Moudle(Course Syllabus) Catalogue

2023-2024

College/ Institute	Erbil Technology College					
Department	Construction and Material Technology Engineering (C&MTE)					
Module Name	INTRODUCTION TO FLUID MECHANICS					
Module Code	IFM 364					
Degree	Technical Diploma			Bachelor	X	
	High Diploma		Master		PhD	
Semester	Semester 6					
Qualification	Ph.D. in Civil/Environmental Engineering					
Scientific Title	Assistant Professor					
ECTS (Credits)	6					
Module type	Prerequisite		Core	X	Assist.	
Weekly hours	4 hrs.					
Weekly hours (Theory)	(2)hr Class	(2)Total hrs Workload				
Weekly hours (Practical)	(2)hr Class	(4) Total hrs Workload				
Number of Weeks	16					
Lecturer (Theory)	Assistant Professor Dr.Abdulfattah Ahmad Amin					
E-Mail & Mobile NO.	/					
Lecturer (Practical)	Assistant Professor Dr.Abdulfattah Ahmad Amin					
E-Mail & Mobile NO.	abdulfattah.amin@epu.edu.iq					
Websites	/					

Corse Description	Fluid mechanics is the sub discipline of continuum mechanics that studies fluids, that is, liquids and gases. It can be further subdivided into fluid statics, the study of fluids at rest, and fluid dynamics, the study of fluids in motion. Fluids are composed of molecules that collide with one another and solid objects. The continuum assumption, however, considers fluids to be continuous. That is, properties such as density, pressure, temperature, and velocity are taken to be well-defined at infinitely small points, and are assumed to vary continuously from one point to another. Fluid static's and forces on submerged bodies Introduction to kinematics of fluid flow. Energy, continuity and momentum equations. Navier-Stokes equations. Viscous flow through closed conduits. Fundamentals of boundary layer analysis. Dimensional analysis. Potential flow. Introduction to hydraulic machinery.
Course objectives	**The general objectives of this module are:** The objective of this course is developing an understanding of fluid dynamics in aerospace engineering as well as a variety of other fields. Learn to use control volume analysis to develop basic equations and to solve problems. Understand and use differential equations to determine pressure and velocity variations in internal and external flows. Understand the concept of viscosity and where viscosity is important in real flows. Learn to use equations in combination with experimental data to determine losses in flow systems. Learn to use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity. Mechanics can be seen as the prime, and even as the original, discipline of physics. It is a huge body of knowledge about the natural world. It also constitutes a central part of technology.
Student's obligation	To pass this module the students should attend all lectures and complete all tests, exams and assignments. • Attendance of students to the lectures. • Conducting assignments. • Conducting seminars. • Conducting presentation. • Conducting laboratory reports. • Conducting exams (Theoretical and Laboratory

<table>
<tr><td>Required Learning Materials</td><td colspan="5">Forms of teaching
Oral presentations lectures, Group discussions, Seminars, Problem-solving based learning, Project based learning.
• Theoretical are prepared in the form of PowerPoint presentation by using data show.
• Tutorials are prepared in the form of PowerPoint presentation by using data show.
• Using white board to explain examples and offer more details.</td></tr>
<tr><td rowspan="14">valuation</td><td colspan="2">Task</td><td>Weight (Marks)</td><td>Due Week</td><td>Relevant Learning Outcome</td></tr>
<tr><td colspan="2">Paper Review</td><td>/</td><td></td><td></td></tr>
<tr><td rowspan="6">Assignments</td><td>Homework</td><td>6</td><td>1-12</td><td>Improve to solving problems</td></tr>
<tr><td>Class Activity</td><td>6</td><td>1-12</td><td>To analyze and solve fluid mechanics problems</td></tr>
<tr><td>Report</td><td>10</td><td></td><td>To learn how to write technical reports</td></tr>
<tr><td>Seminar</td><td>10</td><td>1-12</td><td>Improve the ability of presentation</td></tr>
<tr><td>Essay</td><td>/</td><td></td><td></td></tr>
<tr><td>Project</td><td>/</td><td>1-12</td><td></td></tr>
<tr><td colspan="2">Quiz</td><td>8</td><td>1-12</td><td></td></tr>
<tr><td colspan="2">Lab.</td><td>/</td><td></td><td></td></tr>
<tr><td colspan="2">Midterm Exam</td><td>20</td><td>1-12</td><td></td></tr>
<tr><td colspan="2">Final Exam</td><td>40</td><td>1-12</td><td></td></tr>
<tr><td colspan="2">Total</td><td>100</td><td></td><td></td></tr>
</table>

Specific learning outcome:	*On successful completion of this module the learner will be able to:* The lectures are divided on four weekly hours. Mainly, the first two hours will be dedicated for theoretical principles. Notes and handouts are given to the students containing the detail of the topics. This will be assisted by presentations using word and/or power point slides during the lecture time. The second part of the week (left two hours) is practical time in fluid laboratory. The practical time let the students work in groups and submitting weekly laboratory report. Discussion time is provided for the students for questions at theoretical and practical times. Collaborate with others to solve problems by group or team working.

Course References:	- Lecture notes. - Munson, P., R., Okiishi T., H., Huebsch, W., W., Rothmayer, A., P., (2013). Fundamentals of Fluid Mechanics, 7th ed. Jefferson City. John Wiley & Sons Inc. - Cengel , Y., A., Cimbala J., M., (2006). Fluid Mechanics, Fundamentals and Applications. New York. McGRAWHILL. - White, F., M., (2002). Fluid Mechanics, 5th edn. New York. McGRAW-HILL. - John K. Vennard Elementary of Fluid Mechanics. - Marcel Esudier , Engineering Fluid Mechanics. - Egon Krause, Fluid mechanics. - Robert W. Fox “Introduction to Fluid Mechanics” (2004), 6th ed. John Wily and Sons INC. .

Course topics (Theory)	Week	Learning Outcome
Introduction, System of units, primary and secondary units, an introduction to fluid mechanics, important laws (Newton's Laws included).	Week 1	
Scalars and Vectors, vector sums, laws of parallelogram and rectangular, force components and force system.	Week 2	
Moments and equilibrium.	Week 3	
Centroid and center of gravity.	Week 4	
Moment of inertia area.	Week 5	

Fluids: liquids and gases.	Week 6	
Midterm Examination	**Week 7**	
Midterm Examination	**Week 8**	
Pressure, pressure gages, manometers and mechanical gages.	Week 9	
Static pressure, Buoyancy and Archimedes statement.	Week 10	
Bernoulli's equation, Fluid flow continuity.	Week 11	
Laminar and turbulent flows, Flow in pipes friction factor.	Week 12	
Pressure drop Moody diagram, Water pumps, pump characteristics, serial and parallel pumps.	Week 13	

Flow in open channels.	Week 14	
Final Examination	Week 15	
Final Examination	Week 16	
Practical Topics	**Week**	**Learning Outcome**
Density of Liquids.	1	
Viscosity.	2	
Bourdon gauge.	3	
Centre of pressure.	4	
Rotameter	5	
Flow measurement apparatus (Venturi-meter).	6	
Midterm Examination	**Week 7**	
Midterm Examination	**Week 8**	
Flow measurement apparatus (Orifice-meter).	9	
Flow measurement apparatus (Orifice-meter).	10	
Pressure drops over flow measurement apparatus (head loss).	11	

Pressure drops over flow measurement apparatus (head loss).	12	
Friction loss apparatus (head loss).	13	
Pressure drops over flow measurement apparatus (head loss).	14	
Final Examination	Week 15	
Final Examination	Week 16	
- **Examinations (question design):** **The following is an example of the examination and its answer:**		

Ministry of Higher Education & Scientific Research

Erbil Polytechnic University

Erbil Technology College.

Dept. of Petroleum Technology

Final Exam-1st Attempt

Stage: First (MORNING)

Fluid Mechanics (Theo.)

Time: 2 hours

Date: Code: 05FLM 205 / 06 /2018 Tuesday

Academic Year: 2017 – 2018

10 Marks

Q1/ a - Fill the symbol, scalars, unit, factor and vectors columns with necessary information?

#	Secondary Units	Symbol	Unit
1	Density		
2	Viscosity		
	Prefix	Symbol	Factor
3	Tera		
		Scalars	*Vectors*
4	Temperature		
5	Velocity		

b - Determine the resultant and its angle of the three forces acting on the bracket shown in Fig.1?

15 Marks

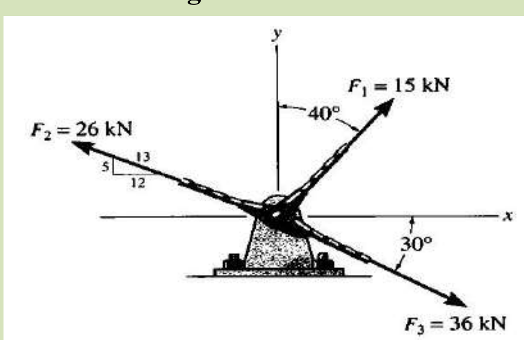


Fig.1

Q_2/ Determine the coordinates of the centroid of the shown shaded area below in

25 Marks

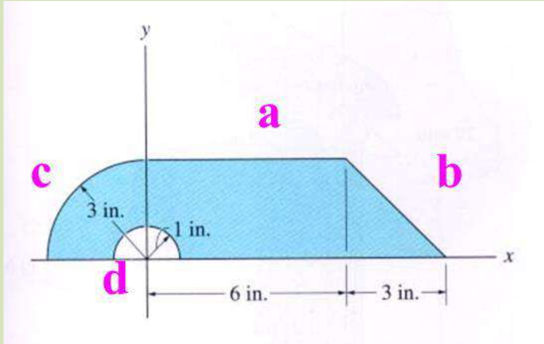


Fig.2

Fig.2?

Q3/ a - Determine the specific weight, density and specific gravity of a liquid that occupies a volume of 210 lit. , and weighs 179 kg. Will this fluid float on the surface of an oil of specific gravity (0.8)? Provide results in SI units?

15 Marks

b - A fluid moves along length 0.080 m with velocity 35 m/s and has shearing stress of 0.45 N/m^2, what are the dynamic viscosity (μ) of the liquid and the kinematic viscosity (□)?

10 Marks

Q4/ What diameter of clean glass tubing is required so that the rise of water at 20°C in a tube due to a capillary action is less than 1.0 mm if you know the value of surface tension (σ = 0.0728 N/m) for water at 20°C and γ water = 9.789 KN/m^3 ?

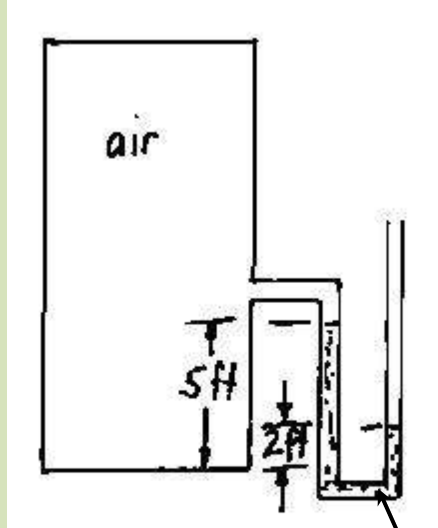
25 Marks

Q5/ a - Calculate the change in water pressure (D from the surface of water to the depth of 30 feet)?

10 Marks

b - A water-filled U-tube manometer is used to measure the pressure inside a tank that contains air shown in Fig.3. The water level in the Utube on the side that connects to the tank is 5 ft above the base of the tank. The water level in the other side of the U-tube (which is open to the atmosphere) is 2 ft above the base, Determine the pressure within the tank use γ water = 62.4 lb/ft^3?

15 Marks



water

Fig.3

<u>NOTE: - ANSWER ONLY FOUR (4) QUESTIONS</u>

GOOD LUCK AND BEST WISHES

Dr.Abdulfattah Ahmad Amin

Lecturer

Extra notes:		
This Course catalogue has been prepared by: Assistant Professor Dr. Abdulafattah Ahmed Amin. **External Evaluator:** Assist. Prof. Mr.Basil Younis Mustaffa		

ANSWERS OF – (*MORNING*)

Fluid Mechanics- Final Exam-1st Attempt / Petroleum Technique Dept.-2017-2018

Secondary Units	Symbol	Unit
Density	▯	kilogram/meter^3 (kg/m^3)
Viscosity	▯	kg/(m.s)
Tera	T	1 000 000 000 000 = 10 ^{12} (e+12)
	Scalars	*Vectors*
	Temperature	
		Velocity

Secondary Units	Symbol	Unit
Density	▯	kilogram/meter^3 (kg/m^3)
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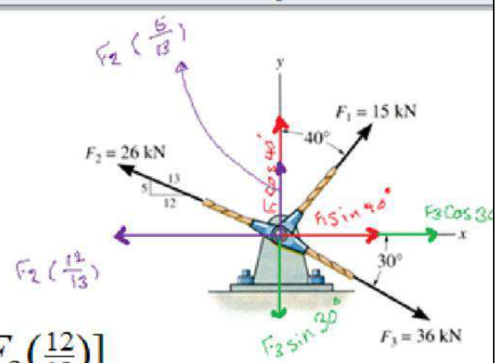
Tera	T	1 000 000 000 000 = 10 ^{12} (e+12)
	Scalars	*Vectors*
	Temperature	
		Velocity

Q1-a:-

Q1-b:-



$$F_{Rx} = \sum F_x$$

$$F_{Ry} = \sum F_y$$

$$F_{Rx} = F_1 \sin 40^0 + F_3 \cos 30^0 + [-F_2(\tfrac{12}{13})]$$

$$F_{Rx} = 15\times 0.6427 + 36\times 0.866 - 26\times 0.923 \quad \boxed{F_{Rx} = 16.818KN}$$

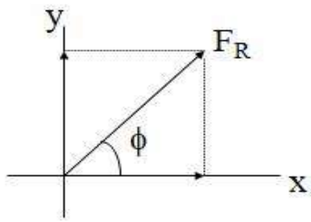
$$F_{Ry} = F_1 \cos 40^0 + (F_3 \sin 30^0) + F_2(\tfrac{5}{13})$$

$$F_{Ry} = 15\times 0.766 - 36\times 0.5 + 26\times 0.384 \quad \boxed{F_{Ry} = 3.49KN}$$

EXAMPLE (continued)

$$F_R = \sqrt{F_{Rx}^2 + F_{Ry}^2} = \sqrt{(16.82KN)^2 + (3.49KN)^2} = 17.2KN$$

$$\phi = Tan^{-1}[\frac{F_{Ry}}{F_{Rx}}] = \frac{3.49KN}{16.82KN} = 11.7^0$$

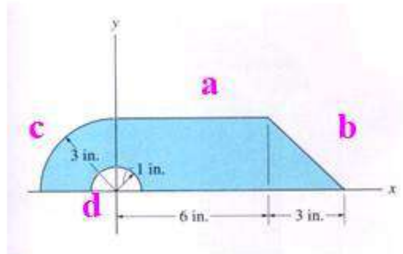


Q2:-

Solution:

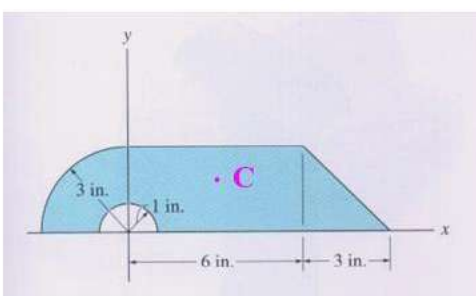
1. This body can be divided into the following pieces: rectangle (a) + triangle (b) + quarter circular (c) – semicircular area (d)

Steps 2 & 3: Make up and fill the table using parts a, b, c, and d.



Segment	Area A (in^2)	$\tilde{x}$ (in)	$\tilde{y}$ (in)	$A\tilde{x}$ (in^3)	$A\tilde{y}$ (in^3)
Rectangle	18	3	1.5	54	27
Triangle	4.5	7	1	31.5	4.5
Q. Circle	$9\pi / 4$	$-4(3) / (3\pi)$	$4(3) / (3\pi)$	-9	9
Semi-Circle	$-\pi / 2$	0	$4(1) / (3\pi)$	0	$-2/3$
Σ	28.0			76.5	39.83

EXAMPLE
(continued)



4. Now use the table data and these formulas to find the coordinates of the centroid.

$\bar{x} = (\Sigma \tilde{x} A) / (\Sigma A) = 76.5\ in^3 / 28.0\ in^2 = 2.73\ in$

$\bar{y} = (\Sigma \tilde{y} A) / (\Sigma A) = 39.83\ in^3 / 28.0\ in^2 = 1.42\ in$

Q3 – a:-

Solution:

Density(ρ): $\frac{178 \times 1000}{200} = 890\ kg/m^3$.

Specific weight(γ): $\frac{178 \times 9.81 \times 1000}{200} = 8730.9\ N/m^3$.

Specific gravity (S.G.): $\frac{890}{1000} = 0.89 > 0.80$

∴ This fluid will not float on the surface of an oil.

Q3-b:-

Solution:

Given: Shear velocity **u** = 30m/s, length **y** = 0.075m, shearing stress **τ** = 0.4N/m². The shearing stress is given by:

τ = μ . u/d

μ = **τ** . d/u

1. $\mu = 0.4 \frac{N}{m^2} \times \frac{0.075m}{30\frac{m}{s}}$ ➡ **μ** = 0.001 N.s/m² ***or*** Pa.s (dynamic viscosity)

Q4

From Eq. 1.16

$$h = \frac{2\sigma \cos\theta}{\gamma R}$$

so that

$$R = \frac{2\sigma \cos\theta}{\gamma h}$$

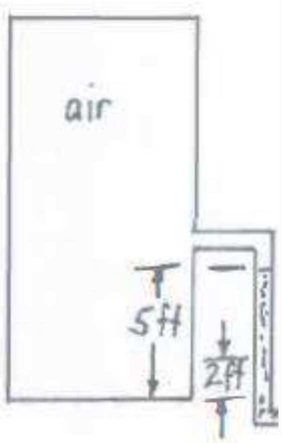
For water at 20 °C (from Table B.2), $\sigma = 0.0728$ N/m and $\gamma = 9.789$ kN/m^3. Since $\theta \approx 0°$ it follows that for $h = 1.0$ mm,

$$R = \frac{2(0.0728 \text{ N/m})(1)}{(9.789 \times 10^3 \text{ N/m}^3)(1.0 \text{ mm})(10^{-3} \text{ m/mm})} = 0.0149 \text{ m}$$

and the minimum required tube diameter, D, is

$$D = 2R = 0.0298 \text{ m} = 29.8 \text{ mm} \qquad \textbf{(Ans)}$$

Q5 -b



$$p_{air} + \gamma_{H_2O}(5 \text{ ft}) - \gamma_{H_2O}(2 \text{ ft}) = 0$$

or

$$p_{air} = -(3 \text{ ft})\gamma_{H_2O} = -(3 \text{ ft})(62.4 \tfrac{lb}{ft^3})$$

$$= -187 \tfrac{lb}{ft^2}$$