

नेपाली सेना

प्रा.उ.से. केमिकल ईन्जिनियर (खुला) पदको लिखित परीक्षाको पाठ्यक्रम

समय : २ घण्टा ३० मिनेट

पूर्णाङ्क : १००

उत्तीर्णाङ्क : ४०

यो पाठ्यक्रम नेपाली सेनाको विभिन्न ईकाईहरूमा रिक्त रहेको प्रा.उ.से.केमिकल ईन्जिनियर (खुला) पदका उम्मेदवार छनौट परीक्षाको लागि निर्धारण गरिएको हो । लिखित परीक्षामा सरिक हुने उम्मेदवारहरूको पेशा सम्बन्धि विषयलाई आधारमानी प्रश्नहरू सोधिने छ ।

(क) लिखित परीक्षाको माध्यम नेपाली/अंग्रेजी वा दुवै भाषा हुनेछ ।

(ख) लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरूलाई मात्र अर्को चरणको परीक्षामा सम्मिलित गराईने छ ।

(ग) प्रश्न पत्र निर्माण गर्दा पाठ्यक्रममा समावेश भएका सबै विषयहरूलाई समेटिनेछ ।

(घ) नेपाली सेनाको आवश्यकता तथा विविध परिस्थितिमा नेपाली सेना अनुकूल हुने गरी उल्लेखित विवरणहरूमा हेरफेर हुन सक्नेछ ।

(ङ) पाठ्यक्रमको रूपरेखा देहायमा उल्लेख गरे अनुसार हुनेछ ।

(च) पाठ्यक्रम लागु मिति २०७३/०३/२२ गते ।

लिखित परीक्षा योजना र पाठ्यक्रम

विषय	पूर्णाङ्क	उत्तीर्णाङ्क	परीक्षा प्रणाली		प्रश्न संख्या X अङ्क	समय
पेशा सम्बन्धी	१००	४०	वस्तुगत (Objective)	बहुवैकल्पिक प्रश्न (MCQs)	४० प्रश्न X १ अङ्क = ४०	२ घण्टा ३० मिनेट
			विषयगत (Subjective)	छोटो उत्तर	६ प्रश्न X ५ अङ्क = ३०	
				लामो उत्तर	३ प्रश्न X १० अङ्क = ३०	

(SYLLABUS FOR CHEMICAL ENGINEER)

1. Chemistry and Chemical Processes

- 1.1 **Thermodynamics:** Thermodynamic laws, its functions; General Equations of Equilibrium; Pressure, Volume, Temperature Relations of Fluids; Gibbs energy, enthalpy, entropy of reactions;
- 1.2 **Chemical reactions:** Gas laws and phase equilibrium; Thermo physics: Heat capacity calculations; Enthalpy changes of reactions; Phase and chemical-reaction equilibria; Effect of Pressure, Temperature and catalysts on chemical reactions; Material & Energy balance calculations for industrial processes.
- 1.3 **Unit Process:**
 - 1.3.1 Introduction and importance of oxidation, Nitration, Halogenation, Hydrogenation, Esterification, Alkylation, Hydrolysis, Sulphonation and sulphation
 - 1.3.2 Oxidation: Definition and Types, Oxidizing agents, Liquid phase oxidation with oxidizing agents and oxygen
 - 1.3.3 Nitration: Definition and scope, nitration agents and importance of nitration with special reference to explosives; Halogenations: Definition, scope and importance of halogenations; Esterification: Definition, scope and importance of esterification; Alkylation: Definition, scope and importance of alkylation
 - 1.3.4 Hydrogenation: Definition and its scope, properties of hydrogen and sources of hydrogen, gas catalytic hydrogenation and hydrogenolysis, factors affecting it, Industrial hydrogenation of fat and oil, Manufacture of Methanol from CO_2 & H_2
 - 1.3.5 Hydrolysis: Definition and types of hydrolysis, Hydrolyzing agents, equipment's of hydrolysis, Industrial Hydrolysis of fat, hydrolysis of carbohydrates, starch to dextrose
 - 1.3.6 Polymerization: Introduction & chemistry of polymerization reactions, classifications of polymers methods of polymerization, Bullet resistant plastics and plastic materials
- 1.4 **Heat transfer**
 - 1.4.1 Modes of Heat Transfer: Fourier conduction equation, General conduction equation in Cartesian, cylindrical and spherical co-ordinates
 - 1.4.2 Heat Transfer by convection: Fluids with and without phase change, Free & force convention, laminar & turbulent flows heat transfer inside and outside tubes, concepts of thermal boundary layers, over all heat transfer co-efficient, fouling factors, transfer units, flow over flat plats with heat transfer, empirical relation
 - 1.4.3 Heat Transfer Coefficient models, including boiling and condensation; Heat Exchangers; Radiation Heat Transfer
- 1.5 **Mass Transfer:**
 - 1.5.1 Mass Transfer Co-efficient: in laminar, turbulent flows, theories of mass transfer, Heat, momentum and mass transfer,
 - 1.5.2 Distillation: Vapour-Liquid equilibrium data, Flash and simple distillation, continuous method

- 1.5.3 Absorption: Equilibrium, material balance for single component transfer, multi-stage & packed tower operation
- 1.5.4 Liquid Extraction: Stage wise, Stage type contractor
- 1.5.5 Drying Mechanism: Batch drying/ continuous drying
- 1.5.6 Crystallization: Equilibrium, operations and equipment

2. Chemical Technology

- 2.1 Raw materials and principles of production of olefins and aromatics; Typical intermediates from olefins and aromatics such as ethylene glycol, ethyl benzene, phenol, cumene (isopropylbenzene) and DMT, dyes, and pharmaceuticals
- 2.2 Chemical manufacturing processes sugar, starch, alcohol, pulp and paper, glyceride, oils and fats, soaps, detergent, cement, lime, ceramic, glass, leather, etc.
- 2.3 Industrial processes for the production of inorganic heavy chemicals such as acids (such as sulphuric, nitric, hydrochloric and phosphoric acids), alkalis, salts, and fertilizers, soda ash, ammonia
- 2.4 Manufacturing of rubber: Classification of Rubber; Chemistry and Properties of natural Rubber; Synthetic Rubber, Rubber compounding
- 2.5 Polymer technology: Polymers, Plastics and their definitions; Ingredients of plastics or moulding powders; Different classification of plastics and Resins, its manufacture; Use of plastics and resins in industry and engineering
- 2.6 Manufacturing of fibers: Different types of fibres – synthetic and natural, cellulose fibres, synthetic fibers and their importance
- 2.7 Manufacture of paints, varnishes, lacquers: Types of paints and its raw materials; Paints manufacture; Varnishes and its characteristics; Lacquers and its composition; Lacquer oils
- 2.8 Manufacture of Industrial solvents: Diethyl ether, Ethyl alcohol, Acetone, Plant process design and optimization
- 2.9 Cement Technology: Definition of Portland cement, Raw materials and its manufacture in detail; Flow sheet diagram for cement manufacture, setting or hardening of cement and different theories; Specifications for Portland cement (Nepal Standard), Analysis of cement and its use; Lime- manufacture and its use, plaster of Paris, Gypsum- manufacture and its use
- 2.10 Petroleum Technology: Composition of Petroleum; Classification of refinery products; Cracking, reforming, Isomerization

3. Management of Chemical Industries

3.1 Project engineering

- 3.1.1 Economics and importance in chemical process industries; interest and equivalence; depreciation and taxes
- 3.1.2 Capital investment, cost estimation, and profitability analysis; scale-up principles of equipment
- 3.1.3 Plant location and layout and concept of techno- economic feasibility report writing
- 3.1.4 Construction of Piping and Instrumentation (P&I) diagram from basic flow diagram and basic engineering of plant design
- 3.1.5 Project engineering management; selection of alternatives; selection of plant capacity

- 3.1.6 Optimum Project design; Project scheduling
- 3.1.7 Standardization and Problems of standardization

3.2 Process instrumentation, safety and waste management

- 3.2.1 First Principles model development; dynamics of first, second and higher order linear systems, Open loop and closed loop systems; Feedback control;
- 3.2.2 Types of hazards in chemical industries, Hazards due to high pressure & explosions, dust & vapor cloud explosions, inflammable materials, toxic materials, chemicals, chemical reactions and operations, electrostatics, ionizing radiation etc.
- 3.2.3 Noise hazards effects of noise hazards on personnel and plant operation
- 3.2.4 Nuclear pollution and hazards: precaution, mitigation measures and nuclear waste management,
- 3.2.5 Chemicals of hazardous nature (for chemical weapons): safety and mitigation measures
- 3.2.6 Fire and Explosion indices and hazard analysis
- 3.2.7 Safety protection, equipment for personal and plant for various hazards, Safety procedures
- 3.2.8 Disaster management, insurance, worker's safety act
- 3.2.9 Sources and effects of environmental pollution: air pollution, water pollution, land pollution, management of industrial waste, reuse, recycling, impact of pollution on environment and its assessment

4. Explosives

- 4.1 Military Explosives: Definition and classification according to application
- 4.2 Development explosives and their application (Emulsions, Gel and slurries)
- 4.3 Explosive nitro compounds - Nitrocellulose, nitroglycerine, TNT, RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) and PETN (pentaerythritol tetranitrate), plastic explosives
- 4.4 Detonating and Initiating systems

5. Mining/Blasting Technology

- 5.1 Application of explosives in mines and development works
- 5.2 Surface Blasting and underground blasting
- 5.3 Fundamentals of blast design
- 5.4 Drilling patterns and blast patterns

6. Management of hazardous waste/Environmental management

- 6.1 Management of explosive wastes
- 6.2 Management of Industrial wastes
- 6.3 Management of radioactive wastes
- 6.4 Management of hazardous chemicals
- 6.5 Methods of waste management, environment protection and mitigation measures

7. Chemistry of explosives and Weapons of Mass Destruction (WMD)

- 7.1 Flash point, auto ignition point, detonation, deflagration and combustion
- 7.2 Combustion/decomposition products, Oxygen balance and its significance in combustion thermodynamics
- 7.3 Detonation energy: detonation pressure, detonation velocity and gas volume
- 7.4 Nuclear reactions: fusion and fission, nuclear fallout
- 7.5 Weapons of mass destruction: nuclear weapons, chemical weapons, biological weapons, radiological weapons

8. Instrumental methods of analysis of explosives and raw materials

- 8.1 Measurement of energy density, Calorific value (net and gross calorific values) and explosive strength
- 8.2 Techniques for measurement of velocity and pressure, Measurement of velocity and pressure, Piezoelectric measurement
- 8.3 Measurement and monitoring of nuclear radiation (nuclear fallout), instruments used including portable dosimeters
- 8.4 Application of UV-Visible, IR spectroscopy, Fourier Transform Infrared Spectroscopy, Gas Chromatography-Mass Spectroscopy, Ion Chromatography, Liquid Chromatography-Mass Spectrometry, X-Ray Diffraction

9. Alternative Energy and Bio-fuels

- 9.1 Hydrogen energy and Fuels cells
- 9.2 Solar technologies (thermal – passive and non-passive applications, photovoltaic applications)
- 9.3 Wind energy technology – scope and potentials
- 9.4 Geothermal – scope and potentials
- 9.5 Solid, liquid and gaseous bio-fuels
- 9.6 Nuclear energy: fusion and fission reactions, raw materials and general application of nuclear energy
- 9.7 Waste to energy – municipal solid waste (RDF), sanitary landfill, gasification

यस पेशा सम्बन्धी विषयको पाठ्यक्रमका एकाईहरूबाट सोधिने प्रश्नहरूको संख्या निम्नानुसार हुनेछ ।

एकाई नं. (Unit No.)	अङ्कभार (Weightage)	बहुवैकल्पिक प्रश्न (MCQs) को संख्या	छोटो उत्तर प्रश्नको संख्या	लामो उत्तर प्रश्नको संख्या
१	२५	१०	६ प्रश्न X ५ अङ्क	३ प्रश्न X १० अङ्क
२	२५	१०		
३	२५	१०		
४	२५	१०		
५				
६				
७				
८				
९				
जम्मा	१००	४० प्रश्न x १ अङ्क = ४० अङ्क	६ प्रश्न X ५ अङ्क = ३० अङ्क	३ प्रश्न X १० अङ्क = ३० अङ्क

Practical Examination (50 Marks)

Syllabus

1. Determination of calorific value of fuel using adiabatic (bomb) calorimeter
2. Determination of flash point of liquid fuel
3. Measurement of nuclear radiation using portable dosimeter or alpha, beta counters
4. Model Construction of domestic solar water heater
5. Detection of metal waste in MSW using atomic absorption spectroscopy
6. Perform Trans-esterification of Jatropha curcas oil and get biodiesel
7. Conduct electrolysis of waste to get hydrogen
8. Gas Chromatography-Mass Spectroscopy (GC-MS) analysis of radioactive waste from hospital
9. Piezoelectric measurement of gas pressure and velocity of propellant
10. Practical work demonstrating the deflagration process
11. Assembly of detonating system or measurement of detonation pressure
12. Measurement of total solar radiation (diffused and direct radiation) using pyranometer
13. Connection/assembly of solar PV system for pumping water
14. Measurement of wind speed and direction using simple wind measuring devices
15. Measurement of fluid velocity using venturimeter, orificemeter and rotameter
16. Separation of binary mixture of ethyl alcohol and water using continuous distillation system
17. Design of Shell and Tube Heat Exchanger
18. Calculation of LMTD Value of given counter current flow system of fluid