Module (Course Syllabus) Catalogue

2022-2023

College/ Institute	Erbil Technology College	
Department	Construction Materials and Technology	
Module Name	Structural Analysis	
Module Code	STA363	
Degree	Technical Diploma ☐ Bachelor ■ High Diploma ☐ Master ☐ PhD ☐	
Semester	6	
Qualification		
Scientific Title		
ECTS (Credits)	6	
Module type	Prerequisite ☐ Core ■ Assist. ☐	
Weekly hours	4	
Weekly hours (Theory)	(2)hr Class	(73)Total hrs Workload
Weekly hours (Tutorials)	(2)hr Class	(73)Total hrs Workload
Number of Weeks	16	
Lecturer (Theory)	Firas Fawzi Jirjees	
E-Mail & Mobile NO.	firas.jirjees@epu.edu.iq	
Lecturer (Practical)	Firas Fawzi Jirjees	
E-Mail & Mobile NO.	firas.jirjees@epu.edu.iq	
Websites		

Course Book

Course Description	This course is one of the major courses for the third year students in Construction Materials and Technology and aims to introduce students to the basic techniques for analyzing common structural elements, including beams, trusses, and frames, determination of internal forces, illustration of shear and moment diagrams, and calculation of deflection and influence lines. The course covers methods to analyze both statically determinate and indeterminate structural systems including force and displacement methods. **Official Course language is: English language** **Passing score is: 50 out of 100** **Course weekly hours: 4 hours (2 theoretical + 2 Practical)** **Score distribution: 60% (during the year evaluations and exams) + 40% (end of the year exams)**
Course objectives	Analysis of statically determinate structures; reactions, shear, and moment; truss analysis; deflections; influence lines and moving loads. Various methods and their underlying mechanics used in determining response of structures when subjected to external agitation will be discussed in this course. This course is comprehensive at the basic level. Journey through this course will help students to build the foundation for more advanced courses related to structural engineering. a) An ability to apply knowledge of mathematics, science, and engineering. b) An ability to design a system, component, or process to meet desired needs. c) An ability to identify, formulate and solve engineering problems. d) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context. e) A recognition of the need for, and an ability to engage in life-long learning. f) An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.
Student's obligation	a) Students should attend the theoretical lectures (2 hours weekly) and also should attend the tutorial lectures (2 hours weekly). b) Students requested to match deadlines for submitting their reports and assignments given by the lecturer. c) Students should be ready for unannounced short quizzes from previous lectures. d) Students are requested to provide detailed reports for the scientific visits arranged to the projects under construction. e) Students should prepare themselves for the semester's major exams both the theoretical and practical parts (announced exams). f) Missed classes will not be compensated including the quizzes and the scheduled assignments.
Required Learning Materials	Mechanics of Materials Mechanics II

	Task		Weight (Marks)	Due Week	Relevant Learning Outcome
Evaluation	Paper Review				
	Assignments	Homework	**10%**	3-14	3, 4
		Class Activity	**2%**	3-14	1-6
		Report	**16%**	3-14	1-6
		Seminar		5	1, 2, 3
		Essay			
		Project		10	6
	Quiz		**8%**	3, 5, 9, 11	1-6
	Lab.			3-14	4, 5
	Midterm Exam		**24%**	7, 8	
	Final Exam		**40%**	15, 16	
	Total		**100%**		

Specific learning outcome:

This course will focus on the following student educational outcomes:

1. To further develop skills in determining reactions and loads on structures.
2. To familiarize the student with the basic concepts of truss analysis.
3. Learn to derive shear and moment expressions from loading functions.
4. Develop a basic understanding of influence lines.
5. Learn to compute deflections of beams using direct integration, conjugate beam, and energy methods.
6. To apply analysis concepts to design structural element.

Course References:

1- Recommended Textbook: "Structural Analysis" by Russell C. Hibbeler, Tenth Edition in SI units, Prentice-Hall, 2020, ISBN 13: 978-1-292-24713-7

2- Ranzi, G., & Gilbert, R.I. (2014). Structural Analysis: Principles, Methods and Modelling (1st ed.). CRC Press. https://doi.org/10.1201/9781315275185

3- Lecture slides and support material will be posted on the ``Moodle'' web page.

4- Short videos for structural analysis from internet.

Course topics (Theory)	Week	Learning Outcome
✓ Types of Structures and Loads	1	1
✓ Idealization and Modeling of Structures	2	2
✓ Equilibrium, Stability and Determinacy of structures; Review of shear force and bending moment diagram in beams and frames	3	2
✓ Analysis of statically determinate structures	4	2
✓ Analysis of statically determinate trusses	5	3
✓ Internal Loadings developed in structural members	6	3, 4
S6-Mid Term Exam- Preparation	7	1, 2, 3, 4
S6-Mid Term Exam	8	1, 2, 3, 4
✓ Influence lines for statically determinate structures	9	3, 4
✓ Deflections	10	4, 5
✓ Analysis of statically indeterminate structures by force method	11	4,5
✓ Analysis of statically indeterminate structures by force method for beams and frames	12	6
✓ Analysis of statically indeterminate structures by force method for trusses	13	6
✓ Displacement method of analysis: slope-deflection equation	14	6
✓ S6-Final Exam- Preparation (First attempt)	15	1, 2, 3, 4, 5, 6
✓ S6-Final Exam (First attempt)	16	1, 2, 3, 4, 5, 6

Questions Example Design

Classify each of the pin-connected structures shown in Figs. 2–21*a* through 2–21*d* as statically determinate or statically indeterminate. If statically indeterminate, report the number of degrees of indeterminacy. The structures are subjected to arbitrary external loadings that are assumed to be known and can act anywhere on the structures.

SOLUTION

Classification of pin-connected structures is similar to that of beams. Applying $r = 3n$ or $r > 3n$ to each of the free-body diagrams, the resulting classifications are indicated.

(a)

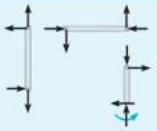
$r = 7, n = 2, 7 > 6$

Statically indeterminate to the first degree. *Ans.*

(b)

$r = 9, n = 3, 9 = 9$

Statically determinate. *Ans.*



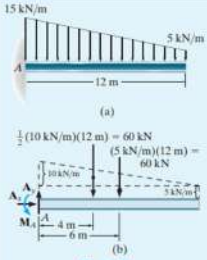


Fig. 2–31

Determine the reactions on the beam in Fig. 2–31*a*.

SOLUTION

Free-Body Diagram. As shown in Fig. 2–31*b*, the trapezoidal distributed loading is segmented into a triangular and a uniform load. The *areas* under the triangle and rectangle represent the *resultant* forces. These forces act through the centroid of their corresponding areas.

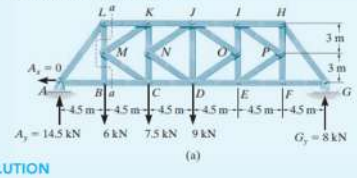
Equations of Equilibrium.

$\stackrel{+}{\rightarrow}\Sigma F_x = 0; \quad A_x = 0$ *Ans.*

$+\uparrow\Sigma F_y = 0; \quad A_y - 60 - 60 = 0 \quad A_y = 120\ \text{kN}$ *Ans.*

$\downarrow+\Sigma M_A = 0; \quad -60(4) - 60(6) + M_A = 0 \quad M_A = 600\ \text{kN}\cdot\text{m}$ *Ans.*

Determine the force in members *BC* and *MC* of the K-truss shown in Fig. 3–28*a*. State whether the members are in tension or compression. The reactions at the supports are given.



(a)

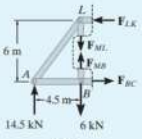
SOLUTION

Free-Body Diagram. Although section *aa* shown in Fig. 3–28*a* cuts through four members, it is possible to solve for the force in member *BC* using this section. The free-body diagram of the left part of the truss is shown in Fig. 3–28*b*.

Equations of Equilibrium. Summing moments about point *L* eliminates *three* of the unknowns, so that

$\downarrow+\Sigma M_L = 0; \quad -14.5(4.5) + F_{BC}(6) = 0$

$F_{BC} = 10.9\ \text{kN (T)}$ *Ans.*



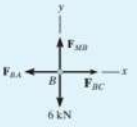
(b)

Free-Body Diagrams. The force in *MC* can be obtained indirectly by first obtaining the force in *MB* from vertical force equilibrium of joint *B*, Fig. 3–28*c*, i.e., $F_{MB} = 6\ \text{kN (T)}$. Then from the free-body diagram in Fig. 3–28*b*,

$+\uparrow\Sigma F_y = 0; \quad 14.5 - 6 + 6 - F_{ML} = 0$

$F_{ML} = 14.5\ \text{kN (T)}$

Using these results, the free-body diagram of joint *M* is shown in Fig. 3–28*d*.



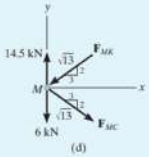
(c)

Equations of Equilibrium.

$\stackrel{+}{\rightarrow}\Sigma F_x = 0; \quad \left(\frac{3}{\sqrt{13}}\right)F_{MC} - \left(\frac{3}{\sqrt{13}}\right)F_{MK} = 0$

$+\uparrow\Sigma F_y = 0; \quad 14.5 - 6 - \left(\frac{2}{\sqrt{13}}\right)F_{MC} - \left(\frac{2}{\sqrt{13}}\right)F_{MK} = 0$

$F_{MK} = 7.66\ \text{kN (C)} \qquad F_{MC} = 7.66\ \text{kN (T)}$ *Ans.*



(d)

Fig. 3–28

Sometimes, as in this example, application of both the method of sections and the method of joints leads to the most direct solution to the problem.

It is also possible to solve for the force in *MC* by using the result for $\mathbf{F}_{BC}$. In this case, pass a vertical section through *LK*, *MK*, *MC*, and *BC*, Fig. 3–28*a*. Then isolate the left part and apply $\Sigma M_K = 0$.

Extra notes:

I have no notifications

External Evaluator

The course book prepared by my colleague is properly arranged and covers the main requirements of the lesson. The lecturing procedures are identified properly. The assessment scheme and forms of teaching are arranged in a way that the student could understand clearly. It can be said that student will be satisfied with this course book and it promises a good outcome.

Name: Signature:

Academic title: