INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**STRUCTURAL ANALYSIS - I**			
Course Code	A40115			
Regulation	R13			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	5	-	-	4
Course Coordinator	G. Anil Kumar, Assistant Professor, CE			
Team of Instructors	G. Anil Kumar, Assistant Professor, CE			

I. COURSE OVERVIEW:

Civil Engineers are required to design structures like buildings, dams, bridges, etc. This course is intended to introduce the basic principles to impart adequate knowledge and successfully apply fundamentals of Structural Engineering within their chosen engineering application area. Take advantage of a strong technical education at the undergraduate level to embark on successful professional careers in industry or to continue with a graduate education in their area of specialization. Apply broad multi-disciplinary skills necessary to accomplish professional objectives in a rapidly changing technological world. Understand the ethical issues pertaining to engineering, adopt industry standards of ethical behavior, and apply appropriate communication and collaboration skills essential for professional practice.

II. PREREQUISITES:

Level	Credits	Periods / Week	Prerequisites
UG	4	5	

III. COURSE ASSESSMENT METHODS:

Session Marks	University End Exam Marks	Total Marks
Mid Semester Test There shall be two midterm examinations. Each midterm examination consists of subjective type and objective type tests. The subjective test is for 10 marks of 60 minutes duration. Subjective test of shall contain 4 questions; the student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks of 20 minutes duration. It consists of 10 Multiple choice and 10 objective type questions, the student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion. **Assignment** Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course.	75	100

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1	I Mid Examination	90 minutes	20
2	I Assignment	-	5
3	II Mid Examination	90 minutes	20
4	II Assignment	-	5
5	External Examination	3 hours	75

V. COURSE OBJECTIVES:

1. To introduce design concept and process of structures.
2. To review analysis of statically determinate structures.
3. To understand the deformations of structures under loading.
4. To introduce flexibility method for analysis of statically indeterminate structures.
5. To introduce stiffness method for analysis of statically indeterminate structures.

VI. COURSE OUTCOMES:

After completing this course the student must demonstrate the knowledge and ability to:

1. An ability to apply knowledge of mathematics, science, and engineering appropriate to the degree discipline
2. An ability to design and conduct experiments, as well as to analyze and interpret data
3. An ability to design a system, component or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability
4. An ability to function on multi-disciplinary teams
5. An ability to identify, formulate and solve engineering problems
6. An ability to understand professional and ethical responsibility
7. An ability to communicate effectively
8. An ability to understand the impact of engineering solutions in a global and societal context, especially the importance of health, safety and environmental considerations to both workers and the general public
9. An ability to stay abreast of contemporary issues
10. An ability to recognize the need for, and to engage in life-long learning
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice appropriate to the degree discipline
12. An ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency assessed by
PO1	An ability to apply knowledge of computing, mathematical foundations, algorithmic principles, and civil engineering theory in design of computer-based systems to real-world problems	H	Assignments, Tutorials, Exams
PO2	The ability to practice civil engineering using up-to- date techniques, skills, and tools as a result of life – long learning ability to design and conduct experiments, as well as to analyze	N	--

	and interpret data.		
PO3	An ability to design , implement, and evaluate a field program to meet desired needs, within realistic constraints such as economic, environmental, social, political, health and safety, manufacturability, and sustainability.	H	Assignments, Tutorials, Exams
PO4	An ability to design a system or component to satisfy stated or code requirements of Civil Engineering	N	--
PO5	An ability to analyze a problem, identify, formulate and use the appropriate computing and Civil engineering requirements for obtaining its solution.	H	Assignments, Tutorials, Exams
PO6	An understanding of professional, ethical, legal, security and social issues and responsibilities.	N	--
PO7	An ability to communicate effectively, both in writing and orally	N	--
PO8	The broad education necessary to analyze the local and global impact of computing and engineering solutions on individuals, organizations, and society	N	--
PO9	Recognition of the need for, and an ability to engage in continuing professional development and life-long learning	N	--
PO10	Knowledge of contemporary issues as they affect the professional and ethical practice of engineering.	N	--
PO11	An ability to use current techniques, skills, and tools necessary for computing and engineering practice	H	Assignments and Tutorials, Exams
Po12	An ability to design and development principles in the construction of Civil Engineering of varying complexity.	N	--
PO13	An ability to recognize the importance of civil Engineering professional development by pursuing post graduate studies or face competitive examinations that offer challenging and rewarding careers in computing.	N	--

N - None **S - Supportive** **H - Highly Related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program specific outcomes		Level	Proficiency Assessed By
PSO 1	An ability to apply knowledge of computing, mathematical foundations, algorithmic principles, and civil engineering theory in design of computer-based systems to real-world problems	H	Lectures, Exercises and Assignments
PSO 2	An ability to design , implement, and evaluate a field program to meet desired needs, within realistic constraints such as economic, environmental, social, political, health and safety, manufacturability, and sustainability.	H	Project
PSO 3	An ability to use current techniques, skills, and tools necessary for computing and engineering practice	S	Guest lectures

N - None **S - Supportive** **H - Highly Related**

IX. SYLLABUS:

UNIT - I

Analysis of Perfect Frames: Types of frames- Perfect, Imperfect and Redundant pin jointed frames. Analysis of determinate pin jointed frames using method of joints, method of sections and tension co-effective method for vertical loads, horizontal loads and inclined loads.

UNIT - II

Energy Theorems: Introduction-Strain energy in linear elastic system, expression of strain energy due axial load, bending moment and shear forces- Castiglione's first theorem - Unit Load Method. Deflections of simple beams and pin - jointed plain tresses. Deflections of statically determinate bent frames.

Three Hinged Arches: Introduction - Types of arches - comparison between three hinged arches and two hinged arches. Linear Arch. Eddy's theorem. Analysis three hinged arches. Normal Thrust and radial shear in an arch. Geometrical properties of parabolic and circular arch. Three Hinged circular arch at Different levels. Absolute maximum bending moment diagram for a three hinged arch.

UNIT - III

Propped Cantilever and Fixed beams: Analysis of Propped Cantilever and Fixed beams, including the beams with varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load, couple and combination of loads- shear force and bending moment diagrams for Propped cantilever and Fixed beams; effect of sinking of support, effect of rotation of a support.

UNIT - IV

Slope - Deflection Method and Moment Distribution Method: Introduction - Continuous beams. Clapeyron's theorem of three moments- Analysis of continuous beams with constant variable moments of inertia with one or both ends fixed- continuous beams with overhang. Effects of sinking of supports. Derivation of slope- Deflection Equation, Application to continuous beams with and without settlement of supports. Analysis of continuous beams with and without settlement of supports using Moment Distribution Method. Shear force and bending moment diagrams, Elastic curve.

UNIT - V

Moving Loads and Influence Lines: Introduction maximum SF and BM at a given section and absolute maximum S.F. and B.M. due to single concentrated load U.D. load longer than the span, U.D load shorter than the span, two point loads with fixed distance between them and several point loads- Equivalent uniformly distributed load- Focal length. Definition of influence line for SF, influence line for BM- load position for maximum SF at a section- load position for maximum BM at a section- Point load, UDL longer than the span, UDL shorter than the span- influence line for forces in members of Pratt and Warren trusses.

TEXT BOOKS:

1. Structural Analysis Vol-I & II by Vazarani and Ratwani, Khanna Publishers.
2. Structural Analysis Vol-I & II by Pundit and Gupta, Tata McGraw Hill Publishers.

REFERENCES:

1. Basic Structural Analysis by K.U.Muthu et al, I.K. International Housing Pvt. Ltd.
2. Structural Analysis by Hibbelar Pearson Education Ltd.
3. Basic Structural Analysis C.S. Reddy., Tata McGraw Hill Publishers
4. Fundamentals of Structural Analysis by M.L.Gamhir, PHI.

X. COURSE PLAN:

Unit	Lecture Number	Topics Planned to cover	Learning Objectives	Reference Books
I	1	**Analysis of Perfect Frames:** Types of frames- Perfect, Imperfect and Redundant pin jointed frames.	**Analysis of Perfect Frames:** Types of frames- Perfect, Imperfect and Redundant pin jointed frames.	**T1**
	2-4	Analysis of determinate pin jointed frames using method of joints for vertical loads, horizontal loads and inclined loads.	Solved problems on Analysis of determinate pin jointed frames using method of joints for vertical loads, horizontal loads and inclined loads.	**T1**
	5-7	Analysis of determinate pin jointed frames method of sections for vertical loads, horizontal loads and inclined loads.	Solved problems on Analysis of determinate pin jointed frames method of sections for vertical loads, horizontal loads and inclined loads.	**T1**
	8-10	Analysis of determinate pin jointed frames using tension co-effective method for vertical loads, horizontal loads and inclined loads.	Solved problems on Analysis of determinate pin jointed frames using tension co-effective method for vertical loads, horizontal loads and inclined loads.	**T1**
II	11-12	**Energy Theorems:** Introduction-Strain energy in linear elastic system	**Energy Theorems:** Introduction-Strain energy in linear elastic system	**T1**
	13-16	expression of strain energy due axial load, bending moment and shear forces	expression of strain energy due axial load, bending moment and shear forces	**T1**
	17-18	Castiglione's first theorem - Unit Load Method.	Castiglione's first theorem - Unit Load Method.	**T1**
	19-21	Deflections of simple beams and pin - jointed	Deflections of simple beams and pin - jointed plain tresses.	**T1**

Unit	Lecture Number	Topics Planned to cover	Learning Objectives	Reference Books
		plain tresses.		
	22-23	Deflections of statically determinate bent frames.	Deflections of statically determinate bent frames.	**T1**
	24	**Three Hinged Arches:** Introduction - Types of arches - comparison between three hinged arches and two hinged arches.	Introduction - Types of arches - comparison between three hinged arches and two hinged arches.	**T1**
	25	Linear Arch. Eddy's theorem.	Linear Arch. Eddy's theorem.	**T1**
	26-28	Analysis three hinged arches. Normal Thrust and radial shear in an arch. Geometrical properties of parabolic and circular arch.	Solved problems on Analysis three hinged arches. Normal Thrust and radial shear in an arch. Geometrical properties of parabolic and circular arch.	**T1**
	29-30	Three Hinged circular arch at Different levels. Absolute maximum bending moment diagram for a three hinged arch.	Three Hinged circular arch at Different levels. Absolute maximum bending moment diagram for a three hinged arch.	**T1**
III	31-36	**Propped Cantilever:** Analysis of Propped Cantilever, including the beams with varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load, couple and combination of loads- shear force and bending moment diagrams for Propped cantilever; effect of sinking of support, effect of rotation of a support.	Solved problems on Analysis of Propped Cantilever, including the beams with varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load, couple and combination of loads- shear force and bending moment diagrams for Propped cantilever; effect of sinking of support, effect of rotation of a support.	**T1**
	35-36	**Fixed beams:** Analysis of Fixed beams, including the beams with varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load,	Solved problems on Analysis of Fixed beams, including the beams with varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load, couple and combination of loads- shear force and bending moment diagrams for Fixed beams; effect of sinking of support, effect of rotation of a support.	**T1**

Unit	Lecture Number	Topics Planned to cover	Learning Objectives	Reference Books
		number of point loads, uniformly varying load, couple and combination of loads- shear force and bending moment diagrams for Fixed beams; effect of sinking of support, effect of rotation of a support.		
IV	37-39	**Slope - Deflection Method and Moment Distribution Method:** Introduction - Continuous beams. Clapeyron's theorem of three moments	Introduction - Continuous beams. Clapeyron's theorem of three moments	**T1**
	40-42	Analysis of continuous beams with constant variable moments of inertia with one or both ends fixed- continuous beams with overhang. Effects of sinking of supports.	Solved problems on Analysis of continuous beams with constant variable moments of inertia with one or both ends fixed- continuous beams with overhang. Effects of sinking of supports.	**T1**
	43-46	Derivation of slope- Deflection Equation, Application to continuous beams with and without settlement of supports.	Derivation of slope- Deflection Equation, Application to continuous beams with and without settlement of supports.	**T1**
	47-50	Analysis of continuous beams with and without settlement of supports using Moment Distribution Method. Shear force and bending moment diagrams	Solved problems on Analysis of continuous beams with and without settlement of supports using Moment Distribution Method. Shear force and bending moment diagrams	**T1**
	51-52	Elastic curve	Solved problems on Elastic curve	**T1**
V	53-57	**Moving Loads and Influence Lines:** Introduction maximum SF and BM at a given section and absolute maximum S.F. and B.M. due to single concentrated load U.D. load longer than the span, U.D load shorter than the span, two point loads with fixed distance	Introduction maximum SF and BM at a given section and absolute maximum S.F. and B.M. due to single concentrated load U.D. load longer than the span, U.D load shorter than the span, two point loads with fixed distance between them and several point loads- solved problems	**T1**

Unit	Lecture Number	Topics Planned to cover	Learning Objectives	Reference Books
		between them and several point loads-		
	58-59	Equivalent uniformly distributed load- Focal length.	Solved problems on Equivalent uniformly distributed load- Focal length.	**T1**
	60-64	Definition of influence line for SF, influence line for BM- load position for maximum SF at a section- load position for maximum BM at a section- Point load, UDL longer than the span, UDL shorter than the span-	Definition of influence line for SF, influence line for BM- load position for maximum SF at a section- load position for maximum BM at a section- Point load, UDL longer than the span, UDL shorter than the span- solved problems	**T1**
	65-66	Influence line for forces in members of Pratt trusses.	Influence line for forces in members of Pratt trusses. Solved problems	**T1**
	67-68	Influence line for forces in members of Warren trusses.	Influence line for forces in members of Warren trusses. Solved problems	**T1**

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	H	H										S	H	S	
II	H	H	S										H	S	
III	H	H	S	S									S	H	
IV	H	S											H	S	
V		H			S								H		

S= Supportive H = Highly Related

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H	S	S										H	S	
2	H			S									S	H	
3		H			S								H	S	
4	H	H											H		
5	H	S											S		

6	H											S	H	S	
7	S												S		
8	S	H											H	S	
9	S	H										S	H		
10	S	H										S	H		
11	S	H										S	H		
12	S	H										S	H		
13	S	H										S	H		

S= Supportive H = Highly Related

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