पूर्वोत्तर पर्वतीय विश्वविद्यालय
जिला: पूर्वी खासी हिल्स, शिलांग - 793022
मेघालय, भारत

North-Eastern Hill University
District: East Khasi Hills, Shillong - 793022
Meghalaya, India

DEPARTMENT OF ENERGY ENGINEERING

No: ENE/PhD-Admission /2024-25/02

February 19th, 2025

Provisional List of Candidates for PhD Entrance Test and Personal Interview (PI) 2024-25 for PhD (Energy Engineering)

The following candidates are provisionally shortlisted for appearing PhD Entrance Test and Interview 2024-25 based on their self-declared credentials in the prescribed application form.

List of Candidates for Entrance Test & PI: PhD in Energy Engineering 2024-25

Sl. No.	Application form No.	Name	Category
1	230003002	ANAND MOHAN JHA	EWS
2	230003596	ROHIT SINHA	GEN
3	230003802	MALA DAS	SC
4	230004179	KARABI DEKA	GEN
5	230004450	ROHIT PAHARIYA	GEN
6	230006517	NIKHIL SAIKIA	GEN

The admission/selection to the Ph.D (Energy Engineering) program for a limited number seat will be done on the basis of PG marks, NET/GATE score, written test of one hour duration (total marks 50) followed by an interview (50 marks). Merit list shall be prepared as per NEHU norms. The decision of the Admission Committee in all matters shall be binding and final. Candidates must secure at least 50% of the total marks in the written test to qualify for the interview.

Date, time and venue of the written test as well as personal interview are as follows:

Important Dates:

Reporting Time and Date	9:30 A.M, 06th March, 2025 (Thursday)
Time and Date for document verification	10:00 A.M, 06th March, 2025
Venue for document verification and interview	Department of Energy Engineering NEHU, Shillong 793022
Time and Date for Entrance Test	11:30 AM- 12:30 P.M, 06th March, 2025
Personal Interview	2:00 P.M., 06th March, 2025
Date of Admission	7th March, 2025

For verification, all candidates are requested to produce ***mark sheets of qualifying examinations, valid NET/GATE (if any) certificate(s), proof of final semester examination marks, pass certificates, Caste certificate, NOC from employer if required, proof of Date of Birth, all in original along with a set of photocopies of all testimonials and application form*** before commencement of the Entrance Test. Those who are employed in any organization, ***if selected for admission***, are required to submit ***No Objection Certificate*** from their current employer. Also, they have to bring a short CV, M. Tech thesis, letter mentioning about their qualification details, research experience and publication (if any), employment details (if any) and area of interest for research. All the selected candidates after the exam are required to come for personal interview.

One set of photocopies of all the testimonials along with application form need to be submitted at the time of reporting.

In case, any candidate fails to report at the reporting time in the venue on the specified date and time mentioned above, he/she will forfeit his/her claim to appear for entrance test and Interview.

If any information provided in the application form is found to be false or if any documents are proven to be forged, the candidature will be canceled.

A syllabus for the admission test is attached in Annexure I

19/02/2025

Head of the Department

Annexure I

Syllabus for PhD Entrance Test in Energy Engineering

1. Research Methodology

Types of Research: Types, Research process and steps in it, Hypothesis, Research proposals and aspects.
Research Design: Need, problem definition, variables, research design concepts, literaturesurvey and review, research design process, errors in research.
Ethics of Research, Plagiarism.
Report Writing: Pre-writing considerations, thesis writing, formats of report writing, formats of publications in research journals, use of standard tools like LaTeX.

2. Energy and Environment

Environment, ecosystems and biodiversity: Concept of environment: components of environment and their interactions; abiotic and biotic factors; Ecosystems: characteristic feature and structure and function of forest, grassland, desert and aquatic ecosystem (Ponds, streams, lakes, rivers, oceans, estuaries); Ecological pyramid; energy flow and nutrient cycling; Biodiversity: value of biodiversity; loss and conservation of biodiversity
Environmental problems and issues: Environmental problems and issues: greenhouse effect, ozone depletion, acid rain; Renewable and non-renewable resources; natural resources, associated problem and its conservation: forest, water, mineral, food, energy and land resources; environmental impact assessment; environment protection act.
Environmental pollution and management: Environmental pollution: sources and types of air, water, soil, radioactive and noise pollution; Industrial pollutants and their impact on environment and human health; Toxicants and toxicity; toxic chemicals: heavy metals and pesticides; Safety and prevention of industrial pollution; bio-transformation and bioremediation; Aerobic and anaerobic treatment of waste water; waste management and cleaner production.

3. Energy Resources and Technology

Conventional and Non-conventional energy resources, Introduction to Renewable Energy, Global and national energy prospective, Renewable energy resources, Basics of Energy security and Climate Change, Dimensions of the energy problem, Energy Technology and system development. Energy Conservation and its relation to GDP, GNP and its dynamics. Conventional Energy Sources and Overall Energy demand and availability.
Energy Resources, Depletion of energy sources and its impact, Impact of Energy on Economy, Role of Energy usage in Socio-economic Development and Environment, Energy and Environmental policies, Resource assessment-Wind energy, Solar energy, Biomass and bioenergy, Geothermal energy and Ocean and Tidal energy.
Energy Security, Exponential rise in Energy consumption, Energy Consumption and role of UNFCCC, Role of renewables in energy security and climate change, International Energy Policies of G-8 Countries, G-20 Countries, OPEC Countries and EU.
Energy Scenario - Indian and Global context, Fossil fuels, Nuclear and Renewable sources including Petroleum, Coal, Bio-fuels, solar, hydro and wind. Energy consumption in Commercial and non-commercial sector and Energy utilization pattern in the past, present

and future projections, study of consumption pattern, Sector wise energy consumption for Industrial, Commercial, Household, Agricultural, Municipality lighting and water pumping.

4. Solar Energy Technology

Earth and Sun Relation, Solar angles, day length, angle of incidence on tilted surface, Sun-path diagrams, Shadow determination, Extra-terrestrial characteristics, Effect of earth atmosphere on terrestrial solar radiation, Measurement and estimation on horizontal and tilted surfaces, Analysis of Indian solar radiation data and applications.

Flat-plate Collectors, Effective energy losses, Thermal analysis, Heat capacity effect, Testing methods, Evacuated tubular collectors, Types of Air flat-plate Collectors, Thermal analysis, Thermal drying, Selective Surfaces, Ideal coating characteristics, Types and applications, Anti reflective coating, Preparation and characterization.

Concentrating Collector Designs, Classification, and performance parameters, Tracking systems, Compound parabolic concentrators, Parabolic trough concentrators, Concentrators with point focus, Heliostats, Comparison of various designs- Central receiver systems, parabolic trough and compound parabolic systems, Solar furnaces.

Solar Cell Basics, Types of photovoltaic cells, Determination of shift in Fermi energy level, Shift of Fermi energy due to doping, Probability of occupation of allowed states, Density of electrons and holes, Carrier transport- Drift, diffusion, continuity equations, Absorption of light, Electron-hole pair generation, Recombination process, Introduction to Excitonic Solar Cells.

5. Biomass and Biofuel Technology

Selection of biomass as feedstock, Introduction to photosynthesis, characteristics of C3 and C4 plants as biomass fuel, physicochemical characteristics of biomass as fuel, Biochemical, chemical and thermo-chemical biomass conversion routes, Biochemical conversion by Aerobic and Anaerobic digestion of biomass.

Types of digesters, design of biogas plants, installation, operation and maintenance of biogas plants, biogas plants manure-utilization and manure values, Biogas storage, biogas for motive power generation, Alcohol production from biomass, Types of Materials of alcohol production-process description, distillation.

Chemical conversion processes, hydrolysis and hydrogenation, Biofuels-different processes of production, Economics on utilization, Mechanism of trans-esterification, fuel characteristics of biodiesel, technical aspects of biodiesel engine application, Bio-diesel storage, Induction time, Oxidation stability, Principle and working of Rancimat apparatus for oxidation stability.

Concept of Waste land, selection of plants for energy plantation, utilization through energy plantation in waste land, Biomass based power generation using biomass gasifiers and biogas plants, Classification of Bio-fuels from Plant and animal wastes, advantages and disadvantages of bio-fuel produced from animal wastes over plant feedstock.

6. Energy Economics, Accounting and Planning

Introduction to Energy economics, Basic concepts, National accounting framework, Criteria for sustainable development, Economic theory of demand, production and cost market structure, Calculation of unit cost of power generation from different sources with examples, Eco-ground rules for investment in energy sector.

Payback period, NPV, IRR, and benefit-cost analysis with examples, Socio-economic evaluation of energy conservation programme, Application of econometrics, input and output optimization and simulation methods to energy planning and forecasting problems, Dynamic models of the economy and simple theory of business fluctuation.
Uncertainties and social cost-benefit analysis of renewable energy systems, Financing mechanism of different renewable energy systems, Case studies, Renewable energy projects for reductions in CO2 emissions, Conflict between energy consumption and environmental pollution, Economic approach to environmental protection and management, Externalities, economics of pollution control, emission taxes, subsidies.
Material and Energy balance, Facility as an energy system, Methods for preparing process flow, material and energy balance diagrams, Energy Action Planning, Key elements, Force field analysis, Energy policy purpose, perspective, contents, formulation, ratification, Organizing the management, location of energy management, Energy Conservation Act 2001 and amendments.
Duties and responsibilities of energy managers and auditors as per Energy Conservation Act 2001, Defining monitoring and targeting, Elements of monitoring and targeting, Data and information analysis and techniques, Energy consumption, production, cumulative sum of differences (CUSUM).

7. Hydro, wind, ocean and Tidal Energy Technology

Introduction to Hydro-energy systems, potential site selection, Site selection and civil works, dam size and construction, estimation of power, Overview of micro, mini and small hydro systems, Elements of turbine, Assessment of Hydro Power, Selection and design criteria of turbines, Speed and voltage regulation.
Ocean energy resources, ocean energy routes, Principle of ocean thermal energy conversion systems, ocean thermal power plants, Principles of ocean wave energy and tidal energy conversion, Indian perspective for ocean and tidal energy-technical problems and limitations.
Wind energy statistics, Measurements and Data Presentation, Wind Turbine Aerodynamics, Momentum Theories, Basics of Aerodynamics, Aerofoils and their Characteristics, HAWT - Blade Element Theory, Prandtl's Lifting Line Theory (prescribed wake analysis), VAWT Aerodynamics, Wind Turbine Loads, and Aerodynamic Loads in Steady Operation.
Wind Turbulence, Yawed Operation and Tower Shadow, Sitting-Rotor Selection, Annual Energy Output, Horizontal Axis Wind Turbine (HAWT) Vertical Axis Wind Turbine, Rotor Design Considerations, Number of Blades, Blade Profile of 2/3 Blades and Teetering, Coning, Upwind/Downwind characteristics and properties

8. Fuel Cell and Hydrogen Energy

Hydrogen as an alternate fuel, Physical and chemical properties of Hydrogen as a fuel, Advantages and limitations of Hydrogen over conventional fuels, Hydrogen Economy, Suitability of Hydrogen as a fuel and Fuel Cell as energy conversion
device, Hydrogen Transport, Technical constraints of transport of Hydrogen by Road, Railway, Pipeline, and by Ship. Safety measures for Hydrogen production, transport and storage.
Hydrogen Production from fossil fuels, electrolysis, thermal decomposition, photochemical, photo-catalytic, hybrid, Sea as a source of Deuterium, production of hydrogen from sea water, Hydrogen Storage in Metal hydrides, Metallic alloy hydrides, Basic thermodynamics of Fuel Cell, Reaction kinetics, Charge and mass transport.

Fuel Cell modelling for charge and mass transport, In-situ and Ex-situ Fuel Cell characterization, System and components of a Fuel Cell, Types of Fuel Cells based on working temperature, electrolyte and fuel, Fuel Cell power stations, Power management, Thermal management, Pinch analysis.

9. Basic Electrical Engineering

Electrical circuits and network: Node, Branch, Mesh, Loop; Active, passive, linear, non-linear, unilateral, bilateral, symmetrical, unsymmetrical network; Electrical circuit elements, Sources: Voltage and Current sources; Dependent and Independent source; Ohm's Law; Source Transformation; Series and Parallel Circuits, Kirchoff's laws, Nodal and Mesh Analysis, Star-Delta conversion; Network Theorems: Superposition Theorem, Thevenin Theorem, Norton Theorem and Maximum power transfer theorem.
Representation of AC voltage and currents: Different forms of emf equations, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor; Phasor diagram; Single-phase AC circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel) and their phasor representation; Impedance and Admittance; Complex power; Three phase balanced circuits. Step response, Impulse response and Pulse response of R-L, R-C, R-L-C Circuit.
Magnetic Circuit: MMF, Flux, Reluctance, Inductance, Self-inductance, Mutual inductance, Coupling coefficient, Dot convention in coupled coils, Electrical Equivalents of Magnetically Coupled Circuits, Magnetic materials, B-H curve of magnetic materials, Laws of Electromagnetism.

10. Electrical Machines

Construction and operating principle of single-phase transformers, Types, EMF equation, Equivalent circuit, Phasor diagram, Open circuit and Short circuit tests, voltage regulation, losses and efficiency, polarity test, back-to-back test, separation of hysteresis and eddy current losses; Three-phase transformer - construction, types of connection; Autotransformers - construction, principle, applications, comparison with two winding transformer, conversion of two winding transformer to autotransformer.
Basic construction of a DC machine, Methods of excitation, separately excited, shunt, series and compound generators, Voltage build up, Armature winding- Lap and Wave winding, EMF equation, Torque equation, Armature reaction-cause, effect & remedial measures, Operating characteristics of DC Generator and DC Motor, Losses and efficiency of DC machines, Starting, braking and speed control of DC motor.
Poly-phase induction Machines: Construction, Principle of operation, Types – Squirrel cage and Slip ring, Slip, Equivalent circuits, Comparison with transformer, Expression for output power and torque, Slip,torque characteristics, Starting, braking and speed control of induction motor; Construction and starting of single phase induction motor.
Synchronous machines: Operating principle, Types – cylindrical and salient pole, EMF equation, Phasor diagram, Power flow equation, Open circuit and short circuit characteristic, Synchronization of two alternators, Starting of synchronous motor, Hunting in synchronous motor.

11. Power System

General layout of a typical coal fired power station, Hydro-electric power station, Nuclear power station, their components and working principles, comparison of different methods of power

generation; Introduction to Solar & Wind energy system; Inductance and Capacitance of a single phase and three phase symmetrical configurations line; Skin effect.
Insulators: Types, potential distribution over a string of suspension insulators; String efficiency and methods of increasing string efficiency; Short, medium & long lines and their representation; ABCD constants, Voltage regulation, Ferranti effect.
D.C Distribution Systems: Classification of distribution systems, voltage drop calculations in DC distributors for the following cases: Radial DC distributor fed one end and at the both the ends (equal unequal voltages) and ring main distributor.
A.C Distribution Systems: Voltage drop calculations in A.C. distributors for the following cases: Power Factors referred to receiving end voltage and with respect to respective load voltages. Underground Cables: Types, different layers; Skin effect; Various line faults associated with transmission and distribution.

12. Power Electronics

Basics of power diodes, power transistors, power MOSFETS, IGBT and GTO. PNPN devices: Thyristors, brief description of members of Thyristor family with symbol, V-I characteristics and applications. Two transistor model of SCR, SCR turn on methods, switching characteristics, gate characteristics, ratings, SCR protection, series and parallel operation, gate triggering circuits, different commutation techniques of SCR.
Phase controlled converters: Principle of operation of single phase and three phase half wave, half controlled, full controlled converters with R, R-L and RLE loads, effects of freewheeling diodes and source inductance on the performance of converters. Single phase and three phase dual converters.
DC-DC converters: Principle of operation, control strategies, step down & step up choppers, types of choppers circuits based on quadrant of operation, multiphase choppers. Cyclo-converter: Principle of operation and schematic.
Inverter: Principle of operation, classification of inverters based on nature of input source, wave shape of output voltage, method of commutation & connections. Principle of operation of single phase and three phase bridge inverter with R and R-L loads, performance parameters of inverters, methods of voltage control and harmonic reduction of inverters. Applications: Speed control of AC & DC motors, HVDC transmission, VAR controller.

13. Thermo-Fluids Engineering

Basic Fluid and Thermodynamics Properties, State; Close and open systems; Thermal properties: Temperature and the Zeroth law; Work, heat and internal energy; Process and cycle; Ideal gas and kinetic theory; Equation of state of ideal gas; Fluid properties and thermodynamic properties of air, water and refrigerants, Viscosity and shear stress; Compressibility; Newtonian and Non-Newtonian fluids; Fluid pressure; Pascal's law; Pressure-height relation.
Steady and unsteady; Uniform and non-uniform; Incompressible and compressible; Laminar and turbulent; Continuity and Bernoulli's equation; Streamline and stream-tube; Flow; Momentum equation, The three basic modes heat transfer and their governing equations.
Conservation of mass and control volume; The first law for a control mass undergoing a process cycle; Internal energy and enthalpy; Constant volume and constant pressure specific heats; The first law for a control volume; The steady-flow energy equation and its applications.
Heat engines and refrigerators; The second law of thermodynamics; Reversible and irreversible processes; Forward Carnot cycle; Rankine cycle; Thermodynamic temperature

scale; Inequality of Clausius; Entropy and irreversibility; T-s diagram; The second law for a control mass/control volume; Isentropic efficiency.