Lesson Plan- CE1022- COMPUTER AIDED STRUCTURAL ANALYSIS (CASA)

Academic year 2015-16

(Semester commencing in January 2016)

Instructional objectives no.	Instructional objectives (IO)
1	Preparation of influence line diagrams for continuous beams and propped cantilevers
2	Analysis of arches and suspension cables
3	Plastic theory and its application in analysis of indeterminate structures
4	Matrix methods of analysis - Flexibility method
5	Matrix methods of analysis - stiffness method and to exposure of structural analysis software packages

Student outcomes

Student outcome number	Student outcome (SO)
a	an ability to apply knowledge of mathematics, science, and engineering
e	an ability to identify, formulate, and solve engineering problems
k	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Mapping of Instructional Objectives (IOs) with Student Outcomes (SOs)

CE1022- COMPUTER AIDED STRUCTURAL ANALYSIS

Instructional objectives	Student Outcomes		
	a	**e**	**k**
1. Preparation of influence line diagrams for continuous beams and propped cantilevers	x	x	
2. Analysis of arches and suspension cables	x	x	
3. Plastic theory and its application in analysis of indeterminate structures	x	x	
4. Matrix methods of analysis - Flexibility method	x	x	x
5.Matrix methods of analysis - stiffness method and to exposure of structural analysis software packages	x	x	x

CE1022	COMPUTER AIDED STRUCTURAL ANALYSIS	Lecture Hours (L)	Tutorial Hours (T)	Practical Hours (P)	Credits (C)
		3	2	0	4

Lesson Plan – 2015-16 **Revision: 0 dated 02/02/2016**

Lecture No.	Topic	No. of hours	IOs	SO	Reference
1.	Introduction -brief recap of SA, MOS, SM- overview of syllabus	1	1,2,3 ,4,5	a,e,k	1-9
	UNIT-I- INFLUENCE LINES- STATICALLY INDETERMINATE STRUCTURES -10 hrs.				
2.	Introduction - Maxwell Betti's Theorem -Muller Breslau's Principles and its application to determine the influence lines of reactions, S.F and B.M at a section of continuous beams – propped cantilevers	1	1	a,e	1,3,4,6,8,9
3.	Influence line diagram for vertical reactions of end and interior supports of two span continuous beams with simple end supports	1	1	a,e	1,3,4,6,8,9
4.	Tutorials	2	1	a,e	1,3,4,6,8,9
5.	Influence line diagram for support BM and span BM of two span continuous beams with simple end supports	1	1	a, e	1,3,4,6,8,9
6.	Influence line diagram for span SF of two span continuous beams with simple end supports	1	1	a,e	1,3,4,6,8,9
7.	Tutorials	2	1	a,e	1,3,4,6,8,9
8.	Qualitative IL diagrams for single bay, single storey portal frames – vertical and horizontal reactions, support moments – concept of pattern loading	1	1	a,e	1,3,4,6,8,9
	UNIT-III -PLASTIC ANALYSIS OF STRUCTURES-10 hrs.				
9.	Introduction to Plastic Analysis -Plastic moment of resistance - Plastic Modulus - Shape factor - Load factor	1	3	a,e	1,3,4,6,8,9
10.	Shape factor for circular, rectangular, triangular and diamond shaped sections	1	3	a,e	1,3,4,6,8,9
11.	Shape factor for Tee and I section	1	3	a,e	1,3,4,6,8,9
12.	Method of plastic analysis – mechanism method and equilibrium method – lower bound, upper bound and uniqueness theorems	1	3	a,e	1,3,4,6,8,9
13.	Plastic hinge- hinge length – simply supported and fixed beam with full/partial udl /central/eccentric point load	1	3	a,e	1,3,4,6,8,9
14.	Plastic analysis of indeterminate beams using mechanism method – continuous beams , fixed beams and propped cantilevers	1	3	a,e	1,3,4,6,8,9
15.	Tutorials	1	3	a,e	1,3,4,6,8,9
	Cycle Test –I	2			
16.	Plastic analysis of indeterminate frames using mechanism method – single bay, single storey rectangular portal frames, Introduction to pushover analysis	1	3	a,e	1,3,4,6,8,9
17.	Tutorials	2	3	a,e	1,3,4,6,8,9

Lecture No.	Topic	No. of hours	IOs	SO	Reference
	UNIT-II- ARCHES AND SUSPENSION CABLES-20 hrs.				
18.	Arches- types of arches- load resisting mechanism-reactions and internal forces	1	2	a.e	1,3,4,6,8,9
19.	Linear arch- Eddy's theorem	1	2	a.e	1,3,4,6,8,9
20.	Analysis of parabolic three hinged arch	1	2	a,e	1,3,4,6,8,9
21.	Analysis of parabolic three hinged arch at different levels	1	2	a,e	1,3,4,6,8,9
22.	Tutorials	2	2	a,e	1,3,4,6,8,9
23.	Influence lines for horizontal thrust, bending moment, normal thrust and radial shear	1	2	a,e	1,3,4,6,8,9
24.	Analysis of circular three hinged arch with supports at same levels	1	2	a,e	1,3,4,6,8,9
25.	Tutorials	2	2	a,e	1,3,4,6,8,9
26.	Analysis of Two hinged parabolic arch- Rib shortening, support movements and temperature effects	1	2	a,e	1,3,4,6,8,9
27.	Tutorials	2	2	a,e	1,3,4,6,8,9
28.	Influence lines for horizontal thrust, bending moment, normal thrust and radial shear, absolute maximum bending moment	1	2	a,e	1,3,4,6,8,9
29.	Analysis methods for fixed arches-principle only	1	2	a,e	1,3,4,6,8,9
30.	Introduction to cables and suspension bridges	1	2	a,e	1,3,4,6,8,9
31.	Length of cable, Maximum tension - Types of supports - Forces in Towers – Cables anchored at different levels	1	2	a,e	1,3,4,6,8,9
32.	Tutorials	2	2	a,e	1,3,4,6,8,9
33.	Two hinged and three hinged stiffening girders-influence line diagrams for bending moment	1	2	a,e	1,3,4,6,8,9
34.	**Cycle Test –II**	2			
	UNIT-V- MATRIX STIFFNESS METHOD-20 hrs.				
35.	Introduction to Matrix methods-Advantages over classical methods of structural analysis	1	4	a,e,k	2,5,7,10,11, 12
36.	Direct stiffness method - continuous beams	1	4	a,e,k	2,5,7,10,11, 12
37.	Tutorials	2	4	a,e,k	2,5,7,10,11, 12
38.	Direct stiffness method -portal frames – single bay single storey – with and without sway	2	4	a,e,k	2,5,7,10,11, 12
39.	Tutorials	2	4	a,e,k	2,5,7,10,11, 12
40.	Concepts -Element and Global stiffness matrices - Co-ordinate transformations - Rotation matrix – Derivation of global stiffness matrix from element stiffness matrix	2	4	a,e,k	2,5,7,10,11, 12
41.	Load vectors and displacement vectors	1	4	a,e,k	2,5,7,10,11, 12
42.	Analysis of Continuous Beams using element approach	2	4	a,e,k	2,5,7,10,11, 12
43.	Tutorials	2	4	a,e,k	2,5,7,10,11, 12
44.	Analysis of pin jointed and rigid jointed plane frames using element approach	2	4	a,e,k	2,5,7,10,11, 12

Lecture No.	Topic	No. of hours	IOs	SO	Reference
45.	Tutorials	2	4	a,e,k	2,5,7,10,11, 12
46.	Introduction to software packages of structural analysis such as STAAD.Pro, SAP, ETABS, etc.	1	4	a,e,k	2,5,7,10,11, 12
	UNIT-IV -MATRIX FORCE METHOD- FLEXIBILITY METHOD-15 hrs.				
47.	Introduction – flexibility method- concepts-co-ordinates -element transformation approach	1	4	a,e,k	2,5,7,10,11, 12
48.	Analysis of indeterminate pin- jointed and rigid-jointed plane frames	1	4	a,e,k	2,5,7,10,11, 12
49.	Analysis of continuous beams	1	4	a,e,k	2,5,7,10,11, 12
50.	Tutorials	1	4	a,e,k	2,5,7,10,11, 12
51.	Direct flexibility method for continuous beams	1	4	a,e,k	2,5,7,10,11, 12
52.	Tutorials	1	4	a,e,k	2,5,7,10,11, 12
53.	Direct flexibility method for frames	1	4	a,e,k	2,5,7,10,11, 12
54.	Tutorials	1	4	a,e,k	2,5,7,10,11, 12
	Model Examination	3			
	Total hours	75			

The faculty members handling the course may conduct surprise test according to their convenience. However a question paper in hard copy as well as key shall be made available for the surprise test. The process shall be same as that of cycle tests.

TEXT / REFERENCE BOOKS

1. Menon.D, "*Structural Analysis",Alpha Science* International Limited, 2009.
2. Pandit.G.S., Gupta.S.P., "*Structural Analysis- A Matrix Approach"*, 2nd Edition, Tata McGraw-Hill Education, New Delhi, 2010.
3. Punmia.B.C, Ashok Kumar Jain, Arun Kumar Jain, "*Theory of Structures"*, Laxmi Publications, New Delhi, 12th Edition, 2004.
4. Bhavikatti.S.S, "*Structural Analysis",Vol-2*, E-2, Vikas Publishing House Pvt Limited, 2009.
5. Vaidyanathan .R, Perumal .P, "*Comprehensive Structural Analysis-Volume II"***,** Laxmi Publications (P) Ltd., New Delhi, 2004.
6. Khurmi.R.S, "*Theory of Structures*",S. Chand and Company Ltd., New Delhi, 1994.
7. Sterling Kinney .J, "*Indeterminate Structural Analysis"*, Narosa Publishing House,1987.
8. Jr. William Weaver and James .M.Gere, "*Matrix Analysis of Framed Structures"*, CBS Publishers and Distributors, Delhi, 1995.
9. Rajasekaran .S and Sankarasubramanian .G., "*Computational Structural Mechanics"*, Prentice Hall of India, 2006.
10. Manickaselvam.V.K, "*Elementary Matrix Analysis of Structures"*, Khanna Publishers, New Delhi, 1994
11. Thadani.B.N., Desai.J.P., "*Structural Mechanics"*, Weinall Book Corporation, 1998
12. Thandavamurthy,"Structural Analysis", Oxford University Press,2014.

Prof. G. Augustine Maniraj Pandian

10-02-2016