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**SECOND SEMESTER 2020-21**  
**COURSE HANDOUT**

**Date: 18.1.2021**

In addition to part I (General Handout for all courses appended to the Time table) this portion gives further specific details regarding the course.

**Course No** : CE F429  
**Course Title** : Design of Foundation System  
**Instructor-in-Charge** : Ravi Kant Mittal

**1. Course Description:** Evaluation and interpretation of soil properties, dynamic properties of soil, geophysical and seismic methods, Stress in soil mass due to applied load, various methods of settlement analysis, static and dynamic bearing capacity of footings, bearing capacity of footings resting on layered soils and footing on or near slopes, tilt, rotation and horizontal displacement of foundations subjected to eccentric-inclined loads, seismic design of shallow foundations, analysis of raft foundations, circular and annular rafts, structural design of shallow foundations, pile foundations load capacity and settlements, various methods of analysis of laterally loaded Pile Foundations, piles subjected to dynamic loads, seismic design of pile foundations, structural design of pile foundations, static and dynamic earth pressure theories, stability analysis of retaining walls, reinforced earth wall design, machine foundations for reciprocating machines, impact type, rotary machines, IS code provisions on foundations, codal provisions on structural and earthquake resistant design of foundations.

**2. Scope and Objective of the Course:** The main goal of this course is to provide an in-depth understanding regarding analysis and design of foundations systems for buildings, bridges substructure, industrial complexes, ports, harbors, water tanks, storage tanks of industrial structure, transmission line towers etc. Complete design of foundation systems considering geotechnical as well structural (R.C.C.) design of foundation systems will be covered. Emphasis will be given on complete coverage of Indian code of practice for various type of foundation. Latest advancement and practices followed in design office as per International code and standards will be covered.

**3. Text Books:**

T1. Coduto, D.P., Kitch, W.A. and Yeung, M.Y. (2016) Foundation design: Principles and practices, 3<sup>rd</sup> edition, Pearson.

T2. Das B M and Luo Z (2017) Principles of Soil Dynamics, Cengage 3rd edition.

**4. Reference Books:**

R1. McCarthy (2015), Essentials of Soil Mech. And Foundation Engg. Pearson, 2015

R2. Saran, S. (2012), "Analysis and design of foundations and retaining structures subjected to seismic loads" I K Lee Publishers.

R3. Das B M (2016), "Principles of Foundation Engineering", Cengage 8th edition.

R4.Saran, S. (2006) "Analysis and design of sub-structures" 2nd ed., Oxford & IBH Publishing. New Delhi

R5. Relevant BIS codes and International code of practice



## 5. Course Plan:

Module	Lecture Session	No Lec.	Ref. to Ch.	Learning Outcome
Static and dynamic properties of soil	Index properties, shear strength and other engineering properties of soil, using laboratory and field tests. Evaluation and interpretation of various tests, selecting foundation design parameters from laboratory and field tests	2	2, 3,4 T1, 4,5 R1	Interpretation and application of index and engineering properties of soil
	Dynamic properties of soil, using laboratory and field tests. Selecting foundation design parameters from laboratory and field tests. Liquefaction of soil using field testing.	3	Ch4 T2,	Understanding and application of dynamic properties of soil
Stress in soil mass due to applied load, various methods of settlement analysis.	Stresses due to different type of applied loading, Boussinesq equations, Newmark chart, & Westergaard's equation.	2	6,7 T1	Stress in soil mass due to external loads
	2-D and 3-D consolidation, PVD, precompression, settlement calculations using lab and field tests	3	7, T1, IS8009,	settlement of shallow foundations and remedial measure
Bearing capacity of shallow foundations	Failure mechanism, generalized bearing capacity eqn, bearing capacity from lab and field tests, special cases for bearing capacity of footings resting on layered soils and footing on or near slopes	2	6 T1, IS6403, 6,7,R3	Computation of SAFE bearing capacity
	Seismic bearing capacity, settlement and displacement of shallow foundation during earthquake.	2	Ch14, R1, Ch6 T2, Class notes	Methods to compute seismic bearing capacity
Analysis of Shallow	Effect of load eccentricity and inclination due to wind,	3	6,7,8 T1, 7R3, NOTES	Computing displacements under



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Foundations subjected to lateral loads and moments	earthquake , pressure distribution, bearing capacity, tilt and settlement, Proportioning of footings subjected to combined vertical loads, biaxial moments and horizontal loads.			combined loads and proportioning foundation
Design of RCC foundation	Load combination, critical sections for shear and B.M., development length, detailing requirements, structural design of isolated footings	4	9 T1,2, 3R3, IS456	Structural design of shallow foundation
Raft foundations	Coefficient of subgrade reaction, Winkler model for footings and mat on elastic foundations. Optimum dimension, in annular rafts	3	10T1, 10,11,12,13 R3	Raft foundation analysis methods
Static and dynamic analysis of Pile Foundations	Types of Piles and their applications - Load capacity - Settlements - Group action	1	11 to17,T1, 8, R4, IS2911	Pile capacity
	Different methods for estimating Lateral load capacity of piles, seismic design consideration	3	16,T1, 7,R1,notes, IS2911	Laterally loaded Pile Foundations and seismic analysis
	RCC design of piles, detailing for driven and bored piles.	3	16, 17T1, 13T2, R4	Design of pile foundation
Analysis and design of foundations for different type of machines.	Types - General requirements and design criteria - General analysis of machine-foundations-soil system - Stiffness and damping parameters - Tests for design parameters -	1	Ch5, T2	Machine Foundations-Design parameters
	Analysis and design of block and frame foundations for reciprocating engines, impact type machines	3	Ch5T2	Learning design of foundations for different type of machines.
Earth pressure and retaining walls	static and dynamic earth pressure theories, stability analysis of retaining walls,	4	8 T2, IRC6-2017, IS1893-part3-2014	Analysis and design of different retaining walls



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	Geosynthetics and reinforced earth wall design,			
Earthquake resistant design of foundations	Liquefaction screening criteria, various methods to evaluate liquefaction potential, Anti-liquefaction measures, In-situ densification.	2	Ch10T2, Ch15 R1, IS1893-part1-2016, 10, T1	Evaluating Liquefaction potential, anti-liquefaction measures
	EQ resistant Foundation guidelines, Seismic soil structure interaction, codal provisions	2	Ch12 R1, IS codes and notes	Learning seismic design of foundation and SSI analysis
	Total	43		

**6. Evaluation Scheme:**

Component	Duration	Weightage (%)	Date & Time	Nature of component (Close Book/ Open Book)
Mid Sem. Test	90 min.	30%		OB
Class (or take home) Assignments/tute	During class	30%	Continuous	OB
Comprehensive Examination	120 min.	40%		OB

**7. Chamber Consultation Hour:** To be announced in the class.

**8. Notices:** Notices will be sent to your BITS email id only.

**9. Make-up Policy:** Make will be given for genuine cases only.

**10. Note (if any):** Reading assignments will be given as and when necessary.

**Instructor-in-charge**  
**Course No. CE F429**