GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2023 (COGC-2023)
Semester-V

Course Title: Marine Electro Technology
(Course Code: 4351805)

Diploma programmer in which this course is offered	Semester in which offered
Marine Engineering	5th Semester

1. RATIONALE

Diploma holders in marine engineering should have enough knowledge about electrical operated machines.
A marine engineer must be capable of trouble shooting any electrical errors occurring onboard.
As well as to read the circuit diagrams onboard to find out and rectify the errors.

2. COMPETENCY

At the end of the study of Vth Semester the student will be able to:

- Understand about 3 phase induction motor & starters.
- Know about how paralleling of generators is done and why it is done & excitation methods.
- Study about Alternators and its operations.
- Understand about emergency generators its requirements and its starting procedures.

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

CO-1	Understand about 3 phase induction motor & starters.
CO-2	Study about Alternators and its operations.
CO-3	Study about Armature reaction in synchronous alternator.
CO-4	Know about how paralleling of generators is done and why it is done & excitation methods.
CO-5	Understand about emergency generators its requirements and starting procedures of emergency generators.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-projectto facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

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

5. SUGGESTED PRACTICAL EXERCISES

Following practical outcomes (PrOs) are the sub-components of the Course Outcomes (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	Study electrical circuit diagrams of important systems in totality.	ALL	04
2	Perform No Load and Blocked Rotor Test on single phase induction motor to determine the equivalent circuit parameter of given induction motor.	1	04
3	Obtain the Slip-Torque characteristics and efficiency curve of 3 phase Induction Motor from circle diagram.	1	02
4	To find performance of 3 phase Induction Motor on No Load condition.	1	02
5	To determine the voltage regulation of an Alternator by Synchronous Impedance method.	2,3	04
6	To obtain load characteristics of an Alternator by performing Direct Load Test & Determine Voltage regulation.	2,3	04
7	To Obtain 'V' curve of a synchronous Motor at No Load.	2,3	02
8	To Study the parallel operation & synchronizing of Alternator.	2,3	02

9	To study the different Methods of starting of induction Motor.	1	02
10	Study the speed control method of induction Motor.	1	02
Total			28

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*

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.

6. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

Sr. No.	Unit	Unit Title	Strategies
1	I	Three phase induction motor	Real life examples. Demonstration ofreal systems. Movies/Animations. Numerical.
2	II	Alternators-general	
3	III	Armature reactionin synchronous alternator	
4	IV	Power Generation Equipment & Automatic Voltage Regulation.	
5	V	Alternative Source of Power & Distribution.	

7. EFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member.
b) Follow safety practices.
c) Follow ethical practices
d) Maintain tools and equipment
e) Practice environment friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I **3Ø Inductionmotor**	1.a Principle of 3Ø system. 1.b Explain how a rotational field is produced in a 3 phase induction motor. 1.c Differentiate between squirrel cage and wound rotor induction motor with their salient features. 1.d Explain various methods of speed control of 3 phase induction motor. 1.e State the maintenance procedure of both squirrel cage and wound rotor induction motor 1.f Induction motor working. 1.g Types of starters.	1.1 Principle of operation and theory of action,slip speed, rotor to stator relationship, rotor frequency, rotor e.m.f. and current. 1.2 Construction, types - Squirrel cage - Single and double cage, Wound rotor 1.3 Equivalent circuit relationship between rotorIR loss and the rotor slip, torque/slip characteristics, starting torque and maximumrunning torque, reversing, speed control of induction motor. 1.4 Starting of induction motor, method of starting D.O.L, Star/Delta, Auto, Testing of motor, Single and three phase induction motor principle and operational characteristics, starting control constructional details. 1.5 Maintenance of different types of inductionmotors
Unit – II **Alternators-General**	2.a Explain the working principle of an alternator. 2.b Construction of alternators 2.c Stator windings & types. 2.d Synchronize an alternator with infinite bus bar. 2.e State the maintenance requirements of the alternators including the different cooling systems of the alternators	2.1 Arrangement of alternators, constructionof salient pole and cylindrical- rotor types. 2.2 Types of stator windings, single and double layer windings, e.m.f equation of an alternator, distribution and pitch factor, waveform of generated e.m.f., alternator on load, percentage regulation, internal voltage drop, production of rotating magnetic field, 2.3 Resultant magnetic field distribution, mathematical

		, reversal of direction of rotation of rotating field. 2.4 Synchronization of alternator with bus bar/alternator. 2.5 Cooling system of alternator. 2.6 Maintenance of different types of alternators
Unit – III **Armature reaction in synchronous alternator**	3.a Paralleling of alternators. 3.b Excitation in generators. 3.c Differentiate the features between the synchronous and induction motor. 3.d State the maintenance requirements of the synchronous motor.	3.1 Armature reactance, prediction of voltage regulation, open circuit test, short circuit test, Synchronous impedance ,torque/angle characteristics, infinite bus bar, synchronizing current, torque and power, hunting of phase swinging, parallel operation of alternators, 3.2 A.c. generators in parallel-excitation control,throttle control, load sharing KW and KVA, principle of action of three phase synchronous motor effect of varying load and excitation, methods of starting 3.3 Advantages and disadvantages of synchronousmotor. 3.4 Maintenance of synchronous motors
Unit – IV **Power Generation Equipment & Automatic VoltageRegulation:**	4.aElectrical& electronic symbols. 4.bParallelin-g of alternators & Flow charts. 4.cAutomatic voltage regulator	4.1 Overview of marine electrical systems thebasic components / systems and the conditions under which they have to function 4.2 Electrical and Electronic Symbols and Interpretation of flow Diagram and circuits. Mandatory requirements for electrical installations 4.3 Electrical control system of Prime Mover.Construction of brushless high speed alternators. 4.4 Automatic Voltage Regulators, rapid voltage response of alternators. Paralleling of alternators.
Unit – V **Alternative Source ofPower & Distribution**	5.a Emergency generators& starting methods. 5.b Electrical distribution. E.S.B & M.S.B	5.1 Emergency Generator & Different startingmethod including auto -start, emergency batteries and its different types & duties, Location of emergency power. 5.2 Different Emergency loads, Rules & Regulation of emergency power, Maintenanceof Emergency power

		source on board. Shore Supply - Specifications as per Voltage /frequency ,Precautions while taking shoresupply. 5.3 Different electrical diagrams and their uses,electrical signals. Type of Distribution, Distribution network on board. 5.4 Main & emergency switch board, construction,different switch gear & protective devices, Grounded and Insulated neutral systems.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	3Ø Induction motor	**6**	**4**	**3**	**3**	**10**
II	Alternators- General	**6**	**4**	**3**	**3**	**10**
III	Armature reaction in synchronous alternator	**10**	**4**	**6**	**6**	**16**
IV	Power Generation Equipment & Automatic Voltage Regulation	**10**	**4**	**6**	**5**	**16**
V	Alternative Source of Power & Distribution	**10**	**4**	**8**	**6**	**18**
Total		**42**	**20**	**26**	**23**	**70**

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

Notes:

1. This specification table shall be treated as a general guideline for students and Teachers. The actual distribution of marks in the question paper may slightly vary from above Table.
2. If mid sem test is part of continuous evaluation, unit numbers I, II and unit III up to 3.4 are to be considered.
3. Ask the questions from each topic as per marks weightage. Numerical questions are to be asked only if it is specified. Optional questions must be asked from the same topic.

8. SUGGESTED STUDENT ACTIVITIES

- Carry out the practicals as mentioned in the above exercises.

9. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-16 *(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:
Effective use of following:

a) Induction motor
b) Alternators
c) Power Generation Equipment
d) Alternative Source of Power

10. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	A Text Book of Electrical Technology Vol-2	B L Thareja – A K Thareja	S. Chand, New Delhi (1959), 978-8121924375
2	Electrical Technology	Hughes Edward	A Longman Text, (UK)1960, 9780582444492
3	Electric Machines	Ashfaq Husain	Dhanpat Rai & Co, New Delhi (2016), 978-8177001662

11. LEARNING WEBSITES

(a) https://youtu.be/EOS2nG7m_Zo
(b) https://youtu.be/gClhE2AQL4Q
(c) https://youtu.be/tiKH48EMgKE
(d) https://youtu.be/nt7SQ4VIvaQ
(e) https://youtu.be/yHy-k8p38dE
(f) https://youtu.be/tQsakkEnelc
(g) https://youtu.be/3FCBovUH0-M
(h) https://youtu.be/6V0o1iqLClw

12. PO-COMPETENCY-CO MAPPING

Semester V	MARINE ELECTRO TECHNOLOGY (Course Code: 4351805)						
	POs						
Competency & Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline specific knowledge	Problem Analysis	Design/ development of solutions	Engineering Tools, Experimentation& Testing	Engineering practices for society, Sustainability & environment	Project Management	Life-long Learning
Competency	**Prepare preventive maintenance charts as per schedule and understand the need of replacement of the electrical instruments such as Induction motors, alternator, generators.**						
Course Outcomes CO-1) Understand about 3 phase induction motor & starters.	3	2	2	2	-	1	2
CO-2) Study about Alternators and its operations.	3	3	2	3	-	1	2
CO-3) Study about Armature reaction in synchronous alternator.	3	2	2	3	-	1	2
CO-4) Know about how paralleling of generators is done and why it is done & excitation methods.	2	3	2	2	-	1	2
CO 5) Understand about emergency generators its requirements and starting procedures of emergency generators.	3	3	3	3	-	1	2

*Legend: '**3**' for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

13. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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1.	Dr.S.H.Sundarani BOS Chairman HOD Mechanical Engg.	Government Polytechnic Ahmadabad	9227200147	gpasiraj@gmail.com
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4	**Prof Ashvin M. Bamaniya** (Head of Electrical Engineering	Government Polytechnic Diu		
5	**Prof Nair Gopikrishnan Lecturer in Marine engineering**	Government Polytechnic Diu		

17. BOS Resource Persons

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3.	Dr. Atul S.Shah (BOS Member & Principal)	B. V. Patel Institute of Technology, Bardoli	7567421337	Asshah97@yahoo.in