Indian Institute of Technology, Kanpur

Proposal for a New Course

1. Course no: CE7**

2. Course Title: Critical state theory for soil

3. Per week lectures: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional Hours: 0 (A)

Credits: 3-0-0-0 **Duration of Course:** Full Semester

4. Proposing Department: Civil Engineering

Other Departments/IDPs which may be interested in the proposed course: None

Other faculty members interested in teaching the proposed course: Dr. Arghya Das

5. Proposing Instructor: Dr. Bipin Kumar Gupta

6. Course Description:

A) Objectives: The course modules will introduce topics on stress-strain analysis, stress paths, and shear strength of soils under the critical state framework. This course modules will also provide a basic understanding of a critical state soil model to interpret soil behaviour followed by an application. The course will include numerical exercises to evaluate the stress-strain response of soils under various drainage conditions, and application problems following the critical state framework.

B) Contents (preferably in the form of 5 to 10 broad titles)

S. no.	Broad title	Topics	No. Of lectures
1	Stress, Strains, and elastic deformations of soils	Stress and strains, Idealized stress-strain response and yielding, Hooke's law, Plane strain and Axisymmetric conditions, Stress and Strain states, Mohr's circle	02
2	Stress path in soils	Stress and strain invariant, stress paths	04
3	Shear strength of soils	Typical response of soils to shearing forces, Models for interpreting the shear strength of soils, practical implications of failure criteria, Interpretation of shear strength of soils, Laboratory tests to determine shear strength parameters	05
4	A critical state model to interpret soil behaviour	Basic concepts, Elements of the critical state model, Failure stress from the critical state model, Modifications of critical state model, Stiffness of soil, Strains from the critical state model, Calculated	10

		stress-strain response, Application of critical state model to cemented soils	
5	Application of critical state model	Shallow foundation analysis using critical state model	05
	Total no. of 1hr 15 min lectures		26

C) Pre-requisites, if any: CE252 and CE351

D) Short summary for including in the Courses of Study Booklet

Stress-strain analysis of soil; Plane Strain and Axisymmetric condition, Concept of Mohr's circle; Stress paths in soils; Typical response of soils to shearing forces; Models to interpret soil behaviour; Laboratory tests for strength parameters; Elements of critical state model, Stiffness of soil; Strains from critical state model; Stress-strain response from critical state model; Critical sate model application to cemented soils; Shallow foundation analysis using critical state framework

7. Recommended books:

Reference Books:

- Soil Mechanics and Foundations, Muni Budhu, Wiley India Edition
- Soil Mechanics: Concepts and Applications, William Powrie, CRC Press, 3rd Edition
- An Introduction to Geotechnical Engineering, Holtz, Kovacs, and Sheahan, Pearson, 2nd edition
- Applied analyses in Geotechnics, Fethi Azizi, Taylor and Francis group

8. Any other remarks: The course is developed for PG students with a background in soil mechanics and foundation design. UG students with a background in these courses can also register.

Dated: 10/04/2026 **Proposer** Dr. Bipin Kumar Gupta

Dated: **DPGC convener**

The course is approved / not approved

Chairman, SPGC

Dated: