

Approximate Weightage of Different Subjects

AAE (Civil)

02.05.2018

Sr. No	Subject	Marks
1	Building Drawing	10
2	Basic Mechanical Engineering	10
3	Building Material	20
4	Construction Technology & Management	20
5	Concrete Technology	15
6	Surveying	20
7	Water Supply & Sanitary Engineering	25
8	Water Resources Engineering	15
9	Hydraulics	15
10	Applied Mechanics	5
11	Design of Structures	5
12	Soil Mechanics	10
13	Basic Transportation Engineering	5
14	Environment Conservation & Hazard Management	10
15	Estimating, Costing & Valuation	15
Total Marks...		200

જગ્યાનું નામ : અધિક મદદનીશ ઇજનેર (સિવિલ) વર્ગ - ૩
(ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ, ગાંધીનગર)

પ્રાથમિક કસોટીનો અભ્યાસક્રમ		
ભાગ - ૨		
માધ્યમ : ગુજરાતી		કુલ ગુણ : ૧૦૦
૧	ભારત / ગુજરાતનો ઇતિહાસ, ભૂગોળ, નાગરિકશાસ્ત્ર (રાજનીતિ અને બંધારણ)	૩૦
૨	ગણિત, વિજ્ઞાન, પર્યાવરણ, બૌદ્ધિક કસોટી	૩૦
૩	ગુજરાતી ભાષા, સાહિત્ય, વ્યાકરણ	૧૦
૪	અંગ્રેજી ભાષા, વ્યાકરણ	૧૦
૫	ભારત તથા ગુજરાતનો સાંસ્કૃતિક વારસો - સાહિત્ય કલા, ધર્મ અને સ્થાપત્યો - ગુજરાતના ખાસ સંદર્ભ સાથે	૧૦
૬	ખેલ જગત સહિત રોજબરોજના પ્રાદેશિક, રાષ્ટ્રિય અને આંતરરાષ્ટ્રિય મહત્વના બનાવો	૧૦

Syllabus for examination of AAE (Civil) in GWSSB

01. Building Drawing

a. Types of Drawings

- Types of drawing with appropriate scale & Uses index map, key plan, village map, site plan, layout plan.
- Types of Projection adopted in Building Drawing
- Scales for various types of Drawings
- Working drawing, large scale drawing enlarges scale drawing.
- Symbols, Conventions and Abbreviations for Electrical fittings, water supply, sanitary fittings, material for construction etc.
- Sizes of various standard papers

b. Building, regulation, byelaws and Principal of Planning

- building bye laws of local body for residential building
- plot area, built up area, carpet area, FSI, size of rooms, margins, heights, passages, ventilation, circulation and others
- principles of planning for residential building in detail such as - Room dimension, area, heights, privacy, roominess factor, orientation, grouping, drainage, aspect, prospect, drainage, economy
- Approval procedure with respect to bye laws

c. Planning of Residential Building

- Concept plan and drawing of residential single and two storied buildings
- Concept plan of public buildings such as hospital, school, shopping center, office building and industrial unit
- Given situation & Plot area, preparation of detailed drawing of a single storied and double storied residential building with detail of Line plan, Detailed Plan, Ground floor Plan, First floor plan, Elevation and Sections

d. Perspective Drawings and modeling

- Introduction of perspective view and other related terms.
- Perspective view of single room residential building and simple public buildings
- Elements of perspective drawing
- Model preparation of simple buildings

e. Constructional details drawing of buildings

- Drawings of Parts of buildings such as staircases, chajjas, projections, columns, pier, slabs, footings etc
- provisions in drawings for building services such as air conditioning, plumbing, water supply and firefighting, elevators, lifts and escalators etc
- Electrification plan and drawings:
- Show building service like water supply, sanitary, electrification on line plan

02. Basic Mechanical Engineering

a. Introduction of mechanical engineering.

- Use of mechanical engineering: In day to day life. Interdisciplinary use.
- Items in general use- identification criteria, major types, specifications and uses : such as bolts, nuts, washers, bearings, bushes, belts, springs, levers, couplings, brakes, screws, rivets, keys, o' rings, oil seals, gears, pulleys, shafts, axles, etc.
- Pipes and pipe fittings- Types, specifications and uses of pipes and pipe fittings.

b. Welding and Gas Cutting

- Types of welding, Arc and Gas welding equipment, accessories and consumables.
- Types of work carried out by welding and gas cutting.
- Welding and gas cutting process: working setup of arc and gas welding, precautions and

safety during arc and gas welding.

- Describe construction, working and applications of centrifugal and reciprocating pumps: Pump, its working principle, types, Working of centrifugal and reciprocating pumps, Performance parameters, Main parts of pumps and their functions, Common troubles and remedies.
- Explain working and applications of water turbines and air compressor : types and its application. Common troubles and remedies.
- Select proper material handling equipment for a given situation: Types, principle of working and applications of material handling equipments. Hoisting equipments, Conveying equipments, Surface & overhead equipments, Earth moving machineries, Construction machineries. Factors affecting selection of material handling equipments.

03. Building Material

a. Clay Products

- Classification of clay products
- Types of bricks, Manufacturing process of bricks
- Test on bricks, Standard requirements and grades of bricks as per BIS
- Types of clay tiles and its uses

b. Rocks and Stones

- Classification of rocks, Rock products
- Characteristics of stones - Structure, texture, strength, gravity, porosity, absorption, hardness, durability, weight.. etc.
- Standard requirement of building stone
- Important stones used in construction with its suitability.

c. Lime and pozzolana

- Classification of Lime, Uses of lime with specific field situation
- Types of pozzolanic materials, Advantages of addition of pozzolonic material

d. Cement Concrete

- Types of cement with their specific use
- Grade of cement as per BIS, Engineering properties of cement, Field and laboratory test of cement as per BIS
- Methods of storing the cement
- Types of aggregate as per BIS, Requirements of aggregate as per BIS
- Engineering properties of aggregate, Tests on aggregate

e. Timber

- Types of timber, Uses and application of timber, Defects in timber and wood, Seasoning

f. Miscellaneous materials

- Plastics and PVC, Ceramic products, Paints and Varnish, Materials for damp proofing, water proofing, Materials for anti termite treatment, Glass and fiber, Steel and iron materials,
- Materials used for false ceiling, Asbestose, Concrete blocks

04. Construction Technology & Management

a. Foundation

- Classification and types of foundations
- Selection of the suitable type of foundation for required structure and as per situation
- Foundations in black cotton soil, loose soils etc.
- Timbering in trenches

- Failures in foundation Precautions & remedial measures

b. Building Construction

- Brick and stone masonry, Selection of suitable type of masonry
- Construction procedures.
- Ingredients of concrete.
- Production of concrete, transportation, placing, compaction, curing, concrete in different situations viz. Hot weather, cold weather, under water etc.
- Purpose & types of scaffolding and centering, Suitability of scaffolding as per situations and type of structures, Erection of centering for different component
- Plastering & pointing- its purpose, various types, construction procedures, advantages and disadvantages, suitability of each.
- Damp proof course (DPC), Construction joints-need and materials used. Plumbing and electrification- various types of fittings and laying procedure.
- Mortar – Types & specific uses, their details, special features, suitable uses, specifications.
- Machineries used for earthwork and for other construction works.

c. Building Maintenance and Safety Measures

- Causes and types of defects in buildings, Preparation of report on maintenance work.
- Remedial measures and execution, procedure of any one type of building maintenance work.
- Importance of various Laws / Norms/ Regulations/ Acts for safety.
- Precautions and precautionary Measures.

d. Construction Project and Organisation Management

- Construction Project management- importance, Functions, Scope.
- Organisation-Types, Characteristics, Functions, principles.
- Construction team - Roles, responsibilities and skills of construction team.
- Stages in Construction, Causes of Project failure.

e. Tendering and Accounting

- Contract-Introduction, requirement, types, Contract documents and conditions of contract, contract agreement.
- Pre-qualification of Contract- Importance, Tender-Types, Terms and Conditions, issue procedure, opening, Scrutiny, Acceptance, Rejecting, Prepare tender Notice.
- Technical terms- Administrative approval, Technical Sanction, Issue rate, Competent Authority, Secured Advance, Mobilization Advance, Heads of accounts in government organization, Original and repair work, Earnest money deposit (EMD) and Security deposit(SD),
- Accounting terms- Work Abstract, Cash book, Work resister, imprest, accounting for the materials,
- Measurement book, Muster roll, types of bills and recording.
- Methods of getting work done in government organization.

f. Construction Planning, Scheduling and Time Management

- Project Planning-methods and factors affecting planning.
- Scheduling and types of Schedules.
- Critical path method-Important terms, Basic Rules, Advantages and disadvantages.
- PERT analysis-Important terms, Advantages and Disadvantages
- Cost optimization
- Software used for project management

g. Construction Resource Management

- Material management-Purpose, Objective, material Scheduling, material handling, Storage, safety precautions, Economy Order Quantity, inspection and testing.
- Labour management-Labour Scheduling, Characteristics, Output of labours, Wages of Workers, Labour acts
- Equipment management- equipment Scheduling, Classification of various equipment, Factor affecting selection of construction Equipment, Owning & operating cost of equipment, Inspection testing of equipment, Maintenance & repair of equipment.

h. Human Resource development (HRD) & MIS

- Supervisor's role as trainer & Motivator. Techniques to deal human resources effectively.
- Professional Ethics in Engineering.
- Management Information System- Purpose, need, Types, Characteristics, Implementation and Applications

i. Safety Management

- Safety management-requirement, importance.
- Causes of accidents and its type.
- Safety precaution-Excavation work, Demolition, Erection.
- Safety measures- Scaffolding, Ladder, Piling, Bituminous works.

05. Concrete Technology

a. Materials for Concrete

- Chemical compound of ordinary Portland cement. Types and Grades of cement and its uses
- Physical properties - Fineness, consistency of Cement, Soundness & Compressive Strength of cement and its I.S. Requirements, Test as per Indian Standards
- Role of Coarse & Fine Aggregates in Concrete, Classifications of aggregate on the basis of its size, shape, texture and weight Sieve Analysis, Water Absorption Specific Gravity of Fine Aggregate & Coarse Aggregate, Coarse Aggregate Impact Value, Crushing Value & Abrasion Value, Flakiness & Elongation Index, its importance & their related Test as per Indian Standards
- Requirements of quality for water in concrete.

b. Fresh Concrete

- Fresh concrete and its properties -Workability, harshness, Segregation and bleeding
- Factors affecting workability, Methods of measurement of workability Slump Test & Compaction Factor Test, Relation between workability and strength of concrete
- Methods of mixing of concrete – Hand & Machine Mixing and its Transportation and Placing, Methods of compaction of concrete and its suitability, Factors affecting compaction
- Curing and its importance , its methods and suitability, Effect of curing on development of strength of concrete
- Admixtures and its benefits , Types of Admixtures - Accelerator and Retarder Plasticizer and Super Plasticizer Water proofing and Air entraining admixture

c. Hardened Concrete

- Hardened Concrete and its Properties - Compressive Strength, Tensile Strength, Bond Strength, Flexure Strength, Durability, impermeability
- Factors affecting Compressive Strength
- Creep of Concrete & its effect, factors affecting Creep
- IS Test Procedure to find Compressive & Tensile Strength of Concrete, Acceptance
- Criteria, Mean Strength & Standard Deviation
- Durability of Concrete & factors affecting it
- Methods of Non Destructive Test of Concrete.

d. Concrete Mix Design

- Factors affecting quality of concrete, Advantages of Quality control.
- Concrete Mix Design, Nominal Mix and Design Mix. Factors affecting concrete mix design. Different methods of Mix Design.

e. Special Concrete

- Light weight concrete, Fibre reinforced concrete, Polymer concrete, High density concrete, Fly ash concrete, Pumped Concrete, Ready mix concrete

f. Prevention & Repair Techniques for Cracks

- Deterioration of concrete and Corrosion of reinforcement, Types of deteriorations and its effects, Prevention of concrete deterioration.
- Effect of corrosion of reinforcement in concrete and remedies.
- Types, causes and remedies of concrete cracks before hardening and after hardening, Prevention of cracks, Materials for repair of cracks.

06. Surveying

a. Chain Survey

- Instruments used in chain survey - Metric Chain, Tapes, Arrow, Tapes, Ranging rod, Offset rod, Open cross staff, optical square
- Technical terms related with chain survey Survey Station, Base line, Check line, Tie line, Offset, Tie station
- Method of Chaining, Errors in length due to incorrect length and related problems, Obstacles in chaining,
- Ranging, Direct Ranging & Indirect Ranging
- Types of offsets, Perpendicular & Oblique
- Conventional Signs, Recording of measurements in a field book

b. Compass Survey

- Triangulation Survey & Traversing
- Components of Prismatic Compass and its functions
- Method to use Prismatic Compass
- Technical Terms - True Meridian & Bearing, Magnetic Meridian & Bearing, Arbitrary Meridian & Bearing, Dip of Magnetic needle, Declination, Fore Bearing & Back Bearing, Whole Circle Bearing, Reduced Bearing
- Local attraction and Closing error, Errors in compass survey and elimination of errors

c. Leveling

- Basic terminology related with leveling like Level surfaces, Horizontal & vertical surfaces, Datum, Bench Marks, Reduced Level, Rise, Fall, Line of collimation, Axis of Telescope, Axis of bubble tube, Station, Back sight, Fore sight, intermediate sight,

Change point, Height of instruments, Focusing, parallax etc.

- Types of Level - Dumpy Level, Tilting Level, Auto Level, Digital Level
- Temporary adjustment of Level
- Classification of Leveling - Simple Leveling, Differential Leveling, Fly Leveling, Profile Leveling, Reciprocal Leveling and Precise Leveling
- Errors in Levelling
- Contour, Uses of contours, Characteristics of contours

d. Theodolite

- Uses of theodolite, Temporary adjustment of a theodolite, Permanent adjustment of theodolite (Fundamental axis of theodolite, Definitions and various technical terms
- Methods of measuring horizontal angles and vertical angles, Use theodolite for measuring a magnetic bearing, prolong a line, ranging a line, Measuring direct and deflection angles
- Errors in theodolite work, Theodolite Traversing, Traverse computations, Closing errors, Balancing the traverse

e. Curves

- Types of circular curves, Definitions and notations, Designation of curve, Relation between Radius and degree of curve, Elements of simple circular curve
- Transition curves, Vertical curves

f. Global Positioning System (GPS)

- Digital Maps, Fundamentals of GPS, Uses of GPS, Field procedures of GPS, applications in Civil Engineering

g. Advanced Survey Equipments

- Basics of Digital Theodolite, Principles of E.D.M.,
- Basics of Total station - Parts of Total station, Advantages, disadvantages and uses of
- Total Station, Types of Total Station, Advancement in Total Station Technology, Surveying using Total Station, Fundamental Parameters of Total Station, Precautions to be taken while using

07. Water Supply & Sanitary Engineering

a. Sources, Quality and Demand of water

- Sources of water, Suitability of water, Choice of source
- Types of demand, Population forecast, Computation of quantity of water, Fluctuation in demand, Factors affecting demand
- Impurities in water, Collection of water sample, Physical Chemical and Biological tests, Standards of quality of water

b. Treatment of Water

- Objectives of water treatment, Location of water treatment plant, Layout of water treatment plant, Basic principles of working of treatment plant
- Various stages of treatment of influent water, Functioning of Coagulation treatment plant, Sedimentation, Filtration, Disinfection, water softening.
- Desalination of water

c. Conveyance of Water

- Types of pipes used for conveyance, Pipe joints, Laying of Pipes, Distribution system,
- Types of valves, Types of Water Meters, Pipe fittings and fixtures
- Methods to prevent leaks

- Measures for conservation of water
- d. Sanitation System**
- Sanitation System, Objective of sewage disposal, Methods of sewage collection, Conservancy system, Water carriage system, Classification of Drains, Sewer section, Sewer joint, Manhole, Flushing tank, Catch basin.
 - Laying of sewer, Appurtenances and its locations, Hydraulic testing of sewer pipe, Maintenance of sewer, Procedure for maintenance of sewerage system.
 - Causes of trouble and odor, Sewer cleaning operations, Requirements of maintenance.
 - Functions of each maintenance equipments and tool, Selection of equipment for given maintenance job., Explosives in sewers., Safety measures for sewer-men.
- e. Sewage Treatment and Disposal**
- Characteristics of sewage, Sampling of sewage
 - Treatment of sewage - Methods
 - B.O.D. Test, C.O.D. test
 - Methods of sewage disposal
- f. Recycling of Waste Water and Solid Waste**
- Different recycling method with respect to quality of waste water
 - Utilization and management of solid waste
- g. House Plumbing**
- Plumbing terms, Plumbing tools, Pipes and pipe fittings, Fixing and jointing pipes and accessories, Traps, House drainage plant, Safety and precautions, Sanitary fittings

08. Water Resources Engineering

a. Hydrology

- Define Hydrology, Hydrological cycle, Forms of precipitation, Precipitation occupancy & its types,
- Measurement of rain fall, Rain gauges Non Recording, recording, Float type, Tipping bucket, weighing bucket.
- Methods of determining average rainfall, Arithmetic average method, Thiessen polygon method, Isohytel method
- Runoff, Factors affecting runoff, Runoff calculation using empirical formula only, Evaporation, Transpiration & Evapo – transpiration, Factors affecting evaporation.

b. Ground Water

- Sources of water
- Importance of ground water and present scenario
- Terms related to groundwater engineering: Aquifer, Aquiclude, Aquifuge, Aquitard, porosity, Specific yield, Specific retention, storage coefficient, coefficient of permeability, coefficient of transmissibility, Yield, specific yield
 - Types of well - Open, Tube and flowing well concept, location and importance
- Necessity of recharging - Artificial recharging as today's need. Types of artificial recharge, spreading method. Pit method / khet-talavadi, Induced recharge method, Recharge well method,
 - Sub-surface dam, Check dam series, Ponds, Unlined canals

c. Storage Works

- Survey and investigations - Investigations for hydrologic data, Geological data,

- Topographic investigations
- Investigation of reservoir site, land acquisition Environmental considerations
- Economical data - Benefit cost ratio.
- Site selection for reservoir
- Methods of estimating reservoir capacity
- Storage zones
- Reservoir losses
- Reservoir sedimentation and its control
- Classification of storage works.
- Factors for selecting type of dam
- Concept of low and high dam
- Component parts of gravity and earthen dam

d. Distribution Works

- Purpose of distribution works, Component parts
- Barrage, Weir. 1) Comparison of weir and barrage. 2) Causes of failure of weir and remedial measures
- Safe exit gradient
- Control of silt entry Scouring sluices, silt excluder, silt ejector, head regulator.
- Classifications of canal - Ridge and contour, Functions of each according to network.
- Canal Alignment Factors influencing canal alignment .
- Regime & semi-regime conditions.
- Canal lining. a. Advantages. b. Types of canal lining materials c. Methods of canal lining.
- Regulation works.
- C.D. Works. -Types , functions & sketches
- Outlets. - types, situation, functions & Sketches
- Water-logging, effects, causes & prevention

e. Watershed Development

- Concept of 'watershed'
- Characteristic of watershed, size, shape, physiography, slope, climate, drainage, land use, vegetation, geology, hydrology, hydrogeology, socio-economics.
- Watershed management & people's participation..

f. Water Harvesting Structures

- Necessity of Rain water harvesting
- Importance of Rain water harvesting
- Rain water harvesting methods - Check dams, Nala / Gully plugging, Percolation tank, Khet-talawadi, Roof harvesting

09. HYDRAULICS

a. Introduction, Pressure and pressure measurement

- Technical terms – Fluid Mechanics, Hydrostatics, Hydro-kinematics, Hydro-Dynamics-Ideal and Real Fluid.
- Properties of liquid – Viscosity-Density-Specific Gravity-Surface Tension-Capillarity Vapour Pressure-Elasticity.
- Various types of pressure – Atmospheric Pressure- Gauge Pressure-Absolute Pressure Vacuum Pressure-Separation Pressure/s
- Measurement of pressure/s by different methods
- Measurement of difference of pressure using “U” tube Manometer and inverted “U”

tube Manometer

b. Hydrostatics

- Relationship between pressure and depth of liquid
- Pressure diagram for different conditions
- Total pressure and center of pressure
- Computation of Total Pressure and depth of centre of pressure

c. Hydro kinematics & Hydrodynamics

- Types of flow - Laminar --Turbulent --Uniform -- Non-uniform --Steady--Un-steady --Rotational and irrotational -- One, Two and Three Dimensional flow.
- Reynold's number, Continuity Equation
- Types of Energy – Potential, Pressure and kinematics
- Bernoulli's Equation, Momentum Equation

d. Orifice, notches and weirs

- Definition and types of orifice
- Various Hydraulic Coefficient and its relation - Coefficient of Contraction, Velocity, Discharge.
- Types of notches and weirs
- Computation of discharge through notches and weirs
- Rectangular Notch, V -Notch.
- Discharge through narrow crested and broad Crested weir.
- Discharge through Cipolletti weir.

e. Flow through pipes

- Characteristics of flow through pipes
- Major and Minor Energy (Head) losses in pipe Flow- frictional loss, loss of head at entry, exit, Sudden enlargement and contraction and at bend.
- Computation of major head by Darcy Weisbach Equation.
- Hydraulic Gradient Line (HGL) and Total Energy Line (TEL)
- Design of Pipeline-using formula & Nomogram

f. Flow through Open Channel

- Characteristics of open channel flow. 1) Comparison of pipe flow and channel flow. 2) Field examples of open channel
- Analyse uniform flow 1) Froud's number, 2) Hydraulic mean depth- concept & computation. 3) Use of Chezy's and Manning's formulae. 4) Most economical sections of channel. Rectangular, Trapezoidal and circular shapes.
- Specific Energy Diagram
- River Gauging, Measurement of mean velocity using surface float, velocity rod and current meter.

10. Applied Mechanics

a. Introduction

- Scalar & Vector Quantities – like force , pressure , velocity , acceleration
- Static & Dynamic – Kinetics & Kinematics
- MKS , CGS & SI units and its conversion along with FPI and Metric System

b. Coplanar Concurrent Forces

- Force – units , elements, Laws/ Principles of forces, Resultant & Equilibrium forces, conditions of equilibrium
- Analytical & graphical method for Law of Parallelogram, Law of Triangle, Lami's Theorems, Law of Polygon

c. Coplanar Non- Concurrent Forces

- Principal of Moment Moment, Couple, application, properties of couple, conditions of equilibrium
- types of supports, end conditions – Hinge, free end, roller,fix
- types of loads like point load, U.D.L, U.V.L, Couple , Analytical method to Evaluate reactions in statically determinate beam subjected to point load and/ or U.D.L by analytical method of solving Statically determinate beams

d. Centroid & Centre of Gravity

- First moment of area; to find Centroid –standard shapes of I , L , Channel & T sections, axis of symmetry
- First moment of mass; to find C.G of standard solids sections, Axis of symmetry

e. Friction

- Friction , Laws of Friction , Angle of Friction , Angle of Repose, types of friction
- Application of Lami's theory and theory of resolution of forces, examples on friction for a block resting on horizontal plane & on inclined plane

f. Work, Power & Energy

- Work – work done, force displacement diagram, torque, work done by torque
- Power – I.H.P and B.H.P of engine, Equation of H.P in terms of Torque and R.P.M, Engineering Problems
- Energy – Kinetic & Potential energy and Engineering Problems.

g. Simple Machines

- **Principles of Machines** to evaluate Mechanical Advantage, Velocity Ratio of simple machine
- **Pulley Blocks**, Draw Line sketch of different systems of Simple and compound levers, Problems, Laws of Machines, reversible & non reversible machines.

11. Design of Structure

Design of Steel Structure

a. Section, Truss, Load – Definitions & types

- Rolled Steel Section – ISA , I&H Section, Channel Section and its application in Steel Structure
- Types of Truss, Pitch of Truss, Rise, Spacing of Truss, Purlin, Principal Rafter, Main Tie, Sag Tie, Members of Truss, Roofing material - G I and A C Sheets
- Dead Load, Live Load, Wind Load

b. Bolt and Welded Connection – Definitions & types

- Rigid Connection, Pinned Connection, Semi Rigid Connection, Black Bolts, Turned Bolts, HSFG Bolts, Grade of Bolts
- Lapand Butt Joint, Minimum and Maximum Pitch, Tack Bolting, Edge Distance,

- Gauge Distance, Bolt Hole
- Shear Capacity of Bolt, Bolt Value, Efficiency of Joint
- Types of Weld, Fillet Weld

c. Tension Member and Compression Member

- Terms - Slenderness ratio, Strut, Buckling.

d. Lacing & Battens, Beam & Purlin

- Objective of Lacing - Single Lacing, Double Lacing
- Objective of Batten
- Definition - Main Beam, Secondary Beam, Standard I Sections, Laterally restrained and unrestrained beam, Shear buckling, Shear Strength and Bending Strength of Section.

Design of Reinforced Concrete Structures

e. Limit State Method

- Reinforced Cement concrete, necessity of steel in concrete, normal location of Tension steel in beams, slabs & in footing
- Limit State of Collapse – Flexure, Shear, Compression, Torsion, Limit State of Serviceability-Deflection, Cracking.
- Characteristic Strength of Concrete and Steel, Partial Safety Factor for Concrete and Steel
- Characteristic or Working Load, Partial Safety Factor for Load, Limit State or Factored Load
- Balance Section, Under Reinforced Section, Over Reinforced Section
- Minimum and Maximum steel in beam and in slab and clear cover as per IS 456
- Condition for Doubly Reinforced Section
- Beam, Minimum and Maximum Spacing of Stirrups, minimum shear reinforcement
- Diagonal Tension Crack in Beam due to Shear
- Anchoring reinforcing bars in Tension and in Compression

f. Slab

- Terms –One way slab, two way slab, Steel for Bending Moment, Distribution Steel, Depth of Slab as per Deflection, Effective span as per IS 456, Dead Load, Live Load on Slab, Shear and Cracking in Slab.
- Maximum and Minimum spacing of Main steel and distribution steel in slab.

g. Axially Loaded Short Column and Isolated Footing

- Terms - Column, slenderness Limit for Short & Long Column, Minimum Eccentricity in column, condition for axially loaded column, equation for axially loaded short column of IS 456
- SBC of Soil, Types of Footing like Isolated foundation, combined footing, raft Foundation, pile foundation.

12. SOIL MECHANICS

- State the types of failures due to soil in Civil Engineering structure
- General characteristics of different types of soils
- Overview of different types of soils in Gujarat / India.

a. Index Properties & Interrelationship

- State three constituents of soil
- Properties of soil like Density, Field density, Dry density, Saturated density, Void ratio, Porosity, Specific Gravity, Degree of saturation, Moisture content, Density Index

b. Soil Classification

- Classification of soil (Grain size) as per Indian Standard
 - Basis /criteria of classification of soils, Three main categories of soils, Scale for classifying soil
- Mechanical Analysis of soil
 - Difference between coarse grained and fine grained Soil on the basis of range of grain size and engineering properties, Sieves designation as per I.S. code, Coarse & Fine Sieve analysis, sedimentation analysis
- Grading Curves and different coefficients i.e. CU and CC
 - Clay, silt, sand and gravel as per particle size, Consistency Limits like Liquid limit, Plastic limit, Shrinkage
- Limit and Plasticity Index

c. Compaction

- Compaction and its Application
 - Effects of compaction on different soil properties like permeability, shear strength, soil settlements-stability of embankments.
- Maximum dry density and O.M.C.
 - Typical compaction curve, Optimum moisture content (OMC), Maximum dry density (MDD)
- Proctor test
 - Light compaction, Heavy compaction test
- Factors affecting compaction like water content, nature of soil (fine or coarse grained), Grading of soil, compaction energy, thickness of layer
- Compaction and Consolidation
- Role of O.M.C in the field
- Methods of Field Compaction & various Equipment for compaction

d. Permeability & Seepage

- Permeable and Impermeable soils
 - Permeability and Impermeability
 - Factors affecting the permeability of soil
 - Factors used to control the permeability of soil to desired extent in various Civil engineering structures
- Methods to find Coefficient of Permeability
 - Constant Head Method
 - Falling Head Method
- Coefficient of permeability
- Seepage pressure
 - Seepage pressure.
 - Quick sand condition.
 - Flow net, its characteristics and application.

e. Shear Strength

- Definition : (a) Cohesion (b) internal friction (c) Shear strength
 - Shear strength of soil

- Different shear tests used to determine shear strength of soil in laboratory
- Procedure of direct shear test (Box shear test)
- Types of soil C-soil, ϕ -soil, C- ϕ soil.

f. Bearing Capacity of soil

- Bearing capacity of soil
 - Net Bearing capacity, Safe Bearing Capacity, Ultimate Bearing Capacity
 - Bearing Capacity of various soil
- Methods of determining bearing capacity of soil – Plate Load Test, Penetration Test
 - Foundation on soils of various bearing Capacity
 - Methods to improve bearing capacity of soil
- Liquefaction
- Occurrence & effect Effects of Liquefaction Remedial for Liquefaction

g. Soil Investigation & Exploration

- Purposes of exploration of soil.
- Planning of exploration program
- Soil samples and collection.
- Field penetration Test : SPT

13. BASIC TRANSPORTATION ENGINEERING

a. Introduction and Road Geometric

- Importance & Classification of roads
- Modes of transportation.
- Requirements of good roads and its advantage.
- Road alignment and their types
- Importance of road alignment.
- Factors affecting the alignment.
- Terms used in road geometry Camber, sight distance, Super elevation, Widening of Road.
- Transition curve and Road Gradient.

b. Road materials and its construction aspects

- Types of Pavement.
- Types of materials used in road Construction
- Various tests on Aggregate and bitumen.
- Importance of drainage works
- Purpose of drainage.
- Methods of Surface and Sub-surface drainage.

c. Introduction to Rail way.

- Components of typical permanent way as per IRS.
- Railway gauge , Types of Rail gauge and uniformity of gauge.

d. Introduction, Investigation and Maintenance of Bridges.

- Term used in Bridge, Component of Bridge and its function
- Classification and types of bridge.
- Factor affecting the selection of Bridge Site.
- Explain following terms: Scour, Afflux, Runoff, Economic Span, Clearance, Free board.

14. Environment Conservation & Hazard Management

a. Ecology and environment

- Importance of environment and scope
- Engineering and environment issues
- Causes of environmental pollution
- Pollution due to solid waste
- water pollution, air pollution, the Noise as pollution,
- Pollution of land due to industrial and chemical waste
- Radiation and its effects on vegetables and animals

b. Sustainable Development

- Concept of sustainable development,
- Natural resources, a-biotic and biotic resources
- Principles of conservation of energy and management
- Need of Renewable energy
- Concept of waste management and recycling.

c. Wind Power & Solar Power

- Types of wind turbines – Vertical axis wind turbines (VAWT) and horizontal axis wind turbines (HAWT)
- Features of solar thermal and PV systems

d. Biomass energy

- Types of Biomass Energy Sources
- Energy content in biomass of different types
- Types of Biomass conversion processes
- Biogas production

e. Seismic Engineering and disaster management

- Features of disasters such as Floods, Earthquakes, Fires, Epidemics, Gas/radioactive leaks etc.
- Management and mitigation of above disasters.

15. ESTIMATING, COSTING & VALUATION

a. Estimation and Modes of Measurement

- Estimating.
- Types of estimate and Data required.
- Overhead charges, contingencies, water charges, provisional sum, prime cost, provisional quantities, spot items, day work.
- General rules for the measurements and its units of different items of civil engineering work.

b. Specifications of Civil Works

- Importance of specification
- Types of specification
- Principle of writing specification.

c. Rate Analysis of Civil Works

- Task Work and Factors affecting it
- Labour required for different works and Labour rates
- Schedule of Rates (SOR)

- Rate analysis and factors affecting it rate analysis

d. Estimation of Civil Works

- Methods of detailed estimation.
- Methods of calculating earthwork quantities for pipe line works and canals.

e. Valuation of Civil Engineering projects

- Cost, Price and Value
- Types of property and Objects of valuation
- Depreciation and Obsolescence
- Valuation tables and Valuation methods for property and land