

CURRICULUM FOR M.Sc. ENTRANCE EXAMINATION

The M.Sc. Entrance examination will be “**Computer Based Examination**” of two hours duration, consisting of two sections. **Section- A** consists of 45 questions of 50 marks. While **Section-B** consists of stream specialized course with 50 questions of 1 mark each. Each question will be of objective type with multiple choice answers and negative marking is 10%.

1.1 SECTION-A

The depth of subject matter in this section shall be similar to Bachelor Level.

1.1.1 Communication English [10]

1. Critical Reasoning [6]

Critical reasoning section aims to test the candidate's comprehension of the interpretative abilities in English as a language of business and communication. Critical reasoning questions measure your ability to read with understanding, insight and discrimination. These questions explore your ability to analyze a written passage from several perspectives, including your ability to recognize explicitly stated elements as well as underlying statements and their implications. This section measures reading comprehension and critical reasoning skills in multiple-choice format.

The critical reasoning section measures your ability to

- (a) Analyze and evaluate a written text and synthesize information obtained from it.
- (b) Analyze relationships among component parts of sentences.
 - Text Completion/Sentence equivalence: [2x1=2]
 - Reading Passages: [2x2=4]

2. Error Analysis [2x1=2]

This section measures your ability to

- Write sentences without any error
- Write proposals, reports, seminars, research article, dissertations, etc. by using most suitable words and technical terms efficiently.

3. Analogies [2x1=2]

This section measures your ability to explain the relation between two words.

1.1.2 Mathematics [40x1]

The format of the multiple choice questions varies. The solution may require simple computations, manipulations or multi-step problem-solving. These sections aim to test the candidate's understanding of

Mathematics – A (B-Arch)

1. Basic Mathematics [4]

- Sets and Functions,
- Two dimensional and three dimensional Coordinate Geometry,

2. Algebra [10]

- Polynomials
- Complex numbers
- Sequence and series
- Permutation and combination
- Equations and inequalities
- Matrices and Determinants
- Linear Programming

3. Vector Analysis [6]

- Vector Algebra: Vectors and Scalars, product of two, three and four vectors, reciprocal system
- Vector Calculus: Gradient, Curl and Divergence

4. Calculus [13]

- Limits and Continuity, Ordinary and Partial Differentiation
- Indefinite and definite Integration
- Application of Derivatives and Anti-derivatives
- Ordinary Differential Equations.

5. Elementary Statistics and Probability [3]

6. Elementary Trigonometry, Logarithm [4]

Mathematics – B (For all except B-arch)

1. Basic Mathematics [3]

- Sets and Functions,
- Two dimensional and three dimensional Coordinate Geometry,

2. Algebra [8]

- Polynomials
- Complex numbers
- Sequence and series
- Permutation and combination
- Equations and inequalities
- Matrices and Determinants

- Eigen values and Eigen vectors, Diagonalization of matrix
 - Linear Programming
- 3. Vector Analysis** **[6]**
- Vector Algebra: Vectors and Scalars, product of two, three and four vectors, reciprocal system
 - Vector Calculus: Gradient, Curl and Divergence, line integral, surface integral and volume integral.
- 4. Calculus** **[12]**
- Limits and Continuity, Ordinary and Partial Differentiation
 - Indefinite and definite Integration
 - Application of Derivatives and Anti-derivatives
 - Ordinary Differential Equations.
- 5. Elementary Statistics and Probability** **[3]**
- 6. Elementary Trigonometry, Logarithm** **[4]**
- 7. Transforms: Laplace transform, Fourier series** **[4]**

1.2 SECTION-B

The depth of subject matter in each subject of stream specialized course shall be that of B.E./B.Arch. level relevant courses offered by T.U.

1.2.1 Applied Science (AS) **[50x1]**

- 1. Mechanical Waves & Oscillations** **[5]**
- Wave motion: Mechanical wave, Velocity of wave, energy, power & Intensity; stationary wave
 - Acoustic phenomena: Echo & reverberation, beats, modes of vibration in string and pipes
 - Ultrasound: production, applications
- 2. Heat & Thermodynamics** **[4]**
- Fundamentals of heat: Calorimetry, Change of state
 - Transfer of heat: Conduction, convection and radiation
 - Thermodynamics: Gas laws, kinetic theory of gas, first law of thermodynamics, second law of thermodynamics,
 - Applications: Entropy, heat engines, refrigerators
- 3. Electromagnetic Waves & Oscillations** **[8]**
- Electric and Magnetic fields: Intensity, potential, potential gradient, capacitors
 - DC and AC Circuit: LR, LC, RC, LR, LCR circuits
 - Maxwell's Equations: Gauss law, Faradays law of electromagnetic induction, Ampere's law & its modification

- Wave optics: Interference , diffraction , polarization, optical fibers

4. Modern Physics **[8]**

- Electrons: e , e/m , motion of electron in electric and magnetic fields
- Photoelectric Effect: Einstein's equation, solar cell, Photovoltaic cell
- Advanced Materials: Semiconductor, dielectric materials, magnetic materials, superconductor, nano-technology & materials
- Quantization of energy: Bohr's theory, energy level, wave-particle duality, uncertainty principle, Laser.
- Radioactivity: radioactive disintegration, fission, fusion
- Energy and Environment: Renewable and non-renewable energy resources, ultraviolet radiation, green-house effect, climate change.

5. Chemistry in Daily Life **[3+2]**

- Carbohydrates, proteins, enzymes, nucleic acids, drugs and their classifications- antacids, antihistamines, neurologically active drugs- tranquilizers, analgesics, antimicrobials antibiotics, anti-septic's and disinfectants, soaps and detergents.
- Organic and Inorganic polymers, biodegradable and non-bio degradable, conducting polymers

6. Environmental Chemistry **[4]**

- Water Pollution: Surface and ground water pollution, water pollutants-visible and invisible, chemical and microbiological, their adverse impacts and remedies.
- Air Pollution: Air pollutants, gases SOX, NOX, COX, O₃, hydrocarbons, particulate-dusts, smokes and fly ash.

7. Water **[3]**

- Soft and hard, degree of hardness, alkalinity, specification for domestic and industrial purposes, boiler feed water, sludge and scale, water treatment.

8. Catalysts **[1]**

- Action of catalysts, characteristics and mechanism of catalysis.

9. Electrochemistry **[3]**

- Electrode potential and its measurements, standard electrode potential , electrochemical cells, electrolytic cells, Nernst equation, EMF of cells, buffer, pH, corrosion, electrochemical series,

10. Applied Chemistry **[2+2]**

- Fuel and Combustion: classification calorific values, coal, petroleum, kerosene, gasoline, biogas.
- Explosives: classification, preparation and applications.

11. 3d Transition Elements **[2]**

- Electronic configuration, oxidation states, complex formation, alloy formation and magnetic properties.

12. Isomerism [1]

- Stereoisomerism- geometric isomerism, optical isomerism.

13. Instrumental Technique in Chemical Analysis [2]

- Visible and ultraviolet spectroscopy, nuclear magnetic resonance (NMR), atomic absorption spectroscopy (AAS)

1.2.2 Architecture and Planning (AP) [50×1]

1. Architecture [35]

1.1 History of Architecture [5]

- 1.1.1 History of Nepalese Architecture
- 1.1.2 History of Easter Architecture
- 1.1.3 History of Western Architecture
- 1.1.4 History of Contemporary Architecture

1.2 Building Material and Technology [5]

- 1.2.1 Building Material-Brick, Timber, Cement, Stone, Aluminum, Mud etc.
- 1.2.2 Building Technology - Load Bearing, Frame Structure, different wall, roof, floor, etc.

1.3 Building Science [5]

- 1.3.1 Climatology
- 1.3.2 Thermal Aspects
- 1.3.3 Architectural Lighting
- 1.3.4 Architectural Acoustics

1.4 Green Building Design [5]

- 1.4.1 Green Building Design Concept
- 1.4.2 Green Building Rating System–LEED, GRIHA, CASBEE, etc.
- 1.4.3 Passive and active Solar Architecture
- 1.4.4 Examples of Green Building and Planning

1.5 Architecture and conservation [5]

- 1.5.1 Historical monument and building of Nepal and World
- 1.5.2 Architectural Conservation of Nepal

1.6 Contemporary Architecture of Nepal [5]

- 1.6.1 Contemporary Architectural practices of Nepal
- 1.6.2 Problem and way out for future in Nepal

1.7 Building Services [5]

- 1.7.1 Electrical Service – Artificial lighting system, Solar Lighting
- 1.7.2 Mechanical Service – HVAC, Lift, Escalator, Solar water heating, etc.
- 1.7.3 Water Supply and Sanitation

2. Planning [15]

2.1 History of Planning – Ancient Town and Settlement [5]

- 2.2 Urban problems in towns of Nepal [5]
2.3 Urban Environment and Urbanization in Nepal [5]

1.2.3 Civil & Agricultural Engineering (CA) [50 × 1]

- 1. Structural Engineering [10]**
Stresses and strains, Bending and deflection and its equations, Statically determinate structure: displacements by energy principles; static and kinematic indeterminacies; analysis of indeterminate structures; slope-deflection and moment-distribution methods; influence lines for determinate and indeterminate structures; trusses; two and three hinged arches; analysis of trusses and frames; concepts of plastic analysis of beams and frames.
- 2. Geo-technical Engineering [10]**
Phase relationship, soil classification, clay mineralogy, soil compaction, permeability, principal of effective stress, seepage analysis, stress distribution, consolidation, shear strength of soil, stability of slopes, soil exploration, earth pressure theories, rigid and flexible retaining structures, bearing capacity and settlement of shallow foundations, analysis of deep foundation (pile, pier, well), foundation soil improvement.
- 3. Water Resources Engineering [10]**
Physical properties of Fluid, Fluid pressure, Equilibrium stability of floating bodies, Fluid kinematics, Classification of fluid flow, Dynamics of flows, Euler's equation, Bernoulli's equation, Navier stokes equation Boundary layer theory, Momentum equation, Open channel flow, Uniform and Non uniform flow, Energy & momentum principle for open channel flow, Flow in mobile boundary channel, Flow over notches & weirs, Gradually varied flow, Hydraulic Jump and its analysis, Similitude and physical modeling, Physical hydrology, Surface runoff, Rainfall-runoff correlation, Hydrograph Analysis, Unit hydrographs, Peak flow estimation and statistical hydrology, Flood routing.
- 4. Transportation Engineering [10]**
Road transportation in Nepalese context, Highway alignment, Geometric design, Highway drainage system, Highway materials, Traffic Studies, traffic control devices and measures, Road intersection and design, Road pavement, Construction and maintenance of road pavements, Bridge type, site selection, components and protection structures, Tunnel components, requirements and methods of tunneling.
- 5. Water Supply & Sanitary Engineering [10]**
Introduction of Water Supply Engineering, Sources of water, Quantity of Water, WHO guidelines, Nepal Drinking water quality standards, Quality of Water, Intake Works, Water Treatments- natural, artificial, Sedimentation, Filtration, Disinfection, Reservoirs and Distribution System, Conveyance of water, Valves and Fittings. Introduction of sanitary engineering, Quantity of Waste Water, Characteristics and Examination of Sewage, Design and Construction of Sewers, Sewer Appurtenances, Sewage Disposal,

sewage Treatment, Sludge Treatment and Disposal, Disposal of Sewage from Isolated Buildings, Solid Waste management, WASH and Ecosan.

1.2.4 Electrical Engineering (EE)

[50x1]

1. Basic Electrical Circuits

[10]

- Network Theorems: Thevenin's, Norton's, Maximum power & Reciprocity Theorems
- AC circuits: Concept of complex impedance phasor diagram, Active, Reactive & Apparent power, Resonance in AC circuits
- Three phase circuits: Phase & line quantities in three phase system, 3-phase power
- Transient response: Transient response analysis for R-L, R-C & R-L-C circuit. Pole zero plots
- Two port Networks: Z-parameters, Y-parameters & ABCD –parameters

2. Electrical Machines

[10]

- Electromagnets: Magnetic circuits, Fleming's Right hand & Left hand rules, Farady's Law of electromagnetic induction, electromechanical energy conversion principle
- Transformers: Equivalent circuits, Phasor diagrams, Losses & efficiency, Voltage regulations, Instrument transformers, three phase transformer connections, parallel operation of 1-1 & 3-1 Transformers
- Synchronous machine: Operating principle. Effect of Excitation, Power angle characteristics, Phasor diagrams, Losses & efficiency, Voltage regulations, parallel operation of alternator,
- Induction machine Operating principle, T-S Characteristics, Losses and efficiency, Testing, Starting methods, Speed Control
- DC generator: Construction, Operating principle and characteristics of different types dc generator
- DC motor: Operating principle, Characteristics of different types dc motor, Speed control and starter

3. Power Systems

[20]

- Transmission line: Line parameters, per unit system representation, single line diagrams, short, medium & long lines, efficiency & regulations.
- Transmission line design: selection of voltage, conductor, sag calculation, stringing chart, line insulators and string efficiency
- Distribution system: Radial and loop distribution, Rural and Urban Distribution system
- Economics of Generation: Load curve, Load duration curve, Diversity factor. Load factor, loss of load factor, tariff schemes,

- Load flow: Bus classification, Y-bus formation G-S & N-R load flow methods
- Stability studies: Swing equations, equal area criterion, Stability enhancement techniques
- Series & shunt compensations
- Fault calculations: Symmetrical & unsymmetrical faults in power systems, grounded & undergrounded systems, over Voltages in transmission lines, surge arrestors
- Over voltage in transmission line: Temperature over voltage, switching over voltages and lightning overvoltage
- Relays and circuit breakers: Instantaneous & IDMT relays, ABC, VCB & gas circuit Surge arresters brasses, differential & distance protection schemes
- Power control: Load-frequency control, VAR-Volt control
- Safety Engineering: Electric shocks, Equipment Earthing Mat earthing of power stations, measurement of earth resistivity and earth resistances

4. Power Electronics [10]

- Power electronics devices: Diode, IGBT, BJT, MOSFET
- Operational amplifier: Thyristers, GTO, TRAIC
- Rectifiers: Single Phase & three phase rectifiers, uncontrolled and controlled rectifiers
- Inverters: single phase & three phase invertors
- Choppers: Step up and step down choppers, chopper Classifications.

1.2.5 Electronics and Computer Engineering (EC) [50x1]

1. Electrical Circuit and System [5]

- Ohms law, Kirchoff's laws
- The venin's Norton's and maximum power transform theorem
- Active, reactive and apparent power (single & three-phase) and resonance
- Transient and steady state analysis, pole zero plots. two-port parameters.

2. Electronics Circuit and System [10]

- Integrated circuit technology and device models
- Operational Amplifier circuits
- Operational Amplifier characterization
- Power supplies and voltage regulators
- Untuned and tuned amplifiers
- Oscillator circuits
- Digital-to-Analog (DAC) and Analog-to-Digital (ADC) conversion
- Instrumentation and isolation amplifiers
- Operational amplifier-bipolar transistor logarithmic amplifiers
- Log-antilog circuit application
- Communication circuits

- Switched power supplies
 - Introduction to power electronics
- 3. Computer Architecture [10]**
- Fundamentals of Computer Architecture & Organization
 - Number System
 - Boolean Algebra
 - Logic Gates
 - Combination and Sequential Logic
 - A/D and D/A Conversion
 - Memory
 - Instruction Set
 - Operating System and Application Program Concepts
 - Computer Applications
- 4. Computer Networks [5]**
- 5. Communication System [4]**
- Analog and Digital Communication Theory and System
- 6. Object Oriented Programming Language [8]**
- Object oriented programming concepts
 - Introduction to C++
 - Operator Overloading
 - Encapsulation
 - Polymorphism
 - Inheritance
 - Templates and file handling
- 7. Discrete Structure [8]**
- Propositional logic and predicate logic
 - Methods of proof and formal reasoning
 - Binary relations
 - Finite state automata
 - Recurrence Relation
 - Graph theory and graph algorithms

1.2.6 Mechanical & Industrial Engineering (MI) [50x1]

- 1. Thermodynamics and Heat Transfer [12]**
- Equality of Temperature and Zeroth Law of Thermodynamics, Heat Transfer and Work
 - Transfer

- Control Mass and Control Volume Formulation of First Law, Steady State Applications
- Entropy, Second Law of Thermodynamics for an Isolated System, Control Mass and
- Control Volume Formulation of second law
- Second Law, Entropy Relations and Isentropic Process,. Heat Engine, Heat Pump and
- Refrigerator
- Carnot Cycle, Brayton Cycle, Rankin Cycle, Otto Cycle, Diesel Cycle, Vapour
- Compression Cycle
- One dimensional steady state heat Conduction through a plane wall, Radial steady state heat conduction through a hollow cylinder, Heat flow through composite structures, Electrical Analogy for thermal resistance, Convection Fundamentals and Radiation Heat
- Transfer Fundamentals
- IC Engines

2. Fluid Mechanics and Fluid Machine [10]

- Basic concepts and Fluid and flow
- Flow measurement
- Continuity equation, Momentum equation, Bernoulli's equation and their applications
- Viscous flow, flow inside closed conduits and head losses
- Water turbines
- Turbo machines
- Water Pumps

3. Mechanics and Strength of Materials [12]

- Concept of particles and rigid bodies
- Effect of forces on particles and rigid body
- Applications of equilibrium equations for solving problems of particles and rigid bodies (in 2- Dimensions and 3-Dimensions.)
- Types of structures, statically determinate and indeterminate
- Moments and couples
- Distributed forces, C.G., Centroid, area and Mass moment of inertia,
- Kinematics of particles and rigid bodies
- Equations of motion
- Dynamic equilibrium
- Kinetics of particles and rigid bodies
- Applications of Newton's Second Law
- Application of Principle of Work and Energy
- Principle of Impulse and Momentum
- Conservation of Energy

- Concept of Stress and Strain
- Types of loads and Beams
- Materials Properties and Material Testing
- Shear Force, Bending Moment diagram
- Mechanical Design

4. Energy [8]

- Sources of conventional energy, fossil fuels, calorific values
- Renewable energy sources and their nature
- Basic concepts of: Solar thermal energy, Solar photo-voltaic energy, wind energy, Biomass, Geothermal energy and Hydraulic energy
- Consumption and environmental aspects of energy

5. Industrial Engineering and Management [8]

- Classification of manufacturing processes.
- Materials selection criteria
- Elements of cost
- Role of production, operation management and system concepts
- Production planning and control
- Plant location and plant layout design
- Forecasting techniques
- Inventory Control
- Decision making process
- Quality Assurance and Quality Control

1.2.7 MSc in Geospatial Engineering (GE) (50x1)

1. Traditional Surveying, Survey Networks and Modern Techniques of Surveying

[12]

- Fundamentals of surveying; triangulation and trilateration; bathymetric survey for determination of depth of waterbodies and profile and cross-sections including discharge measurements; setting out of building, road, bridges and other structures; national trig points, reference level surface (orthometric, ellipsoid, geoid) and gravity measurement; principles of photogrammetry and remote sensing, application of photogrammetry and remote sensing; flight planning; photogrammetric products; different systems of remote sensing; distortions in satellite imageries; image processing and interpretation.

2. Spatial Data and Spatial Information System

[10]

- Map projections and projected coordinate systems; vector and raster data format; topology; spatial data acquisition and analysis (buffer analysis, network analysis, spatial overlay, watershed analysis, terrain analysis, etc.); presentation of outcomes of spatial analysis; importance of GIS and web GIS, different fields of application of GIS and web GIS; E-R model; relational data model; spatial database management system (SDBMS); standard query language (SQL) for spatial databases

3. Geodesy, GNSS and Adjustment of Observations

[12]

- Reference systems: astronomical, geocentric, geodetic and plane coordinate systems; ICRF, ITRF, ECEF, WGS84, Everest 1830; transformation between different reference systems; time systems; measurement of gravity potential; terrestrial, astronomical and satellite positioning; GNSS observables and mathematical models for positioning; satellite orbits; GNSS system biases and mitigation measures; satellite geometry and dilution of precision (DoP); GNSS survey techniques; field survey specifications; integration of INS in GNSS; augmentation systems; redundant observations, error eclipse and confidence level; linear and non-linear adjustment models; least square adjustment method; statistical testing (univariate and multivariate).

4. Cartography and spatial visualization

[6]

- Elements of map; types of map; principles and planning of map design; map design procedure; map layout; color scheme; typographic guidelines; map production and dissemination techniques; application of GIS in map design; static, dynamic, animated, interactive and collaborative web mapping and OGC standards.

5. Cadastre, and Land Administration and Management

[10]

- Concept and types of cadastre; importance of cadastral system; analog vs digital cadastral system; different components of cadastre and technical requirements for cadastral survey in Nepalese context; different methods of cadastral survey including workflow; land registration process, updating and archiving of cadastral documents in Nepal; legal framework for cadastral system; international practices in cadastre; different components and advantages of LIS; stakeholders and their role in LIS; maintenance of cadastre and LIS in Nepal; national land policy; land market, taxation, reform and land use planning; land tenure and tenure security; issues of land management; land conflict and its resolution; modernization of land administration and management in Nepal.