

Course Name	:	Advanced Fluid Mechanics
Course Code	:	CEN-541
Credits	:	3
L T P	:	3-0-0
Course Objectives:		
To learn the basic concept of fluid mechanics. To impart knowledge of kinematics of different types of flows and discuss statistics and measurement of turbulence.		

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Kinematics of Flow: Equation of continuity in Cartesian, polar and cylindrical coordinates, rate of deformation, dilation, vorticity	3
2	Standard 2D Flow Patterns: Source, sink, doublet and their combinations, construction of flows by superposition, D. Alembert's paradox.	5
3	Laplace Equation: Solution by graphical and relaxation methods, conformal mapping, solution by separation of variables.	4
4	Laminar Flow: Derivation of Navier-Stokes equations, exact solutions for flow between parallel plates, Couette flow, flow near a suddenly accelerated plate and an oscillating plate.	8
5	Boundary Layers: Similarity solutions of boundary layer equations, Falkner-Skan Wedge flows, Karman's momentum integral equations, Karman-Pohlhausen approximate solution, separation in boundary layer under adverse pressure gradient, turbulent boundary layer.	8
6	Turbulent Flows: Reynolds equations of motion, semi-empirical theories of turbulence, velocity profiles for inner, outer and overlap layers, equilibrium boundary layers.	8
7	Measurement of Turbulence and Statistical Theory of Turbulence: Isotropic and homogeneous turbulence, probability density functions, correlation coefficients, decay of isotropic turbulence.	6

Course Outcomes:
To apply the learned techniques in real life problems related to fluid mechanics.

Suggested Books:		
S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	"Fluid Mechanics", White, F.M., McGraw-Hill.	1979
2	"Boundary Layer Theory", Schlichting, H., McGraw-Hill.	1979
3	"Turbulent Flow", Garde, R.J., Wiley Eastern.	1994
4	"Turbulent Flows", Pope, S. B., Cambridge University Press.	2000
5	"Advanced Mechanics of Fluids", Rouse, H., John Wiley.	1959
6	"Fluid Mechanics", Ojha, C.S.P., Berndtsson, R. and Chandramouli, P.N., Oxford University Press.	2010

Course Name	:	Free Surface Flow
Course Code	:	CEN-542
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To understand the basic knowledge of open channel flow and its application in flood control, design of drainage ways, water ways.

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Introduction: Free surface flows, velocity distribution, resistance relationships, specific energy and specific force, normal and critical depth computations, governing equation and computation of gradually varied flows.	7
2	Uniform Flow in Mobile-Boundary Channel: Incipient motion condition, regimes of flow, Resistance to flow in alluvial streams, non-scouring erodible boundary channels.	7
3	Hydraulic Jump: Elements of hydraulic jump, hydraulic jump in variety of situations including contracting and expanding geometries and rise in floor levels, control of hydraulic jump using baffle walls and cross jets.	7
4	Supercritical Flows: Flow past deflecting boundaries, oblique shock waves.	
5	Spatially Varied Flows: Flows past side weirs, De Marchi equations, design of side weirs, flow past bottom racks, trench weirs and waste water gutters.	7
6	Unsteady Flows: St. Venant's equations and their solution using method of characteristics and finite difference schemes; dam break problem, hydraulic flood routing.	8
7	Channel Transitions: Sub-critical and supercritical.	6

Course Outcomes:

Students would be proficient enough to apply the concepts in various applications in the area such as canal & storage structures.

Suggested Books:

S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	"Open Channel Hydraulics", Chow, V.T., McGraw Hill.	1959
2	"Open-Channel Flows", Chaudhary, M.H., Prentice-Hall.	1994
3	"Flow Through Open Channels", Ranga Raju, K.G., Tata McGraw Hill.	2003
4	"The Hydraulics of Open Channel Flow: An Introduction", Chanson, H., Elsevier.	2004
5	"Open-Channel Hydraulics", French, R.H., McGraw-Hill.	1994
6	"Air entrainment in free-surface flows", Wood, I.R., Balkema.	1991

Course Name	:	Advance Hydrology
Course Code	:	CEN-543
Credits	:	3
L T P	:	3-0-0
Course Objectives:		
To introduce the fundamentals of hydrological models used in solving the water resources problems.		

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Introduction, Precipitation, Isohytal method, Area depth duration and intensity duration frequency curves, Design applications, Standard Project Storm	15
2	Water Losses, Measurement and estimation of evaporation and transpiration	8
3	Runoff, Rainfall runoff relationship Hydrograph, Design Flood, Unit Hydrograph, Instantaneous Unit Hydrograph	12
4	Flood Routing, Flood Forecasting, Hydrologic Models.	7

Course Outcomes:
Students will be able to analyze the rain fall data with the help of hydrological models and to estimate the design flood.

Suggested Books:		
S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	Applied Hydrology; K.N. Mutreja, Tata – Mc-Graw Hill.	1990
2	Hydrology for Engineers, Linsley, Kohler, Mc-Graw Hill.	1949
3	Handbook of Applied Hydrology, V.T.Chaw	1988
4	Enginneering Hydrology, E.M.Wilson, Macmillan	1990
5	Engineering Hydrology , K.Subramanya, Tata Mc-Graw Hill	1994

Course Name	:	Water Resources, Planning & Management
Course Code	:	CEN-544
Credits	:	3
L T P	:	3-0-0
Course Objectives:		
To understand the concept of planning of water resources projects including feasibility studies and to learn the concept of relevant mathematical tools.		

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Project Planning	4
2	Elements of Water Resources Development, Issues in Planning	8
3	Planning Process Data Needed for Planning, Project analysis	8
4	Integrated River Basin Development, Water Resources Planning	6
5	Systems Engineering, Linear Programming, Dynamic Programming	10
6	Projects Economics, Comparison of Alternatives.	6

Course Outcomes:
Students will be able to make use of concept of planning, optimal design criteria and application of economics in water resources projects.

Suggested Books:		
S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	Water Resources Systems Engineering, Hall and Dracup, Mc-Graw Hill.	1970
2	Economics of Water Resources Planning, James – Lee, Mc-Graw Hill	1971
3	Water Resources Engineering, Linsley and Franzini, Mc-Graw Hill.	1955
4	Optimization Theory and Applications, S.S.Rao, Wiliey East. Ltd.	1978

Course Name	:	Numerical Methods and Optimization Techniques
Course Code	:	CEN-599
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To understand the concept of optimization and its application in civil engineering project, and to learn the concept of relevant mathematical tools.

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	RDBMS Civil Engg. Software Packages	6
2	Fundamentals of optimization, Statistical optimization	6
3	Linear Programming, Dynamic Programming.	7
4	Finite difference methods, Taylor's series, Fourier series	7
5	Different Implicit and Explicit schemes- MacCormack Scheme, Lambada Scheme, Preissmann Scheme	8
6	Stability analysis, Boundary Conditions, Algebra of tensors.	8

Course Outcomes:

Students will be able to make use of Software Packages and its application in solving the civil engineering project problems.

Suggested Books:

S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	Software Engineering – Roger Pressman.	1982
2	Software Development in `C` – Yashwant Kanetkar	2013
3	Operations Research – D.S.Heera & P.K.Gupta	2005
4	Optimisation Theory & Applications – S.S.Rao, S. Chand & Company Ltd	2014

Course Name	:	Design of Experiments & Research Methodology
Course Code	:	ENN-505
Credits	:	3
L T P	:	3-0-0
Course Objectives:		
To introduce the fundamentals of Statistical techniques, Sampling techniques, and Data collection and their interpretation.		

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Basic principles of design of experiment, Error analysis in experiments.	5
2	Concept of modeling, Different types of models, Random variables, Random numbers, and Analysis of variance	6
3	Estimation of parameters, Residual analysis and model checking, Sample size problem	6
4	Different types of distributions, Distribution tests, Concept of simulation, Monte Carlo simulations	6
5	Geostatistics	5
6	Que model, Time series analysis, Fitting statistics	5
7	Research Methodology – Nature and objective of research, Research topic, Literature review, Formulation of problem, Research design, Sampling techniques, Data collection	5
8	Statistical and sensitive analysis of data, Interpretation of result and report writing	4

Course Outcomes:
Students will be able to make use of various Research methodologies and its applications in the relevant field of engineering.

Suggested Books:		
S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	Probability and Statistics for Engineers and scientists, Walpole, Myers, Myers and Ye, Pearson Education.	7th edition, 2002
2	Statistics in Research, Bernand Ostle and Richard N.Mensing, Oxford & IBH Pub Co.	3rd edition, 1975
3	Probability and Statistics in Engineering, Hines, Montgomery, Goldsman and Borror, John Wiley & Sons.	4th edition, 2003
4	Experimental design, Theory & application, Federer, Oxford & IBH pub Co.	1955
5	Introduction to probability & statistics for Engineers and scientists, Sheldon M. Ross Elsevier Academic press, California, USA	2014

Course Name	:	Programme Lab-I (Hydraulic Engineering Lab-I)
Course Code	:	CEN-553P
Credits	:	2
L T P	:	0-0-3
Course Objectives:		
To understand the practical aspects of fluid flow in various hydraulic structures such as open channel, canal falls, hydraulic jump etc.		

Total No. of Lectures: 42

List of Experiments		No. of Turns
1	To study the velocity distribution in an open channel and to estimate the energy and momentum correction factors.	3
2	To find the critical depth & surface profile using broad crested weir.	3
3	To study the characteristics of a hydraulic jump	3
4	To find the Drag Coefficient of flow past a cylinder	3
5	To study the boundary layer velocity profile and to determine the exponent in the power law of velocity distribution, boundary layer thickness and displacement thickness.	3
6	Fall Velocity of Objects	3
7	Energy Loss in Bends	3
8	Computation of Back Water and Draw Down Curves	6
9	Analysis of Distribution Network	6
10	Analysis of Precipitation Data & To Develop a Rainfall-Run Off Relationship	9

Course Outcomes:
Application of model results in verifying the analysis and design of structures.
Design of hydraulic structures on the basis of evolved practical relationships by of practical analysis.

Course Name	:	Programme Lab-II (Hydraulic Engineering Lab-II)
Course Code	:	CEN-554P
Credits	:	2
L T P	:	0-0-3

Course Objectives:

To understand practical flow aspects of fluid flow in various hydraulic structures such as open channel, canal falls, hydraulic jump, dams and spillway etc.

Total No. of Lectures: 42

List of Experiments		No. of Turns
1	Flow through Porous Media	3
2	Seepage Analysis Study by Heleshaw Apparatus	3
3	Design of Practical Profile of Gravity Dam	3
4	Seepage and Stability Analysis of Zone Dam	3
5	Estimation of Storage Capacity of Reservoir	3
6	Design of Spillway Profile	3
7	Selection & Design of Energy Dissipaters	3
8	Application of Software for Solving Free Surface Flow Problems, Hydrologic Analysis and simulation Problems	15
9	Estimation of Design Flood & Regional Flood Frequency Analysis	3
10	Hydrologic and Hydraulic Flood Routing	3

Course Outcomes:

Application of model results in verifying the analysis and design of structures.

Design of hydraulic structures on the basis of evolved practical relationships by practical analysis.

Course Name	:	Irrigation & Drainage Design
Course Code	:	CEN-545
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To introduce the basic concepts of Irrigation engineering and its use in crop production with the help of canal network system including drainage aspects

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Available water Resources & Their Present Utilization	5
2	Soil water plant Relationship & Soil Fertility, Water Requirements of crops	7
3	Consumptive use, Estimation of Consumptive use	6
4	Frequency of Irrigation, Irrigation methods, management of Irrigation systems	6
5	Irrigation works, Water Logging, Drainage, Design of Drainage Systems	18

Course Outcomes:

Students can be able to estimate the design discharge required for the canal network system and its control.

Suggested Books:

S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	Irrigation Engineering by Zimmermann.	1996
2	Irrigation Engineering by Bharat Singh, Nem Chand & Bros.	2005
3	Irrigation Theory and Paractice By A.M.Michael	2009

Course Name	:	Ground Water Engineering
Course Code	:	CEN-546
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To introduce the basic concept of Ground water Engineering and to learn the analytical technique in ground water flow analysis.

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Role of Ground Water in Hydrologic cycle	4
2	Classification of Aquifers, Flow and Storage, Characteristics of Aquifers	4
3	Darcy's Law, Governing Equations of Ground Water, Ground Water-Inventry	8
4	Flow – into wells, Construction of wells, Shallow wells	8
5	Replenishment of Ground water, Investigations of ground water	6
6	Ground water Management, Salinity problems in aquifers, Ground Water modeling	10

Course Outcomes:

Students can be able to solve ground water real life problems and estimate the ground water potential in the region under consideration

Suggested Books:

S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	Johnsons – Groundwater and wells – Johnson and Johnson Publication.	1986
2	Todd. D.K. Groundwater Hydrology – Wiley.	2007
3	H.M.Raghunath, Ground Water – Wiley Eastern Ltd	2007

Course Name	:	Fluvial Hydraulics
Course Code	:	CEN-547
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To introduce the flow characteristics in an alluvial channel with erodible boundary.

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	The sediment problems, properties of sediments, incipient motion of uniform and non-uniform sediments.	8
2	Bed forms and channel resistance.	5
3	Bed load and suspended load transport for uniform and non-uniform bed material, total load equations, sediment sampling.	10
4	Stable channel design and sediment control.	4
5	Bed level variations, local scour, degradation, aggradations and reservoir sedimentation.	7
6	Physical and mathematical models.	4
7	Design of guide bunds and other river training banks	4

Course Outcomes:

Students can be able to design the mobile boundary channel, river training works.

Suggested Books:

S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	"River Morphology", Garde, R.J., New International Publishers.	2006
2	"Erosion and Sedimentation", Julien, P.Y., Cambridge University Press.	1998
3	"Principals of River Engineering", Jansen, P.P.H., VSSD Publications.	1994
4	"Mechanics of Sediment Transportation and Alluvial Stream Problems", Garde, R.J. and Ranga Raju, K.G., Wiley Eastern Limited.	2006

Course Name	:	Design of Hydraulic Structure
Course Code	:	CEN-548
Credits	:	3
L T P	:	3-0-0
Course Objectives:		
To know the basics of Hydraulic structures along with the design of different components associated with it.		

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Planning and investigations of reservoir and dam sites, Choice of dams, preparation and protection of foundation and abutments.	4
2	Forces acting on solid gravity dam, modes of failures, stability analysis, elementary and practical profile of gravity dam, internal stresses and stress concentrations in gravity dam joints, seals, keys in gravity dams, dam safety and hazard mitigation	8
3	Homogeneous and zoned embankment dams, factors influencing design of embankment dams, criteria for safe design of embankment dam, steps in design of embankment dam, seepage analysis and its control through body and dam foundation, classification of rock fill dams and their design considerations.	8
4	Capacity of spillways, components and profile of different types spillways, Non-conventional type of spillways, selection and design of energy dissipaters	8
5	Components of diversion head works and their functions, design of weirs and barrages on permeable foundations	6
6	Canal regulation structures and design of cross drainage works, canal drops, operation and maintenance of canals.	6
7	Review of codes of practice	2

Course Outcomes:

Students can be able to design the various hydraulic structures on the basic of designed flood flow and their proper regulations.

Suggested Books:

S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	USBR, "Design of gravity dams", A Water Resources Technical Publication, Denver, Colorado	1976
2	USBR, "Design of small dams", A water resources technical publication, Oxford and IBH publishing co., New Delhi	1974
3	Creager W P, Justin J D and Hinds J., "Engineering for dams" Nemchand and Brothers, Roorkee	1995
4	Khatsuria R M, "Hydraulics of spillways and energy dissipaters", CRC Press	2005
5	Novak P, "Hydraulic Structures", Taylor and Francis Group publishers	2001

Course Name	:	Hydro Power Engineering
Course Code	:	CEN-549
Credits	:	3
L T P	:	3-0-0
Course Objectives:		
To introduce fundamentals of hydropower, transient analysis and various component of a hydropower plant.		

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Water Power: Introduction, sources of energy, role of hydropower in a power system	3
2	Estimation of Water Power Potential: Flow duration curves of gauge and 13n gauged streams, load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power, secondary power, prediction of load.	7
3	Types of Hydro-power Plants: Run of river plants, general arrangement of run of river plants, valley dam plants, diversion canal plants, high head diversion plants, storage and pondage, pumped storage power plants.	4
4	Penstocks: General classification, design criteria, economical diameter, losses, anchor blocks, valves, bends and manifolds.	6
5	Trash racks: Types, losses, design, stability.	4
6	Intakes: Types, losses, air entrainment, anti-vortex device, air vent, power channels, forebay, and tunnel.	6
7	Turbines: Introduction, types of turbines, hydraulics of turbines, velocity triangles, draft tubes, cavitation in turbines, turbine model testing, characteristics of turbines.	6
8	Water Hammer and Surges: Introduction, water hammer, transients caused by turbine, load acceptance and rejection, resonance in penstocks, surge tanks, channel surges.	6

Course Outcomes:
To solve the hydropower related problems arising in real life situation.

Suggested Books:		
S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	“Water Power Engineering”, Dandekar, M.M., and Sharma, K.H., Vikas Publishing House Pvt Ltd.	2000
2	“Water Power Engineering”, Barrows, H.K., Tata McGraw Hill Publishing Company Ltd.	1943
3	“Hydro Power Structures”, Varshney, R.S., Nem Chand & Bros.	2001
4	“Hydro Electric Engineering”, Nigam, P.S., Nem Chand & Bros.	2001
5	“Applied Hydraulic Transients”, Choudhary, M.H., Van Nostrand Reinhold Company	1987
6	“Fluid Transients”, Streeter, V.L., and Wylie, B., McGraw-Hill Book Company.	1967
7	“Hydropower Engineering”, Warnick, C.C., Prentice-Hall.	1984
8	Norwegian Institute of Technology: Hydropower Development: Vols. 3, 4, 5 & 6, Division of Hydraulic Engineering.	1992-93

Course Name	:	Embankment Dams
Course Code	:	CEN-550
Credits	:	3
L T P	:	3-0-0
Course Objectives:		
To introduce types and design of embankment dams and their analysis along with construction aspects.		

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Introduction, advantages of embankment dams, types of embankment dams, safety criteria for design of embankment dams, factors affecting the design of embankment dams.	8
2	Theoretical analysis of seepage through embankment and its applications, control of seepage through embankment and foundation.	12
3	Stability analysis including seismic considerations.	12
4	Rockfill dams.	2
5	Methods of construction for embankment and salient aspects of construction including construction equipments, instrumentation, and field and laboratory tests for quality control, typical problems associated with embankment dams and their possible solutions	8

Course Outcomes:
Students can be able to design the embankment dam and their stability analysis.

Suggested Books:		
S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	“Earth and Earth-Rock Dams”, Sherard, J.L. et. Al., John Wiley.	1963
2	“Engineering for Embankment Dams”, Singh, B., and Varshaney, R.S., OIBH.	1995
3	“Design of Small Dams”, USBR Publications, OIBH.	1960,1973
4	“Hand Book of Dam Engineering”, Golze, A.R., OIBH.	1977
5	“Embankment Dams”, Sharma, H.D., India Book House Ltd.	1991
6	“Earth and Rockfill Dams”, Singh, B., and Sharma, H.D., Nem Chand and Brothers.	1976
7	“Seepage, Drainage and Flownets”, Cedergren, H.R., John Wiley.	1997
8	“Construction, Planning, Equipment and Methods”, Peurifoy, R.L., McGrawHill.	2010

Course Name	:	Flood Control & River Training Works
Course Code	:	CEN-551
Credits	:	3
L T P	:	3-0-0
Course Objectives:		
To study the flood flow & its prevention by using hydraulic structures.		

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Alluvial streams and their hydraulic geometry, bed level variation of alluvial streams, variation in plan form of alluvial streams	12
2	Analytical models of river morphology, Numerical models for morphological studies, flood plain analysis and morphology of some Indian rivers.	6
3	Computational of peak floods, flood frequency analysis	6
4	Floods in major Indian river basin, types and design of flood forecasting and protection systems	6
5	Operational hydrology, reservoir operation for flood control and management, flood damage estimation models.	4
6	Guide lines for planning and design of river training works, Planning, design, construction and maintenance of river training works and bank protections for alluvial rivers.	6
7	Application of Geo- synthetics in river training works.	2

Course Outcomes:
Students can be able to design the flood control structure and excess flood prevention.

Suggested Books:		
S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	BIS 107051(1994), 12094 (2000), 12926 (1995), 8408 (1994)	-
2	“Applied Hydrology”, Chow V T, Maidment David R and Mays Larry W, McGraw-Hill Book Company, New Delhi	1988
3	“Mechanics of sediment transportation and alluvial streams problems”, Garde R J and Ranga Raju K G , New age International (P) Limited, Publishers, New Delhi	2000
4	“River Morphology”, Garde R J , New Age International Publishers, New Delhi	2006
5	“Hydraulic Design Handbook”, Mays Larry W., Mc Graw Hill Companies, New Delhi	1999
6	“Applied Hydrology” Mutreja K.N. Tata McGraw-Hill Publishing company Ltd., New Delhi	1990
7	“Elementary Hydrology”, Singh Vijay. P, Prentice Hall, INDIA	1992

Course Name	:	Watershed Management
Course Code	:	CEN-552
Credits	:	3
L T P	:	3-0-0
Course Objectives:		
To study the concept of watershed management through rain water harvesting and recharge technique.		

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Hydrology of small watersheds, Concept of sustainable development	6
2	Concept of watershed, Land preparation, conservation measures	6
3	Reclamation of saline soils, utilization and salvaging of water	6
4	Water harvesting and recharge	6
5	Conjunctive use and integrated water resource management, Artificial recharge	8
6	Biomass management, Micro farming	4
7	Integrated approach, Sustainable economic viability	6

Course Outcomes:
Students may be able to design the rain water harvesting structure in a particular watershed.

Suggested Books:		
S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	Water Resources Conservation and Management, Chatterjee, S. N., Atlantic Publishers	2008
2	Land and Water Management, Murthy, V.V.N., Khalyani Publishers	2004
3	Watershed Management, Muthy, J. V. S., New Age International Publishers	1998
4	Soil and Water Conservation Practices, Suresh Rao, Standard Publishers	1998

Course Name	:	BRIDGE ENGINEERING
Course Code	:	CEN-510
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To familiarize with the types, suitability, selection, design criteria of various types of bridges, Introduction to Analysis and Design of various types of bridges and construction methods.

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	General Bridge systems: Considerations in alignment, Planning, Economic considerations, Aesthetics and selection of type of bridge, Bridge Hydrology, Scour Depth, Depth of foundation, Estimation of Design Discharge	7
2	Loading Standards: Specifications for loading, geometrical proportioning etc. Road, Rail-cum-Road bridges, Indian Road Congress and Indian Railway loading standards and their comparison with loading standards followed in U.K., U.S.A. and Europe.	7
3	Design of Bridges: Reinforced Concrete Bridges, Slab culverts, T-Beam Bridges, Box Girder Bridges	8
4	Bridge Bearings	3
5	Design of sub structure - Piers and Abutments.	4
6	Dynamic Response of Bridges: Design considerations for pre-stressed bridges, trussed steel, Cable stayed and suspension bridges.	9
7	Limit State concept for Design of RCC bridges.	4

Course Outcomes:

Students can be able to design the various types of bridge and the construction technique.

Suggested Books:

S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	Bridge Superstructure, N. Rajagopalan, Narosa Publishing House	2006
2	Bridge Engineering Handbook, W. F. Chen and L. Duan, CRC press	2003
3	Bridge Analysis Simplified, B. Bakht and L.G. Jaeger, McGraw Hill	1987
4	Bridge Deck Analysis, E. J. O'Brien, and D. L. Keogh, Taylor and Francis	1999
5	Structural Bearings, H. Eggert and W. Kauschke, Ernst & Sohn	2002
6	Design of Prestressed Concrete Structures, T. Y. Lin and N. H. Burns, John Wiley and Sons	1981
7	L. Fryba, Dynamics of Railway Bridges, Thomas Telford	1996
8	Bridge Deck Analysis, E. J. O'Brien, and D. L. Keogh, Taylor and Francis	1999
9	Structural Bearings, H. Eggert and W. Kauschke, Ernst & Sohn	2002
10	Design of Prestressed Concrete Structures, T. Y. Lin and N. H. Burns, John Wiley and Sons	1981
11	Dynamics of Railway Bridges, L. Fryba, Thomas Telford	1996
12	Design of Bridges, N.Krishna Raju, Oxford and IBH Publications	1988
13	Victor D.J, Essential of Bridge Engineering Oxford & I.B.H. Publishing Co., New Delhi.	2001

Course Name	:	ADVANCED FOUNDATION ENGINEERING
Course Code	:	CEN-514
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To learn the different types of foundation and their suitability for particular site and structure. To understand soil-structure interaction and calculation of allowable load and settlement of the foundation.

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Shallow Foundations: Design considerations - factors of safety (including limit state), allowable settlements, location and depth of foundations, Codal provisions. Presumptive bearing, capacity. Bearing capacity theories. Layered soils. Choice of shear strength parameters. Bearing capacity from N-values, static cone tests, plate load tests. Settlement: Total and differential settlement. Stress distribution. Consolidation settlement in clays (with correction factors). Immediate settlement. Settlement in sands from N-values, elastic solutions. Static cone tests, Plate load test.	14
2	Deep foundations: Type of Piles. Construction methods. Axial capacity of single piles-static formulae, Skin friction and end bearing in sands and clays. Axial capacity of groups. Settlement of single piles and groups. Uplift capacity (including under-reamed piles). Negative skin friction. Pile load tests. Pile integrity tests. Codal provisions. Laterally Loaded Piles: Short and long piles; Free head and fixed head piles; Lateral load capacity of single piles; Lateral deflection; Elastic analysis; Group effect; Lateral load test; Codal provisions. Caissons and Wells.	12
3	Soil structure interaction: Introduction to soil-foundation interaction problems, soil behaviour, Foundation behaviour, Interface behaviour, Soil Foundation interaction analysis, Soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.	6
4	Soil Liquefaction and remedial measures, stone column, vibrofloatation, deep compaction.	4
5	Foundations in difficult soils: Expansive soils, chemically aggressive environment, soft soils, fills, regions of subsidence.	6

Course Outcomes:

Ability to make geotechnical design the foundation for civil engineering structure under varied field conditions.

Suggested Books:

S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	Design aids in soil mechanics and foundation engineering, Kaniraj S.K.	1988
2	Pile Foundation Analysis and Design, Poulos, H.G., and Davis, E.H., John Wiley	1980
3	Foundation Analysis and Design, Joseph E. Bowles	1996

Course Name	:	ADVANCED SOIL ENGINEERING
Course Code	:	CEN-534
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To understand the engineering properties and behavior of Soil under different field condition and loading.

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	Origin, nature and distribution of soils: Engineering Behaviour of Soils of India: Black cotton soils, alluvial silts and sands, laterites, collapsible and sensitive soils, aeolin deposits.	4

2	Description of individual particle: Clay mineralogy, clay-water-electrolytes. Soil fabric and structure. Effective stress principle. Steady state flow in soils. Effect of flow on effective stress.	5
3	Consolidation: One, two and three dimensional and radial consolidation. Sand drain and prefabricated drain. Variation of effective stress during consolidation, Stress-path. Shear behaviour of granular soils. Factors affecting shear behaviour. Determination of parameters. Shear behaviour of fine grained soils. Pore-pressure parameters. UU, CU, CD tests. Total and effective stress paths.	6
4	Factors affecting strength: Stress history, rate of testing, structure and temperature. Anisotropy of strength, thixotropy, creep. Stress-strain characteristics of soils. Determination of modulus values. Critical state model.	5
5	Geosynthetics: Types and functions; Materials and manufacturing processes; Principles of soil reinforcement; Design and construction of geosynthetic reinforced soil retaining structures – walls and slopes; embankments on soft soils; Geosynthetics in Pavements: Geosynthetics in roads and railways; separations, drainage and filtering in road pavements and railway tracks.	8
6	Methods of site investigations: Direct methods, semi-direct methods and indirect methods, Drilling methods. Boring in soils and rocks, methods of stabilizing the bore holes, measurement of water table, field record. Field tests: In-situ shear test, in-situ permeability test, SPT, DCPT, SCPT, in-situ vane shear test, pressure meter test, Dilatometer test Codal provisions.	8
7	Slope Stability analysis: Bishop (Rigorous and Simplified) Method, Mongestern's Method, and Spencer's Method.	6

Course Outcomes:

To be able to ascertain the behavior of Soil as a construction material or supporting medium for Civil Engineering structures. To be able to analyze distress/failure condition relating to Soil and hence to suggest remedial measures.

Suggested Books:

S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	Soil Mechanics in Engineering Practice, Terzaghi and Peck, John Wiley and Sons.	1967
2	Physical and geotechnical properties of soils, Bowles	1984
3	Design aids in soil mechanics and foundation engineering, Kaniraj S.K.	1988
4	Soil Mechanics, Lambe and Whitman, Wiley India	2000
5	Reinforced soil and its engineering application, Swami Saran, I k International	2010(2 nd Ed.)

Course Name	:	ADVANCED ENGINEERING GEOLOGY
Course Code	:	CEN-535
Credits	:	3
L T P	:	3-0-0
Course Objectives:		
Enhance megascopic and microscopic knowledge of mineral and rocks in turn. Importance of Geomorphic principles operated in the past. Aerial photo-interpretation and its use in identification of different Landforms. To understand significance of Landslides and Structural features in engineering construction. Critically examine role of Geological considerations in Civil Engineering Structures.		

Total No. of Lectures: 42

Lecture Wise Break Up		No. of Lectures
1	MINEROLOGY AND GEOMECHANICS: Important rock forming minerals, their megascopic and Microscopic properties. Outline classification, mode of formation & occurrence of important Rock groups (Sedimentary, Igneous and Metamorphic).	10
2	GEOMORPHOLOGY: Principles of geomorphology, occurrence of ground water in different rock types. Geophoto interpretation of Aerial photograph. Application in highway planning, Analysis of land forms, soil types, vegetative cover, Land forms (glacial, arid and fluvial), Snow cover features from aerial photographs.	14
3	ENGINEERING PROBLEMS: Landslides: cause, classification, zonation and protection, subsidence and related phenomenon, structure of rocks (folds, faults, joints, unconformity) and their significance in Engineering construction, foundation problems in different type's rocks. Geological considerations in the selection of site for buildings, dams, reservoirs, tunnels, abutments, air fields. Road stones and suitability of various rocks for road use.	18

Practical:

1	Identification of Crystal forms	14
2	Microscopic studies of important rocks and minerals through thin section slides	
3	Studies of representative aerial photographs under Mirror Stereoscope	
4	Understand Geological maps & their utility in the Civil Engineering Projects	
5	Draw structural & cross sectional profiles from the Geological map.	

Course Outcomes:

Students should be able:

1	To distinguish minerals in hand specimen and under the microscope.
2	To ascertain rocks and know their occurrence.
3	To use aerial photographs for interpretation of different landforms.
4	To apply knowledge of geological structures in engineering construction. Geological considerations as site for selection to various civil engineering structures.

Suggested Books:

S.No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	Geology for Engineers, Blyth, F.G.H. and de Freitas, M.H. ELBS.	1994
2	Engineering Geology, Goodman, R.E. John Wiley and Sons, NY	1993
3	The Dynamic Earth-An Introduction to Physical Geology, Skinner, B.J. and Porter, S.C. John Wiley and Sons, N.Y. 1989	1989