GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Naval Architecture
(Course Code: 4341801)

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

1. RATIONALE

Diploma holders in marine engineering should have enough knowledge about different parts of ship. They should know about the basic principles of naval architecture. They should know how the ship floats. Basic knowledge about the area and volume is required. They should know about propellers and rudders.

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 naval architecture in maritime industry. Understand how the ship floats in water and identify various minor and major structural parts of a ship.**

3. COURSE OUTCOMES (COs)

1. Understand the concept of stability and buoyancy of ship.
2. Know about the basic principles of naval architecture.
3. Study about position of center of gravity of the ship.
4. Acquire broader ideas about area, volume and moment.
5. Study about propellers and rudder.

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	
3	0	0	3	30	70	0	0	100

***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 12 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 22 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. UNDERPINNING THEORY

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.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit – I **Basic geometric concepts, Area, and Volume**	1a. Geometric planes. 1b. Calculation of area of various geometric planes.	1.1. Middle line plane, transverse plane, water plane, water plane area – waterline, amidships, mid ship section – mid ship section area, beam,moulded depth. 1.2. Calculation of Area under a curve, Simpson's first rule, Application of Simpson's rule to calculation of Volume, Use of intermediate ordinates, Simpson's second rule, Trapezoidal rule.
Unit – II **Hydrostatics and Centre of gravity**	2a. Basics of hydrostatic fluids & Laws. 2b. Centre of gravity	2.1. Density - Relative density - Archimedes' principle – Buoyancy Floating bodies - Displacement – Volume of

	and its calculation.	Displacement– TPC – Effect of density on draught of a ship – Fresh water allowance - Coefficient of forms - Wetted surface area. 2.2. Centre of gravity - Shift in center of gravity due to addition of mass - Shift in center of gravity due to movement of mass - Effect of suspended mass.
Unit – III **Transverse Stability**	3a. Stability of ships. 3b. Metacenter and its calculation. 3c. Free surface effect.	3.1 Stability of ships - Statical stability at small angles of heel - Stable, Unstable and Neutral equilibrium. 3.2 Transverse metacenter - Calculation of KM for rectangular and triangular cross section - Metacentric diagram - Inclining experiment. 3.3 Free surface effect - Effect of tank divisions on free surface - Stability at large angles of heel – Curve of statical stability - Dynamical stability - Stability of wall sided ship.
Unit – IV **Longitudinal Stability**	4a. Trim, Draught, and changes according to GM. 4b. Reserve buoyancy.	4.1 Trim - Centre of flotation - Mean draught – longitudinal metacenter – longitudinal metacentric height – Effect of adding small masses - moment to change trim by one centimeter - Change in draught due to addition of masses - Change in mean draught due to change in density – Bilging. 4.2 Reserve buoyancy -

		Permeability
Unit – V Propeller and Rudder	5a. Propellers and various terminology. 5b. Rudders and forces acting on it.	5.1 Propellers – Diameter – Pitch - Pitch ratio - Theoretical speed - Apparent slip - Real slip – Wake - Projected area - Developed area - Blade area ratio - Disc area ratio – Thrust - Measurement of pitch – Cavitation - Built and Solid propellers. 5.2 Rudders - Force on rudder - Torque on stock - Angle of heel due to force on rudder -Angle of heel when turning.

6 SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basic geometric concepts, area, and volume.	06	04	03	03	10
II	Hydrostatics and center ofgravity.	06	03	03	04	10
III	Transverse stability.	10	04	06	06	16
IV	Longitudinal stability.	10	04	07	05	16
V	Propeller and rudder.	10	04	06	08	18
Total		**42**	**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.*

7 SUGGESTED STUDENT ACTIVITIES

Sr. No	Activity
1	Prepare Drawing of General Arrangement of a Container Ship.
2	Prepare Drawing of General Arrangement of a modern Tanker Ship
3	Assigns the calculations problems on pressure exerted by a liquid, load on an immersed plane, center of pressure and load diagram.
4	Assigns the calculations problems on Archimedes' principle, floating bodies, Tonne per Centimeter Immersion, Co-efficient of Form, Wetted Surface Area,
5	Prepare Chart of Typical design Spiral of a large merchant ship.
6	Assigns tutorials for different calculations problems.
7	Prepare PPT on i. The role of technology in green ship design. ii. How are marine rules and regulations developed, applied and how do they influence ship design.

8 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	Basic geometric concepts, area, and volume.	• Real-life examples. Demonstration of real systems. • Movies/Animations. Numerical, Massive Open Online Courses (MOOCs).
II	Hydrostatics and center ofgravity.	
III	Transverse stability.	
IV	Longitudinal stability.	
V	Propeller and rudder.	

9 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.

10 SUGGESTED LEARNING RESOURCES

Sr. No	Title of Books	Author	Publications & ISBN
1	Naval architecture for marine engineers	E A Stokoe	Thomas Reed Publications & ISBN: 07136-6734-6
2	Naval Architecture for Marine Engineers	W. Muckle	Butterworth & Co (Publishers) Ltd & ISBN: 0 408 00169 0
3	Introduction to Naval Architecture	Eric C. Tupper	Elsevier Ltd. & ISBN: 978-0-08-098237-3
4	Introduction to Naval Architecture	Thomas C Gillmer & Bruce Johnson	Naval Institute Press
5	Basic Ship Theory	E. C. Tupper & KJ Rawson	Butterworth-Heinemann & ISBN: 0750653981

11 SOFTWARE/LEARNING WEBSITES

Sr. No	Software/Website address	Topic covered.
1	MAXSURF Naval Architecture Software	Vessels Design
2	https://nptel.ac.in/courses/114105003	Hydrostatics & Stability
3	https://www.youtube.com/watch?v=Iml-lynj3bM&list=PLso4Ha2Bb_IgELAmOCBtFDwKiTlntVbmp&index=2	Ship Geometry
4	https://www.youtube.com/watch?v=nrMuk77e9t8&list=PLso4Ha2Bb_IgELAmOCBtFDwKiTlntVbmp&index=3	Pressure and Buoyancy
5	https://www.youtube.com/watch?v=XJU7ACOKjYI&list=PLso4Ha2Bb_IgELAmOCBtFDwKiTlntVbmp&index=4	Intact Stability
6	https://www.youtube.com/watch?v=PVn66rotHQs&list=PLso4Ha2Bb_IgELAmOCBtFDwKiTlntVbmp&index=5	Effects of Loading on Stability
7	https://www.youtube.com/watch?v=keK3l_Qfehk&list=PLso4Ha2Bb_IgELAmOCBtFDwKiTlntVbmp&index=6	Damage Stability
8	https://www.youtube.com/watch?v=Vymw5oq8S6k&list=PLso4Ha2Bb_IgELAmOCBtFDwKiTlntVbmp&index=7	Subdivision and Floodable Length
9	https://www.youtube.com/watch?v=vzVdyj8dvyc&list=PLso4Ha2Bb_IgELAmOCBtFDwKiTlntVbmp&index=10	Weights and Centers
10	https://www.youtube.com/watch?v=3IqlXhwZTcY&list=PLso4Ha2Bb_IgELAmOCBtFDwKiTlntVbmp&index=11	Calculating GM
11	https://www.youtube.com/watch?v=WTIg6P90WfM&list=PLso4Ha2Bb_IgELAmOCBtFDwKiTlntVbmp&index=12	Free Surface Correction
12	https://www.youtube.com/watch?v=gWYTTZQLYDA	How ship floats on water - Archimedes

		principle

12 COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons:

Sr. No	Name & Designation	Institute	Contact No	Email
1	Mr. H U Tandel, LME	Government Polytechnic, Dahod	9624536218	hirentandel5153@gmail.com
2	Mr. B J Patel, LME	Government Polytechnic, Waghai	9601164005	bjp.gpv@gmail.com

BOS Resource Persons:

Sr. No	Name & Designation	Institute	Contact No	Email
1	Dr.S.H. Sundarani BOS Chairman HOD Mechanical Engineering	Government Polytechnic Ahmedabad	9227200147	gpasiraj@gmail.com
2	Dr. Rakesh D. Patel BOS Member HOD Mechanical Engineering	B & B Institute of Technology VV Nagar	9825523982	rakeshgtu@gmail.com
3	Dr.Atul.S. Shah BOS Member Principal	B.V. Patel Institute of Technology Bardoli	7567421337	Asshah97@yahoo.in