GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering
Level: Diploma
Branch: Electronics & Communication Engineering
Subject Code: DI04011051
Subject Name: Renewable Energy & Emerging Electronics

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	Professional Elective - II

Rationale:	Learning about Renewable Energy and Emerging Trends in Electronics is essential, as these fields play a crucial role in shaping the future of technology, sustainability, and global development. Comprehending sustainable energy sources like solar, wind, hydro, and geothermal energy is essential to mitigating climate change and minimizing the ecological consequences of energy generation. The field of electronics is dynamic and constantly evolving. The utilization of the newest technologies in electronics is facilitated by keeping up with new trends, thereby promoting innovation across a range of industries.

Course Outcome:

No	Course Outcomes	RBT Level
01	Demonstrate fundamental principles of renewable energy systems and their applications.	R, U, A
02	Explore current trends and innovations in Smart Materials and systems	R, U, A
03	Gain knowledge of Emerging Trends in Electronic Components	R, U, A
04	Interface Sensors & Actuators with Raspberry PI	R, U, A
05	Computing through Machine Learning tools.	R, U, A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Renewable Energy Systems and Applications 1.1 Introduction to Renewable Energy and its Importance 1.2 Types of Renewable Energy Sources- • Solar • Wind • Hydroelectric • Biomass • Geothermal 1.3 Explain Emerging renewable energy technologies & innovations • Tidal wave • Solar thermal • Hydrogen 1.4 Introduction to Solar Cell, Photovoltaic effect, Principle of photovoltaic conversion 1.5 Types of Solar Cells- • Silicon, Mono-crystalline Silicon, Polycrystalline, Thin Film, Amorphous Silicon, Cadmium Telluride, Copper Indium Gallium Selenide 1.6 Block diagram of Solar rooftop system 1.7 Block diagram of an electric vehicle & EV architecture Types of EV- • Battery Electric Vehicle (BEV) • Hybrid Electric Vehicle (HEV) • Plug-in Hybrid Electric Vehicle (PHEV) • Fuel Cell Electric Vehicle (FCEV) 1.8 Different Energy sources for EV • Battery • Fuel Cell • Ultracapacitor • Flywheel • Regenerative Braking • Hybrid Energy Sources 1.9 National Green hydrogen Mission • What is green hydrogen? • Green hydrogen production methods • Green hydrogen production by electrolysis • Concept of Grey hydrogen, greenhydrogen and blue hydrogen	10	22%

Unit No.	Content	No. of Hours	% of Weightage
	• Hydrogen storage, transport& applications		
2.	Smart Materials and Systems 2.1 Introduction to Nanotechnology 2.2Applications of Nanotechnology 2.3Introduction to Smart Materials • Types of Smart Material and its Application 2.4 Wearable Technology: Smart Watches and Smart glasses, or wearable health monitoring system 2.5 Introduction to UAVs or drones and their applications • Working principle of drone • Major components of drone 2.6 Smart System Examples: self-driving cars, Automation levels in self driving car and working of it, artificial pancreas, Internet of Things (IoT), M2M-enabled advanced manufacturing robots 2.7 Smart Systems Case Study • Water pollution monitoring • Smart Street light control and monitoring • Smart Health Monitoring • Smart Homes & Gadgets	10	22%
3.	Emerging Trends in Electronic Components 3.1 Introduction to Organic and Inorganic Electronics • Characteristics & Differences • Advantages of Organic Electronics 3.2 Different types of organic components: • Organic LED (OLED) • Organic FET(OFET) • Organic Photovoltaic devices (OPVD) 3.3 Introduction to Biometrics: • Types of biometrics • Biometric system: sensor module, basic building block of generic biometric system 3.4 Introductionto AR/VR- Industry perspectives and opportunities	7	16%
4.	**Advanced Trends in Interfacing Electronics components** 4.1 Block diagram & pin configuration of Raspberry PI. 4.2 Getting Started with Raspberry Pi 4.3 Installation and setup of Raspberry Pi computer using Raspberry Pi imager on SD card	10	22%

Unit No.	Content	No. of Hours	% of Weightage
	4.4 Types of Sensors and actuators 4.3 Control various electronic components using Scratch/python on the Raspberry Pi • LED • button • buzzer and sensors - • PIR • temperature • humidity • IR Sensor • Ultrasonic Sensor • Stepper Motor		
5.	**Introduction to AI & ML** 5.1 Definition of AI, Future of Artificial Intelligence, AI ethics and limitations 5.2 Difference between AI & ML 5.3 AI applications in various industries (healthcare, finance, manufacturing, Education, Military, Chatbots etc.) 5.4 Introduction to Machine Learning and its Types- • Supervised • Unsupervised • Reinforcement 5.5 Basics of Python for Machine Learning using libraries like NumPy, pandas, keras etc. 5.6 Introduction to ML tools for machine learning implementations • Machine learning for kids • Scratch • scikit-learn • Tensor Flow	8	18%
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
30%	34%	34%	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. "Renewable Energy: Power for a SustainableFuture "byGodfreyBoyle,3rdEdition (2012)
2. "Renewable and Sustainable Energy Reviews "ElsevierJournal Open Access.
3. "Introduction to Biometrics" by forwarded James Wayman Anil K. Jan, Arun A Ross Kartik Nandkumar
4. "Organic Electronics an Introduction"by Dr Sanjay Tiwari Professor & Head SOS in Electronics & Photonics Pt. Ravishankar Shukla University, Raipur
5. The Official Raspberry Beginners Guideby 5th Edition by Gareth Halfacree

(b) Open source software and website:

1. https://cfdflowengineering.com/working-principle-and-components-of-drone/#:~:text=The%20basic%20components%20of%20a,at%20each%20of%20these%20components
2. DronesForDummies 1steditionbyMarkLayFaypublishedbyForDummies
3. https://nghm.mnre.gov.in/overviews.php
4. https://nghm.mnre.gov.in/admin/uploads/resources/167465243440278NationalGreenH2Mission.pdf
5. https://www.energy.gov/eere/fuelcells/hydrogen-production-electrolysis
6. DronesForDummies 1steditionbyMarkLayFaypublishedbyForDummies
7. https://toshiba.semicon-storage.com/ap-en/semiconductor/application/consumer/wearable-device/detail.smart-watch.html- Smart watch working
8. https://www.thezebra.com/resources/driving/how-do-self-driving-cars-work/
9. https://www.fda.gov/medical-devices/artificial-pancreas-device-system/what-pancreas-what-artificial-pancreas-device-system
10. https://www.niddk.nih.gov/health-information/diabetes/overview/managing-diabetes/artificial-pancreas
11. https://www.claysys.com/blog/types-of-biometrics/- different types of biometrics
12. https://www.biometricsinstitute.org/what-is-biometrics/types-of-biometrics/- different types of biometrics
13. https://www.lncc.br/~jauvane/papers/RelatorioTecnicoLNCC-2503.pdf-ARand VR Technology

14. https://www.geeksforgeeks.org/machine-learning/types-of-machine-learning/Types of Machine learning

Suggested Course Practical List: If any

Sr. No.	PracticalOutcomes(PrOs)	Unit No.	Approx. Hrs. Required
1	Understand the Block Diagram of a Home Solar rooftop system*	1	2
2	Study E-vehicle kit with various parts of electric vehicle & compare specifications of different EVs	1	2
3	Perform electrolysis of water and make observation(Simulator:https://www.olabs.edu.in/?sub=96&brch=49&sim=317&cnt=4)	1	2
4	Study wearable systems like Smart Watches, Smart glasses & wearable health monitoring systems	2	2
4	Understand the structure of a drone*	2	2
5	Understand the block diagram of a generic biometric system*	3	4
6	Study various AR-VR gadgets and technologies	3	4
7	Install Raspberry Pi OS on your SD card using Raspberry Pi imager, Setup and configure Raspberry Pi computer *****	4	4
8	Interface/Simulate LED, button and buzzer with Raspberry Pi	4	2
9	Interface PIR, temperature and humidity sensors withRaspberry Pi	4	4
10	Demonstrate a burglar alarm system using Raspberry Pi*	4	4
11	Automated LED light control based on input from PIR (to detect if people are present) and LDR (ambient light level)	4	4
12	Getting started with machine learning using tools like machine learning for kids/scratch/scikit-learn or TensorFlow *	5	4

Sr. No.	PracticalOutcomes(PrOs)	Unit No.	Approx. Hrs. Required
13	Create a cartoon that smile if you type nice things to it and cry if you type bad things to it. (Train, test and implement text classification machine learning algorithm using machine learning for kids/scratch/scikit-learn or TensorFlow)	5	4
14	Make a dancing panda that gets shy and stops dancing if it sees you looking. (Train, test and implement image classification machine learning algorithm using machine learning for kids/scratch/scikit-learn or TensorFlow)	5	4
15	Make a cartoon that learns to recognize Gujarati/other languages. (Train, test and implement sound classification machine learning algorithm using Machine learning for kids/scratch/scikit-learnerTensor Flow)	5	2

List of Laboratory/Learning Resources Required:

Sr. No.	EquipmentNamewithBroadSpecifications	Pr.No.
1	Solar roof top system	1
2	E-vehicle kit to study various parts of electric vehicle	2
3	Smart gadgets like smart watches, gogglesetc..	3
4	Drone	4
5	Biometric system	5
6	AR-VR gadgets	6
7	Raspberry Pi	7
8	Various Sensors and electronic components	8,9,10,11
9	Machine learning software and hardware system	12,13,14,15

Suggested Project List:

1. IoT sensors-based electronic circuits on renewable energy assets, such as solar panels and wind turbines, monitor performance, weather conditions, and maintenance needs
2. Burglar Alarm using Raspberry Pi
3. Line follower robot using RaspberryPi
4. Weather station using RaspberryPi
5. Train, test and implement image classification machine learning algorithm using machine learning for kids /scratch/ scikit-learn or TensorFlow
6. Train, test and implement text classification machine learning algorithm using machine learning for kids /scratch/scikit-learn or TensorFlow
7. Train, test and implement sound classification machine learning algorithm using machine learning for kids /scratch/scikit-learn or TensorFlow

Suggested Activities for Students: If any

1. Prepare and submit a report on Renewable Energy Megaprojects (Large-Scale Solar and Wind Installations) of Smart City
2. Visit a nearby renewable energy power plant and report documentation.
3. Prepare a Power Point presentation on drone technology.
4. Prepare a Power Point presentation on advanced technologies in Electric vehicles.
5. Prepare a Power Point presentation on AR/VR**.**

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