PhD Examination pattern

1. The Entrance Test syllabus shall consist of 50% of research methodology, and 50% shall be subject specific.
2. Total 100 multiple choice question to be asked (50 multiple choice from Research Methodology and 50 multiple choice questions from the concern subject).
3. Total marks will be 100.
4. Students who have secured 50 % marks in the entrance test are eligible to be called for the interview

Syllabus

Research Methodology

Meaning of Research Meaning, aims, nature and scope of research, Prerequisites of research Types of research. Research Problem Meaning of research problem Sources of research problem Characteristics of a good research problem Hypothesis: Meaning and types of hypothesis. Research proposal or synopsis. Methods of Research Studies Qualitative and Quantitative research methods. Review of Related Literature Purpose of the review. Identification of the related literature. Organizing the related literature. Data Collection (Sampling) Population and sample, Characteristics of a good sample Techniques of sample Selection Types of data in research Tools of Data Collection Characteristics of good research, Types of data collection tools. Descriptive Statistics Tabulation, Organization, and Graphical Representation of Quantitative data Measures of Central Tendencies: Mean, Median, Mode Measures of Variability: Range, Quartile Deviation, Standard Deviation, Research Report Format of the research report Style of writing the report

Syllabus for PhD entrance exam for Academic Year 2022-23

Ph.D. in Metallurgical and Materials Engineering

Engineering Mathematics**:** Linear algebra: Matrix algebra, Eigen values and Eigen vectors. Calculus: Functions of single variable, limit, continuity, differentiability, integration, maxima and minima. Differential equations: first order equations, higher order equations. Vector calculus: Gradient, divergence and curl, line, surface and volume integrals, Stokes, Gauss and Green's theorem.

Thermodynamics and kinetics: First, second and third law of thermodynamics, basic thermodynamics functions, free energy, entropy, thermodynamic relations, applications of Maxwell relations, Activation energy.

Atomic structure and bonding: electrons in atoms, types of bonding-ionic bonding, covalent bonding, metallic bonding and secondary bonding.

Structure of crystalline solids: crystalline and non-crystalline materials, geometry of crystals, Miller indices, crystal structures in metal and ceramics, solid solutions.

Defects in solids: Point defects, line defects and dislocations, interfacial defects, volume defects, significance of defects in materials.

Diffusion: Diffusion: Fick's 1^{st} and 2^{nd} laws of diffusion, factors influencing diffusion.

Phase Diagram: Definitions and basic concepts, nucleation and growth, Hume-Rothery's rule, Gibbs phase rule, interpretation of binary phase diagram, Iron-Carbon phase diagram, types of phase transformation.

Alloys: Ferrous and nonferrous alloys.

Heat treatment of steel: Heat treatment process, annealing, tempering, transformations on heating and cooling, Hardening, factors in heat treatment

Mechanical properties of materials: Elastic deformation, plastic deformation, interpretation of stress-strain curve, engineering stress-strain curve, True stress-strain curve, factors affecting tensile properties, Fracture, factors affecting fatigue properties, typical creep curve, factors affecting creep behavior, slip system.

Electrical Properties of Materials: Electrical conduction, Semiconducting nature of materials, Dielectric behavior of materials, Ferroelectric and Piezoelectric behavior of materials.

Thermal Properties of materials: Heat capacity, Thermal expansion, Thermal conductivity, Thermal stresses

Magnetic Properties of materials: Basic concepts, Diamagnetism, Paramagnetism, Ferromagnetism, Antiferromagnetism, Ferrimagnetism, Influence of temperature, Domains and Hysteresis.

Optical Properties of materials: Interaction of light with solids, Optical properties of metals and non-metals

Materials Characterization**:** X-ray diffraction, Electron microscopy: SEM, TEM, Scanning probe microscopy: STM and AFM. Spectroscopy technique: Raman spectrocopy, FTIR spectroscopy, UV spectroscopy, Photoluminesce, TGA, DTA and DSC.

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PhD. in Energy Engineering

Basics of Renewable Energy, Solar Energy, Material Science, Bioenergy, Alternative Fuels, Solar Photovoltaics,

Control Systems, I. C. Engines

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Ph.D. in Geoinformatics

Electromagnetic Radiation (EMR): Wavelength regions and their applications Atmospheric windows, Interaction of EMR with atmosphere & Earth's Surface, Spectral response pattern, Geostationary & Sun Synchronous Satellites, Resolutions- Spectral, Spatial, Temporal and Radiometric, Earth Resource Satellite Sensors, Advances in remote sensing technologies: Thermal, RADAR, Microwave, Hyperspectral, Lidar etc.

Introduction to cartography, Map and Scale, Important Map Projections, Generalization- Elements, Control & Classification (Semantic & Geometric), Introduction to Global Positioning System, GPS Segments, GPS Positioning Types- Absolute, Differential, Geopositioning, GNSS: NAVSTAR, GLONASS, GALILEO etc

Basic concepts about spatial information, Spatial vs. non-spatial data, Components of GIS, Spatial data models – Raster and Vector, Data base design - editing and topology creation in GIS, Linkage between spatial and non-spatial data, Integration of Raster & Vector Data, Feature Based Topological functions, Interactive Data Exploration, Vector Data Query, Attribute Data Query.

Remote sensing systems, remote sensing sensors, Electromagnetic Radiation, Interaction of EMR with atmosphere & Earth's Surface, Spectral properties of major elements, Photographic System, Cameras, Filters & Films, Resolutions, Earth Resource Satellite, Satellite missions (Indian and Foreign), Major Remote Sensing Agencies, Fundamental of Digital Image Processing, Geographic Information System (GIS)& its components, Application of Geoinformatics. Remote Sensing (RS) Applications in Agriculture, Forestry, Land cover/ Land use, Water resources, cryosphere, disaster management- floods, landslide, cyclone, forest fire, drought & Environmental Impact Assessment (EIA)

Components of Earth System, Internal Structure of Earth, Lithosphere, Biosphere, Hydrosphere & Atmosphere, Plate Tectonics Theory and Its Relationship to Earthquakes and Volcanic Activity, rock types and structures, weathering and erosion, landforms of Fluvial, Eolian, Glacial and Marine origin. Water resources, Hydrological Cycle, Watershed and Watershed management, Groundwater, Aquifers, Agro-climatic regions, Forestry and ecology. Environment, Sustainable development, Global warming, Climate change, GHGs, Disaster Management, Recent disaster events, Major disaster management agencies.

Operating System, Databases, Internet and Web technologies, HTML, XML, Data formats, helper applications, Java, databases and the Web, Internet Map Servers, Web GIS Architectures, C++, JAVA, PYTHON applications.

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Ph.D. in Tibetan Language & Culture

Research methodology, Tibetan language, Tibetan Linguistics, Literature and Culture, Tibetan Buddhism & Linguistics.

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Ph.D. in Civil engineering (Area of research : Water resources engineering / Transportation engineering)

Water Resources Engineering: Fluid Mechanics-Continuity, Momentum and Energy equations- Potential flow- Laminar and Turbulent flow, Flow in Pipes -Boundary layer- Hydraulics -Energy depth relations - Specific Energy, Gradually varied flow, Unsteady free surface flow, Hydrologic Cycle-Precipitation, Evaporation, Watershed management, Flood routing, Surface run-off models-Well hydraulics-Hydrograph analysis-Irrigation Duty, Delta, Crop water requirements, Design of lined and un-lined canals, Groundwater occurrence; Darcy's Law, steady and unsteady flow in confined and unconfined aquifers, groundwater exploration techniques; overview of groundwater recharge estimation and artificial recharge techniques, Soil, water and wind erosion, Engineering Measures for Soil and Water Conservation, Biological and Engineering measures to control erosion.

Transportation Engineering: Urban transportation problems, travel demand estimation, Trip Generation & distribution models, mode split analysis, traffic assignment, corridor identification, stated preference methods, components of traffic system, traffic studies, microscopic & macroscopic traffic stream models, highway capacity, geometric design of traffic flow systems, design of at grade intersections, parking facilities, bicycle & pedestrian facilities-stresses in flexible & rigid pavements, design of flexible & rigid pavements, highway construction equipment, pavement construction, Evaluation of pavements, Pavement Maintenance.

Environmental Engineering: Water and Wastewater-Water standards-Surface water treatment-Distribution of water- Sewage and Sewerage treatment-Primary, secondary and tertiary treatment of waste water-Effluent discharge standards- Air pollution-air quality standards- Noise pollution-control and measurement-Municipal solid waste- characteristics-collection and transportation-Engineered systems for solid waste management.

Geotechnical Engineering

Engineering properties of soils- Compaction and Consolidation-Foundation engineering- types of foundations – Shallow foundations -bearing capacity theories-Deep foundations; Earth pressure theories and earth retaining structures; Soil dynamics- free and forced vibrations; Rock mechanics-rock mass classification-laboratory and In-situ testing- foundations on rock-tunnelling. Soil exploration- sampling, drilling, in-situ tests-bore logs.

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