SRI VIDYA COLLEGE OF ENGINEERING & TECHNOLOGY

COURSE PLAN (THEORY)

ACADEMIC YEAR: 2018-2019 (EVEN)

Subject Code	**CE8402**	**L**	**P**	**T**	**C**
Subject Title	**STRENGTH OF MATERIALS - II**	3	0	0	3
Year / Dept / Sem	**II / CIVIL / IV**	Regulation Year	2017		
Faculty Name / Design / Dept	Mr.S.KEERTHI PRIYAN / Assistant professor/ CIVIL				
Course Prerequisite	1. Well known about SFD & BMD concepts on beams. 2. Understood the concepts of stress, strain and shear on elements.				

CE8402 STRENGTH OF MATERIALS - II L T P C

3 0 0 3

OBJECTIVES:

- To know the method of finding slope and deflection of beams and trusses using energy theorems and to know the concept of analyzing indeterminate beam
- To estimate the load carrying capacity of columns, stresses due to unsymmetrical bending and various theories for failure of material.

UNIT I ENERGY PRINCIPLES 9

Strain energy and strain energy density – strain energy due to axial load (gradual, sudden and Impact loadings) , shear, flexure and torsion – castigliano's theorems – maxwell's reciprocal theorem - principle of virtual work – unit load method - application of energy theorems for Computing deflections in determinate beams , plane frames and plane trusses – lack of fit and Temperature effects - Williot Mohr's diagram.

UNIT II INDETERMINATE BEAMS 9

Concept of analysis - propped cantilever and fixed beams - fixed end moments and reactions – Sinking and rotation of supports - theorem of three moments – analysis of continuous beams – Shear force and bending moment diagrams.

UNIT III COLUMNS AND CYLINDERS 9

Euler's column theory – critical load for prismatic columns with different end conditions – effective length – limitations – Rankine -Gordon formula - eccentrically loaded columns – middle third rule - core of a section – thin cylindrical and spherical shells – stresses and change in dimensions thick cylinders – compound cylinders – shrinking on stresses.

UNIT IV STATE OF STRESS IN THREE DIMENSIONS 9

Stress tensor at a point – stress invariants - determination of principal stresses and principal planes - volumetric strain. Theories of failure: maximum principal stress theory – maximum principal strain theory – maximum shear stress theory – total strain energy theory – maximum distortion energy theory – application

problems.

UNIT V ADVANCED TOPICS 9

Unsymmetrical bending of beams of symmetrical and unsymmetrical sections – shear centre - curved beams – Winkler Bach formula – stresses in hooks.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Determine the strain energy and compute the deflection of determinate beams, frames and trusses using energy principles.
- Analyze propped cantilever, fixed beams and continuous beams using theorem of three Moment equation for external loadings and support settlements.
- Find the load carrying capacity of columns and stresses induced in columns and cylinders.
- Determine principal stresses and planes for an element in three dimensional state of stress And study various theories of failure
- Determine the stresses due to unsymmetrical bending of beams, locate the shear center, And find the stresses in curved beams.

TEXT BOOKS:

1. Rajput R.K. "Strength Of Materials (Mechanics Of Solids)", S.Chand & Company Ltd., New Delhi, 2015.

2. Rattan.S.S., "Strength Of Materials", Tata Mcgraw Hill Education Pvt. Ltd., New Delhi, 2011.

3. Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain,"Theory of Structures" (SMTS) Vol - II, Laxmi Publishing Pvt Ltd, New Delhi 2017.

4. Basavarajiah and Mahadevapa, Strength of Materials, University press, Hyderabad, 2016

REFERENCES:

1. Kazimi S.M.A, “Solid Mechanics”, Tata McGraw-Hill Publishing Co., New Delhi, 2003.

2. William A .Nash, “Theory and Problems of Strength of Materials”, Schaum’s Outline Series, Tata McGraw Hill Publishing company, 2007.

3. Singh. D.K., “ Strength of Materials”, Ane Books Pvt. Ltd., New Delhi, 2016

4. Egor P Popov, “Engineering Mechanics of Solids”, 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2012.

Course Objectives (CO)	CO1: To know the method of finding slope and deflection of beams and trusses using energy theorems and to know the concept of analysing indeterminate beam CO2: To estimate the load carrying capacity of columns, stresses due to unsymmetrical bending and various theories for failure of material. CO3: To analyse the support moments for continuous beams. CO4: To analyse the support moments for fixed beams.

	CO5: To analyse the support moments for Propped cantilever beams. CO6: To know about failure theories.
Expected Course Outcomes (ECO)	At the end of the course, the students should be able to: ECO1: Determine the strain energy and compute the deflection of determinate beams, frames and trusses using energy principles. ECO2: Analyze propped cantilever, fixed beams and continuous beams using theorem of three Moment equation for external loadings and support settlements. ECO3: Find the load carrying capacity of columns and stresses induced in columns and cylinders. ECO4: Determine principal stresses and planes for an element in three dimensional state of stress And study various theories of failure ECO5: Determine the stresses due to unsymmetrical bending of beams, locate the shear center, And find the stresses in curved beams. ECO6: Estimate the stresses in Curved beams.

Mapping of CO & PO(Specify the PO's) - ***(Fill the col.s with the legend given below)***

PROGRAM OUTCOMES (Pos)

Engineering graduates will be able to:

1. ENGINEERING KNOWIEDGE: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. PROBLEM ANALYSIS: identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principals of mathematics, natural sciences and engineering sciences.
3. DESIGN/ DEVELOPMENT OF SOLUTIONS: Design solutions for complex engineering problems and design systems components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural societal, and environmental considerations.
4. CONDUCT INVESTIGATIONS COMPLEX PROBLEMS: 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.
5. MODERN TOOL USAGE: Create, select, and apply appropriate techniques resources, and modern engineering and it tools including production and modeling to complex engineering activities with an understanding of the limitations.
6. THE ENGINEERING AND SOCIETY: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the

professional engineering practices.

7. ENVIRONMENT AND SUSTAINABLITY: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. ETHICS: Apply ethical principles and commit to professional and responsibilities and norms of the engineering practices.

9. INDIVIDUAL AND TEAM WORK: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary setting.

10.COMMUNICATION: Communicate effectively on complex engineering activities with the engineering community and with society at large such as being able to comprehend and write effectives reports and design documentations, make presentations, and give and receive clear instructions.

11.PROJECT MANGMENT AND FINANCE: Demonstrate knowledge and understanding of the engineering and management principals and apply these to ones own work as a member and leader in a team to manage project and in multidisciplinary environments.

12. LIFE LONG LEARNING: Recognize the need for, and have the preparations and ability to engage in independent and lifelong learning in the broadest context of technological change.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	2	3	2	1	1		1		1	11	3	
CO2		1	1	1	1		1					
CO3	2	3	2	1		1			1		3	
CO4	2	3	2	1	1	1	1			1	3	
CO5	2	3	2	1	1	1	1		1		3	
CO6	2	3	2	1	1	1	1				3	

Bridging the Curriculum Gap (Additional Topics beyond syllabus/Seminars/ Assignments)	BCG1: Find out the deflection of indeterminate beams such as propped cantilever beam BCG2: Find out the stresses developed in spherical shell structures. BCG3: Find out the redundant of truss structures
Related Website URLs	W1: courses.washington.edu/me354a/Unsym.pdf W2: www.slideshare.net/VenkateshCa/unsymmetrical-bendingppt W3: http://www.eurocode.us/design-of-steel-structures/info-qfg.html

	Course Name	**Coordinator & Institute**	**Website URL**
Related Video Course Materials (min.3 no.s)	Introduction About Strength of Material	Prof.S.K.Bhattacharya & IIT Kharagpur	https://www.youtube.com/watch?v=GkFgysZC4Vc

	Indeterminate Beams	Prof.P.Banerjee & IIT BOMBAY	https://www.youtube.com/watch?v=c0i5zevJytQ
	Stresses in Beams	Prof.S.K.Bhattacharya & IIT Kharagpur	https://www.youtube.com/watch?v=sP34uzn7diA
Text books	T1. Rajput R.K. "Strength Of Materials (Mechanics Of Solids)", S.Chand & Company Ltd., New Delhi, 2015. T2. Rattan.S.S., "Strength Of Materials", Tata Mcgraw Hill Education Pvt. Ltd., New Delhi, 2011. T3. Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain,"Theory of Structures" (SMTS) Vol - II, Laxmi Publishing Pvt Ltd, New Delhi 2017. T4. Basavarajiah and Mahadevapa, Strength of Materials, University press, Hyderabad, 2016		
Reference Books	R1. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 2003. R2. William A .Nash, "Theory and Problems of Strength of Materials", Schaum's Outline Series, Tata McGraw Hill Publishing company, 2007. R3. Singh. D.K., " Strength of Materials", Ane Books Pvt. Ltd., New Delhi, 2016 R4. Egor P Popov, "Engineering Mechanics of Solids", 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2012.		

S.No	Topic Name	Book	Page no	Mode of delivery	No of hrs	Cumulative hrs
UNIT I- ENERGY PRINCIPLES						
1	Introduction about the strain energy and strain energy density	T1	861-862	Class room Teaching	1	1
2	Strain energy due to axial load, (gradual, sudden and impact loadings) shear, flexure and torsion	T1	862-889	Class room Teaching	2	3
3	Castigliano"s theorem	T1	900-916	Class room Teaching	2	5
4	Maxwell reciprocal theorem- Principle of Virtual work -	T1	916-918	Class room Teaching	3	8

	unit load method					
5	Application of energy theorems for computing deflections in determinate beams, plane frames and plane trusses	T1	896 - 900	Class room Teaching	2	10
6	Wiliot Mohr's Diagram lack of fit and temperature effects	**T1**	**852**	Class room Teaching	2	12
UNIT II- INDETERMINATE BEAMS						
1	Introduction about Indeterminate Beams-Concept of analysis	T1	529-530	Class room Teaching	2	14
2	Propped Cantilever and Fixed Beams	T1	492-506&530-538	Class room Teaching	2	16
3	Fixed end moments and reactions	T1	538-559	Class room Teaching	2	18
4	sinking and rotation of supports	T1	553- 560	Class room Teaching	2	20
5	Theorem of three moments	T1	560-572	Class room Teaching	2	22
6	Analysis of continuous Beams & Shear force and Bending Moment Diagrams	T1	560-572	Class room Teaching	2	24
UNIT III- COLUMNS AND CYLINDER						
1	Introduction to Column & Cylinder – Euler"s column theory - Effective length	T1	928 – 930	Class room Teaching	2	26
2	Critical loads for prismatic columns with different end conditions - limitations	T1	930 - 942	Class room Teaching	2	28
3	Rankine - Gordon formula	T1	943-962	Class room Teaching	1	30
4	Eccentrically loaded columns Middle third rule – core of a section	T1	962-966	Class room Teaching	2	32

5	Thin cylindrical and spherical shells – stresses and change in dimensions	T1	589 - 611	Class room Teaching	2	34
6	Thick cylinders - Compound cylinders - shrinking on stresses.	T1	624-659	Class room Teaching	2	36
UNIT IV- STATE OF STRESS IN THREE DIMENSIONS						
1	Introduction to Principle stress in three dimension - Stress tensor at a point – Stress invariants	T1	91 - 96	Class room Teaching	1	37
2	Determination of principal stresses and principal planes - Volumetric strain	T1	91 - 96	Class room Teaching	2	39
3	Theories of failure: Maximum Principal stress theory –	T1	1104 - 1106	Class room Teaching	2	41
4	Maximum shear stress theory	T1	1106 - 1108	Class room Teaching	2	43
5	Maximum Principal strain theory - Total Strain energy theory – Maximum distortion energy theory	T1	1108 -1113	Class room Teaching	2	45
6	Application problems.	T1	1121 - 1126	Class room Teaching	2	47
UNIT V - ADVANCED TOPICS						
1	Introduction to Advanced topics in bending of beams	T1	1222	Class room Teaching	2	49
2	Unsymmetrical bending of beams of symmetrical sections	T1	1223-1234	Class room Teaching	2	51
3	Unsymmetrical bending of beams of unsymmetrical sections	T1	1223-1234	Class room Teaching	2	53
4	Shear Centre	T1	1234-1244	Class room Teaching	2	55
5	Curved beams - Winkler Bach formula - stresses in hooks	T1	1163-1206	Class room Teaching	2	57

	Prepared by	***Approved by***
Signature		
Name	Mr.S.KEERTHIPRIYAN M.E.,	Dr.P.GANESAN
Designation	Assistant Professor / CIVIL	HOD / CIVIL
Signed date		

LEGEND:

METHODOLOGY TO MAP OBJECTIVE WITH OUTCOME

Course outcomes are achieved through

- **a.** Suitable Analogies.
- **b.** Class room Teaching.
- **c.** Assignments.
- **d.** Tutorials
- **e.** Weekly, monthly and model exams.
- **f.** Brain storming.
- **g.** Group discussion and role play.
- **h.** Seminars