COURSE PACKAGE

Part A: Course Specifications

Course Code	:	Mech						
Course Descriptive Title	:	Mechanics and Hydromechanics for Marine Engineering						
Prerequisite	:	NGEC 9		**Corequisite**	:	None		
Year Level	:	First Year		**Semester Offered**	:	Second Semester		
Course Credits	:	3 units	**Theoretical Contact Hours Per Week**	:	3 hours	**Demonstration/ Practical Work Contact Hours Per Week**	:	0 hours
Course Description	:	This Course provides the required theoretical knowledge and understanding as required by the STCW Code. The Course deals with mechanics such as statics, dynamics, friction, balancing, stress and strain, bending of beam, torsion. It also covers the basics of Hydromechanics such as volume, pressure, mass flow, venturi meters, Bernoulli's equation, Jet, orifice coefficients, dynamics and kinematic viscosity, Reynolds numbers, flow losses in pipes and fittings. This course is equivalent to the former Mechanics and Hydromechanics under JCMMC no.1 s2019.						

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 into the Course.			
		A-III/2	Marine engineering at the management level	Plan and schedule operations	*Theoretical knowledge* Mechanics and Hydromechanics

Course Outcome	:	*PO-B.1, B.3* *PO-C.2* *PO-E.1* *PO-E.4-.9* *PO-E.8-.9*	*At the end of the course, the student must be able to:* **CO1.** Apply mechanics principles and fundamentals to marine engineering **CO2.** Apply hydromechanics principles and fundamentals to marine engineering

	:	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; • with at least 12 months of seagoing experience as 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 disciple; • with at least one (1) year industrial and/or teaching experience; • 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; • 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); ***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. The 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 with modules containing PPT, videos, etc. • 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** Moment of Forces **TA2** Balancing **TA3** Stress and Strain **TA4** Bending of Beam **TA5** Torsion **TA6** Volume and Mass Flow **TA7** Venturi meter **TA8** Bernoulli's Equation **TA9** Jets, Orifice Coefficients **TA10** Dynamic and Kinematic Viscosity **TA11** Reynolds Number **TA12** Flow Losses in Pipes and Fittings *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** Applied Mechanics, 3rd Edition; Hanna and Hillier **R4** Fluid Mechanics, 4th Edition; Frank M. White **R5** Fluid Mechanics and Hydraulics; Schaum **R6** Reed's Volume 2: Applied Mechanics for engineers; William Embleton; revised by J.T. Gunn *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	1-2	*Mechanics* **1. Equilibrium in a Rigid Body** 1.1 Moment of Forces 1.2 Forces in a Rigid Body 1.3 The general conditions of equilibrium 1.4 Center of Gravity	6	-
	3	**2. Balancing** 2.1 Static balance-two masses in a plane 2.2 Dynamic balance-two masses in a plane 2.3 Static balance-several masses in one plane 2.4 Dynamic balance of several masses in one plane	3	-
	4-5	**3. Stress and Strain** 3.1 Relationship between stress and strain: Young's modulus of elasticity 3.2 Thermal strain and its effect 3.3 Stress in compound bars 3.4 Elastic strain energy	6	-
	6-7	**4. Bending of Beam** 4.1 Pure Bending of an elastic beam 4.2 Shear force and bending moment diagrams 4.3 Bending stresses 4.4 Strength of a beam in bending 4.5 Deflection of beams. Macaulay's method.	6	-
	8-9	**5. Torsion** 5.1 Stress, strain, and strain energy due to torsion 5.2 Torsion on a thin tube 5.3 Stiffness and strength 5.4 Power and torque	6	-
	10	**6. Volume and mass flow** 6.1 Fluid 6.2 Measurement of Pressure 6.3 Transmission of fluid pressure	3	-

Term	Week	Topic	Time Allotment (in hours)	
			Theoretical	Demonstration / Practical Work
		6.4 Pressure in a liquid due to its weight		
	11	**7. Venturi Meter** 7.1 Measurement of pipe flow rate 7.2 Coefficient of discharge for a Venturi meter	3	-
	12 - 13	**8. Bernoulli's Equation** 8.1 Conservation of energy 8.2 Pipe flow: equation of continuity 8.3 Variation in pressure head along a pipe 8.4 Pressure energy, Potential energy, Kinetic energy 8.5 Interchange of pressure and kinetic energy	6	-
	14	**9. Jets. Orifice coefficients** 9.1 Discharge through a small orifice 9.2 Power of a jet	3	-
	15	**10. Dynamic and kinematic viscosity** 10.1 Viscosity 10.2 Flow at low velocities 10.3 Onset of turbulence	3	-
	16	**11. Reynolds Number** 11.1 The Three regimes of viscous flow 11.2 Reynolds' sketches of pipe-flow transition	3	-
	17	**12. Flow losses in pipes and fittings** 12.1 Pressure loss in turbulent flow 12.2 Eddy formation	3	-
		Sub-total (Contact Hours)	**51**	-
		Total Contact Hours	**51**	
		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	***Mechanics*** **1. Equilibrium of a rigid body** 1.1 Explain the principles of moment of forces 1.2 Explain the type of contact forces on a rigid body 1.3 Explain the center of gravity of a body 1.4 Explain the second condition for equilibrium of a rigid body 1.5 Identify shipboard operations where forces in equilibrium are applied. 1.6 Calculate parameters relative to forces acting on a rigid body	R1, R2, R3, R6	TA1
	2. Balancing 2.1 Explain the center of gravity of two masses in a steady condition. 2.2 Identify onboard operation where static balance of two masses in a plane is applied. 2.3 Explain the center of gravity of two masses in motion 2.4 Identify onboard operation where dynamic balance of two masses in a plane is applied. 2.5 Explain the methods of balancing rotors by means of maintaining at rest in any position 2.6 Identify onboard operation where methods of balancing rotors is applied 2.7 Explain the dynamic balance of several masses to a rotating `shaft with angular velocity	R1, R2, R3, R6	TA2
	3. Stress and Strain 3.1 Define Stress and Strain 3.2 Classify between Stress and Strain. 3.3 Apply the principle of Young's modulus of elasticity 3.4 Identify onboard operation where principles of stress and strain is applied 3.5 Solve problems involving stress and strain 3.6 Explain the change of temperature of a material gives rise to thermal strain. 3.7 Identify onboard system thermal stress of a material is applied 3.8 Solve illustrative problem by applying thermal stress formula 3.9 Explain the stress of two or more members rigidly fixed together to share the same amount of load extend or compress. 3.10 Identify onboard stress of two or more material is applied	R1, R2, R3, R6	TA3

CO	Topics Learning Outcomes	References/ Bibliographies	Teaching Aids
	3.11 Solve illustrative problems by applying formula 3.12 Explain bar is elastic when work stored as an energy of deformation and is recoverable on removal of the load 3.13 Identify onboard system subjected to elastic strain energy 3.14 Solve illustrative problem by applying formula		
	4. Bending of Beam 4.1. Define Bending, shear, and deflection in terms of their forces. 4.2. Differentiate between bending and shear forces 4.3. Solve illustrative problem by applying formula 4.4. Explain shear forces and bending moment of a body in terms of their diagrams 4.5. Identify system on board related to shear and bending moment 4.6. Solve illustrative problems by applying formula 4.7. Explain bending stresses and apply its principles 4.8. Identify system onboard where bending stresses are applied 4.9. Solve illustrative problem to determine the bending stress in terms of Force when subjected to load 4.10. Explain the maximum strength of a beam in bending when subjected to load 4.11. Identify onboard system operation where the strength of a beam and other material is applied 4.12. Solved illustrative problem to determine the strength of beam in bending in terms of load force 4.13. Explain deflection of beams in terms of Macaulay's method 4.14. Identify onboard system operation where deflection of beam is determined 4.15. Solve illustrative problem using Macaulay's method	R1, R2, R3, R6	TA4
	5. Torsion 5.1. Differentiate between stress, torsion, and twisting in terms of their characteristic Force 5.2. Identify onboard system operation where stress, strain, and strain energy is applied 5.3. Solve problems such as torsion, twisting, and strain energy by applying formula 5.4. Explain the torsional Force of a tube in terms of its radius and its applied torque 5.5. Identify onboard system operation where torsion force of a tube is applied 5.6. Solve illustrative problem to determine the maximum torsional Force of a tube when subjected to torque 5.7. Explain the torsional rigidity of a shaft in terms of its angular twist and applied Force 5.8. Identify system onboard operation where stiffness and strength of a shaft is applied 5.9. Solve illustrative problem to determine maximum strength in terms of Force 5.10. Differentiate between power and torque in terms of torque per unit time and torsional angle	R1, R2, R3, R6	TA5

CO	Topics Learning Outcomes	References/ Bibliographies	Teaching Aids
	5.11. Identify system onboard operation where power and torque of a shaft is applied 5.12. Solved illustrative problem to determine the maximum power transmitted by a shaft in terms of the applied torque		
CO2	***Hydromechanics*** **6. Volume and Mass flow** 6.1. Define fluid 6.2. Identify between liquid and gas as fluid 6.3. Identify system onboard operation where fluid of a system is present 6.4. Solve illustrative problem to determine volume and mass flow in terms of its units 6.5. Define pressure in terms of its applied force and unit area of an enclosed system 6.6. Identify system onboard operation where pressure of a system is present 6.7. Solve illustrative problem where fluid of a system is present in terms of applied pressure 6.8. Explain how a fluid is transmitted when subjected to pressure 6.9. Identify system onboard operation where the transmitted fluid is present 6.10. Explain the mass of a liquid in a column when subjected to pressure 6.11. Identify system onboard system where the pressure in a column is present. 6.12. Solve illustrative problem by applying the formula to determine the total mass of a liquid in column	R1, R2, R4, R5, R6	TA6
	7. Venturi meter 7.1. Define venturi meter. 7.2. Identify system onboard where measurement of pipe flow rate is applied. 7.3. Solve problems to determine the flow rate of a liquid 7.4. Explain the Coefficient of discharge for a Venturi meter in terms of its flow rate	R1, R2, R4, R5, R6	TA7
	8. Bernoulli's equation 8.1. Define. Bernoulli's equation 8.2. Classify between pressure, potential, and kinetic energy. 8.3. Apply the Bernoulli's principle (Conservation of energy) 8.4. Solve problems by applying Bernoulli's equation and formula to determine the flow rate of liquid, pressure, potential, and kinetic energy. 8.5. Explain the volume of liquid passing any section per second in pipe flow 8.6. Solve illustrative problem to determine the pipe flow rate for a volume liquid 8.7. Explain the changes in pressure head along an enclosed pipe	R1, R2, R4, R5, R6	TA8

CO	Topics Learning Outcomes	References/ Bibliographies	Teaching Aids
	8.8. Identify system onboard where the changes in pressure head along a pipe is applied. 8.9. Solve illustrative problem involving changes in pressure 8.10. Differentiate between pressure, potential, and kinetic energy in term of their application 8.11. Identify system onboard where Pressure energy, Potential energy and Kinetic energy is applied 8.12. Solve problems by applying formula 8.13. Explain the interchange of pressure loss and gain of kinetic energy 8.14. Differentiate between pressure loss and gain of kinetic energy 8.15. Solve related problems applying formula to determine pressure loss and gain kinetic energy		
	9. Jet's Orifice Coefficients 9.1. Define the Coefficient of velocity. 9.2. Understand the Coefficient of discharge for a small orifice. 9.3. Solve problems such as discharge, velocity, impact of jets, and power of jets. 9.4. Explain the power of a jet in terms of velocity of the liquid and cross-sectional area of an enclosed pipe 9.5. Identify system onboard where application of jet power is applied 9.6. Solve an illustrative problem to determine the power of a jet in terms of its applied velocity and cross-sectional area of a pipe	R1, R2, R4, R5, R6	TA9
	10. Dynamic and Kinematic Viscosity 10.1. Define viscosity. 10.2. Identify system onboard where the viscosity of a liquid is applied 10.3. Solve an illustrative problem to determine the viscosity of a liquid according to its type and its applied temperature 10.4. Describe between viscosity, and flow at low velocities of a liquid 10.5. Cite onboard system all liquid that flow at low velocities 10.6. Solve illustrative problem to determine velocities of a liquid in terms of its viscosity 10.7. Explain the onset of turbulence in terms of disturbance of uniform flow due to high velocity 10.8. Cite onboard system operation that encountered onset of turbulence	R1, R2, R4, R5, R6	T10
	11. Reynold's Number 11.1. Cite the three regimes of Reynold's number 11.2. Explain the three regimes of dense in terms of their flow	R1, R2, R4, R5, R6	TA11
	12. Flow losses in pipes and fittings	R1, R2, R4, R5, R6	TA12

CO	Topics Learning Outcomes	References/ Bibliographies	Teaching Aids
	12.1. Explain the flow losses in pipes and fittings and pressure loss caused by a turbulent flow. 12.2. Cite onboard system some example of flow losses in pipes and fittings 12.3. Solve illustrative problems to determine losses of pipes and fittings in terms of its pressure 12.4. Explain the eddies formation due to sudden enlargement or contraction, rapid increase in pipe diameter, sharp bends, and valves. 12.5. Cite onboard system some example of eddy formation along pipes and other pipe systems		

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.