INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams

Subject Code: DSC-501 **Course Title**: Hydrologic Safety Evaluation of Dams

L-T-P: 2-1-0 **Credits:** 3 **Subject Area:** PCC

Course Outlines: Basic concepts of hydrological safety evaluation, Design flood estimation for gauged and ungauged catchments using hydro-meteorological approach; Design storm analysis; Design floodestimation for gauged and ungauged catchments using statistical analysis, Reservoir routing and spillway capacity determination, hydrologic and hydraulic channel routing; Dam breach modelling; preparation and revision of reservoir rule curves, Hydrological safety under changing climate.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams

Subject Code: DSC-503 **Course Title**: Reservoir Sedimentation and Silt Management

L-T-P: 2-0-2 **Credits:** 3 **Subject Area:** PCC

Course Outlines: Need of Silt Management in the Reservoir; Erosion and Sedimentation in Drainage Basins; Catchment area Development; Sediment Delivery Ratio; Reservoir Sedimentation Process; Incipient Condition and Sediment Transport; Sediment Yield; Trap Efficiency; Distribution of Sediment in a Reservoir; Sediment Measurement and Monitoring; Mathematical and Physical Modelling; Mitigation of Reservoir Siltation; Structural and Non-Structural Adaptive Measures; National and International Practices of Reservoir Sediment Management.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams

Subject Code: DSC-505 **Course Title**: Seepage through Dams

L-T-P: 2-0-2 **Credits:** 3 **Subject Area:** PCC

Course Outlines: Importance of seepage in dam safety and rehabilitation, Flow through porous media, Darcy's law, seepagevelocity, Dupuits theory, Phreatic lines, free surface and seepage discharge. Flow nets, Boundary conditions, Numerical techniques; Measurement of seepage, seepage control, Seepage detection, control and monitoring, Selection of core materials, Dam filters and Design criteria, use of geo-textiles, stability conditions, Drainage of embankments, Dam Grouting, Design and installation of grout curtains.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams

Subject Code: DSC-507 **Course Title**: Geotechnical Safety Evaluation of Dams

L-T-P: 2-0-2 **Credits:** 3 **Subject Area:** PCC

Course Outlines: Basics of Soil Mechanics; Basics of Rock Mechanics; Strength Behavior of Intact and Jointed Rocks: Mohr envelopes, Linear and Non-Linear Strength Criteria; Geo-mechanical Modeling and Geological Hazards: Geological discontinuities, Classification Systems; Bearing capacity; Reservoir rim slopes; Retaining structures: Earth pressure theories; Design principles of gravity and embankment dams; Probabilistic methods in Geotechnical Engineering: Probabilistic analysis of slopes, foundations and retaining structures; Hazard, Vulnerability and Risk; Software analysis: Different software and their applications in designs.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams

Subject Code: DSC-509 **Course Title:** Seismic Hazard Assessment for Dams

L-T-P: 2-0-2 **Credits:** 3 **Subject Area:** PCC

Course Outlines: Introduction to seismology; Causes of earthquakes, their classifications & their effects on Dam& structures; Plate tectonics; Internal structure of earth; Body & surface waves; Seismic phases; Intensity & magnitude, Principles of seismograph; networks; Probabilistic & deterministic Seismic Hazard Assessment; Earthquake occurrence models; maximum credible earthquake; design basis earthquake; Frequency magnitude relationship; Poissonian & Non Poissonian models; GMP equations; Return periods; Geophysical Methods: Seismic; Well logging; SASW & MASW methods; GPR; bedrock profiling; Site Effects.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams

Subject Code: DSS-501 **Course Title**: Sustainable Tourism around Dams

L-T-P: 1-0-2 **Credits:** 2 **Subject Area:** SSC

Course Outlines: Concept of sustainability and sustainable development. Concept of Sustainable Tourism around dams, issues, challenges and limitations. The current state of tourism around dams in India, UNWTO. The Framework Convention on Tourism Ethics, SF-MST, India's and different state's tourism policy, Socio-cultural problems and understanding feasibility assessment for dam tourism and its key components. Highlight best case studies and effective strategies for implementing agencies to enhance tourism around dams.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams

Subject Code: DSS-502 **Course Title:** Stakeholder Management of Dams and Large Infrastructure Projects

L-T-P: 1-1-0 **Credits:** 2 **Subject Area:** SSC

Course Outlines: Relevance of stakeholder management in dam projects; Variety, variability & complexity of issues; Project impediments: social, environmental, legal, and associated issues of financing, contracts, resource management; Identification and classification; Networked effect; Stakeholder model for dam projects; Two-way process of stakeholder relationship; Level of relationship, Measurement of stakeholder value; Social & environmental safeguards; Stakeholder oriented organizations.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams (ICED)

Subject Code: DSL-501 **Course Title:** Assessing and Managing Risks Associated with Dams

L-T-P: 2-1-0 **Credits:** 3 **Subject Area:** PEC

Course Outlines: Overview of Dams' Risk Assessment and Management, Basis for a Risk-Informed Dam Safety Management Program for India, Initial Risk-Based Screening, Identification of Failure Modes, Semi-Quantitative Risk Analysis, Risk Evaluation (Quantitative Risk Assessment), Risk Governance, Institutional Framework in Dam Safety, National and International Guidelines, Dam Insurance Aspects.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams (ICED)

Subject Code: DSL-502 **Course Title:** Disaster Management and EAPs for Dams

L-T-P: 2-0-2 **Credits:** 3 **Subject Area:** PEC

Course Outlines: Overview of Disaster Management, Flood Risk Associated with Dams, Flood Mapping, Disaster Mitigation, Remote Sensing and Geographic Information Systems (GIS) applied to Emergency Preparedness and Flood Mapping, Dam Hazard & Vulnerability Classification Framework in India, Institutional Framework for EAP and Stake Holder Consultation under Dam Safety Act, Emergency Action Plans Preparation & Implementation.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams (ICED)

Subject Code: DSL-503 **Course Title:** Dam Safety Surveillance, Instrumentation and Monitoring

L-T-P: 2-1-0 **Credits:** 3 **Subject Area:** PEC

Course Outlines: Dam Safety Inspection Program, Documenting an Inspection, Comprehensive Dam Safety Evaluation, Instrumentation System Planning, Seismological and Hydro-Meteorological Instrumentation, network design, Data Collection and time and frequency domain analysis of data, Forecasting, Automation of Instrumentation, Institutional Framework for Dam Instrumentation under Dam Safety Act.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams (ICED)

Subject Code: DSL-504 **Course Title:** Environmental Monitoring and Impact Assessment of Dams

L-T-P: 2-0-2 **Credits:** 3 **Subject Area:** PEC

Course Outlines: Water quality issues, Ecosystem resilience issues, Assessment of carbon footprints in dams, Guidelines and Standard Codes, EIA methods and Tools, Environmental Clearances, Legal Issues, Societal considerations in dams, Water quality analysis using advanced instruments like TOC, flow cytometer, zeta-sizer, UV spectrometer, Advanced membrane-based water purification systems, JAR tests for water purification using different chemicals.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams (ICED)

Subject Code: DSL-505 **Course Title:** Earthquake Geotechnical Engineering

L-T-P: 2-0-2 **Credits:** 3 **Subject Area:** PEC

Course Outlines: Introduction to the Earthquakes, Engineering Seismology, Earthquakes Magnitude and Intensity, in Different Geological Set-Ups, Mapping, Wave Propagation, Dynamic Soil Properties, Ground Response Analysis, Liquefaction, Evaluation of liquefaction potential, Earth Pressure, Seismic Slope Stability, Ground Improvement Techniques, Remote Sensing in Earthquake Geology.

List of Experiments: Processing of pre and post-earthquake satellite images, Collection of data using GPS and mapping, Use of SAR interferometry for surface displacement measurement, Liquefaction Resistance of Soil using Vibration Table, Shear Velocity Profile using MASW, N values of cohesionless soils using SPT, c and Φ of soil using direct shear/triaxial tests, Liquefaction resistance of soil using cyclic triaxial test apparatus, Determination of dynamic properties using laboratory tests.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams (ICED)

Subject Code: DSL-506 **Course Title:** Geospatial Techniques for Monitoring of Dams

L-T-P: 2-0-2 **Credits:** 3 **Subject Area:** PEC

Course Outlines: Overview of Geospatial Technologies, Introduction to Optical Remote Sensing and its applications to surface water changes; Fundamentals of Digital Image Processing, Introduction to microwave (SAR) remote sensing; InSAR processing and its application to dam monitoring and associated tools/software; Structural Monitoring of Dam Structures using SAR, Introduction to UAV sensing; Introduction to LiDAR, Introduction to GPS Systems, Monitoring of Catchment Characteristics using geospatial technologies, Monitoring of landslide zones using geospatial technologies and their representation in GIS, Application of geospatial technologies for land use/cover change monitoring in flood-prone downstream areas of dams and risk assessment.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams (ICED)

Subject Code: DSL-507 **Course Title**: Hydraulic Design of Spillways and Energy Dissipators

L-T-P: 2-0-2 **Credits:** 3 **Subject Area:** PEC

Course Outlines: Introduction to hydraulic structures and their necessity, Embankment Dams, Gravity Dams, Spillways, Energy dissipators, Supercritical flow, oblique jump, supercritical transition, Hydraulic modelling of spillways and energy dissipators, dimensional analysis, modelling of turbulence, friction, air entrainment etc., scale effects, Lifetime assessment of dam and associated works.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams (ICED)

Subject Code: DSL-508 **Course Title**: Contract and Financial Management

L-T-P: 2-1-0 **Credits:** 3 **Subject Area:** PEC

Course Outlines: Contract Types, Contract Specification, Contract Document, Contract Processing, Online Contracts, Breach, Force Majeure, Damages, Risk, Warranties, Delivery, Bank Guarantees, Arbitration, Taxation and Vigilance. Financial Management of Dam Projects, Financial Statements, Ratio Analysis, Financial Viability Studies and Innovative Financing Options.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams (ICED)

Subject Code: DSL-509 **Course Title**: Seismic Safety Evaluation of Dams

L-T-P: 2-0-2 **Credits:** 3 **Subject Area:** PEC

Course Outlines: Seismic Behavior of Different Types of Dams, Fundamentals of Soil and Structural Dynamics, Seismic Site Characterization, Ground Response Analysis, Local Site Effects and Liquefaction; 2D and 3D FEM Modelling of Dams, Dynamic Response and Stability Checks for Gravity Dams, Seismic Slope Stability Analysis of Embankment Dams.

List of Experiments: Dynamic response analysis of a gravity dam using response spectrum and time history; Stability assessment of an existing dam using SLOPE/W; Seismic stability assessment of an existing dam using QUAKE/W; Generation of spectrum compatible time histories; Deconvolution of time histories to obtain base input motions; Dam model studies using shake table; Experiments for material characterization.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: International Centre of Excellence for Dams (ICED)

Subject Code: DSL-510 **Course Title**: Planning and Design of Hydro-Mechanical Components in Dams

L-T-P: 2-1-0 **Credits:** 3 **Subject Area:** PEC

Course Outlines: Introduction and Types of Gates, Gates Design and Weight Estimation, Hydro-dynamic Forces, Gate Operating Systems including Hydraulic Hoist, Materials, Fabrication, Erection, Testing & Commissioning, Hoist Bridge, Operation & maintenance of Gates, Gate Inspection, Gate Rehabilitation and Gate Automation.