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DRONE TECHNOLOGY **Course Code : 316335**

Programme Name/s	**: Automation and Robotics/ Digital Electronics/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics/ Electronics & Computer Engg./**
Programme Code	**: AO/ DE/ EJ/ EK/ ET/ EX/ IE/ TE**
Semester	**: Sixth**
Course Title	**: DRONE TECHNOLOGY**
Course Code	**: 316335**

I. RATIONALE

Drones, or UAVs, are transforming industries and are regulated by rules like the DGCA Drone Rules 2021. Emerging technologies like autonomous flight and AI are expanding drone capabilities. This course will provide a comprehensive knowledge of drone technology and its operations. It will prepare students to work in this field.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help students to attain the following industry/employer expected outcome through various teaching-learning experiences: Maintain various components of Drone System.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Classify different types of Drones.
- CO2 - Interpret drone technology along with its rules and regulations.
- CO3 - State function of Drone system and subsystems.
- CO4 - Test the drone system.
- CO5 - Select drone for a given application.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316335	DRONE TECHNOLOGY	DRT	DSE	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

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Total IKS Hrs for Sem. : 2 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe history of Flight and Ancient concepts related to it. TLO 1.2 Describe evolution of UAV technology. TLO 1.3 Explain Drones, types and their applications. TLO 1.4 Explain Drone classification by weight category (as per Drone Rules 2021) . TLO 1.5 Explain terminologies related to Drones . TLO 1.6 Describe Flying area of Drones .	**Unit - I Introduction and Classifications of Unmaned Aerial Vehicle (UAV)/Drones** 1.1 Historical references of ancient flight concepts (IKS) 1.2 Evolution of Drone/UAV technology 1.3 Introduction to Drones : types (fixed,rotary, hybrid) and applications 1.4 Drone classification by weight category (as per Drone Rules 2021) 1.5 Terminologies related to Drones (as per Drone Rules 2021) - UAV (Unmanned Aerial Vehicle), Remote pilot, UAS (Unmanned Aircraft System), RPAS (Remotely Piloted Aircraft System), GCS (Ground Control Station), VLOS (Visual Line of Sight), BVLOS (Beyond Visual Line of Sight), UIN (UAV Identification Number), UAOP (UAV Operations Permit) 1.6 Digital sky platform : Airspace map for zone identification	Lecture Using Chalk-Board Video Demonstrations Model Demonstration

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Describe the operation of basic building blocks of the drone system and subsystem. TLO 2.2 Describe Drone components and its function. TLO 2.3 Explain principles of Flight. TLO 2.4 Explain Drone flying rules, regulations and safety precautions .	**Unit - II Drone Technology - Building blocks, Components, Flight Dynamics, and Regulations.** 2.1 Building blocks of the Drone system and subsystem 2.2 Drone components and its function : frame, motors, propellers, ESC, flight controller, battery, basic Sensors(accelerometer, magnetometer (compass), barometer, GPS),camera, Drone transmitter and receiver, Drone software and firmware 2.3 Principles of flight : lift, thrust, drag, weight, the axis of drone motion (pitch, roll, and yaw), aerodynamic principles that enable flight 2.4 Regulations and safety : Drone flying rules, regulations and their safety precautions (as per Drone rules 2021) governed by DGCA India	Lecture Using Chalk-Board Video Demonstrations Model Demonstration
3	TLO 3.1 Describe the working of Drone motors. TLO 3.2 Demonstrate programming for drone flight control using programming ESC. TLO 3.3 Describe the power management used in Drone . TLO 3.4 Explain the power management system in Drone. TLO 3.5 Describe Propellers and it's type . TLO 3.6 Describe frames and it's type . TLO 3.7 Explain the working of other components associated with Drone.	**Unit - III Drone Motors, Power Systems, and other components** 3.1 Motor: Brushless motor , motor specification, thrust-to-weight ratio, KV ratings and motor selection based on application 3.2 Electronic Speed Controllers (ESC): working principle and specification 3.3 Flight controller: Introduction and working principle 3.4 Power Management: batteries, calculation of flying time based on battery capacity ,the power distribution board 3.5 Propellers and it's type 3.6 Frames and it's type 3.7 Camera, gimble and and role of following sensors in the drone (Gyroscope, Accelerometer, Magnetometer (Compass), Barometer, GPS, Temperature Sensor)	Lecture Using Chalk-Board Video Demonstrations Model Demonstration

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Describe selection criteria for different components used in drone. TLO 4.2 Explain assembly and integration system of drone. TLO 4.3 Describe procedure for Drone operation . TLO 4.4 Explain the maintenance process of Drone	**Unit - IV Drone assembly, operation and maintenance** 4.1 Component Selection : Frame, Motor, Propeller, Power distribution board, Battery, Flight controllers, Transmitter and Receiver, Cameras, and Sensors (Accelerometer, Magnetometer (Compass), Barometer) 4.2 Assembly and Integration: Basic wiring and soldering, assembling components into a functional Drone 4.3 Procedure for Drone operation 4.4 Troubleshooting and Maintenance: Diagnosing and fixing common issues (Power Issues, Connectivity Problems, GPS Issues, Motor and ESC Malfunctions, Propeller Problems, Battery Problems, Camera & Gimbal Issue, Firmware or Software Errors), Maintenance (Pre-flight Maintenance, Post-flight Maintenance, Battery Maintenance, Motor and Propeller Maintenance, Firmware and Software Updates, Regular Inspections) and calibration	Lecture Using Chalk-Board Video Demonstrations Model Demonstration
5	TLO 5.1 Explain the application of Drone in various sector. TLO 5.2 Explain Autonomy and AI concept used in the Drone. TLO 5.3 Explain role of the Drone technology in future.	**Unit - V Drone Applications and Future Trends** 5.1 Applications: Drones in agriculture, construction, logistics, military and cinematography 5.2 Basics of autonomous flight : waypoint navigation, sensor fusion, and machine learning for object detection 5.3 Emerging Trends: Drone swarming, Solar-powered drone, Advanced Sensors used in Drones for Imaging Technology	Lecture Using Chalk-Board Video Demonstrations Model Demonstration

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Prepare a report/chart on the history of flight and ancient concepts of aerodynamics(IKS) . LLO 1.2 Prepare of a report/chart on the overview of drones, including their history, types, and applications.	1	Preparation of a report/chart on the history of flight and illustrate the evolution timeline of UAV technology till date	2	CO1
LLO 2.1 Explore Digital sky platform.	2	Exploration of Digital sky platform	2	CO1
LLO 3.1 Identify the zones (Red,Yellow,Green) by using Airspace map for any district and area near the airport.	3	* Identification of zones (Red,Yellow,Green) by using Airspace map for any district and area near the airport	2	CO1
LLO 4.1 Prepare a report/chart on the classification of drones by weight categories and define the related terminologies as per Drone Rules 2021.	4	Preparation of a report/chart on the classification of drones by weight categories and define the related terminologies as per Drone Rules 2021	2	CO1

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 5.1 Identify the mechanical components in drones, and describe their specifications and functions.	5	Identification of mechanical components in drones, and describe their specifications and functions	2	CO2
LLO 6.1 Identify electrical components in drones, describing their specifications and functions.	6	*Identification of electrical components in drones, describing their specifications and functions	2	CO2
LLO 7.1 Identify electronic components used in drones, describing their specifications and functions.	7	*Identification of electronic components in drones, describing their specifications and functions	2	CO2
LLO 8.1 Prepare a report/chart on DGCA Regulations & Safety Protocols for Drone Operation .	8	Preparation of a report/chart on DGCA Regulations & Safety Protocols for Drone Operation	2	CO2
LLO 9.1 Plot the Speed-Torque Characteristics of a BLDC Motor used in Drone .	9	Plot the speed-torque characteristics of Drone's BLDC motor	2	CO3
LLO 10.1 Inspect battery pack for bulges and leakage.	10	*Inspection of a battery pack for bulges and leakage	2	CO4
LLO 11.1 Calculate the flying time based on battery capacity.	11	*Calculation of the flying time based on battery capacity	2	CO3
LLO 12.1 Assembling of the quadcopter Drone.	12	*Assemble the quadcopter Drone using the given components	2	CO4
LLO 13.1 Configure and operate the Drone transmitter and receiver.	13	Configuration and operation of Drone transmitter and receiver	2	CO4
LLO 14.1 Test the assembled drone. LLO 14.2 Troubleshoot the assembled drone.	14	*Test the assembled drone	2	CO4
LLO 15.1 Prepare a report/chart on application of Drone technology in Agriculture.	15	*Preparation of a report/chart on application of Drone technology in Agriculture	2	CO5
LLO 16.1 Prepare a report/chart on the application of Drone technology in cinematography.	16	Preparation of a report/chart on the application of Drone technology in cinematography	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Explore and make ppt on current drone regulations (DGCA) and summarize the key safety and operational rules.
- Explore Indian Government schemes related to Drone used in various sectors and tabulate it .
- Create a chart that compares different types of drones (fixed-wing, rotary-wing, hybrid). Include details such as their flight mechanism, uses, and advantages/disadvantages.

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- Create a comparison table of popular drone software frameworks like ArduPilot, PX4, and ROS. Highlight their features, advantages, and differences in functionality.
- Create an infographic or chart that shows the key components of a drone (motors, ESCs, flight controller, GPS, sensors). Briefly describe each part's role in the flight system.
- Draw a diagram illustrating the principles of drone flight (lift, thrust, drag, weight). Label the forces and explain how they work together in stable flight.
- Make a chart explaining the Drone policy implemented in India for various applications.

Assignment

- Compare different types of quadcopter frames based on their application (racing frames, photography/videography frames, industrial frames, toy drone frames, fpv frames, heavy-lift frames)
- Explain how Electronic Speed Controller (ESC) calibration is essential for ensuring optimal drone performance. In your answer, discuss the role of ESC calibration in motor performance, throttle range, safety, and battery management. Additionally, explain the potential consequences of failing to properly calibrate the ESC in a drone.
- How is drone technology transforming Indian agriculture? Discuss the role of initiatives like the Kisan Drone Scheme and Namo Drone Didi by the Government of India in accelerating this transformation. Highlight the benefits and challenges of using drones for crop monitoring, spraying, and precision farming, and explore how these advancements are shaping the future of farming in India.
- Compare different types of quadcopter propellers based on their application (racing frames, photography/videography frames, industrial frames, toy drone frames, fpv frames, heavy-lift frames)
- Compare the drone regulations in India with those of other countries (any two) around the world and explain how they differ.
- Compare different types of quadcopter motors based on their application (racing frames, photography/videography frames, industrial frames, toy drone frames, fpv frames, heavy-lift frames)
- Comment on the power vs. speed characteristics of the drone based on the thrust-to-weight ratio and KV rating.
- Drone Maintenance for Agricultural Monitoring Fleet Scenario: You are the lead technician responsible for maintaining a fleet of drones used for agricultural monitoring. The drones are equipped with high-resolution cameras, GPS modules, and autonomous flight systems. Your goal is to ensure their continuous operation and minimize downtime due to maintenance issues. Answer the following questions based on your knowledge of drone maintenance, safety procedures, and preventive measures. Question 1: What daily, weekly, and monthly maintenance tasks should be performed to keep the drones in optimal working condition. Question 2: Explain the importance of calibrating the GPS modules regularly. What steps should be taken to calibrate the GPS system in the drones. Question 3: Describe the procedures you would follow to inspect and maintain the drone’s high-resolution cameras and propellers to prevent any operational issues. Question 4: How would you monitor and maintain the health of the drone batteries to ensure long-duration flights in agricultural fields. Question 5: What emergency procedures should be followed if a drone malfunctions during flight, and how would you ensure the safety of crops and equipment in such cases.
- Drones face significant challenges with weight and battery limitations, which affect their flight time, payload capacity, and overall performance. How can the integration of solar power help overcome these issues. Discuss the potential benefits of solar-powered drones.

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Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer system with internet connectivity.	1,2,3,4,8,15,16
2	Any office software and browser	1,2,3,4,8,15,16
3	Quadcopter Drone Kit	5,6,7,9,10,11,13,12,14
4	Tachometer	9
5	Digital Multimeter	9,10,13,12,14

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction and Classifications of Unmaned Aerial Vehicle (UAV)/Drones	CO1	12	4	4	4	12
2	II	Drone Technology - Building blocks, Components, Flight Dynamics, and Regulations.	CO2	12	4	6	6	16
3	III	Drone Motors, Power Systems, and other components	CO3	12	4	6	6	16
4	IV	Drone assembly, operation and maintenance	CO4	14	2	4	10	16
5	V	Drone Applications and Future Trends	CO5	10	2	4	4	10
Grand Total				**60**	**16**	**24**	**30**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit tests of 30 marks and average of two unit test marks will be considered for out of 30 marks. For formative assessment of laboratory learning 25 marks. Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks. End semester summative assessment of 25 marks for laboratory learning

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XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	1	1	1	3	1	2			
CO2	2	2	3	3	3	2	3			
CO3	2	2	3	3	3	2	3			
CO4	2	3	3	3	3	2	3			
CO5	2	3	3	3	2	2	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Ms. Dharna Nar, Dr. Radhika Kotecha	Drone Technology for Beginners: Learn | Build | Fly Drones	Drone School India and Ane Books Pvt Ltd, ISBN : 978-8197222184
2	Aalok Tripathi	DRONE TECHNICIAN THOERY	ARIHANT PUBLICATIONS INDIA LIMITED, ISBN : 978-9364378895
3	Terry Kilby, Belinda Kilby	Make: Getting Started with Drones: Build and Customize Your Own Quadcopter	Shroff Publishers & Distributors Pvt. Ltd, ISBN : 978-9355428899
4	Garvit Pandya	Basics of Unmanned Aerial Vehicles : Time to start working on Drone Technology	Notion Press Media Pvt Ltd, Chennai, ISBN : 978-1637453865
5	Dr Raja Mogili Amirisetty	THE DRONE LAW IN INDIA	Gogia Law Agenency , ISBN : 978-8193978559
6	David McGriffy	Make: Drones - Teach an Arduino to Fly	Shroff Publishers & Distributors Pvt. Ltd, ISBN : 978-9355425188
7	Mr. I.V.S.Yeswanth & Dr. A.V.S.Sridhar Kumar	Fundamentals of Drone Technology	Authors Click Publishing, ISBN : 978-9366652450

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://digitalsky.dgca.gov.in/airspace-map/#/app	A digital sky airspace map is an interactive, real-time representation of airspace boundaries, flight paths, and aviation regulations, often used for flight planning and navigation

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Sr.No	Link / Portal	Description
2	https://digitalsky.dgca.gov.in/home	Digital Sky Platform is an online portal by the Indian government for managing and regulating the operations of drones in Indian airspace.
3	https://www.dgca.gov.in/digigov-portal/jsp/dgca/homePage/viewPDF.jsp?page=InventoryList/headerblock/drones/Drone%20Rules%202021.pdf	The Drone Rules, 2021, Unmanned Aircraft System Rules, Government of India in the Ministry of Civil Aviation

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 04/09/2025 **Semester - 6, K Scheme**