

वैकल्पिक ऊर्जा पर्वद्धन केन्द्र
प्राविधिक सेवा, सातौ तह, इञ्जिनियर पदको प्रतियोगितात्मक परीक्षाको पाठ्यक्रम
एवं परीक्षायोजना

पाठ्यक्रमको रूपरेखा:—यस पाठ्यक्रमको आधारमा निम्नानुसार चरणमा परीक्षा लिइने छ ।

प्रथम चरण :- लिखित परीक्षा पूर्णाङ्क :- २००
द्वितीयचरण :- अन्तर्वार्ता पूर्णाङ्क :- ३०

१. प्रथम चरण: - लिखित परीक्षा योजना (Written Examination Scheme)

पत्र	विषय	पूर्णाङ्क	उतीर्णाङ्क	परीक्षा प्रणाली	प्रश्नसंख्याX अङ्क	समय
प्रथम	इञ्जिनियरिङ्ग I	१००	४०	वस्तुगत (Objective):बहुवैकल्पिक प्रश्न (MCQ)	५० प्रश्नX २ अङ्क	४५ मिनेट
द्वितीय	इञ्जिनियरिङ्ग II	१००	४०	विषयगत (Subjective)	१०प्रश्नX १०अङ्क	३ घण्टा
जम्मा		२००				

२. द्वितीय चरण: - अन्तर्वार्ता (Interview)

विषय	पूर्णाङ्क	परीक्षाप्रणाली
व्यक्तिगत अन्तर्वार्ता (Interview)	३०	मौखिक(Oral)

द्रष्टव्य :

- यो पाठ्यक्रम रूपरेखालाई (प्रथम चरण (लिखित परीक्षा) र द्वितीय चरण (अन्तर्वार्ता) गरी दुई चरणमा विभाजन गरिएको छ ।
- प्रथमपत्र र द्वितीय पत्रको लिखित परीक्षा छुट्टाछुट्टै हुनेछ ।
- लिखित परीक्षाको माध्यमभाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुवै हुनेछ ।
- वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरूको गलतउत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अङ्क कट्टा गरिनेछ । तर उत्तर नदिएमा त्यस बापत अङ्क दिइने छैन र अङ्क कट्टा पनि गरिने छैन ।
- बहु वैकल्पिक प्रश्नहरू हुने परीक्षामा कुनै प्रकारको क्याल्कुलेटर (Calculator) प्रयोग गर्न पाइने छैन ।
- विषयगत प्रश्नका लागि तोकिएका १० अङ्कका प्रश्नहरूको हकमा १० अङ्कको एउटा लामो प्रश्न वा एउटै प्रश्नका दुई वा दुई भन्दा बढी भाग (Two or more parts of a single question) वा एउटा प्रश्न अन्तर्गत दुई वा बढी टिप्पणीहरू (Short notes) सोध्न सकिने छ ।
- विषयगत प्रश्नका हकमा प्रत्येक भाग/खण्डका लागि छुट्टाछुट्टै उत्तर पुस्तिकाहरू हुनेछन् । परीक्षार्थीले प्रत्येक भाग/खण्डका प्रश्नहरूको उत्तर सोही भाग/खण्डको उत्तरपुस्तिकामा लेख्नुपर्नेछ ।
- यस पाठ्यक्रम योजना अन्तर्गतका पत्र/विषयका विषयवस्तुमा जेसुकै लेखिएको भए तापनि पाठ्यक्रममा परेका कानून, ऐन, नियम तथा नीतिहरू परीक्षाको मिति भन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भई हटाईएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्यक्रममा परेको सम्झनु पर्दछ ।
- प्रथम चरणको परीक्षाबाट छनौट भएका उम्मेदवारहरूलाई मात्र द्वितीय चरणको परीक्षामा सम्मिलित गराइनेछ ।
- पाठ्यक्रम लागू मिति :- २०७७/११/१

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प्रथमपत्र:-इञ्जिनियरिङ्ग सम्बन्धी I

Section (A) = 26 %Marks

1. Work shop technology and Metrology

- 1.1 Basic tools and basic hand operations
- 1.2 Machine tools: Lathe, Shaper, Milling, Grinding, Drilling Machines
- 1.3 Metal joining: Soldering, Brazing, Gas welding, Arc welding
- 1.4 Types of fits
- 1.5 Linear measurement: Block Gages, Length Bars, Comparators
- 1.6 Errors in measurement

2. Thermodynamics and heat engines

- 2.1 Basic concepts: Thermodynamic System, Thermodynamic Property, Pure Substance, Zeroth Law
- 2.2 First Law of Thermodynamics: Control mass and Control volume formulation
- 2.3 Second Law of Thermodynamics: Heat engine, Refrigerator and Heat pump, Kelvin Planck and Clausius Statements, Entropy cooling, humidification and dehumidification process, Air conditioning systems
- 2.4 Thermodynamic Cycles: Carnot cycle, Otto cycle, Diesel Cycle, Brayton cycle, Rankine cycle

3. Fluid Mechanics

- 3.1 Fluid Properties: Viscosity, Surface tension, Compressibility, Vapor Pressure
- 3.2 Fluid Statics: Pressure variations in static fluid, Pressure head, Manometer, Force on submerged surfaces
- 3.3 Equations of Fluid Flow: Types of flow, Continuity equation, Bernoulli's equation, and Momentum equation
- 3.4 Viscous Effects: Reynolds number, Boundary layer, Frictional resistance to flow in pipes
- 3.5 Flow measurement: Pitot-static tube, Orifice, Venturimeter, Nozzle, Rotameter

4. Hydraulic and Electric Machines

- 4.1 Water turbines: Pelton, Francis, Kaplan and Cross flow (Working principle and Characteristics)
- 4.2 Pumps: Centrifugal pump and Reciprocating pump (Working principle and Characteristics), Hydraulic ram
- 4.3 DC Motors: Shunt field, Series field and Compound field motors, Torque-speed characteristics
- 4.4 DC Generators: Shunt, Series and Compound field machines, Voltage/speed/load characteristics, Effects of variable load, variable torque
- 4.5 Synchronous and Induction Machines: Basic structure of synchronous machines, Generator on isolated load, Generator on large system, Synchronous motor

5. Construction Materials and Concrete Technology

- 5.1 Properties of building materials: physical, chemical, constituents, thermal etc
- 5.2 Stones-characteristics and requirements of stones as a building materials
- 5.3 Ceramic materials: ceramic tiles, Mosaic Tile, brick types and testing.
- 5.4 Cementing materials: types and properties of lime and cement, cement mortar tests
- 5.5 Metals: Steel; types and properties; Alloys
- 5.6 Timber and wood: timber trees in Nepal, types and properties of wood
- 5.7 Miscellaneous materials: Asphaltic materials (Asphalt, Bitumen and Tar); paints and varnishes; polymers
- 5.8 Constituents and properties of concrete (physical and chemical)
- 5.9 Water cement ratio

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- 5.10 Grade and strength of concrete, concrete mix design, testing of concrete
- 5.11 Mixing, transportation pouring and curing of concrete
- 5.12 Admixtures, High strength concrete
- 5.13 Pre-stressed concrete technology

Section (B) = 24% Marks

6. Basic Electrical and Electronics Engineering

- 6.1 Electrical Engineering Materials: Conducting, insulating & semiconductor materials
- 6.2 Circuit Parameters: resistance, inductance, capacitance and temperature effect of resistance
- 6.3 Circuit Fundamentals: Series & parallel circuits, circuit elements, independent & dependent sources, Ohm's law, Kirchhoff's Voltage & current laws
- 6.4 Network Theorems: Mesh's and Nodal's analysis of electrical circuits, Thevenin's, Norton's, maximum power & reciprocity theorems
- 6.5 AC circuits: Concept of complex impedance, phaser diagram, Active, Reactive & Apparent power, Power factor, resonance in AC circuit
- 6.6 Bi-polar junction transistor: construction, operating characteristics, use as amplifier and switch.
- 6.7 Logic circuit: Decimal, Binary and Hexadecimal system, logic gates, adder, Encoder, Decoder, Multiplexer, Demultiplexer.
- 6.8 Semi-conductor devices: Diodes, Transistors, BJT, MOSFET, thyristors
- 6.9 Rectifier : Rectifier using diodes - half wave, full wave, single phase, three phase, capacitor and inductor filters, Controlled rectifier using thyristors - half wave, full wave, single phase, three phase.

7. Instrumentation

- 7.1 Transducers: Measurement of electrical, mechanical, thermal and hydraulic variables
- 7.2 Accuracy and Precision: Parallax, Absolute and Relative Errors
- 7.3 Oscilloscope: Operating principles, Analog and Digital Oscilloscope
- 7.4 Digital instrumentation: Fundamental principles, interfacing to the computers, Microprocessor based instrumentation
- 7.5 Instrument Transformers: Construction and Operating Principles of Measuring and Protection type CTs, Potential transformers

Section (C) = 40 % Marks

8. Estimating, Costing, Specification and Valuation

- 8.1 Types of estimates and their specific uses
- 8.2 Methods of calculating quantities
- 8.3 Key components of estimating norms and rate analysis
- 8.4 Preparation of bill of quantities
- 8.5 Purpose, types and importance of specification
- 8.6 Purpose, principles and methods of valuation

9. Engineering Drawing

- 9.1 Drawing sheet composition and its essential components
- 9.2 Suitable scales, site plans, preliminary drawings, working drawings
- 9.3 Theory of projection drawing: perspective, orthographic and axonometric projection, first and third angle projection
- 9.4 Drafting tools and equipments
- 9.5 Drafting conventions and symbols
- 9.6 Topographic, electrical, plumbing and structural drawings

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9.7 Techniques of free hand drawing

9.8 Community buildings: School and hospital buildings and their design considerations

10. Engineering Economics

10.1 Benefit cost analysis, cost classification, sensitivity analysis, internal rate of return, time value of money; economic equilibrium, demand, supply and production, net present value, financial and economic evaluation

11. Professional Practices

11.1 Ethics, integrity and professionalism: code of conduct and guidelines for professional engineering practices

11.2 Relation with clients, contractor and fellow professionals

11.3 Building Bylaws

12. Environmental engineering

12.1 Environmental Pollution- units of measurements, material balance and energy fundamentals, classification of pollution

12.2 Air Pollution: Causes and effects

12.3 Water Pollution: Causes and effects, Waste water treatment

12.4 Industrial Waste: Collection and disposal

12.5 Global warming and climate change

12.6 Environment assessment: IEE and EIA

12.7 Environmental hazards; tools and techniques of hazard assessment

13. Energy Resources

13.1 Energy consumption scenario of Nepal, commercial and non-commercial energy resources

13.2 Hydroelectricity, national potentials, achievements and utilization

13.3 Solar energy and its applications: Solar thermal, solar photovoltaic

13.4 Biomass energy, wind energy, Methods of enhancing energy efficiency & energy conservation , energy audit, energy banking, energy crisis and management.

13.5 1.12 Concept of Quality Control and Quality Assurance

Section (D) = 10 %Marks

14. कानून, ऐन, नियम तथा नीतिहरु

14.1 नेपालको वर्तमान संविधानको सामान्य जानकारी

14.2 चालु आवधिक योजनामाउर्जा नीति सम्बन्धी जानकारी

14.3 नवीकरणीय ऊर्जा अनुदान नीति, २०७३ तथा अनुदान परिचालन कार्यविधि, २०७३

14.4 जैविक ऊर्जा रणनीति, २०७३

14.5 वैकल्पिक ऊर्जा विकास समिति कर्मचारी सेवाशर्त नियमावली, २०६६

14.6 वैकल्पिक ऊर्जा पर्वद्धन केन्द्र आर्थिक अनुशासन तथा सुशासन नियमावली, २०७५

14.7 वैकल्पिक ऊर्जा विकास समिति (गठन), आदेश २०५३

14.8 सार्वजनिक खरिद ऐन, २०६३ तथा सार्वजनिक खरिद नियमावली, २०६४

14.9 भ्रष्टाचार निवारण ऐन, २०५९

Section (A) = 20 Marks(10 Marks × 2 Questions)

1. Work shop technology and Metrology

- 1.1 Basic tools and basic hand operations
- 1.2 Machine tools: Lathe, Shaper, Milling, Grinding, Drilling Machines
- 1.3 Metal joining: Soldering, Brazing, Gas welding, Arc welding
- 1.4 Types of fits
- 1.5 Linear measurement: Block Gages, Length Bars, Comparators
- 1.6 Errors in measurement

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- 2.1 Properties of building materials: physical, chemical, constituents, thermal etc
- 2.2 Stones-characteristics and requirements of stones as a building materials
- 2.3 Ceramic materials: ceramic tiles, Mosaic Tile, brick types and testing.
- 2.4 Cementing materials: types and properties of lime and cement, cement mortar tests
- 2.5 Metals: Steel; types and properties; Alloys
- 2.6 Timber and wood: timber trees in Nepal, types and properties of wood
- 2.7 Miscellaneous materials: Asphaltic materials (Asphalt, Bitumen and Tar); paints and varnishes; polymers
- 2.8 Constituents and properties of concrete (physical and chemical)
- 2.9 Water cement ratio
- 2.10 Grade and strength of concrete, concrete mix design, testing of concrete
- 2.11 Mixing, transportation pouring and curing of concrete
- 2.12 Admixtures, High strength concrete
- 2.13 Pre-stressed concrete technology

3. Engineering Design and Drawing

- 3.1 Types of Projection
- 3.2 Production Drawings
- 3.3 Loading: Tensile, Compressive, Shearing, Bending, Bearing and Torsion
- 3.4 Common Types of Failure: Theories of failure, Stress concentration effects, Ductile and brittle materials, Factor of safety

Section (B) = 20 Marks(10 Marks × 2 Questions)

4. Thermodynamics and heat engines

- 4.1 Basic Concepts: Thermodynamic System, Thermodynamic Property, Pure Substance, Zeroth Law
- 4.2 First Law of Thermodynamics: Control mass and Control volume formulation
- 4.3 Second Law of Thermodynamics: Heat engine, Refrigerator and Heat pump, Kelvin Planck and Clausius Statements, Entropy
- 4.4 Thermodynamic Cycles: Carnot cycle, Otto cycle, Diesel Cycle, Brayton cycle, Rankine cycle

5. Hydraulic and Electric Machines

- 5.1 Water turbines: Pelton, Francis, Kaplan and Cross flow (Working principle and Characteristics)
- 5.2 Pumps: Centrifugal pump and Reciprocating pump (Working principle and Characteristics), Hydraulic ram
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- 5.4 DC Generators: Shunt, Series and Compound field machines, Voltage/speed/load characteristics, Effects of variable load, variable torque
- 5.5 Synchronous and Induction Machines: Basic structure of synchronous machines, Generator on isolated load, Generator on large system, Synchronous motor

Section (C) = 40 Marks(10 Marks × 4 Questions)

6. Engineering Management

- 6.1 Role of production/Operation Management and System Concepts
- 6.2 Plant Location and Plant Layout Design
- 6.3 Production Planning and Control: Selection of materials, methods, machines and manpower
- 6.4 Project management –Objectives, goals, project cycle, Project information system, social and financial analysis of the project, decision making and contract negotiation, use of result framework
- 6.5 Network methods: PERT, CPM
- 6.6 Inventory Control: Inventory costs and Inventory models
- 6.7 Forecasting Techniques: Requirements of forecasting, Time series and Moving average methods, Regression analysis
- 6.8 Quality Management: Importance of quality, Statistical process control
- 6.9 Statistical Analysis: Measurement of central tendency, Deviation, Distribution

7. Estimating, Costing, Specification and Valuation

- 7.1 Types of estimates and their specific uses
- 7.2 Methods of calculating quantities
- 7.3 Key components of estimating norms and rate analysis
- 7.4 Preparation of bill of quantities
- 7.5 Purpose, types and importance of specification
- 7.6 Purpose, principles and methods of valuation

8. Engineering Economics

- 8.1 Types of engineering economics decisions
- 8.2 Time Value of Money: Simple interest, Compound interest, Continuous compound interest
- 8.3 Project Evaluation Techniques: Payback period method, NPV method, Future value analysis, IRR method
- 8.4 Benefit and Cost Analysis: Cost benefit ratio, breakeven analysis
- 8.5 Corporate tax system in Nepal
- 8.6 Depreciation and its type

9. Professional Practice

- 9.1 Ethics and Professionalism: Perspective on morals, Codes of ethics and guidelines of professional engineering practice
- 9.2 Legal aspects of Professional Engineering in Nepal: Engineering Council act, Provision for private practice and employee engineers
- 9.3 Contract
- 9.4 Tendering and contract documents

10. Environmental engineering

- 10.1 Air Pollution : Causes and effects
- 10.2 Water Pollution : Causes and effects, Waste water treatment
- 10.3 Industrial Waste : Collection and disposal
- 10.4 Indoor Air Quality : Indoor pollutants, Effects of indoor pollutants and Control of indoor pollutants
- 10.5 Global impacts : Green house effects, Acid rain, Montreal Protocol

11. Energy Resources

- 11.1 Energy consumption scenario of Nepal
- 11.2 Solar energy and its applications: Solar thermal, solar photovoltaic
- 11.3 Biomass energy
- 11.4 Hydroelectricity

Section (D) = 20 Marks(10 Marks × 2 Questions)

12. Basic Electrical and Electronics Engineering

- 12.1 Electrical Engineering Materials: Conducting, insulating & semiconductor materials
- 12.2 Circuit Parameters: resistance, inductance, capacitance and temperature effect of resistance
- 12.3 Circuit Fundamentals: Series & parallel circuits, circuit elements, independent & dependent sources, Ohm's law, Kirchhoff's Voltage & current laws
- 12.4 Network Theorems: Mesh's and Nodal's analysis of electrical circuits, Thevenin's, Norton's, maximum power & reciprocity theorems
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- 12.8 Semi-conductor devices: Diodes, Transistors, BJT, MOSFET, thyristors
- 12.9 Rectifier : Rectifier using diodes - half wave, full wave, single phase, three phase, capacitor and inductor filters, Controlled rectifier using thyristors - half wave, full wave, single phase, three phase.

13. Instrumentation Engineering Survey

- 13.1 Introduction and basic principles, classification of surveys
- 13.2 Linear measurement techniques:- chain and tape method, ranging rods and arrows, representation of measurement and common scales, sources of errors, effect of slope and slope correction, correction for chain and tape measurements, abney level and clinometers
- 13.3 Compass:- types of compass, problems and sources of errors in compass survey
- 13.4 Plane table surveying: principles and methods of plane tabling
- 13.5 Leveling: principle of leveling, temporary and permanent adjustment of level, bench marks, booking methods and their recording, longitudinal and cross sectioning, reciprocal leveling, trigonometric leveling
- 13.6 Contouring: contour interval and characteristics of contours, methods of contouring, interpolation, use of contour map
- 13.7 Theodolite traversing: need of traverse and its significance, principle of traverse, computation of coordinates; adjustment of closed traverse and linked traverse, closing errors
- 13.8 Tacheometry: principle, tacheometric formula, relation of distance and elevation
- 13.9 Uses of total station and electronic distance measuring instruments
- 13.10 Transducers: Measurement of electrical, mechanical, thermal and hydraulic variables
- 13.11 Accuracy and Precision: Parallax, Absolute and Relative Errors

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- 13.12 Oscilloscope: Operating principles, Analog and Digital Oscilloscope
- 13.13 Digital instrumentation: Fundamental principles, interfacing to the computers, Microprocessor based instrumentation
- 13.14 Instrument Transformers: Construction and Operating Principles of Measuring and Protection type CTs, Potential transformers