CURRICULUM

3rd – 8th Semester July 2018 admission onwards

APPROVED BY

BOARD OF STUDIES (BOS)

12thMEETING, February20th, 2019

(Modified for Survey Camp and approved in 20th Meeting of the Standing Committee of Institute Senate on 16th June 2020)

B. Tech. in Civil Engineering

Revised Teaching Scheme

DEPARTMENT OF CIVIL ENGINEERING

Dr B R AMBEDKAR NATIONAL INSTITUTE OF TECHNOLOGY,

Jalandhar

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B Tech in Civil Engineering

Programme Core (PC): 93, Programme Elective (PE): 15, Open elective (OE): 09, Core Institute (CI): 63 (1st Year 47, 4thSemester Mathematics and Humanities course 07, Projects 06, Industrial lecture 01, Practical Training: 02), Total Credit: 180

First and Second Semester, Total Credit: 50

I Semester

Course Code	Subject	L	T	P	Contact hours	Credits
PHCI-101	Applied Physics	3	1	0	4	4
CECI-101	Elements of Civil Engineering	3	1	0	4	4
CSCI-101	Computer Programming	3	0	0	3	3
MACI-101	Applied Mathematics - I	3	1	0	4	4
HMCI-101	Management, Principles and Practice	3	0	0	3	3
MECI-101	Engineering Graphics & CADD	3	0	0	3	3
PHCI-102	Physics Laboratory	0	0	2	1	1
CSCI-102	Computer Programming Laboratory	0	0	2	2	1
Total						**23 Total**

II Semester

Course Code	Subject	L	T	P	Contact hours	Credits
CYCI-101	Applied Chemistry	3	1	0	4	4
MACI-102	Applied Mathematics - II	3	1	0	4	4
MECI-101	Elements of Mechanical Engineering	3	1	0	4	4
HMCI-102	English Communication& Report Writing	3	0	0	3	3
IPCI-101	Manufacturing Process	2	0	0	2	2
CYCI-104	Environmental Science and Technology	3	0	0	3	3
HMCI-103	English Communication Laboratory	0	0	2	2	1
CYCI-103	Applied Chemistry Laboratory	0	0	2	2	1
IPCI-102	Product Realization through Manufacturing Laboratory	0	0	4	4	2
Total						**24 Total**

III Semester

Course Code	Subject	L	T	P	Contact hours	Credits
CEPC-201	Highway and Traffic Engineering	3	1	0	4	4
CEPC-203	Surveying	3	1	0	4	4
CEPC-205	Concrete Technology	3	0	0	3	3
CEPC-207	Strength of Materials	3	1	0	4	4
CEPC-209	Building Construction	2	0	0	2	2
CEPC-211	Water Supply Engineering	3	1	0	4	4
CEPC-221	Highway and Traffic Engineering Laboratory	0	0	2	2	1
CEPC-223	Concrete Technology Laboratory	0	0	2	2	1
CEPC-225	Surveying Laboratory	0	0	2	2	1
Total		**17**	**4**	**6**	**27**	**Core – 24 Total - 24**

IV Semester

Course Code	Subject	L	T	P	Contact hours	Credits
HMCI-204	Human Resource Management	3	0	0	3	3
MACI-203	Numerical Methods	3	1	0	4	4
CEPC-202	Structural Analysis-I	3	1	0	4	4
CEPC-204	Wastewater Engineering	3	1	0	4	4
CEPC-206	Earth Sciences	3	0	0	3	3
CEPC-208	Fluid Mechanics	3	1	0	4	4
CEPC-222	Fluid Mechanics Laboratory	0	0	2	2	1
CEPC-224	Structural Analysis-I Laboratory	0	0	2	2	1
CEPC-226	Wastewater Engineering Laboratory	0	0	2	2	1
Total		**18**	**4**	**6**	**28**	**Core – 20 Total- 25**

V Semester

Course Code	Subject	L	T	P	Contact hours	Credits
CEPC-301	Design of Concrete Structures-I	3	1	0	4	4
CEPC-303	Railway, Airport and Harbour Engineering	3	0	0	3	3
CEPC-305	Soil Mechanics	3	1	0	4	4
CEPC-307	Structural Analysis-II	3	1	0	4	4
CEPC-309	Construction Management	3	0	0	3	3
CEPC-311	Irrigation Engineering	3	0	0	3	3
CEPC-321	Soil Mechanics Laboratory	0	0	2	2	1
CECI-301	Minor Project, Phase-I	0	0	2	2	0*
Total		**18**	**3**	**4**	**25**	**Core - 22 Total - 22**

VI Semester

Course Code	Subject	L	T	P	Contact hours	Credits
CEPC-302	Foundation Engineering	3	1	0	4	4
CEPC-304	Design of Concrete Structures-II	3	0	0	3	3
CEPC-306	Design of Steel Structures-I	3	1	0	4	4
CEPC-308	Elements of Earthquake Engineering	3	1	0	4	4
CEPE-XXX	Departmental Elective-I	3	0	0	3	3
CEOE-XXX	Open Elective-I	3	0	0	3	3
CEPC-322	Concrete Structures-II Drawing	0	0	2	2	1
CECI-302	Minor Project* (Phase-II)	0	0	2	2	2*
CEPC-330	Survey Camp**	-	-	-	-	2**
Total		**18**	**3**	**4**	**25**	**Core - 16 Total - 26**

* Minor Project will be allotted in 5th Semester, will be evaluated after 6th Semester.

** The students will undergo Survey Camp of duration of 2-3 weeks at the end of 3rd semester (during the winter vacation) or at the end of 4th semester (during summer vacation) or at the end of the 5th semester (during winter vacation) either at a hill station or in the Institute or nearby.

VII Semester

Course Code	Subject	L	T	P	Contact hours	Credits
CEPC-401	Design of Hydraulic Structures	3	0	0	3	3
CEPC-403	Design of Steel Structures-II	3	0	0	3	3
CEPE-XXX	Departmental Elective-II	3	0	0	3	3
CEPE-XXX	Departmental Elective-III	3	0	0	3	3
CEOE-XXX	Open Elective–II	3	0	0	3	3
CEPC-421	CAD Laboratory	0	0	2	2	1
CEPC-423	Hydraulic Structures Drawing	0	0	2	2	1
CECI-300	Industrial Practical Training*	0	0	0	0	2*
CECI-400	Major Project (Phase-I)	0	0	4	4	0
Total		**15**	**0**	**8**	**23**	**Core - 08 Total - 19**

* Industrial Practical Training will be held during summer vacation after sixth semester

VIII Semester

Course Code	Subject	L	T	P	Contact hours	Credits
CEPC-402	Estimating and Costing	3	0	0	3	3
CEPE-XXX	Departmental Elective-IV	3	0	0	3	3
CEPE- XXX	Departmental Elective-V	3	0	0	3	3
CEOE-XXX	Open Elective-III	3	0	0	3	3
CECI-402	Industrial Lecture	1	0	0	1	1
CECI-400	Major Project (Phase-II)	0	0	8	8	4*
Total		**13**	**0**	**8**	**21**	**Core - 03 Total - 17**

* Major Project will be allotted in 7th Semester, will be evaluated after 8th Semester

List of Departmental Electives

(A) Semester VI: Departmental Elective I

01 subjects out of following group:

Course Code	Subject	L	T	P	Contact hours	Credits
CEPE-332	Plastic Analysis of Structures	3	0	0	3	3
CEPE-334	Structural Analysis-III	3	0	0	3	3
CEPE-336	Hydrology and Dams	3	0	0	3	3
CEPE-338	Advanced Construction Practices	3	0	0	3	3
CEPE-340	Elements of Remote Sensing and GIS	3	0	0	3	3
CEPE-342	Highway Pavement Design and Construction	3	0	0	3	3

(B) Semester VII: Departmental Elective II, III

02 subjects out of following group:

Course Code	Subject	L	T	P	Contact hours	Credits
CEPE-431	Advanced Foundation Engineering	3	0	0	3	3
CEPE-435	Industrial Structures	3	0	0	3	3
CEPE-437	Pre-stressed Concrete Design	3	0	0	3	3
CEPE-439	Finite Element Methods in Engineering	3	0	0	3	3
CEPE-441	Architecture & Town Planning	3	0	0	3	3
CEPE-449	Smart Cities	3	0	0	3	3
CEPE-453	Environmental Geo-technology	3	0	0	3	3
CEPE-455	Traffic Engineering and Management	3	0	0	3	3
CEPE-457	Hydraulics and Hydraulic Machines	3	0	0	3	3

(C) Semester VIII: Departmental Elective IV, V

02 subjects out of following group:

Course Code	Subject	L	T	P	Contact hours	Credits
CEPE-432	Bridge Engineering	3	0	0	3	3
CEPE-434	Soil Dynamics	3	0	0	3	3
CEPE-436	Hydro Power Engineering	3	0	0	3	3
CEPE-438	Software Applications in Structural Engineering	3	0	0	3	3
CEPE-440	Ground Improvement and Ground Engineering	3	0	0	3	3
CEPE-444	Quantitative Methods in Civil Engineering	3	0	0	3	3
CEPE-446	Advanced Environmental Engineering	3	0	0	3	3
CEPE-448	Advanced Civil Engineering Materials	3	0	0	3	3
CEPE -450	Fluvial Hydrodynamics	3	0	0	3	3
CEPE-452	Rural Roads	3	0	0	3	3

Open Electives Courses to be offered by the Department of Civil Engineering for Other Department students:

Course No	Course Title	L	T	P	Credits	Remarks
CEOE-370	Ecology and Environment	3	0	0	3	offered in 6^{th}, 7^{th} and 8^{th}Semester
CEOE-471	Disaster Management	3	0	0	3	
CEOE-472	Green Technology	3	0	0	3	

Syllabus
for
Bachelor Degree in Civil Engineering

THIRD SEMESTER

CEPC-201 **Highway and Traffic Engineering** **3 1 0 4**

Course Objectives

1. To give insight of the various facets of the Highway Engineering, importance and role of the transportation system as a whole and highway engineering vis-à-vis other modes of transportation.
2. To familiarize the learner with the historical development in the field of road construction right from ancient and medieval times upto the modern era, development taking place in the field of highway engineering in the Indian context including various agencies involved in the highway engineering and the roles being played by them.
3. To familiarize the learner with the various studies required for the highway planning and alignment and location surveys along with other allied surveys, preparation of the report for highway projects
4. To familiarize the learner to understand the phase of engineering which deals with the planning, analysis and design of the geometric features of the streets, geometrics design of streets, highways, abutting land and with traffic operations thereon w.r.t. safe, convenient and economic transportation of people and goods.
5. To familiarize the learner about the various traffic surveys / studies required to be conducted for collecting, processing, analyzing the data and interpretation of the results thereof for planning and designing the geometric features of the streets, highways and planning the transportation network or systems or component thereof.
6. To enable the learner to study the properties of the different materials to be used in the construction of highways and other allied structures, characterize the materials and evaluate their suitability for application in construction.
7. To make the leaner understand about the classification and behaviour of different types of pavements, factors to be considered in the design of pavements, approaches for designing the different types of pavements and the design of pavements.
8. To familiarize the learner about the construction of various types of road pavements, distresses in pavements; and maintenance and rehabilitation of pavements.

Course Curriculum

Introduction: Importance and role of transportation systems; different modes of transportation, historical development of road construction, brief history of road development in India; overview of various roads development programmes in the country and present status thereof, different programmes being executed by the various agencies, classification of roads according to different criteria.

Highway Planning, Alignment and Surveys: Various surveys for planning of the highway, highway alignment, basic requirements of an ideal alignment, factors governing the alignment, different types of surveys for locating highway

Highway Geometric Design: Factors governing the design of geometric features, cross-sectional elements, camber, sight distance-definition analysis of stopping sight and passing sight distances, passing zones. Design of horizontal alignment-super elevation. Extra widening on curves, transition curves. Design of vertical alignment, gradients, types of vertical curves and their design

Traffic Engineering: Traffic Engineering studies (speed, volume, O & D, parking and accident studies), traffic signs, traffic signals, road markings, road intersection, highway lighting.

Highway Materials: Different materials for subgrade, sub-base, base course and surface/ wearing course, desirable properties of these materials for different types of pavements, various tests to be conducted for evaluating their suitability as an highway construction materials, requirements as per codal provisions

Pavement Design: Different types of pavements, comparison between them vis-à-vis based on the structural behaviour and other parameters, factors affecting design of pavements, Various approaches of designing the pavement and methods falling under each category, analysis and design of pavement (flexible and rigid) using IRC method.

Highway Construction, Distresses and Maintenance: Construction of different types of pavements (flexible and rigid, Semi-rigid, composite, etc.), low cost and low volume roads, stabilized roads, bituminous surface treatment, etc.; distresses (failure) in pavements, maintenance including strengthening of the pavement.

Course Outcomes

Upon the successful completion of the course, the leaner shall be able to:

1. Know the various modes of transportation, their significance in the nation's building.
2. Know the development taking place in the field of highway construction until recent time.
3. Know the development in the field of highway engineering in the country and the present status thereof along with the role played by various agencies in the field.
4. Know different studies required to be carried out for highway planning, factors to be considered for highway alignment; and various surveys to be carried out for highway alignment along with the project preparation.
5. Know the cross-section elements of highway or road, different geometric features of the highway, factors affecting the design of the geometric features.
6. Understand the analysis and design of geometric features of the highway.
7. Be familiarized with different traffic studies/ surveys required to be carried out for the planning of the transportation network/ transportation system and geometric design of the streets and highways.
8. Understand as to how to conduct the traffic surveys and analyze the data to be used in the transportation/ traffic planning and geometric design.
9. Understand the properties of the various materials to be used in the construction of different types of pavements/ roads, their characterization and suitability for utilization in the construction.
10. Study the factors affecting the design of different types of pavement and analyze and design the pavements.
11. Know the construction of different types of roads/ pavements including the technique and procedure, failures in different types of pavements, maintenance and rehabilitation thereof.

Books Recommended

1. Khanna, S.K., Justo, C.E.G. and Veeraragavan, A. 2014. Highway Engineering. Nem Chand and Bros., Roorkee (Revised 10th Edition)
2. Kadiyali, L.R. and Lall, N.B., 2005. Principles and Practice of Highway Engineering. Khanna Publishers, Delhi.
3. Saxena, Subhash Chandra, 2014. A Text Book of Highway and Traffic Engineering. CBS Publishers and Distributors.
4. Sriniwaskumar, R.A., 2013. Text Book of Highway Engineering. University Press, Hyderabad.
5. Venkatramaiah, C., 2016. Transportation Engineering (Vol.-I)- Highway Engineering. University Press, Hyderabad.
6. Rao, G.V., 2000. Principles of Transportation and Highway Engineering. Tata McGraw Hill Publishing House Pvt. Ltd., New Delhi.
7. Sharma, S.K., 2014. Principles, Practice and Design of Highway Engineering (Including Airport Engineering). S. Chand and Company Pvt. Ltd., New Delhi.
8. Chakraborty, Partha and Das, Animesh, 2013. Principles of Transportation Engineering. Prentice Hall India Learning Pvt. Ltd., New Delhi

Reference Books

1. Kandhal, Prithvi Singh, 2016. Bituminous Road Construction in India:*;* PHI Learning Pvt. Ltd., Delhi
2. Papacostas, C.S. and Prevedouros, P.D., 2012.Transportation Engineering and Planning. Prentice Hall India Learning Pvt. Ltd., New Delhi.
3. Khisty, C.J. and Lall, Kent, B. 2018. Transportation Engineering. Prentice Hall India Learning Pvt. Ltd., New Delhi.
4. Srinivasakumar, R., 2015. Pavement Design. University press, Hyderabad (First Published 2013; Preprinted in 2015).

Additional Reading

Relevant specifications of Bureau of Indian Standards for Highway Material Testing, Indian Roads Congress (IRC) and Ministry of Road Transport and Highways (MoRTH) w.r.t. Planning related aspects in the context of Highway Geometrics/ Traffic Planning/ Pavement Design and Highway Construction).

Note: Some of the recent specifications may not have been incorporated in few books. For this, titles of multiple books are given in the list of the Recommended Books. The latest editions shall be used. In addition to this, relevant specifications/ codes shall be referred to.

CEPC-203 **Surveying** **3 1 0 4**

Course Objectives

1. At the end of the course the student wills possess the knowledge about Chain surveying, Compass surveying, Plane table surveying, Levelling, Theodolite surveying and Engineering surveys.
2. To apply knowledge of mathematics, science, and engineering to understand the measurement techniques and equipment used in land surveying.
3. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

Course Curriculum

Introduction: Definition, classification of surveys, principle, distorted or shrunk scales, precision in surveying. Different type of surveying: Chain Surveying, Compass Surveying and Plane Table Surveying.

Levelling: Definitions of terms used in levelling, different types of levels, parallax, adjustments, bench marks, classification of levelling, booking and reducing the levels, rise and fall method, line of collimation method, errors in leveling, permanent adjustments, corrections to curvature and refraction, setting out grades, longitudinal leveling, and profile leveling. Automatic Levels.

Contouring: Definition, representation of reliefs, horizontal equivalent, contour interval, characteristics of contours, methods of contouring, contour gradient, Interpolation of contours, uses of contour maps.Contouring by using total station and theodolite.

Hydrographic Surveying: Objects, applications, Establishing controls, Shore line survey, Sounding, Sounding Equipment, Methods of locating soundings - conventional and using GPS , Reduction of soundings, Plotting of soundings, Nautical Sextant and its use, Three point problem and its use, solution of three point problem by all methods, Tides and tide gauges, determination of MSL.

Remote Sensing and Geographical Information System: Remote Sensing Introduction and definition, Necessity, importance and use of remote sensing, Difference between Aerial photograph and satellite image, Manual & digital image interpretation, Elements of visual image interpretation such as size, shape, tone, texture, etc. Field verification or Ground truthing. Advantages and limitations of RS, Different applications of RS- (Land use and land cover mapping, Disaster management Flood & Earth Quake, and Resource Inventory management,) Digital Image processing, its objectives and different steps in it. Introduction to LIDAR & Underground utility Survey.

Geographical Information System -Introduction, Definition, Objectives, Components (people, procedure, hardware, software & data) & functions (input, manipulation, management, querry& analysis and visualization) of GIS. Coordinate systems and projections, Georeferencing, GIS data - spatial (Raster & vector) & a spatial data.

Introduction to vector and raster data analysis such as network analysis, overlay analysis etc. for vector, DEM, Management of a spatial data. Applications of GIS such as Visibility analysis, Slope analysis, Watershed analysis.& Preparation of thematic maps.Limitations of GIS.

Course outcomes

1. Knowing the concept of survey, its classification and principle.
2. To learn the different methods of surveying and their applications.
3. Understood the errors in traversing, their propagation and adjustment.
4. Able to book and reduce field observations.
5. Able to use advance equipment like total station, GPS etc. for traverse measurements.
6. Understood the use of astronomy in surveying and measurements from aerial photographs.

Text and Reference Books:

1. Punmia B.C, 2018. "Surveying" Vol.1, Laxmi Publications Pvt. Ltd., New Delhi.
2. Punmia B.C, 2018. "Surveying" Vol.2, Laxmi Publications Pvt. Ltd., New Delhi.
3. Kanetkar T.P and Kulkarni S.V, 2016. "Surveying and leveling" Vol. I, VGP, Pune.
4. Kanetkar T.P and Kulkarni S.V, 2016 "Surveying and Leveling" Vol. II, VGP, Pune.
5. Basak N N, 2017. "Surveying and leveling", Tata McGraw Hill, New Delhi.
6. Agor R, 1991. "Advance Surveying" Khanna Publishers, New Delhi.
7. Venkataramiah C, 2011. "A Text Book of Surveying" University Press, Hyderabad.
8. Alfred Leick , 2003. "GPS Satellite Surveying", Wiley.
9. Chandra A.M and Ghosh S.K, 2015. "Remote sensing and Geographical Information System", Alpha Science International Ltd.
10. Bhatta.B, 2011. "Remote Sensing & GIS", Oxford University Press.
11. Burrough P.A, Mcdonnel R.A and Lloyd C.D, 2015. "Principles of Geographical Information System", Oxford University Press.
12. SatheeshGopi, R.Sathikumar and N. Madhu, 2017. "Advanced Surveying -Total Station, GIS and Remote Sensing", Pearson publication.

CEPC-205 Concrete Technology 3 0 0 3

Course Objectives

1. To provide awareness regarding concrete as a structural material.
2. To make students knowledgeable about the materials used to make concrete; including their sources, production and properties.
3. To provide knowledge regarding designing of normal concrete mixes.
4. To make students aware of understanding of various properties of concrete in fresh and harden state.

Course Curriculum

Introduction: Concrete as a Structural material, constituent materials of concrete.

Cement: Types of cements, basic chemistry, heat of hydration, Testing of cement: Fineness, consistency, setting times, strength, types of Portland cements, expansive cements, pozzolanas.

Aggregates: Classification of aggregates, Mechanical properties: Bond, strength, toughness, hardness, physical Properties, Specific Gravity, Bulk density, porosity and absorption, Moisture content, bulking of sand, sieve analysis, fineness modulus, grading of aggregate, maximum aggregate size.

Mix Design: Factors to be considered: water/cement ratio, durability, workability, cement and aggregate content, Design of mix by IS Code Method.

Physical Properties of Fresh Concrete: Workability: factors affecting, methods of determination of workability, Density of fresh concrete.

Mixing, Handling, Placing & compaction of concrete: Mixers, mixing time, ready mixed concrete, pumped concrete, vibration of concrete, internal & external vibrators, re-vibration, shotcrete.

Strength of concrete: Porosity, Gel/space ratio, Total voids in concrete, factors affecting strength: Water/cement ratio, relation between tensile & compressive strengths; bond to reinforcement.

Permeability and Durability: Permeability, sulphate attack, action of frost, frost resistance concrete.

Course outcomes

1. Introduction of concrete as a structural material.
2. Describe the materials used to make concrete; including their sources, production and properties.
3. Knowledge of designing of normal concrete mixes.
4. An understanding of various properties of concrete in fresh and harden state.

Text and Reference Books:

1. Neville A M and Brookes J J, "Concrete Technology" Pearson Publishers, New Delhi,1994.
2. Neville A M, "Properties of Concrete" Pearson Publishers, New Delhi, 2004.
3. Gambhir M L, "Concrete Technology" Tata McGraw Hill, New Delhi, 1995.
4. Shetty M S, "Concrete Technology" S. Chand & Company, New Delhi, 2002.
5. Mehta P K,"Microstructure of Concrete" Indian Concrete Institute and ACC, Bombay, 1997.

CEPC-207 Strength of Materials 3 1 0 4

Course Objectives

1. To provide the basic concepts and principles of strength of materials.
2. To analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.
3. To give an ability to calculate stresses and deformations of objects under external loadings.
4. To give an ability to apply the knowledge of strength of materials on engineering applications and design problems.

Course Curriculum

Simple stresses and strains: Concept of stress and strain: St. Venants principle of stress and strain diagram, Hooke's law, Young's modulus, Poisson ratio, stress at a point, stresses and strains in bars subjected to axial loading, Modulus of elasticity, stress produced in compound bars subject to axial loading, Temperature stress and strain calculations due to applications of axial loads and variation of temperature in single and compound walls.

Compound stresses and strains: Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress, ellipse of stress and their applications, Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain, Relationship between elastic constants.

Bending moment and shear force diagrams: Bending moment and shear force diagrams, S F and B M definitions. BM and SF diagrams for cantilevers, Simply supported and fixed beams with or without overhangs and calculation of maximum BM and SF and the point of contra-flexure under: Concentrated loads, Uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Theory of bending stresses: Assumptions in the simple bending theory, derivation of formula: its application to beams of rectangular, circular and channel sections, composite/fletched beams, bending and shear stresses in composite beams.

Torsion: Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts torsional rigidity, combined torsion and bending of circular shafts principal stress

and maximum shear stresses under combined loading of bending and torsion, analysis of close-coiled-helical springs.

Thin cylinders and spheres: Derivation of formulae and calculations of hoop stress longitudinal stress in a cylinder, and sphere subjected to internal pressures increase in Diameter and volume.

Columns and struts: Columns under uni-axial load, Buckling of Columns, Slenderness ratio and conditions. Derivations of Euler's formula for elastic buckling load, equivalent length, Rankine Gordon's empirical formula.

Strain energy: Energy of dilation and distortion, resilience stress due to suddenly applied loads, Castigliano's theorem, Maxwell's theorem of reciprocal deflection.

Theories of Failure: Maximum principal stress theory, maximum shear stress, theory, maximum strain energy theory, maximum shear strain energy theory, graphical representation and derivation of equation for each and their application to problems relating to two dimensional stress systems only.

Course outcomes

1. Develop an understanding of the concepts of stress and strain and their use in the analysis and design of structures.
2. Ability to draw bending moment and shear force diagrams.
3. Calculate stresses for axial, torsion, bending, combined bending and axial stress.
4. An understanding of the behavior of columns and struts under axial loading.
5. Knowledge of different theories of failure.

Text and Reference Books

1. Pytel A H and Singer F L, "Strength of Materials", 4th Edition, Harper Collins, New Delhi, 1987.
2. Beer P F and Johnston (Jr) E R, "Mechanics of Materials" SI Version, Tata McGraw Hill, India, 2001.
3. Timoshenko S P and Young D H, "Elements of Strength of Materials", 5th Edition, East West Press, New Dlehi, 1984.
4. Bedi D S, "Strength of Materials", 3rd Edition, Khanna Publishing Company 3rd Edition, New Delhi, 2000.
5. Jindal U C, "Introduction to Strength of Materials", GalgotiaPublsihing Private Limited 3rd Edition, New Delhi, 2001.

CEPC-209 **Building Construction** **2 0 0 2**

Course Objectives

1. To make students understandable about the different terms used in brick masonry.
2. To share knowledge of different components of building and method of construction.
3. To make students aware about the different types of slopping roofs.

Course Curriculum

Brick Masonry: Definitions of various terms used, bond – definition, need and scope, type of bonds – Stretcher bond, Header bond, English bond and Flemish bonds, their merits and demerits.

Stone Masonry: Rubble and ashlars work.

Hollow block Masonry: Hollow cement concrete block masonry and hollow clay block masonry.

Walls: Types (i) load bearing and (ii) Non-load bearing walls, Thickness considerations.
Damp Proofing: Causes and ill – effects, preventive measures
Arches and Lintels: Definitions of various terms used in arches, Types – Flat, segmental, semi – circular and Horse – shoe, brick and stone arches, types of lintels, their merits and demerits.
Floors: Constituents, various types of floors commonly used and their suitability for different buildings, constructional details of concrete and terrazzo floors.
Doors and Windows: Location and sizes, types of Doors and windows, Method of fixing door and window frame in walls, ventilators.
Sloping roofs: Definitions of terms used, wooden trusses – king post and queen post truss, steel trusses – fink, fan and north light truss roofs, Jack arch roofs.
Stairs and Staircases: Definition of terms used, Essential requirements, proportioning of steps, types – straight flight, quarter turn, half turn and spiral staircases, ramps, escalators and lifts.
- Footings-types and details
Miscellaneous topics (to be covered briefly): Plastering and Pointing. White washing, color washing, distempering and painting, Scaffolding, underpinning and shoring, Building Bye-laws.

Course outcomes
1. To understand the different terms used in brick masonry
2. Knowledge of different components of building and method of construction.
3. Understand the different types of slopping roofs.

Text and Reference Books:

1. Rangwala S C, "Engineering materials" Charotar Publishing House, Anand, 2000.
2. Bindra & Arora, "Building Construction" Dhanpat Rai Publications (P) Ltd, New Delhi, 2003.
3. Sinha S K and Jha J, "Building Construction" Khanna Publishers, New Delhi, 2001.
4. Rangawala S C, "Building Construction" Charotar Publishing House, Anand, 1993.
5. Ghose D N, "Materials of Construction" Tata McGraw Hill, New Delhi, 2003.

CEPC-211 Water Supply Engineering 3 1 0 4

Course Objectives
1. To make the students learn about technical aspects of drinking water treatment and distribution in an integrated way.
2. To make the students pay attention to the choice of technologies and tools for water supply, ranging from low cost to advanced options.

Course Curriculum
Public Water Supply: Beneficial uses of water, water demand, per capita demand, variation in demand, causes detection and prevention of wastage of water, population forecasting.
Sources of Water Supply: Surface and underground sources, relation and development of source in r/o quality and quantity of water, development of wells. Storage reservoir balancing and service storage, capacity determination by mass curves method. Intake and transmission system: distribution systems: network design. Hydrology principles, zones of under-ground water.

Quality and Examination of Water: Necessity for examination of water impurities in water. Sampling of water, physical, chemical & bacteriological quality for domestic water supply.Drinking water quality standards and criteria.

Water Supply and Drainage of Buildings: System of water supply house connections, metering, internal distribution, sanitary fittings, pipe joints, different types of pipes and pipes materials.

Water Treatment: Unit operations in water treatment, screening, plain sedimentation tank and its theory, sedimentation, aided with coagulation, design of sedimentation tank, flocculation sand filtration, rapid gravity filter, pressure filters, disinfections; Necessary; requirements of a disinfectant, methods, of disinfecting, different practices of chlorination.

Miscellaneous Methods of Water Treatment: Aerial colour, odors & Taster from water, control, removal of iron & manganese from water softening processes, base exchange process, swimming pool water treatment.

Course outcomes

The student will be able to:

1. Identify different types of water demands and select suitable source of water.
2. Predict future population and estimate future water demands.
3. Demonstrate a firm understanding of various water quality parameters.
4. Design different water treatment units to meet the drinking water quality standards and criteria.
5. Plan and design the pumping stations and pipe network.
6. Design low cost water treatment techniques in the rural areas.

Text and Reference Books:

1. Garg, S.K., 2003. Water Supply Engineering Vol. I, Khanna Publishers, New Delhi.
2. Raju, B.S.N., 1997. Waste and Wastewater, Tata McGraw Hill, New Delhi.
3. Peavy, H.S. and Rowe, D.R., 2003. Environmental Engineerin, McGraw Hill, New Delhi.
4. Birdie, G.S., 2003. Water Supply & Sanitary Engineering, Dhanpat Rai Publications, New Delhi.

CEPC-221 Highway and Traffic Engineering Laboratory 0 0 2 1

Course Objectives

1. At the end of the course the student wills possess the knowledge about test on aggregate and bitumen which used in the construction of pavements.
2. Able to do the mix design of flexible pavement.

Course Curriculum

1. Aggregate crushing value test.
2. Aggregate attrition test.
3. Impact value test.
4. Abrasion test (Dorry's& Los Angeles)
5. Soundness test.
6. Flakiness test.
7. Water absorption & specific gravity test.
8. Laboratory C. B. R. test.

9. North Dakota cone test.
10. Penetration test on bitumen.
11. Softening point test for bitumen.
12. Ductility test.
13. Specific gravity Test.
14. Viscosity test.
15. Flash point and fire point test.
16. Marshall Stability test.

Course outcomes

1. Understood different type of aggregate and bitumen test.
2. Able to use transportation equipment in laboratory to characterizes the aggregate and bitumen properties.
3. Able to do the mix design of flexible pavement

CEPC-223 **Concrete Technology Lab** **0 0 2 1**

Course Objectives

1. To determine various properties of cement experimentally
2. To determine specific gravity and water absorption of fine and coarse aggregates.
3. To perform various test of fresh and harden concrete.
4. To carry out the test procedure of compressive test and flexure test.

Course Curriculum

1. Standard Consistency of cement.
2. Initial and final setting time of cement.
3. Soundness of cement.
4. Specific Gravity of Cement.
5. Compressive Strength of Cement.
6. Water absorption and Specific Gravity of Fine aggregates.
7. Water absorption and Specific Gravity of Coarse aggregates.
8. Workability of Concrete by Slump cone method.
9. Workability of Concrete by Compaction Factor method.
10. Workability of Concrete by Vee-Bee consistometer
11. Compressive and Flexural Strength of concrete.

Course outcomes

1. Determination of various properties of cement experimentally
2. Determination of specific gravity and water absorption of fine and coarse aggregates.
3. Various test of fresh and harden concrete.
4. Carry out the test procedure of compressive test and flexure test

CEPC-225 **Surveying Laboratory** **0 0 2 1**

Course Objectives

1. At the end of the course the student wills possess the knowledge about Chain surveying, Compass surveying, Plane table surveying, Levelling, Theodolite, Hydrographic surveying and Engineering surveys.
2. Able to use GPS and nautical sextant for measurement.

Course Curriculum

1. To range a line between two stations.
2. Plotting of details in chain survey.
3. Plotting of traverse with a compass.
4. To determine the reduced levels of stations by height of instrument and rise and fall method.
5. Plotting of details using plane table by method of intersection and method of radiation.
6. Temporary and permanent adjustments of a Theodolite.
7. Measurement of horizontal angles using a Theodolite by method of repetition and method of reiteration.
8. Traverse adjustment using Gales' traverse table.
9. Total station
10. Study and use of nautical sextant and measurement of horizontal angles
11. Plotting of river cross-section by hydrographic surveying
12. Solution to three-point problem by analytical method

Course outcomes

1. Understood working of different type of surveying equipment.
2. Able to use surveying equipment in field for measurement of distance, direction and elevation.
3. Able to adjust the traverse and calculation of coordinates i.e., latitude and departures.

FOURTH SEMESTER

HMCI-204 Human Resource Management 3 0 0 3

Human resources are the most important resources of any organization without which other resources are meaningless. In many industries, human resources provide sustainable competitive advantage. In knowledge economy and information age, their importance has increased than ever before. In this perspective, the course in human resource management is being offered with following objectives:

Course Objectives

1. To learn about basic understanding about human resources, their importance and their management.
2. To understand the key elements of human resource management.
3. To understand the key and emerging issues of human resource management in the changing business scenario.

Course Curriculum

Meaning and nature of human resource management (HRM), line and staff aspects of HRM, trends shaping HRM, operating and managerial functions of HRM, system approach to HRM, job analysis, personnel planning, recruitment, selection, psychological tests, interviews, placement and induction, talent management, training and development, performance appraisal, employee retention, career development and management, compensation and financial incentives, benefits and services, managing employee relations, ethics, employee rights and disciplines, labour relations and collective bargaining, industrial dispute act, employee health, safety and welfare, factory act, HR as a profit centre, Green HRM, HR scorecard, managing diversity and global HR resources.

Course Outcomes

1. The students would be able to understand the basic framework and dimensions of human resource management.
2. The students would be able to understand how human resources are required to be managed differently from all other resources.
3. The students would also learn how human resources can be better synchronized thorough systemic thinking to give overall synergetic outcomes and serendipitous results.

Text and Reference Books:

1. Gary Dessler, Human Resource Management, 15th Edition, Pearson.
2. George W Bohlander and Scott A Snell (2016), Principles of Human Resource Management, Cengage.
3. C.B. Mamoria and VSP Rao, Personnel Management, 13th Edition, Himalaya Publication.
4. Edwin B Flippo, Personnel Management, 6th Edition, Tata McGraw Hill Education.

MACI-203 **Numerical Methods** **3 1 0 4**

Course Objectives:

1. To make students ware about the mathematical problems arising in engineering.

Course Curriculum

Roots of algebraic and transcendental equations, Bisection method, Regula-Falsi method, Newton-Raphson method, Bairstow's method and Graeffe's root squaring method.
Solution of simultaneous algebric equations, matrix inversion and eigen-value problems, triangularisation method, Jacobi's and Gauss-Siedel iteration method, partition method for matrix inversion, power method for largest eigen-value and Jacobi's method for finding all eigen-values.
Finite differences, interpolation and numerical differentiation, forward, backward and central differences, Newton's forward, backward and divided difference interpolation formulas, Lagrange's interpolation formula, Stirling's and Bessel's central difference interpolation formulas, numerical differentiation using Newton's forward and backward difference formulas and numerical differentiation using Stirling's and Bessel's central difference interpolation formulas.
Numerical integration, Trapezoidal rule, Simpson's one-third rule and numerical double integration using Trapezoidal rule and Simpson's one-third rule.
Taylor's series method, Euler's and modified Euler's methods, Runge-Kutta fourth order methods for ordinary differential equations, simultaneous first order differential equations and second order differential equations.
Boundary value problems, finite difference methods for boundary value problems.
Partial differential equations, finite difference methods for elliptic, parabolic and hyperbolic equations.

Course Outcomes

1. After studying this course the students will be able to solve the numerical problems which arises in engineering. Students will also be able to get solution to their research problems.

Text and Reference Books

1. S S Sastry, Introductionary Methods of Numerical Analysis, 3rd edition, Prentice Hall of India Pvt.Ltd., New Delhi, India-1999.
2. S C Chapra and R P Canale, Numerical Methods for Engineers, 2nd edition, McGraw Hill Book Company, Singapore 1990.
3. Grewal B S, "Numerical Methods", Khanna Publishers, Delhi.

CEPC-202 **Structural Analysis-I** **3 1 0 4**

Course Objectives

1. Ability to idealize and analyze statically determinate and indeterminate structures.
2. Familiarity with structural analysis software.
3. Familiarity with professional and contemporary issues.
4. To introduce the students to concept of global structural stability, theory of structural analysis, and methods in structural analysis.

Course Curriculum

Introduction: Need of analysis, techniques of structural idealization, basic tools of analysis, reactions in structure, notations and sign conventions, free – body diagrams, static determinacy, stability of structures, principle of superposition, loads on structures.

Plane Trusses: Introduction, member arrangement in a truss, stability and determinacy, roof and bridge trusses, analysis of trusses, notations and sign conventions, equations of condition, zero load test, classification of trusses.

Deflection of Beams: Introduction, direct integration method, moment – area method, conjugate beam method, Principle of virtual work, unit load method, Betti's law, Maxwell's law, Castigliano's theorem.

Combined Bending and Axial Loads: Introduction, limit of eccentricity for no tension in the section, core of the section, middle third rule, wind pressure on chimneys, forces on dams.

Rolling Loads Introduction to rolling loads and influence lines, Determination of shear force, bending moment at a section and absolute shear force and bending moment due to single point load, uniformly distributed load, several point loads etc.

Influence lines: Introduction, moving loads, influence lines, influence lines for reactions, shear force and bending moment, influence lines for beams, girders with floor beams, trusses and arches, absolute maximum B. M. & S. F, Muller Breslau Principle

Arches: Introduction, curved beams, arch versus a beam, three hinged arch, moment, shears and normal thrust in three hinged arches

Cables and Suspension Bridges: Introduction, shape of a loaded cable, cable carrying point loads and UDL, cables with ends at different level, cable subjected to temperature stresses, suspension bridge with two hinged and three hinged stiffening girders, influence lines.

Statically determinate space Trusses:

Concurrent forces in space, moment of force, constraint of point in space, tension coefficient method, simple space trusses, method of sections.

Course outcomes

1. Understand the need of analysis, techniques of structural idealization, basic tools of analysis.
2. Analysis of statically determinate structural systems.
3. Concept of deflection of beams.
4. Understand the concept of rolling loads and/or reactions, support displacements and on the structures.
5. Analysis of statically determinate plane and space trusses.
6. Able to draw the influence lines of beams, trusses, girders and arches.

Text and Reference Books

1. Utku S, Norris C H and Wilbur J B, “Elementary Structural Analysis, McGraw Hill, New York, 1990.
2. Jain A K, “Elementary Structural Analysis” Nem Chand & Brothers, Roorkee, 1990.
3. Reddy C S , “Basic Structural Analysis” Tata McGraw Hill, New Delhi, 2003.
4. Hibbeler C, “Structural Analysis” Pearson Publishers, New Delhi, 2002.
5. Punmia B C, Jain A K and Jain A K “Theory of Structures" Luxmi Publications, 2000.

CEPC-204 Wastewater Engineering 3 1 0 4

Course Objectives

1. To make the students learn about wastewater network
2. To make the students aware of the various terms used in wastewater treatment.
3. To make the students learn the basics of wastewater treatment.

Course Curriculum

Introduction: Terms & definitions, systems of sanitation and their merits and demerits, system of sewerage, choice of sewerage system and suitability to Indian conditions. Design & planning of a sewage system.

Design of Sewers: Quantity of sanitary and storm sewage flow, forms of sewers, conditions of flow in sewers, sewers of equivalent section, self cleansing and limiting velocity, hydraulic formulas for flow of sewerage in sewers and their design.

Construction & Maintenance of Sewers: Sewer appurtenances, Materials for sewers, laying of sewers, joints in sewers, testing of sewers pipes, Maintenance operations and precaution before entering a sewer. Excavating Trenches.

House Drainage: Principles of house drainage, traps, Inspection chamber Indian and European type W. C., Flushing Cisterns soil waste and anti-siphonage pipes, plumbing systems.

Characteristics & Testing of Sewage: Composition of sewage, sampling, physical& chemical analysis of sewerage, biological decomposition of sewage, kinetics of organic waste stabilization. Populating equivalent & relative stability.

Treatment of Sewage: Unit processes of waste water treatment, screens, grit chambers, detritus tank, skimming tank, grease traps, sedimentation, chemical treatment, aerobic biological treatment, trickling filter (LRTF & HRTF), activated sludge processes, anaerobic treatment, units-sludge digesters and biogas plants.

Low cost waste water treatment units: Oxidations Ponds, Lagoons, ditches, septic tanks and imhoff tanks, theory, design, advantages & disadvantages.

Sewage Disposal: Dilution, self-purification of streams, oxygen deficiency of polluted streams, oxygen sag serve, deoxygenation and deoxy- genation. Dilution in seawater, disposal by land treatment.Effluent irrigation and sewage farming.Sickness and its preventive measures.

Course outcomes

The student will be able to:

1. Demonstrate a firm understanding of various sewerage systems and their suitability.
2. Design sewer and drainage systems layout for communities.
3. Evaluate the waste water characteristics to determine the degree of treatment required.
4. Explain the physical, chemical and biological techniques of wastewater treatment.
5. Compare the applicability of treatment technologies under different conditions.
6. Design the treatment units and assess the efficacy of an entire treatment system.
7. Ability to make decisions regarding the treatment plant site selection, operation and maintenance and the need of advanced treatment.

Text and Reference Books

1. Garg, S.K., 2003. Water Supply Engineering Vol. I, Khanna Publishers, New Delhi.
2. Birdie, G.S., 2003. Water Supply & Sanitary Engineering, Dhanpat Rai Publications, New Delhi.
3. Peavy, H.S. and Rowe, D.R., 2003. Environmental Engineerin, McGraw Hill, New Delhi.
4. Fair, G.M. and Geyer, J.C., 2002. Water Supply & Waster Water Disposal.
5. Nathanson, J.A., 1999. Basic Environmental Technology, Prentice Hall of India, New Delhi.

CEPC-206 **Earth Sciences** **3 0 0 3**

Course Objectives

1. To inculcate the essentials of Civil Engineering field to the students of all branches of Engineering.
2. To provide the students an illustration of the significance of the Civil Engineering Profession in satisfying societal needs.

Course Curriculum

General Geology: Divisions of geology, Importance of Engineering Geology versus geology applied to Civil Engineering practices. Weathering, definition types and effect.Geological works of rivers, wind, glaciers as agents of erosion, transportation and deposition, resulting features and engineering importance.
Rocks and Minerals: Minerals, their identification and physical properties of minerals, igneous, sedimentary and metamorphic rocks, their formation and structures. Classification of rocks for engineering purpose.Rock quality designation (RQD).
Structural Geology: Brief idea about stratification, apparent dip, true dip, strike and unconformities.
Folds: Definition, parts of a fold, classification, causes relation to engineering operations.
Faults: Definition, parts of a fault, classification cause relation to engineering purposes.
Joints: Definition, attitude, joint set, joint systems, classification in relation to engineering operations.
Engineering Geology: Geological considerations in the Engineering Projects like tunnels, highways, foundations, dams, and reservoirs. Earthquake.Definition, terminology, earthquake waves, intensity, recording of earthquake, seismic zones in India, factors to be considered and methods in earthquake proof construction.

Earth movements: Landslides and land subsidence, elementary idea about classifications, factors causing landslides and land subsidence, preventive measures like relating walls, slope treatment, chemical stabilization and drainage control.

Engineering Properties of Rocks and Laboratory Measurement: Uniaxial compression tests, tensile tests, permeability test, shear tests, effect of size and shape of specimen and rate of testing. Confining pressure, stress strain curves of typical rocks. Strength of intact and fissured rocks, effect of anisotropy, influence of effect of pore fluid type instauration and temperature.

In-situ determination of Engineering Properties of Rock Masses: Necessity of in-situ test, uniaxial load tests in tunnels and open excavation, cable tests, flat jack test, shear test, pressure tunnel test. Simple methods of determining in-situ stresses, bore hole over coring technique-bore hole deformation gauges.

Improvement in Properties of Rock Masses: Pressure grouting for dams and tunnels, rock reinforcement, rock bolting.

Course outcomes

1. Understand the structure of earth.
2. To understand the importance of geology applied to civil engineering practice.
3. Knowledge of different types of rocks and minerals and their physical properties.
4. Knowledge of in situ determination of engineering properties of rock masses.
5. Understand the concepts of folds and faults, their classification and relation to engineering purposes.

Text and Reference Books:

1. Goodman R E, "Introduction to Rock Mechanics", John Wiley & Sons, New York, 1989.
2. Jaguer J C and Cook N G W, "Foundational of Rock Mechanics" 3rd ed., Chapman & Hall London, 1979.
3. Lama R D and Vutukuri V S with Saluja S S, "Handbook on Mechanical Properties of Rocks" Vols. I to IV, Trans Tech Publications, Rockport, MA.
4. Arora D S, "A Text Book of Geology", Mahindra Capital Publishers, Chandigarh, 1988.
5. Singh P, "Engineering and General Geology" S. K. Kataria and Sons, New Delhi, 1992.

CEPC-208 **Fluid Mechanics** **3 1 0 4**

Course Objectives

1. To inculcate the understanding of fluid and it behavior.
2. To provide the students an illustration of the significance of the fluid in Civil Engineering Profession.
3. To illustrate the fluid analysis over different bodies and medium

Course Curriculum

Laminar Flow: Navier-stokes equations in cartesian coordinates (no derivation), meaning of terms, flow between parallel plates, stokes law, Flow through porous media, Transition from laminar to turbulent flow.

Boundary Layer Analysis: Assumptions and concept of boundary layer theory, Boundary layer thickness, displacement momentum & Energy thickness, laminar and Turbulent boundary layers on a flat plate, Laminar sub-layer, smooth and rough boundaries, Local and average friction coefficients, Separation and control.
Turbulent Flow: Definition of turbulence, scale and intensity, Effects of turbulent flow in pipes, Equation for velocity distribution in smooth and rough pipes (no derivation), Resistance diagram.
Flow past immersed bodies: Drag and lift, deformation Drag and pressure drag, Drag on a sphere, cylinder and Airfoil, lift-Magnus Effect and circulation, lift on a circular cylinder.
Uniform flow in open Channels: Flow classifications, basic resistance, Equation for open channel flow, Chezy, Manning, Bazin and kutter formulae, Variation of roughness coefficient, conveyance and normal depth, Velocity distribution, Most efficient flow sections- Rectangular, trapezoidal and circular.
Energy and Momentum Principles and Critical Flow: Energy and specific Energy in an open channel; critical depth for rectangular and trapezoidal channels. Alternate depths, applications of specific Energy to transitions and broad crested weirs. Momentum and specific force in open channel flow.
Gradually Varied Flow: Differential Equation of water surface profile; limitation, properties and classification of water and surface profiles with examples. Computation of water surface profile by graphical, numerical and analytical approaches.
Hydraulic Jump and Surges: Theory of Jump, Elements of jump in a rectangular channel, length and height of jump, location of jump, Energy dissipation and other uses. Surge as a moving hydraulic jump.Positive and negative surges.

Course outcomes

1. An understanding of fluid mechanics fundamentals, including concepts different types of flows and their principles.
2. Knowledge of laminar and turbulent boundary layer fundamentals.
3. An understanding of energy and momentum principles.
4. Computation of water surface profile by graphical, numerical and analytical approaches.

Text and Reference Books

1. Massey B S, “Mechanics of Fluids” ,ELBS, Van Nostrand Reinhold Co. Ltd., U. K, 1998.
2. Streeter V L, Wylie E B and Bedford K W, “Fluid Mechanics” McGraw Hill, New York, 2001.
3. Kumar D S, “Fluid Mechanics”, S. K. Kataria& Sons Publishers, New Delhi, 1998.
4. Subramanya K, “Theory and Application of Fluid Mechanics” Tata McGraw Hill, New Delhi 2001.
5. White F M, “Fluid Mechanics” McGraw Hill, New York, 1997.

CEPC-222 **Fluid Mechanics Lab** **0 0 2 1**

Course Objectives

1. To visualize the flow in different medium.
2. To understand the flow properties and behavior.
3. To demonstrate the flow behavior in Civil Engineering Profession for satisfying societal needs.

Course Curriculum

1. To draw flow net from Hele-Shaw Experiment (flow past a Circular cylinder)
2. To study the transition from laminar to turbulent flow in a pipe.
3. Verification of Stokes law
4. To draw flow net by electrical analogy method
5. Determination of Elements of Hydraulic Jump.
6. Discharge & flow profile of a broad crested weir.
7. To determine the viscosity of a given liquid by capillary-tube-viscometer.
8. To determine Manning's co-efficient of roughness for the bed of a given flume.
9. To measure the velocity distribution in a rectangular flume and to determine the energy and momentum correction factors.
10. To calibrate a current meter.
11. To study the flow over a hump placed in an open channel.
12. Demonstration of surges in an open channel.
13. Demonstration of forced vortex.

Course outcomes

1. To study the transition from laminar to turbulent flow in a pipe.
2. Determination of surges in open channels.
3. Demonstration of forced vortex flow.
4. Determination of various coefficients experimentally.
5. To draw flow net by electrical analogy method.

CEPC-224 Structural Analysis-I Laboratory 0 0 2 1

Course Objectives

1. Able to analyze the determinate structure and its reaction diagram.
2. Able to draw the influence line diagram for rolling loads.
3. Able to interpret the various methods of structural displacements.

Course Curriculum

1. To determine the flexural rigidity of a given beam.
2. To verify the moment area theorems for slope and deflection of a given beam.
3. Deflection of a simply supported beam and verification of Clark-Maxwell theorem.
4. Experiments on curved beam.
5. Deflection of statically determinate pin jointed truss.
6. Study of behaviour of columns and struts with different end conditions.
7. Experiment on three-hinged arch.
8. Experiment on two-hinged arch.
9. Deflection of a fixed beam and influence line for reactions.
10. Deflection studies for a continuous beam and influence line for reactions.
11. Unsymmetrical bending of a cantilever beam.

Course outcomes

1. To carry out different experiment on beams and verify the important theorems.
2. To conduct an experiment on curved beam.
3. To study the behaviour of columns and struts with different end conditions.
4. To analyse two hinged and three hinged arches.

CEPC-226 Wastewater Engineering Laboratory 0 0 2 1

Course Objectives

1. To impart practical knowledge of water chemistry to the students
2. To make students familiar with laboratory procedures for water and wastewater

Course Curriculum

1. Determination of Total, suspended, dissolved volatile & fixed residue in a sewage/water sample.
2. Determination of Turbidity.
3. Estimation of the pH-Value.
4. Determination of the carbonate, Bicarbonate and Hydroxide Alkalinity.
5. Determination of the type and Extend of Acidity.
6. Estimation of the Hardness of water (EDTA Method).
7. Estimation of the chloride concentration.
8. Determination of the Dissolved oxygen and percentage saturation.
9. Determination of Biochemical Oxygen Demand BOD of wastewater.
10. Estimation of Chemical Oxygen Demand. (COD)

Course Outcomes

1. To conduct experiments as per standard methods of sampling and analysis.
2. To demonstrate the expertise to characterize water and wastewater samples.
3. To understand the importance of laboratory analysis as a controlling factor in the treatment of water and wastewater.

Text and Reference Books:

1. Sawyer,C.N., McCarty, P.L. and Parkin,G.F., (2002). Chemistry for Environmental Engineering and Science. 5th edition, McGraw-Hill Publishing Company.
2. Standard methods for the examination of water and wastewater, 21st Edition, Washington: APHA., 2012.

FIFTH SEMESTER

CEPC-301 Design of Concrete Structures-I 3 1 0 4

Course Objectives

1. Be able to perform analysis and design of reinforced concrete members.
2. Be able to identify and interpret the appropriate relevant industry design codes.
3. To become familiar with professional and contemporary issues in the design and fabrication of reinforced concrete members.
4. To be familiar with professional and ethical issues and the importance of lifelong learning in structural engineering.

Course Curriculum

Introduction: Plain and Reinforced Concrete, Objectives of design. Structural systems.Introduction to design philosophies.

Analysis of Beams: Working Stress Method, Assumptions made in theory of reinforced concrete construction, moment of resistance of singly, doubly reinforced and flanged beams.

Limit State Method: Assumptions in analysis, Analysis of singly and doubly reinforced rectangular sections, Analysis of singly reinforced flanged sections.

Design of Beams for flexure: Codal provisions for design as per IS 456:2000 according to working stress and limit state method, Design of singly and doubly reinforced sections, Design of flanged sections.

Design for Shear, Bond & Torsion: Shear Stresses in homogeneous rectangular beams, critical sections, design shear strength of plain concrete, Design of shear reinforcement, Bond stress, Anchorage development length, bond failure & bond strength,

Introduction to torsion in R. C. C. beams, General behaviour in torsion, Design of sections subjected to torsion, shear and flexure.

Design of Slabs: One-Way and two-way slabs. Design of slab sections using IS method. Introduction to flat slabs.

Design of Continuous beams and slabs: Analysis of continuous systems General guidelines &Codal provisions design and detailed drawings of continuous beams and slabs.

Design of columns: Classification and effective length of columns, codal requirements, Analysis and design of sections subjected to axial loading and axial loading combined with bending moment.

Design of Isolated Footings: Types of footings, soil pressure under footings, General design considerations and Codal provisions. Design of isolated, square, rectangular and circular footings. Design of footings subjected to eccentric loads.

Staircases: Types of staircases, loads on stairs, Design of different types of staircases.

Course outcomes

1. To learn about the reinforced concrete, its properties.
2. To learn about different design philosophies for design of concrete structures.
3. To carry out analysis of beams.
4. Understand the limit state method of design of rcc members.
5. Knowledge of design provisions given in Indian standard code.
6. To design the various members like beams, slabs, columns, footings etc with limit state design method.

Text and Reference Books

1. Pillai U. and Menon D., "Reinforced Concrete Design" Tata McGraw Hill, New Delhi 2003.
2. Jain A.K., "Limit State Design of R. C. C. Structures" Nem Chand & Sons, Roorkee 2002.
3. Varghese "Limit State Design of Reinforced Concrete" Prentice Hall of India, New Delhi 2003.
4. Dayaratnam P., "Design of Reinforced Concrete" Oxford & IBH Publishers, New Delhi 2002.
5. Chandra R., "Limit State Design of Reinforced Concrete" Standard Book House, New Delhi 2002.

CEPC-303 Railway, Airport and Harbour engineering 3 0 0 3

Course Objectives

1. Students should be able to relate their understanding of the railroad industry, history, and principal components.
2. Finding out the traffic load analyzing them and designing transportation systems.

Course Syllabus

Railway Introduction: History of development of Railways, Permanent Way, Requirement of ideal permanent way, cross-sections of single and double tracks in embankment and cutting.

Rail & sleepers: Component Parts of RailwayTrack, Gauges, Resistances to Traction and Stresses in Track, Various Resistances and Their Evaluation, Hauling Capacity and Tractive Effort, Stresses in Rail, Sleepers, Coning of Wheels, Creep, Wear, Joints in Rails, Sleeper Types, Rail Fittings and Fixtures: welding, rail to rail connection, rail to sleeper connection, bearing plates and chairs

Geometric design of railway: Geometric Design, Track Alignment, Horizontal Curves, Super Elevation, Equilibrium Cant and Cant Deficiency, Transition Curves, Vertical Curves- Gradients and Grade Compensation

Points and Crossing: Simple types currently in use: points and crossing terminology, layout plans of simple cross over, turnouts, diamond crossing, Geometric design of a simple turn out design of crossings & switches.

Signaling and Interlocking: Objects of signaling, types of signals, Interlocking and devices used in interlocking.

Airport Introduction: Airport classification, classification of flying activities. Characteristics & airport size.

Airport Planning: Types of runway patterns, Running layout effect of metrological conditions, wind rose, specifications for runway clearances and other airport utilities, Airport Site Selection, Airport Obstructions, Zoning, Classification of Obstructions, Imaginary Surfaces, Approach Zone and Turning Zones,

Runway & Taxiway Design: Airport Capacity, Loading Apron, Service Hanger, Taxiway Design, Introduction to Airport Pavement Design.

Docks and Harbours: Definition, location & layout of docks, classification of docks Simple description, frequent dealing with natural and artificial harbour, their classification & requirement, action of wind, water, tides and lateral drift on harbour structures.

Course outcomes

1. Knowledge of history of development of railways.
2. Understand the working of different elements of railway track.
3. Understand the airport planning for efficient development of airports.
4. To get familiar with docks and harbours, their classification and requirement.

Text and Reference Books

1. Rangawala, S. C., 2002. Railway engineering. Charotar Publishers, Anand.
2. Arora, S. P., and Saxena, S. C., 2001. Railway engineering. Dhanpat Rai Publishers, New Delhi.
3. Khanna, S. K., Arora, M. G. and Jain, S. S., 2002. Airport planning & design. Nem Chand & Bros., Roorkee.
4. Srinivasan, R. and Rangwala, S. C., 1999. Harbours. Charotar Publishers, Anand.

CEPC-305 Soil Mechanics 3 1 0 4

Course Objectives

1. To understand origin of soil, different types.
2. Knowledge of different index properties of soil.
3. Study of classification of fine grained and coarse grained soils.
4. To understand the concept of compaction and consolidation of soil.
5. Understand the shear strength of soil and its engineering importance and application.

Course Curriculum

Basic Concepts: Definition of soil and soil mechanics common soil problem in Civil Engineering field. Principal types of soils. Important properties of very fine soil i. e. adsorbed water, base exchange and soil structure. Characteristics of main clay mineral groups.Basic definitions in soil mechanics.Weight volume relationship physical properties of soils.

Index Properties: Determination of Index properties, classification of coarse grained soils and fine grained soils.

Permeability and seepage: Concept of effective stress principle. Seepage pressure, critical hydraulic gradient and quick sand condition, Phreatic Line.Capillary phenomenon in soil.Darcy's law and its validity seepage velicity. Co-efficient of permeability and its determination average permeability of striated soil mass Factors affecting 'K' and brief discussion.

Compaction: Definition and object of compaction and concept of O.M.C. and zero Air Void Line. Modified proctor test. Factors affecting compaction. Effect of compaction on soil properties and their discussion. Field compaction methods their comparison of performance and relative suitability. Field comp active effort. Field control of compaction by proctor needle.

Consolidation: Definition and object of consolidation difference between compaction and consolidation. Concept of various consolidation characteristics i.e. a_v, m_v and C_v primary and secondary consolidation. Terzaghi's method for one-dimensional consolidation. Consolidation test. Determination of C_v from curve fitting methods. Normally consolidated and over consolidated clays importance of consolidation settlement in the design of structures.

Stress Distribution: Boussinesq's equation for a point load, uniformly loaded circular and rectangular area, pressure distribution diagrams. New marks chart and its construction. Two- to – one method of

load distribution. Comparison of Bossinesq and Westerguard analysis for a point load. Limitations of elastic formula.

Shear Strength: Stress analysis of a two - dimensional stress system by Mohr circle. Concept of pole.Coulomb's law of shear strength Coulomb - Mohr strength theory. Relations between principle stresses at failure Shear strength tests. Derivation of Skempton's pore pressure parameters. Stress strain and volume change characteristics of sands.

Course outcomes

1. The students will be able to understand the origin of soil and will have the knowledge of different index properties
2. They will be able to classify soil and understand the engineering behaviour of soil

Text and Reference Books

1. Holtz, R.D. and Kovacs, W.D., 1981. An Introduction to Geotechnical Engineering. Prentice Hall.
2. Ranjan, G. and Rao A.S.R., 2000. Basic and Applied Soil Mechanics. New Age International Pvt. Ltd., Publishers, New Delhi.
3. Murthy V N S., 2001. Principles of Soil Mechanics and Foundation Engineering. UBSPD.
4. Das, B.M. 2002. Principles of Geotechnical Engineering. Cengage Pulishers
5. Lambe, T.W. and Whitman, R.V., 2000. Soil Mechanics. John Wiley and Sons
6. Couduto, D.P., 2002. Geotechnical Engineering – Principles and Practices", Prentice Hall of India.

CEPC-307 Structural Analysis-II 3 1 0 4

Course Objectives

1. To understand indeterminate structure and methods of analysis.
2. To analysis of indeterminate beams and frames by slope deflection method, moment distribution method, kani's method
3. To analysis of indeterminate beams and frames without and with sidesway by using moment distribution method.
4. To analysis two hinged arches.
5. To understand application of influence line method for indeterminate beams.

Course Curriculum

Statically Indeterminate Beams and Frames: Introduction, types of supports-reaction components, external redundancy, statically indeterminate beams and frames, degree of redundancy

Fixed and Continuous Beams: Bending moment diagrams for fixed beams with different loadings, effect of sinking of supports, degree of fixity at supports, advantages and disadvantages of fixed beams, continuous beams, Clayperons theorem of three moments, various cases of load and geometry of continuous beams.

Slope Deflection Method: Fundamental equations, Applications to continuous beams and portal frames, side sway in portal frames.

Moment Distribution Method: Basic propositions, stiffness of a member, distribution theorem, carry-over theorem, relative stiffness, distribution factors, applications to continuous beams, portal frames with and without side sway, analysis of multi-storeyed frames, method of substitute frame.
Rotation Contribution method: Basic concepts, rotation factor, and application to continuous beams, portal frames and multistoried frames, story shear.
Approximate methods of Structural Analysis: Portal method, Cantilever Method, Substitute Frame Method.
Strain Energy: General principles, strain energy due to axial loading and bending, law of reciprocal deflections, Castigliano's first theorem, beam deflections using Castigliano's first theorem, minimum strain energy, Castigliano's second theorem, analysis of statically indeterminate beams and portal frames.
Redundant Frames: Order of redundancy, frames with one and two redundant members. Stresses due to lack of fit, the trussed beam, portal frames.
Analysis of two hinged arches
Influence lines for indeterminate Structures: Muller Breslau Principle, Influence lines for shear force, bending moment and reactions in continuous beams, balanced cantilevers and rigid Frames.

Course outcomes

1. Analysis of statically indeterminate beams and frames.
2. Understand the concept of slope deflection method and its application to continuous beams and portal frames.
3. To analyze the beams and portal frames with different types of method.
4. Knowledge of approximate methods of structure analysis.
5. To carry out analysis of redundant frames.

Text and Reference Books

1. Reddy C S, "Basic Structural Analysis" Tata McGraw Hill, New Delhi, 2003.
2. Wang C K, "Intermediate Structural Analysis" McGraw Hill, 1998.
3. Punmia B C, "Theory of Structures" Luxmi Publications, New Delhi, 1996.
4. Sinha N C, "Advanced Theory of Structures" Dhanpat Rai Publications, New Delhi, 2000.
5. Ramamrutham S and Narayan R, "Theory of Structures:" Dhanpat Rai & Sons, New Delhi, 1996.

CEPC-309 Construction Management 3 0 0 3

Course Objectives

1. To develop skills in the management and control of construction operations.
2. To study the techniques of planning resources and executing them.
3. To predict the probability of completion of project and in less time.

Course Curriculum

Introduction: Need of project planning & Management, value Engineering, time value of money, construction schedule activity & event, bar chart, milestone chart, uses & draw backs.
PERT: Construction of PERT network, time estimate & network analysis, forward pass & backward pass, event slack, critical path, data reduction.

CPM: Definitions, network construction, fundamental rules determination of project schedule, activity time estimates, float types, their significance in project control, critical path.
Three phase application of CPM: Planning scheduling & controlling, updating an arrow diagram, time grid diagram, resource scheduling.
Cost analysis & contract: Types of project cost, cost time relationships cost slopes, conducting a crash programme, determining the minimum total cost of a project.
Factor affecting Selection of equipment: Type of equipment, depreciation cost, operating cost, Economic life of equipment, maintenance & repair cost.
Earth Moving Machinery: Tractors & related equipment, bulldozers, scrapers, Power shovels, dragline, hoes etc.
Construction Equipment: Grading / proportioning, batching mixing, types of mixers, concrete pumps, placing & compacting concrete.
Hoisting & Transporting Equipment: Hoists, winches, cranes, belt conveyors, truck etc.

Course outcomes

1. To understand the need of project planning and management.
2. Knowledge of different methods of project planning.
3. To perform cost analysis to determine minimum cost of project.
4. To make aware with different construction equipment and their working.

Text and Reference Books

1. Srinath, L. R., 1999. PERT & CPM. Affiliated East-West press (P) Ltd., New Delhi.
2. Modi, P. N., 1995. PERT & CPM, Standard Book House, Delhi.
3. Wiest, J. D., 1997. A management guide to PERT & CPM. Prentice Hall of India (P) Ltd, New Delhi.
4. Peurify, R. L, 1996. Construction, planning equipment & management. McGraw Hill Book company, New Delhi.
5. Sharma, S. C., 1990. Construction equipment & its management. Khanna Publishers, Delhi.

CEPC-311 Irrigation Engineering 3 0 0 3

Course objectives

1. To provide the basics of hydrological cycles and water harvesting
2. To understand the type or crops and irrigation methods in India and globe
3. To provide the basics of ground water and its uses in irrigation engineering
4. To give knowledge of irrigation project report and its preparation

Course Curriculum

Introduction: Water shed and its management, its relation to hydrologic cycle (in brief), introduction about rain water harvesting and about the present need in Punjab.
Surface water hydrology - Rainfall and its measurement, mean rainfall, runoff; Flow measurements; Infiltration losses
Methods of Irrigation: Advantages and disadvantages of irrigation, water requirements of crops, factors affecting water requirement, consumptive use of water, water depth or delta and crop relation, Duty of

water, relation between delta, duty and base period, Soil crop relationship and soil fertility, sprinkler Irrigation – advantages & limitations, Planning and design of springler irrigation, Drip irrigation – advantages & limitations, suitability.

Canal Irrigation: Classifications of canals, canal alignment, Inundation canals, Bandhara irrigation, advantages and disadvantages. Silt theories – Kennedy's theory, Lacey's theory, Drawbacks in Kennedy's &Lacey's theories, comparison of Lacey's and Kennedy's theories, Design of unlined canals based on Kennedy &Lacey's theories, suspended and bed loads.

Lined Canals: Types of lining, selection of type of lining, economics of lining, maintenance of lined canals, silt removal, strengthening of channel banks, measurement of discharge in channels, design of lined canals methods of providing drainage behind lining.

Investigation and preparation of irrigation project: Classification of projects, project preparation investigations, design of works and drawings, concepts of multi purpose projects, Major, medium and minor projects, planning of an irrigation project, economics & financing of irrigation works documentation of project report, Present cutes of water changed by Irrigation Department from cultivation.

Tube Well Irrigation: Types of tube wells strainer type, cavity type and slotted type. Type of strainers, aquiclude, aquifer, porosity, uniformity coefficient, specific yield & specific retention, coefficients of permeability, transmissibility and storage.Yield or discharge of tube well, assumptions, Theim&Dupuit's formulas. Interference of tube wells with canal or adjoining tube wells, optimum capacity. Duty and delta of a tube well.Rehabilitation of tubewells.

Course outcome:

1. To understand the concepts of water shed management and its relation to hydrological cycle.
2. Knowledge of different methods of irrigation, their advantages and disadvantages.
3. Concept of canal irrigation, and various theories for canal designing.
4. Study of river training works, its objectives, classification and design of various elements.

Text and Reference Books

1. Singh Bharat, "Fundamentals of Irrigation Engineering" Nem Chand & Brothers, Roorkee, 1975.
2. Arora K R, "Irrigation Water Power & Water Resources Engineering" Standard Publishers Distributors, Delhi, 2002.
3. Garg S K, "Irrigation Engineering & Hydraulic Structures" Khanna Publishers, Delhi, 1995.
4. Varshney, Gupta & Gupta, "Irrigation Engineering & Hydraulic Structure" Nem Chand & Bros., Roorkee,1982.
5. Asawa G L, "Irrigation Engineering" Wiley Eastern Ltd., New Delhi,1993.
6. Subramanya K, "Engineering Hydrology" Tata McGraw-Hill, New Delhi, 2001.

CEPC-321 **Soil Mechanics Laboratory** **0 0 2 1**

Course Objectives

1. To carry out the visual examination of soil.
2. Determination of different index properties of soil.
3. To carry out hydrometric analysis.
4. To conduct compaction and consolidation test on soils.

Course Curriculum

1. Visual Examination of soil samples. Field identification tests. Classification as per IS Code.
2. Determination of water content of soil:
    a. By oven drying method
    b. Pycnometer method
3. Determination of in- situ density by core cutter method and sand replacement method.
4. Determination of Liquid Limit & Plastic Limit by Casagrande apparatus and penetrometer method.
5. Determination of specific gravity of soil solids by pyconometer method.
6. Grain size analysis of given sample of sand and determination of coefficient of uniformity and coefficient of curvature.
7. Hydrometer analysis.
8. Direct shear test on a given soil sample.
9. Unconfined compression test for fine-grained soil.
10. Tri-axial Shear Test.
11. Lab vane shear test
12. Determination of permeability by constant head Methods and variable head method.
13. Compaction test (Proctor) and Modified proctor test. Plot of zero air voids line.
14. Consolidation Test

Course outcomes

1. Students will be able to visually examine the soil
2. Students will be able to determine Water content, specific gravity, Atterberg's Limits and Gradation of soil
3. Students will be able to determine laboratory as well as field compaction
4. Students will be able to determine the shear properties (cohesion and angle of friction).

CECI-301 **Minor Project Phase-I** **0 0 2 0**

The students will be allotted the minor project in phase – I.

SIXTH SEMESTER

CEPC-302 Foundation Engineering 3 1 0 4

Course Objectives

1. To provide knowledge based on the current practices in foundation engineering to carry out the job of selection, design and construction of foundations.
2. To study the earth pressure theories.
3. To carry out the soil investigation and study of methods involved in it.
4. Understand the significance and determine the load bearing capacity for shallow and deep foundations.
5. To carry out analysis and design of pile foundation and machine foundation.
6. Understand the concepts of stability of slopes.

Course Curriculum

Earth Pressure: Terms and symbols used for a retaining wall. Movement of wall and the lateral earth pressure. Rankine's and Coulomb's theory for lateral earth pressure.Culmann's graphical construction and Rebhan's graphical construction.

Arching in soil and Braced Cuts: Theory of Arching, Braced excavations, Deep cuts in sand, saturated soft to medium clays.

Soil Investigation: Object of soil investigation for new and existing structures. Depth of exploration for different structures.Spacing of bore holes.Methods of soil exploration and relative merits and demerits.standard penetration test, dynamic cone penetration test, static cone penetration test, field vane shear test, large shear box test, field permeability test, Geophysical Tests, Dynamics properties of soil planning of soil exploration programme.

Shallow Foundation: Types of shallow foundations, definitions Terzaghis analysis. Types of failures.Factors affecting bearing capacity.Skemptons equation.B. I. S. recommendations for shape, depth and inclination factors. Plate Load Test and Standard Penetration Test. Contact pressure distribution. Causes of settlement of structures comparison of immediate and consolidation settlement Calculation of settlement by plate load test and Static Cone Penetration Test data. Allowable settlement of various structures according to IS Code. Situation most suitable for provision of rafts.Proportioning of rafts in sand and clays.Various methods of designing raft.Floating foundation.

Types of foundations, selection of type of foundation, basic requirements of a foundation, computation of loads, Design steps.

Pile Foundation : Necessity and uses of piles, classification of piles. Merits and demerits of different types based on composition. Types of pile driving hammers & their comparison.Effect of pile driving on adjacent ground.Use of Engineering news formula and Hiley's formula for determination of allowable load. Pile Load Test, separation of skin friction and point resistance using cyclic pile load test data. Related Numerical problems.Determination of point resistance and frictional resistance of a single pile by static formula. Piles in clay, safe load on a friction and point bearing pile. Pile in sand spacing of piles in a group, factors affecting capacity of a pile group. Efficiency of pile group bearing capacity of a pile group in clay. Settlement of pile groups in clay and sand Negative skin friction.

Stability of Slopes: Necessity, causes of failure of slopes. Stability analysis of infinite and finite slopes in sand and clay.Taylor's stability number and its utility.

Caissons and wells: Major area of use of caissons Advantages and disadvantages of open box and pneumatic caissons. Essential part of a pneumatic caisson.Components of a well.

Machine Foundations: Theory of vibrations, foundations subjected to vibrations, determination of dynamic properties of soil, Dynamic analysis of block foundations.

Course outcomes

1. The students will be able to select the correct foundation for the structure, calculate the bearing capacities
2. They will be able to determine the stability of slopes, calculate lateral earth pressures

Text and Reference Books

1. Ranjan, G. and Rao A.S.R., 2000. Basic and Applied Soil Mechanics. New Age International Pvt. Ltd., Publishers, New Delhi.
2. Murthy V N S., 2001. Principles of Soil Mechanics and Foundation Engineering. UBSPD.
3. Das, B.M. 2004. Principles of Foundation Engineering. Cengage Pulishers
4. Couduto, D.P., 2002. Geotechnical Engineering – Principles and Practices", Prentice Hall of India.

CEPC-304 Design of Concrete Structures-II 3 0 0 3

Course Objectives

1. To design special reinforced concrete components such as footings, retaining walls, curved beams, domes and water tanks.
2. To model and predict the response of reinforced concrete members under axial, flexure and shear loads.
3. To have the ability to compose, solve and evaluate the internal forces, the deformations, the stresses and reinforcements in various structures made of special Reinforced Concrete.

Course Curriculum

R. C. C. Footings: Design of combined footings (Trapezoidal and rectangular) Design of Strap footing and raft foundations. Design of piles and pile footings.

Beams curved in plan: Design of semicircular beams supported on three supports. Design of circular beam supported on symmetrically placed columns.

Domes: Introduction to different types of domes and shells. Design of spherical and conical domes. Design of cylindrical shells supported on edge beams.

Retaining Walls: Design of cantilever and counter fort retaining walls. Design of basement walls.

Water Tanks: Introduction, Design of tanks resting on ground, under ground tanks and elevated tanks.

Course outcomes

1. Able to design various types of footings with reference to is codes.
2. Able to design of special structural elements like, beams curved in plan, domes.
3. Able to design of different types of retaining wall.
4. Design of different types of water tanks.

Text and Reference Books

1. Raju N K, "Advanced Design of Structures" Tata McGraw Hill, New Delhi, 2000.
2. Varghese P C, "Advanced Reinforced Concrete Design" Prentice Hall of India, New Delhi, 2001.
3. Dayaratnam, P," Advanced Design of Concrete Structures" Oxford and IBH Publishing Co, Pvt. Ltd., New Delhi, 2002.
4. Syal I C, "Behaviour, Analysis and Design of Reinforced Concrete structural Elements" S. Chand & company, New Delhi, 2003.
5. MacGregor J G, "Reinforced Concrete- Mechanics and Design", Prentice Hall, N.J., New York,1997.

CEPC-306 Design of Steel Structures-I 3 1 0 4

Course Objectives

1. To make students aware about different types of steel joints and their design.
2. To share knowledge of design provisions given in Indian standard code.
3. To make students aware about the concepts of basic elements like, tension and compression members, column bases, plate girder.
4. To provide knowledge about the analysis and design the roof trusses.

Course Curriculum

Joints: Introduction to different joints,Stresses in bolts, strength and failure of bolted joints, Types of welds and welded joints, stresses in welds, design of welds, eccentrically loaded welded joints

Tension Members: Types of tension members, net and gross areas, permissible stresses. Design of members subjected to axial loads, combined bending moments and axial loads, lug angles. Tension Splice

Compression Members: Failure modes of columns, end conditions and effective length of columns, various empirical formulae. IS code formula, General codal provisions for design of compression members, Built up compression members, lacing and battening of compression members, splicing of compression members.

Column Bases and Foundations: Types of column bases, design of slab base, Gussetted base and grillage foundations.

Design of Flexural Members: Failure modes permissible stresses, design of laterally supported and unsupported beams, web crippling, web buckling, compound beams.

Design of plate Girders: Components of a plate girder, basic design assumptions, stiffeners in plate girders, design of various components of a welded and riveted plate girder.

Roof Trusses: Types of roof trusses loads on roof trusses, calculation of forces due to combination of different loads, Design of members and joints.

Course outcomes

1. Understand the different types of steel joints and their design.
2. Knowledge of design provisions given in Indian standard code.
3. Able to design the basic elements like, tension and compression members, column bases, plate girder.
4. Able to analyze and design the roof trusses.

Text and Reference Books

1. Chandra R, "Design of Steel Structures" Standard Publishing House, 1999.
2. Raghupathi M, "Design of Steel Structures" Tata McGraw-Hill, New Delhi, 1998.
3. Arya A S and Ajmani J L, "Design of Steel Structures" Nem Chand Bros. Roorkee,2000.
4. Kazimi S M A and Jindal R S, "Design of Steel Structures" Prentice Hall of India, New Delhi,1999.
5. Dayaratnam P, "Design of Steel Structures" Wheeler Publishers, New Delhi, 1999.

CEPC-308 Elements of Earthquake Engineering 3 1 0 4

Course Objectives

1. To make the students familiar with the dynamics problems for damped and undamped free vibration for single degree freedom system.
2. To make the students understandable regarding the earthquake resistance design philosophy.
3. To carry out lateral load analysis with reference to Indian standard code.
4. To do seismic design and detailing of structures with reference to is code.

Course Curriculum

Undamped free vibrations of single degree of freedom systems: Introduction, definitions, characteristics of a dynamic problem, degrees of freedom, Newton's law of motion, De Alembert's Principal, free body diagram, derivations of differential equation of motion, solution of differential equation of motion, equivalent stiffness of spring combinations, springs in series, springs in parallel.

Damped free vibrations of single degree of freedom systems: Introduction, types of damping, free vibrations with viscous damping, over-damped, critically- damped and under- damped systems, logarithmic decrement, structural damping.

Earthquake Resistant Design Philosophy: Introduction, criteria for earthquake resistant design, principles of reliable seismic behaviour, structural forms for earthquake resistance, earthquake forces versus other forces.

Lateral Load Analysis: Idealization of structures and selection of analysis, equivalent lateral force concepts, response spectrum analysis, seismic forces as per IS : 1893 – 1984 and IS : 1893 – 2002.

Behaviour and Design of Concrete Structures: Characteristics of concrete and reinforcing steel, influence of bond and anchorage and confinement of concrete, Seismic design and detailing of reinforced concrete and masonry buildings (IS 13920; IS 13827: IS 13828; IS 4326) and flexural strength and ductility of RC members.

Course outcomes

1. Study the dynamics problems for damped and undamped free vibration for single degree freedom system.
2. Understanding the earthquake resistance design philosophy.
3. To carry out lateral load analysis with reference to Indian Standard code.
4. Able to do seismic design and detailing of structures with reference to IS code.

Text and Reference Books

1. Paz M, "Structural Dynamics – Theory and Computation" CBS Publishers and Distributors, New Delhi, 2003.
2. Chopra A K, "Structural Dynamics" John Wiley & Sons, New Delhi, 2002.
3. Dowrick D J, "Earthquake Resistant Design for Engineers and Architects" John Wiley & Sons, New York, 2000.
4. Paulay and Priestley, "Seismic Design of Reinforced Concrete and Masonry Buildings" John Wiley and sons, New York, 1992.
5. Rao S S,"Mechanical Vibrations" Pearson Education Publishers, 2004.

Departmental Electives

CEPE-332 **Plastic Analysis of Structures** **3 0 0 3**

Course Objectives

1. To apply the theorems and methods and principles of limit analysis of structures under various actions.
2. To understand the concept and use of ductility factors.
3. To use regulations for analysis and design of plastic structures, in addition to automatic calculation programs in structural analysis, for understanding the analysis results and the design principles.

Course Curriculum

Introduction: Ductility of metals: Concept of plastic design, Overloaded factors, Ultimate load as design condition.

Analysis of Indeterminate Structures: Hinge formation in indeterminate structures, Redistribution of moments, Assumption made for structure subjected to bending only.

Minimum Weight Design: Concept, assumption, Design of frame with prismatic members, Elements of linear programming and its application to minimum weight design problems.

Deflection: Assumption, Calculation of deflection at ultimate loads, Permissible rotations.

Secondary Design Considerations: Influence of direct load, shear local bucking, lateral bucking, repeated loading and brittle fracture on moment capacity. Design of eccentrically loaded columns.Problem of incremental Collapse, Shake down analysis. Special considerations for design of structures using light gauge metals.

Course outcomes

1. Introduction to plastic design.
2. Able to do analysis of indeterminate structures.
3. An understanding of Special considerations for design of structures using light gauge metals.
4. Calculation of deflections at ultimate loads.

Text and Reference Books:

1. Neal B G, "Plastic Methods of Structural Analysis" Chapman Hall, London, 1977.

2. ManikaSelvam V K, “Limit Analysis of Structures” Dhanpat Rai Publications, New Delhi, 1997.
3. Arya A S and Ajmani J L, “Design of Steel Structures” Nem Chand & Bros, Roorkee,1992.
4. Chandra R, “Design of Steel Structures” Vol. I & II Standard Book House, Delhi, 1999.
5. M.P. Nielsen, “Limit Analysis and Concrete Plasticity” CRS Press, London, 1998.

CEPE-334 Structural Analysis-III 3 0 0 3

Course Objectives

1. Introduce flexibility method for analysis of statically indeterminate structures.
2. Introduce stiffness method for analysis of statically indeterminate structures.
3. Introduce finite difference method for analysis of slabs
4. Introduce introduction to finite element method for analysis of statically indeterminate structures

Course Curriculum

Review of Determinants and Matrices: Introduction, summation convention, determinants and their properties, Cramer’s rule, matrices and their properties, solution of non-homogeneous equations by matrix methods, differentiation and integration of a matrix.

Flexibility method of Analysis: Introduction, method of consistent deformation, application to pin jointed frames, effect of temperature and pre-strain, displacements and forces in members of indeterminate structures, flexibility matrix of a plane member.

Stiffness Method of Analysis: Introduction, relation between slope deflection method and stiffness method, choice between flexibility and stiffness method, stiffness method for members with relative displacement of supports, analysis of indeterminate structures, analysis of pin-Jointed frames.

Computer Applications: Matrix structural analysis using spreadsheets, MS Excel Matrix Commands, MS Excel procedure for stiffness method of analysis, analysis of single span beams, continuous beams, plane trusses and plane frames.

Course outcomes

1. Review of matrices and determinants.
2. To perform analysis of beams and pin jointed frames by flexibility and stiffness methods.
3. To develop ms spread sheets for matrix analysis.

Text and Reference Books:

1. Gere W and Weaver J M, “Matrix Analysis of Structures” CBS Publishers, New Delhi, 1986.
2. Kanchi M B, “Matrix Methods of Structural Analysis” Wiley Eastern Limited, New Delhi, 2002.
3. Ganju T N, “Matrix Structural Analysis using Spreadsheets” TMH Publishing Co. Ltd. New Delhi,2002.
4. Vazirani V N and Ratwani M M, “Advanced Theory of Structures and Matrix Methods” Khanna Publishers, New Delhi, 1995.
5. Pandit G S and Gupta S P, “Structural Analysis A Matrix Approach” Tata McGraw Hill, New Delhi, 1994.

CEPE-336 **Hydrology and Dams** **3 0 0 3**

Course Objectives

1. To provide information of hydrological cycles
2. To show the all the processes, simulation and factors of hydrological cycles
3. To estimate the quantity of water in subsurface and surface zones.
4. To evaluate the peak flow in natural streams for designing of hydraulic structures

Course Curriculum

Introduction, Precipitation, Importance of hydrological data in water resources planning.The hydrologic cycle.mechanics of precipitation, types and causes, measurement by rain gauges, Gauge net-works, hyetograph, averaging depth of precipitation over the basin, mass-rainfall curves, intensity duration frequency curves, depth area-duration curves.

Interception, Evapo-transpiration and infiltration: Factors affecting interception. Evaporation from free water surfaces and from land surfaces, transpiration, Evapo-transpiration.

Infiltration-Factors affecting infiltration, rate, infiltration capacity and its determination.

Runoff: Factors affecting runoff, run-off hydrograph, unit hydrograph theory, S-curve hydrograph, Synder's synthetic unit hydrograph.

Peak Flows: Estimation of Peak flow-rational formula, use of unit hydrograph, frequency analysis, Gumbel's method, design flood and its hydrograph, Principles of flood routing through a reservoir by ISD method (description only).

Dam's hydrology: Outflow hydrograph of dam, stage hydrograph, flow routing, topography and flood inundation using Arc GIS.

Ground water hydrology - Introduction, types of aquifers, wells, well yield

Course outcome:

1. Understand the hydrological cycle and its importance in water resource planning.
2. Understand the concept of evapo transpiration, interception and infiltration.
3. Estimation of surface runoff and peak flows using unit hydrograph theory.
4. Analysis of different types of dams like, gravity dams, buttress dam, earthen dam.

Text and Reference Books:

1. Subramanya K, "Engineering Hydrology" Tata McGraw-Hill, New Delhi, 2001.
2. Wilson E M, "Engineering Hydrology" ELBS, English Language Book Society/Macmillan Education Ltd. London, 1999.
3. Raghunath H M, "Hydrology" Wiley Eastern, New Delhi, 2000.
4. Pence V M, "Hydrology – Principles and Practices" Prentice Hall, New Jersy. , 1998.
5. Karanth K R, "Hydrology" Tata McGraw Hill, New Delhi 2001.
6. ArcGIS software (prefer latest version).

CEPE-338 Advanced Construction Practices 3 0 0 3

Course Objectives

1. To share overview of latest concrete construction methods.
2. To make the students understandable of various methods of handling and placing of concrete.
3. To make the students familiar with the construction techniques in marine environment.
4. To make students aware about the quality and safety measures in construction works.

Course Curriculum

Concrete Construction Methods,Formwork Design and Scaffolding; Slip Forms and other moving forms; Pumping of Concrete; Grouting and Mass Concreting Operations(roller compacted concrete); Ready-Mix Concrete; Various Methods of Handling and Placing Concrete, Accelerated curing, Hot and cold weather concreting, Under water concreting, Prestressing. Steel and Composite Construction Methods, Fabrication and erection of structures including heavy structures, Prefab construction, Industrialized construction and Modular coordination. Special Construction Methods, Construction in Marine Environments, High Rise Construction, Bridge Construction including Segmental Construction, Incremental Construction and Push Launching Techniques; Geosynthetics; Safety, Quality Measures and Reliability

Course outcomes

1. To get overview of latest concrete construction methods.
2. An understanding of various methods of handling and placing of concrete.
3. Understand the construction techniques in marine environment.
4. To make aware the quality and safety measures in construction works.

Text and Reference Books:

1. Neville A M and Brooks J J, "Concrete Technology" Pearson Education Asia, Singapore, 1994.
2. Neville A M, "Properties of Concrete" Pearson Education, New Delhi, 2004.
3. Peurifoy R L, "Construction Planning, Equipment and Methods" McGraw Hill Ltd., New York, 2002.

CEPE-340 Elements of Remote Sensing and GIS 3 0 0 3

Course Objectives

- To study the fundamental concepts of geographic information systems
- To study the fundamentals of remotely sensed data and its integration with geographic information systems

Course Curriculum

Introduction to Geographic Information System: Definitions and related terminology, evolution of GIS, components of GIS, approaches to the study of GIS.

Maps and GIS: Introduction, Map scale and classes of maps, the mapping process, plane coordinate systems and transformations, geographic coordinate system of earth, map projection, georeferencing and topographic mapping.

Digital Representation of Geographic Date: Introduction, database and database management systems, raster geographic date representation, vector data representation, data representation and data analysis in GIS.
Raster Basic GIS Data Processing: Introduction, acquiring and handling raster geographic data, raster based GIS data analysis, cartographic modeling.
Vector Based GIS Data Processing: Introduction, Characteristics of vector based GIS data processing, topological and non-topological functions.
Remote Sensing: Introduction, Spectral Reflectance Signature, Digital Image Processing, Visual Interpretation of Satellite data, Aerial Photo and Its Interpretation, Advanced Remote Sensing Technologies, Advantages and Benefits of RS, Overview on Remote Sensing Technology, Fundamentals of Remote Sensing, Physics of Electro Magnetic Energy, Remote Sensing Platforms, Sensors and Data Products, Remote Sensing Applications, Indian Remote Sensing Systems.
Applications of Technology: Water shed Studies, Flood Studies, Ground water Studies, Health Issues, Utility Studies, Security and Defense Studies, Urban and infrastructure Studies

Course outcomes

1. Introduction to basis of GIS.
2. Understand the mapping process and geographical coordinate system of earth.
3. Able to do vector based and raster based data processing.
4. Knowledge of remote sensing and its components.
5. To apply integration of remote sensing and GIS.

Text and Reference Books

1. Lo C P and Young K W, "Concepts and Techniques of Geographic Information Systems" PHI Pvt. Ltd, New Delhi, 2002.
2. Campbell J B, "Introduction to Remote sensing" CBS Publishers & Distributors, New Delhi,2003.
3. Burrough P A, "Principles of Geographic Information Systems for Land Resources Assessment" Oxford University Press, 2003.
4. Duggal S K, "Surveying Volume 2" Tata McGraw Hill, New Delhi, 2004.
5. Donnay J P, "Remote Sensing and Urban Analysis" CBS Publishers & Distributors, New Delhi,2003.

CEPE-342 Highway Pavement Design and Construction 3 0 0 3

Course Objectives

1. To study the different types of highway pavements depending upon the mode of transportation using it and further, depending upon the structural behaviour.
2. To understand the concept of consideration of wheel loads, axle loads, wheel –axle configuration and allied aspects as a pre-requisite in the analysis and design of the pavement.
3. To study the various types of structural responses (stresses and deformations) inducing in the pavements due to wheel load and other climatic variations using in the flexible and rigid pavements and subsequent, the design of these pavements.
4. To introduce the constructions of different types of highway pavements and use of ground improvement techniques w.r.t. application in highway constructions.

5. To study the different types of distresses in the pavement, evaluation of the existing pavements using different methods and rehabilitation of the distressed pavements.
6. To study the design methodology and construction technology w.r.t. low volume roads.

Course Curriculum

Introduction: Pavement structure and functional attributes, factors affecting pavement design, types of wheel loads for highway and airports, development of design methods for highways and airport pavements.

Analysis of Pavements: Stresses in flexible pavements- Single layer, Two layer and Three layer theories , ESWL, EWLF, etc.; Stresses in rigid pavements- Wheel load, temperature and combined stresses.

Flexible Pavement Design: Various approaches for designing the pavements (empirical, semi-empirical, mechanistic empirical, etc.), methods falling under each of these methods, overview of the revision of specifications pertaining to these methods; design of pavements using these methods.

Rigid Pavement Design: Various approaches for designing the pavements and methods falling under each of these methods, overview of the revision of specifications pertaining to these methods; design of pavements using these methods, design of joints

Highway Constructions: Construction of water bound macadam, wet mix macadam roads, bituminous concrete Roads, bituminous surfacing and treatment, cement concrete roads, semi-rigid and composite pavements, pavement construction using Pozzolanic and waste materials, roller compacted concrete pavement, fiber reinforced concrete pavements, quality control and quality assurance during constructions, etc., highway drainage with special considerations to be given in hilly areas.

Ground Improvement Technique:

Different method of soil stabilization, use of geotextiles, geogrids and fibres in highway construction, use of sand drains and band drains.

Evaluation and Strengthening:

Distresses in flexible and rigid pavements, condition and evaluation surveys, present serviceability index, roughness measurement, pavement maintenance, Benkelman beam deflections, different methods of designing the overlays, different overlays overview of the revision of specifications pertaining to the various methods of designing the overlays, design of different types of overlay , skid resistance and measurement

Low Volume and Low Cost Roads: Classification of low cost roads, stabilization of subgrade, sub-base and base and its advantages, low cost materials and methods used for construction, design of such pavements.

Course Outcomes

1. Understand the structural actions involved in the pavement due to different types of load acting thereon and the various methods of analysis of these pavements.
2. Understand the application of analysis in the design of pavements using various methods of pavement designs along with the design of low volume roads.
3. Understand the various aspects of the construction of different types of roads including that of low volume roads and the use of ground improvement techniques in the context of road constructions.
4. Know the different types of failures occurring in the existing pavements and carry out the structural and functional evaluation of pavements;
5. To apply the knowledge gained in evaluating the pavements in pre-empting the failure and subsequently, in arriving upon the methodology of the rehabilitation of pavements.

Text and Reference Books:

1. Sharma, S.K., 2014. Principles, Practice and Design of Highway Engineering (Including Airport Engineering); S. Chand and Company Pvt. Ltd., New Delhi.
2. Srinivasakumar, R., 2015. Pavement Design; University Press, Hyderabad (First Published 2013; Preprinted in 2015).
3. Kadiyali, L.R.andLall, N.B., 2005. Principles and Practice of Highway Engineering; Khanna Publishers, Delhi
4. Yang H. Huang, 2008. Pavement Analysis and Design; Pearson Prentice Hall, USA
5. Das, Animesh, 2017. Analysis of Pevement Structures; CRC Group, Taylor and Francis Group
6. Khanna, S.K., Justo, C.E.G. and Veeraraghavan, A.,2015. Highway Engineering; Nem Chand and Bros., Roorkee (Revised 10^{th} Edition).
7. Saxena, Subhash Chandra, 2014. A Text Book of Highway and Traffic Engineering; CBS Publishers and Distributors, New Delhi
8. Venkatramaiah, C., 2016. Transportation Engineering (Vol.-I)- Highway Engineering.; University Press, Hyderabad.
9. Rao, G.V., 2000. Principles of Transportation and Highway Engineering;Tata Mc-Graw Hill Publishing House Pvt. Ltd., New Delhi.
10. Chakraborty, P. and Das, A., 2013. Principles of Transportation Engineering, Prentice Hall India Learning Pvt. Ltd., New Delhi (Eighth Printing: January 2013).

Reference Books

1. Yoder E.J. and Witzack M.W. , 1991. Principles of Pavement Design; John Wiley and Sons, New York.
2. Kandhal, PrithviSingh , 2014. Bituminous Road Construction in India; PHI Learning Pvt. Ltd., Delhi
3. Delattee, Norbert J., 2017. Concrete Pavement: Design, Construction and Performance (Second Edition)
4. Mallick, Rajib B. and Korchi, Tahar El, 2017. Pavement Engineering: Principles and Practice, CRC Press, Taylor and Francis Group (Third Edition)
5. Nikolaides, A., 2017. Highway Engineering: Pavement Materials and Control of Quality, CRC Press, taylors and Francis Group.

Additional Reading

1. Relevant specifications of Bureau of Indian Standards for Highway Material Testing, Indian Roads Congress (IRC) and Ministry of Road Transport and Highways (MoRTH) w.r.t. / Pavement Design and Highway Construction revised time to time shall be referred to, e.g.:
2. IRC: 37-2012. "Tentative Guidelines for the Design of Flexible Pavements," Indian Road Congress, Delhi.
3. IRC: 58-2011. "Tentative Guidelines for the Design of Rigid Pavements," Indian Road Congress, Delhi.
4. IRC: 81-2012. "Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique," Indian Road Congress, Delhi
5. IRC: SP: 76-2008. "Tentative Guidelines for Conventional, Thin and Ultra-Thin White-topping," Indian Road Congress, Delhi.

Note: Some of the recent specifications may not have been incorporated in few books authored by Indian Authors. For this, titles of multiple books are given in the list of the Recommended Books. The latest editions shall be used. In addition to this, relevant specifications/ codes with the latest revisions thereof shall be referred to.

CEPC- 322 **Concrete Structures-II Drawing** **0 0 2 1**

Course Objectives

1. To make the students familiar with the use of relevant Indian Standard specifications applicable to design of steel structures.
2. To prepare detail drawings of different components of RCC buildings.

Course Curriculum

Structural Drawings/Reinforcement detailing of

- R.C.C. Footings
- Beams curved in plan
- Domes
- Staircases
- Retaining Walls
- Water Tanks

Course outcomes

1. Use of relevant Indian Standard specifications applicable to design of steel structures.
2. Prepare detail drawings of industrial building, steel foot bridge and railway bridge.

CECI-302 **Minor Project (Phase II)** **0 0 2 2**

* Minor Project allotted in 5^{th} Semester, will continue during the 6^{th} semester and be evaluated after 6^{th} Semester.

CEPC-330 **Survey Camp** **0 0 0 2**

The students will undergo Survey Camp (2-3 weeks) during the summer vacation in a hill station.

SEVENTH SEMESTER

CEPC-401 Design of Hydraulic Structures 3 0 0 3

Course Objectives

1. To inculcate the essentials of hydraulic structures in Civil Engineering field.
2. To provide the students an illustration of the significance of the hydraulic structures in Civil Engineering Profession in satisfying societal needs.
3. To demonstrate various methods to design these structures and show its economic

Course Curriculum

Dams: Gravity dams, arch dams and earthen dams, also introduction about rivers and canal projects in Punjab.

Earth Dams: Components of earth dams and their functions, Phreatic line determination by analytical and graphical methods.

Theory of Seepage: Seepage force and exit gradient, salient features of Bligh's Creep theory, Lane's weighted Creep theory and Khosla's theory Determination of uplift. Pressures and floor thickness.

Gravity Dams-Non Overflow Section: Forces acting, Stability factors, stresses on the faces of dam, Design of profile by the method of zoning, Elementary profile of a dam.

Gravity Dams Spillways: Creagers profiles neglecting velocity of approach, profile taking velocity of approach into account, upstream lip and approach ramp, Advantages of gated spillways, Discharge characteristics of spillways.

Arch Dam: Classification of arch dam-constant radius constant angle and variable radius types, cylinder theory, expression relating central angle and cross-sectional area of arch. Types of buttress dams, advantages of buttress dams.

Energy Dissipation Devices: Use of hydraulic jump in energy dissipation, Factors affecting design, types of energy dissipation and their hydraulic design.

Dam's Safety: instruments, stress-strain meter, piezometric reading of seepage, seepage analysis, sensors.

Canal Falls: Necessity and location, types of falls and their description, selection of type of falls, principles of design, design of Sarda type, straight glacis and inglis or baffle wall falls.

Distributory Regulators: Off take alignment, cross regulators-their functions and design, Distributory head regulators - their functions and design, canal escape.

Cross Drainage Works: Definitions, choice of type, hydraulic design considerations. Aqueducts their types and design, siphon aqueducts their types and design considerations, super passages, canal siphons and level crossings.

Design of Weirs: Weirs versus barrage, design consideration with respect to surface flow, hydraulic jump and seepage flow. Design of a barrage or weir.

Tunnels: Head-race tunnel, diversion tunnel.

Course outcome:

1. Analysis and Design of different types of dams like, gravity dams, arch dams, buttress dams, earthen dams.
2. Design of canal outlets.
3. Design of cross drainage works and diversion head works.
4. Study of theory of seepage

5. To know about energy dissipation devices and their applications

Text and Reference Books

1. Sharma S K, "Design of Irrigation Structures" S. Chand & Company (Pvt.) Ltd., New Delhi.
2. Murty C S, "Design of Minor Irrigation and Canal Structures" Wiley Eastern Ltd. New Delhi.
3. Garg S K, "Irrigation Engineering & Hydraulic Structures" Khanna Publishers, Delhi, 1999.
4. Arora K R, "Irrigation Waterpower & Water Resources Engineering" Standard Publishers Distributors, Delhi, 2003.
5. Asawa G L, "Irrigation Engineering" Wiley Eastern Ltd., New Delhi 2001.

CEPC-403 Design of Steel Structures-II 3 0 0 3

Course Objectives

1. To make the students familiar with design the round tubular structures.
2. To make the students familiar with design of steel foot bridge and its various components.
3. To make the students familiar with design of complete industrial building.
4. To carry out analysis and design of single track railway bridge.

Course Curriculum

Design of Round Tubular Structures: Introduction, round tubular sections, permissible stresses, tube columns and compression members, tube tension members, tubular roof trusses, Design of tubular beams, Design of tubular purlins.

Design of steel foot bridge: Introduction, design of flooring, cross girders, analysis of N- type truss, design of various members of truss, design of joints, design of bearings.

Design of complete industrial building with design of:

a) Gantry Girder
b) Column bracket.
c) Mill bent with constant moment of inertia
d) Lateral and longitudinal bracing for column bent etc.

Design of a single track through type Railway Bridge with lattice girders having parallel chords (for B. G):

a) Design of stringer and stringer bracing
b) Design of cross girders
c) Design of connection between stringer and cross girder
d) Design of main girders – various members and their joints
e) Design of bottom lateral bracing and top lateral bracing
f) Design of portal bracing and sway bracing

Design of bearings – rocker and rollers

Course outcomes

1. Able to design the round tubular structures.
2. Design of steel foot bridge and its various components.
3. Design of complete industrial building.
4. To carry out analysis and design of single track railway bridge.

Text and Reference Books:

1. Arya A S and Ajmani J L, "Design of Steel Structures" Nem Chand & Bros, Roorkee,1996.
2. Chandra R, "Design of Steel Structures" Vol. I & II Standard Book House, Delhi,1991
3. Raz S A, "Structural Design in Steel" New Age International (P) Ltd., New Delhi, 2002
4. Raghupathi M, "Design of Steel Structures" Tata McGraw-Hill Publishing Company ltd.,
5. Dayaratnam P, "Design of Steel Structures" Wheeler Publishers, New Delhi, 2000.

Departmental Electives

CEPE-431 Advanced Foundation Engineering 3 0 0 3

Course Objectives

1. Knowledge of different tests for soil exploration.
2. To get familiar general design principles of foundation design with reference to Indian code.
3. Able to analyze and design of bridge sub-structure components.
4. Understating the behavior of foundations in expensive soils.

Course Curriculum

Shallow Foundations: Introduction, bearing capacity of footings, skemptons bearing capacity factor, footings on layered soils, footings with eccentricity, allowable bearing pressure, raft foundations floating raft, uplift capacity of footing.

Pile Foundations: Introduction, bearing capacity of piles, vertical piles subjected to lateral loads, proportioning and design of pile foundations, lateral load capacity of single pile, batter piles under lateral load, uplift capacity of piles ultimate lateral load resistance of a pile group.

Drilled Piers: Introduction, current construction methods, use of Drilled Piers, analysis and design of drilled piers, settlements of drilled piers, structural design of drilled piers, laterally loaded drilled pier analysis.

Bridge Sub Structures: Definitions, elements of substructures, maximum depth of scour, depth of foundation allowable bearing pressure, loads to be considered, lateral stability, design of pier cap & pier, sinking stresses in wells, design of well cap, well staining, well curb, cutting edge, bottom plug.

Sheet Piles and Coffer Dams: Types of sheet piles structures, design of cantilever sheet pile wall, design of anchored bulkheads, anchorage methods design of braced sheeting in cuts, Design of cellular coffer dams. Calculation of allowable bearing pressure.Conditions for stability of a well.Terzaghi's analysis for Lateral stability of a well, embedded in sand. Forces acting on a well foundation.Computation of scour depth, Tilts & Shifts.

Foundation in Expansive Soils: Introduction, Material structure, identification of expansive soils, Indian expansive soils, swell potential and sewelling pressure, traditional Indian practice, methods of foundations in expansive soils, replacement of soils and CNS concept. Underreamed pile foundations, remedial measures for cracked buildings.

Course Outcomes

1. Students will be able to design foundation on slopes, foundation with eccentricty

2. Students will be able to design the piles subjected to lateral and uplift loads
3. Students will be able to analyze and design drilled piers and well foundations
4. Students will be able to analyze and design sheet piles and coffer dams
5. Students will be able to plan and design foundations on expansive soils

Text and Reference Books

1. Ranjan, G. and Rao A.S.R., 2000. Basic and Applied Soil Mechanics. New Age International Pvt. Ltd., Publishers, New Delhi.
2. Murthy V N S., 2001. Principles of Soil Mechanics and Foundation Engineering. UBSPD.
3. Das, B.M. 2004. Principles of Foundation Engineering. Cengage Pulishers
4. Couduto, D.P., 2002. Geotechnical Engineering – Principles and Practices", Prentice Hall of India.
5. Peck R. B., Hanson W. B. and Thornburn T. H., 1974. Foundation Engineering. John Wiley and Sons Inc, New York.
6. Bowles J. E., 1988. Foundation Analysis and Design. McGraw Hill, New York.

CEPE-435 Industrial Structures 3 0 0 3

Course Objectives

- To make the students familiar with identification of different types of industrial structures and their components.
- To make students aware about design of various structures like, bunkers, silos, chimneys, virendreel girders.
- To make the students knowledgeable for general requirements of machine foundation, their analysis and design.

Course Curriculum

Bunkers and Silos: Introduction, Analysis of Bunkers and Silos, Janssen's and W. Airy's formulas for design of silos, Bunker with a hopper bottom.

Shell Roofs and Folded Plates: Introduction, Terminology, classification and general specifications. Analysis of shells by different methods, general design considerations, design of folded plates by different theories.

Machine Foundations: Introduction, General requirements, foundations for reciprocating, impact type and rotary type machines. Type of connections.

Braced Industrial Buildings: Introduction, design of goodowns, small Industrial shed with a gantry girder.

Virendeel Girders: General features, analysis of virendeel girders. Design of members.

R.C. C. Chimneys: Introduction, Design for Stresses due to self-weighs, wind, load, stress due to temperature gradient, combined effects of self-load, wind load & temperature.

Course outcomes

1. Identification different types of industrial structures and their components.
2. Able to analyze and design of various structures like, bunkers, silos, chimneys, virendreel girders.
3. Knowledge of general requirements of machine foundation, their analysis and design.

Text and Reference Books

1. Raju N K,"Advanced R. C. C. Design" Tata McGraw Hill, New Delhi, 2000.
2. Chandra R, "Design of Steel Structures" Vol. II Standard Publication House, New Delhi, 1991.
3. Syal I C, "Behaviour Analysis and Design of R. C. C. Structure" S. Chand & company, New Delhi, 2003.
4. Ramaswamy G S, "Design and Construction of Concrete Shell Roofs" CBS Publication House, New Delhi.
5. Arya A S and Ajmani J L, "Design of Steel Structures" Nem Chand & Bros, Roorkee.1992.

CEPE-437 Pre-stressed Concrete Design 3 0 0 3

Course Objectives

1. To recognize the effects of transfer and development length on flexural and shear strengths.
2. To construct moment-curvature and load-deflection curves for a prestressed concrete beam.
3. To analyze and design prestressed concrete members for shear.
4. To become familiar with professional and contemporary issues in the design and fabrication of prestressed concrete members.

Course Curriculum

Introduction: Basis concepts, Materials used, advantages of prestressed Concrete, Applications of prestressed concrete.

Materials for prestressed Concrete: High strength concrete, strength requirements permissible stresses in concrete, creip& shrinkage, deformation characteristics, high strength steel, strength requirements, permissible stress in steel.

Prestressing Systems: Introduction, prestensioning systems, post-tensioning systems, chemical prestressing.

Losses of Prestress: Nature of losses, different types of losses and their assessment.

Analysis of Prestress& Bending Stress: Basic assumptions, Resistant stresses at a section, pressure line, and concept of land balancing, stresses in grading moment.

Flexural Shear Strength of Prestressed Concrete Sections: Types of flexural failure, strain compatibility method, code procedures, shear and principal stresses, ultimate shear resistance of pressed concrete members, prestressed concrete members in torsion.

Transfers of Prestress in Pre-tensioned and Post-tensioned members: Transmission Length, bond structures, Transverse tensile stress End-zone reinforcement, stress distribution in end block.

Design Prestressed Concrete Sections: Design of section for flexure, Axial tension compression & bending, shear, bond and torsion.

Design of concrete Pipes & Tanks: Circular prestressing type of prestressed concrete pipes, design of prestressed concrete pipes, Analysis and design of prestressed concrete tanks.

Course outcomes

1. To apply basic concepts, applications and advantages of prestressed concrete.
2. Knowledge of materials of prestressed concrete and their properties.
3. To carry out analysis and design of prstressed concrete sections.

4. Design of prestressed concrete pipes and tanks.

Text and Reference Books:

1. Raju N K, "Prestressed Concrete" Tata McGraw Hill, New Delhi, 2001.
2. Rajagopalan N, "Prestressed Concrete" Narosa, New Delhi, 2001.
3. Dayaratnam P, "Prestressed Concrete" Oxford & IBH, New Delhi, 1999.
4. Lin T Y, "Prestressed Concrete" McGraw Hill, New York, 1985.
5. Edward G Nawy, "Prestressed Concrete-A Fundamental Approach" Prentice Hall Publishers, NY, 2000.

CEPE-439 Finite Element Methods in Engineering 3 0 0 3

Course Objectives

1. To provide students with an introduction to Finite Element Analysis and to help the students use this method and commercial software package to solve problems in structural elements and mechanics of materials.
2. To introduce the concepts of Mathematical Modeling of Engineering Problems.
3. This course provides an introduction to finite elements method with a focus on one and two dimensional problems in structures, static and dynamics.

Course Curriculum

Introduction, background and applications, general description of the method, summary of the analysis procedure, matrix theory, differential equations.

Review of Solid mechanics: Equations of equilibrium, stresses and strains, strain displacement relations, linear constitutive relations, two – dimensional elasticity, non-linear material behaviour, material characterization.

One – dimensional finite elements: The concept of an element, various element shapes, displacement models, finite element modelling, coordinates and shape functions, stiffness matrix, the finite element equations and treatment of boundary conditions.

Two-dimensional finite elements: Introduction, two-dimensional boundary value problems, various element shapes, constant strain triangular elements, quadrilateral elements, natural coordinates, connectivity and nodal coordinates, problem modelling and boundary conditions.

Two-dimensional Isoparametric Elements: Introduction, the four-nodded quadrilateral element, numerical integration, interpolation formulas and shape function formulas, computations of element stiffness matrix.

Beams and Frames: Introduction, finite element formulation, load vector, boundary conditions, displacement method for beam analysis, beam finite elements, shear force and bending moment, plane frames.

Course outcomes

1. To get familiar about background and applications of FEM.
2. Introduction to one –dimensional and two- dimensional finite elements.
3. Introduction, the four-nodded quadrilateral element, its computation of stiffness matrix.
4. To performs FEM analysis on beams and frames.

Text and Reference Books

1. Desai C S and Abel J F, "Introduction to the finite element method" CBS Publishers and Distributions, Delhi, 2004.
2. Buchanan G R, "Schaum's Outline Series, Theory and Problems of Finite Element Analysis" McGraw Hill International Edition/Tata McGraw Hill, New Delhi, 2004.
3. Chandrupta T R and Belegundu A D, "Introduction to Finite Elements in Engineering" PHI, New Delhi,1997.
4. Krishnamoorthy C S, "Finite Element Analysis – Theory and Programming" TMH Publishing Co. Ltd. New Delhi, 2002.
5. Bathe K J, "Finite Element Procedures" Prentice Hall of India, New Delhi, 1997.

CEPE-441 Architecture and Town Planning 3 0 0 3

Course Objectives

1. To make the students knowledgeable about design elements of architecture.
2. To make the students familiar with the industrial revolution.
3. To make the students understandable the concepts of town planning.
4. To make use of general principles and techniques of town planning.

Course Curriculum

Elements of Design: Line direction. Shape, size, texture, value and colour, balance, scale and proportion.
Principles of Design: Repetition, gradation, harmony, contrast and unity, creation of 2 D and 3 D compositions.
The Industrial Revolution: The age of revivals, the emergence of engineer, new materials and techniques and the evolution of balloon frame and steel frame.
Origin of Modern Architecture: definition and concept of modern architecture, various pioneers of modern architecture.
Town Planning: Definition and meaning, age of planning, scope and motives of planning, brief history of town planning – its origin and growth, historically development of town planning in ancient valley civilizations. Indus Nile Tigris and Euphrates, Greek Roman, Medieval and Renaissance town planning
New Concepts: Garden city movement, Linear city and concentric city concepts, Neighbourhood and Radburm, La-cite industrille, Radiant city to present day planning.
Planning Principles: Types of town and their functions, types of town planning – Grid Iron, Radial, Spider webs, Irregular and Mixed, their advantages and disadvantages.
Planning Practice and Techniques: Zoning – its definition, procedure and districts, height and bulk zoning, F. A. R., Master Plan – Meaning, preparation and realization, the scope of city planning – city rehabilitation and slum clearance.

Course outcomes

1. Knowledge of design elements of architecture.
2. To review the industrial revolution.
3. Understanding the concepts of town planning.
4. To apply the general principles and techniques of town planning

Text and Reference Books

1. Cherry, Gordon,"Urban Planning Problems" Board Hill, London,1974.
2. Sundaram,K V ,"Urban and Regional Planning in India" Vikas Publishing house(P) Ltd.,New Delhi,2000.
3. Gallion A B,Eisner S, "The Urban Pattern" Van Nostrandreinhold,New York,1993.
4. Jon Lang,"A concise history of Modern Architecture in India" Permanent Black Publishers,New York,1998.
5. Taurus Parke,"A City with view Florence" I.B.Taurus Publishers, New York, 1994.

CEPE-449 **Smart Cities** **3 0 0 3**

Course Objectives

1. To make the students familiar with the elements of planning for pre-exist and new-planned cities.
2. To make students conversant with different systems like; road network, water distribution systems, sewer systems, municipal solid waste management and electrification systems etc.

Course Curriculum

Introduction to smart cities: Definition, Concept, Need and importance, Benefits of smart cities, Features & components of a smart city, Strategies to be adopted, Characteristics and factors of smart cities, Smart structures, Classification of smart structures, Challenges faced in developing smart cities, Scope of smart cities, Some examples of smart cities.

Introduction to Smart Materials: Natural materials, Sustainable materials, Types of smart materials- Active & Passive, Applications of different types of smart materials, Future Applications. Smart Construction, Planning & Design, Theory and principles, Orientation of buildings, Sustainable buildings- Concept of green buildings, Features of green building rating systems in India: LEED, GRIHA. Sustainable site, Green home rating system, Green neighborhood concept, Concept of Net zero energy building, Net zero community.

Power and energy requirements: Energy, material and indoor environmental issues for smart buildings, Alternate sources of energy, Renewable sources-biomass, geothermal, wind, solar, water, green fuels, Sustainable energy uses, Energy efficient techniques, Smart electricity, Smart Grid, Utility metering, substation automation.

Smart City Framework: : Smart Transport, Concept of smart transportation, Challenges Faced, Intelligent Transport systems- Background, Technologies, IT applications, periodic traffic forecasts, journey/route planning of public and private transport mobile applications (based on real time data), etc., Smart Traffic Signals, Smart Transport Cards, Smart Parking, Electric vehicles, Hybrid vehicles, charging stations, Urban transport systems, Vehicle tracking systems, Integrated traffic management, Examples.

Smart Water and Waste Management: Integrated water management, Solid waste management, Smart utility services, Water harvesting, Water pollution monitoring systems, Energy Optimization System for wastewater treatment, Smart water networks, Recycling systems and technologies, Waste to energy equipment, Sensor Based Waste Storage and Collection, Automated waste collection systems.

Course outcomes

1. Various elements of planning for pre-exist and new-planned cities.
2. Introduction to different systems like; road network, water distribution systems, sewer systems, municipal solid waste management and electrification systems etc.

Text and Reference Books

1. Eleonra R S, Raffaella R S, Valentina V, "Smart Rules for Smart Cities" Springer
2. Mohammad O and Petros N, " Smart Cities and Homes Key Enabling Technologies" Morgan Kaufmann
3. Carol L S, " Building Smart Cities: Analytics and Design Thinking"

CEPE-453 Environmental Geo-technology 3 0 0 3

Course Objectives

1. To make the students familiar with the elements of planning for pre-exist and new-planned cities.
2. To make students conversant with different systems like; road network, water distribution systems, sewer systems, municipal solid waste management and electrification systems etc.

Course Curriculum

Introduction to smart cities: Definition, Concept, Need and importance, Benefits of smart cities, Features & components of a smart city, Strategies to be adopted, Characteristics and factors of smart cities, Smart structures, Classification of smart structures, Challenges faced in developing smart cities, Scope of smart cities, Some examples of smart cities.

Introduction to Smart Materials: Natural materials, Sustainable materials, Types of smart materials- Active & Passive, Applications of different types of smart materials, Future Applications. Smart Construction, Planning & Design, Theory and principles, Orientation of buildings, Sustainable buildings- Concept of green buildings, Features of green building rating systems in India: LEED, GRIHA. Sustainable site, Green home rating system, Green neighborhood concept, Concept of Net zero energy building, Net zero community.

Power and energy requirements: Energy, material and indoor environmental issues for smart buildings, Alternate sources of energy, Renewable sources-biomass, geothermal, wind, solar, water, green fuels, Sustainable energy uses, Energy efficient techniques, Smart electricity, Smart Grid, Utility metering, substation automation.

Smart City Framework: : Smart Transport, Concept of smart transportation, Challenges Faced, Intelligent Transport systems- Background, Technologies, IT applications, periodic traffic forecasts, journey/route planning of public and private transport mobile applications (based on real time data), etc., Smart Traffic Signals, Smart Transport Cards, Smart Parking, Electric vehicles, Hybrid vehicles, charging stations, Urban transport systems, Vehicle tracking systems, Integrated traffic management, Examples.

Smart Water and Waste Management: Integrated water management, Solid waste management, Smart utility services, Water harvesting, Water pollution monitoring systems, Energy Optimization System for wastewater treatment, Smart water networks, Recycling systems and technologies, Waste to energy equipment, Sensor Based Waste Storage and Collection, Automated waste collection systems.

Course outcomes

1. Various elements of planning for pre-exist and new-planned cities.
2. Introduction to different systems like; road network, water distribution systems, sewer systems, municipal solid waste management and electrification systems etc.

Text and Reference Books

1. Eleonra R S, Raffaella R S, Valentina V, "Smart Rules for Smart Cities" Springer
2. Mohammad O and Petros N, " Smart Cities and Homes Key Enabling Technologies" Morgan Kaufmann
3. Carol L S, " Building Smart Cities: Analytics and Design Thinking"

CEPE-455 Traffic Engineering and Management 3 0 0 3

Course Objectives

1. To understand all the traffic characteristics and further, different traffic surveys conducted for the analysis of the road transportation network.
2. To study different statistical methods w.r.t. their application in traffic engineering.
3. To study the various terms in regard with the capacity of a roadway, factors affecting capacities, different types of capacities.
4. To understand the significance of traffic control devices and different types of traffic control devices, their applications and to understand the intelligent transportation system.
5. To study the intersections, their types and application and design; and further, to study the causes of the road accidents and preventive measures along with traffic management system.
6. To study the facilities meant for parking and pedestrians; and highway lighting.

Course Curriculum

Traffic Characteristics: Road users' characteristics, vehicular characteristics, power performance of vehicles.

Traffic Studies: Various traffic studies (Speed including delay, volume, occupancy, origin-destination, parking, accident), objectives/ uses, methods of conducting these studies with pros and cons thereof, methods of analysis of data and interpretation of results, introduction to the photographic techniques in traffic surveys.

Statistical Methods and their Applications in Traffic Engineering: Distribution, sampling theoryand significance of testing, regression and correlation, traffic forecasting.

Highway Capacity: Passanger Car Unit, level of service, types of capacities, factors affecting capacity, capacity and level of service analysis

Traffic Control: Traffic control devices, Basic requirements, Different types of Traffic signs, Traffic Signals- Types and design, different types of pavement/ road markings, miscellaneous traffic control aids, introduction to intelligent transportation systems.

Road Intersections: Classification of intersections, factors to be considered in the design of intersection, requirements of different types of intersections, various forms of intersections, rotary intersections, design of rotary.

Accident and Road Safety: Accident causes, recording systems, analysis and preventive measures.

Traffic Management: Various measures and their scope, relative merits and demerits
Parking and Pedestrian Facilities: Classification and types of parking, Pedestrian facilities- Side Walks , Cross Walks
Highway Lighting: Need for street lighting, important definitions, law of illumination, discernment by artificial lighting, mounting height, spacing, lantern arrangements, types of lamps, design of highway lighting system.

Course Outcomes

1. Are expected to understand the complete knowledge of the traffic characteristics, traffic surveys and management skills related to various problems on roads/ streets.
2. Shall be able to analyze the large data bases generated out of extensive traffic surveys required to be carried out for planning the transportation network by resorting to the various statistical methods and its application in the planning.
3. Shall be able to plan and design the intersection, traffic signals and implement other traffic control devices such as traffic signs and pavement marking on the road transportation network for effective traffic engineering.
4. Are expected to get knowledge related to all the modern techniques and various approaches/ methods needed for effective traffic management.

Books Recommended

1. Kadiyali, L.R., 2011. Traffic Engineering and Transportation Planning. Khanna Publishers, Delhi
2. Saxena, Subhash Chandra, 2014. A Text Book of Highway and Traffic Engineering. CBS Publishers and Distributors.
3. Papacostas, C.S. and Prevedouros, 2016. Transportation Engineering and Planning:, PHI Learning Pvt. Ltd. , New Delhi.
4. Sharma, S.K., 2014. Principles, Practice and Design of Highway Engineering. S. Chand Publishers, New Delhi.
5. Khanna, S.K., Justo, C.E.G. and Veeraraghavan, A., 2014. Highway Engineering: Nem Chand Bros. , Roorkee (10^{th} Revised Edition)
6. Pignatro, G.J. , 1973. Principles of Traffic Engineering ; Mc-Graw Hill

Reference Books

1. Chakraborty, Partha and Das, Animesh, 2013. Principles of Transportation Engineering. Prentice Hall India Learning Pvt. Ltd., New Delhi
2. Papacostas, C.S. and Prevedouros, P.D., 2012.Transportation Engineering and Planning. Prentice Hall India Learning Pvt. Ltd., New Delhi.
3. Khisty, C.J. and Lall, Kent, B. 2018. Transportation Engineering. Prentice Hall India Learning Pvt. Ltd., New Delhi.

CEPE-457 Hydraulics and Hydraulic Machines 3 0 0 3

Course Objectives

1. To introduce the importance of study of open channel flow, to give brief description on different types of flows and channels and hydraulic design principles of channels.
2. To learn the fundamentals of Uniform and Non-Uniform flow in open channels.
3. To understand about the concepts of specific energy, critical flow and their applications.
4. To give an idea about the gradually varied flow and rapidly varied flow and their equations and computations.
5. To introduce the concepts of momentum principles.
6. To impart the knowledge on pumps and turbines.

Course Curriculum

Open Channel Flow - Uniform Flow

Introduction, Classification of flows, Types of channels; Chezy, Manning's, Bazin, Kutter's Equations; Hydraulically efficient channel sections - Rectangular, Trapezoidal and Circular channels; Velocity distribution; Energy and momentum correction factors; Pressure distribution.

Open Channel Flow - Non - Uniform Flow

Concept of specific energy; Specific energy curves; Critical flow; Critical flow in a rectangular channel; Critical slope; Different slope conditions; Channel transitions- Reduction in width of channels, hump; Momentum principle applied to open channel flow; Specific force.

Open Channel Flow - Gradually Varied Flow

Dynamic equation; surface profiles; Computation of surface profiles by single step method; Back water curves and Draw down curves; Examples of various types of water surface profiles.

Open Channel Flow - Rapidly Varied Flow

Hydraulic jump; Elements and characteristics of hydraulic jump; Types of hydraulic jump; Location and applications of hydraulic jump; Energy loss in a hydraulic jump.

Momentum Principles

Action of jets on stationary and moving flat plates and curved vanes; Angular momentum principle; Torque in roto dynamic machines.

Hydraulic Turbines

Classification; Impulse; Reaction; Radial, Axial, mixed and tangential flow turbines; Pelton, Francis turbines; Runner profiles; Velocity triangles; Head and efficiency; Draft tube theory; Similarity laws; Concept of specific speed and unit quantities; Selection of Turbines; Operational characteristics.

Centrifugal Pumps

Manometric head; Losses and efficiencies; Work done; Working Principle; Priming; Velocity triangles; Performance and characteristic curves; Cavitation effects; Similarity considerations.

Dimensional Analysis and Similitude

Dimensional homogenity; Rayleigh's method; Buckingham π -method ; Geometric, Kinematic and Dynamic similarities; Reynold's, Froude, Euler, Mach and Weber numbers; Model laws; Scale effect; Distorted models.

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Course outcomes

1. To know the different types of flows and channels.
2. To understand the performance of turbines and pumps.

3. To know the applications of momentum principles.
4. To make the student is expected to prepare models for prototypes of hydraulic structures.
5. To make the student is expected to have thorough knowledge on the selection of turbines and pumps for practical purposes.

Text and Reference Books:

1. Hydraulics and Fluid Mechanics including Hydraulic Machines by P. N. Modi and S. M. Seth; Standard Book house, New Delhi,2009.
2. Kumar D S, "Fluid Mechanics", S. K. Kataria& Sons Publishers, New Delhi, 1998.
3. Fluid Mechanics by A. K. Jain; Khanna Publishers, Delhi, 2008.
4. Flow in Open channels by K. Subramanya, 3rd Edition, Tata McGraw-Hill,2008.
5. Fluid Mechanics and Hydraulic Machines by R. K. Bansal,9th Edition, Laxmi Publications, 2011.

CEPC-421 **CAD Laboratory** **0 0 2 1**

Course Objectives

1. To provide students with a broad introduction to Computer-Aided Design (CAD) and modeling with a focus on construction- and architecture-specific applications.
2. To make students familiar with the use of industry-leading CAD software programs so that they can model construction projects, and then create and distribute basic, industry-standard architectural drawings.

Course Curriculum

Intro to CAD, Intro to AutoCAD, Precision Drawing & Drawing Aids, Geometric Shapes, Basic Printing, Editing Tools, Architectural Views & Drafting Views with AutoCAD (Surfaces, Solids), Annotating in AutoCAD with Text & Hatching Layers, and Templates. Advanced plotting (Layouts, Viewports), Office Standards, Dimensioning, Internet and collaboration, Blocks, Drafting symbols, Attributes. Drawing of various components of RCC and Steel constructions

Course outcomes

1. Understanding of the power and precision of computer-aided modeling and drafting;
2. Ability to construct accurate 2D geometry as well as complex 3D shapes and surface objects;
3. Ability to create 2D representations of 3D objects as plan view, elevations and sections;
4. Ability to assemble these drawings in industry-standard plan form and produce plotted hardcopies ready for distribution;
5. Awareness of architectural drafting with a focus on industry standards

CEPC-423 Hydraulic Structures Drawing 0 0 2 2

Course Objectives

1. To make students knowledgeable regarding drawing of weirs, barrages and cross drainage works.
2. To make students familiar with drawings of various elements of hydraulic structures including plan, elevation and section views.

Course Curriculum

Drawings (Plan, Elevations and Section) of
Canal Falls
Distributory Regulators
Cross Drainage Works
Design of Weirs

Course outcomes

1. Make drawing of weirs and cross drainage works.
2. Make drawings of various elements of hydraulic structures including plan, elevation and section views.

CECI-300 Industrial Practical Training* 0 0 0 2

Industrial Practical Training will be held during summer vacation after sixth semester and will be evaluated in 7^{th} semester.

CECI-400 Major Project (Phase I) 0 0 4 0

Independent study by the student in any area of interest related to civil engineering.

EIGHTH SEMESTER

CEPC-402 **Estimating and Costing** **3 0 0 3**

Course Objectives

1. To inculcate the essentials of Civil Engineering field to the students of all branches of Engineering.
2. To provide the students knowledge regarding estimation of quantities involved in Civilengg. works

Course Curriculum

Estimates: Types, complete set of estimate, working drawings, site plan, layout plan, index plan, plinth area, administrative approval and Technical Sanction.

(i) Estimate of buildings
(ii) Estimate of R. C.C. works
(iii) Estimate of sloped roof and steel structures
(iv) Estimate of water supply and sanitary works
(v) Estimates of roads (a) Earthwork (b) Bridges and culverts c) Pavement
(vi) Estimate of Irrigation works.

Analysis of Rates: For earthwork, concrete works, D. P. C., Brickwork, stone masonry, plastering, pointing, road work, carriage of materials.

Specifications: General specification for different classes of building, detailed specifications for various Civil Engineering Works.

Contracts: Types of contracts, tender, tender notice, tender form, submission and opening of tender, earnest money, security money, measurement book, muster roll, piecework agreement and work order

Accounts: Division of accounts, cash, receipts of money, cashbook, temporary advance, imprest and accounting procedure.

Arbitration: Arbitration, arbitrator and arbitration act, powers of arbitrator, arbitration awards.

Course Outcomes

1. Able to prepare rough and detailed estimate of buildings for different items.
2. Knowledge of specifications of different items of building.
3. Able to perform rate analysis of different work items.
4. Knowledge of contracts, accounts and arbitration.

Text and Reference Books:

1) Chakraborti, M., 2002. Estimating and costing, Calcutta.
2) Dutta, B. N., 1999. Estimating and costing in civil engineering. UBS Publishers' Distributors Ltd., New Delhi.
3) Birdie, G. S., 1994. Estimating and costing, Dhanpat Rai & Sons, Delhi.
4) Kohli, D. and Kohli, R.C., 2004. Estimating and costing. S.Chand& Company, New Delhi.
5) Spence, G., 1950. Building and public works administration: estimating and costing. Newnes Publishers, London, UK.

Departmental Electives

CEPE-432 **Bridge Engineering** **3 0 0 3**

Course Objectives

1. To equip the students with a thorough understanding of the behavior and design of bridges including decks, wing walls, abutments, girders, bearings and foundations.
2. To understand various applied loads, such as truck load, impact, horizontal braking/centrifugal forces, wind and seismic loads.
3. To develop an understanding of and appreciation for basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location and functionality.
4. To help the student develop an intuitive feeling about the sizing of bridge elements, ie. develop a clear understanding of conceptual design.
5. To carry out a design of bridge starting from conceptual design, selecting suitable bridge, geometry to sizing of its elements

Course Curriculum

Introduction: Definition, components of a bridge, classifications, importance of bridge
Investigation of Bridges: Need for investigations, selection of bridge site, preliminary data to be collected, design discharge and its determination, linear waterway, economical span, vertical clearance above HFL, scour depth, choice of bridge type.
Standard Specifications: For road bridges, I.R.C. loadings, code provisions on width of carriage way, clearances, loads considered etc. Standard specifications for railway bridges, Railway bridge code.
Reinforced Concrete Bridges: Slab culverts, T-beam bridge, Courbon's theory for load distribution, Balanced cantilever bridges, illustrative examples, pre-stressed concrete bridges, (General discussions).
Sub Structure: Types of piers and abutments, design forces, design of piers and abutments.
Bearing and Joints: Various types of expansion bearing and fixed bearings, elastomeric bearings, joints and their types. Introduction to construction, inspection and maintenance of bridges.

Course outcomes

1. Understand the importance of bridges and its components.
2. Knowledge of Indian code provisions for loading on bridges.
3. Able to analyze and design different components of bridge.
4. To get familiar with different types of bearings and their structural response.

Text and Reference Books:

1. Victor D J, "Essentials of Bridge Engineering" Oxford and IBH Publishers, New Delhi, 2003.
2. Ratwani V and Aswani M G, "Design of Concrete Bridges, Khanna Publishers, New Delhi, 1986.
3. Bindra S P, "Principles and Practice of Bridge Engineering" Dhanpat Rai & Sons, New Delhi, 1999.
4. Ponnuswamy S," Bridge Engineering" Tata McGraw Hill, New Delhi, 2003.
5. Punmia B C , Jain A K ,"RCC Designs" Laxmi Pub.(P) Ltd.,2003.

CEPE-434 **Soil Dynamics** **3 0 0 3**

Course Objectives:

1. Identification of dynamic loads and their characteristic.
2. To apply theories of vibrations.
3. Able to determine dynamic soil parameters.
4. Understand the concept of Vibration isolation and screening.

Course Curriculum

Introduction, Nature of Dynamic Loads; Theory of vibrations;
Dynamic Earth pressure and dynamic bearing capacity of shallow foundations; Liquefaction of Soils; Wave propagation in an elastic, homogeneous and isotropic medium; Determining dynamic soil parameters.
Machine foundations for reciprocating, impact type and Rotary machines; Vibration isolation and screening.

Course Outcomes:

1. Students will learn the basics of dynamic loads and their characteristics, apply theories of vibrations
2. Students will be able to determine the dynamic soil parameters and understand the concept of vibration isolation.

Text and Reference Books:

1. Barken, D. D.,1962. Dynamics of bases and foundations. McGraw Hill, New York.
2. Saran, S., 1999. Soil Dynamics and Machine Foundations. Galogotia Publications Pvt. Ltd, New Delhi.
3. Rao, N. D. V. K., 1998. Vibration Analysis and Foundation Dynamics. Wheeler Publishing Div. of A. H. Wheeler & Co. Ltd. New Delhi.
4. Krammer, S., 2003. Geotechnical Earthquake Engineering. Pearson Education Pvt. Ltd. New Delhi.
5. Prakash, S., 1981. Soil Dynamics. McGraw Hill Book Company, New York.

CEPE-436 **Hydro Power Engineering** **3 0 0 3**

Course Objectives

1. To provide the requirement of power and necessity of hydropower projects of all branches of Engineering.
2. To know the structures like dams to generate the power
3. To estimate the power as well as design of hydro power projects and its feasibility analysis.

Course Curriculum

Introduction: Waterpower Development – its types, distribution and use

World's largest hydropower generating plants, Estimate of flow rate and waterpower, Peak Load hydropower plants,

Dams: Classifications, types, site selection for dams.

Gravity Dams: Forces acting on gravity dams, Modes of failure, principal and shear stresses, Elementary profile of a gravity dam, high and low gravity dams, profile of a dam from practical considerations, stability analysis methods.

Joints and galleries in gravity dams

Arch Dams: Types, methods for design of arch dam.

Buttress Dams: Types, forces acting on Buttress dam, stability analysis.

Spillways: Spillway capacity, classification of Spillways, Design of Ogee Spillway, Stilling Basins, Spillway crest gates.

Intake structures: functions, location, intake type, trash rack, dimension, design, spacing of bars, method of cleaning, shape of inlet, power canal, location, site, forebay, size, capacity, gates and valves.

Tunnels: geometric and hydraulic design, penstock, location, type, Economical diameter of penstock.

Surge tank: Functions, type, Design of Surge tank, methods of surge analysis, restricted orifice and differential surge tanks, downstream surge tanks.

Power House: Location, site and general arrangements, draft tubes, tail trace and their hydraulic design, turbines, number, make, size, type, characteristics and efficiency,pumps, Generators, exciters, switchboard, transformers and other accessories.

Course outcomes:

1. To estimate flow rate and peak load of hydro power plants.
2. Able to analyze and design of different types of dams. Knowledge of intake structures, their functions and applications.
3. An understanding of general requirements and locations of power house and its components.

Text and Reference Books:

1. Barrows H K, "Water Power Engineering" Tata McGraw Hill Publishing Company Ltd. New Delhi, 1999.
2. Varshney R S, "Hydro Power Structures" Nem Chand & Bros., Roorkee, 2000.
3. Garg S K, "Irrigation Engineering and Hydraulic Structures" Khanna Publishers, New Delhi, 1998.
4. Galce A A, "Handbook of Dam Engineering" Van NostrangRheinhold Co., New York, 2000.
5. Justin J D and Creager W P, "Engineering for Dams" Vols. 1 to 3, John Wiley & Sons, New York, 1998.

CEPE-438 Software applications in Structural Engineering 3 0 0 3

Course Objectives

1. To familiarize with graphic primitives, transformations and two dimensional and three dimensional drafting of computer graphics.
2. To get practiced with computer methods of structural analysis.

3. To understand the basic commands, principles and features behind commercially available software's.
4. To utilize structural software for detailed analysis of complex structures.

Course Curriculum

Introduction: Software and software engineering, software metrics Estimation and planning.
System and Software Requirements Analysis: Computer based systems, computer systems engineering, system analysis, requirements analysis fundamentals, structured analysis and its extensions, object oriented analysis and data modeling.
Design and Implementation of Software: Software design fundamentals, data-flow oriented design, object oriented design, data oriented design methods, programming languages and coding.
Software Quality Assurance: Software quality and software quality assurance, software testing techniques, software Testing strategies, software maintenance, reverse engineering techniques.
Application Software in Civil Engineering: Introduction and application of softwars like STAAD III, STAAD PRO, ATENA, ADINA, ANSYS, DIANA, project work and application to practical problems.

Course outcomes

1. To develop an understanding of different software's used in structural analysis.
2. Able to do structural analysis of different types if structures in different software's.

Text and Reference Books:

1. Pressman R S, "Software Engineering A Practitioner's Approach" McGraw Hill International, New York, 2001.
2. Broeton P, "Software Engineering Environments" Wiley, New York, 2002.
3. Blum I B, "Software Engineering A Holistic View" Oxford University Press, 2001.
4. Blanchard B S and Fabrycky W J, "Systems Engineering and Analysis" Prentice-Hall International, New York1998.
5. Roy S K and Chakrabarty S, "Fundamentals of Structural Analysis with Computer Analysis & applications" S. Chand & Company, New Delhi, 2002.

CEPE-440 Ground Improvement and Ground Engineering 3 0 0 3

Course Objectives:

1. Understand the basic principles, techniques of soil stabilization.
2. Knowledge of different methods of soil stabilization.
3. Identify the geosynthetic materials and its applications.
4. To get familiar with different techniques of improvement of bearing capacity.

Course Curriculum

Introduction: The mechanics of soil stabilization, Principles and techniques.
Shallow Stabilization with additives: Lime, flyash, cement and other chemicals and bitumen.

Deep Stabilization: sand column, stone column, sand drains, prefabricated drains, electro-osmosis,lime column. soil-lime column. Grouting : permeation, compaction and jet. Vibro-floatation, dynamic compaction, thermal, freezing. Dewatering systems
Geosynthetics and Reinforced Soil Structures:Types and functions; Materials and manufacturing processes; Testing and evaluations; Principles of soil reinforcement; Design and construction of geosynthetic reinforced soil retaining structures - walls and slopes; Codal provisions; Bearing capacity improvement; embankments on soft soils; Indian experiences.

Course Outcomes

1. Students will learn the basics of stabilization and different techniques and materials used for stabilization
2. Students will learn about geosynthetics and their properties
3. Students will learn to design the foundations on stabilized soils and will be able to compare the results with not stabilized soils

Text and Reference Books

1. Swami, S., 2006. Reinforced Soil and Its Engineering Applications. I K International.
2. Shukla, S. K. and Yin, J. H., 2006. Fundamentals of Geosynthetics Engineering. Taylor and Francis.
3. Koerner, R. M., 2005. Designing with Geosynthetics. Prentice-Hall, N.J., U. S. A.
4. Rao, V. G. and Raju, N. S., 1999. Engineering with Geosynthetics. Tata McGraw Hill Publications,New Delhi.
5. Shukla, S. K., 2002. Geosynthetics and their Applications. Thomson Telford.
6. Han, J.,1964. Principles and Practices of Ground Improvement. John Wiley & Sons, Inc., New Jersey.

CEPE-444 Quantitative Methods in Civil Engineering 3 0 0 3

Course Objectives:

1. Review the basic concepts of probability and statistics.
2. To apply linear programming for optimization of various problems.
3. To get familiar with queuing theory, decision theory and game theory.
4. To get overview of modifications and improvement on CPM/PERT techniques

Course Curriculum

Introduction and concepts of probability and statistics, Optimization through Linear programming- Need for linear programming, Linear programming model, dual problem, dynamic programming. Transportation model, solution of Transportation model, Assignment problems, solution of assignment problem. Queuing theory- waiting line models, deterministic model, probabilistic model, Decision theory-decision analysis, decision under uncertainty, Nature of Games, Games model, solution of Games model, simulations as applied to construction- simulation models, steps in simulation, Monte Carlo simulation. Modifications and improvement on CPM/PERT techniques.

Course Outcomes

1. Students will learn the basics of probability and statistics, linear programming for optimization, queuing theory, game theory and CPM/PERT tecniques

Text and Reference Books

1. Verma, M., 1985. Construction Planning and Management Through System Techniques" Metropolitan Book Company, New Delhi.
2. Chitkara, K. K., 2000. Construction Project Management – Planning, Scheduling and Controlling. Tata McGraw Hill, New Delhi,.
3. O'Brien, J.,1999. CPM in Construction Management. McGraw Hill, New York.
4. Harris, R B. Precedence and Arrow Networking Techniques for Construction. John Wiley & sons, New York.
5. Levy, S., 2000. Project Management in Construction. McGraw hill, New York.

CEPE-446 Advanced Environmental Engineering 3 0 0 3

Course Objectives

1. To make students familiar with other concepts in environmental engineering.
2. To introduce the concept of sustainability and life cycle assessment

Course Curriculum

Water Pollution: Natural treatment Systems, Classification, Treatment Mechanisms
Air Pollution: composition, air of occupied rooms, discomfort, indices of thermal comfort, comfort zones, air pollution sources, pollutant, metrological conditions, indications of air pollution, health & other aspects of air pollution, prevention & control disinfections of air.
Land Pollution: Introduction, Causes, Site Investigation, Risk Assessment
Sustainability: Concept, Life Cycle Assessment
Ventilation: Concept, standard of ventilation, types of ventilation.
Lighting: Requirements of good lighting, measurement of light, natural lighting, light measurement units, measurement of day light, artificial lighting, method of artificial illumination, lighting standards.
Noise Pollution: Definition, effect of noise, Exposure, noise control.
Radiation: Source of radiation exposure, type of radiation, radiation units, Biological effect of radiation, radiation protection.
Housing: Criteria for good housing, house standards, rural housing, housing & health over crowding.
Excreta Disposal: Public health, importance, extent of problem how diseases is carried from excreta, sanitation barrier, method of excreta disposal, excreta disposal in un-sewered area.

Course outcomes

1. Understand the basic concepts of inter-relationship between different ecosystems with environment.
2. Compute the causes of different types of pollution along with related regulations (local, national, and international).
3. Explain the mechanisms of air pollutants transport/dispersion in the atmosphere and select the systems to control them at different sources.

4. Prepare the life cycle assessment of Solid waste from its generation to disposal.
5. Evaluate different methods of solid waste management and identify the suitable disposal alternatives available.

Text and Reference Books

1. Garg, S.K., 2003. Environmental Engineering, Khanna publishers, New Delhi.
2. Rao, C.S., 2001. Environmental Engineering, McGraw Hill Book Company.
3. Metcalf and Eddy, 2003. Waste Water Engineering- Treatment Disposal and Reuse, Tata-McGraw Hill Publishing company limited, New Delhi.
4. Masters, G.M., Introduction to Environmental Engineering and Science, Prentice Hall of India, New Delhi.
5. Eckenfelder, W.W., 1989. Industrial Water Pollution control, McGraw Hill, New Delhi.

CEPE-448 Advanced Civil Engineering Materials 3 0 0 3

Course Objectives

1. To make the students knowledgeable for different types of material used in construction works.
2. To make the students understandableabout the properties of composite materials.
3. To make the students familiar with design and prepare steel fibrous concrete

Course Curriculum

Plastics: Brief history, composition, polymerisation, classification of plastics, resins, Moulding compounds, Fabrication, properties of plastics, uses of plastics, PVC pipes in building.
Glass: General, properties, types and uses, special varieties of glass.
Timber: Characteristics, identification and uses of common Indian timber –teak, deodar, shisham, chil, sal, veneers, plywood, laminated boards-their uses and properties, uses and strength of bamboo, preservation of timber against fire and weather etc.
Miscellaneous Materials: Fly ash, Rubber –types, uses and properties, Heat insulating materials, Sound absorbent materials.
Steel: Market forms, properties of mild steel and hard steel, preventive measures for corrosion.
Composite Materials: Definition, classification – particulate composites, fibrous composites, properties of fibres and conventional materials.
Unidirectional composites: Introduction, volume fractions, weight fractions, longitudinal strength and stiffness, factors influencing longitudinal strength and stiffness, transverse strength and stiffness.
Short fiber composites: Introduction, modulus and strength of short fiber composites, rubber reinforced composites, Laminated composites - and its applications, Fiber reinforced plastics (FRP) and its applications
Mortars: Properties and uses of cement, lime and surkhi mortars, proportions, mixing, uses.
Steel fibrous concrete: Introduction, types of fibers, properties of steel fibrous concrete.

Course outcomes

1. Knowledge of different types of material used in construction works.
2. Understand the properties of composite materials.
3. To design and prepare steel fibrous concrete

Text and Reference Books

1. Agarwal B D and Broutman, L J, " Analysis and Performance of Fiber Composites" Wiley Interscience Publication, John Wiley & sons New York, 1980.
2. Rangwala S C, "Engineering Materials" Charotar Publishing House, Anand, 1985.
3. Weatherhead R G, "FRP Technology" Applied Science Publishers Ltd., London, 1998.
4. Raina K B, "Civil Engineering Materials" Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1999.
5. Budinski K G, "Engineering Materials, Prentice Hall of India, New Delhi, 1985.

CEPE-450 Fluvial Hydrodynamics 3 0 0 3

Course Objectives:

1. To understand the mechanism of sediment transport
2. To get familiar with processes of flow in natural streams
3. To know about flow structure in open channels

Course Curriculum

Introduction to sediment: Physical properties of fluid and sediment, origin and properties of sediments, nature of problems.

Fluvial hydraulics: Scour criteria and problems: regimes of flow, Shields curve, incipient motion of sediment particles, terminal fall velocity of sediment in fluid, alluvial bed forms and Resistance to flow.

Sediment transport: Bed load, suspended load and total load transport, Meyer-Peter approach, du Boys' approach, Einstein's approach, Engelund and Fredsøe's approach, sediment samplers, design of stable channels, alluvial stream and their hydraulic geometry.

Turbulence in Open-Channel Flows: Decomposition and averaging procedure, equation of motion (Reynolds equations), Prandtl's mixing length theory, hypothesis of von Kármán, velocity distribution, the linear law in viscous sub-layer, the logarithmic law in turbulent wall shear layer, law in buffer layer, log-wake law and velocity defect law, turbulence intensity, calculation of bed shear stress using bed slope, velocity distribution, average velocity, Reynolds shear stress distribution, turbulent kinetic energy distribution.

River Training Works: Objectives, classification of river training works, design of guide banks, groynes or spurs their design and classification ISI Recommendations of approach embankments and afflux embankments, pitched islands, artificial cut-offs, objects and design considerations, river control-objectives and methods.

Sediment control: Silt management, management of canal in Punjab, Bhakra calal, delta formation.

Course Outcomes:

1. Students should be able to evaluate the quantity of sediment transport in alluvial channels.
2. Students should be able to analyze the flow structure on deformable boundaries.
3. Students should be able to take initiative to protect the rivers by erosion and deposition.

Text and References

1. Dey, Subhasish, "Fluvial Hydrodynamics" 2014, Springer, India

2. Garde, R.J., Raju, K.G.R, "Mechanics of Sediment Transportation and Alluvial Stream Problems" 1985, Wiley Eastern Ltd.
3. Yang, C.T., "Sediment Transport: Theory and Practice." 1996, McGraw-Hill, USA.
4. Yalin, M.S., "Mechanics of Sediment Transport" 1977, Pergamon Press, Oxford.

CEPE-452 **Rural Roads** **3 0 0 3**

Course Objective

1. To understand the rural roads and the connectivity of road network.
2. To understand the different parameter for geometrical design.
3. To understand the low cost road design.

Course Curriculum

Introduction

Definition& distinctions between rural roads and highways, Indian scenario – road development plans ofGOI, PGMSY-phase I, II, III, and NRRDA

Geometric Design

Speed, typical cross-section, road width, camber, sight distance, longitudinal gradient

Structural Design

Traffic conditions, Assessment of sub-grade and construction materials, Design methodology specification, premises of rural roads

Construction

Equipment for construction, suitability of local construction materials for sub-base and base coarse, compaction of different layers, quality control

Stabilized soil roads

Use of lime, flyash, cement, bitumen etc - their influence on soils, advantages of agglomeration, OMC, MOD, CBR, conjugation methodology including curing

Course outcomes

1. Describe awareness among the local available materials used in rural roads.
2. Recognize Objectives of rural roads design and maintenance.

Text and Reference Books:

1. IRC-2010. "Rural Roads Manual", Indian Road Congress.
2. Indian Roads Congress (IRC) specifications: Guidelines and special publications on "Traffic Planning and Management", Indian Road Congress.
3. Guidelines of Ministry of Road Transport and Highways, Government of India.

CECI-402 **Industrial Lecture** **1 0 0 1**

Minimum 04 Industrial lectures are to be organized by the department in final year of study. The grades are to be awarded based upon quizzes on the same day of lecture.

CECI-400 **Major Project (Phase-II)** **0 0 8 4**

Major Project allotted in 7th Semester, will be evaluated after 8th Semester.

Open Electives Courses for Other Departments

CEOE-370 **Ecology and Environment** **3 0 0 3**

Course Objectives

To inculcate the essentials of ecology and environment to the students of all branches of Engineering.
To demonstrate the need of protecting environment
To illustrate the concept of pollution through air, water and soil

Course Curriculum

Ecology: introduction – Biosphere, scope, Ecosystem, population regulation, earth of organisms, relationships natural cycles – Hydrological cycle, carbon cycle, Nitrogen cycle, sulphur cycle, energy flow, forests & wild life, human activities.
Environmental Sanitation: Community Health – significance, disease transmission principles of Sanitation, vector control, housing needs, community sanitation measures, and health education.
Occupational safety: Hazards in various types occupation, objectives of occupational Health plan prevention and control.
Soil & Agricultural Pollution: Top soil, pollution, parameter of soil analysis, remedial measures, noise control ill effects, noise measurement, preventive & control measures.
Waste Water from Industries: Pollution – harmful effects, waste characteristics, mixing of industrial & domestic wastes. Pre-treatment of industrial waste – reduction of waste strength & volume equalization & neutralization. Case studies from two/three industries e.g. Dairy, Chemical and tanneries.
Metrology & Natural Purification Process: Scales of motion, heat, pressure, wind, moisture, relative humidity. Lapse rates & dispersion, pressure systems and dispersion, modeling.
Engineering System for Solid Waste Management: Solid waste generation, on-site handling, storage and proceeding, collection of solid wastes.Transfer & Transport, processing techniques, ultimate disposal.
Ventilation: Concept, standard of ventilation, types of ventilation
Environmental Management: Environmental impact Assessment, introduction project detail, Material flow analysis, Risk Assessment, Life cycle assessment.
Environmental Audit –Meaning of Environmental audit, audit items, audit procedure, safety audit.
Pollution Control Board – Legal aspects, court judgments, function of pollution control board.

Course outcomes

1. Understand the importance of ecology
2. Appreciate the importance of protecting the environment
3. Comprehend the complexities of the interaction among human being, animals, plants and the environment.

Text and Reference Books

1) Canter, L.W., 1996. Environmental impact assessment. McGraw-Hill.
2) Davis, M.L. and Masten, S.J., 2004. Principles of environmental engineering and science. McGraw-Hill.
3) Rubin, H. S., 2001. Introduction to Engineering & Environment. Mc-Graw Hill.
4) Michael, P. N., 2016. Ecology. CBS Publishers.
5) Eckenfelder, W.W., 2000. Industrial Water Pollution Control. McGraw-Hill.
6) Peavy, R. and Rowe, D.R., Tchobanoglous, G., 1985. Environmental Engineering. McGraw Hill.
7) Allen, D. T., Shonnard, D. R., 2011. Sustainable Engineering: Concepts, Design and Case Studies. Prentice Hall.

CEOE-471 Disaster Management 3 0 0 3

Course Objectives

1. To create awareness on disasters through intensive public education.
2. To ensure disaster prevention, risk and vulnerability reduction, as a means of reducing the impact of disasters on society.
3. To be in a position to provide the first line response in times of disaster.
4. To assist in post-emergency rehabilitation and reconstruction effort.

Course Curriculum

Natural Disasters - Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, Volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.

Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

Disaster Management - Preparedness through (IEC) Information, education & Communication Pre-disaster stage (mitigation), Effect to mitigate natural disaster at national and global levels. International strategy for disaster reduction,

Emerging approaches in Disaster Management-Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media.

Central, state, district and local administration, Armed forces in disaster response; Disaster response; Police and other organizations.

Course outcomes

1. Identify various types of disasters, their causes, effects & mitigation measures.
2. Demonstrate the understanding of various phases of disaster management cycle and create vulnerability and risk maps.
3. Understand the use of emergency management system to tackle the problems.
4. Discuss the role of media, various agencies and organisations for effective disaster management & preparedness for future through various case studies.

5. Design early warning system and understand the utilization of advanced technologies in disaster management.

Text and Reference Books

1. Khanna, B.K., 2005. Disasters: All you wanted to know about, New India Publishing Agency, New Delhi.
2. Edwards, B., 2005. Natural Hazards, Cambridge University Press, U.K.
3. Chakraborty, S.C., 2007. Natural Hazards and Disaster Management, PargatishilProkashak, Kolkata.
4. Sahni, P., 2002. Disaster Mitigation Experiences and Reflections, Prentice Hall of India , New Delhi.

CEOE-472 Green Technology 3 0 0 3

Course Objective

1. To understand the sources of energy and present scenario in India.
2. To understand the sustainable development through present and future energy system.
3. To understand the different criteria for green building and green roads.
4. To understand the basic of green chemistry.
5. To understand the green nano-materials used in construction.

Course Curriculum

Energy sources: Introduction to nexus between Energy, Environment and Sustainable Development; Energy transformation from source to services; Energy sources, sun as the source of energy; biological processes; photosynthesis; food chains, classification of energy sources, quality and concentration of energy sources; fossil fuel reserves - estimates, duration; theory of renewability, renewable resources; overview of global/ India's energy scenario.

Green Energy and sustainable development: The inseparable linkages of life supporting systems, biodiversity and ecosystem services and their implications for sustainable development; global warming; greenhouse gas emissions, impacts, mitigation and adaptation ; future energy Systems- clean/green energy technologies; International agreements/conventions on energy and sustainability - United Nations Framework Convention on Climate Change (UNFCC); sustainable development;

Green building and roads: Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Green Composites for buildings: Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management.Management of Solid Wastes.Management of Sullage Water and Sewage.Urban Environment and Green Buildings. Green Cover and Built Environment. Green roads and its construction procedure.

Green Chemistry: Introduction to Green Chemistry: Principles of Green Chemistry, Reasons for Green Chemistry (resource minimisation, waste minimisation, concepts), Green reactions solvent free reactions, Catalyzed (heterogeneous/homogeneous) reactions, MW/ Ultrasound mediated reactions, Bio catalysts etc

Green Nanotechnology: Introduction to nanomaterials: Nanoparticles preparation techniques, Nanomaterials for "Green" Systems: Green materials, including biomaterials, biopolymers, bioplastics,

and composites Nanotech Materials for Truly Sustainable Construction: Windows, Skylights, and Lighting. Paints, Roofs, Walls, and Cooling.

Course outcomes

1. Describe awareness among stakeholders and promote green agenda and green initiatives in their working environments leading to green movement.
2. Recognize Objectives of Green building and roads.

Text and Reference Books

1) Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A, 2nd Edition, John Wiley, 2006. "Energy and the Environment", ISBN: 9780471172482, Wiley, New York.
2) World Energy assessment, 2000. "Energy and the Challenge of Sustainability", UNDP, New York.
3) NebojsaNakicenovic, ArnulfGrubler and Alan McDonald, 1998. "Global Energy Perspectives", Cambridge University Press.
4) Robert Bent, 2002. "Energy: Science, Policy, and the Pursuit of Sustainability", ISBN13: 9781559639118, ISBN10: 1559639113, Island Press.
5) Jagadish K.S, Venkataramareddy B.U and Nanjundarao K.S, 2014. "Alternative Building Materials and Technologies", New Age International.
6) Ursula Eicker, 2009. "Low Energy Cooling For Sustainable Buildings", John Wiley and Sons Ltd.
7) Dennis C. Brewer, 2008. "Green My Home: 10 Steps to Lowering Energy Costs and Reducing Your Carbon Footprint", ISBN: 9781427798411, Kaplan Publishing.
8) James H.Clarke& Duncan Maacquarrie, 2002. "Handbook of Green Chemistry and Technology", Wiley-Blackwell.
9) Paul T.Anastas and John C. Warner, 2000. "Green Chemistry: Theory and Practice", Oxford University Press.
10) LoucasTsakalakos, 2010. "Nanotechnology for Photovoltaics" ISBN: 9781420076745, CRC Press.
11) Dahl A, Maddux B.L.S, Hutchison J.E, 2007. "Toward Greener Nanosynthesis. Chemical Reviews", American Chemical Society.
12) Michael F, Ashby, Daniel L, Schodek, Paulo J, Ferreira, 2009. "Nanomaterials, nanotechnologies and design: an introduction for engineers", Elsevier.
13) Luis M. Liz-Marzán, Prashant V. Kamat, 2003. "Nanoscale materials", Springer.
14) Glen E. Fryxell, Guozhong Cao, 2007. "Environmental applications of nanomaterials: synthesis, sorbents and sensors", World Scientific Pub. Co. Inc.