Pokhara University
Faculty of Science and Technology
**Entrance Examination Curriculum**
Master of Science in Structural Engineering

**Total Marks: 100** **Qualifying Marks: 45**
**Time: 2 hrs**

Entrance curriculum mainly covers common topics of all streams covering Mathematics (Quantitative aptitude), Soil Mechanics and Foundation Engineering, Concrete Technology and Masonry Structures and all Structural Engineering related subject contents of Bachelor in Civil Engineering and equivalent.

| Section | Course | Weightage (%) |
|---|---|---|
| A | Fundamental of Mathematics | 10 |
| B | Soil Mechanics and Foundation Engineering | 15 |
| C | Applied Mechanics and Strength of Materials | 15 |
| D | Structural Analysis | 20 |
| E | Design of RCC Structure | 20 |
| F | Design of Steel and Timber Structure | 10 |
| G | Concrete Technology and Masonry Structures | 10 |
| | Total | 100 |

**Section A: Fundamental of Mathematics**

1. **Basic of Set, Contiguity, Derivative, Vector and Scalar:** Set and functions, limit, continuity and differentiability of functions, higher order derivatives. Integration by parts, special trigonometric forms and rational functions, standard integrals, vectors and scalars, resolution of vectors, scalar and vector product of two and more vectors.

2. **Linear Algebra:** Definition and basic properties of matrices and determinants Rank of matrix, system of linear series, inverse of a matrix.

3. **Infinite series:** Definitions of sequence and infinite series, the necessary conditions for convergence of an infinite series, test of convergence, alternating series test.

4. **Fourier series:** Periodic functions, trigonometric series, Fourier series on the functions of period 2p, Euler's formula, Fourier series of a function having arbitrary period, even and odd functions and their Fourier series, half range functions

5. **Laplace transformation:** Laplace transform, Application of Laplace transform, Inverse Laplace transform, Convolution theorem on Laplace transform and application

6. **Z-transform:** one-sided and two-sided z-transform, linear time invariant system, Unit impulse function, properties of z-transform, region of convergence, inverse z-transform by residue and partial fraction, Parseval theorem, convolution.

7. **Nonlinear Equations:** Review of calculus and Taylor's theorem, errors in numerical calculations, trial and error method, Bisection method, Newton's method, Secant method

8. **Introduction and Descriptive Statistics:** Presentation and classification data frequency distribution, histogram, pictorial and diagrammatic method, measures of central tendency and location-mean, median, quartiles and percentiles, measures of dispersion (variability) range, quartile deviation, deviation, standard deviation.

**Section B: Soil Mechanics and Foundation Engineering:**

1. **Soil Mechanics:**
   Unique nature of soils, soil formation processes and type of soils, phase relations, index properties of soils, Nepal standard soil classification system, Effective stress equation for saturated soils, practical significance of effective stress, capillary phenomenon in soils, capillary head and capillary pressure, computation of effective stress for "no flow" and "flow" conditions, seepage force and quick sand condition, total pressure and elevation heads, permeability of soils, recapitulation of Darcy's law, process of compaction and compaction theories, moisture density relationship and degree of compaction, effect of compaction on engineering behavior of soils, stress history and effective stress on compressibility, factors affecting consolidation and compressibility parameters; Normally consolidated and over consolidated soils, Trazaghi theory of one dimensional consolidation and time-rate consolidation, concept of shear strength, stress at a point and Mohr's stress circle, Mohr-Coulomb failure criteria, relation between principle stresses at failure, effective stress and total stress, causes of instability in slopes, modes of failure, infinite slopes and concepts of factors of safety, stability analysis of finite slopes- methods of slices, Bishop's simplified method, acceptable values of factors of safety, stability of earth dam slopes-critical conditions and approximate analyses, friction circle method and Taylo's stability number.

2. **Foundation Engineering:**
   Methods of soil exploration, boring, sampling, types of samplers and samples, standard penetration test, Static and Dynamic cone tests, correlations between penetration resistance and strength parameters, plate load test, number of bore holes, depth of exploration, earth pressure at rest, active and passive earth pressure computations using Rankine's and Coulomb's earth pressure theories, Culmann's graphical construction, stability analysis for various types of retaining walls, sheet pile walls, cantilever and anchored sheet pile walls, bracings for open cuts - Recommended design diagrams of earth pressure for typical soils, calculation of strut loads, theory of arching and its practical implications, review of major soil parameters used in the proportioning of foundations, types of shallow foundations and their selection, bearing capacity, Terzaghi's bearing capacity theory, computation of bearing capacity in cohesionless and cohesive soils, Skempton's equations; Effect of various factors on bearing capacity; Use of field test data; Generalize a bearing capacity equations, Settlement - Components of settlement; Limits of settlement; Total settlement, concept of compensated/ floating raft,conventional method for design of raft foundation, piles: Outline of steps involved in the proportioning of pile foundations, Estimation of load carrying capacity of piles using pile load formulas, pile driving formulas, penetration tests and pile load tests, Group action of piles in sand and clay, bearing capacity and settlement of group of piles; Negative skin friction, construction of pile foundation, well foundation, construction of well foundation, tilt and shift of well foundation, proportioning - depth and size of wells on the basis of scour depth, bearing capacity and settlement, machines and their foundations.

**Section C: Applied Mechanics and Strength of Materials:**

1. Resolution and composition of forces
2. Principles of transmissibility and equivalent forces
3. Resultant of force and moment for a system of force
4. Equation of Equilibrium in Two/Three Dimensions
5. Moment of Inertia, polar moment of inertia, moment of inertia of composite and built up section
6. Position, velocity and acceleration of a particle and rigid body
7. Rectilinear and curvilinear motion of particles
8. Rectangular components of velocity and acceleration
9. Tangential & normal components and radial and transverse components
10. Equations of Motion, Motion due to central force and dynamic equilibrium
11. Undamped free vibration, simple harmonic motion, frequency and period of oscillation
12. Centroids of composite and built up section
13. Axial loading, normal stress, normal strain and Hooke's law
14. Transverse loading, shear stress, shear strain and their relationship
15. Poisson's ratio, volumetric strain, bulk modulus and Generalized Hook's law, Deformation of axially loaded bars, Temperature effect
16. Analysis of axial force, shear force and bending moment diagrams for plane frame
17. Equations for transformation of plane stress and strain
18. Principal strains, Maximum shear strains and their planes
19. Beams of uniform and symmetric cross section in pure bending
20. Normal and shearing stress due to bending
21. Analysis of torsional stress in solid circular section and their deformations

**Section D: Structural Analysis:**

1. Static and kinematic indeterminacy of 2D and 3D structures
2. Strain energy due to axial force, shear force, bending moment and torsion
3. Displacement of structures by strain energy method, unit load method, castigliano's method, integration method, conjugate beam method, moment area method
4. Determination of maximum and absolute maximum shear force and bending moment using ILD method
5. Axial force, shear force and bending moment diagrams in three hinged parabolic and circular arch
6. Analysis of parabolic cables
7. Analysis of three-hinged stiffened girder
8. Analysis of indeterminate structures by consistent deformation method, slope deflection method, flexibility method, stiffness matrix, and direct stiffness matrix

**Section E: Design of RCC Structures:**

1. Differences between Working Stress Method, Ultimate Load Method and Limit State Method
2. IS 456-2000 requirement for RCC structural design
3. Limit State Method (LSM) based on IS Code: Partial safety factors, Characteristics strength and loads, Design strengths of materials, Assumptions made on LSM, Analysis and design of singly and doubly reinforced section, Flexural design, Shear design, torsional design
4. Detail analysis and design of one way and two way slabs, simply supported beam, Continuous slab/beam, Cantilever beam/slab with LSM
5. Detail analysis and design of different types of short and slender columns with LSM
6. Detail design of isolated, combined and raft footings with LSM

**Section F: Design of Steel and Timber Structures:**

1. Design methods of Steel Structure (i.e. LSM and WSM)
2. Analysis of Bolted and Welded joint
3. Net cross sectional area of tension member.
4. Design concept of Tension and Compression Member (LSM)
5. Design concept of lug angles (LSM)
6. Design concept of lacing and battens (LSM)
7. Column splices and column bases (LSM)
8. Stiffened and unstiffened steel beam (LSM)
9. Elements of Plate Girder
10. Load on roof truss and Design of Purlin (LSM)
11. Timber beam and column (WSM)

**Section G: Concrete Technology and Masonry Structures:**

1. Introduction of concrete and its ingredients: Cement, Aggregates, water, mineral admixtures and chemical admixtures (sources, composition, processing, quality checks and their effect on quality of concrete)
2. Mix design methods (Nominal, DOE and IS standard design methods)
3. Methods and required quality control on selection of ingredients, batching, mixing, transportation, placing, compaction, curing in normal as well as in extreme weather
4. Different types of concrete: Ordinary concrete, Light weight concrete, Heavy weight concrete, Self-compacting concrete, Shotcrete, Fibre reinforced concrete, polymer concrete, Latex-modified concrete, Ferro-cement concrete, Vacuum concrete, Sulphate infiltrated concrete
5. Properties of hardened concrete: Hydration and strength gaining process, modulus of elasticity, transition zone, inter-relationship between strength-porosity-gel/space ratio-W/C ratio, creep and shrinkage, fatigue and impact, different types of strengths with their inter-relationships and their respective testing methods including non-destructive tests, grade of concrete and its determination method based on IS
6. Durability of concrete: permeability, Alkali-aggregate reaction, Rusting of reinforcement bars and Chemical attack