Habitations, Public Parks and water supply wells.
   (iv) 20 km away from Airports or Airbase

   (a) (i) and (ii)   (b) (i) and (iii)

   (c) (i), (ii) and (iii)   (d) (i), (ii), (iii) and (iv)

4. Before establishing any landfill site, baseline data of ground water quality in the area shall be collected and kept in record for future reference. The ground water quality within of the periphery of landfill site shall be periodically monitored covering different seasons in a year

   (a) 50 meters   (b) 100 meters

   (c) 500 meters   (d) 1000 meters

5. The post-closure care of landfill site shall be conducted for at least

   (a) 5 years   (b) 10 years

   (c) 15 years   (d) 20 years

6. A coastal city produces Municipal Solid Waste (MSW) with high moisture content, high organic materials, low calorific value and low inorganic materials. The most effective and sustainable option for MSW management in that city is

   (a) Composting   (b) Incineration

   (c) Landfill   (d) Dumping in sea

7. The maximum C/N ratio in a Municipal Solid Waste Compost is

   (a) 10:1   (b) 20:1

   (c) 30:1   (d) 40:1

8. For estimating the bulk density of Municipal Solid Waste compost, the compost sample should be

   (a) Dried in a hot air oven at 70°C for 24 hours   (b) Dried in a hot air oven at 70°C for 12 hours

   (c) Dried in a hot air oven at 103°C for 24 hours   (d) Dried in a hot air oven at 103°C for 12 hours

24. Anthropogenic emission of chlorofluorocarbons (CFCs) is likely to deplete the ozone layer in troposphere leading to increase _____ on earth surface.
    (a) Radioactivity
    (b) Air temperature
    (c) Ultraviolet radiation
    (d) Acid rain

25. Which of the following is not an example of Secondary Air Pollutant?
    (a) Ozone
    (b) Formaldehyde
    (c) Acid Mist
    (d) Halogen Compounds

26. The full form of the secondary air pollutant PAN is
    (a) Peroxy Acetyl Nitrate
    (b) Peroxy Amine Nitrate
    (c) Photochemical Acetyl Nitrate
    (d) Photochemical Amine Nitrate

27. Which of the following plume behaviour will have the most severe implications on human health?
    (a) Coning
    (b) Fanning
    (c) Trapping
    (d) Fumigation

28. Which of the following air pollution control equipment is not an example of Inertial Separators?
    (a) Baffle type separator
    (b) Louvre type separator
    (c) Dust trap
    (d) Settling chamber

29. Ringelmann Chart is most commonly used for
    (a) Estimating the density of smoke
    (b) Estimating the direction of smoke
    (c) Estimating the particulate matter from automobiles
    (d) Estimating the flue gas velocity

30. Which of the following method is adopted for the measurement of NO_2 in air?
    (a) Chemiluminescence
    (b) Beta attenuation
    (c) Non-Dispersive Infrared Spectroscopy
    (d) Gravimetric

31. What is the permissible 1-hourly concentration of Carbon monoxide in ecologically sensitive areas?
    (a) 2 mg/m^3
    (b) 2 µg/m^3
    (c) 4 mg/m^3
    (d) 4 µg/m^3

32. Which of the following methods are correct for calculating the annual average concentration of a criteria air pollutant?
    (a) Arithmetic mean of minimum 104 sampling points in a given area sampled for 24 hours once in a year
    (b) Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week for 24 hourly sampling at uniform intervals
    (c) Arithmetic mean of minimum 208 measurements in a year at a particular site taken four times a week for 24 hourly sampling at uniform intervals
    (d) Arithmetic mean of 365 measurements in a year at a particular site for 24 hourly sampling

2. (b)   TDS = Electrical conductivity × correction factor
          ∴ TDS ∝ electrical conductivity

3. (c)   Rivers contain water with the maximum amount of turbidity.

4. (a)   LIST-I   LIST II
          (A) Hardness   (ii) 200 mg/L
          (B) Chlorides   (iii) 250 mg/L
          (C) Iron   (i) 0.3 mg/L
          (D) Flouride   (iv) 1 mg/L

5. (a)   LIST-I   LIST-II
          (A) Absence of flourides   (iii) Dental cavaties
          (B) Excess of lead   (iv) Anaemia
          (C) Presence of excess nitrate (i) Methaemoglobinemia
          (D) Absence of iodide   (ii) Goitre

6. (b)   If alkalinity of water equals or exceed hardness all of the hardness will be carbonate hardness.

7. (d)   1NTU = 1mg of formazin dissolved in 1 L of distilled water with the test being run according to scattering principle.

8. (b)   Blue green algae can fix atmospheric nitrogen.

9. (c)   Hardness test employs Ethylene Diamine Tetra Acidic Acid as a titrating agent

10. (d)   Coliform organisms are non-spore forming.

11. (b)   Tintometer, is used for measuring colour.

12. (a)   Orthotolidine test is done for assessing residual chlorine.

13. (d)   In EDTA method the indication used is called Erichrome black T and the complex formed is wine red colour.

14. (c)   Acidity in natural water is due to CO_2

15. (b)   (P) Nitrate > 45ppm   (4) Methemoglobenemia
          (Q) Mercury > 0.001ppm   (1) Minamata disease
          (R) Fluoride < 1.0ppm   (3) Cavities in teeth
          (S) Fluoride > 1.5ppm   (2) Discolouration of teeth

16. (a)   Pollutant   Limits
          (i) Chloride   (iv) 1000mg/L
          (ii) Sulphate   (v) 400mg/L
          (iii) Total Alkalinity   (vi) 600mg/L

New Batches are going to start.....

Contact:

7622050066

Test Series Available..

Total weekly test   **: 35**

Total mid subject test   **: 16**

Total full length test   **: 13**

Mock test   **: 16**

Total test   **: 80**

13. (b) If flocculation time is increase by 30 minutes the flocs will entrap air and will float in the sedimentation tank.

14. (c) Ganga water Pollution is mainly due to industrial and domestic waste water.

15. (b) The correct sequence of the removal of impurities in a water treatment plant if following impurities are present:-
    (i) Hydrogen-di-sulphide → Aeration
    (ii) suspended matter → Filteration
    (iii) Excess of Alkalinity → Hardness Removal
    (iv) Pathogenic bacteria → Disinfection

Chapter – 4 Wastewater Management

1. (d) BOD = (Initial DO - Final DO) × Dilution ratio
   $= (10 - 2) \times 100$
   $= 800 \text{mg/L}$

2. (d) Sewage sickness occurs when voids of soil get clogged due to continuous application, of sewage on a piece of land.

3. (b) The Biochemical oxygen demand will always be less then COD.
   $$COD > ThOD > BOD_u > BOD_5$$

4. (c) The tolerance limit for BOD_5 is marine environment disposal is 100mg/L.
   $\therefore$ Minimum efficiency $= \frac{200-100}{200} \times 100 = 50\%$

5. (a) 5 days 20°C BOD = 3 days 27°C BOD

6. (c) Minimum level of DO is 4mg/L.

7. (b) Presence of nitrogen in a waste water is due to decomposition of proteins.

8. (a) The TOC test consists of acidification of waste water to convert inorganic carbon to CO_2. TOC is measured through infrared analysis for glucose:
   $$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$
   $$\frac{COD}{TOC} = \frac{6 \text{ mole of } O_2}{6 \text{ mole of } C} = \frac{6 \times 32}{6 \times 12} = 2.66$$

9. (b) A well oxidized sewage contains nitrogen mainly as nitrates.

10. (b) For detecting nitrates in sewage colour may be developed by adding phenol-di-sulphuric acid and potassium hydroxide

201, Siddhi Vinayak Complex, Besides Bank of India, Near Panchratna furniture,
Ellorapark, Subhanpura, Vadodara – 390023
Contact: 7622050066 | Website: www.acumenhr.in

17. (a) Check valve is a device that only allows the flow of fluids in one direction and works automatically is known as non-return valve.

18. (b) SO_2 and CO adversely affect the functioning of respiratory system and O_2 carrying capacity of blood.

19. (a) Ozone layer thickness is measured in Dobson Units (DU). This is number of molecules of ozone that would be required to create a layer of pure ozone 0.01 mm thick at a temperature of 0°C and pressure 1 atm.

20. (a) The global warming potential of:
$CO_2 \rightarrow 1$
$CH_4 \rightarrow 25$
$N_2O \rightarrow 265$
$CFC \rightarrow 10,200$

21. (b) Thermal pollution refers to discharge of high temperature liquid effluents in water bodies.

22. (c) Ozone layer depletion is not the effect of climate change.

23. (d) Oxides of nitrogen and hydrocarbons are responsible for photochemical smog.

24. (c) Ultraviolet radiation.

25. (d) Halogen compounds is an example of primary air pollutants whereas ozone, formaldehyde, acid mist are the examples of secondary air pollutants.

26. (a) PAN - Peroxy Acetyl Nitrate

27. (d) Fumigation is the most dangerous plume.

28. (d) Settling chamber is not an example of inertial separators. It is the device that is introduced to the industrial exhaust system to remove solid particles from the emission. The Particles while passing through the chamber settle over the settling trays under the action of gravity thus cleaning the gas.

29. (a) Ringelmann chart is used to estimate density of smoke.

30. (a) Chemiluminescence is used to measure NO_2.

31. (c) Permissible 1 hourly concentration of $CO = 4mg/m^3$

32. (b) Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week for 24 hourly sampling at uniform intervals.

33. (a) Five toxic chemicals are Antimony, Lithium, Mercury, Arsenic and Lead

11. A soil sample is having a specific gravity of 2.60 and a void ratio of 0.78. The water content in percentage required to fully saturate the soil at that void ratio would be
    (a) 10   (b) 30
    (c) 50   (d) 70

12. A clay sample has a void ratio of 0.50 in dry state and specific gravity of solids is 2.70. Its shrinkage limit will be
    (a) 12 %   (b) 13.5 %
    (c) 18.5 %   (d) 22 %

13. Consider the following statement in the context of Aeolian soils:
    (i)   The soil has low density and low compressibility
    (ii) The soil is deposited by wind
    (iii) The soil has large permeability
    Which of these statements are correct?
    (a) (i), (ii) and (iii)   (b) (ii) and (iii)
    (c) (i) and (iii)   (d) (i) and (ii)

14. The collapsible soil is associated with
    (a) Dune sand   (b) Laterite soil
    (c) Loess   (d) Black cotton soil

15. Consistency as applied to cohesive soils is an indicator of its
    (a) Density   (b) Moisture content
    (c) Shear strength   (d) Porosity

16. If the water content of a fully saturated soil mass is 100%, then the void ratio of the sample is
    (a) Less than specific gravity of soil   (b) Equal to specific gravity of soil
    (c) Greater than specific gravity of   (d) Independent of specific gravity
        soil   of soil

17. According to the Indian Standards, the specific gravity is the ratio of the Unit weight of soil solids to that of water a temperature of
    (a) 24°C   (b) 15°C
    (c) 20°C   (d) 27°C

18. Sensitivity is measure of change in consistency or strength of soil on_____
    (a) Compression   (b) Consolidation
    (c) Compaction   (d) Remoulding

19. At shrinkage limit, soil is in
    (a) Saturated condition   (b) Unsaturated condition
    (c) Submerged condition   (d) Dry Condition

23. Inorganic Silts with low plasticity is represented by
    (a) MH   (b) SL
    (c) ML   (d) CH

24. Which are the corrections applied to the hydrometer readings?
    (i) Meniscus correction
    (ii) Temperature correction
    (iii) Density correction
    (iv) Dispersing agent correction
    (a) (i) and (ii)   (b) (i), (ii) and (iii)
    (c) (i), (ii) and (iv)   (d) (i), (ii), (iii) and (iv)

25. Which of the following are the uses of a Particle Size Distribution Curve for a coarse grained soils?
    (i) For approximately assessing the coefficient of permeability
    (ii) For approximately judging the compressibility of soil
    (iii) To assess the susceptibility of soil to frost action
    (iv) For assessing the mode of deposition of soil
    (a) (i) and (ii)   (b) (i), (ii) and (iii)
    (c) (i), (ii) and (iv)   (d) (i), (ii), (iii) and (iv)

CHAPTER – 3 CLAY MINERALOGY

1. If the ratio of the plasticity index and the percentage of clay fraction finer than 2 is 2, then the soil is classified as
   (a) Inactive   (b) Normal
   (c) Active   (d) Hyperactive

2. The correct sequence of plasticity of minerals in soil is an increasing order is
   (a) Kaolinite, silica, illite,   (b) Silica, kaolinite, illite,
       montmorillonite   montmorillonite
   (c) Silica, kaolinite, montmorillonite, (d) Kaolinite, silica,
       illite   montmorillonite, illite

3. Among the following types of water, which one is chemically combined in the crystal structure of the soil mineral and can be removed only by breaking the crystal structure?
   (a) Structural water   (b) Hygroscopic water
   (c) Capillary water   (d) Adsorbed water

4. Assertion (A): Black cotton soils are clay and exhibit characteristic property of swelling.

   Reason(R): These clays contain montmorillonite which attracts external water into its lattice structure.
   (a) Both A and R are true and R is   (b) Both A and R are true and R is
       not the correct explanation of A   the correct explanation of A
   (c) A is false but R is true   (d) A is true but R is false

GPSC - CIVIL

Structural Analysis

"All of us do not have Equal Talent.
But, all of us have an Equal Opportunity
to Develop our Talents."
A.P.J. Abdul Kalam

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

15. The hydraulic head that would produce a quick condition in a sand stratum of thickness of 2m, if G = 2.7 and e = 0.7, is
    (a) 0.5   (b) 2
    (c) 1   (d) 2.5

16. Piping occurs when
    (a) Effective stress is zero   (b) Flow is downwards
    (c) Flow is upwards   (d) Flow is horizontal

17. The quantity of seepage depends on which of the following statements?
    (1) The coefficient of permeability
    (2) The differential head across the flow path
    (3) The length of flow path
    (a) 1 and 2   (b) 1, 2 and 3
    (c) 1 and 3   (d) 2 and 3

18. Pore water pressure is also called as neutral pressure because
    (a) It cannot be measured under loading condition
    (b) It produces pressure on neutral plane.
    (c) It gets neutralized by complementary pore pressure
    (d) It cannot resist shear stresses

CHAPTER - 5 EFFECTIVE STRESS, SEEPAGE

1. In a typical deposit of submerged soil, the approximate depth at which the inter-granular pressure is equal to 50 KN/m^2 is
   (a) 2.5 m   (b) 5.0 m
   (c) 7.5 m   (d) 10.0 m

2. A flow net can be used to determine
   (a) Seepage, coefficient of permeability and uplift pressure
   (b) Seepage, coefficient of permeability and exit gradient
   (c) Seepage, exit gradient and uplift pressure
   (d) Seepage and exit gradient only

3. Which of the following factors are associated with the behaviour of sand mass during earthquake to cause liquefaction?
   (1) Number of stress cycle
   (2) The frequency and amplitude of vibration of waves generated by an earthquake
   (3) Characteristics of sand
   (4) Relative density
   Select the correct answer using the choice given below:
   (a) 1, 2 and 3   (b) 2 and 4
   (c) 3   (d) 1, 2, 3 and 4

7. In a compaction test if the compacting effort is increased, it will result in
   (a) Increase in maximum dry density and the Optimum Moisture Content
   (b) Increase in maximum dry density but Optimum Moisture Content remains same
   (c) Increase in maximum dry density and decrease in Optimum Moisture Content
   (d) No change in maximum dry density and Optimum Moisture Content

CHAPTER – 8 CONSOLIDATION

1. Undisturbed soil samples are required for
   (a) Specific gravity test
   (b) Hydrometer test
   (c) Shrinkage limit test
   (d) Consolidation test

2. If H is the drainage path and C_y is the coefficient of consolidation, then the time 't' required for attaining a certain degree of consolidation of clay layer is proportional to
   (a) H^2 and C_y
   (b) H^2 and $1/C_y$
   (c) $1H^2$ and C_y
   (d) $1H^2$ and $1/C_y$

3. The following represents the slope of the linear portion of the pressure void ratio curve in the consolidation test.
   (a) Coefficient of compressibility
   (b) Coefficient of volume compressibility
   (c) Compression Index
   (d) Coefficient of consolidation

4. Consolidation time of a soil sample
   (a) increases with an increase in permeability
   (b) increases with a decrease in permeability
   (c) increases with an increase in compressibility
   (d) increases with a decrease in compressibility

5. When sustained downward seepage force are acting on the soil and later when seepage stops, soil will become
   (a) Pre consolidated
   (b) Normally consolidated
   (c) Under consolidated
   (d) Pre compacted

6. Considerable loss of shear strength due to shock or disturbance is exhibited by
   (a) Under-consolidated clays
   (b) Normally consolidated clays
   (c) Over consolidated clays
   (d) Organic soil

7. Terzaghi's consolidation theory is applicable to one-dimensional consolidation test
   (a) for small load increment ratios
   (b) for large load increment ratios
   (c) for a load increment ratio of nearly one
   (d) in situations where there is no excess pore pressure

14. At liquid limit, all soils possess
    - (a) same shear strength of small magnitude
    - (b) same shear strength of large magnitude
    - (c) different shear strengths of small magnitude
    - (d) different shear strengths of large magnitude

15. The shear box test is
    - (a) Fast and simple procedure
    - (b) Pore water pressure cannot be measured
    - (c) Quick drainage is possible
    - (d) None of the above

16. Shear strength of a soil is its
    - (a) minimum resistance to shear stresses just before the failure
    - (b) minimum resistance to shear stresses just after the failure
    - (c) maximum resistance to shear stresses just before the failure
    - (d) maximum resistance to shear stresses

17. In a Mohr circle, the shear stress τ_f on the plane of maximum obliquity is
    - (a) less than the maximum shear stress τ_{max}
    - (b) more than the maximum shear stress τ_{max}
    - (c) equal to the maximum shear stress τ_{max}
    - (d) numerically equal to $(\sigma_1-\sigma_3)/2$

18. Which of the following test is not used to measure the shear strength of a soil?
    - (a) Triaxial Compression Test
    - (b) Standard Proctor Test
    - (c) Unconfined Compression Test
    - (d) Shear Vane Test just after the failure

CHAPTER – 10 SLOPE STABILITY

1. For assessing the long-term stability of a slope in stiff fissured clay which type of the following laboratory test has to be done.
    - (a) Undrained triaxial test
    - (b) Drained triaxial test
    - (c) Consolidated undrained test
    - (d) Quick vane shear test

2. To determine stability of earth dam slopes immediately after construction the pore pressure are generally estimated using
    - (a) Bishop's method
    - (b) Hilf's method
    - (c) Culmam's method
    - (d) Kirchoff's method

3. Bishop's method of stability analysis
    - (a) Is more conservative
    - (b) Is not preferred
    - (c) Neglects the effect of forces acting on the sides of the slices
    - (d) Assumes the slip surface as an arc of a circle.

7. In a soil mass, Earth pressure at rest is _____ than active earth pressure and _____ than passive earth pressure
   (a) Greater, greater
   (b) Smaller, smaller
   (c) Greater, smaller
   (d) Smaller, greater

8. The coefficient of active earth pressure for a loose sand having an angle of internal friction of 30^0 is
   (a) 1 / 3
   (b) 3
   (c) 1
   (d) 1 / 2

9. Coefficient of earth pressure at rest is
   (a) Less than coefficient of active earth pressure but greater than coefficient of passive earth pressure
   (b) Greater than coefficient of active earth pressure but less than coefficient of passive earth pressure
   (c) Less than both coefficient of active earth pressure and coefficient of passive earth pressure
   (d) Greater than both coefficient of active earth pressure and coefficient of passive earth pressure

10. In an active state of plastic equilibrium in a non-cohesive soil with horizontal ground surface
   (a) the major principal stress is horizontal
   (b) the minor principal stress is vertical
   (c) the major principal stress is vertical
   (d) the minor and major principal stresses are equally inclined to horizontal

CHAPTER – 12 SHALLOW FOUNDATION

1. The number of blows observed in a Standard Penetration Test (SPT) for different penetration depths are given as follows:

Penetration of sampler	No. of blows
0-150 mm	6
150-300 mm	8
300-450 mm	10

   The Standard Penetration Number (N) will be
   (a) 8
   (b) 14
   (c) 18
   (d) 24

2. The bearing capacity factors Nc, Nq and Nγ are functions of
   (a) Width and depth of footing
   (b) Cohesion of soil
   (c) Density of soil
   (d) Angle of internal friction of soil

3. In case of footings in sand, if the soil pressure distribution is triangular, the maximum soil pressure is _____ the average soil pressure.
   (a) equal to
   (b) Double
   (c) three times
   (d) four times

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Test Series Available..

Total weekly test : 35

Total mid subject test : 16

Total full length test : 13

Mock test : 16

Total test : 80

13. In case of foundations on black cotton soils, the most suitable method to increase the bearing capacity of soils is to
    (a) Increase the depth of foundation (b) Drain the soil
    (c) Compact the soil (d) Replace the poor soil

14. A raft foundation is to be constructed on a sandy soil. As per IS code, the maximum differential settlement and maximum limiting settlement range are respectively
    (a) 40 mm, 65 mm to 100 mm (b) 40 mm, 40 mm to 65 mm
    (c) 25 mm, 65 mm to 100 mm (d) 25mm, 40mm to 65 mm

15. In a raft foundation, the ratio of intensity of soil pressure 'p' and the average settlement 's' is known as
    (a) Modulus of subgrade reaction (b) Reaction coefficient
    (c) Settlement coefficient (d) Compressibility coefficient

16. Rise of water table in cohesionless soils upto ground surface reduces the net ultimate bearing capacity approximately by
    (a) 25 % (b) 33 %
    (c) 50 % (d) 75 %

17. The allowable bearing capacity is based on
    (a) Shear failure of soil (b) Settlement criteria of soil
    (c) Both shear and settlement criteria of soil (d) Equal to safe bearing capacity (SBC)

18. The ___ test is used to determine the beating capacity of foundation on saturated homogeneous clay immediately after construction.
    (a) Unconsolidated, undrained (b) Consolidated, undrained
    (c) Consolidated, drained (d) Unconsolidated, drained

19. For multi- storeyed buildings having isolated foundations on sand, the maximum permissible settlement is
    (a) 50 mm (b) 60 mm
    (c) 75 mm (d) 100 mm

20. The factor of safety for shallow foundation against overturning shall be not less than _____ when dead load, live load and earth pressures are considered together with wind load or seismic forces.
    (a) 1.5 (b) 2.0
    (c) 2.5 (d) 3.0

21. Terzaghi's bearing capacity factors namely N_c, N_q, N_γ are functions of
    (a) Shape of the foundation (b) Size of the foundation
    (c) Angle of shearing resistance (d) Cohesion

22. As per IS 1904-1986 all foundations shall extend to a depth of at least below _____natural ground level
    (a) 500 mm (b) 1000 mm
    (c) 1500 mm (d) 2000 mm

7. Mechanical stabilization requires
   (a) Addition of chemical to soils
   (b) Mixing of two or more types of natural soils
   (c) Mixing of lime with soils
   (d) Addition of cementing material to soils

8. Which of the following formation has poor permeability, but seepage is possible?
   (a) Aquifer
   (b) Aquiclude
   (c) Aquifuge
   (d) Aquitard

9. Sand drains are used to
   (a) Reduce settlement
   (b) Accelerate consolidation
   (c) Increase permeability
   (d) Transfer load

10. With respect to the site investigation for a foundation, significant depth is defined as
   (a) the depth upto which the stress increment due to superimposed load can produce significant settlement
   (b) the depth at which the ground water is encountered
   (c) the depth at which a rock strata is obtained
   (d) the depth at which coefficient of consolidation equals coefficient of compressibility

23. (a) Relation between porosity and void ratio is
    n = porosity
    e = void ratio
    $\therefore e = \frac{n}{1-n}$

24. (d) Lacustrine soils are soils deposited in lake beds.

25. (b) Plasticity index $(I_p) = W_L - W_p$
    If W_p is greater than W_L, than plasticity index is reported as zero.

26. (b) Toughness index $= \dfrac{\text{Plasticity Index}}{\text{Flow Index}}$

27. (b)

Consistency	Description	I_C
Liquid	Liquid	< 0
Plastic	Very Soft	0-0.25
	Soft	0.25-0.5
	Medium Stiff	0.5-0.75
	Stiff	0.75-1.00
Semi Solid	Very stiff or Hard	>1
Solid	Very Hard	>1

28. (d) For a soil to be well graded:
    $[1 < Cc < 3]$ and $[C_u > 4]$ for gravels
    $[C_u > 6]$ for sands
    For uniform soils/poorly graded soils, $C_u \approx 1$

29. (b) The effective size, uniformity co-efficient and coefficient of curvature are used to define grading of soil.

Chapter – 2 Soil Classification

1. (a) The cone penetrometer is used to determine plastic limit.

2. (c) The consistency limits and related indices are useful for soils classification.

3. (c) Consistency Index
    $I_c = \dfrac{W_L - W_N}{W_L - W_P}$
    $= \dfrac{60 - 30}{60 - 28}$
    $= 0.9375$
    So, I_c is in the range of $0.75 - 1.00$, it is stiff soil.

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7. (b) In a sedimentary Soil deposit, permeability in horizontal direction is greater than that in the vertical direction.

8. (a) Constant head permeability test is useful for coarse grain soil and it is a laboratory method.

9. (b) Air entrapped in the soil and organic matter block the passage of water through soil, hence permeability considerably decreases.

11. (c) Discharge velocity $V = 5 \times \frac{10^{-7} \text{ m}}{\text{s}}$
    $e = 0.5$
    Porosity (n) $= \frac{e}{1+e} = \frac{0.5}{1.5}$
    Seepage velocity $= V_S = \frac{V}{n}$
    $V_s = \frac{5 \times 10^{-7} \times 1.5}{0.5}$
    $V_s = 15 \times 10^{-7}$ m/s

12. (b) Unit of permeability is sec/m.

13. (b) From kozney-korman equation
    $k = \frac{1}{c} \times \frac{1}{S^2} \times \frac{\gamma_\omega}{\mu} \times \frac{e^3}{1+e}$
    $k \propto \frac{\gamma_\omega}{\mu}$
    $\frac{k_1}{k_2} = \frac{\mu_2}{\mu_1} \times \frac{\gamma_{\omega_1}}{\gamma_{\omega_2}}$
    $\frac{k}{k_2} = \frac{0.7\mu}{\mu} \times \frac{\gamma_\omega}{0.9\gamma_\omega}$.
    $k_2 = \frac{k \times 0.9}{0.7}$
    $k_2 = 1.2857 \text{ k}$
    Change in k = 28.57%

14. (c) The permeability of a soil deposit in -situ can be best obtained by pumping test.

15. (b) Critical hydraulic gradient
    $i = \frac{G-1}{1+e} = \frac{2.7-1}{1+0.7} = 1$
    The hydraulic head that would produce a quick condition in sand stratum.
    $= i \times \text{thickness}$
    $= 1 \times 2$
    $= 2$

16. (c) Piping occurs, when flow is upwards.

18. (c) Pore water pressure is also called as neutral pressure because, it gets neutralized by complementary pore pressure.

GPSC - CIVIL

Structural
Analysis

The content of this book covers all PSC exam syllabus
such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

13. (c) Quick sand is a hydraulic condition usually observed in coarse silt or fine sand subject to artesian conditions.

Chapter – 6 Stress Distribution

1. (b) The westergaard analysis is used for stratified soils.

2. (b) Westergaard's analysis for stress distribution beneath loaded areas is applicable to clayey soils.

4. (c) Westergaard's equation can be adopted for computing the pressure distribution for stratified soil layers.

5. (d) Boussinesq's theory does not depend upon the poisson's ratio.

6. (c) As compaction energy increases, MDD increases and OMC decreases.

Chapter – 7 Compaction

1. (c) The more the loss of water the more the shrinkage. On DS the available WC is relatively less and hence there will be low shrinkage.

2. (c) Optimum moisture content → Max. dry density
Vibratory rollers → compaction of granular soil
Zero air void line → 100% saturation

3. (a) Oedometer tests are performed by applying different loads to a soil sample and measuring the deformation response. The result from these tests is used to predict how a soil in the field will deform in response to a change in effective stress.

4. (c) If compacting effort increased it will increase maximum dry density and it decreases the OMC.

5. (b) Sheep foot rollers are used for compacting road and railway embankments of sandy soils.

6. (a) Clay < silty clay < sand < gravel sand clay mixture

7. (c) In a compaction test if the compacting effort is increased, it will result in increase in maximum dry density and decrease in optimum moisture content.

Chapter – 8 Consolidation

1. (d) Undisturbed soil samples are required for consolidation test.

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4. (c) By Taylor's stability method safe height of slope is
    $$H_C = \frac{C}{\gamma\, F_c S_n} = \frac{2}{2 \times 2 \times 0.1} = 5 \text{ m}$$

5. (b) In active state of plastic equilibrium in a non cohesive soil with horizontal ground surface major principal stress is vertical.

6. (c) The descending order of earth pressure intensity is
    Passive > At rest > Active

Chapter – 11 Lateral Earth Pressure

1. (c) Rankine's theory of earth pressure assumes that back of the wall is vertical and smooth.

2. (b) The angle of internal friction of round grained loose sand is about 25° to 30°.

3. (b) Coefficient of active earth pressure:
    $$K_a = \frac{1 - \sin\phi}{1 + \sin\phi} = \frac{1 - \sin 30°}{1 + \sin 30°}$$
    $$K_a = 0.33$$

4. (d) $\dfrac{k_p}{k_a} = \left[\dfrac{1 + \sin\phi}{1 - \sin\phi}\right]^2 = \left[\dfrac{1 + \sin 30°}{1 - \sin 30°}\right]^2 = 9$

5. (c) Theoretical depth to which the clay can be excavated without side collapse:
    $$H_C = \frac{4c}{\gamma\, \sqrt{K_a}} = \frac{4 \times 18}{16 \times \sqrt{1}} = 4.5 \text{ m}$$

6. (c) Rankine's theory of earth pressure assumes that the back of the wall is vertical and smooth.

7. (c) In a soil mass, earth pressure at rest is greater than active earth pressure and smaller than passive earth pressure.

8. (a) $K_a = \dfrac{1 - \sin\phi}{1 + \sin\phi} = \dfrac{1 - \sin 30°}{1 + \sin 30°} = \dfrac{1}{3}$

9. (b) Coefficient of earth pressure at rest is greater than coefficient of active earth pressure, but less than coefficient of passive earth pressure.

10. (c) In an active state of plastic equilibrium in a non cohesive soil with horizontal ground surface the major principal stress is vertical.

13. (c) Load carrying capacity of pile group
= Group efficiency factor $\times$ No. of piles $\times$ individual pile capacity
= $0.8 \times 9 \times 200$
= $1440 KN$

Chapter – 14 Soil Exploration

1. (a) Split spoon sampler is most commonly used sampler for obtaining a disturbed sample of soil.

2. (d) Lime stabilization is very effective in treating plastic clayey soils.

3. (c) Auger boring is used in cohesive & other soft soil above the water table.

4. (d) A stand pipe in the grout hole is absolutely essential during grouting operation of soil, when
    (i)   There are many surface cracks.
    (ii) Rock is very weak.
    (iii) Drainage is towards the hole.

5. (c) Resistivity logging method is used in subsurface investigation of GW.

6. (b) Diamond core drilling → Exploration upto a shallow depth below ground level.
Open pit excavation → Rocky formation
Uncased wash boring → Soft cohesive soils and cohesionless soils for large depths.
Cased boring → Medium strong cohesive soils.

7. (b) Mechanical stabilization requires mixing of two or more types of natural soils.

8. (d) Aquitard has poor permeability, but seepage is possible.

9. (b) Sand drains are used to accelerate consolidation.

10. (a) **Significant depth:**
Depth upto which increase in the pressure due to structural loading is likely to cause shear failure. For footing, depth of exploration = 1.5 B.

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18. Basic principle of Surveying "working from whole to part" is
    (a) To complete the work rapidly
    (b) To prevent accumulation of errors
    (c) To avoid mistakes in work
    (d) All of the above

19. The type of survey in which the curvature of the earth's surface is neglected, is called
    (a) Plane survey
    (b) Geodetic survey
    (c) Preliminary survey
    (d) Aerial survey

CHAPTER – 2 LINEAR MEASUREMENT

1. A metallic tape is made of
   (a) Steel
   (b) Invar
   (c) A composite material of steel and brass
   (d) Cloth interwoven with metallic fibres

2. If the slope of a ground is 3°, then the gradient can be represented as
   (a) 1:3
   (b) 1:9
   (b) 1:12
   (d) 1:19

3. Normal tension for a tape is defined as the pull
   (a) Applied by an average adult
   (b) Applied for standardizing the tape
   (c) Which equalizes the effect due to sag
   (d) That equalizes the effect due to the slope

4. Correction due to sag of a tape is
   (a) Always positive
   (b) Always negative
   (c) Sometimes positive and sometime negative
   (d) Dependent on the temperature

5. A lighthouse is visible above the horizon at a certain station at the sea level. If the distance between the station and the lighthouse is 40 km, then the height of lighthouse is approximately
   (a) 108 m
   (b) 126 m
   (c) 132 m
   (d) 148 m

6. The total length of eight links in a 'Revenue chain' is
   (a) 16.5 feet
   (b) 33 feet
   (c) 26 feet
   (d) 13 feet

7. Which of the following instruments is used for measurement of bases in India by the Survey of India?
   (a) Tellurometer
   (b) Jaderin's apparatus
   (c) Colby apparatus
   (d) Hunter's short base

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Total full length test   : 13

Mock test   **: 16**

Total test   **: 80**

17. If the actual length of a 20 m chain is found to be 19.8 m, then the actual length of a line measured as 100 m with that chain will be
    (a) 98 m   (b) 99 m
    (c) 101 m   (d) 102 m

18. Correction due to sag of a tape is
    (a) Always positive   (b) Always negative
    (c) Sometimes negative and   (d) Dependent on the temperature
        sometimes positive   conditions

19. In an optical square, the two mirrors are placed at an angle of
    (a) 30°   (b) 45°
    (c) 60°   (d) 90°

20. The instrument used to set out right angles to a chain line is
    (a) Cross staff   (b) Optical square
    (c) Prism square   (d) All of the above

21. Clinometer is used for chaining
    (a) Sloping ground   (b) Around water bodies
    (c) When ends are not intervisible (d) All of the above

22. Error in chaining due to sag is
    (a) Cumulatively negative   (b) Cumulatively positive
    (c) Cumulatively positive or negative (d) Non cumulative negative

CHAPTER – 3 COMPASS SURVEY

1. If the bearing of line AB is N87°32'00"E and that of line BC is S 65°35'20"E, then the deflection angle between the lines at B is
   (a) 21°56'40"   (b) 26°52'40"
   (c) 115°6'40"   (d) 153°07'20"

2. The latitude of a line is
   (a) The average latitude in which the lines lie   (b) The projection of the line on the east-west meridian
   (c) The projection of the line on the north-south meridian   (d) The projection of the line with respect to the great circle

3. If the latitude and departure of a line are 100 m and 45.83 m, then the length of the line is
   (a) 54.17 m   (b) 110.0 m
   (c) 145.83 m   (d) 88.9 m

4. The magnetic bearing of a line AB is S52°30'W. If the magnetic declination is 4°15'W, then the true bearing of the line will be
   (a) S48°15' E   (b) S56°45'W
   (c) S48°15'W   (d) S56°45'E

14. Imaginary line passing through points having equal magnetic declination is termed as
    (a) Isogonic line
    (b) Isoclinic line
    (c) Agonic line
    (d) Aclinic line

15. The reduced bearing of a line is N 87°W. Its whole circle bearing is
    (a) 93°
    (b) 87°
    (c) 3°
    (d) 273°

16. The whole circle bearing of line AB and AC are 20°15' and 337°45' respectively. What is the value of the included angle BAC?
    (a) 317°30'
    (b) 42°30'
    (c) 358°
    (d) 177°

17. A bearing of a line is also known as
    (a) Reduced bearing
    (b) True bearing
    (c) Magnetic bearing
    (d) Azimuth

18. A negative declination shows that the magnetic meridian is to the
    (a) Eastern side of the true meridian
    (b) Western side of the true meridian
    (c) Southern side of the true meridian
    (d) Northern side of the true meridian

19. The horizontal angle between the true meridian and magnetic meridian at a place is called
    (a) Azimuth
    (b) Declination
    (c) Local attraction
    (d) Magnetic bearing

20. In Surveyor's compass the incorrect statement is
    (a) Needle is edge bar type
    (b) Graduations are engraved erect
    (c) Graduations are in quadrantal bearing
    (d) Reading is taken with the help of prism at eye slit

21. Isogonic lines are the lines joining equal
    (a) Magnetic meridian
    (b) True meridian
    (c) Magnetic Declination
    (d) True bearing

22. In free or loose needle survey method, direction of magnetic meridian is established at
    (a) Starting traverse station only
    (b) Any intermediate traverse station
    (c) Each traverse station
    (d) Temporary bench mark position

23. If the whole circle bearing of side AB of an equilateral triangle ABC is 38°45', then the bearing of the third side CA of the triangle is
    (a) 278°45'
    (b) 197°30'
    (c) 98°45'
    (d) 81°15'

20. Hypsometry is a method of
    (a) Surveying of water bodies
    (b) Determining elevations based on the boiling point of liquids
    (c) Determining elevations based on the atmospheric pressure
    (d) Finding temperatures at different heights

CHAPTER – 5 THEODOLITE SURVEY

1. In a theodolite, the circular main scale is divided into degrees and each degree is divided into three parts. If the theodolite is to have a least count of 20", then............. main scale divisions are divided into .... vernier scale divisions
    (a) 19, 20
    (b) 29, 30
    (c) 49, 50
    (d) 59, 60

2. To change the reading on the circle while measuring an angle
    (a) Upper clamp is tightened and lower clamp is loosened
    (b) Upper clamp is loosened and lower clamp is tightened
    (c) Both upper and lower clamps are loosened
    (d) Both upper and lower clamps are tightened

3. In the method of reiteration of measuring horizontal angles,
    (a) The same angle is measured three times
    (b) The same angle is measured by face-left and face-right observations
    (c) The angle is measured and the instrument turned to close the horizon
    (d) The angle is measured three times each using face- left and face-right observations

4. When you transit the telescope, you rotate the telescope about the
    (a) Trunnion axis
    (b) Vertical axis
    (c) Optical axis of the telescope
    (d) Line of collimation

5. In the method of repetition for measuring horizontal angles, to rotate the instrument without changing the readings,
    (a) Lower clamp screw is tightened and upper clamp is loosened
    (b) Lower clamp screw is loosened and upper clamp is tightened
    (c) Any one of the clamp screws is loosened
    (d) Both the clamp screws are loosened

6. Optical plummet is used
    (a) In optic theodolite for compensating any tilt in the axis
    (b) In electronic theodolite for compensating any tilt in the axis

9. A transition curve is essentially used to
   (a) Generate more frictional forces for stability
   (b) Allow vehicles to have increased speed while driving
   (c) Neglect the effect of centrifugal forces
   (d) Avoid abrupt change in radius from a straight line to a finite radius curve

10. Which one of the following is carried out by two theodolite method ?
    (a) Circular curve ranging
    (b) Tachometry survey
    (c) Geodetic survey
    (d) Astronomical survey

11. The angle of intersection of a curve is the angle between the
    (a) Back tangent and forward tangent
    (b) Prolongation of back tangent and forward tangent
    (c) Forward tangent and long chord
    (d) Back tangent and long chord

12. Which of the following is carried out by the two theodolite method?
    (a) Circular curve ranging
    (b) Tacheometry survey
    (c) Geodetic survey
    (d) Astronomical survey

13. Which one of the following is not used for setting out circular curve
    (a) Rankine method of tangential angle
    (b) Two theodolite method
    (c) Three theodolite method
    (d) Tachometric method

14. In using the two-theodolite method for setting curves, the principle used is
    (a) Deflection angle is equal to the tangential angle for any chord to the point
    (b) Angle of intersection is the same as the angle subtended at the centre
    (c) deflection to any point P from the first tangent is the same as the angle between the long chord and the direction to P from the second tangent point
    (d) Equal chords subtend equal angles at the centre

CHAPTER – 8 AREAS AND VOLUMES

1. In a topographical map of a proposed reservoir the area enclosed by contour lines is Shown below

Contour (m)	Area enclosed (ha)
105	100
110	150
115	350
120	500
125	900

The Volume of impounded water using trapezoidal formula will be
   (a) 5000 ha-m
   (b) 7500 ha-m
   (c) 8200 ha-m
   (d) 10000 ha-m

5. Stadia tacheometry is based on the principle that
   (a) Trigonometrical formulae can be used to calculate distances from vertical angles
   (b) Intercepts on measuring rods are proportional to the distance
   (c) Horizontal distances vary linearly as vertical angles
   (d) Knowing the side and two angles of a triangle, another side can be calculated

6. The multiplying constant in the distance formula by tacheometry is given by
   (a) Focal length of the objective lens divided by the distance between the stadia wires
   (b) Focal length of the objective lens multiplied by the distance between the stadia wires
   (c) Stadia intercept divided by the focal length of the objective lens
   (d) Stadia intercept multiplied by the focal length of the objective lens

CHAPTER – 10 PHOTOGRAMMETRY

1. Terrestrial photogrammetry is taking photographs of
   (a) The terrain of the earth from a moving aircraft
   (b) The terrain of the earth from a static aircraft
   (c) The terrain of the earth from cameras on ground
   (d) Celestial bodies from a moving aircraft

2. Overlap in aerial photography refers to
   (a) The overlap of ground features due to inclination of cameras
   (b) The overlap of ground features due to difference in elevations of objects
   (c) The same ground features taken from two camera positions
   (d) The blurring due to lack of focus in photographs

3. Parallax in aerial photographs is an error due to
   (a) Movement of camera and ground relief
   (b) Overlap in photographs
   (c) Distortion caused by camera lens
   (d) Distortion due to lack of focus

4. In a vertical photograph, relief displacement is always radial from the
   (a) Isocenter
   (b) Nadir point
   (c) Zenith point
   (d) Principal point

5. If net length covered by each photograph is 1.5 km and length of the strip is 18 km, then number of photographs required is
   (a) 11
   (b) 12
   (c) 13
   (d) 14

6. The elevations of objects on an aerial photograph can be measured due to
   (a) Tilt
   (b) Drift
   (c) Overlap
   (d) Stereoscopic fusion

GPSC - CIVIL
Surveying

The best Brains of the Nation may be found on the last Benches of the Classroom.

A.P.J. Abdul Kalam

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SOLUTIONS

Chapter – 1 Introduction

1 (c), 2 (a), 3 (d), 4 (c), 5 (c or d), 6 (a), 7 (c), 8 (a), 9 (b), 10 (c), 11 (a), 12 (a), 13 (b), 14 (d), 15 (b), 16 (a), 17 (c), 18 (d), 19 (a)

Chapter – 2 Linear Measurement

1 (d), 2 (d), 3 (c), 4 (b), 5 (a), 6 (a), 7 (c), 8 (c), 9 (d), 10 (a), 11 (b), 12 (b), 13 (a), 14 (c), 15 (b), 16 (c), 17 (b), 18 (b), 19 (b), 20 (d), 21 (a), 22 (b)

Chapter – 3 Compass Survey

1 (b), 2 (c), 3 (b), 4 (c), 5 (c), 6 (b), 7 (c), 8 (b), 9 (c), 10 (d), 11 (d), 12 (c), 13 (b), 14 (a), 15 (d), 16 (b), 17 (c), 18 (b), 19 (b), 20 (d), 21 (c), 22 (c), 23 (a), 24 (c), 25 (b), 26 (a)

Chapter – 4 Levelling

1 (a), 2 (a), 3 (c), 4 (d), 5 (a), 6 (d), 7 (b), 8 (d), 9 (c), 10 (c), 11 (d), 12 (c), 13 (d), 14 (b), 15 (c), 16 (c), 17 (b), 18 (d), 19 (c), 20 (b)

Chapter – 5 Theodolite Survey

1 (d), 2 (b), 3 (d), 4 (a), 5 (b), 6 (c), 7 (d), 8 (d), 9 (c), 10 (c), 11 (a), 12 (c), 13 (c), 14 (c), 15 (d), 16 (b)

Chapter – 6 Trignometric Levelling

1 (b), 2 (a)

Chapter – 7 Curves

1 (c), 2 (d), 3 (b), 4 (b),5 (c), 6 (a), 7 (c), 8 (c), 9 (d), 10 (a), 11 (a), 12 (a), 13 (c), 14 (c)

Chapter – 8 Areas and Volumes

1 (b), 2 (c), 3 (b), 4 (a)

Chapter – 9 Tacheometry

1 (d), 2 (d), 3 (a), 4 (c), 5 (b), 6 (a)

Chapter – 10 Photogrammetry

1 (c), 2 (c), 3 (a), 4 (d), 5 (c), 6 (d), 7 (a), 8 (b)

Chapter – 11 Miscellaneous

1 (a), 2 (d), 3 (c), 4 (d), 5 (d), 6 (c), 7 (a), 8 (a), 9 (b), 10 (b), 11 (b), 12 (a), 13 (b), 14 (a), 15 (c), 16 (c), 17 (a), 18 (b), 19 (c)

14. (c) $\therefore$ Csag $= \dfrac{w^2 l}{24p^2}$

$\therefore$ The magnitude of the sag correction during measurement of length by chaining is proportional to the square of the weight of the chain in kg per m run.

15. (b)   Reciprocal ranging and random line ranging both are used when two stations are not intervisible.

16. (c)   The error are of two types positive and negative. If the designated length of tape is shorter than original length of tape then always, the measured length will always be greater than actual value and error will be positive and vice-versa.

17. (b)

$$L = \frac{l'}{l} \times L'$$

$$= \frac{19.8}{20} \times 100 = 99 \text{ m}$$

18. (b)   Correction due to sag of a tape is always negative.

19. (b)   In an optical square the two mirrors are placed at an angle of 45°.

20. (d)   Following are the instrument used to set out right angles to a chain line is:-
(i) Cross staff
(a) Open cross staff
(b) French cross staff
(c) Adjustable cross staff
(ii) Prism square and box or optical square

21. (a)   Clinometer is an instrument used for measuring angles of slope (or tilt), elevation, or depression of an object with respect to gravity direction.

22. (b)   Error in chaining due to sag is cumulatively positive.

Chapter – 3 Compass Survey

1. (b) $FB_{AB} = N87^0 \ 32'00''E$
$FB_{BC} = S65^0 \ 35'20''E$
Deflection angle $\Delta = (180 - 65^0 \ 35'20'') - 87^0 \ 32'00''$
$= 26^0 \ 52'40''$

2. (c)   The latitude (L) of a line is the orthographic projection of the line on the N-S axis representing the meridian

5. (a) The bench mark is a fixed point of known elevation above the datum. Any point whose elevation is definitely known can be used as a bench mark.

6. (d) When differential levelling is done in order to connect a bench mark to the starting of the alignment of any project is called fly levelling.

7. (b) tan Θ = (50 - 46.655)/150 = 1/44.84 (Falling)

8. (d) A level line is a line lying in a level surface. It is therefore normal to the plumb line at all points.

9. (c) **Backsight (B.S.):** It is the sight taken on the staff held at a point of known elevation. It is also known as plus or positive sight.

10. (c) Error due to refraction may not be completely eliminated by reciprocal levelling.

11. (d) BM = 135.15 m
RL of roof slab = 135.15 + 1.05 + 2.3
= 138.5 m

12. (c) Arithmetic check for the computation of RL by rise and fall method is
ΣB.S – ΣF.S = L.R.L – F.R.L = ΣRise - ΣFall

13. (d) Actual height difference between A&B = $284.295 - 283.665 = 0.63$
Height difference between A&B on staff readings = $3.462 - 2.847$
$= 0.615$
Distance between A&B = $50 - 25 = 25$ m
∴ collimation error per 100 m = $(0.63 - 0.615) \times \frac{100}{25} = 0.060$m

14. (b) The intercept of a staff is minimum if the staff is held truly normal to the line of Sight

15. (c) Reciprocal levelling eliminates the error due to curvature & refraction

16. (c) Arithmetic check for height of instrument method is not applied on intermediate side. $\Sigma BS - \Sigma FS$ = Last RL - First RL

17. (b) **Correction due to refraction:**
From practical observation it is seen that C_r remains 1/7 of Cc. It is always additive in nature.
∴ Cr = $\frac{1}{7}$ Cc = 0.01121 d^2

18. (d) RL of point = 123.45 m
Staff reading = 1.875 m
∴ HI = RL + staff reading
= 123.45 + 1.875
= 125.325 m

9. (c) The Descending order of precision among following types of survey is
    (i)   Micro-optic theodolite
    (ii) Theodolite
    (iii) Compass
    (iv) Chain.

10. (c) Revolving the telescope in the horizontal plane about its vertical axis is called swinging of telescope or simply Swing.

11. (a) Sensitiveness of a bubble tube depends upon:
    (i)   The radius of curvature of the internal surface i.e larger the radius greater is the sensitiveness.
    (ii) The diameter of the bubble i.e. larger the diameter, greater the sensitiveness.
    (iii) The length of the bubble i.e., larger the length greater is the sensitiveness.
    (iv) The viscosity and surface tension of liquid. i.e., lesser the viscosity more is its sensitiveness.

12. (c) Open traverse is a traverse which starts from a point of known location, but closes at another point of unknown location. An open traverse can be checked by method of chords or astronomical observations.

13. (c) In theodolite, the plate bubble in the plate level will more considerably from its central position, if the tripod leg is moved in the same direction of the bubble moved.

14. (c) (a) **Bessel's method:-** The orientation of a plane table at new station is carried out with the help of three well defined visible points available on the ground along with their corresponding plot on the plan using Bessel's graphical solution.
    (b) **Triangulation:-** Measuring all the angles and the base line.
    (C) **Bowditch rule:-** Balancing the latitudes and departures.
    (d) Adjustment of bringing the various fixed parts of the surveying instruments into proper relation with one another.

15. (d) In traverse surveying the frame work consists of a series of connected line forming an open or closed polygon. The directions of survey lines are measured by any angle measuring instruments and the sides of traverse are measured with a chain or a tape.

16. (b) The horizontal circle in a theodolite is graduated in the whole circle bearing system i.e., from 0^0 to 360^0.

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Total weekly test   : 35

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Total full length test   : 13

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Total test   : 80

7. (c) Since, tangent length (T) $= R \tan \frac{\Delta}{2}$

Length of long chord (L) $= 2\,R\sin\frac{\Delta}{2}$

$\therefore L = 2 \times T$

here T is tangent length

$\therefore$ Length of long chord is twice the tangent length

8. (c) A compound curve consists of two circular arcs of different radii with their centres of curvature on the same side of the common tangent.

9. (d) When a vehicle moves on a curve, a centrifugal force act on it. Thus, sudden transition from a straight path to a circular curve of radius R will introduce the centrifugal force suddenly. Hence, a sudden lateral shock will be felt by the passengers. To avoid this, we introduce a curve of varying radius between straight path and circular curve such that the radius changes from infinity (i.e., straight line) to a radius R of circular curve. Thus, curve of varying radius is called transitions curve.

10. (a) The method of setting out a circular curve is carried out by two theodolite method.

11. (a) The back tangent and the forward tangent when extended intersect at a point is called as the vertex and the angle made is called intersection angle.

12. (a) The method of setting out a circular curve is carried out by two theodolite method.

13. (c) Following are the Angular methods used for setting out circular curve:-
    (i) Rankine method of tangential angles.
    (ii) Two theodolite method.
    (iii) Tacheometric method.

14. (c) **Principle of Two Theodolite method:-** In this method the property of circle "that the angle between the tangent and the chord equals the angle which that chord subtends in the opposite segment" is used.

Chapter – 8 Areas and Volumes

1. (b) **Trapezoidal formula:-**
    $V = \frac{L}{2}[(A_1 + A_n) + 2(A_2 + A_3 + \cdots)]$
    $V = \frac{5}{2}[(150 + 900) + 2(100 + 350 + 500)]$
    $V = 7375 \text{ ha m } \simeq 7500 \text{ ha m}$

2. (c) If the boundary lines is irregular, Simpson's rule is most suitable to calculate the area of the given tract.

TRANSPORTATION ENGINEERING

25. According to Indian Road Congress, the width of carriage way is
    (i)   3.75 m for single lane
    (ii)   7.0 m for two lanes without raised kerbs
    (iii)   7.5 m for two lanes with raised kerbs
            Which of these statement (s) is / are true?
    (a)   (i) and (ii)   (b)   (ii) and (iii)
    (c)   (i) and (iii)   (d)   (i), (ii) and (iii)

26. For water-bound macadam roads in localities   of heavy rainfall, the recommended value of camber is
    (a)   1 in 30   (b)   1 in 48
    (c)   1 in 60   (d)   1 in 36

27. If super elevation is not provided on a horizontal curve of a highway, then on which portion of the road are the pot holes likely to develop
    (a)   Outer edge of the road   (b)   Inner edge of the road
    (c)   Centre of the road   (d)   Shoulder of the road

28. A compound curve has
    (a)   A simple circular curve and a transition curve at one end   (b)   A simple circular curve and transition curves at both the ends
    (c)   Two or more simple circular curves of different radii   (d)   Two simple circular curves having centers in opposite directions

29. A transition curve is essentially used to
    (a)   Generate more frictional forces for stability   (b)   Allow vehicles to have increased speed while driving
    (c)   Neglect the effect of centrifugal forces   (d)   Avoid abrupt change in radius from a straight line to a finite radius curve

CHAPTER – 3 HIGHWAY MATERIALS

1. California bearing ratio is a
    (a)   Measure of soil strength   (b)   Method of soil identification
    (c)   Measure to indicate the relative strengths of paving materials   (d)   Measure of shear strength under lateral confinement

2. Which of the following pairs is NOT correctly matched
    (a)   Horizontal curves -Super elevation   (b)   Origin and Destination studies-Desire Lines
    (c)   Los Angeles Test - Hardness of aggregates   (d)   Soundness test - Purity of bitumen

2. The essential difference between rigid and flexible pavements is
    (a) Distribution of load over sub-grade (b) Distribution of load over sub-base
    (c) Materials used (d) Thickness of layers

3. Rigid pavement are commonly made of
    (a) Bitumen (b) Portland cement concrete
    (c) Dry lean concrete (d) High performance concrete

4. Which of the following layer of pavement should withstand high level of deformation?
    (a) Base course (b) Sub-base
    (c) Sub-grade (d) Surfacing course

5. IRC 37-2001 revised version for flexible pavement design has been designed as
    (a) 4-layer (b) 3-layer
    (c) 2-layer (d) 5-layer

6. Strength, stability and bearing power of a highway depend on
    (a) Sub base course (b) Sub grade
    (c) Base course (d) Wearing course

7. The instrument used to measure Roughness index is
    (a) Profilometer (b) Deflectometer
    (c) Brinellnometer (d) Bump integrator

8. The group index value of a soil sub grade is 7. The sub grade soil is rated as
    (a) Poor (b) Very poor
    (c) Good (d) Fair

9. Dowel bars in concrete pavement are placed
    (a) Perpendicular to the direction of traffic (b) Along the direction of traffic
    (c) Along 45° to the direction of traffic (d) Can be placed along any direction

10. Which of the following strength parameter of concrete is used in the design of a plain jointed cement concrete pavement:
    (a) Tensile strength (b) Compressive strength
    (c) Shear strength (d) Flexural strength

11. The critical combination of stresses for corner region in cement concrete roads is
    (a) Load stress + warping stress - frictional stress (b) Load stress + warping stress + frictional stress
    (c) Load stress + warping stress (d) Load stress + frictional stress

12. For the Pavement design, Benkelman Beam is used for which of the following?
    (a) Design of bituminous concrete mix (b) Overlay design
    (c) Gradation of asphalt design (d) Determination of softening point

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Water Resource Engineering

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2. Which set of traffic studies is needed for functional design as well as for highway capacity design.
   (a) Origin and Destination studies
   (b) Parking and Accident studies
   (c) Speed and volume studies
   (d) Axle load studies

3. Speed and Delay study is conducted by which of the following method / instrument
   (a) Floating car method
   (b) Workspot interview method
   (c) Doppler Radar
   (d) Electronic Detector

4. Space mean speed is used for which of the following studies
   (a) Road conditions studies
   (b) Accident studies
   (c) Traffic flow studies
   (d) Delay studies

5. Traffic volume can be defined as
   (a) Number of vehicles occupying a unit length of road at a given instant of time
   (b) Number of vehicles at the cross roads.
   (c) Number of vehicles passing a given point on road in a given unit of time in a given direction.
   (d) Number of vehicles passing a given point on road in a given unit of time in all the possible directions.

6. In highway geometric design, once the cumulative speed distribution is drawn, the design speed is checked at which percentile?
   (a) 85th percentile
   (b) 95th percentile
   (c) 98th percentile
   (d) 99th percentile

7. When the speed of the traffic flow becomes zero, then
   (a) Traffic density attains its maximum value whereas traffic volume becomes zero
   (b) Traffic density and traffic volume both attain respective maximum values
   (c) Traffic density and traffic volume both becomes zero
   (d) Traffic density becomes zero whereas traffic volume attains its maximum value.

8. It was noted that on a section of road, the free speed was 80 kmph and the jam density was 70 vpkm. The maximum flow in vph that could be expected on this road is
   (a) 800
   (b) 1400
   (c) 2800
   (d) 5600

9. Travel time and delay studies on a defined section of highway are conducted by
   (i) Traffic Counters
   (ii) Floating Car Method
   (iii) Moving vehicle method
   (iv) Radar Gun
   (a) Only (ii)
   (b) (ii) and (iii)
   (c) (i), (ii) and (iii)
   (d) (ii) and (iv)

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18. For long span such as 800 m, which type of bridge is provided?
    (a) Beam bridges (b) Cantilever bridges
    (c) Truss bridges (d) Suspension bridges

CHAPTER – 8 RAILWAY ENGINEERING

1. Which one of the following types of steels is used in the manufacture of rails?
   (a) Mild steel (b) Manganese steel
   (c) Cast steel (d) Bessemer steel

2. The main function of Fish plates in rail joints is to:
   (a) Join two rails together (b) Provide for any expansion or contraction
   (c) Transfer the load to the ballast (d) Join rails with sleeper

3. The distance through which the tongue rail moves laterally at the toe of the switch for movement of trains is called
   (a) Flangeway clearance (b) Heel divergence
   (c) Throw of the switch (d) Flangeway of the heel

4. For a Broad Gauge route with N+7 sleeper density, the number of sleepers per rail length is
   (a) 18 (b) 19
   (c) 20 (d) 21

5. For a sleeper density of (N+5), the number of sleepers required for constructing a broad gauge railway track of length 650 m is
   (a) 975 (b) 900
   (c) 918 (d) 880

6. On Indian Railways, the maximum gradient permitted in station yards is taken as
   (a) 1 in 200 (b) 1 in 300
   (c) 1 in 400 (d) 1 in 500

7. Railway tunnels, are generally
   (a) Polycentric (b) Rectangular
   (c) Parabolic (d) Circular

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2. (d) Perpendicular offset from the junction of a transition curve and circular curve to the tangent $= 4 \times$ Shift.

3. (c) Full amount of super elevation is provided at the end of transition curve.

4. (d) $P = \dfrac{WV^2}{gR}$

$P \propto 1/W^{1/2}$

5. (c) A clothoid is an ideal transition curve in which length is inversely proportional to the radius of the curve.

6. (c) Shift of Curve $= \dfrac{L^2}{24R}$

7. (a) The 30th highest hourly volume is the hourly volume that will be exceed only 29 times in a year and all other hourly volumes will be less than this value.

8. (a) Two circular curves with opposite deflection angles is known as reverse curve.

9. (c) Braking Distance $= \dfrac{V^2}{2g\,(f \pm n)}$

It does not depend on reaction time

10. (d) Total reaction time $=$ Perception time $+$ Brake reaction time
Perception time varies from driver to driver and also depends upon several of the vehicle, distance of object and other environmental conditions.
According to PIEV (Perception, Intellection, Emotion and Volition) theory, the total reaction time depends upon several factors such as physical and psychological characteristics of the driver, type of the problem involved, environmental conditional and temporary factors (e.g. motive of the trip, travel speed, fatigue, consumption of alcohol, etc.).

11. (a) As per IRC, ISD $= 2$ SSD

12. (c)

Pavement	Heavy rainfall area	Light rainfall area
Cement concrete High bituminous	2%	1.7%
Thin bituminous	2.5%	2%
WBM	3%	2.5%
Earth Road	4%	3%

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Transportation Engineering

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22. (b) $e = \dfrac{V^2}{225R}$

$e = \dfrac{100^2}{225 \times 500} = 0.08 > 0.07$

Now $e + f = \dfrac{V^2}{127R}$ and $e = 0.07$

$f = \dfrac{100^2}{127 \times 500} - 0.07 = 0.08 < 0.15$

Therefore, $e = 0.07$

23. (a)

Pavement	Heavy Rainfall Area	Light Rainfall Area
Cement concrete or High Bituminous	2%	1.7%
Thin Bituminous	2.5%	2%
WBM	3%	2.5%
Earth Road	4%	3%

24. (c) Length of transition curve depends on both radial acceleration and rate of change of super elevation.

25. (d)

Lane	Width (m)
Single	3.75
Two lane without kerb	7
Two lane with kerb	7.5
Intermediate lane	5.5
Multiple lane	3.75 ×No. of lane

26. (a)

Pavement	Heavy Rainfall Area	Light Rainfall Area
Cement concrete or High Bituminous	2%	1.7%
Thin Bituminous	2.5%	2%
WBM	3%	2.5%
Earth Road	4%	3%

27. (a) If super elevation is not provided on a horizontal curve of a highway, then pot holes are likely to develop along outer edge of the road.

28. (c) A compound curve has two or more simple curves with different radii that bend the same way and are on the same side of a common tangent.

29. (d) A transition curve is essentially used to avoid abrupt change in radius from a straight line to a finite radius curve. Transition curves are provided to serve following purposes:
    - To provide super elevation in a gradual manner and to reduce the radius from infinity at a straight junction to a radius R at curved junction gradually.
    - Transition curves also reduces the effect of sudden jerk on passengers due to the effect of centrifugal force induced on vehicles at curves.

5. (b) IRC 37-2001 revised version for flexible pavement design has been designed as 3-layer.

6. (b) Strength, stability and bearing power of a highway depends on subgrade.

7. (d) Bump Integrator also known as Roughometer or Automatic Road Unevenness Recorder gives quantitative integrated evaluation of surface irregularities on a digital counter.
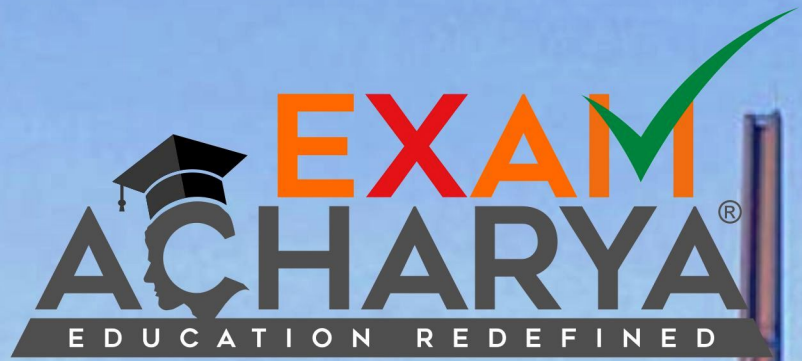
8. (a)

Type of Subgrade Soil	Group Index range of subgrade
Good	0-1
Fair	2-4
Poor	5-9
Very Poor	10-20

9. (b) Dowel bars are typically placed at the mid-depth of the slab and should be parallel to the pavement surface and parallel to the direction of travel.

10. (d) Pavement made up of cement acts as a beam, even though the soil below the pavement settles at some sections, the whole beam will either not settle or settlement will take place as a whole, similar to a beam. Thus, plain jointed cement pavement will be designed for appropriate flexural strength.

11. (c) At corner regions there are no frictional stresses, the critical combination occurs at top fibre of slab during mid nights.
critical stress combination = (load stress + warping stress), at corner region

12. (b) Benkelman Beam Deflection (BBD) technique is widely used all over the world for evaluation of structural capacity of existing flexible pavements and also for estimation and design of overlays for strengthening of any weak pavement.

13. (b) As per IRC guidelines for designing flexible pavements by the CBR method, the load parameter required is cumulative standard axles in Million Standard Axle.

14. (d) Modulus of subgrade reaction is the reaction pressure sustained by the soil sample under a rigid plate of standard diameter per unit settlement measured at a specified pressure or settlement.

15. (b) Group Index method of flexible pavement design is an empirical method which is based on the physical properties of the soil sub-grade.

16. (c) California Bearing Ratio method of designing flexible pavements is more accurate as it involves character of the road making materials.

16. (d) (i) Bearings are provided in bridges to transmit the load from superstructure to the substructure.
    (ii) Fixed bearing allow rotational and limited translational movements.
    (iii) The design of bearing depends upon the type of superstructure, type of supports and also on the length of support.

17. (d) Breast Wall, Wing Wall and Back Wall are the components of an abutment.

18. (d) For long span such as 800 m, suspension bridge is provided.

Chapter – 8 Railway Engineering

1. (b) The normal rails are made of steel containing 0.7% C and 1% Mn, which are called as Carbon Manganese rail steel.

2. (a) Functions of Fish Plates are:
   (i) To join the rail ends to maintain the line and level of the top table and gauge face of the rail ends and to resist the impact and prevent the deflection of the rail joint with the help of closely spaced sleeper support.
   (ii) To transfer the load of the wheels from one rail to the other.
   (iii) To provide vertical and lateral stiffness to the rail joint.
   (iv) To allow for the expansion and contraction of rail ends due to temperature variations.

3. (c) **Throw of Switch:** It is the distance through which the toe of the tongue rail moves sideways to provide desired direction over the turnout.

4. (c) Sleeper density $= M + x$
   where M = Rail length
   For Broad gauge: Rail length is equal to 12.8 approximately equal to 13 m
   M + 7 = 13 + 7 = 20

5. (b) Number of sleepers $= 13 + 5 = 18$
   Rail length $= 13$ m
   So total 18 sleepers are there in 1 rail length (i.e., in 13m)
   So, Number of sleepers required for 650 m $= (18/13) \times 650 = 900$

6. (c) In Indian Railways, the maximum gradient permitted in station yards is taken as 1 in 400 while the minimum gradient recommended for station yard is 1 in 1000.

7. (a) Railway tunnels are generally polycentric as well as it has number of centers and provides a sufficient flat base for traffic movement.