B.Tech. Degree

in

CIVIL ENGINEERING

CURRICULUM DETAILS

(For students admitted in 2019 to 2023)

DEPARTMENT OF CIVIL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY

TIRUCHIRAPPALLI – 620015

TAMIL NADU, INDIA

INSTITUTE VISION

To be a university globally trusted for technical excellence where learning and research integrate to sustain society and industry.

INSTITUTE MISSION

1. To offer undergraduate, postgraduate, doctoral and modular programmes in multi-disciplinary / inter-disciplinary and emerging areas.
2. To create a converging learning environment to serve a dynamically evolving society.
3. To promote innovation for sustainable solutions by forging global collaborations with academia and industry in cutting-edge research.
4. To be an intellectual ecosystem where human capabilities can develop holistically.

DEPARTMENT VISION

Shaping infrastructure development with societal focus

DEPARTMENT MISSION

Achieve International Recognition by:

1. Developing Professional Civil Engineers
2. Offering Continuing Education
3. Interacting with Industry with emphasis on R&D

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates of the Programme will contribute to the development of infrastructure that is sustainable.
2. Graduates of the Programme, as part of an organization or as Entrepreneurs, will continue to learn to harness evolving technologies.
3. Graduates of the Programme will be professional Civil Engineers with ethical and societal responsibility.

PROGRAMME OUTCOMES (POs)

Graduates of the Civil Engineering Programme will be able to:

a. Apply the knowledge of mathematics, science, engineering fundamentals, and Civil Engineering principles to the solution of complex problems in Civil Engineering.

b. Identify, formulate, research literature, and analyse complex Civil Engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.

c. Design solutions for complex Civil Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions related to Civil Engineering problems.

e. Create, select, and apply appropriate techniques, resources, and modern engineering tools such as CAD, FEM and GIS including prediction and modelling to complex Civil Engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional Civil Engineering practice.

g. Understand the impact of the professional Civil Engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the Civil Engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communicate effectively on complex Civil Engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage Civil Engineering projects and in multidisciplinary environments.

l. Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

CURRICULUM

The total minimum credits for completing the B.Tech. Programme in Civil Engineering is **157** [50 + 107].

The structure of B.Tech. Programmes shall have General Institute Requirements (GIR), Programme Core (PC), Elective Courses (PE, OE and MI) and Essential Programme Laboratory Requirements (ELR) as follows:

Table 1 Course Structure

Course Category	Courses	No. of Credits	Weightage (%)
GIR (General Institute Requirement Courses)	22	50	31.8
PC (Programme Core)	15	49	31.2
Programme Electives (PE) / Open Electives (OE)	14$	42	26.8
Essential Laboratory Requirements (ELR)	Maximum 2 per session up to 6th semester	16	10.2
Total		**157**	**100**
Minor (Optional)	Courses for 15 credits	15 Additional credits	-
Honours (Optional)	Courses for 15 credits	15 Additional credits	-

**Minimum of 4 programme core courses shall be 4 credits each

$Out of 14 elective courses (PE/OE), the students should study at least eight programme elective courses (PE)

(I) GENERAL INSTITUTE REQUIREMENT (GIR)

Sl. No.	Name of the course	Number of courses	Max. Credits
1.	Mathematics	3	10
2.	Physics	1	3
	Physics Lab	1	2
3.	Chemistry	1	3
	Chemistry Lab	1	2
4.	Industrial Economics and Foreign Trade	1	3
5.	English for Communication	2	4
6.	Energy and Environmental Engineering	1	2
7.	Professional Ethics	1	3
8.	Engineering Graphics	1	3
9.	Engineering Practice	1	2
10.	Basic Engineering	2	4
11.	Introduction to computer Programming	1	3
12.	Branch Specific Course (Introduction to the Branch of study)	1	2
13.	Internship / Industrial Training / Academic Attachment	1	2
14.	Project work	--	--
15.	Comprehensive viva	1	1
16.	Industrial Lecture	1	1
17.	NSS/NCC/NSO	1	Compulsory participation
Total		**22**	**50**

(II) PROGRAMME CORE (PC)

Sl. No.	Course Code	Course Title	Prerequisites	Credits
1.	CEPC10	Engineering Mechanics	-	4
2.	CEPC11	Mechanics of Solids	CEPC10	4
3.	CEPC12	Hydraulics and Fluid Machinery	-	3
4.	CEPC13	Surveying	-	3
5.	CEPC14	Concrete Technology	-	3
6.	CEPC15	Analysis of Indeterminate Structures	CEPC11	4
7.	CEPC16	Geotechnical Engineering - I	-	3
8.	CEPC17	Environmental Engineering - I	-	3
9.	CEPC18	Environmental Engineering - II	CEPC17	3
10.	CEPC19	Geotechnical Engineering - II	CEPC16	3
11.	CEPC20	Highway and Pavement Engineering	-	3
12.	CEPC21	Basic Reinforced Concrete Design	-	3
13.	CEPC22	Hydrology and Irrigation Engineering	CEPC12	4

14.	CEPC23	Railway, Airport and Harbour Engineering	-	3
15.	CEPC24	Basic Steel Structural Elements	-	3
Total				**49**

(III) ELECTIVES

a. PROGRAMME ELECTIVE (PE)

Students pursuing B.Tech. in Civil Engineering should complete at least eight courses from the Programme Electives listed below.

Sl. No.	Course Code	Course Title	Prerequisites	Credits
1.	CEPE10	Construction Techniques and Equipments	-	3
2.	CEPE11	Elementary Structural Dynamics	CEPC10	3
3.	CEPE12	Maintenance and Rehabilitation of Structures	CEPC13	3
4.	CEPE13	Construction Management	-	3
5.	CEPE14	Structural System Analysis	CEPC15	3
6.	CEPE15	Prestressed Concrete Structures	CEPC21	3
7.	CEPE16	Advanced Reinforced Concrete Design	CEPC21	3
8.	CEPE17	Advanced Steel Structural Elements	CEPC24	3
9.	CEPE18	Advanced Structural Analysis	CEPC15	3
10.	CEPE19	Traffic Engineering and Safety	CEPC18	3
11.	CEPE20	Pavement Analysis and Design	CEPC18	3
12.	CEPE21	Transportation Planning	CEPC18	3
13.	CEPE22	Air Pollution Management	CEPC20	3
14.	CEPE23	Industrial Wastewater Treatment	CEPC20	3
15.	CEPE24	Environmental Management and Impact Assessment	CEPC20	3
16.	CEPE25	Solid Waste Management Techniques	CEPC20	3
17.	CEPE26	Models for Air and Water Quality	CEPC20	3
18.	CEPE27	Advanced Foundation Engineering	CEPC19	3
19.	CEPE28	Geotechnical Earthquake Engineering	CEPC19	3
20.	CEPE29	Reinforced Earth and Geotextiles	CEPC19	3
21.	CEPE30	Earth and Earth Retaining Structures	CEPC19	3
22.	CEPE31	Marine Foundation Engineering	CEPC19	3
23.	CEPE32	Geodetic Surveying	CEPC14	3
24.	CEPE33	Advanced Surveying Techniques	CEPC14	3
25.	CEPE34	Groundwater Hydrology	CEPC12	3

26.	CEPE35	Applied Hydraulics Engineering	CEPC12	3
27.	CEPE36	Design of Hydraulic Structures	CEPC22	3
28.	CEPE37	Simulation Modelling for Water Resources Engineering	CEPC22	3
29.	CEPE38	Design of Offshore and Coastal Structures	CEPC19 CEPC24	3
30.	CEPE39	Coastal Engineering	CEPC12	3
31.	CEPE40	Disaster Modelling and Management	CEPC12 CEPC22	3
32.	CEPE41	Prefabricated Structures	-	3
33.	CEPE42	Heritage Structures	CEPC13	3
34.	CEPE43	Earthquake Resistant Structures	CEPC11 CEPC15	3
35.	CEPE44	Steel Concrete Composite Structures	CEPC21 CEPC24	3
36.	CEPE45	Steel Structural Systems	CEPC24	3
37.	CEPE46	Basic Bridge Engineering	CEPC10 CEPC21 CEPC24	3

b. OPEN ELECTIVE (OE)

The courses listed below are offered by the Department of Civil Engineering for students of other Departments.

Sl. No.	Course Code	Course Title	Prerequisites	Credits
1.	CEOE10	Remote Sensing and GIS	-	3
2.	CEOE11	Ocean Energy	-	3
3.	CEOE12	Earthquake Engineering	-	3
4.	CEOE13	Urban and Regional Planning	-	3
5.	CEOE14	Experimental Stress Analysis	-	3
6.	CEOE15	Health Monitoring of Structures	-	3
7.	CEOE16	Forensic Engineering	-	3
8.	CEOE17	Sustainable Infrastructure	-	3

c. MINOR (MI) (offered for the students of other departments)

A student can earn 15 credits, in addition to the credits specified by the department for B.Tech. degree, as optional courses from the minor electives offered by single department from the 4th semester.

Sl. No.	Course Code	Course Title	Prerequisites	Credits
1.	CEMI10	Construction Technology	-	3
2.	CEMI11	Surveying Practices	-	3
3.	CEMI12	Structural Analysis and Design	-	3
4.	CEMI13	Soils and Foundations	-	3
5.	CEMI14	Transportation Systems	-	3

6.	CEMI15	Water and Air Pollution Management	-	3
7.	CEMI16	Irrigation Engineering and Management	-	3
8.	CEMI17	Quantity Estimation and Valuation	-	3

(IV) ESSENTIAL PROGRAMME LABORATORY REQUIREMENT (ELR)

Sl.No.	Course Code	Course Title	Co requisites	Credits
1.	CELR11	Strength of Materials and Concrete Laboratory	-	2
2.	CELR12	Survey Laboratory	-	2
3.	CELR13	Fluid Mechanics Laboratory	-	2
4.	CELR14	Building Planning & Drawing	-	2
5.	CELR15	Geotechnical Engineering Laboratory	-	2
6.	CELR16	Environmental Engineering Laboratory	-	2
7.	CELR17	Transportation Engineering Laboratory		2
8.	CELR18	Computational Laboratory	-	2
Total				**16**

(V) ADVANCED LEVEL COURSES FOR B.Tech. (HONORS)

A student can obtain B.Tech. (Honors) degree provided;

1. Students should not have obtained “V” or” X” grade in any course
2. Maintains CGPA of 8.5 in all semesters excluding honours courses.
3. Completes additional theory courses for 15 credits from the list of honors courses, of P.G. level, offered by the department, maintaining an aggregate of at least B grade in Honours courses.

Sl. No.	Course Code	Course Title	Pre requisites	Credits
1.	CEHO10	Basic Structural Dynamics	CEPC15	3
2.	CEHO11	Basics of Finite Element Methods	CEPC15	3
3.	CEHO12	Elementary Theory of Elasticity and Introduction to Plasticity	CEPC11	3

4.	CEHO13	Nonlinear Analysis of Structures	CEPC15	3
5.	CEHO14	Theory of Plates and Introduction to Shells	CEPC11	3
6.	CEHO15	Theory of Traffic Flow	CEPC18	3
7.	CEHO16	Pavement Construction and Management	CEPC18	3
8.	CEHO17	Soil Dynamics and Machine Foundations	CEPC19	3
9.	CEHO18	Numerical Modelling in Geotechnical Engineering	CEPC19	3
10.	CEHO19	Physicochemical Methods for Water and Wastewater Treatment	CEPC20	3
11.	CEHO20	Biological Treatment of Wastewater	CEPC20	3
12.	CEHO21	Free Surface Flow	CEPC22	3
13.	CEHO22	Computational Fluid Dynamics	CEPC22	3
14.	CEHO23	Wave Hydrodynamics	CEPC22	3
15.	CEHO24	Advanced Remote Sensing Techniques	CEPC14	3

ROADMAP OF CURRICULUM

FOR B.Tech. (CIVIL ENGINEERING) STUDENTS

Semester I (July Session)

Sl. No.	Course Code	Course Title	Prerequisite / Co requisite	Credit	Type	Year of Study	Session/s
1.	HSIR11	English for Communication (Theory)	-	2	GIR	I	July / ~~January~~
2.	HSIR11	English for Communication (Lab)	-	2	GIR	I	July / ~~January~~
3.	MAIR11	Matrices and Calculus	-	3	GIR	I	July / ~~January~~
4.	CHIR11	Chemistry	-	3	GIR	I	July / ~~January~~
5.	CHIR12	Chemistry Lab	-	2	GIR	I	July / ~~January~~
6.	CEIR15	Introduction to Civil Engineering	-	2	GIR	I	July / ~~January~~
7.	EEIR11	Basics of Electrical and Electronics Engineering	-	2	GIR	I	July / ~~January~~
8.	MEIR11	Basics of Mechanical Engineering	-	2	GIR	I	July / ~~January~~
9.	MEIR12	Engineering Graphics	-	3	GIR	I	July / ~~January~~
Total No. of Credits				**21**			

Semester II (January Session)

Sl. No.	Course Code	Course Title	Prerequisite / Co requisite	Credit	Type	Year of Study	Session/s
1.	MAIR21	Complex Analysis and Differential Equations	-	3	GIR	I	~~July~~ / January
2.	PHIR11	Physics	-	3	GIR	I	~~July~~ / January
3.	PHIR12	Physics Lab	-	2	GIR	I	~~July~~ / January
4.	CSIR11	Introduction to Computer Programming (Theory & Lab)	-	3	GIR	I	~~July~~ / January
5.	ENIR11	Energy and Environmental Engineering	-	2	GIR	I	~~July~~ / January
6.	PRIR11	Engineering Practice	-	2	GIR	I	~~July~~ / January
7.	CEPC10	Engineering Mechanics	-	4	PC	I	~~July~~ / January
Total No. of Credits				**19**			

Semester III (July Session)

Sl. No.	Course Code	Course Title	Prerequisite / Co requisite	Credit	Type	Year of Study	Session/s
1.	HSIR13	Industrial Economics and Foreign Trade	-	3	GIR	II	July / ~~January~~
2.	CEPC11	Mechanics of Solids	CEPC10	4	PC	II	July / ~~January~~
3.	CEPC12	Hydraulics and Fluid Machinery	-	3	PC	II	July / ~~January~~
4.	CEPC13	Concrete Technology	-	3	PC	II	July / ~~January~~
5.	CEPC14	Surveying	-	3	PC	II	July / ~~January~~
6.	CELR11	Strength of materials and concrete Laboratory	-	2	ELR	II	July / ~~January~~
7.	CELR12	Survey Laboratory	-	2	ELR	II	July / ~~January~~
8.		Programme Elective I	-	3	PE	II	July / ~~January~~
Total No. of Credits				**23**			

Semester IV (January Session)

Sl. No.	Course Code	Course Title	Prerequisite / Co requisite	Credit	Type	Year of Study	Session/s
1.	MAIR4*	Probability and Numerical Techniques	-	4	GIR	II	~~July~~ / January
2.	CEPC15	Analysis of Indeterminate Structures	CEPC11	4	PC	II	~~July~~ / January
3.	CEPC16	Geotechnical Engineering-I	-	3	PC	II	~~July~~ / January
4.	CEPC17	Environmental Engineering-I		3	PC	II	~~July~~ / January
5.	CELR13	Fluid Mechanics Laboratory	-	2	ELR	II	~~July~~ / January
6.	CELR14	Building Planning and Drawing	-	2	ELR	II	~~July~~ / January
7.		Programme Elective II	CEPC10 CEPC12 CEPC13 CEPC14	3	PE	II	~~July~~ / January
8.		Programme Elective III	CEPC10 CEPC12 CEPC13 CEPC14	3	PE	II	~~July~~ / January
9.		Open Elective I*	-	3	OE	II	~~July~~ / January
10.		Minor 1#	-	3	MI	II	~~July~~ / January
Total No. of Credits				**24**			

Note: Department(s) to offer MI/OE and OC course as 2/3 credits to those willing students in addition to 24 credits.

Semester V (July Session)

Sl. No.	Course Code	Course Title	Prerequisite / Co requisite	Credit	Type	Year of Study	Session/s
1.	CEPC18	Environmental Engineering-II	CEPC17	3	PC	III	July / ~~January~~
2.	CEPC19	Geotechnical Engineering-II	CEPC16	3	PC	III	July / ~~January~~
3.	CEPC20	Highway and Pavement Engineering	-	3	PC	III	July / ~~January~~
4.	CEPC21	Basic Reinforced Concrete Design	-	3	PC	III	July / ~~January~~
5.	CELR15	Geotechnical Engineering Laboratory	-	2	ELR	III	July / ~~January~~
6.	CELR16	Environmental Engineering Laboratory	-	2	ELR	III	July / ~~January~~
7.	HSIR14	Professional Ethics	-	3	GIR	III	July / ~~January~~
8.		Programme Elective IV	CEPC10 CEPC12 CEPC13 CEPC14 CEPC15	3	PE	III	July / ~~January~~
9.		Open Elective II*	-	3	OE	III	July / ~~January~~
10.		Minor II[#]	-	3	MI	III	July / ~~January~~
11.		Honors I[+]	CEPC11 CEPC14	3	HO	III	July / ~~January~~
Total No. of Credits				**22**			

Note: Department(s) to offer MI/OE/OC and Honours course as 2/3 credits to those willing students in addition to 22 credits.

Semester VI (January Session)

Sl. No.	Course Code	Course Title	Prerequisite / Co requisite	Credit	Type	Year of Study	Session/s
1.	CEIR17	Industrial Lecture	-	1	GIR	III	~~July~~ / January
2.	CEPC22	Hydrology and Irrigation Engineering	CEPC12	4	PC	III	~~July~~ / January
3.	CEPC23	Railway, Airport and Harbour Engineering	-	3	PC	III	~~July~~ / January
4.	CEPC24	Basic Steel Structural Elements	-	3	PC	III	~~July~~ / January
5.	CELR17	Transportation Engineering Laboratory	-	2	ELR	III	~~July~~ / January
6.	CELR18	Computational Laboratory	-	2	ELR	III	~~July~~ / January
7.		Programme Elective V	CEPC10 CEPC12	3	PE	III	~~July~~ / January
8.		Programme Elective VI	CEPC13	3	PE	III	~~July~~ /

			CEPC14				January
9.		Programme Elective VII	CEPC15 CEPC19 CEPC20	3	PE	III	~~July~~ / January
10.		Open Elective III*	-	3	OE	III	~~July~~ / January
11.		Minor III#	-	3	MI	III	~~July~~ / January
12.		Honors II+	CEPC11 CEPC14 CEPC15 CEPC19 CEPC20	3	HO	III	~~July~~ / January
Total No. of Credits				**24**			

Note: Department(s) may offer MI/OE/OC and Honours course to those willing students in addition to 24 credits

Semester VII (July Session)

Sl. No.	Course Code	Course Title	Prerequisite / Co requisite	Credit	Type	Year of Study	Session/s
1.	CEIR16	Internship / Industrial Training / Academic Attachment	-	2	GIR	IV	July / ~~January~~
2.		Programme Elective VIII	CEPC10 CEPC12 CEPC13 CEPC14 CEPC15 CEPC18 CEPC19 CEPC20 CEPC21 CEPC24	3	PE	IV	July / ~~January~~
3.		Programme Elective IX		3	PE	IV	July / ~~January~~
4.		Programme Elective X		3	PE	IV	July / ~~January~~
5.		Programme Elective XI		3	PE	IV	July / ~~January~~
6.		Open Elective IV*	-	3	OE	IV	July / ~~January~~
7.		Minor IV#	-	3	MI	IV	July / ~~January~~
8.		Honors III+	CEPC11 CEPC14 CEPC15 CEPC18 CEPC19 CEPC20	3	HO	IV	July / ~~January~~
9.		Honors IV+		3	HO	IV	July / ~~January~~
Total No. of Credits				**14**			

Note: Department(s) may offer MI/OE/OC and Honours course to those willing students in addition to 14 credits

Semester VIII (January Session)

Sl. No.	Course Code	Course Title	Prerequisite / Co requisite	Credit	Type	Year of Study	Session/s
1.	CEIR18	Comprehensive Viva	-	1	GIR	IV	~~July~~ / January

2.	CEIR19	Project work	-	6	GIR	IV	~~July~~ / January
3.		Programme Elective XII	CEPC10 CEPC12 CEPC13 CEPC14 CEPC15 CEPC18 CEPC19 CEPC20 CEPC21 CEPC24	3	PE	IV	~~July~~ / January
4.		Programme Elective XIII[$]		3	PE	IV	~~July~~ / January
5.		Programme Elective XIV[$]		3	PE	IV	~~July~~ / January
6.		Open Elective V*[$]	-	3	OE	IV	~~July~~ / January
7.		Open Elective VI*[$]	-	3	OE	IV	~~July~~ / January
8.		Minor V[#]	-	3	MI	IV	~~July~~ / January
9.		Honors V[+]	CEPC11 CEPC14 CEPC15 CEPC18 CEPC19 CEPC20	3	HO	IV	~~July~~ / January
Total No. of Credits				**10**			

Note: Department(s) may offer Minor (MI) Course, ONLINE Course (OC) and Honours Course (HO) to those willing students in addition to 10 credits

Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
Credit	**21**	**19**	**23**	**24**	**22**	**24**	**14**	**10**	**157**

Note:

1. Minimum of 4 programme core courses of 4 credits each.
2. Out of 14 elective courses (PE/OE), the students should study **at least eight programme elective courses (PE).**
3. MI – Minor Degree: **15 credits over and above** the minimum credit as specified by the departments. The details of MINOR will be mentioned only in the transcript not in the Degree certificate.
4. HO – Honours Degree: **15 credits over and above** the minimum credit as specified by the department. The project work is not compulsory

* To be offered as an Open Elective for other Department students

To be offered as Minor for other Department students

$ For students opting not to register for CEIR19 Project Work

+ To be offered for students who register for B.Tech. (Honours) in Civil Engineering

ELECTIVES (CHOICES)

To get a B.Tech degree in Civil Engineering, possible choices of electives in Programme Electives and Open Electives are:

I. For students opting CEIR19 Project Work

Program Electives	Open Electives	Total
8	4	12
9	3	12
10	2	12
11	1	12
12	0	12

II. For students not opting CEIR19 Project Work

Program Electives	Open Electives	Total
8	6	14
9	5	14
10	4	14
11	3	14
12	2	14
13	1	14
14	0	14

Note: Out of 14 elective courses, eight should be Program Elective courses (PE). For the remaining six electives both open and programme electives are permitted. Out of these six electives, a student can opt for Project Work instead of two electives equivalent to 6 credits

(I) GENERAL INSTITUTE REQUIREMENT (GIR)

HSIR13 INDUSTRIAL ECONOMICS AND FOREIGN TRADE

Course Learning Objectives

1. Give a simple yet thorough introduction into the main methods of economic analysis of industry structure and firm behaviour under various conditions of technology, competition, and organization.

2. Elaborate students' skills and abilities to use modern theoretical and empirical tools to formulate and solve economic problems.

3. Explore in details how economists approach and answer specific empirical questions.

Course Content

Demand and Supply – Forecasting techniques – Cost and Revenues.

Competitive nature of the firms – Keynesian economics – National income.

International Trade – Meaning and Benefits – Basis of International Trade – Foreign Trade and Economic Growth – Balance of Trade – Balance of Payment – Current Trends in India – Barriers to International Trade – WTO – Indian EXIM Policy.

Foreign Exchange Markets – Spot Prices and Forward Prices – Factors influencing Exchange rates – The effects of Exchange rates in Foreign Trade – Tools for hedging against Exchange rate variations – Forward, Futures and Currency options – FEMA – Determination of Foreign Exchange rate and Forecasting

Exchange Rate determination – Marketing – Product life cycle – Marketing research – Branding – Personality – Motivation – Leadership – Working in Teams.

References:

1. Adhikary Manab, Business Economics, Excel Books, 2004.

2. Dwivedi, D.N., Macro Economics Theory & Policy, Tata Mc Graw-Hill, 2005.

3. Aczel D. Amir, Soundarapandian Jayavel, Complete Business Statistics, Tata Mc Graw-Hill, 2005.

4. Robins P. Stephen, Organizational Behaviour, Prentice-Hall, 2002.

5. Apte P.G., International Financial Management, Tata McGraw Hill, 2011.

6. Jeff Madura, International Corporate Finance, Cengage Learning, 9th Edition, 2011.

Course Outcomes:

At the end of the course student will be able to

1. Analyze the risk of decision making in a firm.

2. Describe and explain the determinants of the size and structure of firms.

3. Give an overview of trade cycle, inflation, cash flow analysis and Balance sheet.

4. Explain the marketing research, product life cycle, motivation and leadership.

5. Describe the competitive nature of the firm and team working.

MAIR4* PROBABILITY AND NUMERICAL TECHNIQUES

Course Learning Objectives

Objective is to introduce

1. various standard probability distributions and its applications to engineering problems.
2. testing of hypothesis and various test for testing of hypothesis.
3. correlation and regression for the given data.
4. numerical methods for Solving Linear Systems
5. numerical method for solving non-linear equations
6. numerical interpolation, differentiation and integration
7. numerical Solutions of Ordinary Differential Equations
8. numerical Methods to solve partial differential equations.

Course Content

Definitions of probability, Bayes' theorem-Random variable –Standard distributions(Binomial, Poison and Normal distributions), Moment generating function, Characteristic function.

Central Limit Theorem, Law of large numbers, Tests of significance, large and small samples, t-test, F-test and chi-square test for goodness of fit - Simple-Multiple and partial correlation –Regression.

Solution of linear system -Gaussian elimination and Gauss-Jordan methods -LU - decomposition methods -Crout's method -Jacobi and Gauss-Seidel iterative methods.

Solution of nonlinear equation -Bisection method -Secant method -Regula falsi method -Newton-Raphson method for $f(x) = 0$ and for $f(x,y) = 0$, $g(x,y) = 0$

Newton's forward, backward and divided difference interpolation –Lagrange's interpolation –Numerical Differentiation and Integration –Trapezoidal rule – Simpson's 1/3 and 3/8 rules

Euler's method -Euler's modified method -Taylor's method and Runge-Kutta method for simultaneous equations and 2nd order equations, Numerical solution of Laplace equation and Poisson equation by Liebmann's method, Crank -Nicolson method.

References

1. *Sheldon M. Ross, Introduction to Probability Models, Academic Press, 2014.*
2. *Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, John Wiley & Sons, 2010.*
3. *E. Ward Cheney, David R. Kincaid, Numerical Mathematics and Computing, Cengage Learning, 2012*
4. *Curtis F. Gerald., Applied Numerical Analysis, Pearson Education India. 2004*
5. *Jain, M.K., Iyengar, S.R. and Jain, R.K., Numerical Methods for Scientific and Engineering Computation, New Age international, 2019*

Course outcomes

completion of the course, students should be able to:

1. find probabilistic models for statistical problem

2. apply testing of hypothesis using t-test,F-test and χ2-test.
3. Compute regression lines and calculate correlation coefficients.
4. compute numerical solution of given system AX=B by direct and iterative methods.
5. compute interpolating polynomial for the given data
6. compute numerical differentiation and integration.
7. compute numerical solution of ordinary differential equations by finite difference method.
8. compute numerical solution of partial differential equations by finite difference method.

HSIR14 PROFESSIONAL ETHICS

Course Learning Objectives

1. Identify the core values that shape the ethical behavior of an engineer
2. To create an awareness on professional ethics and Human Values
3. To appreciate the rights of others

Course Content

Morals, Values and Ethics - Integrity - work Ethic - Service Learning - Civic Virtue - Respect for others - Living peacefully - Caring - Sharing - Honesty - Courage - Valuing time - Co-operation - Commitment - Empathy - Self-Confidence - Character - Spirituality - The role of engineers in modern society - social expectations.

Sense of 'Engineering Ethics' - Variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - Consensus and controversy - Models of Professional Roles & Professionalism - theories about right action - Self-interest - customs and religion - uses of ethical theories.

Engineering as experimentation - engineers as responsible experimenters - Research ethics Codes of ethics - Industrial Standard - Balanced outlook on law - the challenger case study.

Safety and risk - assessment of safety and risk - Riysis - Risk benefit analysis and reducing risk - Govt. Regulator's approach to risks - the three-mile island and Chernobyl case studies & Bhopal - Threat of Nuclear power, depletion of ozone, greenery effects - Collegiality and loyalty - respect for authority - collective bargaining - Confidentiality - conflicts of interest - occupation crime - professional rights - employees' rights - Intellectual Property rights (IPR) - discrimination.

Multinational corporations - Business ethics - Environmental ethics - computer ethics - Role in Technological Development - Weapons development engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Honesty - leadership - sample code of conduct ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management Institution of electronics and telecommunication engineers (IETE), India, etc.,.

Reference

1. *Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).*

2. *Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, (2000).*

3. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, (2003)
5. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, (2001)

Course Outcome

At the end of the course student will be able to

1. Understood the core values that shape the ethical behaviour of an engineer
2. Exposed awareness on professional ethics and human values.
3. Known their role in technological development

(II) PROGRAMME CORE (PC)

CEPC10 ENGINEERING MECHANICS

Course Learning Objectives

1. To explain the importance of mechanics in the context of engineering and conservation equations
2. To explain the significance of centroid, center of gravity and moment of inertia.
3. To introduce the techniques for analyzing the forces in the bodies.
4. To analyze the internal member forces acting on cables and trusses.
5. To understand the basic principles of dynamics.

Course Content

Fundamentals: Mechanics and its relevance, concepts of forces, laws of mechanics – Lami's Theorem, Concept of free-body diagram, centroids, center of gravity, area moment of inertia, mass, moment of inertia.
Friction: Laws of friction, application of laws of friction, wedge friction, body on inclined planes.
Statics: Principles of statics, Types of forces, concurrent and non-concurrent forces, composition of forces, forces in a plane and space, stresses and strains, elastic constant.
Beams, Cables and Trusses: Beams subjected to concentrated loads, UDL with supports at different levels- analysis of Trusses – method of joints – method of sections. Dynamics: Principles of dynamics, D'Alembert's principle, conservation of momentum and energy, vibrations of simple systems.

References

1. *Kumar K.L., Kumar V, 'Engineering Mechanics', Tata McGraw Hill, 2011.*
2. *Rajasekaran S and Sankarasubramanian G, 'Engineering Mechanics Statics and Dynamics', Third Edition, Vikas Publishing House Pvt.Ltd, 2005.*
3. *Timoshenko S, and Young D.H, 'Engineering Mechanics', Tata McGraw Hill, 2006.*
4. *Popov E.P, 'Engineering Mechanics of Solids', Prentice Hall, 1998.*
5. *Shames I.H, and Rao G.K.M, 'Engineering Mechanics – Static and Dynamics', Pearson Education, 2009.*
6. *Beer F.P and Johnson Jr.E.R, 'Vector Mechanics for Engineers', Tata McGraw Hill, 2009.*

Course outcomes

The terminal objectives of the course is that, on successful completion of teaching-learning and evaluation activities, a student would be able to identify and analyze the problems by applying the fundamental principles of engineering mechanics and to proceed to research, design and development of various engineering systems.

CEPC11 MECHANICS OF SOLIDS

Course Learning Objectives

1. To learn about the concept of stress, strain and deformation of solids

2. To know the concepts of virtual work, strain energy and principal stress
3. To learn the bending moment, shear force and the corresponding stress distribution for different types of beams
4. To study the different methods of finding deflection of beams and trusses and understand the torsion behaviour of solid and hollow circular shafts
5. To analyse columns of varying end support conditions by Euler Theory and Rankine's formula

Course Content

Simple, compound and thermal stresses - composite bars – strain energy and resilience - Principal stress and principal planes Mohr's circles

Shear force and bending moment for different determinate beams – Euler Bernoulli beam theory - Stress distribution at a cross section due to Bending Moment and Shear

Deflection of beams using double integration and semi graphical methods such as conjugate beam and moment area method- Principle of virtual displacement and virtual forces - Castigliano's first theorem - Maxwell's reciprocal theorem.

Strain energy and dummy unit load approaches to deflection of trusses - Theory of torsion - Torsion of circular and hollow circular shafts and shear stresses due to torsion

Theory of columns: Axial load- Euler's theory-Rankines formula, combined bending and axial load

References

1. *Hibbeler, R.C., Mechanics of Materials, Pearson, 2016*
2. *Ramamrutham, S., Strength of Materials, Dhanpat Rai Publishing Co Pvt Ltd., 2011*
3. *Timoshenko, S.P. and Gere, J.M. Mechanics of Materials, Tata McGraw Hill, 1992*
4. *Rajput R.K., Strength of Materials, S. Chand & Co., Ltd., 1996.*

Course outcomes

On completion of the course, the students will be able to:

1. determine the strength parameters of the materials and solve principal stress and principal plane problems
2. determine shear force, bending moment, bending and shear stress distribution
3. determine deflection of a beam for various loading conditions and also trusses
4. analyze members subjected to torsion
5. visualize the behavior of column for combined bending and axial loading

CEPC12 HYDRAULICS AND FLUID MACHINERY

Course Learning Objectives

1. To understand the properties of fluids and fluid statics.
2. To solve kinematic problems such as finding particle paths and stream lines.

3. To use important concepts of continuity equation, Bernoulli's equation and turbulence, and apply the same to problems.
4. To study about specific speed and performance characteristics of different types of turbines.
5. To study types of centrifugal Pumps, work done and efficiency of the different types centrifugal pumps and also study about performance of pumps & characteristic curves.

Course content

Continuum concept - CGS, MKS and SI systems - Properties of Fluids - Ideal and real fluid - Flow classification, stream lines, streak lines, continuity equation, velocity, tangential, normal, local and convective acceleration, types of fluid motions, stream function, velocity potential function, flownet.

Pressure at a point – pascal law - Hydrostatic law - pressure measurement – Hydrostatic forces on immersed plane and curved surfaces, Buoyancy, Stability of floating and submerged bodies. Bernoulli's equation, Energy correction factor, Coefficients of contraction, velocity and discharge, free vortex motion, Analysis of free liquid Jet, Cavitation.

Laminar and turbulent flow - Reynold's number - Navier stoke equations of motion - shear stress and pressure gradient - Laminar flow between parallel plates - Couette flow - Hagen Poiseuille equation for flow through circular pipes.

Turbulence - Major losses - Darcy-Weisbach equation for flow through circular pipe - Friction factor - Smooth and rough pipes - Moody diagram - Minor losses - pipes in series and parallel - Equivalent length - water hammer phenomena- flow measurement – orifice mouth piece, weirs, flow under sluice gates.

Centrifugal pump - minimum speed to start the pump – multistage Pumps –Positive displacement pumps – reciprocating pump - negative slip - flow separation conditions - air vessels -indicator diagram and its variation - savings in work done- Turbines - draft tube and cavitations –classification - radial flow turbines - axial flow turbines – Impulse and Reaction turbines.

References

1. *Nagaratnam, S., Fluid Mechanics, Khanna Publishers, 1995.*
2. *Natarajan, M.K. Principles of Fluid Mechanics, Oxford & IBH Publishing Co, 1994.*
3. *JagdishLal, Hydraulics and Fluid Mechanics, Tata McGraw Hill, 2001.*
4. *Streeter V.L., Fluid mechanics, Tata McGraw Hill, 1998.*

Course outcomes

On completion of the course, the students will be able to:

1. Understands the basic principles of fluid mechanics.
2. Understands the concepts of statics and dynamics of fluid flow.
3. Develops skills in analyzing fluid flows through the proper use of modeling and the application of the basic fluid-flow principles.
4. Acquire knowledge in the selection of type of turbine required with reference to available head of water and also used for Identification of type of turbine with estimated specific speed.

5. Capable of estimating efficiency of different pumps and performance of the pumps with the study of characteristics curves.

CEPC13 CONCRETE TECHNOLOGY

Course Learning Objectives

1.To understand the properties of ingredients of concrete

2.To study about the concrete design mix

3.To study the behaviour of concrete at its fresh and hardened state

4.To know about the procedures in concreting

5.To understand special concrete and their use

Course content

Introduction -Concrete materials –Cement including Special Cements - Physical tests on cement -Concrete materials -Tests on aggregates -Quality of Water for mixing and curing -use of sea water for mixing concrete -Mineral and chemical Admixtures.

Mix Design -factors influencing mix proportion -Mix design by ACI method and I.S. code method.

Batching -Mixing -Transportation -Placing of concrete -curing of Concrete. Fresh and hardened properties of Concrete –Quality control -Sampling and testing-Acceptance criteria.

Creep, Shrinkage and temperature effects of concrete -durability of concrete: deterioration under chemical attacks and freeze and thaw attack -permeability of concrete –Corrosion of rebar -Causes and effects -remedial measures-Fire resistance of concrete –Rebound hammer and Ultra-sonic pulse velocity testing methods.

Special Concrete –Lightweight concrete – High Density Concrete – Hot and Cold weathering Concrete -Fibre reinforced concrete -Polymer concrete -Ferro cement -Ready mix concrete-High Performance Concrete -Self compacting concrete – Sustainability of concrete.

References

1. Mehta P. K. and Monterio P. J. M. (2017), Concrete: Microstructure, Properties, and Materials, 4th edition, McGraw Hill Education, USA.

2. Shetty, M.S., Concrete Technology (Theory & Practice), S.Chand and Co, Revised edition, 2015.

3. Gambhir, M.L., Concrete Technology, Tata McGraw Hill, fifth edition, 2013.

4. A.M.Neville, Properties of Concrete, Pearson India, fifth edition.

5. IS 456 (2000), Plain and Reinforced Concrete - Code of Practice, Bureau of Indian Standards (BIS), New Delhi, India.

6. IS 10262 (2019), Concrete Mix Proportioning – Guidelines, Bureau of Indian Standards (BIS), New Delhi, India.

7. ACI 318 (2014), Building code requirements for structural concrete (ACI 318-2014) and Commentary (ACI 318R-2014). American Concrete Institute, Detroit, MI, USA.

Course outcomes

On completion of the course, the students will be able to:

1.test all the concrete materials as per IS code

2.design the concrete mix using ACI and IS code methods

3.determine the properties of fresh and hardened of concrete

4.ensure quality control while testing/ sampling and acceptance criteria

5.design special concretes and their specific applications

CEPC14 SURVEYING

Course Learning Objectives

1. To understand the importance of surveying in the field of civil engineering
2. To get introduced to different plane and geodetic surveying applications such as chain, compass, plane table, leveling, triangulation, trigonometric leveling etc
3. To understand the significance of each method in civil engineering and master the skill to carry out proper surveying method on the field.
4. To design numerical solutions for carrying out surveying in civil engineering field.
5. To get introduced to modern advanced surveying techniques involved such as remote sensing, Total station, GPS etc.

Course content

Introduction and Principles of surveying – Classification – Brief introduction to chain surveying –Compass surveying – Bearing of survey lines – systems and conversions – Local attraction – Latitude and departure – Traverse adjustment of closing errors

Plane Table surveying – instruments and accessories – methods of plane tabling - Levelling – Levelling instruments – Temporary and permanent adjustments – Booking – Reduction to levels – Correction for Curvature and refraction

Theodolite surveying – Vernier theodolite – Temporary and permanent adjustments – Measurement of horizontal and vertical angles –Tacheometric surveying – Stadia system –Fixed and Movable hair methods –Subtense bar – Tangential method

Geodetic surveying - Triangulation – different networks – orders and accuracies – intervisibility and height of stations – Trignometrical levelling – Observations for heights and distances – Geodetic observations

Application of surveying - Curve setting – Types – Setting out of buildings, culverts, tunnels - Introduction to Advanced Surveying equipments - EDM – Total station - Remote Sensing – GPS

References

1. *Duggal, S.K. Surveying Vol. I and II, Tata McGraw Hill, 2004.*

2. Punmia, B.C. Surveying Vol.I and II, Standard Publishers, 1994.

3. Arora, K. R. Surveying Vol. I and II, Standard Book House, 1996.

3. Arora, K. R. Surveying Vol. I and II, Standard Book House, 1996.

4. Satheesh Gopi. Advanced Surveying, Pearson Education, 2007.

5. Satheesh Gopi. The Global Positioning System and Surveying using GPS, Tata McGraw, 2005.

Course Outcomes

On completion of the course, the students will be able to

1. to plan a survey, taking accurate measurements, field booking, plotting and adjustment of traverse can be understood through leveling, plane table surveying etc
2. Understanding of fundamental function, use of Theodolite and tacheometry in practical applications such as road alignment, height of building, control point setting etc, g with respect to utility and precision through the use of Theodolite, tacheometry
3. To understand the concepts of geodetic surveying in plan a large scale survey
4. To use the principles of curve, building setting and understand the importance of advances surveying measurement techniques in civil engineering applications.

CEPC15 ANALYSIS OF INDETERMINATE STRUCTURES

Course Learning Objectives

1. To learn the concepts of indeterminacy and methods for calculating bending moment and shear force on basic indeterminate beams
2. To understand the concept of analysis of indeterminate structures by various classical methods
3. To study the use of ILD for determinate structure
4. To learn the concepts of moving loads and its effect on structures
5. To understand the approximate methods for analysis multistorey plane frames

Course Content

Propped cantilevers, Continuous and Fixed Beams – Clapeyron's 3 moment theoram- Bending moment and shear force diagrams – static and kinematic indeterminacy

Slope deflection method - analysis of indeterminate structures- Settlement- Moment distribution method - analysis of frames - settlement of supports - sway. Energy methods - Kani's method - analysis of indeterminate structures - settlement of supports - sway.

Moving loads -single load - two point loads - several points loads - maximum bending moment and maximum shear force - equivalent u.d.l. - absolute maximum bending moment.

Enveloping curves for maximum bending moment and maximum shear force and determination of equivalent UDL, ILD for shear, moment and reactions for beams and trusses - Reversal of stresses under live load.

Analysis of multistorey frames for gravity and lateral loads by approximate methods - Portal and Cantilever methods

References

1. *Hibbeler, R.C., Structural Analysis, Pearson, 2017*
2. *Vaidyanathan, R., and Perumal, P., Structural Analysis Vol I, Laxmi Publications, 2016.*
3. *Menon, D., Structural Analysis, Narosa Publishing House, 2008*
4. *Jindal. R.L, Indeterminate Structures, Chan Tea, New Delhi, 2000*

5. Punmia B.C., Theory of Structures, Standard Book House, New Delhi, 2000

Course outcomes

On completion of the course, the students will be able to:

1. Analyse the basic indeterminate beams such as Propped cantilevers, Continuous and Fixed Beams
2. use various classical methods for analysis of indeterminate structures
3. determine the effect of support settlements for indeterminate structures
4. apply the concepts of ILD and moving loads on determinate structures
5. apply approximate methods to analyse multistorey plane frames

CEPC16 GEOTECHNICAL ENGINEERING-I

Course Learning Objectives

1. To explain how three phase system is used in soil and how are soil properties estimated using three phase system
2. To explain the role of water in soil behaviour and how soil stresses, permeability and quantity of seepage including flow net are estimated
3. To emphasise the importance of soil stress distribution and stress influence due to varies loads.
4. To explain how soil shear parameters are affected by drainage conditions
5. To estimate the magnitude and time-rate of settlement due to consolidation

C**ourse content**

Historical development of Soil Engineering - Origin and general types of soils - soil structure, clay minerals-Three phase system- Identification and Classification of soils.

Soil water - capillary phenomena - concept of effective and neutral stresses – Permeability - determination of coefficient of permeability in the laboratory - Seepage flow - Head, gradient, pressure - steady state flow - two dimensional - flow net.

Vertical stress distribution in soil - Boussinesq and Westergaard's equation - Newmark's influence chart - principle, construction and use - Equivalent point load and other approximate methods - pressure bulb - Compaction.

Shear strength - Mohr-Coulomb failure criterion - shear strength tests – Different drainage conditions - Shear properties of cohesionless and cohesive soils - Use of Mohr's circle - relationship between principal stresses and shear parameters.

Compressibility and consolidation - Terzaghi's one dimensional consolidation theory - pressure void ratio relationship - preconsolidation pressure - Total settlement and time rate of settlement - coefficient of consolidation - curve fitting methods - Correction for construction time.

References

1. *Gopal Ranjan Rao, P. Basic and Applied Soil Mechanics, New Age International Pvt. Limited, New Delhi, 2002.*
2. *Murthy, V.N.S., A text book of Soil Mechanics and Foundation Engineering, UBS*

   Publishers Distributors Ltd., New Delhi, 1999

3. *Punmia, B.C. Soil Mechanics and Foundation Engineering, Laxmi Publications Pvt. Ltd., New Delhi, 1995.*
4. *Braja M. Das, Fundamentals of Geotechnical Engineering, Thomson Asia Pvt. Ltd.,*
   Singapore, 2005.
5. *Braja M. Das, Principles of Geotechnical Engineering, Thomson Asia Pvt. Ltd., Singapore, 2008.*
6. *Robert D. Holtz, William D. Kovacs and Thomas C. Sheahan, An Introduction to Geotechnical Engineering, Pearson, 2013.*
7. *Donald P. Coduto, Man-Chu Ronald Yeung and William A. Kitch, Geotechnical Engineering, Principles and Practices, PHI Learning Private limited, 2011.*

Course Outcomes

Upon completion of this course, the students will be able to

1. Understand the importance of geotechnical engineering in civil engineering and do proper soil classification and the phase system to solve problems
2. Solve any practice problems related to soil stresses estimation, permeability, seepage including flow net diagram.
3. Do proper stress estimation under any system of foundation loads
4. Estimate appropriate soil strength parameters with respect to the drainage conditions
5. Solve any practical problems related to consolidation like consolidation settlement, time rate of settlement

CEPC17 ENVIRONMENTAL ENGINEERING –I

Course Learning Objectives

1. To make the students conversant with sources of water and its demand
2. To understand the basic characteristics of water and its determination
3. To expose the students to understand components of water supply lines
4. To provide adequate knowledge about the water treatment processes and its design
5. To have adequate knowledge on distribution network and water supply to buildings

Course Content

Physical, chemical and biological characteristics of water – Water analysis – IS and WHO standards – Requirements of water supply – Types of demand and their contribution – Rate of consumption – Forecasting the population – Variation in demand pattern. Sources of water – Quantitative and qualitative studies. Intakes – Channels and pipes for conveying water – Pipes – Hydraulic design of pressure pipe – Materials – Laying – Joining – Testing – Pipe appurtenances – Pumps and pumping stations. Treatment plants – Process of treatments – Mixing, aeration, sedimentation, coagulation, filtration, disinfection, softening – Advanced water treatment. Distribution systems – Analysis of distribution networks. Operation and maintenance of water supply to buildings – Rural water supply – Protected water supply –Saline water intrusion.

References

1. *Manual on Water supply and Treatment – CPHEEO, 1999.*
2. *Peavy H. S., Rowe D. R. and Tchobanoglous G., Environmental Engineering, McGraw Hill, New York, 1985.*
3. *Davis M. L. and Cornwell D. A., Introduction to Environmental Engineering, Tata McGraw Hill Education Pvt. Ltd,. New Delhi, 2010.*
4. *Birdie, G. S. and Birdie, Water Supply and Sanitary Engineering, Dhanpat Rai & Sons, 2014.*
5. *Duggal, K. N., Elements of Environmental Engineering, S. Chand & Co., 2008.*
6. *Punmia B. C., Ashok Jain & Arun Jain, Water Supply Engineering, Laxmi Publication Pvt., Ltd., New Delhi, 2005.*

Course Outcomes

On completion of the course, the students will be able to

1. analyze various water quality parameters
2. forecast the population and estimate water demand
3. differentiate various intake structures and select suitable pipe material for water conveyance
4. design various water treatment units and distribution network

CEPC18 ENVIRONMENTAL ENGINEERING-II

Course Learning Objectives

1. To learn the basics of sewage composition and its characteristics
2. To have adequate knowledge about various sewage treatment processes and its design
3. To provide the adequate information on various disposal standards for industrial effluents
4. To study the effect of air pollution and its control measures
5. To gain knowledge about solid waste disposal and Environmental Impact Assessment

Course Content

Characteristics and composition of sewage – Sampling – Analysis – Population equivalent – Drainage in buildings – Plumbing systems for drainage. Primary treatment – Secondary treatment – Biokinetics – Lagooning – Sludge digestion – Tertiary treatment. Disposal standards – Self-purification of rivers – Streeter Phelps equation – Oxygen sag curve. Toxic and hazardous wastes – Equalization and neutralization – Biological degradation – Recycle and reuse of waste effluents – Treatment of industrial wastewater – Diary, Tannery, Petrochemical, Fertilizer, Textiles, Pulp and paper. Air pollution – Effects – Stack emission – Automobile exhaust – Control devices – Solid waste management – Environmental Impact Assessment.

References

1. *Peavy H. S., Rowe D. R. and Tchobanoglous G., Environmental Engineering, McGraw Hill, New York, 1985.*
2. *Davis M. L. and Cornwell D. A., Introduction to Environmental Engineering, Tata McGraw Hill Education Pvt. Ltd,. New Delhi, 2010.*

3. *Birdie, G. S. and Birdie, Water Supply and Sanitary Engineering, Dhanpat Rai & Sons, 2014.*
4. *Duggal, K. N., Elements of Environmental Engineering, S. Chand & Co., 2008.*
5. *Metcalf and Eddy, Wastewater Engineering, Collection, Treatment and Disposal, Tata McGraw Hill, Inc., New York, 2005.*
6. *Manual on Water supply and Treatment – CPHEEO, 1999.*

Course Outcomes

On completion of the course, the students will be able to

1. determine the various characteristics of sewage
2. design various sewage treatment units
3. predict the quality of water in river, using mass balance approach and specific models
4. select suitable treatment units for specific industries
5. identify the sources of air pollutants, effects on human health and the environment

CEPC19 GEOTECHNICAL ENGINEERING-II

Course Learning Objective

1. To emphasize the importance of soil investigations including destructive and non-destructive methods.
2. To explain how earth pressure theory is important in retaining structure design
3. To explain the concept of bearing capacity and how to estimate the safe bearing capacity for various foundation system including settlement consideration
4. To explain how to select a suitable shallow foundation system for various site conditions and also to carry out analysis of different foundation system
5. To explain in what circumstances pile is needed and how to estimate pile and pile group capacity under various soil conditions

Course content

Soil exploration - Planning - Augur boring - Soundings - Sampling - Plate load test, static and dynamic penetrations tests - geophysical explorations

Lateral Earth Pressure – Plastic equilibrium - Rankine's theory - Active and passive earth pressure for cohesionless and cohesive soils - Earth pressure at rest - Coloumb's wedge theory - Rebhann's and Culmann's graphical solutions, Stability analysis

Foundation - functions and requisites- Different types - choice of foundation type – general principles of design. Bearing capacity - types of failures - Prandtl's and Terzaghi's bearing capacity analysis - Bearing capacity based on settlement and building codes

Shallow foundation - spread footings - combined footings - trapezoidal and strap footings -Raft foundation - Contact pressure distribution - settlement analysis - Types of settlement, Control

Deep foundation - piles - types - load carrying capacity of pile - static and dynamic formula - pile load test - penetration test - pile groups - Efficiency - Feld's rule – Converse Labarre formula, Settlement of piles and pile groups - Negative skin friction – under-reamed piles

References

1. *Murthy, V.N.S, A text book of Soil Mechanics and Foundation Engineering, UBS Publishers & Distributors Pvt. Ltd., New Delhi 1999.*
2. *Punmia, B.C., Soil Mechanics and Foundation Engineering, Laxmi Publications Pvt. Ltd., New Delhi, 1995.*
3. *Gopal Ranjan and Rao, Basic and Applied Soil Mechanics, New Age International (P) Limited, New Delhi, 2002.*
4. *Nainan P Kurian, Design of foundation Systems Principles and Practices, Narosa, 2011*
5. *Braja M. Das, Principles of Foundation Engineering, Thomson Asia Pvt. Ltd., Singapore, 2005.*
6. *Donald P. Coduto, Man-Chu Ronald Yeung and William A. Kitch, Geotechnical Engineering, Principles and Practices, PHI Learning Private limited, 2011.*
7. *Joseph E. Bowles, Foundation Analysis and Design, McGRAW-Hill, 1998.*
8. *Shenbaga R Kaniraj, Design Aids in Soil Mechanics and Foundation Engineering, Tata McGraw Hill, 2011.*

Course outcomes

Upon completion of this course, the students will be able to

1. Understand the importance of soil investigation for any civil engineering construction
2. To analyse earth retaining structures in various types of soil medium
3. Do proper bearing capacity estimation including IS code methods
4. Do proper foundation proportioning for any kind of shallow foundation system and also get exposed in foundation analysis
5. To estimate pile and pile group capacity for any kind of soils including group efficiency and negative friction

CEPC20 HIGHWAY AND PAVEMENT ENGINEERING

Course Learning Objectives

1. To understand the importance of transportation, characteristics of road transport, highway planning, alignment and surveys
2. To know the geometric design of highways
3. To study traffic characteristics and principles of intersection design
4. To know about pavement materials and design
5. To understand pavement construction, distresses in pavements and maintenance options

Course Content

Highway Planning: Different modes of transportation, Characteristics of Road Transportation, Highway Development in India, Classification of Roads, Network patterns. Principles of highway alignment – requirements and controlling factors. Engineering surveys for alignment - conventional and modern methods. Typical cross sections of Urban and Rural roads - cross sectional elements.

Highway Geometric Design: Factors affecting geometric design. Sight distance - stopping sight distance, overtaking sight distance, sight distance at intersections.

Design of horizontal alignment - super elevation, widening of pavements, transition curves. Design of vertical alignment - gradients, summit and valley curves.

Traffic Engineering: Road user, vehicle and highway characteristics –-Principles of traffic studies. Concept of PCU, Traffic capacity and Level of service. Traffic signs and road markings - objectives, classification and uses. Principles of design of at-grade intersections – channelized, rotary and signalized intersections. Introduction to grade separated interchanges.

Pavement Materials and Design: Desirable properties of subgrade soil, road aggregates and bituminous materials - Pavement components and their functions - Factors influencing the design of pavements - Design of flexible and rigid pavements as per IRC.

Pavement Construction and Maintenance: Construction of gravel, WBM, bituminous and cement concrete roads. Pavement failures - Types and causes of failures in flexible and rigid pavements. Maintenance of highway pavements. Strengthening of existing pavements - evaluation, overlay design. Recycling of pavements.

References

1. *Khanna, S. K., Justo, C. E. G. and Veeraragavan A., Highway Engineering, Nem Chand and Bros, Roorkee, 2014.*
2. *Kadiyali, L.R, Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 2011.*
3. *Kadiyali, L.R, and Lal, N.B. Principles and Practice of Highway Engineering, Khanna Publishers.2005*.

Course outcomes

Upon completion of this course, the students will be able to

1. carry out surveys involved in planning and highway alignment
2. design cross section elements, sight distance, horizontal and vertical alignment
3. implement traffic studies, traffic regulations and control, and intersection design
4. determine the characteristics of pavement materials and design of pavements
5. understand construction and maintenance of pavements

CEPC21 BASIC REINFORCED CONCRETE DESIGN

Course Learning Objectives

1. To study the stress strain behavior of steel and concrete
2. To understand the concept of working stress and limit state methods
3. To gain the knowledge of limit state design for flexure, shear, torsion, bond and anchorage
4. To understand the behavior of columns subjected to eccentric load and use of interaction diagrams
5. To study the design of various foundation

Course Content

Stress-strain behavior of steel and concrete- Introduction to working stress method (WSM) - permissible stresses. Ultimate load method (ULM) - Limit state method--

Probabilistic Analysis and Design - Characteristic strength and load - Partial safety factor – Codal recommendations

Behavior in flexure –Modular ratio and cracking moment, Transformed sections, Analysis at WSM and ULM - Design of singly and doubly reinforced beams, T and L beams – Serviceability Limit States: Deflection and Cracking

Design of Slabs - one way and two way slabs for different edge conditions - Yield line theory - Flat slabs - Stair cases - different types.

Design for Shear – behaviour of reinforced concrete under shear – design shear strength with and without shear reinforcement. Desgin for Torsion - general behavior in torsion - design strength in torsion. Design for Bond – bond failure and strength – splicing of reinforcement – codal recommendations

Design of compression members - Columns - axially loaded and eccentrically loaded columns Interaction diagrams - biaxial bending and slender columns– effective length

Footings - isolated footings - square, rectangular and circular footings - Combined footing

Note: *Assignments include the design and drawings of various R.C.C structural elements.*

References

1. *Krishna Raju, N., Reinforced Concrete Design: IS:456-2000 Principles and Practice, New Age International Publishers, 2018*
2. *Pillai, S. U. and Menon, D. Reinforced Concrete Design. McGraw Hill Education Private Limited, New Delhi, India, 3rd edition, 2009*
3. *Park, R., and Paulay, T., Reinforced Concrete Structures, John Wiley & Sons, 1975*
4. *Varghese, Limit state design of concrete, Oxford IBH, 2000.*
5. *McCORMAC J.C. and Brown R. H., Design of Reinforced Concrete, John Wiley & Sons Inc, USA, 8th edition, 2010*
6. *IS456-2000 Code of practice for Plain and reinforced concrete code of practice.*
7. *ACI 318 (2014), Building code requirements for structural concrete (ACI 318-2014) and Commentary (ACI 318R-2014). American Concrete Institute, Detroit, MI, USA*

Course outcomes

On completion of the course, the students will be able to:

1. apply the fundamental concepts of working stress method and limit state method
2. use IS code of practice for the design of concrete elements
3. design the beams, slab, stairs, column and footing
4. draw various RCC structural elements

CEPC22 HYDROLOGY AND IRRIGATION ENGINEERING

Course Learning Objectives

1. To provide knowledge on principles and processes governing the movement of water through the hydrologic cycle, including surface runoff, infiltration, and groundwater flow.
2. To develop the skills in understanding design storm estimation, hydrologic statistics, and frequency analysis techniques applied to problems of engineering hydrologic design.
3. To understand the basic types of irrigation, crop water assessment and command area development and water management, managing climate change impacts on the water resources.
4. To provide knowledge on design of diversion, impounding and canal network structures

Course Content

The global hydrological cycle, components of the hydrological cycle, Surface water hydrology and groundwater hydrology, measurement of precipitation, evapotranspiration, infiltration, and streamflow. Water balances, urban hydrology, surface runoff, hyetograph, unit hydrograph and S-hydrograph, Flow duration curve, Synthetic and GIUH derivation for flood estimation, hydrological effects of climate change.

Design storm, Probable Maximum Precipitation, Probable Maximum Flood Design Flood, Flood frequency analysis, Intercity-Duration-Return period, Statistical analysis of hydrological data -Flood and drought.

Need and classification of irrigation, National Water Policy India, and Tamilnadu scenario. Physical properties of soil moisture, movement of water into and within the soils, Water-Plant relationship. Crop water demand, crop season, duty-delta & base period consumptive, irrigation scheduling, Irrigation methods: Surface and Sub-Surface and Micro Irrigation – design of drip and sprinkler irrigation.

Diversion and impounding structures-Types of impounding structures, Gravity dam, Earth dams, Forces on a dam -Design of Gravity and Earth dams, Diversion Head works, Distributory Regulators, Offtake alignment, cross regulators, their functions, design of Distributory, Head regulators – their functions and design, Canal fall, Canal drop, Canal escape and Cross drainage works, seepage and waterlogging.

Structures on Pervious formations- Silt theories, Bligh's creep theory and Khoslas's theory, Khosla's corrections, Weir and Barrages, Design of vertical drop weir. Canal types, alignments, Canal lining, Kennedy's and Lacey's Regime theory, Design of lined and unlined canal.

References

1. *K. Subramanya, Engineering Hydrology, Tata McGraw Hill Pub. Co. New Delhi.*
2. *C.S.P. Ojha, R, Berndtsson and P. Bhunya, Engineering Hydrology, Oxford University Press, New Delhi.*
3. *Sharma S K "Design of Irrigation Structures" S. Chand & Company (Pvt.) Ltd., New Delhi.*
4. *Murty C S "Design of Minor Irrigation and Canal Structures" Wiley Eastern Ltd. New Delhi.*
5. *Garg S K "Irrigation Engineering & Hydraulic Structures" Khanna Publishers, Delhi,1999.*

Course outcomes

By the end of this course the students will

1. gain background in hydrology an understanding of water resources systems, flood flows and flood routing
2. acquire the knowledge on hydrological cycle and interpret precipitation data and evapotranspiration.
3. assess the crop water requirement for various crops in the command area and soil water relationships
4. know the knowledge in the design of diversion structures and reservoirs
5. understand the complete design of various Canal irrigation system

CEPC23 RAILWAY, AIRPORT AND HARBOUR ENGINEERING

Course Learning Objectives

1. To know about the basics and design of various components of railway engineering.
2. To study about the types and functions of track, junctions and railway stations.
3. To learn about the aircraft characteristics, planning and components of airport.
4. To study about the types and components of docks and harbours.
5. To know about various urban transportation systems and Intelligent Transportation Systems.

Course content

Railway Engineering - Location surveys and alignment - Permanent way - Gauges - Components - Functions and requirements - Geometric design

Track Junctions-Points and crossings - types and functions - design and layout - simple problems - Railway stations and yards. Signaling and interlocking - control systems of train movements.

Airport Engineering-Aircraft characteristics - Airport obstructions and zoning - Runway - taxiways and aprons- Terminal area planning

Docks and Harbours - Types - Layout and planning principles- breakwaters - docks- wharves and quays - Transit sheds- warehouses- navigation aids.

Urban transportation systems - Bus transit - Mass Rapid Transit System - Light Rail Transit. Transport economics and Financing - Intelligent Transportation Systems (ITS)

References

1. *M.M. Agarwal, Railway Engineering, Prabha & Co. 2007.*
2. *Khanna, S.K. and Arora, M.G. Airport Planning and Design, Nemchand and Bros. 1999.*
3. *Oza and Oza, Elements of Dock and Harbour Engineering, Charotar Publishing House, 1996.*

Course outcomes

On completion of the course, the students will be able to:

1. Carry out the surveys for railways, airports and harbours.

2. Perform geometric design for the three modes.
3. Plan the layout of different types of terminals.
4. Apply the principles of bus transit, MRTS and LRT.
5. Demonstrate the fundamentals of Intelligent Transportation Systems.

CEPC24 BASIC STEEL STRUCTURAL ELEMENTS

Course Learning Objectives

1. To understand the provisions of IS800-2007 code of practice for the design of Compression, Tension and Flexural members using various cross-sections.
2. To study the behavior and design of compression and tension members using simple and built-up sections.
3. To understand behavior of flexural members and the design laterally restrained and unrestrained beams.
4. To study the design of bolted and welded connections and arranging field visit to industries.

Course content

Introduction - elastic and plastic properties of steel sections – stress distribution under various internal forces. Design of axially loaded tension members - Types of tension members - modes of failures

Design of axially loaded compression members – Plastic moment and shape factor - section classifications - effective length - slenderness ratio – simple sections – built-up sections - design of lacings and battens - single angle and double angle strut – continuous and discontinuous strut.

Flexural members – types of steel beams – Lateral stability of beams –effective length - design of laterally restrained and unrestrained beams – rolled sections - built-up beams/compound beams – Design for strength and serviceability, web yielding, web crippling, bearing stiffeners.

Bolted connections - types of bolts - resistance of bolted connections under various failure modes – shear moment resistant connections - design of beam and columns splice.

Welded connections - types - strength of welds - design of fillet and butt welds - shear and moment resistant connections - design and detailing of connections.

Note: *Assignments include the design and drawings of various steel structural elements.*

References

1) *Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi 2008.*
2) *Shiyekar, M.R., Limit State Design in Structural Steel, PHI, 2013.*
3) *Bhavikatti, S.S., Design of Steel Structures, I.K. International Publishing House Pvt. Ltd., New Delhi, 2010*
4) *IS 800 - 2007, Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi.*
5) *SP6 (1)-1964, IS hand book for structural Engineers. Bureau of Indian Standards, New Delhi.*

6) Online Teaching Material – Institute for Steel Development and Growth (INSDAG)

Course outcomes

On completion of the course, the students will be able to:

1. Apply the IS code of practice for the design of steel structural elements.
2. Design compression and tension members using simple and built-up sections.
3. Calculate forces on the various members of the truss and design them.
4. Analyze the behavior of bolted connections and design them.
5. Design welded connections for both axial and eccentric forces.

(III.a) PROGRAMME ELECTIVE (PE)

CEPE10 CONSTRUCTION TECHNIQUES AND EQUIPMENTS

Course Learning Objectives:

1. To learn the principles of construction of building components
2. To know about prefabricated construction and building services
3. To study the different repair and rehabilitation technique
4. To understand the planning and operation of various construction equipment

Course Content

Principles of construction: Bonding , Reinforced brick work , Stone masonry, Hollow block masonry Composite masonry, Cavity walls, Flooring, Formwork, Centering and Shuttering sheet piles, Slip and moving forms, Roofs and roof covering, Joints in Concrete, Plastering and Pointing, Shoring and Scaffolding, Under pinning, Submerge Structures.

Prefabricated structures and building services: Prefabricated panels & structures, Production, Transportation and Erection of structures, Sound insulations, Ventilations, Fire resisting construction, Damp proofing, Termite proofing.

Basics of construction equipment: Factors affecting the selection of equipment, economic life of equipment, cost of equipment, maintenance of equipment.

Construction equipment and machinery: Earthwork equipment, Hoisting and lifting equipment, Material handling equipment, Concrete equipment, Dewatering equipment.

Construction automation and robotics - construction equipment: graders, scrapers, rollers, etc.

References

1. *Arora, S.P. and Bindra, S.P. A Text Book of Building Construction, Dhanpat Rai Publications, New Delhi, 2005.*
2. *Varghese, P.C., Building Constructions, Prentice Hall, 2007.*
3. *Sharma & Kaul, Building Construction, S.Chand & Company Pvt, New Delhi, 1998*
4. *Peurifoy, R.L., Schexnayder, J.C., and Shapira, A, Construction Planning, Equipment and Methods, Tata McGraw Hill, New Delhi, 2010.*
5. *Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2013.*

Course outcomes

On completion of the course, the students will be able to:

1. Supervise and execute all the construction jobs with the knowledge of the different construction techniques
2. Identify the building defects and apply suitable repair techniques to rectify them
3. Evaluate the costs of equipment and make proper selection of the suitable construction equipment
4. Ensure the proper completion of a construction task using particular construction equipment

CEPE11 ELEMENTARY STRUCTURAL DYNAMICS

Course Learning Objectives

1. To introduce the concepts of dynamic systems
2. To study the dynamic response of SDOF
3. To study the dynamic response of MDOF
4. To introduce the continuous systems subjected to different types of dynamic loads
6. To learn free and forced vibrations response of structural systems

Course content

Dynamic analysis - Elements of vibratory systems and Simple Harmonic Motion.

Free vibration of Single Degree of Freedom Systems; undamped and dampedsystems.Viscous damping and Coulomb damping. Evaluation of damping

Forced vibration of undamped and damped systems –Structures subjected to harmonic loads

Resonance condition.Dynamic Amplification Factors. General types of loads - Duhamel's integral approach to solution.Free vibration analysis using Rayleigh's method Differential equation of motion – Thin Beam flexural vibration analysis – Beam functions.

Free vibration of Multi-Degree of freedom systems- Solution of the eigen value problem - Iteration due to Holzer and Stodola. Idealization of multi-storeyed - lumped SDOF system

References

1. *Mario Paz, Structural Dynamics, CBS, Publishers, 1987.*
2. *Roy R Craig, Jr., Structural Dynamics, John Wiley & Sons, 1981.*
3. *A.K. Chpora "Dynamics of Structures Theory and Application to Earthquake Engineering" Pearson Education, 2001.*

Course outcomes

On completion of the course, the students will be able to:

1. Apply the concepts of dynamic systems.
2. Identify, formulate and solve dynamic response of SDOF.
3. Identify, formulate and solve dynamic response of MDOF.
4. Analyse continuous systems subjected to different types of dynamic loads.
5. Identify, formulate and solve free and forced vibrations response of structural systems.

CEPE12 MAINTENANCE AND REHABILITATION OF STRUCTURES

Course Learning Objective

To provide a comprehensive knowledge on the diagnosis the damage, condition assessment of structures and quality of material application relating to maintenance and rehabilitation of structures.

Course content

Performance of construction materials and components in services for strength, permeability, thermal properties and cracking effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, Effects of cover thickness

Maintenance and Diagnosis

Maintenance, Repair and rehabilitation, Facets of Maintenance, Importance of Maintenance, Preventive measures based on various aspects of inspection-Condition assessment and rating procedure for evaluating a damaged structure. Diagnosis of construction failures. Different types of concrete deterioration

Corrosion damages and protection

Corrosion damage of reinforced concrete, methods of corrosion protection,

Corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection, rust eliminators. Causes of deterioration of concrete, steel, masonry and timber structures, surface deterioration, efflorescence, causes, prevention and protection.

Materials and Techniques

Surface repair strategies and materials - Special concrete and mortar, concrete chemicals, expansive cement, polymer concrete sulphur infiltrated concrete, Ferro cement, fiber reinforced concrete, Surface preparation and protective treatments, - surface coatings, Waterproofing materialsMethods of repair in concrete, steel and masonry structures. Gunite and shotcrete, epoxy injection.

Strengthening and demolition

Strengthening of existing structures - repairs to overcome low member strength, deflection, cracking, chemical disruption, weathering, wear, fire, leakage, marine exposure, coatings for set concrete and steel reinforcement. Demolition techniques of structures - case studies.

References

1. *Raiker .R.N, "Learning from Failures, Deficiencies in Design, Construction and Service", - R&D Centre (SDCPL), Raikar Bhavan, Bombay 1987.*
2. *Emmons P.H., Concrete Repair and Maintenance Illustrated, RS Means InC., 1993.*
3. *Varghese P.C., Maintenance Repair and Rehabilitation & Minor Works of Buildings, PHI Learning Pvt. Ltd., 2014*
4. *"Repair & Rehabilitation", Compilation from The Indian Concrete Journal,– ACC – RCD Publication 2001.*
5. *Allen .R.T, and Edwards .S.C, Shaw D.N, "Repair of Concrete* Structures",Chapman and Hall, 2005
6. *Newman A., Structural Renovation of Buildings, McGraw-Hill Education, 2000*
7. *Woodson R. D., Concrete Structures – Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, 2009*

Course outcomes

On completion of the course, the students will be able to:

1. Diagnosis the damage of distress structures
2. Investigate the condition assessment of structures

3. Select the proper repair materials and its application
4. Select the method to Strengthen the distressed structures

CEPE13 CONSTRUCTION MANAGEMENT

Course Learning Objectives

1. To know the managerial duties and responsibilities
2. To learn about man power planning and estimation of equipment cost
3. To understand project planning and scheduling concepts
4. To know the types of construction contracts and their drafting
5. To learn the application of computer software in construction management

Course content

Introduction: project forms, management objectives and functions; organizational chart of a construction company; manager's duties and responsibilities; public relations; Leadership and team - work; ethics, morale, delegation and accountability.

Man and Machine: Man-power planning, training, recruitment, motivation, welfare measures and safety laws; machinery for Civil Engineering., earth movers and hauling costs, factors affecting purchase, rent, and lease of equipment, and cost-benefit estimation.

Planning, scheduling and Project Management: Planning stages, construction schedules and project specification, monitoring and evaluation; Bar-chart, CPM, PERT, network- formulation and time computation.

Contracts: Types of contracts, Formation of contract – Contract conditions – Contract for labour, material, design, construction – Drafting of contract documents based on IBRD/ MORTH Standard bidding documents – Construction contracts – Contract problems – Arbitration and legal requirements

Computer applications in construction management: Software for project planning, scheduling and control.

References

1. *Dharwadkar, P.P., Management in Construction Industry, Oxford IBH, New Delhi, 1992.*
2. *Patrick, C., Construction Project Planning and Scheduling, Pearson, 2012.*
3. *Brien, J.O. and Plotnick, F.L., CPM in Construction Management, Mcgraw Hill, 2010.*
4. *Punmia, B.C., and Khandelwal, K.K., Project Planning and control with PERT and CPM, Laxmi Publications, 2002.*
5. *Kumar Neeraj Jha, Construction Project Management: Theory and Practice, Pearson, 2011*
6. *Oberlender G. Project Management for Engineering and Construction, McGraw-Hill Education; Third Edition, 2014*

Course outcomes

On completion of the course, the students will be able to:

1. Perform the role of a manager efficiently with precise knowledge of the roles and responsibilities
2. Estimate the man power requirement and can recruit suitable candidates for construction jobs

3. Analyse and compare the cost estimates of different construction equipment
4. Compute construction schedules, network diagrams and time estimates of projects
5. Evaluate and make tenders and contract documents of their own
6. Use the computer software to monitor real-time projects

CEPE14 STRUCTURAL SYSTEM ANALYSIS

Course Learning Objectives

1. To understand the importance of degrees of freedom and the concept of principle of superposition
2. To know about the concept of strain energy and principle of virtual work
3. To study the transformation of system matrices and element matrices for the determinate and indeterminate structures
4. To analyze the forces in structures like continuous beam, truss and frames using stiffness and flexibility method
5. To understand the behaviour of structures due to thermal expansion and lack of fit

Course Content

Generalized measurements - Degrees of freedom - Constrained Measurements - Behavior of structures - Principle of superposition. Stiffness and flexibility matrices - Constrained measurements - Stiffness and flexibility coefficients from virtual work.

Strain energy - Stiffness and flexibility matrices from strain energy - Symmetry and other properties of stiffness and flexibility matrices - Betti's law and its applications - Strain energy in systems and in elements.

Determinate and indeterminate structures - Transformation of element matrices to system matrices - Transformation of system vectors to element vectors - Normal coordinates and orthogonal transformations.

Flexibility method applied to statically determinate and indeterminate structures - Choice of redundants - Transformation of redundants - Internal forces due to thermal expansion and lack of fit.

Development of the method - Internal forces due to thermal expansion and lack of fit - Application to symmetrical structures - Comparison between stiffness and flexibility methods.

References

1. *Moshe, F., Rubenstein, Matrix Computer Analysis of Structures, Prentice Hall, New York, 1986.*
2. *Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India, New Delhi, 2001*
3. *Manickaselvam V.K., Elements of Matrix and Stability Analysis of Structures, Khanna Publishers, New Delhi, 1998.*

Course outcomes

On completion of the course, the students will be able to:

1. apply the basic concepts of matrix methods in structural analysis
2. develop stiffness and flexibility matrices

3. analyze the structures using flexibility and stiffness method
4. transform system coordinates to element coordinates
5. determine the forces in various members due to lack of fit and thermal expansion

CEPE15 PRESTRESSED CONCRETE STRUCTURES

Course Learning Objectives

1. To learn the principles, materials, methods and systems of prestressing
2. To know the different types of losses and deflection of prestressed members
3. To learn the design of prestressed concrete beams for flexural, shear and tension and to calculate ultimate flexural strength of beam
4. To learn the design of anchorage zones, composite beams, analysis and design of continuous beam
5. To learn the design of water tanks

Course Content

Principles of prestressing - Materials of prestressing - Systems of prestressing - Losses in prestress – Analysis of members - Deflection of Prestressed Concrete members.

Slabs - Pre-tensioned and Post-tensioned beams - Design for flexure, bond , shear, and Torsion - IS code provisions - Ultimate flexural and shear strength of prestressed concrete sections –Transmission of prestress - Design of end anchorage zones using IS code method.

Composite beams - Analysis and design. Partial prestressing - non-prestressed reinforcements.

Analysis of Cantilever and Continuous beams - Cable layout - Linear transformation - Concordant cables.

Design of compression members and tension members. Special topics Circular prestressing - Water tanks - Pipes - Analysis and design - IS Codal provisions.

References

1. *Lin. T.Y., Burns, N.H., Design of Prestressed Concrete Structures, John Wiley & Sons, 1982.*
2. *RajaGopalan N. Prestressed Concrete, Narosa Publishing House, New Delhi, 2002.*
3. *Raju K. N., Prestressed Concrete, McGraw Hill Education, 6th edition, 2018*
4. *Nawy, E. G., Prestressed concrete a fundamental approach 4th edition, Pearson Education, Inc. New Jersery, US., 2003*
5. *IS 1343: 2012. Prestressed concrete - code of practice, Bureau of Indian Standards (BIS), New Delhi, India., 2012*

Course outcomes

On completion of the course, the students will be able to:

1. design a prestressed concrete beam accounting for losses
2. design the anchorage zone for post tensioned members
3. design composite members

4. design continuous beams
5. design water tanks

CEPE16 ADVANCED REINFORCED CONCRETE DESIGN

Course Learning Objectives:

1. To understand the design concept of various structures and detailing of reinforcements
2. To understand the design of underground and elevated liquid retaining structures
3. To study the design of material storage structures
4. To know the effect of temperature on concrete structures
5. To study the design of bridges subjected to IRC loading

Course Content

Earth Retaining structures - Retaining walls- types - cantilever and counterfort - design - drainage and other construction details. Liquid Retaining structure - Water tanks - types - square, rectangular, circular - Design of underground and elevated tanks - design of staging - spherical & conical roof for circular tanks. Material storage structures - Determination of lateral pressure on side walls of bunker - Rankine's theory - design of bunker - design of circular silo using Jansen's theory. Environmental Structures - Chimneys - Principles and Design - Design of long columns. Transportation structures - Bridges - Slab bridge - Design of single span slab bridge - Tee beam bridge - Design of Tee beam bridge with stiffness - Tee beam bridge with cross girders - Introduction to earthquake design

Note: *Assignments include the design and drawings of various RCC structures.*

References

1. *Vazirani, V.N., and Ratwani, Concrete Structures, Vol. IV, Khanna Publishers, New Delhi, 1995.*
2. *Dayaratnam, P., Design of Reinforced Concrete Structures, Oxford & IBH Publishers & Co., New Delhi, 2005.*
3. *Victor, D.J., Essentials of Bridge Engineering, Oxford & IBH Publishers Co., New Delhi, 1991.*
4. *Raju N. K., Advanced Reinforced Concrete Design, CBS Publishers and Distributors Pvt. Ltd., India, 2016*
5. *Varghese P.C., Advanced Reinforced Concrete Design, PHI, India, 2nd Edition, 2010.*
6. *IS456-2000 Code of practice for Plain and reinforced concrete code of practice.*

Course outcomes:

On completion of the course, the students will be able to:

1. apply the concepts of liquid retaining structures
2. design material storage structures using various theories
3. apply the concepts of environmental and transportation structures
4. demonstrate the detailing of reinforcement
5. draw the various RCC structures

CEPE17 ADVANCED STEEL STRUCTURAL ELEMENTS

Course Learning Objectives

1. To study the behavior and design of member subjected to combined forces
2. To understand the analysis procedure and design of base plate subjected to different loading conditions
3. To study the design of Gantry girder, welded plate girder, stiffeners and connections.
4. To calculate the wind forces on various types of structures.
5. To understand the design of industrial buildings/bents/
6. To understand the design of moment resisting connections used in steel frames

Course content

Introduction to beam-column - behavior - strength interaction - design of beam column - beam - column subjected to combined forces - column bases - slab base - gusseted base - moment resistant base plate.

Welded plate girders – analysis and design using IS800-2007 - curtailment of flange plates –stiffeners – Introduction to hybrid girders - analysis and design of gantry girder.

Design of industrial building - roofing, cladding and wall material - structural components and framing - types of roof trusses - components - wind load estimation for different type of structures for various zones.

Approximate analysis of industrial bents/PEB - design of purlins and wall girts using Channel and Angle sections; cold formed steel purlin – Design of wind bracings – wind girders – gable columns

Analysis and design of framed connections.

Note: *Assignments include the design and drawings of various steel structures.*

References

1. *Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi 2008.*
2. *Bhavikatti, S.S., Design of Steel Structures, I.K. International Publishing House Pvt. Ltd., New Delhi, 2010.*
3. *IS 800 - 2007, Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi.*
4. *IS875 Part (3) - 1987, Code of Practice for Design Loads (other than earthquake) for buildings and structures: Wind loads. Bureau of Indian Standards, New Delhi.*
5. *SP6 (1) - 1964, IS hand book for structural Engineers. Bureau of Indian Standards, New Delhi.*

Course outcomes

On completion of the course, the students will be able to:

1. Design eccentrically loaded compression members (Beam-Columns) and their base plates.
2. Design welded plate girder and other components

3. Design Gantry girder for industrial structures
4. Calculate the wind load acting on various structures to be built in various locations.
5. Design Industrial structures and their components such as girts, wind girders, bracings systems purlins etc

CEPE18 ADVANCED STRUCTURAL ANALYSIS

Course Learning Objectives

1. To understand the influence line concepts for indeterminate structures
2. To understand the methods of analysis of intermediate trusses for external loads, lack of fit and thermal effect
3. To study behaviour of arches and their methods of analysis
4. To know the concept and analysis of cable stayed bridge
5. To study the multi storey frames subjected to gravity loads and lateral loads

Course content

Influence lines - Maxwell Betti's theorem - Muller Breslau's principle and its application. Influence lines for continuous beams and single bay, single storey portals with

prismatic members.

Analysis of plane truss with one or two redundants - trusses with lack of fit - Thermal stresses - Settlement of supports - Trussed beams.

Theory of arches - Analysis of three hinged, two hinged and fixed arches - influence lines, rib shortening, settlement and temperature effects.

Analysis of cables - Suspension bridges with three and two hinged stiffening girders - influence lines.

Analysis of multistorey frames for gravity and lateral loads by approximate methods - Substitute frame - Portal and Cantilever methods – Introduction to earthquake load

References

1. Punmia, B.C, Theory of Structures, Laxmi Publications, 2000.

2. Timoshenko, S.P.,Young, D.H., Theory of Structures, Tata McGraw Hill, 1983.

3. Wang. C.K., Intermediate Structural Analysis, International Text Book Co, 1983.

4. Hibbeler. R.C., Structural Analysis, Pearson Education (Singapore) Ptc. Ltd., Indian Branch, 2002.

Course outcomes

On completion of the course, the students will be able to:

1. Demonstrate the concepts of qualitative influence line diagram for continuous beams and frames.
2. Apply the methods of indeterminate truss analysis.
3. Demonstrate the behavior of arches and their methods of analysis.
4. Analyse cable suspension bridges.

5. Analyse multistory frames subjected to gravity loads and lateral loads.

CEPE19 TRAFFIC ENGINEERING AND SAFETY

Course Learning Objectives

1. To understand the fundamentals of traffic stream characteristics
2. To learn the skills of traffic control and management
3. To learn the methods of safe intersection design
4. To learn the importance and methods of accident investigation and prevention
5. To understand the concepts of road safety audit and safety improvement methods

Course Content

Traffic stream characteristics:, Fundamental parameters and relationship of traffic flow, speed and concentration. Traffic stream models. Speed data collection and analysis, Density and travel time measurement and analysis, Moving Observer Method, Automated Traffic Measurements - Traffic forecasting and growth studies. Capacity and level of service of roads. Pedestrian studies – flow characteristics - Design principles of pedestrian facilities.

Traffic Management: Parking studies – parking parameters, parking surveys, parking requirements - on street and off street parking. Lay-byes and bus stops. Principles of Traffic Control: Basics of traffic management. Traffic System Management - speed control, one way streets, reversible lanes, access control, bus priority measures, turning restrictions.

Design of Intersections for Safety: Uncontrolled intersections, Conflicts at intersections, Channelization, Traffic islands, Design of median islands, turning vehicle templates- Design of traffic rotaries. Traffic signal design - Design Principles of Traffic Signal, Signal Coordination, Vehicle Actuated Signals and Area Traffic Control. Design of Grade Separated interchanges - trumpet, diamond, cloverleaf, rotary and directional.

Accident Investigation and Prevention: Characteristics of road accidents, causes of accidents: road – driver – vehicle - environment, Significance of accident data, Accident recording and analysis - Crash reporting and collision diagrams - Statistical Interpretation and Analysis of Crash Data. Identification of potential sites for treatment - Safety countermeasures. Monitoring and evaluation.

Road Safety Audit – Overview, stages of road safety audit, audit process, checklists and elements of good road safety audit. Highway safety improvement program - Safety Education, Traffic Law Enforcement. Road Safety Management System. Case studies.

References

1. *Khanna, S. K., Justo, C. E. G. and Veeraragavan A., Highway Engineering, Nem Chand and Bros, Roorkee, 2014.*
2. *Kadiyali, L.R, Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 2011.*
3. *IRC SP: 88 – 2010*
4. *Rune Elvik, Alena hoye, Truls Vaa and Michael Sorensen, The handbook of Road Safety Measures, Emerald Group Publishing Limited, 2009*

5. *Highway Safety Manual, ITE, 2010*

Course Outcomes

On completion of the course, the students will be able to:

1. Carry out traffic surveys
2. Implement traffic system management
3. Carry out intersection design for safety
4. Record and analyse accident data and suggest countermeasures
5. Carry out road safety audit

CEPE20 PAVEMENT ANALYSIS AND DESIGN

Course Learning Objectives

1. To study about the types and components of pavements
2. To learn about the stresses in flexible pavements and equivalent single wheel load
3. To study the design of flexible pavements
4. To learn about the stresses in rigid pavements
5. To study the design of rigid pavements

Course content

Pavements - Types and Components - Factors affecting Design and Performance of Pavements, Comparison between Highway and Airport pavements - Functions and Significance of Sub grade properties.

Stresses in Flexible Pavements - Stresses and Deflections in Homogeneous Masses - Burmister's 2-layer, 3-layer Theories - Wheel Load Stresses, ESWL of Multiple Wheels, Repeated Loads and EWL factors.

Flexible Pavement Design - Empirical - Semi-empirical and Theoretical Approaches; Principles and procedure, Design, Advantages and applications of different Pavement Design Methods – IRC Method of Design.

Stresses in Rigid Pavements - Types of Stresses and Causes - Factors influencing the Stresses, General conditions in Rigid Pavement Analysis, ESWL, Wheel Load Stresses, Warping Stresses, Friction Stresses, Combined Stresses.

Rigid Pavement Design - Types of Joints in Cement Concrete Pavements and their Functions, Joint Spacing, Design of Slab Thickness, Design of Joint Details for Longitudinal Joints, Contraction Joints and Expansion Joints, IRC Method of Design.

References

1. *Yoder and Witezak, Principles of Pavement Design¸ John Wiley and sons, 1975*
2. *Yang H. Huang, Pavement Analysis and Design, Pearson Prentice hall, 2004.*
3. *IRC: 37 - 2012, Guidelines for the Design of Flexible Pavements*
4. *IRC: 58 - 2011, Guidelines for the Design of Plain Jointed Rigid Pavements for Highways*

Course outcomes

On completion of the course, the students will be able to:

1. Identify the pavement components and compare highway and airport pavements.
2. Calculate the stresses and ESWL in flexible pavements.

3. Design the flexible pavement using empirical, semi empirical and IRC methods.
4. Analyze the warping, friction, wheel load stress and calculate the combined stress.
5. Design rigid pavements by IRC method and evaluate the pavements.

CEPE21 TRANSPORTATION PLANNING

Course Learning Objectives

1. To know about the processes and concepts of transportation planning
2. To study about trip generation
3. To study about trip distribution
4. To study about modal split analysis
5. To study about trip assignment

Course content

Transportation Planning Process and Concepts - Role of transportation - Transportation problems - Urban travel characteristics - Concept of travel demand - Demand function - demand estimation - Sequential, recursive and simultaneous processes

Trip Generation Analysis - Zoning - Types and sources of data – O-D studies - Expansion factors - Accuracy checks - Trip generation models - Zonal models - Household models - Category analysis - Trip attractions of work centers.

Trip Distribution Analysis - Trip distribution models - Growth factor models - Gravity models - Opportunity models.

Mode Split Analysis - Mode split Models - Mode choice behaviour, competing modes, Mode split curves, Probabilistic models.

Traffic Assignment - Route split analysis: Elements of transportation networks, Nodes and links - minimum path trees - all-or-nothing assignment - Multipath assignment - Capacity restraint.

References

1. *Hutchinson B.G., Principles of Urban Transportation System Planning, McGraw Hill, 2007.*
2. *Bruton M. J., Introduction to Transportation Planning, Hutchinson, London, 1992.*
3. *C. Jotin Khisty, B. Kent Lall, Transportation Engineering, Prentice Hall of India, 2002.*
4. *C.S. Papacostas and P.D. Prevedouros, Transportation Engineering and Planning, Prentice Hall of India Pvt. Ltd., 2001.*

Course outcomes

On completion of the course, the students will be able to:

1. Apply the principles of the transportation planning process and demand estimation.
2. Analyse the trip production and trip attraction models.
3. Analyse the growth factor, gravity and opportunity models.
4. Apply the mode choice behaviour and mode split models.

5. Apply the shortest path models for route assignment.

CEPE22 AIR POLLUTION MANAGEMENT

Course Learning Objectives

1. To provide general understanding of air quality and its impact on the environment
2. To understand the fundamentals of meteorology and stability of atmosphere
3. To study the fate and transport of air pollutants and its measurement techniques
4. To discuss the different control methods and its principles for gaseous pollutant
5. To review the sources and control of indoor air pollution

Course Content

Air pollutants – Sources – Classification of air pollutants – Particulates and gaseous pollutants – Effects of air pollutants on human health, vegetation and property – Global issues and air pollution – Global warming – Ozone layer depletion – Ambient air quality and emission standards – Air pollution indices – Air act. Fundamentals of meteorology – Wind roses – Atmospheric stability – Atmospheric diffusion of pollutants – Transport, transformation and deposition of air contaminants – Plume behaviour – Atmospheric diffusion theories – Plume rise – Gaussian dispersion models. Control principles – Principles and equipment description of control technologies – Particulates control by Gravitation, centrifugal, filtration, scrubbing, electrostatic precipitation – Absorption, adsorption, condensation, incineration and biofiltration for control of gaseous air pollutants – Biological air pollution control technologies – Bioscrubbers, biofilters. Air pollutants in indoor environments – Levels of pollutants in indoor and outdoor air – Indoor air pollution from outdoor sources – Measurement methods – Control Technologies.

References

1. *Anjaneyulu, D., Air Pollution and Control Technologies, Allied Publishers, Mumbai, 2002.*
2. *Rao, C. S., Environmental Pollution Control Engineering, New Age International, New Delhi, 2006.*
3. *Rao, M. N. and Rao H. V. N., Air Pollution, Tata McGraw-Hill, New Delhi, 2007.*
4. *W. L. Heumannn, Industrial Air Pollution Control Systems, McGraw-Hill, New York, 1997.*
5. *Davis M. L. and Cornwell D. A., Introduction to Environmental Engineering, Tata McGraw Hill Education Pvt. Ltd,. New Delhi, 2010.*
6. *Peavy H. S., Rowe D. R. and Tchobanoglous G., Environmental Engineering, McGraw Hill, New York, 1985.*
7. *Mahajan S. P., Pollution Control in Process Industries, Tata McGraw-Hill Publishing Company, New Delhi, 1991.*

Course Outcomes

At the end of the course, the students will be able to

1. identify the types and sources of air pollutants
2. predict the effects of air pollutants on human health and the environment

3. choose appropriate technologies for removal of particulates and gaseous pollutants
4. measure the pollutant concentration in indoor environment
5. suggest the control techniques for indoor air pollution

CEPE23 INDUSTRIAL WASTEWATER TREATMENT

Course Learning Objectives

1. To study characteristics of industrial wastewater and its effects on water bodies
2. To know the quality of industrial effluents required before disposal on environment
3. To learn various physico-chemical and biological treatment techniques to treat industrial wastewater
4. To gain knowledge about the reuse of treated industrial effluents
5. To give exposure on common effluent treatment plants

Course Content

Industrial wastewater – Characteristics – Environmental impacts – Effects of industrial wastes on streams, land – Effluent standards – Scenario in India – Regulatory requirements for industrial wastewater – Prevention Vs control of industrial pollution – Volume reduction – Process Modification – Strength reduction – Methods and materials changes – Waste minimization strategies – Zero discharge concept. Physico-chemical treatment of industrial wastewater – Equalization and neutralization – Separation of solids – Removal of organic and inorganic solids – Oil separation – Precipitation – Membrane methods – Reverse Osmosis – Biological treatment methods – Aerobic and anaerobic methods. Separation Vs degradation methods – Chemical oxidation – Phototcatalysis – Ozonation – Ion exchange – Advanced oxidation processes – Electrochemical methods – Nutrient removal – Land treatment – Sludge production and its management – Quantification and characteristics of sludge – Treatment of sludge and its disposal. Reuse of industrial wastewater – Advantages – Quality requirements for reuse – Zero effluent discharge systems – Residuals of industrial wastewater treatments – Individual and common effluent treatment plants.

References

1. *Eckenfelder, W. W., Industrial Water Pollution Control, McGraw Hill, 2014.*
2. *Nemerow N. L., Industrial Water Pollution, Addison-Wesley Publishing Company Inc., USA, 1978.*
3. *Narayana Rao M. and Amal K. Dutta, Wastewater Treatment, Oxford & IBH Publishing Co., Pvt., Ltd., New Delhi, 2001.*
4. *Bhatia S. C., Handbook of Industrial Pollution and Control, Volume I & II, CBS Publishers, New Delhi, 2003*
5. *Mahajan, S. P., Pollution Control in Process Industries, Tata McGraw Hill Publishing company, New Delhi, 1991.*

Course Outcomes

At the end of the course, the students will be able to

1. recognize various environmental problems due to improper management of industrial wastewater

2. determine appropriate technologies for treatment and management of industrial pollutants
3. recommend different techniques for the safe disposal of industrial effluents
4. analyse the quality requirements for reuse of industrial effluents

CEPE24 ENVIRONMENTAL MANAGEMENT AND IMPACT ASSESSMENT

Course Learning Objectives

1. To learn the importance of environmental impact assessment in various development projects
2. To understand the legal provisions on EIA and EIA notifications
3. To brief the various methodologies involved in environmental impact assessment
4. To identify the prediction tools for the assessment of different environmental impacts
5. To describe the concepts of environmental management system.

Course Content

Impacts of development projects on environment and Environmental Impact Assessment (EIA) and Environmental Impact Statement (EIS) – Objectives – EIA Types – EIA in project cycle – Capacity and limitations – Legal provisions on EIA – Environmental Impact Assessment notification – Environmental Impact Assessment consultants. Methods of categorization of industries for EIA – Elements of EIA – Process screening, baseline studies, mitigation, matrices, checklist – Methods of EIA – Strength, weakness and applicability – Appropriate methodology solution. Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Socio economic impact – Mathematical models for impact prediction, rapid EIA, public participation – Post environmental audit. Plan for mitigation of adverse impact on environment – Options for mitigation of impact on water, air and land, energy, flora and fauna; addressing the issues related to the project affected people – Environment Management Plan – ISO 14000. EIA case studies for new and expansion projects – wastewater treatment plants, water supply and drainage, highways and bridges, railways, dams, irrigation projects, power plants.

References

1. *Canter, R. L., Environmental Impact Assessment, McGraw Hill Inc., New Delhi 1996.*
2. *Anjaneyulu, Y., Environmental Impact Assessment Methodologies, B. S. Publications, Hyderabad, 2002.*
3. *S. K. Shukla and P. R. Srivastava, Concepts in Environmental Impact Analysis, Common Wealth Publishers, New Delhi, 1992.*
4. *John G. Rao and David C. Hooten (Ed.), Environmental Impact Analysis Handbook, McGraw Hill Book Company, 1990.*

Course Outcomes

At the end of the course, the students will be able to

1. analyse the environmental impacts of proposed projects
2. categorize the type of EIA required for proposed projects
3. predict and assess the impact of proposed projects on the environment
4. use mathematical tools to predict the environmental impacts
5. propose proper mitigation measures to avoid environmental impacts

6. summaries the EIA report with suitable environmental management plan

CEPE25 SOLID WASTE MANAGEMENT TECHNIQUES

Course Learning Objectives

1. To understand the sources, types and composition of municipal solid waste and the factors governing their generation
2. To acquire an understanding on the reduction, segregation and storage of wastes at source
3. To familiarize the different waste collection systems and their analysis
4. To study the importance of transfer stations and processing technologies for resource recovery
5. To enumerate and describe different disposal and treatment methods for municipal solid waste

Course Content

Sources and types of municipal solid waste – Waste generation rates – Factors affecting generation, composition, characteristics - Methods of sampling – Effects of improper disposal of solid wastes – Public health and environmental effects. Elements of solid waste management – Municipal solid waste rules – Source reduction of waste – Reduction, Reuse and Recycling – Segregation of wastes at source – Onsite storage methods – Materials used for containers – Case studies under Indian conditions. Methods of collection of municipal solid wastes – Collection vehicles – Manpower – Collection routes – Analysis of collection systems – Need for transfer and transport – Transfer stations – Selection of location, operation & maintenance. Objectives of waste processing – Processing technologies – Biological and chemical conversion technologies – Resource recovery from solid waste – composting and biomethanation – Thermal processing options. Land disposal of solid waste – Sanitary landfills – Site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas – Landfill closure and environmental monitoring – Landfill bioreactor – Dumpsite rehabilitation.

References

1. *George Tchobanolglous and Frank Kreith Handbook of Solid Waste Management, McGraw Hill, New York, 2002.*
2. *Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000.*
3. *Peavy H. S., Rowe D. R. and Tchobanoglous G., Environmental Engineering, McGraw Hill, New York, 1985.*
4. *Davis M. L. and Cornwell D. A., Introduction to Environmental Engineering, Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2010.*
5. *Bhide A. D. and Sundaresan, B. B. Solid Waste Management Collection, Processing and Disposal, 2001.*
6. *Manser A. G. R and Keeling A. A, Practical Handbook of Processing Recycling of Municipal Solid Wastes, Lewis Publishers, CRC Press, 1996.*

Course Outcomes

At the end of the course the students will be able to:

1. explain the various functional elements involved in solid waste management system
2. quantify and categorize solid wastes for any region

3. analyse the collection route and collection system
4. select suitable waste processing technologies and disposal methods
5. design a suitable sanitary landfill for disposal of solid waste on land

CEPE26 MODELS FOR AIR AND WATER QUALITY

Course Learning Objectives

1. To provide an understanding of mass balance approach for the prediction of air and water quality
2. To study the transport phenomena of contaminants in surface water
3. To develop mathematical model for transport of contaminants in river and estuaries
4. To brief the models for lakes, and microorganisms growth and decay
5. To give an idea of micro meteorological processes and its role in the transport of air pollutants

Course Content

Introduction to mathematical models – Modelling approaches to water quality – Classification of models. Conservation of mass – mass balance – steady state system – time variable response systems. Mathematical models for water quality – Mass transport mechanisms – Model development, calibration and verification – Model limitations. DO and BOD models for streams: Streams and sinks of dissolved oxygen – Streeter Phelps model – Oxygen sag curve – Determination of deoxygenation and reaeration coefficients – Benthal oxygen demand. Models for estuary and lakes: Water quality distribution in estuaries – Modelling estuaries and lakes for water quality – Temperature models for lakes. Models for microorganisms – Growth and Decay. Air quality models – Micrometeorological processes –wind rose and stability classes – Gaussian dispersion model – Line source models – Indoor air quality model.

References

1. *Chapra and Steven C., Surface Water Quality Modelling, Waveland press, Inc., 2008.*
2. *Gilbert M. Masters, Introduction to Environmental Engineering and Science, 3rd Edition, Pearson Education Limited, 2013.*
3. *Davis M. L. and Cornwell D. A., Introduction to Environmental Engineering, Tata McGraw Hill Education Pvt. Ltd,. New Delhi, 2010.*

Course Outcome

On completion of the course, the students will be able to

1. explain various transport mechanisms in estuary and river
2. develop mathematical model for water quality
3. predict the quality of water in river, lakes and estuaries using mass balance approach and specific models
4. determine the microbial population using various growth models
5. quantify the concentration of pollutant in ambient air using dispersion models

CEPE27 ADVANCED FOUNDATION ENGINEERING

Course Learning Objectives

1. To explain the analysis of sheet pile wall under different support conditions
2. To explain overall stability analysis of well foundation
3. To explain fundamentals of soil dynamics and its application to machine foundation analysis including Codal provisions
4. To explain problems related to expansive soils and solution to overcome
5. To explain the concept of slope stability analysis for various slope conditions including graphical methods

Course Content

Sheet pile structures - cantilever sheet pile walls in granular and cohesive soils - Anchored bulk heads - Free earth support and fixed earth support methods - Anchors.

Cofferdams - types - cellular cofferdam - uses - Design by TVA and Cumming's method.

Well foundations - Types of caissons - Analysis of well foundations - determination of scourdepth - staining thickness - well sinking.

Foundations subjected to vibrations - elements of vibrations - Free, damped, free and forced vibrations - Design criteria - Pauw's analogy - IS Code of practice for impact and reciprocating machines.

Foundation drainage and water proofing - Dewatering well points system, sand drains. Foundations in expansive soils - Mechanism - factors influencing swelling - Use of Geosynthetics.

Stability analysis of slopes - infinite slopes in sand and clays - finite slope - Swedish circle - stability of earth dam slope during steady and sudden draw down - friction circle method - Taylor's stability number. Sheet pile structures - Anchored bulk heads

References

1. *Bowles, J.E., Foundation Analysis and Design, McGraw Hill., 1996.*
2. *Braja M. Das, Principles of Foundation Engineering, Thomas Asia Pvt. Ltd., Singapore, 2005.*
3. *Shamsher Prakash, Soil Dynamics, McGraw - Hill Book Company, 1985.*

Course outcomes

On completion of the course, the students will be able to:

1. analyze and design any kind of sheet pile wall system including coffer dam
2. analyze and design well foundation including complete stability analysis
3. estimate soil parameters under dynamic conditions including machine foundations
4. design a suitable foundation system for any kind of problematic soils
5. analyze the stability of any kind of slope by using both theoretical and graphical methods

CEPE28 GEOTECHNICAL EARTHQUAKE ENGINEERING

Course Learning Objectives

1. To explain the mechanism of earthquake and its related causes to build structures and in-situ soils
2. To explain how ground motion is recorded and how do quantify the earthquake intensity and frequency related parameters
3. To explain how seismic site investigation will be done and seismic soil design parameters are estimated
4. To explain how seismic resistant design of foundation will be done and also explain the concept of liquefaction and related causes including codal recommendations
5. To explain how to do hazard assessment and mitigation and explain how do prepare a risk and microzonation mapping

Course Content

Mechanism of Earthquakes - Causes of earthquake - Earthquake Fault sources - Elastic Rebound theory - Seismic wave in Earthquake shaking - terminology - Locating an earthquake - Quantification of earthquakes. Strong Motion Records - characteristics of ground motion - Factors influencing Ground motion - Estimation of frequency content parameters

Seismic site investigations – Selected Case Studies - Evaluation of Dynamic soil properties – Codal Provisions

Design Ground Motion - Developing Design Ground Motion-Codal recommendations.

Earthquake Resistant Design of foundation of buildings - Design considerations -. Earthquake Response of slopes - Evaluation of slope stability - Liquefaction-Susceptibility - Liquefaction Resistance-Codal recommendations.

Risk mapping - Hazard assessment – Mitigation measures - Seismic microzonation and its importance

References

1. *Kameswara Rao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing - New Delhi, 2000.*
2. *Krammer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International Series, Pearson Education (Singapore) Pvt. Ltd., 2004.*
3. *Kameswara Rao, Vibration Analysis and Foundation Dynamics, Wheeler*
4. *Robert W. Day, Geotechnical Earthquake Engineering Hand book, McGraw Hill, 2002*

Course outcomes

On completion of the course, the students will be able to:

1. demonstrate the principles of earthquake loading
2. quantify earthquake intensity and ground motion
3. estimate seismic soil design parameters
4. analyze and design seismic resistant foundation for buildings
5. prepare soil risk and microzonation maps

CEPE29 REINFORCED EARTH AND GEOTEXTILES

Course Learning Objectives

1. To explain the basic mechanisms of soil reinforcement and design principles in reinforced earth wall
2. To understand the applications of geosynthetics in geotechnical problems and its design principles
3. To explain the usage of geosynthetics in geoenvironmental and pavement engineering with design
4. To explain the present status of development in geo-synthetics and filed instrumentation and control

Course content

Reinforced Earth – The mechanisms of the reinforced earth techniques – Design principles – Materials used for construction – Advantages of reinforced earth – Reinforced earth construction techniques.

An overview of Geosynthetics, Description of Geotextiles – Geogrids – Geonets – Geomembranes – Geocomposites– Geocells – Designing with Geotextiles – Geotextile properties and test methods – Functions of Geotextile – Design methods for separation – stabilization – filtration – Drainage.

Designing with Geogrids – Geogrid properties and test methods – Designing with Geonets – Geonet properties and test methods – Designing with Geomembranes – Geomembrane properties and test methods – construction practices with Geotextiles, Geogrids, Geonets, Geomembranes.

Design of liquid Contaminant liners – liquid contaminant liners – Covers for reservoirs- Water conveyance (Canal liners)-- solid material liners – underground storage tanks – Design of pavements – Geo composites as liquid /Vapour Barriers – Improvement in bearing capacity – Erosion Control for water ways.

Geo Synthetics: Recent research and Developments. Control of Improvement – Field Instrumentation – design and analysis for bearing capacity and settlement of improved deposits.

References

1. 1.*Robert M. Koerner, Designing with Geosynthetics, Prentice Hall ,1989 .*
2. *Rao, G. V., and Suryanarayana Raju, G. V. S., Engineering with Geosynthetics, Tata Mc Graw Hill Publishing Co. New Delhi, 1990.*
3. *3.Shukla, S. K., Geosynthetics and their Applications, Thomas Telford, London,2002.*

Course outcomes

Upon completion of this course, the students will be able to

1. Understand the principles of soil reinforcement and they can able to do any reinforced wall design using steel strip or geo-reinforcement
2. Understand the application of geosynthetics in geotechnical engineering
3. Decided what kind of geosynthetics should be used for the problem specific application including its design principles
4. Do proper field test using the recent development in geosynthetics

CEPE30 EARTH AND EARTH RETAINING STRUCTURES

Course Learning Objective

1. To explain the concept of earth dam design including stability analysis under seepage
2. To evaluate stability of slopes under different drainage conditions using different methods including slope protection and quality control
3. To estimate active and passive earth pressure using different earth pressure theory including graphical method
4. To explain design principles of retaining structures and coffer dams

Course content

Introduction: Earth dams – types of dams – selection of type of dam based on material availability – foundation conditions and topography- Design details – crest, free board, upstream and downstream slopes, upstream and downstream slope protection – central and inclined cores – types and design of filters- Seepage analysis and control – seepage through dam and foundations – control of seepage in earth dam and foundation.

Stability analysis – critical stability conditions – evaluation of stability by Bishop's and sliding wedge methods under critical conditions - Construction techniques – methods of construction –quality control Instrumentation – measurement of pore pressures.

Rigid retaining structures – active and passive earth pressures against gravity retaining walls – Surcharge - computation of earth pressures by Trial wedge method – a mathematical approach for completely submerged and partly submerged backfills – importance of capillarity tension in earth pressure.

Graphical methods of earth pressure computation – trial wedge method for coulomb's and Rankine's conditions, for regular and irregular ground and wall conditions – Rebhan's construction for active pressure – friction circle method – logarithmic spiral method.

Design of gravity retaining wall – cantilever retaining walls - Flexible retaining structure – type and methods of construction – design strength parameters – safety factor for sheet pile walls – computation of earth pressures against cantilever sheet piles in cohesionless and cohesive soils – anchored sheet piles – free earth method – fixed earth method – Rowe's moment reduction method – stability of sheet piling Diaphragm walls and coffer dams – type of diaphragm walls and their construction techniques in various soil types –earth pressure on braced cuts and coffer dams – design of coffer dams

References

1. *Clayton, Milititsky and Woods, Earth Pressure and Earth-Retaining Structures, Taylor and Francis, 1996*
2. *Huntington, Earth pressure on retaining walls, John Wiley and Sons, 1957.*
3. *Bowles, Foundation Analysis and Design, 1968.*
4. *Jones, Earth Reinforcements and Soil structures, 1996.*
5. *Prakash, Ranjan and Saran, Analysis and Design of Foundations and Retaining structures, Saritha Prakashan, Meerut, 1977.*

Course outcomes

Upon completion of this course, the students will be able to

1. Do earth dam design and stability analysis for all kind of drainage conditions
2. Do stability analysis of any kind of slope and its protection
3. Understand the earth pressure theories and able to calculate lateral earth pressure for different conditions
4. Do retaining structure design and its stability analysis

CEPE31 MARINE FOUNDATION ENGINEERING

Course Learning Objective

1. To emphasize the importance of offshore soil investigations for offshore structures
2. To analysis the response of foundations of gravity structures under offshore environmental loading
3. To analysis the foundation response of jacket and jack-up platforms under static and dynamic loading
4. To provide a suitable foundation system for mooring structures and offshore pipe lines

Course content

Offshore soil investigation: General characteristics of offshore soil exploration – sampling using free corer, gravity corer, tethered systems and manned submersibles – deep penetration sampling using wire line techniques – sampling disturbances – mechanical and environmental - In-situ determination of strength of submarine soils – penetrometer, piezocone, vane and pressure meter techniques – penetration tests from tethered submersible platforms, manned submersibles and using wire line techniques - classification of marine soils – relative distribution of marine soils in the different marine regions – general characteristics of marine deposits in some specific locations and in the Indian sub continent.

Foundations for gravity structures: Types of gravity structures – Installation techniques – movement of gravity structures – settlement of soil beneath gravity structures – stress distribution beneath gravity structures – stability of gravity structures under static and cyclic loads.

Foundation for jacket type structures: Types – installation techniques – design considerations – axial and lateral load capacity of piles – lateral load deformation behaviour of piles – calculation of bearing capacity of piles- design of piles subjected to lateral loads – Reese-Matlock method and p-y curves method

Foundations for jack up platforms: Types of jack up platforms – piles and mat supported – spud cans – different types – installation techniques – techniques for removal of jack ups – stability of jack up platforms –determination of penetration of supports – stability under lateral loads –stability under static and cyclic load effects.

Sea bed anchors, submarine pipe lines: General introduction to sea bed anchors, moorings, submarine pipe line etc., - general design considerations (brief outline only) – geotechnical aspects in the design and installation of sea bed anchors, moorings, submarine pipelines etc

References

1. *Arous, D.A. (Ed.), Offshore Site Investigation, Graham Trotman*
2. *Chaney, R.C and Demars, K.R , Strength Testing of Marine Sediments – Laboratory and In-situ Measurements, ASTM, STP-883*

3. *George P. and Wood D., Offshore Soil Mechanics, Cambridge University Press.*
4. *Le Tirant, Sea Bed Reconnaissance and offshore Soil Mechanics for the Installation of Petroleum Structures, Gulf Publ. Company*
5. *Poulos, H.G and Davis, E.H, Pile Foundation Analysis Design, John Wiley, New York*

Course outcomes

Upon completion of this course, the students will be able to

1. Recommend suitable offshore investigation techniques for the proposed project and able to provide appropriate soil design parameters
2. Perform foundation analysis for gravity structures, jacket and jack-up kind of offshore structures
3. Analysis suitable anchor system for mooring structures and able to provide foundation system for offshore pipeline.

CEPE32 GEODETIC SURVEYING

Course Learning Objectives

1. To know the significance of geodetic surveying in field measurements in terms of utility and precision of data collection
2. To learn the principles of Triangulation, Trigonometric levelling and their procedures
3. To get introduced to the concept of curves and curve setting
4. To know in detail different types of errors and their adjustments
5. To get introduced to the coordinate systems, reference plans and projections

Course content

Triangulation – different networks – orders and accuracies – intervisibility and height of stations – signals and towers – Baseline measurement – instruments and accessories – tape corrections – extension of baseline – satellite stations – Reduction to centre.

Trignometrical levelling – Plane Observations – Geodetic observations – Corrections for refraction, curvature, axis signal – Reciprocal observations

Curve setting – Horizontal curves - Elements of simple and compound curves – Methods of setting out – Reverse curve – Transition curve – Length of curve – Elements of cubic parabola, true spiral and cubic spiral – Vertical curve – parabola

Errors – Types of errors – Theory of least squares – weighted observations – most probable value – computations of indirectly observed quantities – method of normal equations – conditioned quantities, method of correlates, method of differences – adjustment of simple triangle and quadrilateral network without central station.

Reference Surfaces – Datums – Geoids – Coordinate systems – Map Projections

References

1. *Duggal, S.K. Surveying Vol. I and II, Tata McGraw Hill, 2004.*
2. *Punmia, B.C. Surveying Vol. I and II, Standard Publishers, 1994.*
3. *Arora, K. R. Surveying Vol. I and II, Standard Book House, 1996.*

4. *Satheesh Gopi. Advanced Surveying, Pearson Education, 2007.*
5. *Satheesh Gopi. The Global Positioning System and Surveying using GPS, Tata McGraw, 2005.*

Course Outcomes

On completion of the course, the students will be able to:

1. Apply geodetic methods such as Triangulation in different fields of Civil Engineering
2. Apply geodetic methods such as Trigonometric levelling in different fields of civil engineering
3. Select the correct, best suited curve and set the curve on the road
4. Identify the errors present in the field observation and to adjust the errors using suitable methods
5. Demonstrate the principles of the earth surface, its projections and different coordinates involved in map making

CEPE33 ADVANCED SURVEYING TECHNIQUES

Course Learning Objectives

1. To know the significance of advanced surveying in field measurements in terms of utility and precision of data collection
2. To learn the principles of Electromagnetic distance measurement, Total Station and their accuracy
3. To get introduced to the concept of photogrammetry in preliminary identification and map making
4. To know in detail the concept of remote sensing in identification of land features from space and to get introduced to different data acquisition techniques like LIDAR, RADAR etc.
5. To get introduced to the field of geodesy, coordinate systems, Map projections, GPS, its working principle, data collection, data processing and analysis

Course content

Electromagnetic distance measurement (EDM) – Principle of EDM Carrier waves – Types of EDM instruments – Distomat – Total Station – Principle – procedure & surveying using Total Station – precise levelling - micro-optic theodolite.

Photogrammetry – Terrestrial and Aerial Photogrammetry – Horizontal position of a point from photographic measurement – elevation of a point – Determination of focal length of camera – determination of scale – Ground co-ordinates - Relief displacement – Photo interpretation.

Remote sensing – concepts – Idealized remote sensing system – characteristics – Types of remote sensing system – Remote sensing from space – Data interpretation – application of remote sensing – LIDAR – RADAR - SONAR.

Geodesy – Figure of earth – Classification – Earth surface - Geodetic reference surfaces - Coordinate systems – Geodetic datums and elements – Map – Scale of map – projection – UTM – Map projection of India – Space Geodesy.

GPS Basics – system overview – working principle of GPS – Satellite ranging – calculating position – Ranging errors and its correction – GPS surveying Methods – static, Rapid static, DGPS and Kinematic methods – visibility diagram – GAGAN - GNSS.

References

1. *Duggal, S.K. Surveying Vol. II, Tata McGraw Hill, 2004.*
2. *Punmia, B.C. Surveying Vol.III, Standard Publishers, 2005.*
3. *Arora, K. R. Surveying Vol. III, Standard Book House, 1996.*
4. *Satheesh Gopi. Advanced Surveying, Pearson Education, 2007.*
5. *Satheesh Gopi. The Global Positioning System and Surveying using GPS, Tata McGraw, 2005.*

Course Outcomes

On completion of the course, the students will be able to:

1. Apply advanced surveying techniques in different fields of Civil Engineering
2. Select the advanced technique which is best suited for a work
3. Apply total station and EDM in distance measurement and traversing
4. Demonstrate the principles of the earth surface, its projections and different coordinates involved in map making
5. Apply GPS in transportation engineering, structural engineering and land use planning

CEPE34 GROUNDWATER HYDROLOGY

Course Learning Objectives

1. To know different types of aquifers
2. To understand the surface and subsurface investigation in detail
3. To integrate the fundamental and basic knowledge of ground water movement
4. To understand the process of sea water intrusion and recharge
5. To introduce the different model studies

Course content

Groundwater occurrence – distribution – aquifer – types - Surface investigation - Geophysical - electrical resistivity - Seismic refraction - Gravity and magnetic - Geologic - Air photo interpretation - Dowsing.

Subsurface investigation - test drilling - resistivity logging- potential logging - temperature and caliper logging.

Steady unidirectional flow - well in a uniform flow - steady flow with uniform recharge - unsteady radial flow to a well - well flow near aquifer boundaries - Multiple well systems - partially penetrating wells - characteristic well losses.

Secular and seasonal variations - Fluctuations due to evapo-transpiration, Meteorological phenomena, tides, external loads and earthquakes - control by drains and wells. Recharge through sewage pits, shafts and wells.

Occurrence of sea water intrusion - Ghypon-Heizberg relation between fresh and saline waters - shape length and structure of the fresh salt water interface -

prevention and control of seawater intrusion - role of sea water in ground water - coastal zoning.

Sand models - Electrical models - Viscous fluid models - membrane models - numerical analysis methods

References

1. *Raghunath H.M., Ground Water Hydrology, New-Age International, 2nd Edition, 1990.*
2. *Todd, D.K, Ground Water Hydrology, Prentice hall, 2004*

Course outcomes

On completion of the course, the students will be able to:

1. Identify types of aquifers
2. carry out surface and subsurface investigation to locate groundwater
3. visualise the occurrence and movement of groundwater
4. select suitable type of ground water recharge
5. Assess sea water intrusion and its control

CEPE35 APPLIED HYDRAULICS ENGINEERING

Course Learning Objectives

1. To classify the types of flows in open channel and also to design open channel sections in a most economical manner.
2. To study about non uniform flows in open channel and longitudinal slopes in open channel and also to learn about the characteristics of hydraulic jump.
3. To develop an understanding of fluid flow patterns and learn to use boundary layer theory and Drag.
4. To Provide insights to the Open channel hydraulics and introduce dimensional analysis for fluid flow problems.

Course content

Open channel flow and its classifications, and properties, energy and momentum principles, Critical flow computation and its applications, transitions with sub critical and super critical flows. Types and regimes of flow – Velocity distribution in open channel – Wide open channel

Design of non- erodible channels for uniform flow, most efficient channel section, compound Sections. Velocity measurement – Manning's and Chezy's formula – Determination of roughness coefficients – Determination of normal depth and velocity.

Gradually varied flow: Theory and analysis, gradually-varied flow computations in prismatic channels, gradually varied flow in non-prismatic channels. Characteristics of flow profiles –

Draw down and back water curves – Profile determination – Graphical integration, direct step

And standard step method – Flow through transitions

Rapidly varied flow- Theory of hydraulic jump, evaluation of jump elements in rectangular and non-rectangular channel, location of jump on horizontal floor, channel controls and transition – surges

Boundary Layer Theory: Introduction, Development of boundary layer over a flat plate, boundary layer thickness, displacement, momentum and energy thicknesses, Application of momentum equation to boundary layer flow, local and mean drag coefficients.

References

1. Streeter, V.L. Fluid Mechanics, Tata McGraw Hill, 1998.
2. Chow, V.T. Open Channel Hydraulics, Tata McGraw Hill, 1975.
3. Nagaratnam, S. Fluid Mechanics, Khanna Publishers, 1989.
4. Chaudhry, M and Hanif. Open Channel Flow. Englewood Cliffs, NJ: Prentice-Hall, 1993.
5. Chanson, H (2004b).The Hydraulics of Open Channel Flow-An Introduction, (Butterworth-Heinemann, Oxford, UK) 2ndEdition (ISBN 07506 59785).

Course outcomes

By the end of this course, the students will be able to

1. Acquire specific knowledge regarding fluid flow phenomena observed in Civil Engineering systems such as flow in open channel flow
2. Develop understanding of the basic principles of fluid flow patterns and boundary layer theory and provide skills in analyzing fluid flows in open channel hydraulics
3. Understand gradually varied flow profile in detail.
4. Understand rapidly varied flow profile in detail
5. Knowledge is useful for the design of open channels for rectangular and non-rectangular channels for hydraulic jump phenomena.

CEPE36 - DESIGN OF HYDRAULIC STRUCTURES

Course Learning Objective

1. To impart knowledge regarding the design of the various minor irrigation structures
2. To convey the knowledge on the causes of failure, design criteria and stability analysis of
3. different types of dams
4. To design and analyse energy dissipators
5. To understand the basic design of structures on pervious formations

Course Content

Reservoir Planning: Investigations, Capacities, Zones of storage, Mass Inflow and Mass Demand curves, Life of Reservoir. Earth Dams: Types, causes of failure and design criteria, soils suitabllity for earth dam construction, construction methods, foundation requirements, typical earth dam sections, estimation of seepage through and below the dam, seepage control, stability of slopes by slip circle method of analysis, pore pressures, sudden draw down, steady seepage and construction pore pressure condition.

Gravity dams: Design Criteria, forces acting on gravity dams, elementary profile, low and high gravity dams, stability analysis, practical profile, evaluation of profile by method of zoning, foundation treatment, construction joints, galleries in gravity dams.

Spillways: Ogee spillway and its design, details of syphon, shaft, chute and side channel spillways, emergency spillways. Design of outlets and rating curves Energy dissipators: Principles of energy dissipation Energy dissipators based on tail water rating curve and jump height curves Spillway crest gates - vertical lift and radial gates, their design principles. Design of canal regulating structures, Design of Channel transitions, Design of Sarda type Falls, Design of cross drainage works viz Syphon aquaduct and Canal syphon.

Structures on Pervious formations: Bligh's creep theory, limitations, Khoslas's theory of independent variable, Khosla's corrections, Design of Weir and Barrages: design of waterways and crest levels, design of impervious floors and protection works.

Canal Structures and Hydropower Plants: Design of canal falls, Regulators, Cross drainage works, Introduction of Hydropower development, general features of hydro-electric schemes, selection of turbines.

References

1. Engineering for Dams (Volumes I, II & III) by Creager, Justin & Hinds
2. Hydroelectric Hand Book by Creager
3. Hydraulic Structures by Varshney
4. Irrigation & Water Power Engg. by Punmia & Pandey B.B.Lal
5. Water Power Engineering by Dandekar

Course outcomes

The students will be able to

1. Perform the stability analysis of gravity dams
2. Explain the causes of failure of different types of dams and their design criteria
3. Design minor irrigation structures such as regulators, cross drainage works and canal falls
4. Able to design structures on pervious formations

CEPE37 SIMULATION MODELLING FOR WATER RESOURCES ENGINEERING

Course Learning Objectives

1. To build on the student's background in basics of simulation modelling.
2. To develop the skills in modelling of linear and nonlinear regression.
3. To develop skills in the artificial intelligence tools such as fuzzy systems, neural networks and genetic programming.
4. To provide wide knowledge on optimization tools.

Course content

Introduction – Concepts of systems and systems Analysis; Systems Techniques in Water Resources: Optimization with methods using calculus.

Regression – linear regression - multiple regression – non linear regression – types – modelling concepts – Probabilistic functions in hydrology- Monte Carlo simulation - Linear Programming- simplex method – dual simplex method - graphical method.

Dynamic programming – forward recursion – backward recursion – water allocation problem – shortest path algorithm – water distribution network – stochastic dynamic programming.

Artificial Intelligence – Neural networks – concepts – back propagation – bias, neuron, weights - radial basis function – case studies – Genetic algorithm – ANN-basics.

Optimization tool- roulette wheel selection – mutation – crossover- case studies Reservoir optimization – Fuzzy inference system – Fuzzy linear programming.

References

1. *Water Resources systems, Vedula and Majumdar, Tata Mcgraw hill Publishers.*
2. *Engelen, G.B., Kloosterman, F.H.Hydrological Systems Analysis, Water Science and Technology Library, Vol. 20.*
3. *Hydrologic Analysis and Design, Richard H. McCuen, Prentice-Hall, 1989. 3rdEdt*
4. *Engineering Hydrology: Principles and Practices, Ponce, Victor Miguel, Prentice-Hall, Inc., 1989.*

Course outcomes

By the end of this course the students are able to

1. Incorporate skills in developing models for various systems.
2. Acquires knowledge on fundamentals of regression techniques.
3. Develops and improves the knowledge dynamic programming and stochastic programming.
4. Provides basic knowledge on fuzzy system and optimization tools.

CEPE38 DESIGN OF OFFSHORE AND COASTAL STRUCTURES

Course Learning Objectives

1. To understand different types of offshore structures
2. To study the different types of operational loads and environmental loads
3. To understand the different types of waves and wave deformation
4. To learn about breakwaters and coastal features

Course Content

Types of offshore structures and conceptual development - Analytical models for jacket structures - Materials and their behaviour under static and dynamic loads - Statutory regulations - Allowable stresses - Various design methods and Code Provisions - Design specification of API, DNV, Lloyd's and other classification societies - Construction of jacket and gravity platforms

Operational loads - Environmental loads due to wind, wave, current and buoyancy - Morison's Equation - Maximum wave force on offshore structure - Concept of Return waves - Principles of Static and dynamic analyses of fixed platforms - Use of approximate methods - Design of structural elements.

Waves in shallow waters - shoaling, refraction, diffraction and breaking- Interaction currents and waves Sediment characteristics - Initiation of sediment motion under waves - Wave run-up and overtopping Radiation stress-wave set-up and wave set-down Mechanics of Coastal Sediment transport - Limits for littoral drift

Breakwaters- Classification, Design and application in coastal protection and harbor planning Distribution of long shore currents and Sediment transport rates in Surf zone - Stability of tidal inlets Wave forces on coastal structures

Coastal Features - Beach Features - Beach cycles - Beach Stability - Beach profiles Coastal erosion, Planning and methods of coast protection works - Design of shore defense structures Case studies on coastal erosion and protection

References

1. *Hydrodynamics of Offshore Structures by S.K. Chakrabarti, Springer-Verlag*
2. *Handbook of Offshore Engineering by S.K. Chakrabarti, Elseviers, 2005.*
3. *Offshore pipelines by B. Gou, S. Song, J. Chacko and A. Ghalambor, GPP Publishers,2006*
4. *Structural Stability - Theory and Implementation by W.F.Chen and E.M.Lui by Elsevier*
5. *Reeve,D., Chadwick, A. and Fleming, C. Coastal Engineering-Processes, theory and design practice, Spon Press, Taylor & Francis Group, London & Paris,2004.*
6. *Silvester,R. and Hsu,J.R.C. Coastal Stabilisation, Advances on Ocean Engineering-Volume 14, World Scientific, 1997.*
7. *Kamphius,J.W. Introduction to coastal Engineering and Management, Advances on Ocean Engineering-Volume 16, World Scientific,2002*

Course Outcome

By the end of this the students will be able to

1. Gain knowledge on different types of offshore structures
2. Understand the different types of loads acting on offshore structures
3. Gain understanding on waves in shallow water, diffraction, reflection and diffraction
4. Design breakwaters and other coastal defense structures
5. Understand the concepts of littoral drift, wave forces and coastal erosion protection

CEPE39 COASTAL ENGINEERING

Course Learning Objectives

1. To provide basic knowledge on two dimensional wave equation
2. To describe the various types of wave theories.
3. To study the effect of wave loads on different coastal structures
4. To improve the knowledge on physical modelling tools in offshore and onshore activities.

Course content

Basic Fluid Mechanics: Conservation of mass and momentum, Euler Equation, Bernoullis equation, potential flow, stream function. Waves: Classification of water waves - Two dimensional wave equation and wave characteristics.

Indian Scenario – Classification of Harbours. Introduction - wind and waves – Sea and Swell -Introduction to small amplitude wave theory – use of wave tables- Mechanics of water waves – Linear (Airy) wave theory, Introduction to Tsunami

Wave theories - Small amplitude waves – Finite amplitude waves - Stoke, Solitary and CnoidalWater particle kinematics - wave refraction; wave breaking; wave diffraction random and 3D waves- Short term wave analysis – wave spectra and its utilities - Long term wave analysis- Statistics analysis of grouped wave data – Currents: Classification - Behaviour - Design Criteria, Scour and other effects of currents

Dynamic beach profile; cross-shore transport; along shore transport (Littoral transport), sediment movement – Estuaries – Creek – Harbour – Littoral drift.

Field measurement; models, groins, sea walls, offshore breakwaters, artificial beach nourishment - planning of coast protection works - Design of shore defense structures –Case studies.

References

1. *Subratakumar Chakrabarti, Hand book of offshore engineering.*
2. *Coastal, Estuaries and Harbour Engineer's reference book, Michael Abbott, W Alan price.*
3. *Coastal Engineering Research reports*.

Course outcomes

By the end of this course the students will be able to

1. Develop knowledge in basics of wave hydrodynamics
2. Provides understanding various aspects of coastal engineering
3. Describes wave forces, wave pressures and currents in the coastal areas.
4. Improves knowledge on sea defence structures.

CEPE40 DISASTER MODELLING AND MANAGEMENT

Course Learning Objectives

1. To know the types of Disasters and its triggering factures.
2. Understand the stages of disaster in hydrological disaster and kinds of data are required to support emergency management work during the disasters.
3. Develop and understand the causes, effects, impacts and analysis of hydrological, geological and coastal hazards.
4. Assess the potential of new, evolving technologies to meet vulnerability mapping, modelling and emergency management needs for geological hazards, hydrological and coastal hazards.

Course content

Disasters: Definition- Hazard Risk, Mitigation, Natural and human induced disasters-types of hazards, disasters and catastrophes – Disaster Management.

Hydrological Hazards: Flooding – PMP – PMF – Inundation mapping -flood prone area analysis and management. Dam breach analysis - Drought- types of drought - Factors influencing drought - delimiting drought prone areas - drought index, SPI and Palmer.

Geological Hazards: Earthquakes; location, faults, causes, types, associated hazards and impacts, Richter scale and Modified Mercalli scale. Mass movements: Definition of landslide - types – causes - slope stability analysis.

Coastal Hazards – storm surge - Tsunami and floods – cyclone – coastal vulnerability – shore line erosion – shore defence structures.

Mitigation and Management: Hazard, Risk and Vulnerability mapping and modelling using GIS. Case studies for earth quake zonation. Risk Assessment - Preparedness- GIS case studies for earthquake, landslide–risk assessment–GIS case studies for earthquake, landslide and cyclones. Emergency Management Systems (EMS) in the Disaster Management Cycle.

References

1. *National Disaster Management Division (2004) Disaster Management in India - A Status Report, Ministry of Home Affairs, Government of India, New Delhi.*
2. *UNDRO (1995) Guidelines for Hazard Evaluation Procedures,United Nations Disasters Relief Organization, Vienna.*
3. *Nagarajan, R., (2004) Landslide Disaster Assessment and Monitoring, Anmol Publications, New Delhi.*
4. *Ramkumar, Mu, (2009) Geological Hazards: Causes, Consequences and Methods of Containment, New India Publishing Agency, New Delhi.*
5. *Arnold M et.al Ed. (2006) Natural Disaster Hotspots:Case Studies. The World Bank Hazard Management Unit Washington, D.C.204p.*

Course outcomes

By the end of this course the students will be able to

1. Understand different types of disaster and its triggering features
2. Understand and analyse hydrological disaster
3. Understand and develop models for geological disaster
4. Able to understand the coastal hazard and shore defence structures
5. Capable to preparing vulnerability mapping and risk assessment and developing Emergency Management System.

CEPE41 PREFABRICATED STRUCTURES

Course learning Objectives

The objective of the course is to

1. Understand the concepts and behaviour of prefabrication and types and its systems.
2. perform analysis and design of cross section and the joints in structures
3. to analyze and design of prefabricated concrete members
4. Obtain knowledge in design of cross section and the joints.

Course content

Need for prefabrication – Types of prefabrication- Principles - Materials - Modular co-ordination – Standardization – Systems Production – Transportation – Prefabrication of load carrying members – Disuniting of structures – Design of cross section of load carrying members- handling and erection stresses Application of prestressing of roof members- floor systems- Wall panels- hipped plate and shell structures- Large panel constructions – Columns – Shear walls. Joints for different structural connections- Beam to Column, Beam to Beam, Column to Column, Column to Foundation, Connections between wall panels, Connections between floor panels - Design of expansion joints- Jointing Materials.

Production, Transportation and erection- shuttering and mould design – Dimensional tolerances- Design and detailing of prefabricated units

References

1. *Hass, A.M., Precast Concrete Design and Applications, Applied Science Publishers, 1991*
2. *Promyslolw, V., Design and Erection of Reinforced Concrete Structures, MIR Publishers Moscow, 1980*
3. *Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge Based Process Planning 76 for Construction and Manufacturing, Academic Press Inc., 1980*
4. *Bauverlag, GMBH, 1971. 3. Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the Use of Precast Concrete, Netherland Betor Verlag, 1978.*
5. *M. Levitt, "Precast Concrete Material, Manufacture, Properties and Usage" Applied Science Publishers Ltd., 1982.*
6. *A.S.G. Bruggeling and G.F.Huyghe, Prefabrication with concrete, Netherlands: A.A. Balkema Publishers, 1991.*
7. *Elliot K. M., Precast Concrete Structures, A Butterworth-Heinemann,*
8. *Handbook on Precast Concrete Structures, Indian Concrete Institute, 2016*
9. *PCI Design Handbook, 8th edition, Precast/Prestressed Concrete Institute, 2017*

Course outcomes

On completion of this course students should be able to:

1. Know the behaviour of prefabricated structures
2. Become familiar with the production of prefabrication units and erection process.
3. Able to perform an industry relevant design project in a team setting
4. Exhibit their knowledge in designing and detailing of prefabrication units

CEPE42 HERITAGE STRUCTURES

Course Learning Objectives

1. To study the terminologies and criteria for heritage structure
2. To know the salient features and grading of heritage structures
3. To study the preservation techniques of various heritage structures
4. To create awareness on the adaptive reuse of heritage structures
5. To get into more case studies on the protected heritage structures

Course content

Introduction-terminologies- history of conservation- methodology and criteria for listing heritage structure

Grading of heritage structures- model building bye-laws - salient features and mapping of historic settlements

Factors deteriorating heritage structures- conservation and presevation techniques

Conservation projects - heritage conservation and adaptive reuse of heritage structures

Protected sites and monuments - case studies

References

1. Handbook of conservation of heritage buildings - A Guide (2013) published by Directorate General, CPWD, NewDelhi.
2. Effect of vibrations of historic buildings: An overview (1982) by J.H. Rainer, Bulletin of the Association for preservation technology, vol 14(1), pp 2-10
3. Maintenance and restoration of heritage building (2012) published by CPWD, NewDelhi.

Course outcomes

The student will be able to

1. Attain in-depth knowledge on various terminologies and methodology involved for heritage structure.
2. Familiarise the features and building bye-laws
3. Visualise the correct preservative measures and methodology
4. Attain in-depth knowledge about the adaptive reuse of heritage structures
5. Familiarise about the various construction techniques Involved From the collected case Studies

CEPE43 EARTHQUAKE RESISTANT STRUCTURES

Course Learning Objectives

1. To introduce the basics of Earthquake Engineering
2. To introduce the engineering seismology, building geometrics & characteristics, structural irregularities,
3. To introduce tips on earthquake engineering - do's and don'ts
4. To introduce cyclic loading behaviour of RC, steel and pre-stressed concrete elements
5. To discuss code provisions and their application on different types of structures

Course Content

Elements of Engineering Seismology - Theory of Vibrations -Indian Seismicity - Earthquake History - Behavior of structures in the past Earthquakes.

Seismic Design Concepts - Cyclic loading behavior of RC, Steel and Prestressed Concrete elements - Response Spectrum- Design spectrum - capacity based design.

Provision of Seismic Code frames, shear walls, Braced frames, Combinations - Torsion.

Performance of Regular Buildings 3D Computer Analysis of Building Systems (Theory only) - Design and Detailing of frames - Shear walls and Frame walls.

Seismic performance - Irregular Buildings -Soil performance, Modern Concepts - Base Isolation - Adoptive systems - Case studies.

References

1. *Pankaj Agarwal and Manish ShriKhande, Earthquake Resistant Design of Structures, Prentice- Hall of India, New Delhi, 2003.*
2. *Bullen K.E., Introduction to the Theory of Seismology, Great Britain at the University Printing houses, Cambridge University Press 1996.*

Course outcomes

On completion of the course, the students will be able to:

1. apply the basics of Earthquake Engineering
2. demonstrate the dynamics of structural system under earthquake load
3. analyze the influence of the structural / geometrical design in building characteristics
4. demonstrate the cyclic loading behaviour of RC steel and pre-stressed concrete elements
5. apply Codal provisions on different types of structures

CEPE44 STEEL CONCRETE COMPOSITE STRUCTURES

Course Learning Objectives

1. To introduce the concept of steel concrete composite design and construction in civil engineering
2. To discuss shear connector types, degree of shear connector, theeir interaction and the design of composite beams under propped and un-propped condition
3. To introduce design of different types of composite deck slabs
4. To introduce the design of composite columns under axial load and bending moments
5. To discuss effects of temperature, shrinkage and creep on composite sections

Course content

Introduction – history – mechanism of composite action – comparison – applications - limit states of composite sections – introduction to plastic analysis.

Shear connectors – types of shear connectors – degree of shear connection – partial and complete shear connections – strength of shear connectors – experimental evaluation of shear connectors.

Analysis and design of composite beams without profile sheet - propped condition – un-propped condition – deflection – design of partial shear connection.

Design of composite beam with profile sheet – propped and un-propped condition – deflection of composite beams – design of partial shear connection.

Introduction – Composite slabs – profiled sheeting – sheeting parallel to span – sheeting perpendicular to span – analysis and design of composite floor system – floor vibration.

Introduction – types of composite columns – design of concrete encased column – design of concrete infilled column – development of P-M interaction curve.

Effect of temperature loads on composite action – creep and shrinkage of concrete on composite design and construction

References

1. Johnson R.P., "Composite Structures of Steel and Concrete"' Volume-I, Black Well Scientific Publication, U.K., 1994

2. Teaching Resources for "Structural Steel Design". Vol.2 of 3, Institute of Steel Development and Growth (INSDAG), 2000

3. Narayanan R., "Composite Steel Structures – Advances, Design and construction, Elsevier, Applied Science, U.K., 1987

4. Owens, G.W & Knowles, P., Steel Designers Manual," (fifth edition), Steel Concrete Institute (U.K), Oxford Blackwell Scientific Publication, 1992.

5. IS 11384 – 1985 Indian Standard Code of Practice for Composite Construction in Structural Steel and Concrete, Bureau of Indian Standards, New Delhi

Course outcomes

On completion of the course, the students will be able to:

1. Apply the concepts of steel concrete composite in civil engineering construction and practices.
2. Analyse the behavior of shear connectors, degree of shear connection and development of composite action.
3. Design composite beams under propped and un-propped condition.
4. Design different types of composite deck slabs.
5. Analyse the effects of temperature, shrinkage and creep on composite design.

CEPE45 STEEL STRUCTURAL SYSTEMS

Course Learning Objectives

1. To learn the analysis and design procedure of various types of steel trusses
2. To learn the analysis and design procedure of moment resisting steel frames for gravity and lateral loads
3. To learn the analysis and design procedure of steel pre-engineered buildings (PEBs)
4. To learn the analysis and design procedure of steel bunkers and silos
5. To learn the analysis and design procedure of various types of steel water tanks and their staging.

Course content

Various types of steel trusses – functional and structural requirements – application for bridges and large span systems – stability aspects

Multi-storey buildings – structural framing for gravity and lateral loads resistant systems – shear connections and moment connections – base plate and anchor bolt – foundation design criteria.

Introduction to the concept of PEBs – preliminary sizing and design of purlins and rafters – bracing system and arrangement – connection detailing.

Design of steel bunkers and silos – janssen's theory – Airy's theory – design parameters – design criteria – analysis of Bins – Hopper bottoms –design of bins

Design of steel tanks – types of tanks – elevated circular/rectangular tanks – stresses in spherical / conical bottom – circular girder – staging for circular/rectangular tanks.

Note: *Assignments include the design and drawings of various steel structures.*

References

1. *Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi 2008.*
2. *Dayaratnam, P., Design of Steel Structures, S. Chand & Company LTD, New Delhi, 2003*

3. *Ram Chandra and Virendra Gehlot, Design of Steel Structures, Vol. I, Standard Book House, New Delhi*
4. *Ram Chandra and Virendra Gehlot, Design of Steel Structures, Vol. II, Scientific Publishers, New Delhi*
5. *IS 800 - 2007, Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi.*

Course outcomes

On completion of the course, the students will be able to:

1. Design various types of steel trusses
2. Design of gravity and moment resistant steel structural systems
3. Design of pre-engineered buildings in structural steel
4. Design steel bunkers and silos
5. Design steel water tanks and their staging

CEPE46 BASIC BRIDGE ENGINEERING

Course Learning Objectives

1. To learn the components of bridges, classification of bridges, importance of bridges
2. To study the specification of road bridges, loads to be considered
3. To familiarize students with various types of concrete bridges such as slab-bridge, T-beam bridge
4. To familiarize students with various types of steel bridges such as truss bridge and girder bridge and also railway bridges by IRS loadings
5. To get exposure the substructure of bridge substructures and the evaluation and importance of bearings

Course content

Components of Bridges –Classification –Importance of Bridges –Investigation for Bridges –Selection of Bridge site –Economical span –Choice of bridge type.

Specification of road bridges –width of carriageway –loads to be considered -dead load –IRC standard live load and IRS loading–Impact effect.

General design considerations –Concrete bridges - Slab Bridge –Design of T-beam bridge (superstructure only)

Steel bridges - truss bridge-plate girder bridge (superstructure only)

Importance of Bearings –Bearings for slab bridges –Bearings for girder bridges –Electrometric bearing –Joints –Expansion joints – substructure (theory only): piers, piercaps, types of foundations, piles and pilecaps.

Note: *Assignments include the design and drawings of bridge superstructures.*

References

1. *Ponnuswamy, S., Bridge Engineering, Tata McGraw –Hill, New Delhi, 1997*
2. *Victor, D. J., Essentialsof Bridge Engineering, Oxford andIBH Publishers Co., New Delhi, 1980*
3. *N. Rajagopalan, Bridge Superstructure, Narosa Publishing House, New Delhi, 2006.*

Course outcomes

On completion of the course, the students will be able:

1. To be familiar with the components of bridges, classification of bridges, importance of bridges
2. To understand the specification of road bridges, loads to be considered
3. To be familiar with various types of concrete bridges such as slab-bridge, T-beam bridge, pre-stressed concrete bridge
4. To be familiar with various types of steel bridges such truss bridge and girder bridge
5. To get exposed to evaluation of sub structures, type of foundations, importance of bearings

(III.b) OPEN ELECTIVE (OE)

CEOE10 REMOTE SENSING AND GIS

Course Learning Objectives

1. To know about the principles of remote sensing and spectral signatures
2. To know about satellites, types of remote sensing and digital image processing
3. To study about the history and components of GIS
4. To study about data types and operations.
5. To know the applications of remote sensing and GIS for various fields of Civil Engineering

Course content

Remote Sensing – Principle - Electro-magnetic energy, spectrum - EMR interaction with atmosphere – Atmospheric Windows and its Significance – EMR interaction with Earth Surface Materials – Spectral Signature and Spectral Signature curves for water, soil and Earth Surface.

Satellites - Classification – Satellite Sensors – satellite and sensor parameters - Resolution – Types of Remote Sensing - Visual Interpretation of Satellite Images – Digital Image processing – Characteristics of different platforms: Landsat, SPOT, IRS series, IKONOS, QUICKBIRD – Radar, LIDAR, SAR, MODIS, AMSRE, Sonar remote sensing systems introduction of GPS- data receiving mode- DTM generation- View shed analysis.

GIS - History of Development - Components of GIS – Hardware, Software and Organizational Context – Data – Spatial and Non-Spatial – Data Input Sources— DBMS – Data Output - Data models - Raster and Vector data structures – Data compression – Raster vs. vector comparison.

Analysis using Raster and Vector data – Operations – Overlaying - Buffering – Modelling in GIS - Digital Terrain Modelling, Analysis and application – Products of DEMs and their uses – Sources of errors in GIS and their elimination.

Applications of Remote Sensing and GIS – Advanced applications of GIS – Disaster management, Water resource, Landuse – Land cover – Urban planning - Intelligent Transport Systems - Development of Resources Information Systems.

References

1. *Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, Oxford Publication, 2004.*
2. *C.P. Lo and Albert K. W. Yeung, Concepts and Techniques of Geographical Information Systems, Prentice- Hall India, 2006.*
3. *Thomas. M. Lillesand and Ralph. W. Kiefer, Remote Sensing and Image Interpretation, John Wiley and Sons, 2003.*

Course outcomes

On completion of the course, the students will be able to:

1. Demonstrate the concepts of Electro Magnetic energy, spectrum and spectral signature curves.

2. Apply the concepts of satellite and sensor parameters and characteristics of different platforms.
3. Apply the concepts of DBMS in GIS.
4. Analyze raster and vector data and modeling in GIS.
5. Apply GIS in land use, disaster management, ITS and resource information system.

CEOE11 OCEAN ENERGY

Course Learning Objectives

1. Learn the basics of ocean environment
2. Understand the concept of wave measurement and linear wave theory
3. Learn the ocean tidal current turbulence and wave energy systems
4. Develop model testing techniques for marine current turbines

Course Content

Introduction to the ocean environment - Ocean circulation and stratification - Ocean habitat - Ocean economy - Ocean surface waves - Wave measurement - Linear wave theory - Wave spectrum - Wave energy resource

Ocean tidal currents - Current measurement - Current turbulence o Current energy resource - Site selection and characterization for ocean energy system - Wave energy systems - Types of wave energy converters - Linear wave-structure interactions - Frequency domain analysis - Hydrodynamic coefficients and their computation - Time domain analysis - Phase control Arrays

Model testing techniques - Marine current turbines - Types of marine current turbines Hydrodynamic models (BEM, Lifting line, IBEM) - Hydrofoil data and analysis

Cavitation and strength - Design criteria - Multiple turbine interaction - Other types of energy systems o- Ocean Thermal Energy Conversion (OTEC) - Energy from salinity gradient

Power take-off systems - Air turbines, Water turbines - High pressure hydraulic systems - Electrical generation - Energy storage - Mooring and anchoring systems. Operation and maintenance of ocean energy devices - Offshore operations - Maritime safety issues

References

1. *Sorensen, Bent, Renewable Energy, Its Physics, Engineering , environmental impacts, economics, and planning, 3rd Ed. Elisver Academic Press, London, 2004*
2. *Twidell, John and Weir, Tony, Renewable Energy Resources, Taylor and Francis, 2005*

Course Outcomes

By the end of this course the students will be able to

1. Understand the basics of ocean energy sources
2. Capable of understanding the concepts of measurements of current and tides by using measuring devices
3. Understand the different types of marine turbines

4. Improves knowledge on water turbines, Electrical operations and marine safety
5. Understand OTEC

CEOE12 EARTHQUAKE ENGINEERING

Course Learning Objectives

1. To introduce the basics of Earthquake Engineering
2. To understand the mechanism of earthquake wave propagation
3. To explain about seismic measuring devices and scales
4. To explain how to do hazard assessment and mitigation and explain how do prepare a risk and microzonation mapping
5. To explain about various seismic protection methods

Course content

Importance of earthquake engineering – Earth structure – Plate tectonics - Faults – Earthquake generation mechanism – terminologies

Earthquake propagation - Seismic waves in Earthquake shaking – body waves and surface waves – attenuation of wave amplitudes

Measurement of earthquakes – Intensity scales – Seismographs and Seismograms – Magnitude scales – seismic moment and moment magnitude – Accelerographs and Accelerograms

Seismic hazard assessment – methods – ground motion intensity at given site and in given time interval – probabilistic and semi-probabilistic approaches – seismic zonation and microzonation maps

Seismic protection methods – base isolation – energy dissipating devices - Codal provisions

References

1. *R. Villaverde (2009). Fundamental Concepts of Earthquake Engineering, 1st Edition, CRC Press*
2. *S. Elnashai and L. Di Sarno (2008). Fundamentals of Earthquake Engineering, 1st Edition, John Wiley and Sons*
3. *Krammer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International Series, Pearson Education (Singapore) Pvt. Ltd., 2004.*

Course outcomes

On completion of the course, the students will be able to:

1. apply the basics of Earthquake Engineering
2. understand the earthquake wave generation and its propagation mechanism
3. knowledge on earthquake measuring scales and instruments
4. quantify earthquake intensity and ground motion
5. identify the method to protect the structure from seismic forces

CEOE13 URBAN AND REGIONAL PLANNING

Course Learning Objectives

1. To develop an awareness about the trends in urbanization
2. To understand the basic principles and concepts of urban planning
3. To learn the laws and regulations related to the planning process existing in the country.

4. To be acquainted with the various stages of the planning process
5. To get introduces to the various agencies and organizations involved in the planning process

Course Content

Definition and classification of urban areas - Trend of urbanization - Planning process - Various stages of the planning process - Surveys in planning.

Plans - Delineation of planning areas -Regional plan, Master plan, Structure plan, detailed development plan and Transportation plan.

Planning principles of Ebenezer Howard (Garden city movement), Patrick Geddes, Dr. C. A. Doxiades, Soria Y Mata (Linear city) and Clarence, A. Perry (The neighbourhood concept).

Plan implementation - Urban Planning agencies and their functions – Financing - Public, private, Non-governmental organizations - Public participation in Planning.

Development control regulations - Town and country planning act - Building bye-laws.

References

1. *Hutchinson, B.G., Principles of Urban Transport Systems Planning, Scripta, McGraw-Hill, New York, 1974.*
2. *Claire, Hand Book of Urban Planning, Van Nostrand Book Company, 1974.*
3. *Gallian, B. Arthur and Simon Eisner, The Urban Pattern - City Planning and Design, Affiliated Press Pvt. Ltd., New Delhi, 1985.*
4. *Margaret Roberts, An Introduction to Town Planning Techniques, Hutchinson, London, 1980.*
5. *Hiraskar, G. K., Fundamentals of Town Planning, Dhanpat Rai Publications, 1992.*

Course Outcomes

On completion of the course, the students will be able to:

1. Demonstrate the various process involved in urban planning
2. Apply the laws and governmental policies related to the planning process
3. Implement the classical urban planning principles
4. Apply the methods of financing of plans
5. Demonstrate the regulations and by-laws

CEOE14 EXPERIMENTAL STRESS ANALYSIS

Course Learning Objectives

1. To study the working principles of different types of strain gauges
2. To understand the model analysis
3. To know the fundamentals of photo elastic coatings
4. To study the effects of 2-D photo elasticity
5. To study the working principle of load, pressure and displacement transducers

Course Content

Strain gauges – Mechanical, optical, acoustic, electrical inductance and capacitance pneumatic types – description and working principles

Electrical resistance strain gauges, gauge characteristics and types – Equipment for recording static strain – reduction of strain gauge data. Load, pressure and displacement transducers.

Model analysis – direct and indirect models – law of structural similitude – choice of scales – Model materials – limitations of model studies –Buckingham PI theorem – design of direct and indirect models – Beggs deformeter and its applications.

Two dimensional photo – elasticity – optical principles stress optic law – Methods of producing isoclines and isochromatics using polariscopes – Methods of measuring fractional fringe orders – model materials – separation techniques

Fundamental of Photo elastic coatings, Moire fringe and brittle coating techniques – Introduction to stress freezing techniques – Introduction to non-destructive testings

References

1. *Daley and Riley, Experimental Stress Analysis, McGraw Hill Book Company, 1987*
2. *Srinath, L.S. et al., Experimental Stress Analysis, Tata McGraw Hill 1984.*
3. *Hetenyi, M., Hand Book of Experimental Stress Analysis, John Wiley & Sons. Inc New York. 1980.*

Course outcomes

On completion of the course, the students will be able to:

1. identify the different types of strain gauges
2. carry out model analysis
3. apply the concepts of photo elastic coatings
4. analyze the behavior of 2-D photo elasticity
5. apply the working principles of transducers

CEOE15 HEALTH MONITORING OF STRUCTURES

Course Learning Objectives

To investigate the materials, products, structures or components that fall or do not operate or function as intended causing personal injury or damage the property.

Course content

Introduction- Qualitative and non-continuous methods of evaluation of structures- SHM definition- Detecting the existence of the damage on the structure- Locating the damage- Identifying the types of damage- Quantifying the severity of the damage- Sensors- Feature extraction through signal processing and statistical classification- Structure- Data acquisition systems-Data transfer and storage mechanism-Data management- Data interpretation and diagnosis : System Identification-Structural model update-Structural condition assessment-Prediction of remaining service life

Different sensors - accelerometers, strain gauges, displacement transducers, level sensing stations, anemometers, temperature sensors and dynamic weight-in-motion sensors- Case studies- SHM for bridges

References

1. *Raghavan, A. and Cesnik, C. E., Review of guided-wave structural health monitoring," Shock and Vibration Digest, vol. 39, no. 2, pp. 91-114, 2007.*

2. *Shen-En Chen, R. Janardhanam, C. Natarajan, Ryan Schmidt, Ino-U.S. Forensic Practices - Investigation Techniques and Technology, ASCE, U.S.A., 2010.*
3. *C. Natarajan, R. Janardhanam, Shen-En Chen, Ryan Schmidt, Ino-U.S. Forensic Practices - Investigation Techniques and Technology, NIT, Tiruchirappalli, 2010.*
4. *Gary L. Lewis, Guidelines for Forensic Engineering Practice, ASCE, U.S.A., 2003.*
5. *Joshua B.Kardon, Guidelines for Forensic Engineering Practice, ASCE, U.S.A., 2012.*

Course outcomes

On completion of the course the students will be able to:

1. Perform structural health monitoring
2. Handle emerging technologies using sensors
3. Perform notable applications of structural health monitoring in civil applications

CEOE16 FORENSIC ENGINEERING

Course Learning Objectives

1. To undertake problem diagnostics and treatment during the structural design and construction phase
2. To identify, diagnosis and treat complex problem in relation to whole-of-life reliability and resilient performance during occupancy
3. To study the concepts and application of forensic engineering for analysing failure and damage mitigation of structures

Course content

Introduction- competencies and qualification of Forensic Engineers-Failure of Structures- performance problems – responsibility and accountability –– learning from failures – causes of distress in structural members – Diagnosis and Assessment of Distress: Visual inspection – non- destructive tests- Rebound hammer method- Ultrasonic Pulse Velocity method – crack detection techniques – case studies – single and multistorey buildings. Environmental Problems and Natural Hazards: Effect of corrosive, chemical and marine environment – pollution and carbonation problems – durability of RCC structures – damage due to earthquakes and flood- strengthening of buildings – provisions of BIS 1893 and 4326. Modern Techniques of Retrofitting: Structural first aid after a disaster – guniting - jacketing –Concrete chemicals– application of polymers – Ferro cement and fiber concretes as rehabilitation materials – mortar repair for cracks- shoring and underpinning - Case studies

References

1. *Raikar, R.N., Learning from failures – Deficiencies in Design, Construction and Service R&D Centre (SDCPL), Raikar Bhavan, 1987.*
2. *Dovkaminetzky, Design and Construction Failures, Galgotia Publication, NewDelhi, 2001.*

3. *Shen-En Chen, R. Janardhanam, C. Natarajan, Ryan Schmidt, Ino-U.S. Forensic Practices - Investigation Techniques and Technology, ASCE, U.S.A., 2010.*
4. *C. Natarajan, R. Janardhanam, Shen-En Chen, Ryan Schmidt, Ino-U.S. Forensic Practices - Investigation Techniques and Technology, NIT, Tiruchirappalli, 2010.*
5. *Gary L. Lewis, Guidelines for Forensic Engineering Practice, ASCE, U.S.A., 2003.*
6. *6.Joshua B.Kardon, Guidelines for Forensic Engineering Practice, ASCE, U.S.A., 2012.*

Course outcomes

On completion of the course, the students will be able to:

1. Describe and evaluate the use of structural forensics in creating and maintaining of civil infrastructure
2. Identify the common failure modes
3. Investigate the structural failures, reverse engineer the lessons learnt and produce technical notes

CEOE17 SUSTAINABLE INFRASTRUCTURE

Course Learning Objectives

1. To explain the importance of sustainable built environment
2. To emphasis the significance of sustainable development and construction
3. To introduce the techniques and for assessing environmental impact
4. To perform the service life and life cycle assessments

Course content

Extent and values of infrastructure (buildings, structures, plants and networks for communication and transport, water and wastewater treatment, production and distribution of energy); relations between infrastructure and sustainable development; regulations and standards; indicators of sustainability; consequences of climate change; vulnerability and safety of infrastructure; materials and technology for construction and management; Applications for sustainable communities; service life and life cycle assessments (LCA, LCC, MFA, environmental assessment); an international perspective with case studies from around the world.

References

1. *Sarte S. B.,'Sustainable Infrastructure: The Guide to Green Engineering and Design, Wiley; 1st edition, 2010.*
2. *Horne R. E., Grant T., Verghese K., 'Life Cycle Assessment: Principles, Practice and Prospects', CSIRO, 2009.*
3. *Karli Verghese, Helen Lewis, Leanne Fitzpatrick, 'Packaging for Sustainability', Springer, 2012..*
4. *FIB bulletin 88, 'Sustainability of precast structures', 2018.*

Course outcomes

On completion of the course, the students will be able to:

1. understand the values and societal importance of the built environment
2. understand the influence on a sustainable development
3. gain knowledge on how to use environmental impact assessments as a tool for design
4. construction and management of a sustainable built environment

(III.c) MINOR (MI)

CEMI10 CONSTRUCTION TECHNOLOGY

Course Learning Objectives

1. To know the properties and applications of different construction materials
2. To understand the production, processing and testing of concrete
3. To learn the construction principles, formwork and other construction methods
4. To study the types of building finishes and building services
5. To learn the different repair techniques in construction

Course content

Building materials: Classification and requirements of good stone and brick, Brick manufacturing, Harmful ingredients, testing, Constituent of a good brick earth, Lime, manufacturing, Field-testing, Artificial hydraulic lime; Timber: classification, structure, seasoning, defects; Paints: Constituents, types, characteristics of varnishes.

Concrete technology: High grade cements, Advances in manufacture of cement, Concrete Mix Design; Process of manufacture of concrete, Batching, mixing, transporting, placing, compaction, curing, finishing; Testing of fresh and hardened concrete; Non-destructive testing.

Principles of building construction: Bonding, Reinforced brick work, Stone masonry, Hollow block masonry, Composite masonry, Cavity walls, Flooring, Formwork, Shoring and Scaffolding, Slip and moving forms, Roofs and roof coverings, Under pinning, Submerge structures.

Building items: Plastering & pointing, Painting, Distempering and white washing; Damp proof course (DPC), Anti-termite measures and treatments; Construction joints; Plumbing and electrification, various types of fittings and laying procedure.

Construction damages & repair techniques: Causes of damage and deterioration in masonry and concrete structures, Symptoms & Diagnosis, Types of repair and rehabilitation techniques; Case studies.

References

1. *Duggal, S.K., Building Materials, New Age International, 2009.*
2. *Rangwala, S.C., Engineering Materials, Charotar, 2015.*
3. *Arora, S.P. and Bindra, S.P., Building Construction, Dhanpat Rai and Sons, 1997*
4. *Punmia, B.C., Building Construction, Laxmi Publications (P) Ltd., 1993*
5. *Peurifoy, R.L., Form work for Concrete Structures, McGraw Hill Book Co., 1999.*
6. *Shetty, M.S., Concrete Technology, S.Chand and Company., 2011*
7. *Neville A.M., Properties of Concrete, Fourth edition, Pearson Education Ltd. 2004.*

Course outcomes

On completion of the course, the students will be able to:

1. Distinguish the different construction materials and select appropriate materials for construction
2. Design suitable concrete mixes and test the concrete

3. Execute construction jobs with the knowledge of the different construction techniques and building services
4. Identify the building defects and apply suitable repair techniques to rectify them

CEMI11 SURVEYING PRACTICES

Course Learning Objectives

1. To understand the importance of surveying in the field of civil engineering
2. To get introduced to different plane and geodetic surveying applications such as chain, compass, plane table, leveling, triangulation, trigonometric leveling etc
3. To understand the significance of each method in civil engineering and master the skill to carry out the proper surveying method in the field.
4. To design numerical solutions for carrying out surveying in civil engineering field.
5. To get introduced to modern advanced surveying techniques involved such as remote sensing, Total station, GPS etc.

Course content

Surveying – Definition – Objectives and Principles – Types of surveying - Conventional and Advanced Surveying – Drawing practices – Map – Plan – Scale – Layout – Field record – Plans of survey – Standard and Calibration – Survey marks

Datums – Reference planes – Geoid – Ellipsoid – Coordinate systems – Coordinate Transformation – Maps – Map Projections and Transformations – Coordinate systems and Map projections of various countries

Conventional Surveying procedures – Data acquisition – Chain – Tape – Theodolite – Levelling – Output, Applications and importance

Modern Surveying procedures – Data acquisition – Remote Sensing - Photogrammetry – EDMs – Space Geodesy – GPS/GNSS – VLSI – Doppler methods – Output, Applications and importance

Digital data and Software – Data structure – Data flow – Exchange and Standards – Creation and gathering of data – Management of Data – Digital image processing – Future – Land surveying Law and Administration – GIS – Survey resource systems

References

1. *Duggal, S.K. Surveying Vol. I and II, Tata McGraw Hill, 2004.*
2. *Punmia, B.C. Surveying Vol.I and II, Standard Publishers, 1994.*
3. *Arora, K. R. Surveying Vol. I and II, Standard Book House, 1996*

Course outcomes

On completion of the course, the students will be able to:

1. carry out preliminary surveying in the field of civil engineering
2. plan a survey, taking accurate measurements, field booking, plotting and adjustment of traverse
3. use various conventional instruments involved in surveying with respect to utility and precision
4. plan a survey for applications such as road alignment and height of the building
5. undertake measurement and plotting in civil engineering

CEMI12 STRUCTURAL ANALYSIS AND DESIGN

Course Learning Objectives

1. To introduce the concept of structural elements and their analysis
2. To understand and design simple axially loaded RC columns and beams
3. To understand and design simple axially loaded Steel columns and beams

Course content

Introduction to reinforced concrete elements – Analysis and design of axially loaded column - Analysis and design of determinate beams

Analysis and design of laterally restrained and unrestrained steel beams

Analysis and design of axially loaded compression member

Design of lap and butt joints using bolts ad welds

References

1. *Dayaratnam, P., Design of Reinforced Concrete Structures, Oxford & IBH Publishers & Co., New Delhi, 2005.*
2. *IS456-2006 Code of practice for Plain and reinforced concrete code of practice.*
3. *Bhavikatti, S.S., Design of Steel Structures, I.K. International Publishing House Pvt. Ltd., New Delhi, 2010*
4. *IS 800 - 2007, Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi.*
5. *SP6 (1)-1964, IS hand book for structural Engineers. Bureau of Indian Standards, New Delhi.*

Course outcomes

On completion of the course, the students will be able to:

1. Analyse and design simple structural elements
2. Analyse and design simple axially loaded RC columns and beams
3. Analyse and design simple axially loaded Steel columns and beams

CEMI13 SOILS AND FOUNDATIONS

Course Learning Objectives:

1. To explain how soils are formed and its classification
2. To emphasis the importance of identifying problematic soil and ground improvement
3. To explain the mechanism of soil slope failures
4. To emphasize the importance of soil investigations including destructive and non-distractive methods
5. To explain how to select a suitable foundation system for various site conditions

Course content

Origin, formation and classification of Soil – Structure and properties of clay minerals - Problematic Soils – Permeability and seepage – Permeability testing of soils and applications

Introduction to compaction and Consolidation – suitability of soil for foundations – methods of ground improvement

Soil slopes and its failure mechanisms – Types - infinite slopes – finite slopes – slope protection measures

Soil exploration and its importance - Plate load test, static and dynamic penetrations tests - geophysical explorations

Types and Choice of foundation – Combined Foundation – Mat foundation – Types of piles and sheet piles – Under reamed piles - machine foundation.

References

1. *Murthy, V.N.S, A text book of Soil Mechanics and Foundation Engineering, UBS Publishers & Distributors Pvt. Ltd., New Delhi 1999.*
2. *Punmia, B.C., Soil Mechanics and Foundation Engineering, Laxmi Publications Pvt. Ltd., New Delhi, 1995.*
3. *Gopal Ranjan and Rao, Basic and Applied Soil Mechanics, New Age International (P) Limited, New Delhi, 2002.*
4. *Robert D. Holtz, William D. Kovacs and Thomas C. Sheahan, An Introduction to Geotechnical Engineering, Pearson, 2013*.

Course outcomes

Upon completion of this course, the students will be able to

1. Understand the importance of geotechnical engineering in civil engineering
2. decide the type of foundation suitable for a particular soil condition
3. select the right method to improvement the problematic soil
4. Understand the importance of soil investigation for any civil engineering construction

CEMI14 TRANSPORTATION SYSTEMS

Course Learning Objectives

1. To study about the geometric design of highways
2. To know about pavement materials and design
3. To study about the types and functions of track, junctions and railway stations.
4. To learn about the aircraft characteristics, planning and components of airport.
5. To study about the types and components of docks and harbours.

Course Content

Highway Engineering - Classification of roads, highway alignment and surveys; Geometric Design - Cross section elements, sight distance, design of horizontal and vertical alignment.

Pavement Materials and Design - Specifications and tests on pavement materials, pavement design factors, design of flexible and rigid pavements.

Railway Engineering - Location surveys and alignment - Gauges - Components of Permanent way; Track Junctions - Points and crossings - Railway stations and yards.

Airport Engineering - Aircraft characteristics - Airport obstructions and zoning - Runway - Taxiways and aprons - Terminal area planning

Docks and Harbours - Layout and planning principles - Breakwaters – Docks - Wharves and quays - Navigational aids.

References

1. *Khanna, S.K and Justo, C.E.G., Highway Engineering, Nem Chand and Bros.Roorkee (U.P), 1998.*
2. *M.M. Agarwal, Railway Engineering, Prabha & Co. 2007.*
3. *Khanna, S.K. and Arora, M.G. Airport Planning and Design, Nemchand and Bros. 1999.*
4. *Oza and Oza, Elements of Dock and Harbour Engineering, Charotar Publishing House, 1996.*

Course Outcomes

On completion of the course, the students will be able to:

1. Design cross section elements, sight distance, horizontal and vertical alignment
2. Determine the characteristics of pavement materials
3. Plan the layout of railway terminals
4. Apply principles of airport planning
5. Implement the layout of harbours

CEMI15 WATER AND AIR POLLUTION MANAGEMENT

Course Learning Objectives

1. To understand and determine the basic characteristics of water both qualitatively and quantitatively
2. To expose the students to understand the water distribution system and the water treatment processes
3. To provide adequate knowledge about wastewater characteristics and its treatment processes
4. To give an idea about the disposal of wastewater into water bodies and their effects on river systems
5. To study the various treatment techniques for industrial wastewater and understand the concepts of air pollution and its control measures

Course content

Physical, chemical and biological characteristics of water - water analysis- IS and WHO standards- Requirements of water supply – per capita water demand - Sources of water- Water treatment plants - process of treatments. Water distribution - Methods of distribution systems-Layouts - Analysis of distribution networks. Wastewater characteristics - wastewater treatment - primary treatment - Secondary treatment. Disposal standards - self-purification of rivers - Streeter Phelps equation - oxygen sag curve. Industrial wastewater treatment - methods - Air pollution – effects - stack emission - automobile exhaust - control devices.

References

1. *Manual on Water supply and Treatment - CPHEEO, 1999.*
2. *Peavy H. S., Rowe D. R. and Tchobanoglous G., Environmental Engineering, McGrawHill, New York, 1985.*

3. *Birdie, G.S. and Birdie, Water Supply and Sanitary Engineering, Dhanpat Rai & Sons, 1992.*
4. *Duggal, K.N. Elements of Environmental Engineering, S.Chand & Co, 2002.*
5. *Punmia B.C, Ashok Jain & Arun Jain, Water Supply Engineering, Laxmi Publications, Pvt. Ltd., New Delhi, 2004.*
6. *Metcalf and Eddy, Wastewater Engineering, Collection, Treatment and Disposal, Tata McGraw Hill, Inc., New York, 2005.*

Course outcomes

On completion of the course, the students will be able to:

1. Identify the source of water and to calculate water demand.
2. Apply the water treatment concept and methods.
3. Prepare a layout of water distribution network.
4. Characterize wastewater and apply suitable treatment process.
5. Apply the various air pollution control devices to minimize the release of harmful gases into the atmosphere.

CEMI16 IRRIGATION ENGINEERING AND MANAGEMENT

Course Learning Objectives

1. To understand the basic types of irrigation, irrigation standards and crop water assessment
2. To know the irrigation management practices of the past, present and future
3. To study the different aspects of design of hydraulic structures
4. To provide knowledge on various hydraulic structures

Course Content

Irrigation – Need and mode of irrigation – Merits and demerits of irrigation – Crop and crop seasons – consumptive use of water – Duty – Factors affecting duty – Irrigation efficiencies – Planning and Development of irrigation projects. Canal irrigation – Lift irrigation – Tank irrigation – Flooding methods – Merits and demerits – Sprinkler irrigation – Drip irrigation

Weirs – elementary profile of a weir – weirs on pervious foundations - Types of impounding structures - Percolation ponds – Tanks, Sluices and Weirs – Gravity dams – Earth dams – Arch dams – Spillways – Factors affecting location and type of dams – Forces on a dam – Hydraulic design of dams.
Alignment of canals – Classification of canals – Canal drops – Hydraulic design of drops – Cross drainage works – Hydraulic design of cross drainage works – Canal Head works – Canal regulators – River Training works.
Need for optimisation of water use – Minimising irrigation water losses – On farm development works - Participatory irrigation management – Water users associations – Changing paradigms in water management – Performance evaluation.

References

1. *Asawa, G.L., "Irrigation Engineering", New Age International Publishers, 2000*
2. *Punima B.C. & Pande B.B .Lal Irrigation and Water Power Engineering, Laxmi Publishing, New Delhi 2007*
3. *Michael, A.M, Irrigation Theory and Practical, Vikas Publishing Pvt Ltd, 2006*

4. *Gupta, B.L, & Amir Gupta, "Irrigation Engineering", Satya Praheshan, New Delhi*
5. *Dilip Kumar Majumdar, "Irrigation Water Management (Principles & Practices)", Prentice Hall of India (P), Ltd, 2000*
6. *Basak, N.N, "Irrigation Engineering", Tata McGraw-Hill Publishing Co. New Delhi, 1999*

Course outcomes

On completion of the course, the students will be able to:

1. Find the crop water requirement for various crops in the command area.
2. Understand the complete design of Dams and channel systems.
3. Understand the different types of cross drainage works.
4. Understand the participatory irrigation management

CEMI17 QUANTITY ESTIMATION AND VALUATION

Course Learning Objectives

1. To know the importance of preparing the types of estimates under different conditions
2. To know about the rate analysis and bill preparations
3. To study about the specification writing
4. To understand the valuation of land and buildings

Course Content

Preparation of detailed estimates - Preparation of specifications report accompanying the estimate Approximate methods of Costing - types of estimate - costing for various structures - rate analysis - rate for material and labour - schedule of rates -data sheets - abstract estimate. Values and its kinds - Valuation - purpose- scope - methods - land and building method - Factors affecting the value of plot and building - depreciation - Valuation of residential building with case study.

References

1. *Dutta. B.N, Estimating and Costing in Civil Engineering: Theory and Practice including specifications and valuation, UBS Publishers and distributors, 27th revised edition.*
2. *Chakraborthi.M, Estimating, Costing, Specification & Valuation in Civil Engineering, UBS Publishers and distributors, 2006.*
3. *Bhasin, P.L., Quantity Surveying, 2nd Edition, S.Chand & Co., 2000.*

Course outcomes

On completion of the course, the students will be able to:

1. apply different types of estimates in different situations
2. carry out analysis of rates and bill preparation at different locations
3. demonstrate the concepts of specification writing
4. carry out valuation of assets

(IV) ESSENTIAL LABORATORY REQUIREMENT (ELR)

CELR11 STRENGTH OF MATERIALS AND CONCRETE LABORATORY

Course Learning Objectives

1. To find the Young Modulus, torsional strength, hardness and tensile strength of given specimens
2. To find impact value and crushing value of coarse aggregates
3. To find the compressive strength of concrete cubes and bricks
4. To find stiffness of open coiled and closed coiled springs
5. To find the physical properties of given coarse aggregate, fine aggregate and cement samples

Course content

1. Tests on springs - modulus of rigidity of the spring.
2. Stress-strain characteristics of HYSD bars.
3. Young's modulus of the given material (steel or wood) by conducting bending test on simply supported beam.
4. Brinel's, Vickers, Rockwell hardness tester.
5. Normal consistency, fineness, Initial setting and final setting time of cement.
6. Specific gravity, soundness and Compressive strength of Cement.
7. Specific gravity of fine and coarse aggregates.
8. Fineness modulus of fine aggregate and coarse aggregate.
9. Impact strength, crushing strength and water absorption test on coarse aggregate.
10. Concrete mix design (IS method).
11. Tests on Concrete.
12. Compressive and spilt-tensile strength of concrete.
13. Modulus of Elasticity/stress-strain curve in concrete.
14. Permeability test and NDT Tests (only Demonstration)

Course outcomes

On completion of the course, the students will be able to:

1. Evaluate Young Modulus, torsional strength, hardness and tensile strength of given specimens.
2. Determine the strength of coarse aggregates.
3. Design concrete mixes and find the compressive strength of concrete cubes and bricks.
4. Find stiffness of open coiled and closed coiled springs.
5. Determine the physical properties of given coarse aggregates, fine aggregates and cement samples.

CELR12 SURVEY LABORATORY

Course Learning Objectives

The Lab sessions would include experiments on

1. Introduction to Chain Surveying and Compass Surveying.
2. Plane Table Surveying – Radiation, intersection, Traverse, Resection Leveling.
3. Tacheometry and Theodolite survey
4. Trigonometric levelling to determine heights/elevations.
5. Total Station.

Course content

1) Chain and Compass surveying
2) Plane table surveying
3) Leveling: Fly leveling and contouring
4) Radiation, intersection-Traverse- Resection
5) Theodolite surveying
6) Single and two plane observation of trigonometric leveling
7) Determination of Tacheometric Constants
8) Tangential Tacheometry
9) Subtense Bar
10) Total station
11) Survey Camp

Course outcomes

On completion of the course, the students will be able to:

1. Use conventional surveying tools such as chain/tape, compass, plane table, level in the field of civil engineering applications such as structural plotting and highway profiling.
2. Apply the procedures involved in field work and to work as a surveying team.
3. Plan a survey appropriately with the skill to understand the surroundings.
4. Take accurate measurements, field booking, plotting and adjustment of errors can be understood.

CELR13 FLUID MECHANICS LABORATORY

Course Learning Objectives

1. To understand the flow measurement in a pipe flow
2. To determine the energy loss in pipe flow
3. To study the characteristics of turbines
4. To study the characteristics of pumps
5. To measure the discharge in a open channel flow

Course Content

1. Determination of pipe friction
2. Calibration of flow meters - Venturimeter and Orifice meter

3. Determination of discharge coefficients for notches
4. Determination of minor losses
5. Pressure gauge calibration.
6. Centrifugal pump
7. Submersible pump
8. Reciprocating pump
9. Jet pump
10. Gear pump
11. Screw pump
12. Francis Turbine

Course outcomes

On completion of the course, the students will be able to:

1. measure discharge in pipes
2. determine the energy loss in conduits
3. demonstrate the characteristics curves of pumps
4. demonstrate the characteristics curves of turbines
5. carry out discharge measurements in open channel

CELR14 BUILDING PLANNING AND DRAWING

Course Learning Objectives

1. To understand the principles of planning and bylaws
2. To draw plan, elevation and section of public and industrial load bearing and framed structures
3. To draw plan, elevation and section of public and industrial structures
4. To prepare detailed working drawing for doors, windows, etc.

Course Content

Classification of buildings -Principles of planning -Dimensions of buildings -Building bye-laws for floor area ratio, open spaces -Orientation of buildings -Lighting and Ventilation-Planning and preparing sketches and working drawings of Residential buildings (Flat and sloping roof), Schools, Hostels, Hospitals, Single-storey factory buildings with trusses. Detailed working drawings of the component parts -Doors and Windows -Roof Trusses -Staircases-Toilets

References

1. *Shah M.G. Kalec. M. & Patki SY Building Drawing, Tata Mcgraw Hill, New Delhi, 2000*

Course outcomes

On completion of the course, the students will be able to:

1. apply the principles of planning and bylaws used for building planning
2. draw plan, elevation and section for various structures

CELR15 GEOTECHNICAL ENGINEERING LABORATORY

Course Learning Objectives

1. To estimate index properties of soils (coarse and fine)
2. To estimate consistency limit of fine grained soils
3. To estimate shear strength of soils by direct shear test, triaxial shear test, vane shear test & unconfined compressive test
4. To estimate the engineering properties of the soils by density test, CBR test permeability test and consolidation test

Course content

1. Grain Size analysis.
2. Consistency limits
3. Specific gravity.
4. Permeability tests
5. Unconfined compression test.
6. Direct shear test.
7. Core cutter and sand replacement
8. Compaction test
9. California bearing ratio test
10. Vane shear test.
11. Tri-axial test
12. Consolidation test

Course outcomes

Upon completion of this course, the students will be able to

1. Proper soil classification and comments its suitability construction
2. Estimate soil consistency and compaction characteristics
3. Estimate soil design parameter for strength estimation
4. Proper interpretation among the estimated soil design parameters

CELR16 ENVIRONMENTAL ENGINEERING LABORATORY

Course Learning Objectives

1. To analyze the physical and chemical characteristics of water and wastewater
2. To quantify the chemical requirement for turbidity removal
3. To familiarize the methods to estimate the organic strength of wastewater
4. To study the growth of microorganisms and its quantification

Course Content

Physical characteristics of water –turbidity, suspended solids. Chemical characteristics of water– pH, hardness, alkalinity, chlorides, sulphates, iron, residual chlorine, total solids, dissolved solids, organic and inorganic solids, DO, BOD, COD. Optimum coagulant dose-Bacteriological tests – Microscopic tests.

Course Outcomes

On completion of the course, the students will be able to

1. apply different analysis techniques for the measurement of physical and chemical parameters of wastewater
2. quantify the pollutant concentration in water and wastewater
3. recommend the degree of treatment required for the water and wastewater
4. assess the microbial contamination in water

CELR17 TRANSPORTATION ENGINEERING LABORATORY

Course Learning Objectives

1. To organize traffic surveys
2. To collect wide variety of traffic data
3. To conduct standard tests on aggregate and bitumen
4. To do mix design for GSB
5. To carry out design of bituminous mixes

Course Content

Traffic Surveys

1. Volume count
2. Intersection turning movements
3. Speed study
4. Speed and delay study
5. Moving observer survey
6. Parking study

Tests on aggregate

7. Shape Test - Flakiness and Elongation Index
8. Los Angeles Abrasion Test

Tests on bitumen

9. Specific Gravity
10. Penetration Grade
11. Softening Point
12. Ductility Value
13. Flash and Fire Point
14. Viscosity Value

Mix design

15. Granular Sub-base
16. Bituminous Layer

References

1. *Khanna, S. K., Justo, C. E. G. and Veeraragavan A., Highway Engineering, Nem Chand and Bros, Roorkee, 2014.*
2. *Kadiyali, L. R., and Lal, N. B., Principles and Practices of Highway Engineering, Khanna Publishers, 2008.*
3. *Kadyali, L.R., Traffic Engineering and Transport Planning, Khanna Publication, Delhi, 2011.*
4. *Relevant IRC Codes of Practices*
5. *Ministry of Road Transport and Highways, Specifications for Road and Bridge Works, Indian Roads Congress 2004*

Course Outcomes

Upon completion of this course, the students should be able to:

1. conduct various traffic surveys
2. collect traffic data
3. perform laboratory tests on aggregate and bitumen
4. conduct mix design for GSB
5. carry out mix design for Bituminous mixes

CELR18 COMPUTATIONAL LABORATORY

Course Learning Objectives

1. To learn the software developing skills for structural design.
2. To understand the computing techniques in the field of transportation.
3. To gain knowledge in problem solving in water resources.
4. To learn the software skills in structural engineering, transportation engineering, water resources engineering, geotechnical engineering and GIS and Remote Sensing, construction management and project scheduling

Course Content

Usage of commercially established software for

1) Design of the structural elements in concrete and steel.
2) Transportation Engineering problems: Highway geometrics, pavement design.
3) Geotechnical Engineering problems: Earth pressure, Foundation settlement and stress analysis, Consolidation.
4) Problems in Environmental and Water resources engineering: Treatment systems, Pipe networks analysis, Synthetic Unit hydrograph derivation, Flood routing, Water balance model.
5) Problems in BIM, construction management and scheduling for PERT and CPM
6) GIS and Remote sensing applications

References

1. *Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India, New Delhi, 2001.*
2. *Manickaselvam V.K., Elements of Matrix and Stability Analysis of Structures, Khanna Publishers, New Delhi, 1998.*

Course outcomes

1. Apply the software skills in the transportation engineering, water resources and environmental engineering.
2. Apply computing skills to geotechnical engineering.
3. Apply computing skills to structural engineering
4. Apply computing skills to construction management and project scheduling

(V) ADVANCED LEVEL COURSES FOR B.Tech. (HONOURS)

CEHO10 BASIC STRUCTURAL DYNAMICS

Course Learning Objectives

1. To introduce the concepts of dynamic systems
2. To study the dynamic response of SDOF
3. To study the dynamic response of MDOF
4. To introduce the continuous systems subjected to different types of dynamic loads
5. To learn free and forced vibrations response of structural systems

Course Content

Dynamic analysis - Elements of vibratory systems and simple Harmonic Motion- Mathematical models of SDOF systems - Principle of Virtual displacements - Evaluation of damping resonance.

Fourier series expression for loading - (blast or earthquake) - Duhamel's integral - Numerical evaluation - Expression for generalized system properties - vibration analysis Rayleigh's method - Rayleigh - Ritz method.

Differential equation of motion - Beam flexure including shear deformation and rotatory inertia - Vibration analysis using finite element method for beams and frames

Evaluation of structural property matrices - Natural vibration - Solution of the eigen value problem - Iteration due to Holzer and Stodola

Idealization of multi-storeyed frames - analysis to blast loading - Deterministic analysis of earthquake response - lumped SDOF system - Design of earthquake resistant structures.

References

1. *Mario Paz, Structural Dynamics, CBS, Publishers, 1987.*
2. *Roy R Craig, Jr., Structural Dynamics, John Wiley & Sons, 1981.*
3. *Chpora A.K. "Dynamics of Structures Theory and Application to Earthquake Engineering" Pearson Education, 2001.*

Course outcomes

On completion of the course, the students will be able to:

1. apply the concepts of dynamic systems
2. identify, formulate and solve dynamic response of SDOF
3. identify, formulate and solve dynamic response of MDOF
4. analyze continuous systems subjected to different types of dynamic loads
5. identify, formulate and solve free and forced vibrations response of structural systems

CEHO11 BASICS OF FINITE ELEMENT METHODS

Course Learning Objectives

1. To study the strain – displacement and linear constitutive relation
2. To understand the numerical techniques applied in FEM

3. Establishment of element stiffness and load vector
4. To study about the 2-D isoparametric concepts
5. To analyze the 2-D frame elements using FEM techniques

Course Content

Differential equilibrium equations - strain displacement relation - linear constitutive relation - special cases - Principle of stationary potential energy - application to finite element methods - Some numerical techniques in finite element Analysis

Displacement models - convergence requirements. Natural coordinate systems - Shape function. Interpolation function. Linear and quadratic elements - Lagrange & Serendipity elements. Strain displacement matrix - element stiffness matrix and nodal load vector

Two dimensional isoparametric elements - Four noded quadrilateral elements - triangular elements. Computation of stiffness matrix for isoparametric elements - numerical integration (Gauss quadrature) Convergence criteria for isoparametric elements.

Assemblage of elements – Direct stiffness method. Special characteristics of stiffness matrix - Boundary condition & reaction - Gauss elimination and LDLT decomposition. Basic steps in finite element analysis.

Analysis of framed Structures: 2D – truss element - 2D - beam element. Analysis of plate bending- displacement functions - plate bending Elements. Plane stress and plane strain analysis: Triangular elements - Rectangular elements

References

1. *Krishnamoorthy, C.S, Finite Element Analysis Theory & Programming, McGraw- Hill, 1995.*
2. *Desai C.S and Abel, J.F., Introduction to the finite element Method, Affiliated East west Press Pvt. Ltd. New Delhi 2000.*

Course outcomes

On completion of the course, the students will be able to:

1. demonstrate the differential equilibrium equations and their relationship
2. apply numerical methods to FEM
3. demonstrate the displacement models and load vectors
4. compute the stiffness matrix for isoperimetric elements
5. analyze plane stress and plane strain problems

CEHO12 ELEMENTARY THEORY OF ELASTICITY AND INTRODUCTION TO PLASTICITY

Course Learning Objectives

1. To understand the basic concepts of deformation and strains
2. To know about the 3D stress and strain transformation
3. To know about equations and solution methods in cartesian and polar problems in theory of elasticity.
4. To know the theory of torsion of non-circular sections.
5. To study introduction to plasticity.

Course content

Basic concepts of deformation of bodies - Notations of stress and strain in 3D field- Transformation of stress and strain in a 3D field.- Equilibrium equations in 2D and 3D Cartesian coordinates.

Plane stress and plane strain problems- 2D problems in Cartesian coordinates as applied to beam bending using Airy's stress function

Problems in 2D -Polar coordinate- Equations of equilibrium and compatibility- Curved beam bending- stress concentration in holes-Semi-infinite solid subjected to different types of loads.

Torsion of non-circular sections- St. Venant's theory – Torsion different cross sections - Prandtl's membrane analogy - Torsion of rolled profiles-Torsion of thin walled tubes

Plasticity – Introduction - Plastic stress strain relations - Different hardening rules - Yield criteria for metals - Graphical representation of yield criteria - Application to thin and thick cylinders under internal pressure.

References

1. *Timoshenko and Goodier : Theory of Elasticity and Plasticity, McGraw-Hill, 2006*
2. *Mohammed Amin : Computation Elasticity, Narosa Publications,2005*
3. *Chen and Han : Plasticity for Structural Engineers, Springer Verlag,1998.*
4. *K. Bhaskar, T.K. Varadan: Theory of Isotropic/Orthotropic Elasticity, An Introductory Primer, Anne Books Pvt. Ltd. 2009*

Course outcomes

On completion of the course, the students will be able to:

1. Understand the concept of deformations and strains
2. understand 3D stress and strain transformations
3. analyse problems in 2D cartesian and polar elasticity problems.
4. analyse torsion problems in non-circular sections.
5. have the basics of plasticity analysis.

CEHO13 NONLINEAR ANALYSIS OF STRUCTURES

Course Learning Objective

1. To understand the factors influencing nonlinear response of structures
2. To study about the elastic and plastic analysis of structures
3. To learn the various techniques on nonlinear analysis of structures
4. To provide the knowledge on solution techniques

Course content

Introduction – Factors influencing nonlinear response of structures – Geometrical effect, Material effects, Instability phenomena – Snap through, Bifurcation, Post buckling behaviour

Elastic-Plastic analysis of trusses – Elastic-Plastic analysis of beams – Elastic-Plastic analysis of frames

Geometrically nonlinear static analysis of trusses – Member force-deformation relationships – Member tangent stiffness matrices – System equilibrium equations

Solution techniques - static analysis – Linearized incremental procedures – Iterative techniques – Detection of instability

Geometrically nonlinear static analysis of frames – Large rotations – Analysis of individual members – Member tangent stiffness matrices – Solution techniques

References

1.Fertis, D.G, Non-linear Mechanics,CRC Press,1999.

2.Reddy.J.N, Non-linear Finite Element Analysis, Oxford University Press, 2008.

3.Sathyamoorthy.M, Nonlinear Analysis of Structures,CRC Press,2010.

4. Nonlinear Structures, Majid, K.I., John Wiley and Sons, Inc., New York, 1972

Course outcomes

At the end of the course student will be able

1. Identify the factors affect the nonlinear response of structures
2. Analyze the elastic-plastic properties of trusses, beams and frames
3. Carry out various methods on analysis of nonlinear response of structure
4. Apply the solution techniques for nonlinear static analysis of frames and members

CEHO14 THEORY OF PLATES AND INTRODUCTION TO SHELLS

Course Learning Objectives

1. To understand the assumptions in thin plate analysis
2. To understand the methods of analysis of rectangular plates by Navier's and Levy's method.
3. To study axi-symmetric bending of circular plates.
4. To know the problems of orthotropic and moderately thick plates.
5. to understand the classifcation and behaviour of shells

Course content

Thin Plates with small deflection. Laterally loaded thin plates, governing differential equation, various boundary conditions.

Rectangular plates. Simply supported rectangular plates, Navier solution and Levy's method, Rectangular plates with various edge conditions

Axi-symmetric deflections of circular plates.

Analysis of orthotropic plates and moderately thick plates.

Different types of Classification of shells. Structural action of shells.Membrane stresses for cylindrical and conical shells.

References

1. *Timoshenko, S. and Krieger S.W. "Theory of Plates and Shells", McGraw Hill Book Company, New York, 1990.*
2. *K. Chandrasekhara. "Theory of Plates", Universities Press,2001*
3. *Szilard, R., "Theory and Analysis of Plates", Prentice Hall Inc., 1995.*

Course outcomes

On completion of the course, the students will be able to:

1. understand the basic assmuptions in thin plate analysis.
2. understand the different method like Navier's and Levy's methods for rectangular plates.
3. analyse circular plates subjected to different types of axi-symmetric loads..
4. Analyse orthotropic and moderately thick plates
5. understand the classiication and behaviour of shells.

CEHO15 THEORY OF TRAFFIC FLOW

Course Learning Objectives

1. To be introduced to traffic flow theory.
2. To study macroscopic modelling
3. To learn microscopic modelling
4. To study car following models
5. To learn the fundamentals of ITS.

Course Content

Traffic stream parameters - Fundamental diagram of volume-speed-density surface. Counting and Interval Probability distributions. Gap acceptance concepts and their application.

Macroscopic models - Heat flow and fluid flow analogies - Shock waves and bottleneck control approach.

Microscopic models - Application of queuing theory - Queue discipline - Waiting time in single channel queues and extension to multiple channels.

Linear and non-linear car following models - Determination of car following variables - Acceleration noise.

Intelligent Transportation Systems - Area Traffic Control – Automatic Toll Collection – Smart Cards – Collision Detection System.

References

1. *Drew, D.R., Traffic Flow Theory and Control, McGraw Hill., 1978.*
2. *TRB, Traffic Flow Theory - A Monograph, SR165, 1975.*
3. *Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, Oxford Publication, 2004.*
4. *Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.*

Course Outcomes

Upon completion of this course, the student will be able to:

1. analyze the traffic stream parameters
2. demonstrate fluid flow modeling
3. apply the queuing theory
4. implement car following models
5. define the significance of ITS under Indian conditions.

CEHO16 PAVEMENT CONSTRUCTION AND MANAGEMENT

Course Learning Objectives

1. To learn the concept of flexible pavement construction
2. To learn the concept of flexible pavement construction
3. To study about the stabilization, recycling and use of geosynthetics
4. To study the structural and functions failure
5. To understand the concept of Pavement Management System

Course Content

Flexible Pavement Construction: Earthwork, compaction and construction of embankments, specifications of materials, construction methods and field control checks for various types of flexible pavement materials in sub-base, base, binder and surface course layers and their choice.

Cement Concrete Pavement Layers: Specifications and method of cement concrete pavement construction; Construction of interlocking block pavements, Quality control tests; Construction of various types of joints.

Soil Stabilized Pavement Layers: Principles of gradation/proportioning of soil-aggregate mixes and compaction; mechanical, soil-cement, soil-bitumen and soil-lime stabilisation methods. Use of additives, Numerical problems on mix design and applications. Design and construction of surface and sub-surface drainage system for highways and airports, Recycling Techniques in Bituminous Pavements, Use of Geosynthetics in Highway Construction

Pavement Evaluation - Pavement Distress - Functional and structural condition of pavements, Pavement distress survey, Functional condition evaluation of pavements- Roughness, Skid Resistance. Structural evaluation of pavements - non-destructive testing, Benkelman beam and Falling Weight Deflectometer, Pavement strengthening based on deflection as per IRC, Maintenance and rehabilitation techniques.

Pavement Management Systems - Pavement Management Systems- Components, structure, data requirements, Project level and Network level needs, Pavement performance prediction – concepts, modelling techniques, Budget forecasting for maintenance and rehabilitation, Ranking and optimization methodologies, life cycle costing

References

1. *W.Ronald Hudson, Ralph Haas and Zeniswki , Modern Pavement Management, Mc Graw Hill and Co*
2. *Yang H. Huang, Pavement Analysis and Design, Pearson Prentice Hall, 2004.*
3. *Yoder and Witzech, Pavement Design, McGraw-Hill, 1982.*

Course Outcomes

Upon completion of this course, the student will be able to:

1. carry out the construction of flexible pavements
2. carry out the construction of rigid pavements and joints
3. use different stabilization methods, recycling techniques and geosynthetics
4. evaluate of the pavements based on the functional and structural characteristics

5. do develop pavement management systems

CEHO17 SOIL DYNAMICS AND MACHINE FOUNDATIONS

Course Learning Objectives

1. To explain the significance of dynamic load in machine foundation analysis
2. To explain theory of vibration for different field conditions
3. To explain the principles of machine foundation design for reciprocating and impact machines
4. To explain the concept and method of foundation isolation

Course content

Introduction - nature of dynamic loads - stress conditions on soil elements under earthquake loading - dynamic loads imposed by simple crank mechanism - type of machine foundations - special considerations for design of machine foundations.

Theory of vibration: general definitions - properties of harmonic motion - free vibrations of a mass- spring system - free vibrations with viscous damping - forced vibrations with viscous damping - frequency dependent exciting force - systems under transient forces - Raleigh's method - logarithmic decrement - determination of viscous damping - principle of vibration measuring instruments - systems with two degrees of freedom.

Criteria for a satisfactory machine foundation - permissible amplitude of vibration for different type of machines - methods of analysis of machine foundations - methods based on linear elastic weightless springs - methods based on linear theory of elasticity (elastic half space theory) - methods based on semi graphical approach - degrees of freedom of a block foundation - definition of soil spring constants - nature of damping - geometric and internal damping - determination of soil constants – methods of determination of soil constants in laboratory and field based on IS code provisions.

Vertical, sliding, rocking and yawing vibrations of a block foundation - simultaneous rocking, sliding and vertical vibrations of a block foundation - foundation of reciprocating machines - design criteria - calculation of induced forces and moments - multi-cylinder engines - numerical example (IS code method).

Foundations subjected to impact loads - design criteria - analysis of vertical vibrations - computation of dynamic forces - design of hammer foundations (IS code method) - vibration isolation - active and passive isolation - transmissibility - methods of isolation in machine foundations.

References

1. *Shamsher Prakash, Soil Dynamics, McGraw-Hill, 1981.*
2. *Alexander Major, Dynamics in Soil Engineering, A kademiai, 1980.*
3. *Sreenivasalu and Varadarajan, Handbook of Machine Foundations, Tata McGraw-Hill, 2007.*
4. *IS 2974 - Part I and II, Design Considerations for Machine Foundations*
5. *IS 5249: Method of Test for Determination of Dynamic Properties of Soils*

Course outcomes

Upon completion of this course, the students will be able to

1. Understand the influence of dynamic load in the machine foundation analysis and design
2. Use vibration theory in soil dynamics and ascertain soil behaviour accordingly
3. Do machine foundation analysis and design for reciprocating and impact machines
4. Understand foundation isolation and its significance in machine foundation

CEHO18 NUMERICAL MODELLING IN GEOTECHNICAL ENGINEERING

Course Learning Objectives

1. To explain modelling of soil behaviour considering field aspects
2. To explain constitutive relations in soil modelling
3. To explain material modelling with respect to soil behaviour
4. To give an exposure to numerical methods in geotechnical problems
5. To give hand on experience using geotechnical software

Course content

Modelling of Soil Behaviour: Critical state theory; stress paths within and on the state boundary surface; shear strength of clays related to the critical state concept.

Basic Concept of Continuum Mechanics: Notations; stresses and strains in three dimensions; equations of equilibrium, geometric conditions and constitutive relations.

Material modelling: Elastic models; perfect plasticity models-Coulomb model-Drucker-Prager model; Hardening plasticity models; generalized stress-strain relations and stiffness formulations; cap model in isotropic consolidation test and triaxial shear test; simulation of pore pressure; case studies on implementing the models.

Finite element modelling: Introduction to numerical methods - FEM, FDM, BEM; FEM for 1D and 2D problems; FEM for non-linear problems.

Application of Finite element modelling: Effective stress analysis, seepage and consolidation problems; practical aspects related to foundations, embankments and retaining structures; application examples-use of ABAQUS, PLAXIS, FLAC, MIDAS_GTS programs etc.

References

1. *Chen, W. F. and Mizuno, E., Nonlinear analysis in Soil Mechanics: theory and Implementation, Elsevier science publishers, 1990*
2. *Fethi Azizi, Applied Analyses in Geotechnics, E andN Spon of Taylor and Francis group, 2000*
3. *Desai, C. S., Elementary Finite Element Method, Prentice-Hall, 1979.*
4. *Owen, D. R. J., Hinton, E, Finite Element in Plasticity: Theory and Practice, Pineridge Press Limited, 1980*
5. *Helwany, S, Applied Soil Mechanics with ABAQUS Applications, John Wiley and Sons, 2007.*
6. *Lewis, R. W.,Schrefler, B. A., The Finite Element Method in the Deformation and Consolidation of Porous Media, John Wiley and Sons, 1984*
7. *Zienkiewicz, O. C., Chan, A. H. C., Paster, M., Schrefler, B. A., Shiomi, T., Computational Geomechanics with special reference to earthquake engineering, John Wiley and Sons, 1999.*

Course outcomes

Upon completion of this course, the students will be able to

1. Do proper soil modeling with respect to the soil behaviour
2. Understand the constitute relations
3. Select proper material modeling for the FE analysis
4. Use geotechnical software like PLAXIS, FLAC etc.

CEHO19 PHYSICOCHEMICAL METHODS FOR WATER AND WASTEWATER TREATMENT

Course Learning Objectives

1. To learn the physical, chemical and biological characteristics of water and wastewater.
2. To provide an understanding of various physicochemical methods for treatment of water and wastewater.
3. To explain the limitations, advantages and disadvantages of each unit operations and processes.
4. To study the principle and design of the physical and chemical treatment units used for the removal of undesirable constituents (contaminants) from water and wastewater

Course Content

Water and wastewater quality-Physical, chemical and biological parameters - Water Quality requirement-Water quality indices- wastewater discharge standards. Water and wastewater treatment systems: Physical unit operations -chemical unit processes. Aeration and gas transfer- two film theory. Sedimentation: Settling - Types- design. Coagulation and flocculation: Mixing - coagulation processes-stability of colloids- destabilization of colloids- -transport of colloidal particles- flocculation – types- design. Filtration processes- slow sand filtration- rapid sand filter; mechanism of filtration; modes of operation and operational problems. Adsorption: types- adsorption mechanism- adsorption isotherms- kinetics. Disinfection: kinetics- reactions- practices of water chlorination. Ion Exchange, Membrane Processes: Ultrafiltration- Reverse osmosis- Electrodyalisis.

References

1. *Weber, W.J. Physicochemical processes for water quality control, John Wiley and sons, Newyork, 1983.*
2. *Peavy, H.S., Rowe, D.R., Tchobanoglous, G. Environmental Engineering, McGraw Hills, New York 1985.*
3. *Metcalf and Eddy, Wastewater engineering, Treatment and Reuse, Tata McGraw-Hill, New Delhi, 2003.*

Course outcomes

At the end of the course student will be able

1. to evaluate various physical and chemical treatment options for treatment of water and wastewater
2. to explain the mechanism behind the treatment processes and their advantages and disadvantages
3. to design various physico- chemical units for the treatment of water and wastewater

4. to use the modelling concepts in the real field applications

CEHO20 BIOLOGICAL TREATMENT OF WASTEWATER

Course Learning Objectives

1. To learn the fundamentals of process kinetics and bioreactors
2. To study about various biological treatment processes and its operations for the wastewater treatment.
3. To provide the knowledge about the kinetics of biological growth and its application in the design of biological reactors
4. To explain the design principles and operational problems involved in various biological treatment processes

Course Content

Constituents of wastewaters-Sources-Fundamentals of Process Kinetics- Enzyme reactions. Bio reactors- types, Classification, design principles. Design of wastewater treatment systems-Primary, secondary and tertiary treatments- Evaluation of Biokinetic Parameters -Activated Sludge and its process- types- Biological Nitrification and denitrification. Attached Growth Biological Treatment Systems-Trickling Filters- Rotating Biological Contactors. Waste stabilization ponds and Lagoons: Aerobic pond, facultative pond, anaerobic ponds- polishing ponds, aerated Lagoons. Anaerobic processes-Process fundamentals-Standard, high rate and hybrid reactors, Anaerobic filters-Expanded /fluidized bed reactors-Up flow anaerobic sludge blanket reactors, - Expanded granular bed reactors- Two stage/phase anaerobic reactors- Sludge Digestion, Sludge disposal.

References

1. *Benefield, L.D. and Randall C.W. Biological Processes Design for wastewaters, Prentice-Hall, Inc. Eaglewood Cliffs, 1982.*
2. *Grady Jr. C.P.L and Lin H.C. Biological wastewater treatment: Theory and Applications, Marcel Dekker, Inc New York, 1980.*
3. *Metcalf & Eddy, Inc. Wastewater Engineering, Treatment and Reuse. 3rd Edition, Tata McGraw-Hill, New Delhi, 2003.*

Course outcomes

At the end of the course student will be able to

1. describe the range of conventional and advanced biological treatment processes for the treatment of bulk organics, nutrients and micro pollutants.
2. design the biological reactors based on biokinetics
3. select appropriate processes for specific applications, and have some knowledge of practical design considerations.
4. execute and assess the performance of bioreactors in laboratory scale

CEHO21 FREE SURFACE FLOW

Course Learning Objectives

1. To understand the behaviour free surface flow conditions under varying depths of flow in open channel
2. To analyse the inland navigation behaviour in water ways
3. To design suitable channel sections by understanding the river behaviour

4. To describe the steady and unsteady flows in open channels

Course content

Derivation of the general one-dimensional equations of continuity, momentum and energy used in open channel flow analysis.

Steady non-uniform flows, channel transitions and controls, hydraulic jumps surges.

Surface profile for gradually varied flow.

Unsteady flow in open channels, method of characteristics, surge formation. Kinematics of waves, flood routing and overhead flow.

Inland navigation: Introduction, Various Requirements of Navigable Waterways, Various Measures Adopted for Achieving Navigability, India's Navigable Waterways.

River Engineering: Classification of Rivers, Causes of Meandering, The Aggrading type of River, Degrading type of River, Cutoffs, river Training, Types of Training Works.

References

1. *F.M. Henderson, Open Channel Flow, Macmillan publishing company.*
2. *Ven Te Chow, Open channel hydraulics, Mcgrawhill publishers, 2009*
3. *Irrigation Engineering and Hydraulic Structures – Santhosh Kumar Garg.*
4. *Irrigation and Water Power Engineering – DR. B.C. Punmia, Dr. Pande B.B. Lal.*

Course outcomes

1. Basis for understanding the open channel flows
2. Capable of designing different channel regimes due to hydraulic jump, surges and any kind of unsteady conditions.
3. Provides solutions for real time problems in river engineering
4. Able to determine the surface profile for steady and varying flows

CEHO22 COMPUTATIONAL FLUID DYNAMICS

Course Learning Objectives

1. To understand the basic concepts in turbulence modelling.
2. To provide fundamental knowledge on finite difference/ element and volume methods.
3. To describe the solution methodologies for discretized equations.
4. To develop models using structured and unstructured grids.

Course content

Derivation of flow governing equations; turbulence modeling; modeling approaches for multiphase flow; initial and boundary conditions; wellposedness.

Discretization of the governing equations using finite difference/volume/element methods; concepts of consistency, stability and convergence; template for the discretization of a generic unsteady transport equation.

Solution of discretized equations; direct methods; classical iterative methods; advanced methods for structured matrices; conjugate gradient techniques; multigrid methods.

Solution of coupled equations: methods for compressible flows; evaluation of pressure in incompressible flows; pressure-velocity coupling algorithms.

Structured and unstructured grids; structured grid generation; unstructured grid generation. Benchmarking; calibration.

References

1. *John Anderson, Computational Fluid Dynamics, McGraw-Hill Education, 1999*
2. *Pieter Wesseling, Principles of Computational Fluid Dynamics, Springer series, 2009*
3. *Anil W. Date, Introduction to Computational Fluid Dynamics, Cambridge, 2005*
4. *Charles Hisch, Numerical computation of internal and external flows, Elsevier, 2007*

Course outcomes

By the end of this course, the students will be able to

1. Develop knowledge on non linear problems
2. Improve knowledge on finite element, difference and volume methods.
3. Provide solution methodologies for real time problems.
4. Develop hydrological and hydrodynamic models.

CEHO23 WAVE HYDRODYNAMICS

Course Learning Objectives

1. To understand the basics of wave motion.
2. To study the different aspects of linear wave theory
3. To enhance the knowledge on wave transformation
4. To provide knowledge on various other wave theories and wave forces

Course Content

Conservation of mass, moment and Energy; Euler Equation – Bernoullis Equation. Potential and Stream function.

Linear wave theory: Governing Equation, Boundary Conditions and solutions, Dispersion relation, Constancy of wave period.

Wave celerity, water particle velocities, accelerations, displacements and pressures. Approximations for deep and shallow water conditions. Integral properties of waves: Mass flux, Energy and energy flux, Group speed, Momentum and momentum flux.

Shoaling, bottom friction and damping, refraction, reflection and diffraction. Wave Breaking: Type of breaking, Surf similarity parameter. Keulegan-Carpenter number, Ursell Parameter, Scattering parameter, Reynolds Number, Currents – Classification and Design criteria

Non breaking wave forces on slender structures – Morison equation; Diffraction theory, source distribution method. Introduction to non-linear wave theories-Strokes, Cnoidal and Solitary wave theory. Mass transport velocity, Introduction to Random and directional waves.

References

1. *Sarpkaya, T. and Isaacson, M., Mechanics of Wave Forces on Offshore Structures, Van Nostrand Reinhold Co., NewYork, 1981.*

2. *Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994.*
3. *Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, Inc., NewYork, 1978.*
4. *Shore Protection Manual Volume I and II, Coastal Engineering Research Centre, Dept. of the Army, US Army Corps of Engineers, Washington DC, 1984.*
5. *Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, New York, 1978.*

Course outcomes

On completion of the course, the students will be able to:

1. Derive the linear wave theory dispersion relationship.
2. Understand the complete details of wave parameters.
3. Understand the concept of wave transformation.
4. Compute wave forces on slender cylindrical members.

CEHO24 ADVANCED REMOTE SENSING

Course Learning Objectives

1. To learn the advanced concepts of Remote Sensing technology and Geographic Information System and its data types
2. To gain knowledge about the various classifiers and artificial intelligence tools adopted in geospatial techniques
3. To familiarize with the image interpretation technique and its applications.

Course content

Image interpretation and analysis of geological hazards: Optical (moderate and high resolution) and radar image interpretation for geological (lithological and tectonic), geomorphological, and terrain analysis, geological hazard interpretation and analysis; Image interpretation and analysis for hydro-meteorological hazards: Optical (moderate and high resolution) and radar image interpretation for flood and coastal hazard assessment (inundation, storm surge and erosion); Image interpretation and analysis of environmental hazards: Optical (moderate and high resolution) and radar image interpretation for land degradation, soil erosion, drought impact assessment, forest type and forest degradation mapping.

Ortho-image generation: 3-D mapping- case study, High-resolution image ortho-rectification (Cartosat- 1/ ALOS Prism, ASTER, SRTM) and image map generation, elements of risk and hazard-related feature mapping and database generation.

Advance Classifiers and feature extraction methods: Fuzzy, ANN and sub-pixel based classification methods, Automatic feature extraction methods (deterministic objects), Image segmentation and texture analysis of satellite images; Multivariate and Geostatistics - Random variables and distributions, ANOVA, Statistical Tests, Regression Analysis (Multiple and logistic regression), Trend surface analysis, correlation and PCA (with case examples), Regionalized variables, semivariogram, assessment of various estimation (using Kriging methods) and interpolation techniques.

Application of Geosciences in Civil Engineering, Plate Tectonics and Continental Drift, Seismology and the Internal Structure of the Earth, Geological Structures and Geological Hazards, Environmental impacts of Geological hazards, Active faults Mapping and Applications, Tsunami and related hazard, Landslide and Subsidence, Flood and related hazard, Impact over groundwater, soil erosion, draought; Civil Engineering applications – geological considerations in Rivers, Dams and Tunnels.

References

1. *Agarwal, C. S., Garg P. K., Remote Sensing in Natural Resources Monitoring and Management, A. H. Wheeler & Co. Ltd., New Delhi.*
2. *Gibson, P. J. Introductory Remote Sensing-Principles and Concepts, Taylor and Francis Press.*
3. *Gibson, P. J. and C.H. Power, Introductory Remote Sensing-Digital Image Processing and Application, Taylor and Francis Press.*
4. *Lillesand, T. M. and R.W. Kiefer, remote Sensing and Image Interpretation, Fourth Edition, John Wiley.*
5. *C.P. Lo, Albert K.W.Yeung, Concepts and Techniques of Geographic Information Systems, 2nd Edition, Prentice Hall, 2006.*
6. *Ramkumar, Mu, (2009) Geological Hazards: Causes, Consequences and Methods of Containment, New India Publishing Agency, New Delhi.*

Course outcomes

At the end of the course student will be able

1. To analyze the satellite imageries and process it effectively in various applications
2. To work on disaster and hazards in geospatial aspect
3. To carry out modelling using the advanced GIS and remote sensing tools
4. To execute and evaluate the real-time problems using advanced geospatial techniques.