UNIVERSITI MALAYSIA PERLIS

TEACHING PLAN

Faculty	Faculty of Mechanical Engineering and Technology	**Course Coordinator**	Ts. Dr. Tan Wee Choon	L	
Course Code	MMJ10403	**Teaching Team** Lecturer – (L) Teaching Engineer – (TE) Assistant Engineer – (AE)	Assoc. Prof. Ir. Ts. Dr. Nasrul Amri Mohd Amin	L	
Course Name	Thermodynamics I		Ts. Mohd Asrul Bin Md Saad	TE	
No. of Credit	3				
Academic Session	2022/2023				
Semester	2				
Programme	1. Bachelor of Mechanical Engineering 2. Bachelor of Manufacturing Engineering				
Prerequisite	-	**Groups**	Group 1: Bachelor of Mechanical Engineering (72 students) Group 2: Bachelor of Manufacturing Engineering (1 student)		

A. CONTINUOUS QUALITY IMPROVEMENT (*Please skip this section for first time offering*)

Suggestion from the previous CER	Action plan for this semester
Syllabus Contents	
-	-
Delivery Methods	
No change	- Online async clinic sessions will be given to those who has interest. Not compulsory to all students.
Assessments	
Give additional Quiz to student just to ensure that they understand the lecture along the lecturing weeks for CO3.	- The average percentage for Q3 and Q4 of final exam (that are mapped to CO3) are 65.96% and 35.6%, respectively. No other assessment was conducted in sem 1 academic session 2022/2023. However, based on the CER of MMJ10403 in sem 1 academic session 2021/2022, 1 additional quiz and 1 additional assignment were proposed in sem 2 academic session 2021/2022. Such implementation was reported in the CER of MMJ10403 in sem 2 academic session 2021/2022, however it is not being implemented in sem 1 academic session 2022/2023. - Introduce 1 quiz and 1 assignment for CO3, which is similar with the practice in sem 2 session 2021/2022.
No change	- It is suggested to conduct the experiment of First Law of Thermodynamics (Open system) which is related to CO2. Therefore, the component of laboratory report in CO2 instead of both CO1 and CO2 for sem 1 session 2022/2023.
No change	- Original coursework marks distribution in sem 1 2022/2023 is laboratory reports 6 %, quizzes 6 %, assignment 8% and tests 20%. - Suggestion new coursework marks distribution in sem 2 2022/2023 is laboratory reports 3 %, quizzes 10 %, assignments 12% and tests 15% due to newly introduce coursework assessments for CO3.
Other Issue	
-	-

HEA-03 Status: [ ] **Completed** [/] **Not Applicable**

B. COURSE SUMMARY

(B1) Synopsis

This course covers the basic concepts in thermodynamic such as the properties of substances, energy principles, first and second law of thermodynamics which applicable in engineering applications. The course emphasizes the study of energy sources and conservation, enthalpy, entropy, ideal and real gas through its concept and principles.

(B2) Learning Outcomes Matrix

Course Outcomes (CO)		Level of Complexity	Programme Outcomes (PO)												Knowledge Profile (if related)
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	WK SK DK
CO1	Ability to analyse the properties of pure Substance.	C4	X												WK3
CO2	Ability to formulate energy balance accordingly to the first law of thermodynamics for a system.	C5	X												WK3
CO3	Ability to evaluate the second law of thermodynamics with entropy changes of substances in a system.	C5		X											WK3

(B3) Assessment Contribution

Components	Percentage (%)
Final Examination	60
Continuous Assessment	40

(B4) List of Experiments

No.	Title / Topic	Open Ended
1	Lab 1: Marcet Boiler	/
2	Lab 2: Temperature measurement	/
3	Lab 3: First Law of Thermodynamics (Open system)	/

(B5) List of Text Books / References

No.	Text Book / References
1	Cengel, Y. A., Boles, M. A., & Kanoglu, M. (2020). Thermodynamics: an engineering approach, 9th Edition in SI unit. New York: McGraw-hill.
2	Saggion, A., Faraldo, R., & Pierno, M. (2019). Thermodynamics: Fundamental Principles and Applications. Springer Nature.

C. TEACHING PLAN

Week	Topic	Taxonomy Domain	Delivery Activities	Assessment Activities	Notes
1	**Basic Concepts of Thermodynamics** Introduction, Dimensions and Units, Closed and Open System, Properties of a System, State and Equilibrium, Process and Cycles, Temperature and Zeroth Law of Thermodynamics, Measuring Devices.	Cognitive C4	Lecture		
2	**Properties of Pure Substance** Phases of Pure Substances, Phase-Change Processes of Pure Substances, Property Diagrams, Property Tables, The Ideal-Gas Equation of State, Compressibility Factor and other Equations of State.	Cognitive C4	Lecture		
3	Cont			Quiz 1	
4	**Energy Transfer** Forms of Energy, Energy Transfer by Heat, Work and Mass, Forms of Work.	Cognitive C5	Lecture		
5	MID TERM BREAK				
6	Cont			Test 1 Assignment 1 (due)	
7	**First Law of Thermodynamics** The First Law of Thermodynamics, Energy Balanced for Closed System, Specific Heats, Conservation of Mass Principle, Energy Balanced for Steady-Flow System, Steady-Flow Engineering Devices, Energy Balanced for Unsteady-Flow Processes.	Cognitive C5	Lecture		
8	Cont				
9	Cont		Laboratory		
10	Cont			Laboratory Report	
11	**Second Law of Thermodynamics** Introduction, Thermal Energy Reservoirs, Heat Engines, Energy Conversion Efficiencies, Refrigerators and Heat Pumps, Reversible and Irreversible Processes, The Carnot Cycle and Principles, The Carnot Heat Engine, The Carnot Refrigerator and Heat Pump.	Cognitive C5	Lecture	Quiz 2 Assignment 2 (due)	
12	Cont			Test 2	
13	**Entropy** Entropy and Entropy Change of Pure Substances, Isentropic Processes, Property Diagrams involving Entropy, The T ds Relations, Entropy Change of Liquids, Solids and Ideal Gases, Reversible Steady-Flow Work, Isentropic Efficiencies of Steady-Flow Devices, Entropy Balance.	Cognitive C5	Lecture		

Week	Topic	Taxonomy Domain	Delivery Activities	Assessment Activities	Notes
14	Cont			Quiz 3	
15	Cont			Assignment 3 (due)	
16	Study week				
17	Exam week			Final exam	
18	Exam week				
19	Exam week				

D. ASSESSMENT COMPONENTS

Course Outcomes (CO)		Level of Complexity	Programme Outcomes	Assessment Components & Contribution						
				Components	Group (G) Individual (I)	Engineering Problems (WP, SP, DP)	Engineering Activities (EA, TA, NA)	Final Examination (FE)	Continuous Assessment (CA)	Total
								%	%	%
CO1	Ability to analyse the properties of pure Substance.	C4	PO1	Quiz 1	I				4	**30.5**
			PO1	Assignment 1	I				4	
			PO1	Test 1	I				7.5	
			PO1	Final Exam Q1	I			15		
CO2	Ability to formulate energy balance accordingly to the first law of thermodynamics for a system.	C5	PO1	Quiz 2	I				3	**32.5**
			PO1	Assignment 2	I				4	
			PO1	Laboratory Report	I				3	
			PO1	Test 2	I				7.5	
			PO1	Final Exam Q2	I			15		
CO3	Ability to evaluate the second law of thermodynamics with entropy changes of substances in a system.	C5	PO2	Quiz 3	I				3	**37**
			PO2	Assignment 3	I				4	
			PO2	Final Exam Q3	I			15		
			PO2	Final Exam Q4	I	WP1, WP3		15		
Total				**Individual (I) %**	**100**			**60**	**40**	**100**
				Group (G) %	**0**					

Summary of the assessment distribution:

Assessment	Distribution (%)	Components	Percentage (%)
Examination	60	Final Exam	60
Continuous Assessment	40	Quizzes	10
		Assignments	12
		Laboratory Report	3
		Tests	15

E. OTHER INFORMATION (IF ANY)

Please state other relevant information

Items	**Notes**
Sustainable Development Goals (SDGs)	**SDG-7 Affordable and Clean Energy** Related Topics: Energy Transfer **SDG-13 : Climate Action** Related Topics: 2nd Law of Thermodynamics

Knowledge Profile (WK, SK, DK)

Profile	Engineering	Engineering Technology	Engineering Technician
Natural sciences	**WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline.	**SK1:** A systematic, theory-based understanding of the natural sciences applicable to the sub-discipline	**DK1:** A descriptive, formula-based understanding of the natural sciences applicable in a sub-discipline
Mathematics	**WK2:** Conceptually-based mathematics, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline.	**SK2:** Conceptually-based mathematics, numerical analysis, statistics and aspects of computer and information science to support analysis and use of models applicable to the sub-discipline	**DK2:** Procedural mathematics, numerical analysis, statistics applicable in a sub discipline
Engineering fundamentals	**WK3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	**SK3:** A systematic, theory-based formulation of engineering fundamentals required in an accepted sub-discipline	**DK3:** A coherent procedural formulation of engineering fundamentals required in an accepted sub-discipline
Specialist knowledge	**WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.	**SK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for an accepted sub-discipline.	**DK4:** Engineering specialist knowledge that provides the body of knowledge for an accepted sub-discipline
Engineering design	**WK5:** Knowledge that supports engineering design in a practice area.	**SK5:** Knowledge that supports engineering design using the technologies of a practice area	**DK5:** Knowledge that supports engineering design based on the techniques and procedures of a practice area
Engineering knowledge	**WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.	**SK6:** Knowledge of engineering technologies applicable in the sub-discipline	**DK6:** Codified practical engineering knowledge in recognised practice area.
Identified issues	**WK7:** Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability.	**SK7:** Comprehension of the role of technology in society and identified issues in applying engineering technology: ethics and impacts: economic, social, environmental and sustainability	**DK7:** Knowledge of issues and approaches in engineering technician practice: ethics, financial, cultural, environmental and sustainability impacts
Research literature	**WK8:** Engagement with selected knowledge in the research literature of the discipline.	**SK8:** Engagement with the technological literature of the discipline	

Range of Problem Solving (WP, SP, DP)

Attributes	Engineering	Engineering Technology	Engineering Technician
	Complex Engineering Problems have characteristic WP1 and some or all of WP2 to WP7:	*Broadly-defined Engineering Problems have characteristic SP1 and some or all of SP2 to SP7:*	*Well-defined Engineering Problems have characteristic DP1 and some or all of DP2 to DP7:*
Depth of Knowledge Required	**WP1:** Cannot be resolved without in-depth engineering knowledge at the level of one or more of WK3, WK4, WK5, WK6 or WK8 which allows a fundamental-based, first principles analytical approach.	**SP1:** Cannot be resolved without engineering knowledge at the level of one or more of SK 4, SK5, and SK6 supported by SK3 with a strong emphasis on the application of developed technology	**DP1:** Cannot be resolved without extensive practical knowledge as reflected in DK5 and DK6 supported by theoretical knowledge defined in DK3 and DK4
Range of conflicting requirements	**WP2:** Involve wide-ranging or conflicting technical, engineering and other issues.	**SP2:** Involve a variety of factors which may impose conflicting constraints	**DP2:** Involve several issues, but with few of these exerting conflicting constraints
Depth of analysis required	**WP3:** Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models.	**SP3:** Can be solved by application of well-proven analysis techniques	**DP3:** Can be solved in standardised ways
Familiarity of issues	**WP4:** Involve infrequently encountered issues.	**SP4:** Belong to families of familiar problems which are solved in well-accepted ways	**DP4:** Are frequently encountered and thus familiar to most practitioners in the practice area
Extent of applicable codes	**WP5:** Are outside problems encompassed by standards and codes of practice for professional engineering.	**SP5:** May be partially outside those encompassed by standards or codes of practice	**DP5:** Are encompassed by standards and/or documented codes of practice
Extent of stakeholder involvement and level of conflicting requirements	**WP6:** Involve diverse groups of stakeholders with widely varying needs.	**SP6:** Involve several groups of stakeholders with differing and occasionally conflicting needs	**DP6:** Involve a limited range of stakeholders with differing needs
Interdependence	**WP7:** Are high level problems including many component parts or sub problems.	**SP7:** Are parts of, or systems within complex engineering problems	**DP7:** Are discrete components of engineering systems

Range of Engineering Activities (EA, TA, NA)

Attribute	Complex Activities	Broadly-defined Activities	Well-defined Activities
	Complex activities means (engineering) activities or projects that have some or all of the following characteristics:	*Broadly defined activities means (engineering) activities or projects that have some or all of the following characteristics:*	*Well-defined activities means (engineering) activities or projects that have some or all of the following characteristics:*
Range of resources	**EA1:** Involve the use of diverse resources (and for this purpose resources includes people, money, equipment, materials, information and technologies).	**TA1:** Involve a variety of resources (and for this purposes resources includes people, money, equipment, materials, information and technologies)	**NA1:** Involve a limited range of resources (and for this purpose resources includes people, money, equipment, materials, information and technologies)
Level of interactions	**EA2:** Require resolution of significant problems arising from interactions between wide ranging or conflicting technical, engineering or other issues.	**TA2:** Require resolution of occasional interactions between technical, engineering and other issues, of which few are conflicting	**NA2:** Require resolution of interactions between limited technical and engineering issues with little or no impact of wider issues
Innovation	**EA3:** Involve creative use of engineering principles and research-based knowledge in novel	**TA3:** Involve the use of new materials, techniques or processes in non-standard ways	**NA3:** Involve the use of existing materials techniques, or processes in modified or new ways
Consequences to society and the environment	**EA4:** Have significant consequences in a range of contexts, characterised by difficulty of prediction and mitigation.	**TA4:** Have reasonably predictable consequences that are most important locally, but may extend more widely	**NA4:** Have consequences that are locally important and not far-reaching
Familiarity	**EA5:** Can extend beyond previous experiences by applying principles-based approaches.	**TA5:** Require a knowledge of normal operating procedures and processes	**NA5:** Require a knowledge of practical procedures and practices for widely-applied operations and processes.

Learning Domains

Cognitive (Revised Bloom, 2000)		**Psychomotor** (Simpson, 1972)		**Affective** (Krathwohl, 1973)	
C1	Remembering	P1	Perception	A1	Internalizes Values
C2	Understanding	P2	Set	A2	Organization
C3	Applying	P3	Guided Response	A3	Valuing
C4	Analysing	P4	Mechanism	A4	Responds to Phenomena
C5	Evaluating	P5	Complex Overt Response	A5	Receiving Phenomena
C6	Creating	P6	Adaptation		
		P7	Origination		

Sustainable Development Goals (SDGs) - *https://sdgs.un.org/goals*

SDG-1 : No Poverty
SDG-2 : Zero Hunger
SDG-3 : Good Health and Well-being
SDG-4 : Quality Education
SDG-5 : Gender Equality
SDG-6 : Clean Water and Sanitation
SDG-7 : Affordable and Clean Energy
SDG-8 : Decent Work and Economic Growth
SDG-9 : Industry, Innovation and Infrastructure
SDG-10 : Reduced Inequality
SDG-11 : Sustainable Cities and Communities
SDG-12 : Responsible Consumption and Production
SDG-13 : Climate Action
SDG-14 : Life Below Water
SDG-15 : Life on Land
SDG-16 : Peace and Justice Strong Institutions
SDG-17 : Partnerships to achieve the Goal

Entrepreneurship Integrated Education - *https://sqm.unimap.edu.my/images/pdf/BUKU_EIE.pdf*