

Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

Expected Implementation in Academic Year (New format)	AY2019-2020
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Lee-Chua Lee Hong
Course Author Email	clhlee@ntu.edu.sg
Course Title	Maritime Technology
Course Code	MT2003
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

This course aims to equip students with knowledge that is essential to join a shore management team in the maritime industry, looking to understand the technology aspects onboard fleet vessels and how it relates to their day-to-day roles and functions.

In particular, it is useful for total ship management, brokering / chartering activities, shipping finance, trade and purchasing functions.

In addition, junior or new entrants to the shipping business who need to build their knowledge of shipboard technology will find the course extremely beneficial as they look to build their future career.

The course gives a real underpinning to the various technologies as prevailing and transforming the highly diversified maritime industry.

Finally, the course is of great benefit to others more generally related to maritime field, such as legal professionals, insurers, marine consultants and seafarers.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Describe the different aspects and topics in Maritime Technology,
ILO 2	Apply existing methods to problems in Maritime Technology,
ILO 3	Discuss limitations in present day approaches and perspectives in the future,
ILO 4	Identify the various technological applications to various fields of maritime industry
ILO 5	Model and evaluate technological innovations along with concepts of Digitalisation and Autonomy, as to apply into Maritime industry
ILO 6	Adopt system-oriented thinking to analyse complex systems for ship-shore management

Course Content

S/N	Topic	Lecture Hrs	Tutorial Hrs
1	Marine Fuels and properties. Alternative Fuels of the Future.	2	1
2	Shipboard Machinery & System 1 (Supply System and Deck Equipment)	2	1
3	Shipboard Machinery & System 2 (Cargo Equipment and Safety Equipment)	2	1
4	Marine Propulsion Plants	2	1
5	Performance Management and Maintenance Optimization	2	1
6	Fundamentals of ship design, and Propulsion Power – Conceptual design, Design comparison.	2	1
7	Shipbuilding and Ship repair technologies - Principles, processes & technologies of Shipbuilding and Ship repair industries.	2	1
8	Advanced Technologies – 3D printing, Robotics, Digitalisation, Blockchain	2	1
9	Hull Forms , Hydrostatics, and Stability	2	1
10	Technologies in Navigation, Safety at sea and Ship Operations	2	1
11	Maritime Search and Rescue (SAR) , Tracking technologies	2	1
12	Port Operations and Management System ,Concepts of SMART port	2	1
13	Marine communications , Information Technologies	2	1
Total:		26	13

Reading and References (if applicable)

1. Practical Ship Design by D. G. M. Watson
2. Ship Construction 7th Edition by George J Bruce (Author), David J Eyres (Author)
3. Marine Auxiliary Machinery – H.D McGeorge
4. Marine Auxiliary Machinery (Marine Engineering) 6th Edition by David W. Smith (Author), J. Crawford (Author), P. S. Moore (Author)
5. Hydrodynamics of Ship Propellers (Cambridge Ocean Technology Series) by Breslin/Andersen
6. Digitalization in Maritime and Sustainable Logistics by Wolfgang
7. Green Shipping Management (Shipping and Transport Logistics) 1st ed. 2016 Edition by Y.H. Venus Lun (Author), Kee-hung Lai (Author), Christina W.Y. Wong (Author), T. C. E. Cheng (Author)
8. Ship Hydrostatics and Stability Book, 2nd Edition 2013 by Authors: Adrian Biran and Pulido
9. Ship Stability for Masters and Mates ,7th Edition by Capt Derrett
10. Related IMO publications
11. Reports on maritime technologies and developments as prevailing in the industry

Any other add on resource from lecturers

Planned Schedule

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
1	Marine Fuels and properties; Alternative Fuels of the Future – Definition, Products, Process of Distillation, Properties – Density, Viscosity, Catfines , CCAI, LCV; ISO standards, Alternative fuels in Marine – LNG, Biofuel, Fuel Cell, Wind and Mixed Technologies and Zero emission	1, 3, 5, 6	In-person	Lectures & Tutorial	
2	Shipboard Machinery & System 1 (Supply System and Deck Equipment) - System components, Line Diagrams, Purification, Filtration, Cooling Water, Lube Oil, Compressed Air, Deck Equipment- Anchor, Mooring, Steering Gear and Rudder	1, 4, 5	In-person	Lectures & Tutorial	

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
3	Shipboard Machinery & System 2 (Cargo Equipment and Safety Equipment) – Ballast Equipment & System, Lifting Appliances, Container Equipment, Tanker Equipment, Reefer Vessels, Firefighting equipment, LSA, regulations, Fire extinguishers, Emergency Escape, International Shore Line, Lifeboat Appliances, Life Rafts, Hydrostatic Release, Rescue Boat	1, 4, 5	In-person	Lectures & Tutorial	
4	Marine Propulsion Plants, PIDs, Auxiliary Engines and Boiler - Engine principles, 4stroke/2stroke, engine parts, Turbochargers, Injectors, liner, piston; Mechanical/Electrical / Hybrid propulsion; Diesel/Steam/Gas engines; Fuel cells, Batteries, Nuclear & Sail; Azipod, PIDs- BB retrofit, Twisted rudder, Mewis duct	1, 4, 5	In-person	Lectures & Tutorial	

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
5	Performance Management and Maintenance Optimization – Performance Monitoring and Management; Software tool; Machinery Performance, Diagnosis, Hull/Propeller fouling, Optimum cleaning frequency, Trim Optimization, Charter party obligation and predictive tool, Crew behavior towards saving fuel, Risk based and condition-based maintenance, Maintenance optimization, Case studies & CBA.	1, 2, 3, 5, 6	In-person	Lectures & Tutorial	

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
6	Fundamentals of ship design, and Propulsion Power – Conceptual design, Design comparison, Basic dimensions and design ratios, Engine & Powering, Manoeuvrability & sea keeping. Cost estimate; Types of ships, Influencing factors. – size of locks, bridges, canals and water depth; Determination of length, breadth, depth and freeboard; Propulsion Power, Resistances – Frictional, Residual, Pressure, Viscous pressure, Wave making/breaking, Total Resistance; Holtrop & Mennen Method ; Factors affecting propeller efficiency.	1, 4, 5	In-person	Lectures & Tutorial	

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
7	<p>Shipbuilding and Ship repair technologies - Principles, processes & technologies of Shipbuilding and Ship repair industries; Basic and detail design; prefabrication, block erection & assembly, launching, sea trials and delivery of the vessel; Various types of ship/marine repairs, drydocking principles. Various innovative future technologies and their potential in future shipbuilding and repair technology</p>	1, 4, 5, 6	In-person	Lectures & Tutorial	
8	<p>Advanced Technologies – 3D printing, Robotics, Digitalisation, Blockchain. Power of big data and IOT (Internet of Things); Maritime digitalization technology, Next techno wave, IOT in shipping, open data platform and sharing. Application of digitalization technology, Digital Twin. Autonomous Shipping, Block chain, Robotics and 3D printing; Cyber Attack, Potential threats, Steps to defend.</p>	1, 3, 5, 6	In-person	Lectures & Tutorial	

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
9	Hull Forms , Hydrostatics, and Stability - Principles of stability ; Intact and Damage Stability - Center of floatation / Buoyancy - Longitudinal and transverse stability - Significance of metacentric height , Ship Equilibrium - Free surface effects , Parametric Rolling - Inclining experiments - Hull Forms in ship design - Ships Hydrostatics	1, 4, 5	In- person	Lectures & Tutorial	
10	Technologies in Navigation, Safety at sea and Operations - Vessel management and position monitoring - Voyage Routing and tracking - Navigation systems - Automatic Tracking aids - Electronic Chart Display Information System (ECDIS) 1,2,4,6 Lectures Tutorials - Long range Tracking and Identification (LRIT) , - Automatic Identification system (AIS) - Voyage Data Recorder (VDR) - LSA and FFA equipment	1, 2, 4, 6	In- person	Lectures & Tutorial	

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
11	Maritime Search and Rescue (SAR) - Distress signals - Man overboard , Safety - Satellite technology in enhancing SAR (COSPAS/SARSAT system) - Emergency Position Indicating Radio Beacon (EPIRB) - Weather forecast via Satellite - Autonomous Marine technology in SAR operations	1, 2, 4, 5	In-person	Lectures & Tutorial	
12	Port Operations and Management - VTIS , Traffic control and management - Concepts of SMART Port - Alternative Energy / Renewal - Automation and Optimisation - Digital transformation in port operations	1, 3, 5, 6	In-person	Lectures & Tutorial	
13	Marine communications / Information Technology - International Code of Signals , Morse Code (Background) - Data transfer ship to shore and vice versa - MF/HF - SATCOM - IoT Data connectivity - Cyber security - Cloud applications	1, 3, 4, 6	In-person	Lectures & Tutorial	

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lecture	Lesson topics delivered in series as to share, and focus on the concepts, as well as the application to the essentials in various aspects of Maritime technology. Concepts are supported with numerous worked examples, clear diagrams, graphs and equations to assist with your understanding and application of this critical subject
Tutorials	Teamwork shall be included, whereby you will take different approaches in underrating levels to apply concepts by way of case studies. Strong interaction and participation in challenging concepts and achieving practical applications in the related industry are encouraged.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
1	Summative Assessment (EXAM): Final exam(Final Examination)	1 to 6	A,B,C,D,F	60		Individual	Holistic	Relational
2	Continuous Assessment (CA): Test/Quiz(Continuous Assessment 1 (CA1): Quiz)	3,4,5,6	B,C,D,E	20		Individual	Analytic	Multistructural
3	Continuous Assessment (CA): Test/Quiz(Continuous Assessment 2 (CA2): Quiz)	3,4,5,6	B,C,D,E	20		Individual	Analytic	Multistructural

Description of Assessment Components (if applicable)

Program Learning Outcome

A. Related knowledge to maritime :

Develop an overall awareness to technology applications in maritime activities and shipping industry . Develop the fundamentals to apply knowledge into practical applications in managing sub-fields in related environments. To understand the significance of new technologies as big game changers in the maritime industry and their related impacts and potentials.

B. Problem Analysis :

Conceptualise , evaluate and resolve operational issues in maritime industry. Approach and resolve basic maritime problems, though both strategic and research methods. Develop a good insight into technologies' ability to transform the ways in which future shipping companies operate.

C. Design/development of Solutions:

Design , develop and execution of maritime projects. Develop shipping related risk management strategies. Demonstrate ability to capture and analyse technological breakthroughs in the Maritime arena. Able to address ongoing management challenges and improve efficiencies in processes.

D. Environment and Sustainability:

Understand and appreciate how technologies will drive , and the need for sustainable development in line with UN2030 SDGs. Conduct and organize maritime activities with due regards to public health and safety, cultural, societal, and environmental considerations.

Understand the implications of disruptive technologies and the ways to mitigate and achieve sustainability.

E. Teamwork and Communications :

Integrate all related skills and knowledge into the industry and exercise due diligence as a highly responsible professional , contributing and leading towards nation and society. Recognise the importance of a strong and just leadership to uphold highest standards of integrity as a professional individual. Communicate effectively and able to comprehend , write and present effective management Reports.

F. Life-long Learning :

Appreciate the related technologies life-long learning along with evolutions of new business model innovation through the entire value chain of shipping on top of an advanced maritime technology platform.

Formative Feedback

The lectures shall be interactive, and your inputs are highly encouraged in the process.

Case studies basis real life scenerios shall be deployed in the tutorials, in order to guide on the realities and practical approach through concepts as captured in lectures.

Quiz and case study aimed to provide regular feedback to you pertaining to level of understanding in concepts and principles. Answers and sample solutions provided to allow you to assess your understanding, along with measures to overcome weaknesses promptly.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Care for Environment	Intermediate
Curiosity	Intermediate
Global Perspective	Intermediate
Problem Solving	Intermediate
Critical Thinking	Intermediate

Course Policy

Policy (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. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

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>

Policy (Absenteeism)

1. Attendance :

Though there is no mandatory attendance requirement, you are expected to place all lectures and tutorials on their utmost top priority , and note that there shall be no make-up class to effect.

2. Punctuality:

You are expected to be On Time for classes, as late arrivals are disruptive to class activities. Likewise that all assignments to be submitted within dateline.

3. Participation:

You are strongly encouraged to stay dynamic and participate well in class, without hesitation to raise questions when in any doubt.

Policy (Others, if applicable)

This course will adopt NTU's policy on the use of AI for take-home assignments and reports, and project reports and presentation slides. More details could be found via the link
[https://entuedu.sharepoint.com/sites/Student/dept/ctlp/SitePages/Exploring-the-Impact-of-Generative-Artificial-Intelligence-\(GAI\)-Tools-on-Education.aspx#1-proper-citations-and-acknowledgements](https://entuedu.sharepoint.com/sites/Student/dept/ctlp/SitePages/Exploring-the-Impact-of-Generative-Artificial-Intelligence-(GAI)-Tools-on-Education.aspx#1-proper-citations-and-acknowledgements)

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