Annex A

Course Content

Academic Year	2019-2020	**Semester**	1
Course Coordinator	Capt Tan Kim Hock		
Course Code	MT2003		
Course Title	Maritime Technology		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	Lecture: 26 hrs; Tutorial: 13 hrs		
Proposal Date	31 May 2019		

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.

Intended Learning Outcomes (ILO)

After successful completion of this course, students should have an overview about phenomena and significant aspects of technologies and their ability to apply and extend as related.

In detail, the students should be able to:

1) Describe the different aspects and topics in Maritime Technology,
2) Apply existing methods to problems in Maritime Technology,
3) Discuss limitations in present day approaches and perspectives in the future,
4) Identify the various technological applications to various fields of maritime industry
5) Model and evaluate technological innovations along with concepts of Digitalisation and Autonomy , as to apply into Maritime industry
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,	2	1
7	Shipbuilding and Ship repair technologies - Principles, processes &	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

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weightage	Team / Individual	Assessment Rubrics
1. Final Examination	1 to 6	A,B,C,D,F	60%	Individual	
2. Continuous Assessment 1 (CA1): Quiz	3, 4 ,5 & 6	B,C,D,E	20%	Individual	
3. Continuous Assessment 2 (CA2): Quiz	3, 4 ,5 & 6	B,C,D,E	20%	Individual	
Total			100%		

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.

Learning and Teaching approach

Approach	How does this approach support students 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.

Reading and References

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
12. Any other add on resource from lecturers

Course Policies and Student Responsibilities

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.

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 behavior. 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

Instructor	Office Location	Phone	Email
Capt Tan Kim Hock	NTU Spore	+658186 5322	Kh_tan@ntu.edu.sg
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Planned Weekly Schedule

Week	Topic	Course Lo	Readings / Activities
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	Lectures Tutorials
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	Lectures Tutorials
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	Lectures Tutorials
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	Lectures Tutorials
5	Performance Management and Maintenance Optimization – Performance Monitoring and Management; Software tool; Machinery Performance, Diagnosis, Hull/Propeller fouling,	1,2,3 5,6	Lectures Tutorials

	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.		
6	Fundamentals of ship design, and Propulsion Power – Conceptual design,Design comparison, Basic dimensions and design ratios, Engine & Powering, Manoeuvrabilty & 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	Lectures Tutorials
7	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	1,4,5,6	Lectures Tutorials
8	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.	1,3,5,6	Lectures Tutorials
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	1,4,5	Lectures Tutorials

	- Ships Hydrostatics		
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) - Long range Tracking and Identification (LRIT) , - Automatic Identification system (AIS) - Voyage Data Recorder (VDR) - LSA and FFA equipment	1,2,4,6	Lectures Tutorials
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	Lectures Tutorials
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	Lectures Tutorials
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	Lectures Tutorials