GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-IV

Course Title: Marine Auxiliary Machines
(Course Code: 4341804)

Diploma Programs in which this course is offered	Offered in
Marine Engineering	4th Semester

1. RATIONALE

It should be noted that the main engine needs the support of auxiliary machineries. The engineers are responsible for the repair and maintenance of all auxiliary machineries onboard the ship. Hence a basic knowledge about the working of auxiliary machineries is required.

2. EXPECTED COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency.

- **Perceive the role of marine auxiliary machinery in maritime industry. Understand the specification and perform dismantling and assembling activity of different marine auxiliary machinery. Learn the repair and maintenance of all auxiliary machineries onboard the ship.**

3. COURSE OUTCOMES (COs)

At the end of the study of IV Semester the student will be able to

1. Understand about the freshwater system, oil water separator deck machinery.
2. Know about the working of steering machineries.
3. Study about incinerator, sewage plant, pumps, and purifiers.
4. Acquire broader ideas about refrigeration and air conditioning plants in ships.
5. Understand about piping system and vibration.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In hours)			Total Credit	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	L + T + (P/2)	CA	ESE	CA	ESE	
2	0	2	3	30	70	25	25	150

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **E.S.E.** -End Semester Examination.*

(*) 30 marks of Theory PA include two assignments each of 5 marks (Total 10 marks). First assignment must have total 10 numerical from Unit number I, II and III. Second assignment must be of 10 numerical from Unit number IV and V and report on student activities performed. Each numerical of each assignment must have different parameters for each student, that is each student will get total 20 numerical with same problem but with varied parameters. (Values of temperature, pressure, volume, etc. may be different for each student. The remaining 20 marks would be the average of marks of the 2 mid-semester exams to be taken during the semester for assessing the attainment of the cognitive domain. UOs are required for the attainment of the Cos.

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Dismantling and assembling of winch.	I	02
2	Dismantling and assembling of oil-water separator.	I	04
3	Dismantling and assembling of centrifugal pump.	II	04
4	Dismantling and assembling of reciprocating pump.	V	02
5	Dismantling and assembling of gear with reciprocating pump.	V	04
6	Dismantling and assembling of purifier.	IV	04
7	Study about corrosion. Practice of chipping and painting of corroded parts.	VI	04
8	Dismantling and assembling of compressor.	VII	04
	Total hours		**28 Hrs.**

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Identify components (Knowledge)	10
2	Prepare experimental setup. (Procedure followed)	20
3	Perform the experiment with accuracy. (Quality of work)	40
4	Follow safety practices. (Safety followed)	10
5	Submit the report. (Timely submission / Quality of report)	20
Total		**100**

The primary underpinning theory is below based on the higher level UOs of the Revised Bloom's taxonomy formulated for developing the COs and competency. If required, more such UOs could be included by the course teacher to focus on attaining COs and competency.

6 UNDERPINNING THEORY

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit – I **Fresh Water System, oily bilge separators, Deck Machinery**	1a. Fresh water systems. 1b. Oily water separator. 1c. Deck machinery.	1.1. Evaporators: Construction and operation of boiling type and flash type evaporators - fresh water generator and Domestic water treatment plant. 1.2. Pollution prevention oily bilge separators their construction and operation – oil content monitoring system-Bilge level maintenance-bilge pump (gear with reciprocating). Type of deck machinery used in ships. 1.3. winch – windlass - derricks -

		cranes,their requirements operation and maintenance.
Unit – II **Blowers and Compressors, Steering System and Valves**	2a. Construction & operations of blowers and compressors. 2b. Steering systems. 2c. Types of valves.	2.1. Construction and operation of Blowers and compressors used on board ships - uses of compressed air. 2.2. Steering gears - Construction and operation of 2-RAM steering system, 4-RAM steering system, rotary vane steering system - Emergency steering arrangement - under water fittings - propellers, rudder, bow thrusters - maintenance of hull. 2.3. Valves – screw valve – gate valve – globe valve – quick closing valve.
Unit – III **Shipboard equipment's, Pumps and Purifiers**	3a. Testing of Equipment's. 3b. Maintenance of Equipment's. 3c. Pumps & purifiers.	9.1 Auxiliary engines (power generators). 9.2 Incinerators- chemical sewage treatment plant – biological sewage treatment plant - Engine room crane- Different types of ship stabilizer - Different types of bearings used for marine machineries. 9.3 Pumps used in ships- centrifugal pump – reciprocating pump - gear pumps – screw pump- axial flow pump – purifiers.
Unit – IV **Marine Refrigeration, Ventilation, Heat exchangers**	4a. Operation of refrigeration cycle. 4b. Air conditioning plants. 4c. Heat exchangers & types.	10.1 Vapour compression system - vapour absorption system- Refrigerants used in marine practice and their justification. 10.2 Properties of refrigerant- Control of temperature in

		various rooms in Cargo or domestic plants, Ventilation necessity – International requirements for ventilation- control in Humidity in Air Conditioning plants, operation, and maintenance of Air Conditioning plants - control and safety equipment's. 10.3 Heat exchangers (shell & tube and plate type)
Unit – V **Piping system and Vibration**	5a. Piping system. 5b. Vibration & sources.	11.1 Piping Systems – fire main systems – fixed Carbon dioxide system - fresh water systems – sea water systems - fuel oil systems - lubricating oil systems – main steam systems – Bilge systems – overflow arrangement and vents. 11.2 Vibration - source of vibration - various modes of vibration - forced, damped, transverse, longitudinal and torsional vibration. Noise – noise suppression techniques – noise level measurement.

12 SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fresh water system, Oilybilge separators, Deck machinery.	05	04	03	03	10
II	Blowers, Compressors, Steering systems &	05	03	03	04	10

	Valves.					
III	Shipboard equipment's, Pumps & purifiers.	06	04	06	06	16
IV	Marine Refrigeration, Ventilation, Heat exchangers.	06	04	07	05	16
V	Piping system & Vibrations.	06	04	06	08	18
Total		**28**	**19**	**25**	**26**	**70**

***Legends: R**=Remember, **U**=Understand, **A**=Apply and above (Revised Bloom's taxonomy)*

***Note:** This specification table gives general guidelines to assist students in their learning, and to the teachers, for question paper design and teaching methodology to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U, and A) in the question paper may slightly vary from the above table.*

13 SUGGESTED STUDENT ACTIVITIES

Sr. No	Activity
1	Prepare general layout of machinery in the engine room.
2	Locate the Air conditioning & Refrigeration system in layout
3	Sketch & describe the construction and operation of a gear pump.
4	Sketch & describe the construction and operation of a centrifugal pump.
5	List the maintenance carried out on Air Conditioning system
6	Prepare a defect list and important jobs to be done in dry dock

14 SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (IF ANY)

These are sample strategies that the course teacher can use to accelerate the attainment of the various outcomes in this course.

Unit	Unit Title	Strategies
I	Fresh water system, Oily bilge separators, Deck machinery.	• Real-life examples. Demonstration of real systems. • Movies/Animations. Numerical, Massive Open Online Courses (MOOCs).
II	Blowers, Compressors, Steering systems & Valves.	
III	Shipboard equipment's, Pumps & purifiers.	

IV	Marine Refrigeration, Ventilation, Heat exchangers.	
V	Piping system & Vibrations.	

15 SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to them during the semester. While designing the micro-project, it should be kept in mind that it incorporates most of the COs. It should be the application of the theoretical knowledge into some practical aspect.

16 SUGGESTED LEARNING RESOURCES

Sr. No	Title of Books	Author	Publications & ISBN
1	Naval architecture for marine engineers	H D MCGEORGE	Butterworth-Heinemann Ltd ISBN: 978-0750643986
2	Marine Auxiliary Machinery	David W. Smith	Butterworth-Heinemann ISBN: 978-1483100012
3	Marine Auxiliary Machinery and Systems	M Khetagurov	University Press of the Pacific ISBN: 978-1410212146

17 SOFTWARE/LEARNING WEBSITES

Sr. No	Software/Website address	Topic covered.
1	https://www.youtube.com/watch?v=l9MqOBAuNSQ&list=PLp1xcYnVm59g910EGUjAsUlxnJmvXazrO	Wear Ring, Lantern Ring, Shaft sleeve in centrifugal pump
2	https://www.youtube.com/watch?v=arY_3DAJ0Do&list=PLp1xcYnVm59g910EGUjAsUlxnJmvXazrO&index=2	Mechanical seal working & installation in centrifugal Pump
3	https://www.youtube.com/watch?v=i42yEmwf21E&list=PLp1xcYnVm59g910EGUjAsUlxnJmvXazrO&index=3	Characteristic curve & System curve of centrifugal pump
4	https://www.youtube.com/watch?v=yu-xdyBcdbI&list=PLp1xcYnVm59g910EGUjAsUlxnJmvXazrO&index=10	Pressure Measurement, Classification of pumps
5	https://www.youtube.com/watch?v=xm3E_2qiV-M&list=PLp1xcYnVm59g910EGUjAsUlxnJmvXazrO&index=15	Basic Steering Gear Mechanism
6	https://www.youtube.com/watch?v=KfSYOnDflBg&list=PLp1xcYnVm59g910EGUjAsUlxnJmvXazrO&index=16	Main Engine Lube Oil System || Lube oil Line Diagram
7	https://www.youtube.com/watch?v=vLciwBkpy04&list=	Heat Exchanger (Plate

	PLp1xcYnVm59g910EGUjAsUlxnJmvXazrO&index=17	and Tube Cooler)
8	https://www.youtube.com/watch?v=74Js7PUIQUc&list=PLp1xcYnVm59g910EGUjAsUlxnJmvXazrO&index=18	Fuel oil system onboard ship
9	https://www.youtube.com/watch?v=32lgubq7_PU&list=PLp1xcYnVm59g910EGUjAsUlxnJmvXazrO&index=19	Engine Room Bilge Line
10	https://www.youtube.com/watch?v=3_W6ddr_GCs&list=PLp1xcYnVm59g910EGUjAsUlxnJmvXazrO&index=48	Refrigeration cycle
11	https://www.youtube.com/watch?v=q3Ui74Sz96o&list=PLp1xcYnVm59g910EGUjAsUlxnJmvXazrO&index=47	Thermostatic expansion valve
12	https://www.youtube.com/watch?v=tGFt3z_DvvI&list=PLp1xcYnVm59g910EGUjAsUlxnJmvXazrO&index=55	Compressors safety and its alarm

18 COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons:

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