COURSE PACKAGE

Part A: Course Specifications

Course Code	:	Thermo					
Course Descriptive Title	:	Thermodynamics					
Prerequisite	:	NGEC 9		**Corequisite**	:	None	
Year Level	:	First Year		**Semester Offered**	:	Second Semester	
Course Credits	:	6 units	**Theoretical Contact Hours Per Week**	:	6 hours	**Demonstration/ Practical Work Contact Hours Per Week**	: None
Course Description	:	The course provides theoretical knowledge as required by the STCW Code. This course deals with the thermodynamic properties, thermodynamic energy, thermodynamic systems, energy changes, heat transfer, vapors, ideal gases, thermodynamic process, and work transfer.					

STCW Reference :

STCW Table	Function	Competence	Knowledge, Understanding, and Proficiency
Specific underpinning knowledge and understanding under Table III/2 of the STCW Code are incorporated to the Course.			
A-III/2	Marine engineering at the management level	Plan and schedule operations	*Theoretical knowledge* Thermodynamics and heat transmission Heat cycle, thermal efficiency, and heat balance of the following: .1 marine diesel engine .2 marine steam turbine .3 marine gas turbine .4 marine steam boiler Refrigerators and refrigeration cycle

Course Outcome	:	PO-E.4-.5 PO-E.8-.9	*At the end of the course, the student must be able to:* **CO1.** Apply principles of thermodynamics in solving problems relating to heat balance of the various cycles
Course Intake Limitations	:	The number of students that can be accommodated shall not exceed 40 per lecture.	
Faculty Requirement	:	***Instructor*** The faculty that will be assigned to handle the Course must possess the following qualifications: • graduate of Bachelor of Science in Marine Engineering; • Officer-in-charge of an Engineering Watch on seagoing ships powered by propulsion machinery of 750 kW propulsion power or more; • completed Training Course for Instructors (IMO Model Course 6.09); • completed Training Course on Assessment, Examination and Certification of Seafarers (IMO Model Course 3.12); OR • Registered professional holding a bachelor's degree in Mechanical Engineering with Master's degree in the same discipline; • with at least one (1) year industrial and/or teaching experience; • completed Approved Training Course for Instructors (IMO Model Course 6.09); • completed Approved Training Course on Assessment, Examination and Certification of Seafarers (IMO Model Course 3.12); OR • Registered professional holding a bachelor's degree in Mechanical Engineering; • completed Approved Training Course for Instructors (IMO Model Course 6.09); • completed Approved Training Course on Assessment, Examination and Certification of Seafarers (IMO Model Course 3.12); ***Assessor*** The assessor assigned shall have the same qualifications above. *Note:* 1. *The instructor shall conduct the formative assessment.* 2. *Summative assessment shall be conducted by an Assessor not teaching the students (assessee).*	
Teaching Facilities and Equipment	:	**CLASSROOM** The standard classroom size shall be a minimum of 48 square meters; no side shall be less than 6 meters for a class of 40 students. A classroom must be illuminated at 50.76 Lux and well-ventilated. It should contain the following: • Tables and chairs or armed chairs • Whiteboards or chalkboards • Multimedia equipment	

		• Scientific Calculator *(shall be provided by the student)* *Note: The MHEIs can use additional teaching facilities and equipment as deemed necessary to meet the learning outcomes of this course.*
Teaching Aids	:	**TA1** Heat Transfer **TA2** Mechanisms of Heat Transfer **TA3** Thermal Properties of Matter **TA4** First Law of Thermodynamics **TA5** Second Law of Thermodynamics **TA6** Third Law of Thermodynamics **TA7** Zeroth Law of Thermodynamics **TA8** Heat Cycles *Note: The MHEIs can use alternate and/or additional teaching aids as deemed necessary to meet the learning outcomes of this course.*
References/ Bibliographies	:	**References:** **R1** Officer in Charge of an Engineering Watch (IMO Model Course 7.04) **R2** Chief Engineer Officer and Second Engineer Officer (IMO Model Course 7.02) **R3** Hannah - Hillier, J. *Applied Mechanics*. Harlow, Longman 1995. (ISBN 0582 25632.1 **R4** Jackson, L and Morton, T.D. *General Engineering Knowledge for Marine Engineers*. 5th ed. London, Thomas Reed Publications Ltd 1990. (ISBN 0947 637.761) **R5** Joel, R. *Basic Engineering Thermodynamics in SI Units*. 4th ed. Harlow, Longman, 1996 (ISBN 0582 41626 4) **R6** Sears, F.W., Zemansky M.W., Young H.D. (1992); College Physics 7th Edition; Addison-Wesley Publishing Company **R7** Powers, Joseph M. (2021), Lecture Notes on Thermodynamics; Department of Aerospace and Mechanical Engineering, University of Notre Dame; https://www3.nd.edu/~powers/ame.20231/notes.pdf *Note: The MHEIs can use alternate and/or additional references/bibliographies as deemed necessary to meet the learning outcomes of this course.*

Part B: Course Outline and Timetable

Term	Week	Topic	Time Allotment (in hours)	
			Theoretical	Demonstration / Practical Work
Note: MHEIs shall determine the number of periods for terms the semester is divided based on their school calendar activities	1	**1. Mechanisms of Heat Transfer** 1.1 Conduction 1.2 Convection 1.3 Radiation	6	-
	2 - 4	**2. Quantity of Heat** 2.1 Heat transfer 2.2 Heat capacity 2.3 Phase change	18	-
	5 – 8	**3. Thermal Properties of Matter** 3.1 Ideal Gases 3.2 Charles' Law 3.3 Boyle's Law 3.4 Combined Gas Law 3.5 Ideal Gas Law 3.6 Pressure – Volume Diagram 3.7 Phase Diagram	24	-
	9 - 12	**4. The Zeroth & First Law of Thermodynamics** 4.1 Energy, Heat and Work 4.2 Thermodynamic Processes 4.3 Zeroth Law of Thermodynamics 4.4 The First Law of Thermodynamics	24	-
	13 - 17	**5. The Second & Third Law of Thermodynamics** 5.1 Second Law of Thermodynamics 5.2 Third Law of Thermodynamics 5.3 Direction of Thermodynamic Process 5.4 Entropy 5.5 Enthalpy 5.6 Heat Engine and Internal-combustion Engine	30	-

Term	Week	Topic	Time Allotment (in hours)	
			Theoretical	**Demonstration / Practical Work**
		5.7 Otto and Diesel Cycle 5.8 Carnot engine and Carnot cycle 5.9 Refrigerator and refrigeration 5.10 Rankine and Brayton Cycle		
		Sub-total (Contact Hours)	**102**	-
		Total Contact Hours	**102**	
		Examination and Assessment		

Note:

1. *The MHEIs are to develop their respective timetable according to their resources but meets with the minimum time allocation for the contact hours. OR*
2. *The MHEIs shall determine the time allotment for the conduct of summative assessments.*

Part C: Course Syllabus

CO	Topics Learning Outcomes	References/ Bibliographies	Teaching Aids
CO1	**1. Mechanisms of Heat Transfer** 1.1 Explain the three mechanisms of heat transfer and identify examples and applications 1.2 Calculate parameters involving the three mechanisms of heat transfer	R6	TA1
	2. Quantity of Heat 2.1 Explain the principles of heat transfer, quantity of heat and heat capacity 2.2 Explain the process in measuring heat capacity 2.3 Explain the principles of phase change during heat transfer 2.4 Calculate parameters involving heat transfer	R6	TA2
	3. Thermal Properties of Matter 3.1. Explain the properties of ideal gases 3.2. Explain Charles' and Boyle's Law 3.3. Explain the Ideal and Combined Gas Law 3.4. Explain the purpose of pV – diagram for an ideal gas 3.5. Explain the important parameters of pV – diagram for an ideal gas 3.6. Explain the purpose of phase diagram or pT diagram 3.7. Explain the importance parameters of phase diagram 3.8. Calculate parameters involving ideal gases	R4, R5, R6	TA3
	4. The Zeroth & First Law of Thermodynamics 4.1. Explain the principles of the zeroth and first law of thermodynamics 4.2. Explain the relationship of energy, heat and work 4.3. Explain the relationship of work done and heat transfer with change in volume 4.4. Identify the work done in a thermodynamic system using pV – diagram 4.5. Explain the different thermodynamic processes 4.6. Calculate parameters in a system involving the first law of thermodynamics	R1, R2, R5, R6	TA4, TA7

CO	Topics Learning Outcomes	References/ Bibliographies	Teaching Aids
	5. The Second & Third Law of Thermodynamics 5.1. Explain the principles of the second and third law of thermodynamics 5.2. Explain the difference between reversible and irreversible thermodynamic process 5.3. Explain the difference between enthalpy and entropy 5.4. Explain the principles and fundamentals of a heat engine 5.5. Explain the principles and fundamentals of internal-combustion engine 5.6. Explain the difference between Otto cycle and Diesel cycle 5.7. Explain the principles and fundamentals of a refrigerator 5.8. Explain the principles and fundamentals of a Carnot engine 5.9. Explain the principles and fundamentals of Rankine cycle and Brayton cycle 5.10. Explain the parameters of a p H – diagram and pV diagram of a refrigeration cycle 5.11. Explain the purpose and the parameters of a Mollier diagram 5.12. Calculate parameters of a heat and internal-combustion engine 5.13. Calculate parameters of a refrigerator and Carnot engine 5.14. Calculate parameters of a steam engine 5.15. Calculate parameters of a gas turbine	R1, R2, R4, R5, R6	TA5, TA6, TA8

Note: The MHEIs are to develop Part D: Detailed Teaching Syllabus and Instructional Materials (IMs), and Part E: Course Assessment and Assessment Tools (ATs) which satisfactorily meets with the requirements of the course as prescribed in the course outcomes and learning outcomes.