

LATE NOTIFICATIONS**PUBLIC WORKS DEPARTMENT****Notification**

Sachivalaya, Gandhinagar, 29th March, 1979.

CONSTITUTION OF INDIA.

No. G-J-7/79-GAB/1173/(13)/E-2.—In exercise of the powers conferred by the proviso to article 309 of the Constitution of India and in supersession of all the existing rules and orders in this behalf, the Governor of Gujarat hereby makes the following rules to provide for regulating recruitment to the post of Executive Engineer (Civil), in the Gujarat Service of Engineers, Class-I, namely :—

1. These rules may be called the Executive Engineers (Civil), Gujarat Service of Engineers, Class-I, Recruitment Rules, 1979.

2. Appointment to the post of Executive Engineers (Civil), in the Gujarat Service of Engineers, Class-I shall be made either —

(a) by direct selection, or

(b) by promotion of a person of proved merit and efficiency from amongst the persons working as Deputy Engineers (Civil), Gujarat Service of Engineers, Class-II possessing the minimum qualification of diploma in Civil Engineering or an equivalent qualification recognised by Government and having minimum service of seven years as Deputy Engineer (inclusive of the period spent on probation).

3. The appointment by direct selection and promotion shall be made in the ratio of 1:3 (i. e. one by direct selection and three by promotion) :

Provided that if in any year recruitment by direct selection is not made according to the prescribed ratio the shortfall of direct recruits shall lapse and shall not be carried forward in the subsequent year.

4. For appointment by direct selection, a competitive examination shall be held by the Gujarat Public Service Commission in accordance with the rules mentioned in Annexure-I appended hereto. The

examination shall be common for both the services viz., G. S. E. Class I and G.S.E. Class-II, the result thereof shall be arranged in order of merit of the candidates and the appointments to the G.S.E. Class-I or Class-II shall be made seriatim from the list of result prepared for the two cadres by the Gujarat Public Service Commission subject to the fulfilment of requirements of physical fitness and other provisions of these rules. The qualified candidates securing the highest places in order of merit, shall be offered appointments in the G. S. E. Class-I according to the number of vacancies declared for such recruitment to that cadre. The candidates securing the next higher places, in order of merit in the list shall be offered appointments to the G. S. E. Class-II, provided they have indicated their willingness to be so appointed in their application to the Commission for admission to the examination.

5. To be eligible for a appointment by direct selection to the post mentioned in rule 2(a) above, a candidate shall—

(a) be not less than 21 years and not more than 28 years of age:

Provided that the upper age limit shall not apply to a Government servant working as Junior Engineer (Civil) or Deputy Engineer (Civil) possessing the same percentage of marks as prescribed in rule 5(b) below and who was within the age limit when appointed to such post; and

(b) have passed the B. E. (Civil) Examination of recognised University with atleast 60 p. c. of the total marks or having qualification recognised by the Government of Gujarat as equivalent to it.

6. A candidate appointed as Executive Engineer shall have to undergo such training as may be prescribed by the Government from time to time.

7. The selected candidate shall be on probation for a period of two years. During first year of probation, he will not be placed in charge of a Sub-division. On completion of first year of probation, the selected candidate will be posted to work in a normal sub-division, and after completion of probation period, he shall be in charge of a sub-division for other two year against the post of a Deputy Engineer for gaining practical experience:

Provided that the period of probation and period of his posting in Sub-division may be extended by the Government if the Government is satisfied that performance of the officer is not satisfactory and not upto the expected standard.

8. The selected candidate during the probation period (inclusive of the extended period of probation) and during his posting in sub-division as provided for in rule 7 above shall be designated as Assistant Engineer and after completion of four year's service as such he shall be posted to work as Executive Engineer.

9. The selected candidate shall retain inter-se seniority according to his order of merit unless he has joined his first appointment within a period of one month from the date of his appointment :

Provided that the Government in any individual case, may condone the delay on merit by issuing an order giving detailed reasons for condonation.

10. The services of the probationer shall be liable to be terminated, if Government is satisfied that his work at any time during the period of probation is not found to be satisfactory, or if a probationer fails to pass the prescribed professional examination within the prescribed chances and prescribed period.

11. The selected candidates shall be required to pass an examination in Hindi or in Gujarati or both as may be prescribed by the Government from time to time in this behalf.

12. The selected candidates, shall, if so required and unless he has already so served, be liable to serve in any defence service or post in connection with the Defence of India for a period of not less than four years including the period spent on training, if any :

Provided that such Officer—

(i) Shall not be required to serve as aforesaid after the expiry of ten years from the date of appointment to the post in Gujarat Service of Engineers, Class-I, or

(ii) shall not ordinarily be required to serve as aforesaid after attaining the age of forty years.

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13. The selected candidate shall not claim the benefit of any vacancy for direct recruits as per provisions contained in Government Resolution, Public Works Department No. GAB-1059-E(i), dated the 29th April, 1960, which have remained vacant.

14. The seniority of Ex-Engineers appointed by direct selection and by promotion shall be fixed according to their dates of appointments on probation or promotion as the case may be subject to protection of their inter se seniority. If the dates of direct selection and appointment by promotion happen to be the same, the direct recruit shall be considered as senior.

A N N E X U R E—I.

Rules for the competitive examination for recruitment to the post of Executive Engineers, Gujarat Service of Engineers, Class-I.

1. The examination will be held by the Commission on such date and at such places as the Commission may from time to time fix.

2. Ordinarily all candidates who satisfy the prescribed conditions will be admitted to the examination on submission of such proof of their qualifications and character as the Commission may require. The decision of the Commission as to the eligibility of candidate shall be final.

3. A candidate will be required to submit an application in such form as the Commission may prescribe and to pay an application fee of Rs. 8-00 (Rs. 2-00 in case of the candidates belonging to Schedule Class/Schedule Tribes Socially and Educationally backward class including Nomedic and Denotified Tribes) On admission, he will be required to pay a fee of Rs. 50/- (Rupees 12.50 in case of a candidate belonging to Scheduled Caste/Scheduled Tribes/Socially and educationally backward class including Nomedic and Denotified Tribes) in such manner as the Commission may direct. The fees once paid will not be refunded or held over for any subsequent examination on any account.

4. The Commission will fix what should be the qualifying marks in any or all the subjects of the examination and in the total either generally for all candidates or separately for candidates from the Scheduled Castes/Scheduled Tribes/Socially and educationally backward class including Nomedic and Denotified Tribes in respect of vacancies reserved for such candidates and for other candidates, and a candidate shall

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not be deemed to have qualified in the examination if he fails to obtain the qualifying marks fixed by the Commission in the Viva-Voce and Personality Test.

5. The Commission will summon for the Viva-Voce and Personality Test only those candidates who attain such minimum standard at the written examination as the Commission may prescribe generally for all candidates or separately for candidates from the scheduled Castes/Scheduled Tribes/Socially and educationally backward class including Nomadic and Denotified Tribes in respect of vacancies reserved for such candidates and for other candidates.

6. The subjects standard and syllabi of the examination shall be as follows :—

(i) Subject of the Examination.

I. *Written Tests.*

<i>(a) Compulsory</i>	<i>Marks.</i>	<i>Duration</i>
(1) English	100	3 hours
(i) Essay	40	
(ii) Drafting of letter or report.	25	
(iii) Precis writing.	25	
(iv) Test in the use of words, etc.	10	
(2) General knowledge.	100	3 hours
(3) Applied Mechanics.	100	3 hours
(4) Construction	100	3 hours
 <i>(b) Optional</i>		
Any four of the following :		
(1) Fluid Mechanics.	100	3 hours
(2) Structural design	100	3 hours

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(3) Soil and Foundation Engineering	100	3 hours
(4) Public Health-Engineering	100	3 hours
(5) Irrigation and Storage.	100	3 hours
(6) Transportation Engineering	100	3 hours
(5) Surveying-I.	100	3 hours
II. Viva-Voce and Personality Test.	200	

(ii) The standard of the Examination.

(a) The standard of English and General Knowledge papers will be such as may be expected of graduates of Indian Universities.

(b) The standard of the other compulsory papers and that of the optional papers will be that of a degree examination of a University in the State of Gujarat.

(c) The object of the Viva-Voce and Personality Test will be to assess the suitability of the candidate for appointment to the Gujarat Service of Engineers, Class-I or Class-II, as the case may be, and his calibre, including intellectual, social and moral traits of Personality such as critical powers of assimilation clear and logical exposition, judgment variety and depth of interest, and capacity for leadership. While no attempt will be made to test his general or specialised knowledge, the test will seek to elucidate how far the candidate has taken an intelligent interest in the things happening within and outside India.

(iii) Syllabi.

(1) English.

The paper will consist of (a) an essay to be written in English on one of several subjects, (b) drafting of a letter or report on one of several topics, (c) a passage for precis and (d) a test in the use of words including synonyms, antonyms, Spelling, idiomatic usage etc.

(2) General Knowledge.

The paper will include questions on current events, common phenomena and matter of every day observations and experience, history and geo-

graphy (including commercial Geography) which an educated person should be able to answer without special study. There will be some compulsory questions on the Five Year Plans.

(3) APPLIED MECHANICS.

Strength of Materials.—Behaviour of engineering materials in tension, compression and shear; elastic limit, Yield Point, Proof stress ; Nominal stress, Ultimate strength, factor of safety, Load factor; Elastic constants.

Principal stresses and strains; strain energy; Elements of Strength theories of elastic failure.

Analysis of Structures :

Statically Determinate Structures :

Bending Moment and Shear Force in statically determinate beams-analytical and graphical methods stresses due to Bending Moment and Shear Force, Design of Sections, Section Modulus.

Elementary theory of torsion, Combined bending and torsion.

Force in statically determinate planar trusses-analytical and graphical method.

Slope and deflection of statically determinate beams; Deflection of statically determinate Planar trusses.

Columns and struts, Buckling of, columns; Euler's Rankine's and Secant Formulae for long columns, Combined direct and bending stresses for short columns.

Statically Indeterminate Structures :

Statical and Kinematic indeterminacy : Energy theorems; stiffness and Flexibility methods, Elements of matrix analysis of structures, methods of consistent Deformation, slope deflection and Moment distribution.

Analysis of beams (including continuous) and Portal frames.

Influence Lines :

Influence Lines for moment shear and reaction for statically determinate beams and planar trusses; Muller Bresalu Principles and Influence Lines for simple cases of indeterminate beams.

Arches.

Three hinged arches, two-hinged arches and rigid arches, Bending Moment, Normal thrust and Radial shear; and their influence lines.

Dynamic Analysis :

Free undamped vibration of single degree of freedom systems.

Retaining walls and earth pressures :

Rankina's theory, wedge theory, Winger and Blingh's Graphical constructions, with corrections, Designs of various types of retaining walls in masonry.

(4) CONSTRUCTION.

Building Materials Stones-Selection and Characteristics, Chief varieties and uses, quarrying blasting, dressing; tools used.

Bricks and tiles-Classes of bricks and their distinguishing qualities, moulding, drying and slaking, Brick-burning Type of kilns, Fire-bricks. Terracotta, Tile Manufacture.

Cements, limes, and Mortars-Use of Mortar, Natural and artificial cements Varieties of Limes, Hydraulicity. Burning, Kilns, whitewash, distemper, concrete, Portland cement.

Timber. Growth of trees, felling trees, classification and Properties of India timber, Most suitable timbers for particular purposes.

Stone masonry-Ashlar and block in course, Bonds, Dressing stones, Rubble masonry, safe loads, Lewis, Dowel, Joggle Cramp, Template, Scaffolding, shears, Derrick, Gantry.

Brick Masonry-Types and their uses, Bond closers, Bending, Moistures Scaffolding, Precautions against settlement, Racking back, Plastering, pointing, coping, cornice, Blocking course, Parapet, Eaves course, Corbel, Lintel, Uamb, Repeal, sill, Footing, Drip course, Hollow masonry, Reinforced Brick-work.

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Soil and sub-soil Investigation.

Parameters of importance of soil in construction activities, field tests, methods of improving soil characteristics, reclamation of soil for constructional activities.

Shallow Foundations :

Types, design, excavation precautions, problems of black cotton soil for constructions.

Deep Foundations and Foundation Treatments :

Piles, their functions and general action of pile and a group of piles under load, pile driving formulae, types, of piles, design of piles system pile driving equipment, sheet piles, grounding of foundations, stage and packer grouting.

Aids for open excavations, coffer dams, dewatering systems, Wells and caisson sinking, types and constructional procedures for caisson sinking, well-caps, use of chemicals for underground construction.

Temporary Timbering :

Centering, form work, shuttering and moulds, timber trestles and false work, scaffolding and shoring, under pinning.

Concrete and Masonry Construction :

Parameters affecting concrete making, quality control for normal construction and for mass concrete making as in dams; equipments associated in concrete making pre cooling devices, construction and contraction joints, prefabricated constructions, varieties of concrete use of Pozzolana.

Stone, brick hollow, block, reinforced wall and frame constructions, types and suitability of mortars for various purposes, precautions in bending and laying types, of bonds and their suitability in constructions.

Components of Buildings :

Types, suitability joints, fixtures and fastenings of doors and windows, types, layouts, design, suitability and construction of stairs, floorings and roofs, including wood work, structural steel work and the related joinery, treatments, necessary for fire proof, water proof, sound proof, and thermally insulated constructions.

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Mechanical and Power Appliances :

Selection of equipments, standard and special equipments, equipments involved in excavation, conveyance, compaction, and spreading of earth, Pneumatic equipment, equipments, involved in concrete making, mixing, conveying and vibrating, use of pulley blocks lifting tackles, shear gins, derricks, crabs, winches and ginpoles, suitability of these equipment in relation to the conditions of si.

BRIDGES :

Components of a bridge, classification of bridges, requirements of an ideal bridge; classification of bridges.

Selection of bridge site, Bridge alignment, site investigation and collection of data; waterway of the bridge; Economic span, scour depth; Depth of foundations; Afflux; Clearance; Free board.

Types of bridge superstructures and methods of erection; Bridge flooring choice of superstructure type, Bridge bearings; joints in Bridges; Railings and parapets.

Types of bridge foundations; bridge piers; Abutments; Wing Walls, Approaches.

Training work for bridges Maintenance and strengthening of bridges.

Low cost bridges causeways, timber bridges, suspension bridges, floating bridges, flying bridges, culverts.

OPTIONAL SUBJECTS

(1) FIELD MECHANICS

Hydrostatics :

Total Pressure on plane and curved surfaces Centre of Pressure-Buoyancy-equilibrium of floating bodies-metacentre.

Flow Concepts and Basic Equations :

Types of flow-continuity equation-Fuler's equations of motion stress line and stream tube-Bernoulie's equation velocity potential stream functions-potential theory. Measurements of Water Venturimeter, Orifices-Notches and Weirs.

Flow through Pipes :

Laminar and Turbulent flow-viscosity-Reynolds number-laminar flow through circular section. Methods of determination of viscosity. Drag on immersed bodies-boundary layer concepts. Resistance to turbulent flow in Pipes. Darcy's Colebrook and White and Nikuradse formulae pipe network works.

Hydraulic gradients; losses due to bends, contraction and sudden enlargements losses of head through siphons, impacts at bends at thrust blocks.

Open Channels :

Types of Channels uniform flow development of uniform flow formulae-Chesley's Manning's Roughness Coefficients--Economic Sections Velocity distribution in open channels-specific energy critical flow-Parshall flume and S. W. flume-Hydraulic Jump. Gradually Varied flow-afflux and back water curves-computation by approximate methods.

Gauging the flow of water in open channels, water meters.

Water Hammer :

Elementary theory of water hammer-its effect on penstocks and rising mains.

Dimensional Analysis and Principles of Similitude.

Principles of similitude-Froude-Reynolds-Waber's numbers-Models-model scales-scale effects-Concept of dimensions and dimension homogeneity, Buckingham II Theorem and its applications.

Hydraulic Machinery.

Impact of water of fixed and moving vanes, turbines, impulse and reaction, Description of different types of turbines, Determination of vane angles, efficiencies of turbine plan. governing.

Pumps- Reciprocating-centrifugal and turbine.

(2) STRUCTURAL DESIGN.

Loads.

Specifications for loads on Buildings Specifications for loads on Highway Bridges.

Reinforced Cement concrete.

Elastic and Ultimate load theories, resistances to bending shear and bond.

Designs (by both theories wherever applicable) of singly and doubly reinforced. beams, one way two way and flat slabs columns with axial and moment loading, footings, cantilever and counterfort retaining walls, simple underground and elevated reservoirs, cantilever sheds, simple Portal frame and spherical domes.

Prestressed Concrete.

Properties of high grade concrete and high tensile steel, Pretensioning and post-tensioning, losses in prestress, Analysis and design of beams and slabs, deflections.

Steel Structures.

Revetted and Welded connections.

Elastic Design.

Tension and Compression members, Single and built up sections; connections and splices.

Rood trusses, Simple beams and Purlin connections.

Columns, lacing and battening Grillage, Gussetted and slabbase foundations.

Plate and Gentry girders, Sheds, Through and Deck type plate girder bridges with lateral bracings Foot-over bridges.

Plastic Design

Elementary theory; Shape factor, Collapse Mechanism, Upper bound and lower bound methods, Designs of simple continuous beams and portal frames.

(3) SOIL AND FOUNDATION ENGINEERING

Introduction :

Soil and Foundation Engineering, a brief historical development.

Soil Exploration :

Methods of site exploration, Boring, sampling, standard penetration test.

Preliminary definitions and Relationship:

Water content and unit weights, specific gravity; void ratio; porosity and degree of saturation, density index-functional relationship.

Index Properties of soils :

Specific gravity; Grain size distribution; Consistency of soils; Classification of soils.

Laboratory Tests :

Particles size analysis, Liquid limit, Plastic limit, Proctor density, field density, permeability, box shear, consolidation.

Soil Water

Intergranular and pore water pressure, capillary phenomena permeability.

Stress Distribution in Soil :

Introduction to Boussinesq and Westerga and equations, Use of new marks' chart.

Compressibility and Consolidation :

Conceptione dimensional consolidation; laboratory consolidation test, settlement analysis.

Shear strength :

Basic concept- strength theory. The columb Equations Methods of determining shear Strength parameters.

Earth Pressure.

- Lateral earth pressure theory-Rankines' theory-Columb's theory.
- *Stability of slopes*
- Method of slices: Friction circle method, factor of safety under various conditions.

Bearing capacity :

Terzaghi's analysis- Effect of water table on bearing capacity.

Shallow Foundations :

Spread foundations-combined footing and strip footing-Mator Raft Foundation.

(4) *PUBLIC HEALTH ENGINEERING*

Evaluation Parameters for waters and Wastewaters :

Physical, chemical and bacteriological standards for potable waters; waterborne diseases; compension of wastewaters and paremeters to express; analysis of water and wasterwater as per standard Methods.

Quantity of Waters and Wastewaters

Population projections; designs period; fire demand and wastewater flows; design flow rates in distribution lines and sewerage collection and conveyance systems.

Source and Resources of waters :

Devices to tap surface and underground sources: wells and tubewells precautions to prevent pollution; self purification of streams; Streeter Phelps equation; land application; recharge of aquifers.

Distribution and sewerage Networks :

Materials employed; parameters of selection apurtenances for distribution and sewerage systems; lay-outs of networks; service reservoirs; **pumping stations.**

Physical and Chemical Treatment Processes :

Principles of setting; Coagulation-Flocculation systems; filtration mechanisms and devices; disinfection mechanisms and devices, softening reactional devices and practices; desalination principles, absorption devices and practices; application of these principles to water and wastewater treatment.

Biological Wastewater Treatment.

Role of microorganisms in treatment of wastewater environmental parameters for microorganisms; aerobic and anaerobic processes; role of photosynthesis, application of biologic treatment principles to estimation of broad dimensions of units estimation of sludge volumes.

(5) IRRIGATION AND STORAGE

General :

Scope of irrigation—development of irrigation in India.

Soils and Soil Moisture :

Classifications of Soils—their distribution in India and Gujarat suitability of soils for irrigation soil surveys soil deficiencies fertilizers forms of moistures irrigated soils movement of soil moisture. Soil moisture constants preparation of land for irrigation.

Water Requirements of Crops :

Crops and their growing seasons—Methods of applying water-free flooding Basin method—furrow method—border method sub irrigation duty and delta-factors affecting duty, computation of duties.

Hydrology and Hydrography :

Hydrologic cycle—Rainfall—Measurement of rainfall variation in rainfall isohyets computation of rainfall over a basin—Runoff Factors affecting Runoff—Computation of Run-off—Unit hydrography Max Flood—Flood frequency analysis gaugings of streams.

Lift Irrigation :

Open wells—tubewells—aquifers—artesian wells lifting devices different types of pumps Recuperation pumping test—specific capacity of wells—Advantages and disadvantages of well irrigation, degree of permissible salinity.

Direct Irrigation :

Diversion weir headworks-types of weirs-weirs on permeable foundation Bligh's Greep theory-Khosla's theory-undersuices head regulator silt control devices.

RESERVOIR PLANNING :

Investigations for reservoir sites-Storage Capacity—Multipurpose reservoirs.

Dams :

Types of Dams- Selection of type of dams- investigation of dam site-gravity dams-forces acting on dams uplift forces—seismic forces stability requirements—elementary profile—high and low dams—elementary principles of design-galleries—construction joints—earthen dams-causes of failures stability criteria design stability analysis-seepage and its control drainage in earthen dams—construction methods arch dams—elementary principles of design rock fill dams

Spillways :

Types of spillway—energy dissipation methods—hydraulic jump—crestates vertical lift gates—Radial gate .

Distribution system :

- 1) Canals-alignment of canals—design of canals in alluvial and non-alluvial soils—Kennedy's and Lacey's silt theories—maintenance of canals lining of canals.

Regulating works :

Canals head regulator Distributory head regulator cross regulators escapes—Drops or Falls general hydraulic principles of design.

Cross Drainage works :

Aqueducts—syphons aqueducts—Super passages—Canal syphons level crossings—principles of hydraulic design.

Canal outlets :

Pipe outlets Modular and non-modular outlets standing wave flumes.
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Water logging and salt efflorescence :

Cause of water logging preventive measures reclamation of water logged and salt efflorescent areas.

Irrigation Rates and systems :

Principles of assessments types of assessment. betterment levy, Block system of irrigation.

Flood Control :

Causes of Floods—Flood damages—Flood Control measures—flood Control reservoirs. detention basins channel improvements—levies—spurs and groynes—afforestation schemes—flood warning system .

(6) *TRANSPORTATION ENGINEERING*

A. Highway Engineering

History and Development

- (a) Importance of transportation in national development economic, industrial and social. Necessity and importance of highways.
- (b) History of road construction : Telford and Mcadam constructions.
- (c) Highway development in India Jaykar Committee Nagpur Road Conference 20 Years road Development plan 1961-81.

HIGHWAY PLANNING AND PROJECT.

- (a) Highway planning; Objects, requirements, classifications of roads, planning surveys, economic, financial, traffic and engineering.
- (b) Highway Projects : factors governing location, design controls, location surveys, highway plans and interpretation, masterplan and its phasing.

HIGHWAY ADMINISTRATION, ECONOMIC & FINANCING

- (a) Highway administration, Central and State administration, Organisations and associations IRC, CRRI, INTDA, Road Board.
- (b) Economic analysis : Unit cost of transportation vehicle operating costs, highway costs, benefits cost analysis

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- (c) Highway financings, Methods of financing. source of revenue, revenue V/S expenditure :

HIGHWAY GEOMETRICS :

- (a) Cross-section elements : Payment surface, camber, carriage-way width, kerbs road margins formation width, right of way, standard terms and standards.
- (b) Sight distances : Objects and analysis of stopping, passing and overtaking sight distance overtaking zones, sight distance at inter sections.
- (c) Horizontal alignment control : Controlling design factors design of simple horizontal curves-selection of radius, superelevation; extra width on horizontal curves; transition curves-objects, types and design; running out superelevation and extra width.
- (d) Vertical alignment control : gradients-design criteria and types; grade compensation on horizontal curves; vertical curves types, objects design criteria and design procedure.

Subgrade and highway materials.

- (a) Soil subgrade; desirable properties; soil survey; soil classification systems and tests ; subgrade evaluation tests-plate load test and CBR test.
- (b) Road aggregate : types, desirable properties; tests and their significance.
- (c) Bituminous materials : Varieties; Characteristics test and their significance.
- (d) Bituminous mixes : Marshall, Modified Hubbard-Field and Hveem methods of mix design.

Pavement design.

- (a) Design factors : design wheel load, subgrade supporting capacity, strength characteristics of pavement materials, climatic factors.
- (b) Flexible pavement design : road, structure; design method group index CBR, triaxial, Burmister.

- (c) Rigid Pavement design : general considerations; wheel load stresses; temperature stresses ; Westegards' method of thickness design.

Highway construction :

- (a) Plant and machinery : quantity and quality of materials, construction procedure, and relative merits and demerits of low cost roads, macadam roads, black top surfaces, and cement concrete pavements.
- (b) Joints in cement concrete roads : types, functions, location and construction; joint fillers and sealers.

Highway maintenance :

- (a) pavement failures: Types, causes and remedies.
- (b) Maintenance practices for rectifying various defects ruts, spawding, dust nuisance waves and corrugations, sliper-shoulders, drainage, joints.

Miscellaneous :

- (a) Highway drainage : significance; requirements of drainage system ; surface and subsurface drainage ; erosion control.
- (b) Hill roads : types-basic principles of alignment; obligatory points; geometric and design standards.
- (c) Road arboriculture : necessity; plant types ; planting of trees; tree guards road- side equipments; advertisement control.
- (d) Highway lighting : Principles and factors in road lighting; efficiency of lighting system; design procedure lighting practice.

B. Traffic Engineering

- (1) Traffic characteristics; road user characteristics, vehicular characteristics.
 - (2) Traffic studies : Volume; speed, speed and delay studies-purpose, methods, analysis, presentation and use.
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- (3) Origin and destination study; methods, presentation of data and interpretation.
- (4) Traffic flow characteristics and studies, traffic capacity studies; parking studies.
- (5) Traffic accidents: types, causes, remedial measures and records.
- (6) Traffic regulations : controls on vehicles and drivers; flow regulations; one way streets.
- (7) Traffic control devices; traffic signs, signals markings types, characteristics and purpose.
- (8) Intersection control : Channelisation, rotary, grade, separation.

(7) SURVEYING

Distance Measurements :

Use of steel and invar types; applications of corrections, measurement of base line; errors in base line measurements; reduction to mean sea level specifications for base line measurement; optical measurement of distances, use of substance base geodimeters and use of radar and laser systems in trilateration.

Angle Measurements :

Principle of theodolite construction ; adjustments, temporary and permanent; precision in relation to nature of work; compass; varieties; limitations; adjustments.

Vertical Measurements :

Use of levelling instruments; components of levels; level tubes; estimation of sensitivity; optics, care and maintenance, parameters to define quality of telescopes, levelling instruments and theodolites; methods of recording and reducing; stadia reductions, use of level roads.

Establishment of Frame works :

Tringulation principles; choice of stations, statellite stations; adjustments of frame-works.