Engineering Mechanics Course Catalogue

2022-2023

College	**Shaqlawa Technical Institute**	
Department	**Department of Building and Construction**	
Module Name	**Engineering Mechanics**	
Module Code	**ENM204**	
Semester	**2**	
Credit	**8**	
Module type	**Theoretical and Tutorial**	
Weekly hours	**4**	
Weekly hours (Theory)	**(2)hr Class**	**( )hr Workload**
Weekly hours (Tutorial)	**(2)hr Class**	**( )hr Workload**
Lecturer (Theory)	**Ahmed Redha Abdulrahman**	
E-Mail	**Ahmed.abdul-rahman@epu.edu.iq**	
Lecturer (Tutorial)		
Email		

Course Book

- **Course overview:**

This is your first course in Engineering Mechanics, which is the study of the interaction of matter and forces in engineering contexts. It is evident that all objects in the world around us are composed of matter, and they are all subject to forces. As such, Engineering Mechanics is the foundational tool for engineers, and forms the underlying basis for understanding more advanced fields such as Solid Mechanics, Fluid Dynamics, Rigid Body Dynamics, Aerodynamics, Structures, Control and many aspects of Advanced Design.

- **Course objective:**

In this course students will learn a process for analysis of static objects; concepts of force, moment, and mechanical equilibrium; how to analyze forces and moments in two and three dimensions; and how to analyze distributed forces and internal loads. They will be able to analyze forces in various systems such as frames, machines, trusses, beams and cables. The tools learned in this course will provide the basis for later courses and a career in engineering.

- **Student's obligation**

Attending the lecture is a fundamental part of the course. You are responsible for material presented in the lecture whether or not it is discussed in the textbook. You should expect questions on the exams to test your understanding of concepts discussed in the lecture and in the homework assignments.
It can be very helpful to study with a group. This type of cooperative learning is encouraged; however, be sure that you have a thorough understanding of the concepts besides the mathematical steps used to solve a problem. You must be able to work through the problems on your own.

- **Forms of teaching**

Data Show, Handout lecture notes and white board notes.

- **Assessment scheme**

There will be two midterm exams and average of these exams will be account. No notes will be allowed during these exams. Students will not be allowed to take makeup midterm exams. Course scores are weighted as follows:

16 % Mid. Exam
4 % Quiz
40 % Activity (14 % Homework + 2 % Class Activity + 24 % (Report + Seminar + Essay + Project))
40 % Final

I reserve the right to raise grades higher than this scale dictates, based on considerations such as homework performance, class participation, attendance, and improvement over the semester.

- **Specific learning outcome:**

Learning outcomes of the course are that students will:

1. Use a standard process for analyzing static objects.
2. Define a force and a moment.
3. Add forces and moments in two and three dimensions, and find a component of a force or moment in a given direction.
4. Construct free body diagrams of an object or a system of connected objects.
5. Describe conditions of equilibrium and their associated component equations.
6. Use conditions of equilibrium and known forces and moments to solve for unknown external and internal forces and moments present in an object of system of connected objects.
7. Define statically determinate, statically indeterminate, and under-constrained systems, and identify systems having these characteristics.
8. Calculate the center of gravity, center of mass, and centroid for simple and composite volumes.
9. Represent a distributed line or area load by an equivalent point force, and use the equivalent point force in static analysis.
10. Define, identify, and carry out equilibrium analysis of frames, machines, trusses, beams and cables.

- Course Reading List and References:

[1] Engineering Mechanics: Statics & Dynamics, (13th Ed.), R.C. Hibbeler, 2012 (Major)

[2] Vector Mechanics for Engineers: Statics, 9th edition, by F. P. Beer, E. R. Johnston Jr., D. F. Mazurek, and E. R. Eisenberg.

Week	Topic	**Learning Outcome**
Week 1	Introduction to statics; vectors; units; force systems, moments and couples	General Principles
Week 2	Force Vectors	Force Vectors Ch. 1 and Ch. 2
Week 3	Equilibrium of a Particle	Force System
Week 4	Force System Resultants	Ch. 3 and Ch. 4
Week 5	Equilibrium of a Rigid Body	Structural Analysis Ch. 5 and Ch. 6
Week 6	Frames and Machines; Distributed forces; centroids and mass centres;	Internal Forces
Week 7	Midterm Exam	
Week 8	Beams; internal and external effects; shear force and bending moment diagrams	Calculating forces in a specified point
Week 9	Friction; static and dynamic coefficients; wedges, screws, bearings	Understand contact friction cases Ch. 7 and Ch. 8
Week 10	Canter of Gravity and Centroid	
Week 11	Moments of Inertia	
Week 12	Virtual Work	Ch. 9, Ch. 10, and Ch. 11
Week 13	Review and solved examples	

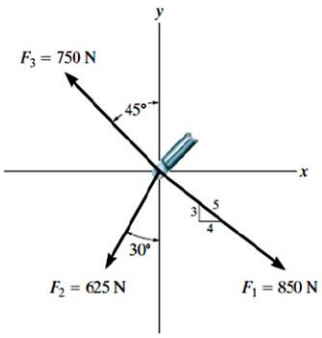
Examinations (question design):

Method of Evaluation:
Could include any of the following: problem solving exams, objective exams, essays, research papers, oral presentations, group projects, quizzes, homework.

ASSIGNMENT 1

2–33.

Determine the magnitude of the resultant force and its direction, measured counterclockwise from the positive x axis.



SOLUTION

$$\stackrel{+}{\rightarrow} F_{R_x} = \Sigma F_x; \qquad F_{R_x} = \frac{4}{5}(850) - 625\sin 30° - 750\sin 45° = -162.8 \text{ N}$$

$$+\uparrow F_{R_y} = \Sigma F_y; \qquad F_{Ry} = -\frac{3}{5}(850) - 625\cos 30° + 750\cos 45° = -520.9 \text{ N}$$

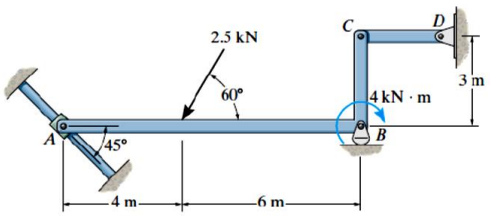
$$F_R = \sqrt{(-162.8)^2 + (-520.9)^2} = 546 \text{ N} \qquad \textbf{Ans.}$$

$$\phi = \tan^{-1}\left[\frac{-520.9}{-162.8}\right] = 72.64°$$

$$\theta = 180° + 72.64° = 253° \qquad \textbf{Ans.}$$

5–2.

Draw the free-body diagram of member ABC which is supported by a smooth collar at A, rocker at B, and short link CD. Explain the significance of each force acting on the diagram. (See Fig. 5–7*b*.)



SOLUTION

The Significance of Each Force:

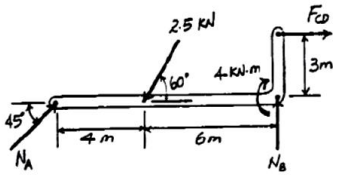
N_A is the smooth collar reaction on member ABC.

N_B is the rocker support B reaction on member ABC.

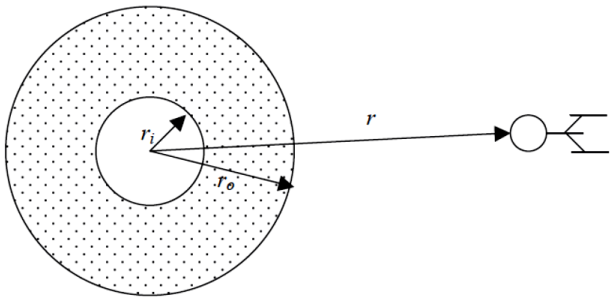
F_{CD} is the short link reaction on member ABC.

2.5 kN is the effect of external applied force on member ABC.

4 kN · m is the effect of external applied couple moment on member ABC.



2) The starship Enterprise is headed for the hollow planet shown below. The planet has an inner radius r_i and outer radius r_o, and the solid part has a constant density ρ. Find the force acting on the Enterprise as a function of its distance r from the center of the planet (assume the ship has a special photon-torpedo drill that allows it to travel through the planet all the way to the center).



We need to consider three distinct cases here. First, when the Enterprise in the in hollow cavity, there is no force due to gravity (we know this from the shell theorem). So,

$$F = 0 \text{ when } r < r_i$$

If the Enterprise is completely outside the planet, the shell theorem states that:

$$F = \frac{GM_p m_E}{r^2} = \frac{G\rho V_p m_E}{r^2} = \frac{G\rho \frac{4}{3}\pi\left(r_o^3 - r_i^3\right)m_E}{r^2} \text{ when } r > r_o$$

Finally, if the Enterprise is tunneling through the planet, only the part of the planet at smaller radius than the Enterprise exerts a net force, so:

$$F = \frac{GM_{p,\text{inner}} m_E}{r^2} = \frac{G\rho V_{p,\text{inner}} m_E}{r^2} = \frac{G\rho \frac{4}{3}\pi\left(r^3 - r_i^3\right)m_E}{r^2} \text{ when } r_i < r < r_o$$

- **Extra notes:**

- **External Evaluator**

Well Done