Programme Cores

Department	Course No.	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	G	P	
Civil Engineering	CEC-6050	Hydraulic Structures	PC	NIL	Theory	4	3	1	0	4

Course Assessment Method

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective

This course is aimed to develop the understanding of basic principles and concepts of analysis and design of hydraulic structures such as weirs and barrage, regulation works, spillways, canals and various river training works and to provide the detailed insight into the theories of sub-surface flow.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. optimize the effective usage of water resources for irrigation purposes and comprehend to the basic design principles for the development of efficient irrigation system.
2. understand and manage the hydraulic structures project evaluation under various conditions of data availability and field constraints.
3. gain the in-depth knowledge on various types of spillways used in dams and their design guidelines.
4. evaluate the essential requirements of the most widely used spillways and design ofefficient stilling basins by following U.S.B.R. and I.S. recommendations.

Topics Covered

Unit 1 Principles of design of hydraulic structures on permeable foundation, design of barrage.

Unit 2 Design of regulation works, silt excluding devises, guide banks and spurs.

Unit 3 Theory of Spillways: types and design of Ogee spillway and Syphon spillway.

Unit 4 Energy Dissipaters: Energy dissipation downstream of hydraulic structures, Hydraulic jump, Jump height curve and Tail water curve, Stilling basins (U.S.B.R. type), design of roller bucket type energy dissipators.

Text Books / Reference Materials

1. Theory and Design of Irrigation Structures Vol I by **R. S. Varshney and S. C. Gupta**.
2. Theory and Design of Irrigation Structures Vol II Canal and Storage Works by **R. S. Varshney**.
3. Irrigation and Water Power Engineering by **B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain**.
4. Irrigation Engineering and Hydraulic structures by **S. K.Garg**

Additional Learning Source

1. Irrigation and Water Power Engineering by **P. N. Modi**
2. Web links to e-learning**: *nptel* and ePathshala**

Department	Course No.	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	G	P	
Civil Engineering	CEC-6060	Advanced Engineering Hydrology	PC	NIL	Theory	4	3	1	0	4

Course Assessment Method

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective

The course is aimed to provide concept of hydrologic analysis and design of the hydraulic engineering system.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. apply the knowledge of the hydrograph analysis for rainfall-runoff modeling of the watershed
2. assess design flood properly with consideration of economy and safety for water resources projects
3. apply at site and regional flood frequency analysis for the assessment of flood peak and its frequency for major water resource projects and utilize the knowledge of the reservoir and channel flood routing for the reservoir planning and flood forecasting.
4. utilize the concept of the random variable and its analysis , theory of probability and statistical methods in the planning and design of water resource projects

Topics Covered

Unit 1 Hydrograph analysis, Separation of stream flow components, Unit Hydrograph, Synthetic Unit Hydrograph, Instantaneous unit hydrograph, Dimensionless unit hydrograph, Distribution graph

Unit 2 Reservoir planning, Various zones of reservoirs, Area-elevation & Storage elevation curve, Design storm, Probable Maximum Precipitation (PMP), Spillway Design Flood (SDF), Standard Project Flood (SPF), Probable Maximum Flood (PMF). Guidelines for selecting design flood

Unit 3 Peak flood estimation, At site flood Frequency analysis, Selection of design return period, Annual and partial duration series, Regional flood frequency analysis, Reservoir and channel flood Routing.

Unit 4 Random variable and Probability, Statistical Analysis of random variables, Probability distribution function, Regression analysis, Risk and Reliability analysis of Hydraulic Engineering Systems.

Text Books / Reference Materials

1. **K. Subramanya**, "Engineering Hydrology", TMH, New Delhi, India.
2. **Chow V.T**, "Hand book of Applied Hydrology", McGraw-Hill, N.Y., USA.
3. **Wister, and Kohler and Paulhus**, "Hydrology", McGraw Hill, Tokyo, Japan.
4. **Linsley, Kohler and Paulhus**, "Applied Hydrology", McGraw Hill, N.Y., USA.
5. **D.K Todd**, "Groundwater Hydrology", John Wiley, N.Y., India..

Additional Learning Source

1. J. Nemec, "Engineering Hydrology", McGraw-Hill, N.Y
2. Web links to e-learning**: *nptel***

Department	Course No.	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	G	P	
Civil Engineering	CEC-6070	Advanced Open Channel Hydraulics	PC	NIL	Theory	4	3	1	0	4

Course Assessment Method

1. Assignments and Quizes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective

The aim of the course is to impart knowledge regarding the advanced topics on steady, unsteady, spatially varied flows and dispersion of pollutants in natural streams.

Course Outcomes

Upon successful completion of the course the students are supposed to

1. Compute back water and drawdown profiles for various Gradually Varied Flow situations and to assess the stage and discharge in channel during flood and dam break catastrophe.
2. Plan and design various types of weirs for discharge measurement as well as special types such as Labyrinth and Piano key weirs for passing high discharges safely during floods.
3. Plan and design special types of diversion works in hydraulic structures for mountainous region.
4. Assess the impact of aeration in providing suitable free board in hydraulic structures and to assess the impact of pollution caused by disposal of domestic and industrial waste in natural streams.

Topics Covered

Unit 1 Gradually Varied Flow: Computation of GVF profiles using analytical and numerical methods. Unsteady Flow: St. Venant's equations and their solution, hydraulic flood routing, Dam break problem.

Unit 2 Rapidly Varied flow: thin plate weirs, special types of weirs such as linear proportional weir, Labyrinth weir, Piano key weir. Hydraulic jump in non-rectangular channels.

Unit 3 Spatially Varied Flow: Side channel spillway, side weir, De Marchi equation, uniformly discharging side weir, Trench weir.

Unit 4 Design of subcritical canal transitions: Hind's method, Vittal and Chiranjeevi's method, diffusion and dispersion in open channels.

Text Books / Reference Materials

1. **K. Subramanya**, Flow in open channel, McGraw Hill Education (India) Pvt Ltd, New Delhi
2. **K. G. RangaRaju**, Flow through open channels, Tata McGraw Hill Publishing Company Limited, New Delhi.
3. **Rajesh Srivastava**, Flow through Open Channel, Oxford University press, New Delhi.
4. **M Hanif Chaudhry,** Open Channel Flow, Prentice Hall of India, New Delhi.
5. **VenTe Chow,** Open Channel Hydraulics, McGraw Hill Book Company, New York.

Additional Learning Source

1. Web links to e-learning**: *nptel***

Department	Course No.	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	G	P	
Civil Engineering	CEC-6080	Fluvial Hydraulics	PC	NIL	Theory	4	3	1	0	4

Course Assessment Method

1. Assignments (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective

To understand the behavior of sediment transport in alluvial channels, design the stable alluvial channel and solve various civil engineering problems encountered in fluvial hydraulics.

Course Outcomes

After the successful completion of the course, a student is expected to

1. Understand the basic concepts of sediment movement and regimes of flow in alluvial channels.
2. Get in-depth knowledge of various predictors of bed load and suspended load.
3. Compute the total sediment load carried in alluvial channel and to design the stable channels.
4. To have an understanding of alluvial river models and sediment transport through pipes.

Topics Covered

Unit 1 Sediment properties, Reservoir sedimentation, types of reservoirs, site selection, incipient motion of sediment, competent velocity, lift concept, critical tractive force of cohesion less and cohesive materials, regimes of flow, ripple and dune regimes, anti-dune regime, importance and prediction of regimes of flow.

Unit 2 Resistance to flow and velocity distribution in alluvial streams, Bed load equations based on dimensional considerations and semi theoretical equations, suspended load, general considerations about sediment distribution equation, prediction of reference concentrations.

Unit 3 Total load transport, microscopic and macroscopic methods based on a single size and fraction wise size calculations, Sediment samplers and sampling, bed load and suspended load sampling. Design of stable channels in alluvium: variables in channel design, general comments on regime and tractive force methods of channel design.

Unit 4 Bed level variation in alluvial streams, local scour, degradation, aggradation, silting of reservoir, estimation of silt, distribution of sediment in reservoir, life of reservoir, sediment flow through pipes.

Text Books / Reference Materials

6. **R.J. Garde and K G Ranga Raju,** Mechanics of sediment transport through alluvial Channels, New Age International (P) Limited, Publishers, New Delhi.
7. **W R White, A D Crabbe, H Milli,** Sediment *Transport*: *New Approach and Analysis*," Journal of the Hydraulics Division, HY11, American Society of Civil Engineers. ... "Shore Protection Manual," Washington, *1975*
8. **A J Raudkivi,** Loose Boundary Hydraulics, CRC Press, Taylor & Francis, USA.

Additional Learning Source

1. Web links to e-learning:*nptel*
2. Web based learning, Journal papers, etc.

Department	Course No.	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	G	P	
Civil Engineering	CEC- 6921	Computational Lab	PC	None	Lab	2	0	1	2	3

Course Assessment Method

1. Class Work (60%)
2. End Semester Examination (40%)

Course Objective

To prepare students for hydraulic and water resources report writing skills using advanced features of MS office.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Prepare the reports related to water resources engineering.
2. Recognise advance features of MS office for preparing hydraulic and water resources engineering reports.
3. Ability to plot different types of graphs using MS Excel.
4. Ability to prepare and present Power Point Presentation.

Syllabus

1. Learning MS Words for Research & Technical Report writing.
2. Introduction to MS Excel and programming in MS Excel.
3. Visual display of data using MS Excel.
4. Writing, preparation and training for presenting Power Point Presentation

Text Books / Reference Materials

1. Mastering Ms Office. Electronic book text, Kumar Bittu, V&s Publishers.
2. Microsoft Office 2016 Word. Lalit Mali, First edition (2017) Notion Press.
3. Mastering Ms Office. Kumar Bittu, V&s Publishers.

Additional Learning Source

1. Web links to e-learning**:** *nptel*
2. Video lectures at https://www.youtube.com/watch?v=NYJSUMwf-Cc

Programme Electives

Department	Course No.	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	G	P	
Civil Engineering	CEE-6310	Rigid Dams	PE	NIL	Theory	4	3	1	0	4

Course Assessment Method

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective

The course is aimed to train the students in planning and designing of various types of rigid dams such as gravity dam, arch dam and buttress dam.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Plan, analysis and design of gravity dam.
2. Assess the various stresses at key points in general and galleries, monitor quality control and behavior of dam during and after construction using proper instrumentation.
3. Plan, analysis and design of arch dam.
   Plan, analysis and design of buttress dam.

Topics Covered

Unit 1 Dam: types, characteristics, relative merits and demerits, site investigations and selections, foundation grouting, forces acting on dam,
Gravity dams**:** stability requirements, modes of failure and factor of safety, elementary profile of gravity dam, methods of analysis, zoning of gravity dams, design criteria.

Unit 2 Stress analysis in gravity dams, normal and shear stresses, principal stresses, internal stresses, galleries in dams, stress concentration around openings, joints in dams, construction of gravity dams, instrumentation in gravity dam.

Unit 3 Arch Dam**:** General consideration, types and characteristics, Forces acting on Arch dams, Design criteria, Cylinder theory and elastic theory of design, Construction of arch dams.

Unit 4 Buttress dam**:** Merits, Types and characteristics, Forces acting, design of deck, buttresses, Unit column theory, Construction of buttress dam.

Text Books / Reference Materials

1. **R.S. Varshney** "Concrete Dams", by 1982, NCB, Roorkee
2. Design of Small Dams, USBR 1960, Calcutta, Oxford and IBH
3. **W.P. Creager, J. Justin,.Daud Hinds**, "Engineering for Dams" Vol. I-III, Wiley, N.Y., USA.
4. IS: 6512-1984, Criteria for Design of solid Gravity Dams.
5. IS:1893-1984, , Criteria for Earthquake resistant Design of structures.

Additional Learning Source

NPTEL course materials from different IITs.

Department	Course No.	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	G	P	
Civil Engineering	CEE-6320	Earth and Rockfill Dams	PE	NIL	Theory	4	3	1	0	4

Course Assessment Method

1. Assignments and Quizes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective

The course is aimed to train the students in planning and designing of earth and rockfill dams and inculcate the knowledge of construction, maintenance and safety of these dams.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Plan and design earthen dams and adopt suitable measures for its safety.
2. Assess the seepage discharge and adopt suitable measures for its control.
3. Plan and design rockfill dams and adopt suitable measures for its safety.
4. Adopt appropriate methods of river diversion, monitor quality control during and after construction using proper instrumentation.

Topics Covered

Unit 1 Basic design aspects, Classification of embankment dams, Criteria for safe design, Free board, Upstream and downstream slope protection, Cracking of earth dams, Hydraulic fracturing, Causes of cracking, Preventive and remedial measures.

Unit 2 Seepage theory, Determination of free surface and seepage discharge through dams for isotropic as well as anisotropic soils. Flow net for earth dam under steady seepage condition, Various methods of seepage control, Selection of core materials, Drainage of embankments, Design of transition filters, Use of geo-textiles.

Unit 3 General characteristics of Rock fill dams, Materials for rock fill dams, testing of rockfill material, Design of dam section, Types of membrane, Rock fill placement, Deformation of rock fill dams, Flow through and over rockfill dam, Concrete faced rockfill dam.

Unit 4 Stability analysis, Method of slices, Graphical method, Foundation exploration for Earth and Rock fill dams, Treatment of foundations, Quality control and instrumentation, River diversion during construction of dam.

Text Books / Reference Materials

1. **Hind, Creager and Justin**, Engineering for dams, Wiley, 1967.
2. **Bharat Singh**, Embankment Dam Engineering, Nem chand& Bros Roorkee.
3. **Sowers G. I.** Earth and Rockfill Dam Engineering Manual, USBR Publication.
4. **Sharma H. D.**, Embankment Dams, Oxford and IBH Pub., 1991.
5. **Design of Small Dams**, USDI, Oxford and IBH, 1976.

Additional Learning Source

1. Web links to e-learning**: *nptel***

Department	Course No.	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	G	P	
Civil Engineering	CEE-6450	Hydro-Power Engineering	PE	NIL	Theory	4	3	1	0	4

Course Assessment Method

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective

The main aim of this course is to provide an insight of planning and design of various components of hydro-power structures such as intakes, penstock, tunnels, surge tanks, and draft tubes etc. giving due consideration to safety measures. Further the focus is made on the appropriate selection and setting out of suitable turbines for various types of hydel plants.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Gain knowledge regarding the various sources of energy available in nature, hydel power terminology and assess the power potential of a natural stream.
2. Plan and design various types of hydro power schemes as well as to assess their efficiency.
3. Plan and design the various components of hydro power plant such as intake, penstock, power tunnels, surge tank.
4. Select suitable turbine for various type of hydro power schemes, schematically plan, proper dimension and layout of power houses with all safety measures.

Topics Covered

Unit 1 Sources of energy, role of hydropower in a power system, Estimation of power potential of stream, Storage and Pondage studies, load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power and secondary power.

Unit 2 Hydro-power plants, Elements, general arrangement of various Hydel plants such as runoff river plants, valley dam plants, diversion canal plants, high head diversion plants, pumped storage power plants etc., Efficiency and Installed capacity of plants.

Unit3 Intakes, Types, losses, air entrainment, air vent, Tunnel, Penstocks, General classification, design criteria, economical diameter, Surge tanks, Classification, Analysis of simple surge, Water hammer.

Unit 4 Selection, setting and cavitation in turbines, Draft tubes, classification, Dimensioning and laying of power houses, Safety measures during construction of power plants.

Text Books / Reference Materials

1. **Dandekar M MSharma, K H**, Water Power Engineering, Vikas Publishing House Pvt Ltd.
2. **Barrows, H K**, Water Power Engineering, Tata McGraw Hill Publishing Company Ltd.
3. **Varshney, RS,** "Hydro Power Structures", Nem Chand &Bros.
4. **Choudhary, M H,** "Applied Hydraulic Transients", Van Nostrand Reinhold.
5. **Streeter, V.L., and Wylie, B**, "Fluid Transients", McGraw-Hill Book.
6. **Warnick, C.C**., "Hydropower Engineering", Prentice-Hall.
7. **Norwegian Inst. of Tech.: Hydropower Development**: Vols. 3, 4, 5 &6, Division of Hydraulic Engg.

Additional Learning Source

1. NPTEL course materials from different IITs.

Department	Course No.	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	G	P	
Civil Engineering	CEE-6360	Irrigation and Drainage	PE	NIL	Theory	4	3	1	0	4

Course Assessment Method

1. Assignments (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective

The main objectives of this course is to provide an insight of planning and design of various components of irrigation engineering system such as types and design of new irrigation system, drainage system and other irrigation related issues.

Course Outcomes

Upon successful completion of this course, it is expected that students will be

1. Gain knowledge regarding the various source and storage of irrigation water measurement of various soil related issue such as moisture content, consumption use etc.
2. Planning & design surface & subsurface irrigation system and study of various flow measuring techniques in open channels.
3. To study various devices which measures soil moisture and give insight for measuring the correct estimation of evapotranspiration.
4. To study the various drainage techniques water salt balance of root zone & teaching efficiencies of soil.

Topics Covered

Unit 1 Introduction, Sources and storage of Irrigation water, Basic Soil-water relations, measurement of soil moisture, consumption use of water, drainage requirement, irrigation efficiencies.

Unit 2 Surface and sub surface irrigation sprinkler's and trickle irrigation, fluid measurement techniques, flow measurement flumes, weirs, irrigation events

Unit 3 Infiltration, infiltrometer, ponding methods, tensiometers, neutron probe, time domain reflectometer, evapotranspiration, crop coefficient, leaf area index, guide lines on evapotranspiration estimation.

Unit 4 Drainage principles, need for drainage, steady state equations, Hooghoudt, Kirkham, Dagan and Ernst equations. Salt balance, water and salt balance of the root zone, salt equilibrium equation and leaching requirement, leaching efficiency.

Text Books / Reference Materials

1. **Walker, W.R., and Skogerboe, G.V**., "Surface Irrigation Theory and Practice", Prentice Hall, INC. 1987
2. Drainage Principles and Applications, "International Institute for Land Reclamation and Improvement", Wageningen. 1973
3. **Asawa, G.L**., "Irrigation Engineering", New Age International Publishers. 1996
4. **Majumdar, D.K.**, "Irrigation Water Management", PHI Learning. 2009
5. Irrigation Principles and Practice by Vaughn, E. H., Orson W., Israelsen Glen. E, Stringham

Additional Learning Source

1. Web links to e-learning: nptel
2. Web based learning, Journal papers, etc.

Department	Course No.	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	G	P	
Civil Engineering	CEE-6470	Water Resources Engineering	PE	NIL	Theory	4	3	1	0	4

Course Assessment Method

1. Assignments (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective

The objective of the course is to have an understanding of planning and management of water resources project, economic analysis of water resources project and knowledge of flood damage mitigation.

Course Outcomes

After the successful completion of the course, a student is expected to

1. Develop an understanding of planning and management for water resources project,
2. Understand the engineering economic analysis of water resources project,
3. Apply the knowledge in assessment of floods and able to design the various component to have least damage due to flood,
4. Create the theoretical and mathematical knowledge of simplified river basin system.

Topics Covered

Unit 1 Objectives and Planning of water resources developments, Levels of planning, Project formulation and Evaluation, Environmental considerations, Functional requirements in Multiple-purpose projects.

Unit 2 Engineering economy in water resources planning, Annual cost comparisons, Selection of an interest rate for an economy study, Economic design of hydraulic structures.

Unit 3 Flood damage mitigation, Design floods, Flood mitigation reservoirs, Design of levees and flood walls, Flood ways, Channel improvement, Evacuation and flood proofing.

Unit 4 Simplified river-basin system, Conventional planning process, Simulation analysis, Mathematical models.

Text Books / Reference Materials

1. **Linsley and Franzini**, Water resource Engineering, McGraw-Hill
2. **L.D. James and R.R.Lee**, Economics of Water Resources Planning, McGraw-Hill New York.
3. **Loucks, D.P., J.R. Stedinger D.A., Haith**: Water Resources sytems, Planning and Analysis, Prentice Hall.
4. **Biwaswas A.K**. Systems Approach to Water Management, McGraw Hill, Kogakusha Ltd.

Additional Learning Source

1. Web links to e-learning: *nptel*
2. Web based learning, Journal papers, etc.