नामांकन प्रकोष्ठ
ADMISSION CELL

झारखण्ड केन्द्रीय विश्वविद्यालय
CENTRAL UNIVERSITY OF JHARKHAND
(भारतीय संसद के अधिनियम 2009 द्वारा स्थापित)
(Established by an Act of Parliament of India in 2009)
Homepage: http://www.cuj.ac.in

Ref. No.: CUJ/Adm. Cell/2025/14/0 4

Date - 12 / 01 / 2026

NOTICE

Subject: <u>Syllabus for CUJRET–2025</u>

With reference to **Notice No. CUJ/Adm. Cell/2025/14/320 dated 23.12.2025**, it is hereby informed that the **syllabus for CUJRET–2025** is enclosed herewith.
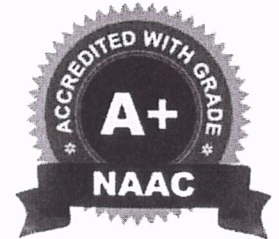
All applicants are advised to **carefully read the syllabus** and prepare accordingly for the entrance test. Compliance with the prescribed syllabus is mandatory.

This notice is issued for information and necessary action by all concerned.

(Prof. G. P. Singh)
Chairman, Admission Cell
अध्यक्ष, नामांकन प्रकोष्ठ
CHAIRMAN, ADMISSION CELL
झारखण्ड केन्द्रीय विश्वविद्यालय
CENTRAL UNIVERSITY OF JHARKHAND

Copy to:

- PS to Hon'ble Vice Chancellor
- PS to Registrar
- Dean, Academic Affairs
- Dean, R&D
- Deans of All Schools
- Department Heads/Coordinators
- Notice Board
- University Website

ACCREDITED WITH GRADE
A+
NAAC

Part A
Research Methodology

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Research Methodology (Common Paper)

CUJRET-2025

1. Research: Meaning and Types

Meaning, objectives, and characteristics of research, **Types of research**: Basic & Applied, Qualitative & Quantitative, Descriptive, Analytical, Exploratory, Experimental and **Scientific method and research process**

2. . Data Collection Methods

Primary data: Questionnaire, Interview, Observation, Schedule, **Secondary data**: Books, journals, reports, databases, **Tools of data collection and measurement scales**

3. Statistical Methods

Measures of central tendency (Mean, Median, Mode), Measures of dispersion (Range, SD, Variance), Correlation and regression, Hypothesis testing, Chi-square test, t-test, ANOVA (basic understanding)

4. Research Ethics

Ethics in research, Plagiarism: meaning, types, and prevention, Copyright and intellectual property rights, Research misconduct
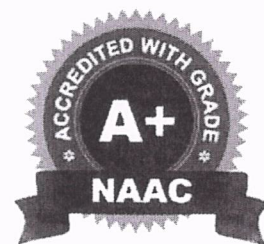
5. ICT and Research Tools

Use of computers in research, Online databases (Google Scholar, Scopus, Web of Science), Basics of plagiarism detection software

6. **Reasoning**: Verbal and Non-verbal

7. **Mathematical aptitude**

8. **English Communication**

Part B

Subject Specific Knowledge

Syllabus: PhD (CSE)

Discrete Mathematics: Discrete Mathematics: Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Monoids, Groups. Graphs: connectivity, matching, coloring. Combinatory: counting, recurrence relations, generating functions.

Digital Logic: Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Computer Organization and Architecture: Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining, pipeline hazards. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).

Programming and Data Structures: Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

Algorithms: Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph traversals, minimum spanning trees, shortest paths

Theory of Computation: Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and contex-free languages, pumping lemma. Turing machines and undesirability.

Operating System: System calls, processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU and I/O scheduling. Memory management and virtual memory. File systems.

Databases: ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

Computer Networks : Concept of layering: OSI and TCP/IP Protocol Stacks; Basics of packet; Data link layer: framing, error detection; Routing protocols; Fragmentation and IP addressing, IPv4, CIDR notation; Transport layer: flow control, UDP, TCP, sockets; Application layer protocols.

Department of Metallurgical and Materials Engineering

Syllabus of the written test for PhD admission in Metallurgical and Materials Engineering

A basic knowledge of Metallurgical and Materials Engineering is expected from the candidate. For the simplicity of candidates, some of the key topics (as part of the syllabus) are given below.

Crystalline Structure and Imperfections: Crystalline and noncrystalline materials, Crystal structures in metals and ceramics, Miller indices, Structure of surfaces and interfaces, nano-crystalline and amorphous structures, Point defects, Line defects, Interfacial defects, Bulk or volume defects, elements of dislocation theory, types of dislocations.

Diffusion mechanisms: Steady and non-steady state diffusion, Factors that influence diffusion, Fick's laws.

Basics of physical and mechanical metallurgy: crystal structure, phase diagram, Gibbs Phase Rule, Interpretation of binary phase diagrams, types of phase transformations, pearlitic, bainitic and martensitic transformations, heat treatments of steels, strengthening mechanisms in solids, engineering stress-strain curve, elastic deformation, plastic deformation, true stress – strain curve, factors affecting tensile properties, hardness, ductile - brittle transition, fatigue testing – S-N curves, mechanisms of fatigue in metals, factors affecting fatigue properties, creep testing – typical creep curve, mechanisms of creep deformation in metals, factors affecting creep behaviour, applications of metals, ceramics, composites and Polymers.

Basics of extractive metallurgy: calcination, roasting, smelting, refining processes, free energy-temperature diagrams (Ellingham diagrams) for the formation of oxides, sulphides, and chlorides and their applications.

Basics of powder metallurgy: mechanical alloying process, sintering phenomena and mechanisms involved.

Basics of foundry technology: mould, pattern and core, materials used to prepare them, Casting and solidification, different casting practices, mould and casting defects, remedies.

Corrosion and protection: forms of corrosion- Galvanic, Crevice, Pitting, intergranular, stress corrosion cracking, corrosion fatigue, hydrogen embrittlement. Importance, properties and application of organic coatings and metallic coatings.

Material characterisation: Basic principles and applications of X-ray diffraction, scanning electron microscope, transmission electron microscope (TEM).

Semiconductor: Basics of Semiconductor, Intrinsic and Extrinsic semiconductor, carrier transport, electron and hole generation/recombination, Band theory, P-N junctions.

Electrical and Magnetic Properties of Materials: Electrical conduction, Dielectric Behaviour, Ferroelectric, Piezoelectric Behaviour and magnetic properties.

Department of Civil Engineering

Syllabus for PhD entrance test

Structural Engineering

Water Resources Engineering (25%)

Properties of fluids, fluid statics; Continuity, momentum and energy equations and their applications. Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, hydraulic jump, uniform flow.

Hydrologic Processes – Precipitation, Infiltration, Evaporation and Transpiration, Hydrograph analysis – Baseflow separation, Separation of losses and rainfall excess, Introduction to unit hydrograph, Flood routing – Hydrologic and hydraulic routing, Hydrologic simulation models – steps in watershed modelling.

Principles and methods of irrigation, surface and pressurized irrigation systems, crop water requirement and irrigation scheduling, soil–water–plant relationships, irrigation efficiencies, and on-farm water management. basics of hydraulics and open channel flow, canal and field channel design.

Governing equations for groundwater flow - Steady State and transient flow, Transport of contaminants in groundwater processes, governing equations. Concepts and foundations of remote sensing- Energy sources and radiation principles - Spectral reflectance of vegetation, soil and water. GIS - Definition,

Spatial and attribute data, Components of GIS, DBMS – Geospatial data representation (Raster, Vector).

Transportation Engineering (25%)

Introduction to transportation modes – classification of roads - road patterns - planning surveys - saturation system – Highway planning in India – Highway alignment – requirements for an ideal alignment - factors controlling alignment – Highway economics

Highway Geometric design - cross-section elements – camber - sight distance - design of horizontal alignment – super-elevation - transition curves – widening of pavement – setback distance - curve resistance - vertical alignment – grade compensation

Traffic characteristics - Road user and vehicular characteristics - traffic studies and surveys – speed studies, volume studies, parking studies, accident studies – traffic signs and markings - Signal design by Webster's method - Types of intersections - Highway capacity

Material requirement for pavements – soil, aggregates, bitumen – properties - material testing and specification – Marshall's mix design – pavement construction and maintenance

Highway pavement design - Design factors - design of flexible pavement: CBR method – stresses in rigid pavements - design of rigid pavements: IRC method – joints in rigid pavements

Urban Transportation Planning: Urban form indicators - land use models - mobility and accessibility - effects of improper urbanization - travel demand models: trip generation, trip distribution, modal split, trip assignment - transit oriented development - Mobility as a Service

- shared mobility

Geotechnical Engineering (25%)

Geotechnical Engineering: Index and engineering properties of soil, compaction and consolidation- shear strength of soils-Site Investigations: Need – Methods of soil exploration – Standard penetration test, cone penetration test, Plate load test – Shallow Foundations: Types-Choice of Foundation-Location of Depth-Safe bearing capacity-Terzaghi -Allowable settlement of structures- contact pressure-immediate settlements- Pile Foundations: Classification of piles– selection of Pile-Load carrying capacity of piles based on static pile formulae in different soils.

Ground improvement techniques: Problematic Soil and Improvement Techniques: Role of ground improvement in foundation engineering – methods of ground improvement –Selection of suitable ground improvement techniques based on soil conditions. Mechanical modification: Shallow compaction and deep compaction- Chemical stabilization

Geosynthetic Reinforcements: Manufacturing of geosynthetics- Types and functions of reinforcements: Metal strips, Geo textiles, geogrid, geocell. Reinforced earth wall – Mechanism – simple design – applications of reinforced earth wall.

Environmental Engineering (25%)

Water Treatment: Drinking water standards, basic unit operations and unit processes for surface water treatment. Advanced water treatment methods including desalination, membrane filtration, ion-exchange, adsorption and electrodialysis.

Wastewater Collection and Treatment: Sewage and sewerage system, quantity and characteristics of wastewater. Primary and secondary treatment of wastewater, sludge disposal, biological nutrient removal (both nitrogen and phosphorous), effluent discharge standards. Advanced wastewater treatment technologies including Up-flow anaerobic sludge blanket reactors (UASB), sequential batch reactors (SBR), and Membrane bioreactors (MBR). Identification and classification of bacteria, bacterial metabolism, growth kinetics, Monod equation, substrate and food mass balance, microbiology of domestic wastewater treatment.

Air Pollution: Types of air pollutants, their sources and impacts, air pollution meteorology, emission inventory, measurement and monitoring of air pollutants, air quality standards and legislations, statistical techniques in air quality data analysis and air quality indices, air pollution modelling, design of air pollution control equipment (both particulate and gaseous), indoor air pollution.

Municipal Solid Waste: Characteristics, generation, collection and transportation of solid wastes, engineered systems (both aerobic, anaerobic and hybrid) for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

Noise Pollution: Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

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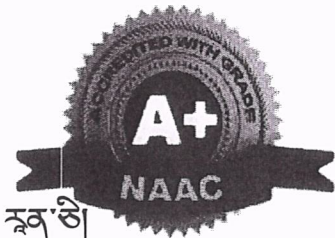
DEPARTMENT OF FAR EAST LANGUAGES

བོད་ཡིག་སྐེ་ཚན། དབུས་གཞུང་རྟོར་འཛྲ་གཙུག་ལག་སློབ་གཉེར་ཁང་། རྣ་ཅི།

SCHOOL OF LANGUAGES

Ph.D. in Tibetan Language & Culture

Part B shall consist of fifty (50) multiple-choice questions (MCQs) designed to assess the candidate's subject-specific knowledge. The questions will cover Classical and Modern Tibetan language, including grammar, syntax, and usage; Tibetan linguistics; Tibetan literature and cultural traditions; and Tibetan Buddhism, encompassing its philosophical schools, textual traditions, and historical development. In addition, the section will include questions on general knowledge related to Tibet and the Indian Himalayan regions, with particular emphasis on their history, culture, society, religious and linguistic heritage.

Sample question

Q1. The Classical Tibetan Grammar "Sumcu-pa" deals with the description about:
    A) Letters   B) Genders   C) Particles   D) Prefixes

Q2. The Mahavyutpatti (Bye-brtag-tu rtogs-par byed-pa chen-po), *The Great Volume of Precise Understanding or Essential Etymology*, was compiled in Tibet during the

    A) 8-9 Century   B) 7-8 Century   C) 12-13 Century   D) 10-11 Century

Q3. Who is the first religious king of Tibet?
    A) Songtsen Gampo B) Trisong Detsen   C) Tri Ralpachen   D) Lang Darma

Q4. Where the largest Tibetan monastery located in Indian Himalayas?
    A) Ladakh   B) Lahaul-Spiti   C) Darjeeling D) Tawang

Remote Sensing and Image Processing

Electromagnetic radiation (EMR): wavelength regions and their applications, atmospheric windows, and interaction of EMR with the atmosphere and Earth's surface; spectral response patterns. Satellite orbits and platforms, including geostationary and sun-synchronous satellites. Sensor resolutions: spectral, spatial, temporal, and radiometric. Earth resource satellite sensors and advances in remote sensing technologies, including thermal remote sensing, RADAR (microwave), hyperspectral sensing, and LiDAR. Fundamentals of digital image processing, radiometric enhancement, spatial enhancement, spectral enhancement, image classification techniques, and accuracy assessment. Overview of Earth resource satellite missions (Indian and foreign) and major remote sensing agencies.

Cartography, GNSS, and Photogrammetry

Introduction to cartography; maps and scale; important map projections; map generalisation - elements, control, and classification (semantic and geometric). Introduction to the Global Positioning System (GPS), GPS segments, and positioning types, including absolute and differential positioning; geopositioning concepts. Overview of Global Navigation Satellite Systems (GNSS) including NAVSTAR, GLONASS, GALILEO, and IRNSS. Photographic systems, cameras, filters, and films, image resolutions, aerial photography and fundamentals of digital photogrammetry, Digital Elevation Models creation & Orthorectification.

Geographic Information System (GIS)

Basic concepts of spatial information; spatial versus non-spatial data; Geographic Information System (GIS) and its components. Spatial data models including raster and vector data structures; database design, data editing, and topology creation in GIS. Linkage between spatial and attribute (non-spatial) data; integration of raster and vector datasets; feature-based topological functions. Interactive data exploration; vector data queries and attribute data queries; raster and vector data analysis, and fundamentals of spatial modelling.

Geospatial Computing, Web GIS, and Programming

Operating systems, databases, and Internet and web technologies; web standards and data formats including HTML and XML, and geospatial helper applications. Programming concepts using Java and C++, databases and the web, Internet map servers, and Web GIS architectures. Mobile mapping concepts and applications. Introduction to cloud-based geospatial platforms and programming environments, including Google Earth Engine APIs, Python, and R (CRAN) applications.

Earth System Processes and Remote Sensing Applications

Remote Sensing (RS) applications in agriculture, forestry, land use and land cover mapping, water resources, cryosphere studies, and environmental monitoring; applications in disaster management, including floods, landslides, cyclones, forest fires, and droughts, and in Environmental Impact Assessment (EIA). Components of the Earth system, internal structure of the Earth, lithosphere, hydrosphere, biosphere, and atmosphere; plate tectonics and its link to earthquakes and volcanic activity; rock types, weathering, erosion, and major landforms of fluvial, aeolian, glacial, and marine origin. Fundamentals of water resources, including the hydrological cycle, surface and groundwater, aquifers, watersheds and watershed management, and agro-climatic regions. Environment and ecology, sustainable development, global warming, climate change, future climate projection, greenhouse gases, recent major disaster events, and the role of disaster management agencies.

Energy Engineering

Section 1: Engineering Mathematics

Calculus: Functions of single variable, Limit, continuity and differentiability, Taylor series, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems.

Differential Equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy's and Euler's equations, Initial and boundary value problems, Laplace transforms, Solutions of one-dimensional heat and wave equations and Laplace equation.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions, linear regression analysis.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations. Integration by trapezoidal and Simpson's rule. Single and multi-step methods for numerical solution of differential equations.

Section 2: Heat Transfer

Equation of energy, steady and unsteady heat conduction, convection and radiation, thermal boundary layer and heat transfer coefficients, boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations; design of double pipe, shell and tube heat exchangers, and single and multiple effect evaporators.

Section 3: Mass Transfer

Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage-wise and continuous contacting and stage efficiencies; HTU & NTU concepts; design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption, membrane separations (micro-filtration, ultra-filtration, nano-filtration and reverse osmosis).

Section 4: Electric circuits

Network Elements: Ideal voltage and current sources, dependent sources, R, L, C, M elements; Network solution methods: KCL, KVL, Node and Mesh analysis; Network Theorems: Thevenin's, Norton's, Superposition and Maximum Power Transfer theorem; Transient response of DC and AC networks, sinusoidal steady-state analysis, resonance, two port networks, balanced three phase circuits, star-delta transformation, complex power and power factor in AC circuits.

Section 5: Power Systems

Basic concepts of electrical power generation, AC and DC transmission concepts, Models and performance of transmission lines and cables, Economic Load Dispatch, Power factor correction

Section 6: Fuels and Combustion

Types of fuels, solid, liquid and gaseous fuels, History of solid liquid and gaseous fuels, production, present scenario and consumption pattern of fuels, fundamental definitions, properties of solid, liquid fuels and their measurement techniques.

Section 7: Energy Resources and Conversion Technologies

Principles of Sustainability: Definition and pillars of sustainability (environmental, social, economic), Sustainable Development Goals; Role of energy in sustainable development; Climate change and energy: Greenhouse gas emissions and global warming; Climate change mitigation and adaptation; Clean Development Mechanism.

Fossil energy resources: R/P ratio, estimation of reserves, unconventional fossil resources (coal bed methane, shale gas, gas hydrates, frozen methane), peak oil theory.

Nuclear energy resources: Energy-mass relation, nuclear reaction conservation laws, binding energy and Q-values, radioactive decay, fission and fusion.

Solar thermal systems: Solar radiation distribution and measurement, solar geometry, optical efficiency, thermal efficiency, energy conversation for solar thermal collectors, flat plate collectors, evacuated tube collectors, solar air heaters, concentrating collectors.

Solar photovoltaic (PV) systems: I-V characteristics, efficiency, fill factor, series and parallel connections, sizing of PV systems (load factor, days of autonomy, battery size, inverter size, PV array size), maximum power point tracking.

Biomass: Biomass resources, biomass composition, characterisation, conversion methods (pyrolysis, gasification, steam reforming), biofuels.

Wind energy conversion systems: Wind resource analysis, types and characteristics of wind turbines, Betz limit, wind turbine motor design considerations, blade profile, wind energy generators.

Hydropower: Hydro resources, hydro power plants, turbines (Pelton, Kaplan, Francis), small hydro systems.

Other non-conventional resources: Geothermal energy, Marine energy (wave, tidal)

Section 8: Energy Storage, Economics, Environment, and Efficiency

Energy storage systems: Batteries (capacity, C-rate, state of charge, state of health, depth of discharge, energy and power densities); conservation of energy and mass for thermal energy storage, pumped hydro storage, Hydrogen Energy, and compressed air storage; charging, discharging, and roundtrip efficiency.

Economic analysis of energy systems: Simple Payback Period, Time Value of Money, Discount rate, Present Worth Factor, Capital Recovery Factor, Life Cycle Costing, Internal Rate of Return, Net Present Value, Annual Worth, Cost of Saved Energy, Levelized Cost of Energy.

Environmental impacts of energy use: Air pollution (SO_x, NO_x, CO, particulates), greenhouse gas emissions and their sources, emission factors and inventories.

Energy management: Energy auditing (methodology, analysis of past trends plants data), electrical systems (demand side management, power factor correction), motor efficiency testing, energy efficient motors, lighting (lighting levels, efficient options, fixtures, daylighting, timers), thermal and mechanical systems (insulation, compressors, pumps, boiler, heating and cooling systems), Energy policy.