PAKISTAN ENGINEERING COUNCIL

Syllabus for Engineering Practice Examination (EPE)

Civil Engineering & Allied Disciplines
(Civil Engineering/Transportation Engineering/Urban Engineering/Environmental Engineering/Building & Architectural Engineering)

Total Marks: 60

PART-II

This is an open book breadth and depth examination, comprising 60 Multiple Choice Questions (MCQs) of one mark each (total 60 marks) with a duration of three hours. There shall be two sections of Part-II for each major discipline of EPE. Qualifying Marks for this part shall be ***sixty per cent***.

SECTION-A / BREADTH

This section will generally confirm to latest (updated) B.E./equivalent qualification of Civil Engineering and allied disciplines. The examination of this section shall comprise 25 MCQs (total 25 marks).

1. MATHEMATICS AND STATISTICS FOR ENGINEERS 10%

i. Fundamentals

- Coordinate System: cartesian and polar coordinate system
- Trigonometric functions
- Maxima and minima of functions
- Application of limit, continuity, differentiation and integration
- Complex numbers
- Binary arithmetic
- Sequence and series

ii. Differential and Partial Differential (PD) Equations and their Solutions

iii. Vectors, matrices and determinants, their properties and applications

iv. Solution of Equations

- Solution of linear simultaneous equations
- Iterative methods for solution of linear simultaneous equations

v. Numerical Differentiation and Integration

vi. Eigen Values and Eigen Vectors

vii. Statistics & Probability

- Frequency curves and their types, frequency histograms
- Measure of dispersion (mean, mode, median, standard deviation)
- AM, GM, HM and their properties
- Simple and multiple regression
- Interpolation and its applications
- Basics of probability, types and methods

Suggested Books:

- George Brinton Thomas, Ross L Finney, "Calculus & Analytical Geometry", Addison-Wesley, 1998
- S M Yousif, "Mathematical Methods", 2nd Edition, Ilmi Kitab Khana
- Hogg & Craig, "Introduction to Mathematics &Statistics", Prentice Hall, 2004.
- Cagora S, "Numerical Methods for Engineers", McGraw Hill, 2006.
- Erwin Kreyszig, "Advanced Engineering Mathematics," Ninth Edition, 2005, International Edition, John Wiley & Sons, ISBN: 0471728977.

2. ENGINEERING MECHANICS 10%

i. Statics

- General principles of statics
- Resultant, resolution and conditions of equilibrium of co-planer forces
- Types of supports and reactions
- Degree of restraints and static determinacy
- Friction

ii. Dynamics

- Velocity, acceleration and their units
- linear and angular motion
- inertia force, impulse, momentum and work
- power and energy

Suggested Books:

- Hibler, R.C. Engineering Mechanics, 11th Ed, Prentice Hall, 2006
- Khurmi, R. S. Engineering Mechanics, 19th Ed, S. Chand, 1990

3. SURVEYING 7%

i. Methods of surveying

ii. Leveling, contouring, plane table surveying

iii. Traversing

iv. Tachometry

v. Basics of Geographic Information System (GIS) and Remote Sensing (RS)

vi. Photogrametry

vii. Basics of field astronomy

viii. Surveying Instruments: levels, theodolite, Electronic Distance Meter (EDM), total station, GPS (Global Positioning System)

ix. Practical problems

x. Calculation of area and volume

xi. Computations and setting out of curves

xii. Tunnel surveying

xiii. Hydrographic surveying

Suggested Books:

- Irvine W, "Surveying for Construction", McGraw Hill Inc., 4th edition1997.
- Bannister, Raymond S, Baker R, Surveying, Pearson Education and Dorling Kindersley Publishing Inc. (1998).
- Kanetkar T.P., 2008, "Surveying & Leveling", Volume I & Volume II, Standard Publishers Distributors, India, 2008.
- Burrough P.A., and McDonnell R.A., "Principles of Geographical Information Systems", 352 pages, Oxford University Press, 1998.
- Geographic information system, available on: http://en.wikipedia.org/wiki/Geographic_information_system

4. CIVIL ENGINEERING MATERIALS AND CONSTRUCTION 10%

i. Construction Materials

- General civil engineering materials, performance requirements (strength, stiffness, durability, appearance)
- Materials quality control and testing
- Concrete: cement, fine and coarse aggregates, properties of cement, aggregates and water, basic concrete mix design procedure, concrete admixtures
- Bricks: properties of brick making materials and methods, types/ specifications of bricks
- Stones: types, characteristics and uses of common construction stones
- Steel: production and properties of steel, steel grades, effect of alloys, protection from corrosion and fire
- Timber: properties, defects, durability and seasoning/preservation of timber
- Asphalt: types, properties and uses of asphalt

ii. Construction Methodologies

- Construction methodologies pertaining to in situ and pre-cast construction
- Mechanized construction techniques
- Layout, earthwork and construction
- Construction equipments

Suggested Books:

- R. C. Smith, Cameron K. Andres *Materials of Construction*, McGraw Hill Inc Ltd, 1998.
- M. Neville "Properties of Concrete", Wiley John & Sons. 3rd Ed. 1994, ISBN: 0803133677

5. FLUID MECHANICS 9%

i. Properties of Fluids (Statics and Dynamics)

ii. Fluid Properties Measuring Techniques: devices for the measurement of static pressure, velocity and discharge in pipes and open channels

iii. Flow in Pipes: minor and major losses in pipelines, empirical formulae for pipe flow, solutions of pipe flow problems and pipe networks

iv. Flow in Open Channels: formulae for flow in open channels and most efficient hydraulic cross-section

v. Forces on Vanes, Turbines and Pumps: impulse momentum equation, forces on flat and curved vanes, components and operations of various turbines and pumps.

Suggested Books:

- Finnemore,E.J & Franzini,J.B.,10th Edition. Fluid Mechanics with Engineering Application. McGraw Hill Book Co. Singapore.
- Jain, A.K. "Fluid Mechanics". Khanna Publishers, New Delhi, India,1990.
- S.S. Rattan, "Fluid Machines" Khanna Publishers, New Delhi, India, 1994.

6. MECHANICS OF SOLIDS 10%

i. Fundamental Laws and principles of stress and strain

ii. Stresses in composite bars and relationships between elastic constants

iii. Shear Force (SF), Bending Moment (BM), SF and BM diagrams, point of contra flexure and point of inflation

iv. Theory of simple bending, moment of resistance, section modulus, flexural formula

v. Shear stresses in beams

vi. Torsion of solid and hollow circular shafts

vii. Strain energy

viii. Experimental stress analysis

Suggested Books:

- Pytel, A. & F.L.Singer, "Strength of Materials", 4th Ed, Harper & row Publishers, 1987.
- G H Ryder, "Strength of Materials", 3rd Edition, Macmillan, 1969.

7. HYDROLOGY AND WATER RESOURCES 10%

i. Water Resources and Hydrologic Cycle: Water Resources of Pakistan, hydrologic cycle, precipitation, evaporation, evapotranspiration, interception and infiltration

ii. Surface Flow: water stage measurement, stream flow routing, surface runoff, floods hydrographs

iii. Groundwater: groundwater resources, flow and water table

iv. Flow in Open Channels and Pipes: specific energy and critical depth. Water surface profiles, hydraulic jump, humps and contractions, water hammer

v. Hydraulic Structures: bridges, cross drainage structures, types of reservoirs.

Suggested Books:

- Awan, N.M. “Surface Water Hydrology”, National Book Foundation, Islamabad, 1981.
- Linsely, R.K., Kohler, “Hydrology for Engineers”, SI. Ed.1996, McGraw Hill
- Driscoll, F.G., “Groundwater and Wells”, Johnson Division, USA, 1987.
- Franzini, J.B. and Finnemore, E.J., “Fluid Mechanics with Engineering Application” , McGraw Hill Book Co., Singapore, 2003.
- Iqbal Ali “Irrigation and Hydraulic Structures: Theory, Design and Practice”, Publisher, Institute of Environmental Engineering & Research, NED University of Engineering &Technology, Karachi, 1993, ISBN: 9698160000

8. GEOTECHNICAL ENGINEERING 10%

i. Subsurface Exploration: common drilling methods and Standard Penetration Test (SPT)

ii. Soil Properties

iii. Classification of Soil: particle size distribution, atterberg limits, unified soil and AASHTO classification systems

iv. Compaction: theory and practice, standard and modified proctor test, Field Density Test (FDT)

v. Permeability: Darcy’s Law and coefficient of permeability

vi. Stresses in a Soil Mass: total and effective stresses, pressure bulb and 2:1 Method

vii. Settlement of Soil: types and determination of settlement

viii. Shear Strength of Soil: shear strength parameters and determination

ix. Lateral Earth Pressure and Retaining Structures

x. Shallow and Deep Foundations: types, bearing capacity and settlement determination

xi. Embankment Dams: types and materials for construction.

Suggested Books:

- Das, B.M. “Principles of Geotechnical Engineering”, 4th edition, PWS Publishing Company, 1998.
- Craig, R.F, “Soil Mechanics”, Van Nostrand Reinhold (UK) Co. Ltd.1983.
- Bowles, J.E “Foundation Analysis and Design”, McGraw Hill Publishing Company, 1988.

9. ENVIRONMENTAL ENGINEERING 7%

i. Public Health Engineering

- Wastewater Treatment: wastewater flow rates, characteristics of sewage, sewage treatment and disposal
- Water Quality: water impurities and their health significance, WHO guidelines
- Water Treatment: treatment of surface and ground water.

ii. Environmental Engineering

- Solid Waste Management: sources, classifications, characteristics, generation rates, collection and disposal of solid waste
- Environmental Impact Assessment (EIA), legislation and regulations
- Introduction to noise and air pollution.

Suggested Books:

- Terence J McGhee, “Water Supply and Sewerage”, 6th Edn, McGraw Hill, 1991, ISBN: 0070609381
- Metcalf and Eddy, “Waste Water Engineering”, 4th Edn, McGraw Hill, 2002
- Mackenzie L. Davis, David A. Cornwell, “Introduction to Environmental Engineering” 4th Ed., McGraw Hill, 2000.

10. TRANSPORTATION ENGINEERING 7%

i. Railway Engineering

- Railway station, site selection and layout, railway track, gauges, sleepers and ballast
- Points, crossings and signaling

ii. Airport Engineering

- Airport site selection, classification, layout and drainage systems
- Runway configurations

iii. Types of Harbors, Docks and Ports

iv. Highway Engineering

- Highway route surveys, classifications, material specifications and testing
- Typical cross-sections of roads
- Geometric design: Horizontal, vertical, and transition curves, curve widening, at-grade and grade-separated intersections

- Sight distance requirements, super elevation, gradients and cambers
- Highway maintenance
- Traffic studies and control devices

v. Pavement Engineering

- Types of pavements, Load distribution characteristics, wheel loads, load repetition and impact factors
- Concept of rigid and flexible pavement design.

Suggested Books:

- Jason C., Yui, Elsevier, "Transportation Engineering, Introduction to Planning, Design and Operations" Latest Edition.
- Paul H. Wright McGraw Hill, "Planning and Design of Airports" "Highway Engineering" Latest Edition.
- Dr. L. R. Kadyali, Dr. N. B. Lal Khanna "Principles and Practices of Highway Engineering" (including Expressway and Airport Engineering), 2010, ISBN: 8174091653
- B. L. Gupta, Amit Gupta. "Roads, Railways, Bridges, Tunnels and Harbour-Dock Engineering".

11. STRUCTURAL ANALYSIS AND DESIGN 10%

i. Types of structures and structural idealization, types of loads and beams, degree of indeterminacy

ii. Analysis of determinate structural members, arches, cables and bridges

iii. Design philosophy and design codes

iv. Methods of design (working stress and ultimate strength design) of structural members, behavior of reinforced concrete members in flexure

v. Design concepts of beam, column, slab, footing, retaining walls, tanks, stairs.

Suggested Books:

- Wang, C.K. "Intermediate Structural Analysis", McGraw Hill, 1983.
- Wang, C.K. & Charles G.S. "Reinforced Concrete Design", 7th Ed, John Wiley & Sons, 2006.
- Aurthor H. Nilson, "Design of Concrete Structures", Mc-Graw Hill, 2003
- Lothers JE, "Steel Structures", National Book Foundation, 1972.

PART-II

SECTION-B / DEPTH

This section shall be based on practical concepts framed to judge the practical experience and field based knowledge of Registered Engineers (REs). The examination of this section shall comprise 35 MCQs. Each candidate may attempt the only opted area of practice, among the followings.

1. STRUCTURES

i. Advanced Methods of Structural Analysis

- Stiffness matrix method
- Flexibility matrix method
- Finite element method

ii. Steel Structures

- Fundamentals of structural design
- Specifications and codes of practice of ASD (Alternate Stress Design) and LRFD (Load and Resistance Factor Design) methods
- Fabrication and erection methods of steel structures, hot rolled, cold formed and built up sections
- LRFD Method: Factor Of Safety (FOS), loads and load combination, concept of load and resistance factors, plastic design and limits on design, analysis and design of tension members, calculation of net area, analysis and design of columns, lacing and slay plates, Euler's buckling load in columns, design concept and methodologies for various structural members

iii. Reinforced Concrete

- Design: design philosophy, design codes, design loads (i.e. dead load, live load, construction loads, wind loads, earthquake load, moving loads, snow loads, impact loads, load combinations), factor of safety and load factors
- Working stress method: serviceability criteria and checks for deflection, crack width and crack spacing
- Ultimate strength method: design of prismatic and non-prismatic sections in flexure, compatibility based analysis of sections and code requirements for flexure
- Slabs: types of slabs, design for flexure of one-way and two-way solid and ribbed slabs
- Shear and Tension: shear stress in reinforced concrete sections, design for diagonal tension
- Bond, Anchorage & Development Length: design and detailing for bond, anchorage, development length, laps and splices
- Columns: analysis of sections in pure compression, design of short columns under pure compression and with eccentric loading, slender columns
- Footing and Foundation: types of footing, design of square, rectangular and combined footing, design of eccentric, strap, strip and raft footings, piles and pile caps, bridge piers

- Stairs: analysis and design of various types of stairs and staircases
- Design of shear and retaining walls
- Prestressed Concrete: prestressing principles & design philosophy, analysis and design of simply supported prestressed beams for flexure and shear
- Concept and design procedure for earthquake resistant structural members.

Suggested Books

- Hassoun, M. N. "Design of Reinforced Concrete Structures", PWS Engineering, 1985.
- Nilson A.H., "Design of Reinforced concrete structures" , John Wiley and Sons.1987.
- Nilson A.H., "Design of Prestressed concrete" 2nd Ed, John Wiley and Sons.1987.
- Lothers, J.E. "Steel Structures", National Book Foundation, 1972.

2. TRANSPORTATION

i. Modes of transportation and their comparison, transportation planning process, inter-modal transportation.

ii. Railways Engineering

- Track alignment and surveys
- Geometric design of railway track
- Modern methods for construction of tracks, maintenance, tools and organization
- Sleeper density, spacing and stiffness of track
- Welding of rails
- Formation failures with remedial measures
- Creep and wear of rail
- Points and crossings various layouts
- Cross drainage work: types, monitoring and maintenance
- Signaling and inter-locking.

iii. Airport Engineering

- Types and layouts of airport terminal buildings
- Types of runways: capacities and exits
- Types of aprons
- Design and evaluation of flexible and rigid pavements for airfields.

iv. Highways and Traffic Engineering

- Types, capacity and level of service of highways
- Motorways and expressways: definition, points of difference, typical cross-section with measurements
- Types, analysis and design of intersections
- Pedestrian facilities
- Highway failures: evaluation and rehabilitation
- Pavement design: empirical and mechanistic approaches

- Human, vehicular and traffic characteristics
- Traffic volume/time delay studies
- Speed zoning and restriction
- Types of parking facilities and design of car park
- Types and functions of traffic control devices, traffic signs, markings, traffic signal design
- Traffic accident and their patterns, analysis and remedial safety measures
- Traffic Impact Assessment Technique.

Suggested Books:

- Jason C., Yui, "Transportation Engineering Introduction to Planning, Design and Operations", Elsevier, Latest Edition. Horon Jeff, R. Planning and Design of Airports, McGraw Hill, Latest Edition. Gregory P. Tsinker, Port Engineering Planning Construction Maintenance and Security, John Wiley, 2004.
- Paul H. Wright McGraw Hill "Highway Engineering", Latest Edition.
- Dr. L. R. Kadyali, Dr. N. B. Lal Khanna "Principles and Practices of Highway Engineering" (including Expressway and Airport Engineering)
- B. L. Gupta, Amit Gupta."Roads, Railways, Bridges, Tunnels and Harbor-Dock Engineering"
- Croney D. "Design and performance of road pavements" 3rd Ed. ISBN: 978-0070144514

3. GEOTECHNICAL

i. Subsurface Exploration

- Drilling and sampling procedures: methods and comparison of drilling methods, split spoon sampler, shelby, pitcher, denison and pistons, coring of rocks
- Field tests: In-situ Density Test, Standard Penetration Test (SPT), Cone Penetration Test
- Boring log interpretation.

ii. Compaction

- Proctor tests/ relative density tests
- Factors affecting compaction
- Field compaction equipment
- Site control procedure using sand cone/ core cutter methods.

iii. Classification of Soil

- Particle size distribution, uniformity coefficient, coefficient of curvature
- Atterberg limits
- Soil correlation and phase relations
- Unified classification system
- AASHTO classification system.

iv. Permeability

- Darcy's Law
- Hydraulic conductivity
- Flow nets, calculation of seepage, critical hydraulic gradient

- Capillarity in soils
- Well analysis (steady flow only).

v. Stresses in Soil Mass

- Principle of effective stress
- Stresses in soils
- Vertical stress increase due to various types of loadings.

vi. Consolidation

- Odometer test, void ratio, log pressure plots, normally consolidated & over consolidated soils
- Settlement and consolidation
- Pre-compression of ground
- Sand drains.

vii. Shear Strength of Soil

- Mohr-Coulomb failure criteria
- Laboratory determination of shear strength parameters.

viii. Lateral Earth Pressure and Earth Retaining Structures

- Active, passive and at rest earth pressure
- Rankine and Coulomb earth pressure theories
- Gravity and cantilever walls
- Braced cuts.

ix. Slope Stability

- Finite and infinite slopes
- Pseudo static analysis

x. Shallow Foundations

- Tolerable, total and differential settlement
- Angular distortion
- Plate load tests.

xi. Deep Foundation

- Estimation of pile capacity (single pile and pile groups)
- Pile load tests
- Pile construction.

xii. Earthquake Engineering

- Seismic zoning of Pakistan
- Dynamic soil parameters
- Liquefaction.

xiii. Embankment Dams

- Types and components of earth dams
- Design considerations
- Stability and seepage analysis.

xiv. Soil Improvement Techniques, Dewatering Methods, Sheet piles:

Suggested Books:

- Das, B.M., "Principles of Geotechnical Engineering", 4th edition, PWS Publishing Company, 1998.
- Craig, R.F, "Soil Mechanics", Van Nostrand Reinhold (UK) Co. Ltd.1983.
- Bowles, J.E., "Foundation Analysis and Design", McGraw Hill Publishing Company, 1988.
- Karl Terzaghi, Ralph Brazelton Peck, Gholamreza Mesri "Soil Mechanics in Engineering Practice" John Wiley and Sons, 1996.

4. CONSTRUCTION MANAGEMENT

i. Quality Control

- Cost and values of quality
- company structure policies and objectives
- engineering designs and specifications
- communications reporting and data processing
- Control of non-compliances
- Contractor relations, client relations
- Measurement of quality and quality documentation
- Concrete maturity & early strength evaluation
- Quality measurement, improvement and auditing

ii. Construction Methodologies

- Construction methodologies pertaining to in situ and pre-cast construction
- Dewatering and pumping
- Mechanized construction techniques: lifting & rigging, crane selection, erection & stability
- Earthwork construction & layout: site layout and control, excavation and embankment (cut & fill), borrow pit volumes, temporary erosion control
- Temporary structures: construction loads, formwork, false work, scaffolding, shoring and reshoring.

iii. Estimating Quantities & Cost

- Cost estimating
- Engineering economics.

iv. Project Management / Scheduling

- Construction sequencing
- Activity time-analysis
- Resource scheduling
- Time-cost trade-off.

v. Contracts and Tendering

- Types and conditions of contracts
- Contract administration during construction: variation orders, extension of time, engineering decisions, dispute resolution
- Tendering process and evaluation.

Suggested Books:

- R. L. Peurifoy, W. B. Ledbetter , C. J. Schexnayder , Cliff J. Schexnayder, “Construction Planning, Equipment and Methods”, By:, McGraw-Hill Inc Ltd.1996.
- Project Management Institute , A Guide to the Project Management Body of Knowledge (PMBOK® Guide) - Fourth Edition, Published by Project Management Institute, weblink: A Guide to the Project Management Body of Knowledge (PMBOK® Guide) - Fourth Edition, 2008.
- Construction Planning for Engineers By: F. H. Griffis , John V. Farr , M. D. Morris , Fletcher Griffis , John Farr, McGraw-Hill Science/Engineering/Math (1999), ISBN-10: 0073033278.
- PEC Standard Bidding/Contract Documents, (weblink: http://www.pec.org.pk/downloads.aspx, www.picc.org.pk).

5. WATER RESOURCES

i. Hydraulics and Irrigation

- Steady flow in open channels: specific energy and critical depth, classification of water surface profiles, design of hydraulic jump and its practical applications, flow over humps and through contractions
- Unsteady flow: discharge through orifices, weirs under varying heads, unsteady flow through pipes, water hammer, instantaneous and slow closure of valves, design of surge chambers
- Dams and Water Power Engineering: types of storage dams, site selection for reservoirs, forces on dams, design of gravity dams, selection of waterpower sites, components and layout of waterpower schemes
- Hydraulic modeling: types of models, similitude in physical model testing, model techniques, analysis and scale effects
- Irrigation: methods of irrigation (surface, drip and sprinkler), design of lined and unlined channels, sediment transport in channels, types of lining, maintenance of canals, estimation of water requirement for crops
- Irrigation works: function and design of canal head regulators, meter flumes, outlets and cross drainage works, design of weirs and barrages
- Waterlogging, salinity, land reclamation techniques and drainage system design.

ii. Hydrology and Water Resources

- Precipitation: types and measurement of precipitation, factors necessary for the formation of precipitation, Interpretation of precipitation data
- Evaporation and infiltration: factors affecting evaporation and evapotranspiration, measurement of evaporation and evapotranspiration, factors affecting interception and infiltration, measurement of interception and infiltration
- Stream flow and surface runoff: water stage and its measurement, Selection of site for stage record, selection of control and metering

section, methods of measurement of stream flow, telemetry and SCADA, interpretation of stream flow data, flood, frequency and duration analysis, flood routing, factors affecting runoff, estimating the volume of storm runoff, characteristics of hydrographs, components of a hydrographs, hydrograph separation, factors affecting hydrograph shape, derivation and application of unit hydrograph

- Groundwater: groundwater sources, discharge, assessment and formations/aquifers, types of wells and design.

Suggested Books:

- Finnemore, E.J & Franzini, J.B., "Fluid Mechanics with Engineering Application" 10th Edition, McGraw Hill Book Co. Singapore.
- Chow, V.T. "Open Channel Hydraulics" Mc. Graw-Hill International Book Company
- Punmia, B.C., Pande, B. B.Lal, "Irrigation and Water Power Engineering", Standard Publisher Distributors, Delhi, 1984.
- Iqbal Ali. "Irrigation and Hydraulic Structures: Theory, Design and Practice", Publisher, Institute of Environmental Engineering & Research, NED University of Engineering &Technology, Karachi
- Awan, N.M. 1981. "Surface Water Hydrology", National Book Foundation, Islamabad.
- Linsely, R.K., Kohler, "Hydrology for Engineers", SI. Edition, McGraw Hill, 1996.
- Driscoll, F.G. "Groundwater and Wells", Johnson Division, USA, 1987.

6. ENVIRONMENTAL ENGINEERING

i. Public Health Engineering

- Water Supply and Sewerage System Design
- Water Quality: physical, chemical, and biological characteristics of water, water borne diseases and their control, water quality guidelines/standards, water quality monitoring
- Water Treatment and Design: screening, plain sedimentation, sedimentation aided with coagulation and flocculation, filtration, disinfection, water softening, removal of colours, odours and tastes from waters, removal of iron and manganese from water, fluoridation and de-fluoridation of water, desalination of brackish water
- Waste Water Treatment and Design: estimation of sewage quantities, characteristics of sewage, effluent disposal guidelines and standards, types of reactors, unit operations and processes, physical, chemical and biological treatment processes, biological nitrification and de-nitrification, advance treatment (e.g. phosphorous removal, wetland treatment), sludge treatment (anaerobic) and disposal, re-use of sewage, environmental legislation and regulations.

ii. Environmental Engineering

- Solid Waste Management and Design: types and characteristics of solid waste, sources and quantities of solid waste, collection, disposal and recycling of solid waste
- Environmental Impact Assessment (EIA): Definitions of EIA, IEE, EIS, methods, techniques and procedures of EIA, format for the organization of EIA report, legislative and regulatory considerations

- Environmental Legislation and Regulations
- Noise and Air Pollution: noise pollution (sources, causes and control, noise quality standards in Pakistan, test procédures), air pollution(sources, causes and control, air pollution and human health, air quality standards, legislation and regulation in Pakistan, elementary study of dispersion models, haze, fog, smog).

Suggested Books:

- Terence J McGhee, "Water Supply and Sewerage", 6th Ed, McGraw Hill, ISBN: 0070609381
- Metcalf and Eddy, "Waste Water Engineering", 3rd Ed, McGraw Hill
- Mackenzie L. Davis, David A. Cornwell, "Introduction to Environmental Engineering", 4th Ed. McGraw Hill, 2000.
- Canter L. W. EIA

7. URBAN ENGINEERING

1. Urban Sociology

- Urban and rural; family, household and clan
- Types and formats of social relationship
- Urban communities
- Space and its types (physical, social and economic);
- Social infrastructure
- Sociology and development (social and psychological characteristics)

Suggested books:

- Bard John W., "Urban Sociology", Illinois, F. E. Peacock.

2. Urban Planning and Management

i. Urban Planning and Management Context
- Current planning process in Pakistan with special focus on Karachi;
- Inter-governmental relationships in local planning its complexity and unresolved issues

ii. Basic Studies of Urban Planning
- Population/demographic study
- Land use study

iii. Implementation, Policies, Plans, Programs, Regulation and Renewal

- Definitions of development objectives, policy and planning program
- Comprehensive plan and its related documentation process Programming of community development and capital intensive projects of government
- Urban zoning issues; Land subdivisions (both at formal and informal level)

Suggested books:

- Kenneth J.Davay, “Elements of Urban Management (1993)”, UMP-UNCHS.
- David E.Dowall and Giles Clarke, “A Framework for Reforming Urban Land Policies in Developing Countries (Aug.1996)”, UMP-UNCHS.
- William J.Fox, “Strategic Options for Urban Infrastructure Management”, UMP-UNCHS.
- John Ratcliffe, “Introduction to Town & Country Planing”, Hutchinson & Co. Ltd. London.

3. Advanced Technologies and Disaster Management

i. Constructional Technologies

- Latest development in trenching and excavation e.g. trench less technology;
- Specialized formworks
- Technologies for building deep waterproof basements Mechanized construction methods and equipments

ii. Maintenance Rehabilitation & Repair Disaster Management

- Strategies for protection
- Loss estimation
- Risk and Vulnerability Analysis
- Disaster Mitigation

Suggested books:

- W. Ronald Hudson, “Infrastructure Management: Integrating Design, Construction, Maintenance Rehabilitation and Renovation”, John Wiley and Sons.
- Steven K. Kramer, “An Introduction to Trench less Technology”, Van Nostrand Reinhold
- C. M. Barrit, “Advanced Building Construction”, Trans-Atlantic Publications
-

4. Law and Regulatory Control Studies

i. Building plans

- Submission of Building applications and drawings
- Procedural checks: ownership verification; planning application forms; Drawing fees, No objection certificates, Advertisement; etc.
- Site visits
- Serving of notices
- Fines and compounding of violation
- Analysis of building proposals: conformity with the development plans, land use zoning planning criteria building bylaws, design guidelines, building line / parking requirements, chamfer requirements, construction over cultivators etc

Suggested books:

- "Sindh Building Control Ordinance 1979", 1979, Sindh Government Press
- "Karachi Building and Town Planning Regularities (Parts I & II)", Sindh Government Press
- "Karachi Building and Town Planning Regularities 2002", 2002, Sindh Government Press
- "Sindh Local Government Ordinance 1979", 1979, Sindh Government Press

5. Financial Resource Management

i. Capital financing and Allocation
   - Difference between sources of capital
   - Equity and borrowed capital

ii. Banking and specialized Credit Institution
   - Functions of Bank and Credit Institution
   - Documentation related to International and Domestic Banks Financial and funding Institutions

Suggested books:

- Eugene F. Brigham, "Financial Management Theory & Practice", Harcourt College

8. BUILDING AND ARCHITECTURAL ENGINEERING

i. Structures

- Plain cement concrete: materials, properties, production, testing, batching, curing, admixtures, mechanics and behavior, simple & T-Beam design, axially loaded columns, codes provision, reinforcement detailing
- Reinforced and prestressed concrete design: design of structural system of RC Frames, beam design in flexure shear and torsion, slabs & columns design, prestressed concrete analysis and design, losses of prestress
- Structural Dynamics and Earth Quake Engineering: free and forced vibration, SDOF and MDOF system, earthquake resistance structures, seismic zoning of Pakistan
- Foundation Engineering: stress distribution, earth pressure, bearing capacity, foundations and structural design of footings, ground improvement techniques

- Steel Structures: types of structural steel, design & analysis of structural components, allowable stress design, plastic analysis and design

Suggested Books:

- Concrete Technology by A.M. Neville
- Design of concrete structures by A.H.Nilson 13th Edition
- Design of Concrete structures (part I, II) by Prof Zahid A Siddiqui
- Dynamics of Structures by Anil K Chopra
- Fundamental structural steel design by ASD by Thomas Burns
- Design of steel structures by Gaylord & Gaylord
- Steel structre design & behavior CG Sollman and John E Johnson

ii. Water Supply and Sewerage System Design for Buildings:

- Water Supply Systems: design period, population and estimation of quantity, hydraulics and design of water distribution system, type of pipe materials
- Waste water collection systems: sanitary and storm sewers, pumping stations, hydraulics and design of sanitary and storm sewers
- Plumbing Design: plumbing elements, layout and design of water supply and drainage pipes, systems for fire prevention, detection and control
- Water Treatment: drinking water quality, standards and public health, sedimentation, coagulation, filtration and disinfection
- Waste water treatment: primary and secondary treatment methods
- Environmental protection: solid waste, air control and environmental remediation.

Suggested Books:

- Water Supply and Sewerage by TJ McGhee & EW Steel

iii. Building HVAC's System Sesign

- Building Air Systems: air transportation system used in heating, ventilation and air conditioning

- Building Hydraulics System: water transportation system used in building, heating and cooling
- Building Thermal Systems: thermal energy flow in building and building systems
- HVAC system: HVAC equipment description, HVAC system types and its applications in buildings
- Engineering design and performance analysis: mechanical systems and energy conservation techniques

Suggested Books:

- Air Conditioning Principles & systems by Edward G Pita
- ASHRAE HANDBOOK FUNDAMENTALS

iv. Building Electrical System Design:

- Electrical equipment ratings: voltage and current
- Interior wiring systems: cables, conductors and enclosures
- Busway/busduct: light duty busway, flat cable assembly, lighting track
- Cable tray/raceways: steel, aluminum, flexible, non metallic, conduits, raceway and wiring systems
- Communication and security systems: communications types, materials and installation systems
- Voice and data communication system: data communication systems, terminal host system, local area network, video network.
- Electronic Security System: level of security, types of security technologies

Suggested Books:

- Modern Wiring Practice by WE Steward
- Electrical Installation Calculations by A J Watkins

v. Building Construction and Management

- Introduction: building construction, site and sitework
- Masonry: structural properties, construction system, materials under stresses

- Concrete: structural properties, construction system, concrete wall, roof systems, materials under stresses
- Steel: structural properties, floor systems, wall systems, roof systems.
- Timber: structural properties, floor systems, wall systems, roof systems
- Construction Management: organizational structures, contract and procurement, Construction Laws, ISO 9000 and total quality management

Suggested Books:

- Barry's Introduction to Construction of Buildings
- Building Construction Handbook by Ray Chudley & Roger Greeno
- Mitchell's Structure & Fabric Part 2
- Building Construction by B C Punima
- Project Management by J R Meredith and S J Mantel