NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF CIVIL ENGINEERING

COURSE PLAN – PART I			
Name of the programme and specialization	B.Tech – Civil Engineering		
Course Title	Theory of Elasticity and Introduction to Plasticity		
Course Code	CEHO12	**No. of Credits**	4
Course Code of Prerequisite subject(s)	CEPC11	**Semester**	V
Session	July 2022	**Section (if, applicable)**	A&B
Name of faculty	Raghavan R	**Department**	Civil Engineering
Email	raghavanr@nitt.edu	**Mobile No.**	9940449658
Name of course coordinator(s) (if applicable)			
E-mail	-	**Telephone No.**	-
Course Type	Honours course		

Syllabus (approved in Senate)

Basic concepts of deformation of bodies – deformation gradient- Tensor notations of stress and strain in 3D field - Traction - Engineering and Cauchy stress and Green-Lagrange Strains - Cauchy form of equilibrium equation - Transformation of stress and strain in a 3D field - Equilibrium equations in 2D and 3D Cartesian coordinates

Compatibility equations - Stresses: Principal, Octahedral, Hydrostatic and deviatoric - Derivation of Constitutive law - reduction to isotropic and uniaxial case

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 - stress concentration in holes - Circular disc subjected to diametral compressive loading - semi-infinite solid subjected to different types of loads. Thin and thick cylinders under internal pressure.

Torsion of sections - St. Venant's theory – Torsion of elliptical sections - Torsion of triangular sections - Prandtl's membrane analogy– Warping Torsion of rolled profiles - Torsion of thin-walled tubes

Plasticity – Introduction - Reasons of plasticity - slip lines - Plastic stress-strain relations - Flow rules (associated and non-associated) - Different hardening rules - Yield criteria for metals - Graphical representation of yield criteria.

COURSE OBJECTIVES

1. To learn about the concept of deformation, stress, strain and constitutive relations of solids
2. To understand practically useful stress definitions such as prihcipal, hydrostatic, octahedral etc
3. To know the usage of Airy Stress functions and solution to problems using the approach
4. To understand the behaviour of non-circular and open sections in torsion
5. To gain a basic introduction to the plastic behaviour in materials and application of failure theories of brittle and ductile materials

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
On completion of the course, the students will be able to:	
1. 1. Relate various stress and strain measures and perform transformation between different bases. 2. determine principal, hydrostatic and octahedral stresses for given stress state 3. obtain the solution to classical problems using the Airy stress function approach 4. analyse non-circular and open sections subjected to torsion 5. apply hardening rules in the plastic range and determine the failure of brittle and ductile materials using various failure theories.	1,2,3,5,6,11,12

COURSE PLAN – PART II

COURSE OVERVIEW

This course gives the students the knowledge about basic principles of deformations, strains, stresses and constitutive equations. Problems in elasticity such as 2D stress functions and torsion of non-circular bars are a part of the course. The final part of the course introduces students to plasticity concepts.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	Week 1	Introduction to the course	PPT
2	Week 2	Continuum mechanics and Elasrticity Introduction, Deformation Gradient	PPT
3	Week 3	Strain-Displacement relations, problems on deformation gradient and strains	PPT, C&T
4	Week 4	Principal strains, Compatibility equations, problems, traction vector	PPT, C&T
5	Week 5	Stresses, transformation matrices, problems, principal, hydrostatic, deviatoric and octahedral stresses, problems	PPT, C&T
6	Week 6	Various problems on stresses and strains	C&T
7	Week 7	Cauchy equilibrium equations, Generalised Hooke's law, Reduction to isotropic case, elastic constants, problems	C&T

8	Week 8	Plane stress and strain and problems, Stress functions – Airy and Maxwell stress functions, Simple problems using Airy Stress functions	C&T
9	Week 9	Cycle Test 1 Simple problems using Airy Stress functions, Stress concentration around holes	C&T
10	Week 10	Stress in thin pressure vessels, Torsion – Circular	C&T
11	Week 11	Torsion – non circular sections with warping (elliptical and rectangular), Torsion of open thin sections	C&T
12	Week 12	Torsion of closed thin sections, problems, Prandtl membrane analogy, Introduction to plasticity	C&T
13	Week 13	Plasticity forms and stress-strain relations, slip lines and flow rules, hardening rules	C&T
14	Week 14	Cycle Test 2 Various yield criteria for ductile and brittle materials, graphical representation, problems.	C&T

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Duration	Week/date	% Weightage
1	Cycle Test 1	75 mins	9	25
2	Cycle Test 2	75 mins	14	25
3	Assignments – 2 Nos	--	TBD	10
4	Final Assessment	3 hrs	17	40
Total				**100**

COURSE EXIT SURVEY

- Feedback from the students during class committee meetings
- Exit survey from the students at the end of the session

COURSE POLICY (including compensation assessment)

- 100% attendance is desirable and minimum 75% attendance is compulsory for attending the final examination.
- Closing date of attendance is week 14.
- Compensation assessment policy: Students who are absent in the cycle tests due to genuine medical reasons will be allowed to sit in a compensation assessment with proof of medical illness from NITT medical officer.

ATTENDANCE

- Every student should maintain a minimum attendance of 75% during the contact hours and assessment.
- A maximum of 10% shall be allowed under On Duty (OD) category.
- Students with less than 65% of attendance shall be prevented from writing the final semester

MODE OF CORRESPONDENCE (email/ phone etc)

- All the correspondence regarding the course will be communicated through webmail or intimated during class hours.
- Queries/ Clarifications (if necessary) may be e-mailed to raghavanr@nitt.edu or can be communicated directly during Institute working hours.

ACADEMIC HONESTY & PLAGIARISM

- Attending all the assessments is mandatory for every student.
- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

MINIMUM PASS MARKS

The passing and grading will be as per absolute grading

FOR APPROVAL

Raghavan R	Dr. R. Manjula	Dr. G. Swaminathan
Course Faculty	CC-Chairperson	HOD/Civil Engineering