GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering
Level: Diploma
Branch: Electrical Engi. / Electronics & Communication Engi. / Information & Communication Technology/ Renewable Energy
Subject Code : DI05000081
Subject Name : Drone Technology

w. e. f. Academic Year:	2026-27
Semester:	5th
Category of the Course:	MOPEC

Prerequisite:	Students should have basic knowledge and skills from the following subjects studied in earlier semesters of Diploma Engineering: • Basic Electrical and Electronics Engineering – understanding of voltage, current, power supply and basic electronic components. • Electronic Devices and Circuits – basic knowledge of sensors, transistors, and simple electronic circuits. • Digital Electronics / Microcontroller Fundamentals – basic idea of digital systems and controllers. • Computer Fundamentals – ability to use computer software and basic simulation tools. • Basic Physics – concepts of motion, force, and energy relevant to flight principles.
Rationale:	Drone technology is rapidly growing and is widely used in areas such as agriculture, surveillance, disaster management, mapping, and infrastructure inspection. Industries require skilled technicians who understand the basic operation, maintenance, and applications of drone systems. This course introduces diploma students to the fundamental concepts of drone technology including components, sensors, flight controllers, and communication systems. It also provides practical exposure through drone assembly, simulator training, and basic flight operation. The course helps students understand safe drone usage and regulatory guidelines issued by the Directorate General of Civil Aviation. Overall, the subject aims to develop basic technical skills and awareness of emerging career opportunities in the drone industry.

Course Outcome:
After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Explain the basic concepts and classifications of drones/UAVs.	R, U
02	Identify and describe the major components of a drone system	R, U
03	Understand sensors and control systems used in drones.	U
04	Describe Drone Communication System	U, A
05	Follow safety guidelines and regulatory requirements for drone operation.	R

**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)	
02	00	02	3	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Drone Technology** **1.1 Definition of UAV and Drone** **1.2 History and evolution of drones** **1.3 Difference between UAV, UAS, and Drone** **1.4 Classification of Drone** • Classification of Drone based on Size/Weight • Classification of Drone based on its Types • Classification of Drone by Altitude • Classification of Drone by Structure/Design i.e. Fixed wing, Rotary wing, Single Rotar drones, Multirotor drones, Hybrid drones **1.5 Basic drone terminology** • Pitch • Roll • Yaw • Throttle • Altitude **1.6 Forces acting on Drone** • Lift • Drag • Thrust • Gravity **1.7 Advantages and Limitations of drones** **1.8 Various Applications of Drone** • Agriculture monitoring • Aerial photography and videography • Disaster management • Surveillance and security	08	20%

	• Infrastructure inspection • Parcel delivery systems • Mapping and surveying		
2.	**Drone Components and Architecture** **2.1 Basic Architecture of a drone system** • Basic Block Diagram of Drone System **2.2 Frame and mechanical structure** • Types of frames • Materials used in frames **2.3 Brushless DC motors** • Construction, Working principle and KV rating of motor **2.4 Electronic Speed Controller (ESC)** • Function of ESC, Connection with motor and flight controller **2.5 Propellers and thrust generation** • Types of propellers, Propeller size and pitch, Clockwise and counterclockwise propellers **2.6 Power system** • Li-Po battery construction, Battery capacity and voltage rating, Battery charging and safety **2.7 Payload systems** • Camera, Gimbal, Additional sensors/Components	07	20%
3.	**Flight Controller and Sensors** **3.1 Flight controller concept** • Definition: Flight controller as "brain of the drone" • Block diagram of drone control system • Inputs to flight controller: Receiver signals, Sensor data • Outputs from flight controller: Signals to ESC → motors • Different Examples/Types of flight controllers **3.2 Working of flight controller boards** • Microcontroller (basic role only, no deep architecture) • Sensor interface (I2C/SPI concept – basic idea only) • Power supply section • Output pins for ESC **3.3 Types of sensors used in drones** • Accelerometer (Definition, Diagram showing 3 axes, Application in drone) • Gyroscope (Definition, Relation with roll, pitch, yaw, Application)	06	25 %

	• Magnetometer (Definition, Its concept and, Application in Navigation) • Barometer (Definition, Relation between pressure and altitude, Application) • GPS (Working concept: satellite-based positioning – basic idea, Parameters: Latitude, Longitude, Altitude, Applications in drone: Position holding, Return to home, Navigation) **3.4 Inertial Measurement Unit (IMU)** • Introduction to IMU, its function and working Principle with block diagram **3.5 Stabilization and basic flight control concepts** • Basic concept of drone stabilization (What is stabilization, Role of sensors + controller, Concept of feedback control System-Diagram, Example: Drone maintaining level position) • PID control concept (Explanation and Block Diagram of drone PID for Velocity Hold Control: Give specific speed Hold example with Setpoint, Process Variable, Error calculation and role of P, I and D for maintaining constant velocity)		
4.	**Communication and Navigation Systems** **4.1 Basics of Drone Communication** • Definition of communication in drones • Need of communication system • Types of communication: Control communication (pilot → drone), Data communication (drone → ground) **4.2 Radio transmitter and receiver** • Definition of transmitter • Basic parts of transmitter: Control sticks (throttle, yaw, pitch, roll), Switches • Function of each control: Throttle, Pitch, Roll, Yaw • Definition of receiver • Working: Receives signal from transmitter, Sends signal to flight controller • Connection with flight controller **4.3 Channel in Drone Communication** • Definition of channel • Minimum channels required: 4 channels (Throttle, Pitch, Roll, Yaw) • Additional channels: Camera control, Flight modes	05	20%

	4.4 Communication Frequency Bands • Basic concept of frequency • Common frequency bands used: 2.4 GHz, 5.8 GHz • Range vs frequency (basic idea) **4.5 Telemetry systems** • Definition, Purpose of Telemetry and its Application **4.6 Ground Control Stations** • Definition • Types (Mobile based, Laptop Based) • Functions • Mobile Apps example **4.7 Waypoint Navigation Concept** • Definition • Concept with example		
5.	**Drone Safety and Regulations** **5.1 Drone safety guidelines** **5.2 Pre-flight checklist** **5.3 Common drone failures and troubleshooting** **5.4 Airspace awareness** (Safe Flying Practices) **5.5 Introduction to drone regulations in India** **5.6 Role of Directorate General of Civil Aviation (DGCA)** **5.7 No-fly zones and restricted areas** • Red Zone, Yellow Zone, Green Zone **5.8 Digital Sky platform overview**	04	15%
	Total	**30**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25	**35**	**40**	-	-	-

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. Quadcopters and Drones: A Beginner's Guide – Kevin Jenkins
2. Introduction to UAV Systems – Paul Fahlstrom
3. DIY Drones for the Evil Genius – Ian Cinnamon

4. Small Unmanned Aircraft Systems Guide – Brandon Jones
5. Make: Drones – Teaching an Arduino to Fly – David McGriffy
6. DGCA Drone Rules and Operational Guidelines (India)

(b) Open source software and website:

1. https://ardupilot.org/
2. https://px4.io/
3. https://ardupilot.org/planner
4. https://qgroundcontrol.com/
5. https://microsoft.github.io/AirSim
6. https://gazebosim.org/
7. https://dronecode.org/

Suggested Course Practical List:

Minimum 10–12 experiments and total min 30 Hrs

1. Study of different types of drones and their components.
2. Identification of drone parts (frame, motors, ESC, propellers, battery).
3. Study of Li-Po battery charging and safety procedures.
4. Interfacing and testing of brushless DC motor with ESC.
5. Study of flight controller board.
6. Calibration of sensors in flight controller.
7. Demonstration of drone assembly process.
8. Installation and configuration of drone control software.
9. Drone flight simulation using computer simulator.
10. Basic drone flight demonstration (take off, hover, landing).
11. GPS positioning and waypoint navigation demonstration.
12. Drone camera operation and aerial image capture.

List of Laboratory/Learning Resources Required:

- Basic quadcopter training drones
- Drone flight simulator software

- Brushless DC motors
- Electronic Speed Controllers (ESC)
- Flight controller boards (Pixhawk / KK / APM type)
- Li-Po batteries and charger
- Radio transmitter and receiver
- GPS modules
- Propellers and frames
- Laptop/PC with drone configuration software
- Basic electronic tools

Suggested Project List:

- Design and assembly of a basic quadcopter model.
- Drone-based aerial photography project.
- Crop monitoring using drone images.

Suggested Activities for Students:

- Drone simulator-based flight training.
- Survey of drone applications in industry.

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