

7th Semester

Course No.	Subject	L	T	P/D	Hours	Credit
CE-471	Foundation Engineering	3	1	0	4	4
CE-472	Project Management and Quantity Surveying	3	1	0	4	4
CE-473	Solid Wastes and Environmental Pollution	3	1	0	4	4
CE-474	Departmental Elective-I	3	1	0	4	4
CE-476	Industrial training** Viva	0	0	0	0	2
CE-477	Major Project-1	0	0	6	6	3
CE-478	Seminar	0	0	3	3	2
Total					25	23

LIST OF DEPARTMENTAL ELECTIVE (CE-474, CE-482, CE-483)

1. Advanced Structural Analysis.
2. Advanced Structural Design
3. Bridge Engineering
4. Traffic Engg.
5. Transportation Planning and Public Transport
6. Soil Dynamics
7. Ground Water Engg.
8. Water Power Engineering
9. Environmental Assessment and Modeling

(NB: Refer for CE-474 in the syllabus of 8th Semester)

- Stability of slopes:** Stability of finite and infinite slopes, types of failures, different factors of safety, determination of factor of safety by method of slices, Swedish circle, friction circle, Bishop's method, Morgenstern-Price method, Taylor's stability number, location of critical circle, stability analysis of earth dam slopes for different conditions. Design of filters and rock toe
- Earth pressure:** Different types of earth pressures, states of plastic equilibrium Rankine's theory and Coulomb's theory, influence of water table, surcharge, wall friction and deformation on the earth pressure, application of Rankine's and Coulomb's theory to cohesionless and cohesive soils, Culmann's graphical method, stability considerations for retaining walls, effect of earthquakes. Design of retaining walls.
- Sheet piles:** Different types of sheet pile walls-free and fixed earth support, anchored bulk heads, design principles, arching in tunnels, open cut strutting and sheeting.
- Foundations:** Different types of loads on foundations, types of shallow and deep foundations, footing-rafts-piles-wells-selection of foundation type-dewatering of foundations-type of explorations, methods of boring, soil samples and samples.
- Shallow foundations:** Definition, bearing capacity, factors affecting bearing capacity, Terzaghi's theory of bearing capacity, effect of foundation size and shape, effect of ground water table, determination of bearing capacity from building codes, plate load test, penetration test, static and dynamic cone tests, Housel's approach, bearing capacity of sands and clays, settlements of foundation. Elastic settlements, consolidation settlements, differential settlements, permissible settlements, design principles of depth of foundation, spread footing, combined footing, raft foundations, principles of floating rafts, foundations on non-uniform soils.
- Deep foundation:** Types of piles based on function, materials and methods of construction, friction and end bearing piles, static formulae-Engineering News and Hiley's formula, group action in piles, block failures, settlement of pile groups in sands and clays pile load test negative skin friction, under reamed piles.
- Well foundation:** Elements, forces acting on well, lateral stability analysis, problems in sinking of wells and remedial measures.
- Machine foundations:** model study, natural frequency of block foundation system, block foundation under vertical vibration.
- Reinforced earth:** Introduction, analysis and design of reinforced earth wall, reinforced earth base.

Books:

1. Analysis and Design of Foundation and Retaining Structures : S. Parkash and Gopal Ranjan
2. Soil Engineering Theory and Practice : Alam Singh
3. Soil Mechanics : B. M. Das
4. Design of Sub-structures : Swami Saran

1. **Net work techniques and construction organisation:** An overview of planning process, planning through bar charts, mile stone charts, Definitions and difference between CPM and PERT, basic concept of network preparations, applications in construction planning scheduling and control, funds, material, layout and equipment planning using network techniques, Different types of organization, their structures, advantages and limitation.
2. **Construction plant and equipment:** Factors affecting selection of equipment, bulldozer, dumpers, trenchers, excavators, hoe , hoists, graders, piling hammers, pumps, compressors, bitumen mix plant, rollers, clam shell, aggregate production techniques, crushers, concrete production (only general features of equipments will be discussed).
3. **Estimating and analysis of rates:** Different types of estimates, deductions for openings, methods of taking out of quantities for building culverts, irrigation works, road works, canal works, sanitary and R.C.C. work, Scheduling of rates, analysis of rates, problem in analysis of rates for earth work, brick masonry, stone masonry, cement concrete, RCC work, iron work, plastering, flooring, white washing, painting, wood work.
4. **Specifications:** Object of specifications, general specifications, detailed specifications of the following: earth work in foundation, lean concrete in foundation, cement concrete, RCC, brick work, plastering, cement concrete floor, mosaic floor, white washing, distempering, painting, doors and windows, DPC, centering and shuttering, stone masonry, cement mortar, lime mortar.
5. **Accounts procedures and valuation:** Regular and work charged establishment, pay bill, ACR, classifications of works, contract, tender, tender notice, earnest money, security money, arranging contract, power of accepting tender, daily Labour, muster roll, classification of contracts, penalty, measurement book, account procedures of stores, issue rate, stock accounting, bill voucher, first and final bill, advance payment, hand receipt, refund of security money, cash book, imprest, deposit works, temporary advances, treasury challan, inventory, administrative approval, competent authority, Gross income, net income, outgoing, scrap value, salvage value, obsolescence, annuity, capitalized value, year's purchase, sinking fund, depreciation, valuation of building, determination of depreciation, method of valuation, fixation of rates, plinth area required for residential building.

Books:

1. Construction Planning equipments and methods : R.L.Peurity
2. PERT and CPM : L.S.Srinath
3. Quantity Surveying : B.N.Dutta.

Solid waste management: Solid waste generation, onsite handling, storage and processing, collection, transfer and transport, processing techniques and equipments, recovery of resources, conversion products and energy, disposal.

Hazardous waste management: Exposure and risk assessment, environment legislation, characterization and site assessment, waste minimization, incineration, transportation, storage, landfill disposal, facility siting, site remediation.

Biomedical waste management and handling: Biomedical waste management issues, waste generation, current practices in health care facilities, environmental concerns, labeling and colour coding for waste storage, collection, transportation, treatment, common treatment facility, disposal.

Ecology and environment: Role of ecology in environmental issues, salient features of major ecosystems, energy transfer, local, regional and global impacts, ecological chain and balance, quantitative ecology in the context of environmental impact assessment of development projects.

Air pollution: Sources, emission of gases, suspended particulate matter, classification dynamics of pollutant dispersion and disposal, effects on environment including living and non-living matter, remedial measures and their effectiveness, environmental assessment, acts relating to air pollution, standards.

Noise pollution: Properties of sound waves, characterization of noise, kinetics of noise, rating systems, measurement and control standards.

Books:

1. Hazardous Waste management : M.D. LaGrega, P.L. Buckingham, J.C.Evans
2. Introduction to Environmental Engineering: M.L.Davis and D.A.Cornwell.
3. Integrated solid Waste Management, Principles and Management Issues : G. Tchobanoglous, H.Theisen, S.Vigil.
4. Manual on Municipal Solid Waste Management : CPHEEO (Ministry of Urban Development)

8th Semester

Course No.	Subject	L	T	P/D	Hours	Credit
CE-481	Design of Hydraulic Structure	3	1	0	4	4
CE-482	Departmental Elective-II	3	1	0	4	4
CE-483	Departmental Elective-III	3	1	0	4	4
CE-484	Departmental Elective-IV	3	0	0	3	3
CE-487	Major Project-II	0	0	6	6	3
Total					22	18

Total Credit= 188

LIST OF DEPARTMENTAL ELECTIVE (CE-474, CE-482, CE-483)

1. Advanced Structural Analysis.
2. Advanced Structural Design
3. Bridge Engineering
4. Traffic Engg.
5. Transportation Planning and Public Transport
6. Soil Dynamics
7. Ground Water Engg.
8. Water Power Engineering
9. Environmental Assessment and Modeling

LIST OF DEPARTMENTAL ELECTIVE (CE-484)

1. Rock Mechanics.
2. Environmental Geotechnology.
3. Ground Improvement Techniques.
4. Advanced Surveying.
5. Remote Sensing and GIS

1. **Canal head works:** Introduction, layout, selection of site for diversion head work, various components and their functions, design of weirs and barrages on permeable foundation, Bligh's creep theory, Khosla's method of independent variables, use of Khosla's charts, silt ejectors and their design principles.
2. **Canal falls:** Necessity and location of canal falls, types, design of Sarda and Glacis falls, energy dissipation devices and arrangement.
3. **Canal regulation works:** Canal head regulators and cross regulators, their functions and design concepts.
4. **Cross drainage works:** Introduction, types of cross drainage works and their selection, design aspects of aqueducts, siphon aqueducts, siphon passages, canal siphon and level crossings.
5. **Storage works:** Investigation and planning for reservoirs, capacity and yield, storage works, types of dams and their choice, selection of suitable site.
Gravity dams: Boreet in time, two dimensional design, stability criteria and foundation treatment.
Earth dams: Design aspects of earth dams, simple design, seepage through earth dams, control seepage, design of filters.
Arch dams: Constant angle and constant center arch dams (simple design and sketch), buttress and multiple arch dams (principle and sketch).
6. **Spillway and stilling basins:** Introduction, spillway capacity, different types, energy dissipation below spillways, stilling basins: type-I and II, gates and valves aerators.

Books:

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| 1. Fundamentals of Irrigation | : Bharat Singh |
| 2. Irrigation Engineering and Hydraulics Structures | : S.R.Sahasrabudhe |
| 3. Theory and Design of Irrigation Structures Vol.I and II | : R.S.Varshney |

L	T	P
3	1	0

1. **Introduction:** Stiffness, flexibility, flexibility and stiffness matrices.
2. **Matrix Methods in skeletal structural analysis:** force and displacement methods, analysis of beams, frames and trusses including analysis using substructures.
3. **Approximate Methods for Structural Analysis:** Cantilever and portal methods-two cycle moment distribution
4. **Theory of Plates and Shells:** Analysis of plates, folded plates and singly curved shells: conventional and approximate methods.

1. **Wind, Snow, Pounding, Seismic, Bridge Loading**
2. **Light and Industrial Building Design:** Industrial Buildings with Cranes, Loading Conditions and Comb, general Building Systems, Roof Systems, Framing Systems, Bracing Systems.
3. **Plate Girder Design:** Introduction to Plate Girders, design of web plate, flanges, curtailment of flange plates, design of web stiffeners, web splices and flange splices, welded plate girder.
4. **Prestressed Concrete Design:** Basic Concepts of Prestressing, Calculation of Stresses in Prestressed Beams, Partial Loss of Prestress, Flexural Design of Prestressed Beams, Flexural Strength Design for Shear.
5. **Yield line theory:** Introduction to Yield line theory for reinforced concrete slabs, Yield line solutions based on work equations.
6. **Timber design:** Timber as a structural material, Material properties, Rigid-joined frames design under combined axial and flexural loads, General concept of glued laminated timber, General rules for designing of glued laminated structures, Design of bolted joints in timber structures.

Books :

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| 1. Reinforced Concrete | : E.G. Nawy |
| 2. Steel Structures | : V.N. Vazirani and M.M. Ratwani |
| 3. Prestressed concrete | : Krishna raju |
| 4. Reinforced Concrete Design | : R.N. Krishna and R.N. Pranesh |

1. **Introduction:** Definitions, components of a bridge, classification, importance and standard specifications.
2. **Investigation for bridge:** Site selection, data drawing, design discharge linear water way, economical span, location of piers and abutments, vertical clearance above HFL, scour depth. Traffic projection, investigation report choice of bridge type.
3. **Standard specification for Road Bridge:** IRC bridge code, determination of dead loads and live loads, wind loads, longitudinal forces, centrifugal forces, horizontal forces due to water current buoyancy effect, earth pressure, temperature effect, deformation stresses, Secondary stresses, erection stresses, seismic forces.
4. **Culverts:** Design of slab culvert and box culvert.
5. **Design of T-beam reinforced concrete bridges.**
6. **Design of pre-stressed concrete bridges.**
7. **Design of sub structure:** Design of piers and masonry abutments.

Books:

1. Essentials of bridge engineering : D.Jhonson Victor
2. Design of concrete bridge : Aswani, Vaziani, Ratwani
3. Concrete bridges : V.K.Raina
4. Bridge Engineering : Ponnuswamy

- 1. Properties of traffic engineering elements:** Introduction to Traffic Engineering, Vehicle Characteristics, Human factors and driver Characteristics, Road Characteristics.
- 2. Traffic engineering studies and analysis:** Introduction to traffic studies, Traffic volume studies, speed studies, origin and destination studies. Travel time and delay studies, parking studies, accident studies.
- 3. Traffic flow characteristics:** Nature of Traffic flow, Approaches to understand Traffic Flow, Parameters connected with Traffic flow, Categories of Traffic flow, Uninterrupted traffic flow model. Analysis of speed, flow and density relationship, Empirical studies of traffic stream Characteristics
- 4. Fundamentals of interrupted traffic flow:** Shock waves, Traffic flow at signalized intersections, Traffic flow at unsignalized intersections.
- 5. Intersection control and design:** Introduction, Types of intersections, Design considerations, Traffic control devices, Conflict areas at intersections, Types of Intersection controls, Traffic signals, warrants for interchanges, Design of interchanges.
- 6. Highway capacity:** Introduction, Highway capacity, Level of service, basic freeway capacity studies, Multilane, Highway capacity, two lane Highway capacities.

Books:

1. Traffic Flow fundamentals: : Adolf D.May
2. Traffic Engineering : Mcshane and Roess
3. Traffic Engineering and Transport Planning : L.R. Kadyali
4. Principles of Transportation Engineering : Patha Chakraborty and Animesh Das

1. **Transportation planning process:** Introduction, Elements of Transportation Planning, Definition goals and objectives, Identification of needs, Generation of Alternatives, Evaluation of alternatives, Implementation of alternatives.
2. **Land use and transportation system:** Urban system components, Concept and definitions, criteria for measuring and comparing urban structure, land use and transportation.
3. **Transport demand analysis:** Nature and analysis of Transportation demand, Sequential demand analysis, Trip-generation models, Trip-distribution models, Models split analysis, Traffic assignment models.
4. **Public transportation:** Historical development of urban transportation, Mass Transit Definitions and classification, Route development, stop location and stopping policy, Schedule development.
5. **Transportation economics:** Scope of transportation economics, Transportation demand, demand, supply and equilibrium, Sensitivity of travel demand, Factors affecting elasticities, elements of engineering economics.

Books:

1. Transportation Engineering : C. Jotin Khisty and B. Kent Lall
2. Principles of Transportation Engineering : P. Chakraborty and A. Das
3. Fundamentals of Transportation Engineering: : C.S. Papacoastas
4. Traffic Engineering and Transport Planning: : L.R. Kadyali

1. **Introduction and fundamentals of vibration:** Soil mechanics and soil dynamics, Nature of dynamic loads, Stress conditions on soil elements under earthquake loading, Problems of dynamic loading of soil and soil structures. Earthquakes causes, origin, classification and effects.
2. **Theory of vibrations:** Undamped and damped vibrations, Forced vibrations with harmonic excitation, System under transient vibrations, Rayleigh's method, Logarithmic decrement, Determination of viscous damping, Transmissibility, Principles of vibration measuring instruments, Systems with two degree of freedom (vibration absorber), Systems with multi degree of freedom, Spectral response.
3. **Wave propagation in an elastic medium:** Wave propagation in an elastic rod, Wave propagation in an elastic infinite medium, Wave propagation in a semi-infinite elastic half space, Waves generated by a surface footing.
4. **Stress-strain characteristics of soil under dynamic loads:** Introduction to dynamic tests, Pendulum loading apparatus, Behaviour of saturated sands under transit loading, Effects of static stress level and number of pulses on strength of cohesive solids, Oscillatory simple shear, Resonant column apparatus, Wave propagation methods, Block resonance test, Cyclic plate load test.
5. **Dynamic earth pressure:** Behaviour of retaining walls during earthquakes, Modification on Coulomb's theory Modified Culmann's construction, Analytical solution of $c-\phi$ soils, displacement analysis, Indian standard code of practice.
6. **Dynamic bearing capacity:** Earthquake load on footing, Effect of horizontal load and moment, Provision of relevant standards, Dynamic analysis for vertical and horizontal loads.
7. **Liquefactions of soil:** Theory and criterion of liquefaction, Factors affecting liquefaction characteristics, Liquefaction studies in triaxial shear and oscillatory simple shear, Evaluation of liquefaction potential, Liquefaction analysis from standard penetration test data, Introduction to shake table and field test.
8. **Machine foundations:** Degrees of freedom of a machine foundation, Vertical sliding, Rocking, Yawing vibrations of a block, Simultaneous rocking sliding and vertical vibrations of a block, India standards for design of foundations for reciprocating machines and impact type of machines.

Books:

1. Soil Dynamics : Shamsheer Parkash
2. Dynamics of bases and foundations : D.D.Barken
3. Soil Dynamics and Machine Foundations : Swami Saran.

1. **Ground water occurrence and quality:** introduction to ground water, water bearing formations, aquifers, aquicludes and aquitards, confined and unconfined and leaky aquifers, ground water origin, modes of occurrence, yield of water and water quality.
2. **Ground water movement:** Permeability, states of flow, Darcy's laboratory permeability tests, formation constants, flow through aquifers, storage equations and differential equations governing ground water flow.
3. **Ground water exploration:** Exploration by geologic and hydraulic methods, surface geophysical methods, map and tracer techniques.
4. **Well hydraulics:** Definition of terms, governing flow, equilibrium and non-equilibrium well equations, effect of hydro-geologic conditions on draw down, draw down from pumping tests, well interference and well efficiency, radius of influence, recharge and boundary conditions, effect of partial penetration, thesis equation.
5. **Well drilling:** Cable tool method, California stove-pipe method, direct rotary, drilling, drilling fluids, air and jet drilling, drilling with earth augers, grouting and sealing of well casing.
6. **Design of well:** Casing diameter, casing material, well depth, well screens length, slot opening and diameter, open area, entrance velocity, design of wells.
7. **Development of water wells:** Introduction, factors affecting development, method of development over pumping, back washing, mechanical surging, other method of well development.

Books :

1. Ground water and well : F.G. Driscoll
2. Ground water Engineering : K.R. Karanth
3. Ground water Hydrology : Todd
4. Manual of ground water and tube-wells technical report : H.D. Sharma and A.S. Chawla

1. **Introduction:** Principal Components of hydro-electric scheme, water requirement, concept of firm power and secondary power, plant capacity.
2. **Types hydro electric plants:** Classification of hydro-power plants. Storage, Run off of the river and pumped storage plants, classification based on operating head, base load and peak load plants.
3. **Pondage and storage:** Need for pondage and storage, requirements of storage, economic analysis of storage capacity, aspects of cost allocation for different purposes, reservoir operation using flow duration and mass curves considerations for flood routing.
4. **Intake:** Types of intake, design of trench weir.
5. **Desilting:** Introduction, types of desilting basins, Principal of desilting, Design of Desilting basins.
6. **Water conductor system:** Intake structures, desilting tanks, conveyance channels and tunnels, surge tanks, surge shafts or fore bays, pressure shafts, penstocks, power house and tail race channels, different types of three structures and their brief design aspects.
7. **Hydraulics prime movers:** Conveyance channels and tunnels, surge tanks, surge shafts or fore bays, Pressure shafts, penstocks, designs of water conveyance systems and penstocks.
8. **Power house:** Types of power houses, various components and power planning.
9. **Economics of hydro power installation:** Engineering feasibility, political consideration, economic feasibility, analysis of cost, cost of power, operation of a power plant system, cost of hydro power.
10. **Project report:** General report, design report, cost and estimate report.

Books :

1. Hydro-electrical Engineering : Creager and Justin
2. Water Power Engineering : Barrows
3. Water Power Development (Vol.-I and II) : Mosony L. Emil

1. **Environmental assessment:** Evolution of environmental impact assessment (EIA), EIA at project, regional and policy level; strategic EIA, EIA process, screening and scoping criteria, rapid and comprehensive EIA, specialized areas like environmental health impact assessment, environmental risk analysis, economic valuation methods, cost benefit analysis, expert system and GIS applications, uncertainties.
2. **Environmental policies and legislation:** Legislative and environmental clearance procedures in India and other countries, sitting criteria, public participation, resettlement and rehabilitation
3. **Methodologies:** Practical applications of EIA, EIA methodologies, baseline data collection, prediction and assessment of impacts on physical, biological and socio-economic environment, environmental management plan, post project monitoring, EIA report and EIS, review process.
4. **Environmental systems Modelling:** Principles of modelling, classification; introduction to air quality models, meteorology, atmospheric stability and turbulence, Gaussian plume model and modification, numerical models, Transport and fate of pollutant in aquatic system, introduction to river, estuarine and lake hydrodynamics, stratification and eutrophication of lakes, dissolved oxygen model for streams, temperature models.

Books:

1. Environmental Impact Assessment for Developing Countries: Asit K. Biswas
2. Environmental Impact Analysis Handbook : G.J. Rau and C.D. Wooten
3. Environmental Impact Assessment : L. Canter
4. Air Pollution : J.H. Seinfeld
5. Principles of Surface Water Quality Modelling and Control : R.V. Thomann and J. A. Muller

1. **Introduction:** Rock Mechanics and its relationship with soil mechanics and engineering geology, application of rock mechanics to civil engineering problems.
2. **Classification of rocks:** Lithological classification, engineering classification of rocks, classification based on wave velocity ratio, R.Q.D. Classification of rock masses i.e. RMR and Q systems.
3. **Rock properties:** Laboratory test, compression, tensile, void index, permeability and shear, effects of size of specimen, rate of testing, confining pressure etc. Stress strain curves of typical rocks, strength of intact and fissured rocks, effects of anisotropy, saturation and temperature effects, shear strength of jointed rock mass.
4. **Field test:** Uniaxial tests in tunnels and open excavations, shear test, pressures tunnel tests etc.
5. **Stability of rock slopes:** Mode of failure of rock slopes, plane wedge analysis, 3D-wedge analysis circular mode of failure, back analysis of slopes, stability charts, types and design of rock bolts.
6. **Determination of in situ stresses:** Stresses in rock, methods of determining in situ stresses i.e hydraulic fracturing, flat jack test and over coring.
7. **Design of tunnels:** Rock pressure theories, ground reaction curve, rock support interaction analysis empirical and semi empirical methods of analysis, simple method of tunnel, design, types and design of tunnel lining.
8. **Foundation of rocks:** Stress distribution in foundation, methods of determination of bearing capacity of rocks, improvement of rock properties, pressure grouting for tunnels and dams, dental concreting, shear zone treatment.

Books:

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| 1. Rock Mechanics in Engineering Practice | : K.G. Stagg |
| 2. Under ground excavation in rock | : Hoek and Brown |
| 3. Rock Mechanics in Engineering Practice | : Cambridge University |
| 4. Introduction to Rock Mechanics | : R.E. Goodman |

- 1. Introduction and waste characterisation:** Waste generation and disposal on land, sources of solid waste, waste quantities, characteristics of solid waste, management of solid waste, impact on environment. Liquid waste characterization, solid waste characterization, Geotechnical properties of solid waste, hazardous waste characterization.
- 2. Ground water contamination processes beneath landfill:** Sources of ground water contamination, Transport Mechanisms, Flow through soil beneath landfills, Transport process in soil beneath landfills, Plume beneath Landfills.
- 3. Land fill planning and design consideration:** Introduction, types of landfills, site selection for landfills, site characterization, landfill layout, landfill section, landfill capacity, planning of phased operation, leachate collection facility, gas collection facility, final cover, surface water drainage, stability aspects, environmental monitoring systems, construction schedule, material requirement, equipment requirement, environmental control during operation, landfill closure and post closure plan.
- 4. Landfill liners compacted clays and amended soils:** Hydraulic conductivity of compacted soils, Factors affecting hydraulic conductivity, Compacted soil liners, liner material, hierarchy of options, compacted clay liners, amended soil liners, liner requirements and specifications, construction aspects of compacted clay liner and amended soil liner.
- 5. Geosynthetics in environmental geotechnology:** Introduction, types of geosynthetics, functions of geosynthetics, physical properties and their determination, role of geosynthetics in environmental geotechnology, lining system, basal lining system, side lining system, drainage blanket, surface lining, use of geosynthetics in abandoned landfills. jute and coir production, status of jute and coir industry in India, physical and chemical characterization, jute and coir geotextiles, durability of jute and coir geotextiles, test procedures, role of vegetation, erosion control products and their classification, erosion process, surface erosion control techniques, installation guide lines for slopes.
- 6. Mine tailings and ash pond:** Introduction, fly ash, chemical composition, need for disposing of fly ash, Geotechnical properties of Indian fly ashes, methods of disposal of fly ash, utilization of fly ash, management strategy, introduction to mine tailings impoundments and ash ponds.

Books:

1. Waste disposal in engineered landfills : Manoj Dutta
2. Geotextiles- Emerging Trends : G.Venkatappa Rao and K. Balan

1. **Compaction:** Principles of compaction, Engineering behaviour of compacted clays, field compaction techniques static vibratory, impact, Earth moving machinery, Compaction control, application to granular soils, cohesive soils, depth of improvement, environmental considerations, induced settlements, compaction using vibratory probes, vibro techniques, vibro equipment, vibro compaction and replacement process, vibro systems and liquefaction, soil improvement by thermal treatment, preloading techniques, surface compaction, introduction to bio technical stabilization, dewatering systems.
2. **Grouting:** Chemical grouting, commonly used chemicals, grouting systems, grouting operations, applications, compaction grouting, application and limitations, plant for preparing grouting materials, jet grouting, jet grouting process, geometry and properties of treated soils and applications.
3. **Stabilization:** Introduction to soil improvement by adding materials, lime, flyash, cement and other chemicals and bitumen, sand column, stone column, sand drains, prefabricated drains, electro-osmosis, lime column, soil-lime column, stabilization of soft clay or silt with lime, bearing capacity of lime treated soils, settlement of lime treated soils, improvement in slope stability, control methods.
4. **Soil reinforcement:** Soil improvement using reinforcing elements, introduction to reinforced earth, load transfer mechanism and strength development, soil types and reinforced earth, anchored earth nailing, reticulated micro piles, soil dowels, soil anchors, reinforced earth retaining walls.
5. **Geosynthetics:** Polymer type geotextiles, woven geotextiles, non woven geotextiles, geo grids, physical and strength properties, behaviour of soils on reinforcing with geotextiles, effect on strength, bearing capacity, design aspects for slopes, clay embankments, retaining walls and pavements.

Books:

1. Text Book on Ground Improvement : Blackie Moseley
2. Text Book on Grouting in engineering Practice : R.Boweven
3. Text Book on Soil Reinforcement with Geotextiles, : R.A.Jewell
4. Text Bok on Soil Improvement Technique and their Evolution : W.E. Van Impe
5. Text Book on Bio Technical and Soil Engineering
and Slope Stabilization : D. H. Gray & R. B. Sotir
6. Text Book on Engineering With Geosynthetics, : G.V. Rao and G.V.S.Rao
7. Construction and Geotechnical Methods in Foundation Korener

1. **Triangulation:** Classification of triangulation system, operation in triangulation survey, reconnaissance, selection of site for base line, its measurement and extension, correction to base line measurement, selection of stations, triangulation figures, scaffolds and signals, marking of stations, inter-visibility, strength of figures, reduction to centre, derivation of relations when observations are taken from the satellite station and towards the station.
2. **Trigonometric Levelling:** Introduction, determination of the level of the top of an object when its base is accessible and not accessible, determination of height of object when two instrument stations are not in the same vertical plane, indirect levelling on a rough terrain, indirect levelling on a slopes, effect of refraction and curvature, axis signal correction, signal correction, difference in elevation in single observation, difference in elevations by reciprocal observation.
3. **Theory of Errors:** Definitions, law of weight, probable errors, most probable value, normal equations, method of least square, triangle station adjustment, figure adjustment, quadrilateral and polygon adjustment of closed traverse and level nets.
4. **Photogrammetry:** Basic concepts, type of photographs, geometry of aerial photographs, measurement of parallax and height determination.
5. **Astronomy:** Solution of an astronomical triangle, co-ordinate systems time solar, sidereal and standard equation of time, conversion of time, sun dial, determination of time, azimuth, latitude and longitude, correction for astronomical observations.
6. **Introduction to Remote Sensing**

Books :

1. Surveying Volume-I : K.R. Arora
2. Surveying Volume I, II and III : B.C. Punmia
3. Advance Surveying : R. Agor

- 1. Introduction:** Introduction to Remote Sensing, data acquisition and processing, sensor systems, applications, Electromagnetic Radiation (EMR) and its characteristics, Radiation principles, Planck's Law, Stefan's Law, Wein's Displacement law, Kirchoff's Law, prosperities of solar radiant energy, atmospheric windows.
- 2. Physical basis of remote sensing:** Interaction in the atmosphere, nature of atmospheric interaction, atmospheric effects of visible, near infra-red thermal and microwave wavelengths, interaction at ground surface, interaction with soils and rocks, effects of soil moisture, organic matter, particles, size and texture, interaction with vegetation, spectral characteristics of individual leaf, vegetation canopies, effect of leaf pigments, cell structure, radiation geometry.
- 3. Platform and sensors:** Multi concept in remote sensing, general requirements of a platform, balloon aircraft, satellite platforms sun-synchronous orbits, sensors for visible and near infra-red wavelengths, profilers, images, scanners, radiometers, optical mechanical and push button scanners, spectral, spatial, radiometric and temporal resolution, IFOV, FOV, geometric characteristics of scanners, V/H ratio, comparison of some satellite/ aerial platforms and sensors and remote sensing data products, land sat MSS and TM, SPOT, IRS, ERS etc.
- 4. Geographical Concepts and Terminology:** Difference between image processing system and geographical system (GIS), utility of GIS, various GIS packages and their salient features, essential components of a GIS, scanners and digitisers, raster and vector data, data storage, hierarchical data, network systems, relational database, data management, conventional database management systems, spatial database management, data manipulation and analysis, reclassification and aggregation, geometric and spatial operation on data management and statistical modeling, applications of GIS in various natural resources and engineering applications.

Books:

1. Remote Sensing and Image Interpretation : T.M. Lillensand and R.W. Keifer
2. Principles of Remote Sensing : P.J. Curren
3. Principles of Geographical Information systems
for land Resources Assessment : P.A. Baurrough
4. Manual of Remote Sensing, Vol.2 : American Society of Photogrammetry
and Remote Sensing
5. Geographical Information systems-
A Management Perspective : Stan Aromoff