NANYANG TECHNOLOGICAL UNIVERSITY

Teaching, Learning and Pedagogy Division

Reg. No. 200604393R

COURSE OUTLINE FOR STUDENTS AT NTU

Academic Year	2018/19	**Semester**	1 & 2
Course Coordinator	Assistant Professor Marcos (Semester 1) Assistant Professor Wu Yanhua (Semester 2)		
Course Code	MA2003		
Course Title	Introduction to Thermo-fluids		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	Lectures: 26 hours Tutorials: 13 hours		
Proposal Date	17 May 2018		

Course Aims

This is a core mechanical engineering course covering the basic concepts and principles of thermodynamics and fluid mechanics. You will be taught how to determine the thermodynamic properties of substances, evaluate closed systems and steady-flow open systems of basic thermodynamic devices and processes on the basis of the first law of thermodynamics. You will also be introduced to the concepts of pressure in fluid and hydrostatic forces on submerged surfaces. The principles of fluid flow are demonstrated through the applications of the Bernoulli's equation and the mass continuity equation. System and control volume concepts will be introduced.

Intended Learning Outcomes (ILO)

Upon successful completion of the course, you will be able to:

1. Evaluate the thermodynamic properties for water/steam, major refrigerants such as R134a and ideal gas.
2. Describe and analyze basic thermodynamic systems and their interactions with the surroundings.
3. Perform energy balances (1st law analysis) for closed systems and steady state control volumes.
4. Describe fluid pressures and their measurements using manometers,
5. Determine hydrostatic forces on flat and curved surfaces and the stability of floating bodies,
6. Apply bernoulli's equation to fluid flow problems for the determination of unknown variables, and
7. Apply the mass continuity and energy equations to solve physical flow problems.

Course Content

	Topic	Hours
1.	**Basic Concepts and Properties of Pure Substances** Closed system and control volume. Property, state and equilibrium, process and cycle. Phase change. State principle. P-v-T relation. Property diagrams. Use of property tables. Ideal gas equations of state and deviations.	6
2.	**Energy and The First Law of Thermodynamics** Work and heat transfer. Energy balance for a closed system. Internal energy, enthalpy and specific heats. Ideal gas and incompressible substance models. Energy analysis of cycles. Mass and energy balance for a control volume. Analysis of steady state control volume devices.	7
3.	**Submerged Surfaces and Bodies** Pressure and manometer. Hydrostatic forces on plane and curved surfaces. Buoyancy and stability of floating bodies. Fluids in rigid-body motion.	7
4.	**Elementary Fluid Dynamics** Description of fluid motion. Classification of flow. Bernoulli's equation and its applications. System and control volume. Continuity equation. Energy equation. Flow measuring devices.	6

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/ Individual	Assessment rubrics
1. Continuous Assessment 1 – Quiz 1	LO1, LO2,	*EAB SLO a, b, c, d*	20%	Individual	
2. Continuous Assessment 2 – Quiz 2	LO4, LO5,	*EAB SLO a, b, c, d*	20%	Individual	
3. Final Examination – Closed Book; 2.5hrs	LO1-LO7	*EAB SLO a, b, c, d, l*	60%	Individual	
Total			100%		

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Formative feedback

Solutions to the quizzes will be discussed after the quiz to provide feedbacks and highlight common misconceptions.

General feedback for your performance as a cohort will be provided at the end of the course.

You are encouraged to contact the instructors for constructive feedbacks.

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Lecture	Theory and content knowledge are presented and explained. Examples to highlight the concepts are discussed.
Tutorial	Tutorial problems are solved and discussed in class. Students are encouraged to ask questions.

Reading and References

Textbook

1. Yunus A. Cengel and Michael A. Boles. Thermodynamics: An Engineering Approach, 7th Edition, McGraw-Hill, NY, 2011, ISBN 978-007-131111-3.

2. Munson, B R, Young, D F and Okiishi, T H, Fundamentals of Fluid Mechanics, 5th Edition, John Wiley, 2006.

References

Nil

Course Policies and Student Responsibilities

As a student of the course, you are required to abide by both the University Code of Conduct and the Student Code of Conduct. The Codes provide information on the responsibilities of all NTU students, as well as examples of misconduct and details about how students can report suspected misconduct.

The university also has the Student Mental Health Policy. The Policy states the University's commitment to providing a supportive environment for the holistic development of students, including the improvement of mental health and wellbeing. These policies and codes concerning students can be found in the following link.
http://www.ntu.edu.sg/SAO/Pages/Policies-concerning-students.aspx

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

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Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Basic Concepts and Definitions 1.1 Definition and Application Areas 1.2 Closed and Open Systems 1.3 Properties of a System 1.4 State and Equilibrium 1.5 State Postulate 1.6 Process and Cycle 1.7 Forms of Energy 1.8 Dimension and Units 1.9 Temperature Scale	LO1	Textbook examples 1.1 to 1.9 Lecture note examples
2	Properties of Pure Substances and Ideal Gas Equation 2.1 Pure Substances 2.2 Phases 2.3 Phase Change 2.4 Property Diagrams 2.5 Property Tables	LO1	Textbook examples 3.1 to 3.12 Lecture note examples
3	Properties of Pure Substances and Ideal Gas Equation (cont'd) 2.6 Ideal Gas Equation of State 2.7 Deviation from Ideal Gas Behavior 2.8 Specific Heats 2.9 Specific Heats for Ideal Gas Model 2.10 Specific Heats for Incompressible Substance Model (for solids and liquids)	LO1, LO2, LO3	Textbook examples 3.1 to 3.12 Lecture note examples
4	Energy Transfer by Heat and Work; First Law for Closed System 3.1 Energy Concepts 3.2 Heat Transfer 3.3 Energy Transfer by Work 3.4 Mechanical Forms of Work 3.5 Non mechanical forms of Work 3.6 First Law of Thermodynamics	LO1, LO2, LO3	Textbook examples, 2.3 to 2.7, 2.9, 4.1 to 4.13 Lecture note examples

5	Energy Transfer by Heat and Work; First Law for Closed System (cont'd) 3.7 Energy Balance for Closed Systems Mass and Energy Analysis of Control Volumes 4.1 Conservation of Mass Principle 4.2 Energy Transfer by Mass Flow 4.3 First Law for Control Volumes (Flow Systems)	LO1, LO2, LO3	Textbook examples 4.1 to 4.13
6	Mass and Energy Analysis of Control Volumes (cont'd) 4.4 Mass and Energy Balance for Steady-State, Steady-Flow Control Volumes (SSCVs) 4.5 Some Steady-Flow Engineering Devices 4.6 Unsteady Flow Processes (qualitative treatment only) 4.7 Cycles	LO1, LO2, LO3	Lecture note examples
7	Introduction to Fluids Properties of fluid	LO4	1.1, 1.3, 1.4, 1.6, 1.8
9	Fluids at Rest Free surface, hydrostatic pressure, pressure variation Manometer, forces on surfaces.	LO4, LO5	2.1 to 2.8
10	Forces on surfaces Buoyancy and Stability	LO4, LO5	2.8 to 2.11
11	Fluids in Rigid Body Motion Linear and rotational motion	LO4, LO5	2.12 to 2.13
12	Bernoulli's Equation Assumptions and concepts, static, dynamic, stagnation pressure Application to Bernoulli's Equation (1) Pitot-static tube, confined flow, conservation of mass	LO6, LO7	3.1 to 3.6, 5.1
13	Application to Bernoulli's Equation (2) Vapor pressure and cavitation System and Control Volumes Reynolds transport theorem	LO6, LO7	3.8 to 3.9, 4.3 to 4.4, 5.1