ABOUT THE COURSE

COURSE NAME:	DRONE PILOT TECHNIQUES
TOTAL DURATION:	45 Hrs
MODE OF DELIVERY	PHYSICAL CLASSROOM TRAINING AT RESPECTIVE COLLEGES
TRAINER TO STUDENT RATIO:	1:50
TOTAL MARKS:	75

TABLE 1	
OVERALL COURSE OBJECTIVE:	The course will up-skill the candidates in the field of drone technology, the participants will obtain knowledge related to the application of drones in various field. The candidates will gain practical knowledge in building of a complete drone from scratch including the functioning of all the components. This will help the candidates of understand the technical aspects of drone building. In addition to that the candidates will be given with pilot training of drone in simulator and in field for a certain hour to ensure the candidates are trained in operating the drone**.**
LEARNING OUTCOME:	• Exploring latest drone technology and its applications. • Demonstrate basic operations of drone • Simulation training to improvise the piloting skills. • Explore the Rules and regulation of drone according to DGCA is thought in the training. • Assemble a complete drone including all the software programming and hardware connections with testing.

TABLE 2: MODULE-WISE COURSE CONTENT AND OUTCOME				
SL. NO	**MODULE NAME**	**MODULE CONTENT**	**MODULE LEARNING OUTCOME**	**DURATION (HRS)**
2	Aerodynamic concept of drone flying	Detailed discussion on technical aspects, Thrust	Complete calculations behind the designing of drone. design an indigenous	4 Hours

	calculations.	and drag calculation of drone. Design of drone frame and cantilever analysis of drone arms and maximum load factor calculation. Life cycle of drone frame calculation, Maximum operating altitude calculation, thrust to weight ratio calculation, Centre of Gravity calculation, Maximum take-off weight calculation, Motor current draw calculation and obtaining the maximum flight time of the drone.	drone. The improvising of drone design techniques will be discussed.	
3	Manufacturing of drone and material selection for drone. Propulsion system of drone	Introduction to manufacturing of drone manufacturing method and materials utilized. Discussion of rapid prototyping method of manufacturing, Injection Moulding	The candidates can decide the efficient materials for different parts of the drone. Identify the drone manufacturing method to minimize the cost of manufacturing. Suitable power system for the drone.	3 Hours

		method, CNC Tooling method, Composite moulding method, Autoclave Utilized composite manufacturing. Components which can be manufactured in different method and usage of components. Kevlar, Carbon composites, Plastic , nylon materials usages in drone. Discussion of Electric propulsion system, gasoline operated system and hybrid operating system		
4	Concept of Autopilot in drone and sensors available in them	Discussion of concept of Autopilot and its function, Sensors available in autopilot. Calibration of sensor and different purposes of each sensor. Global position system in drone	Program the drone's autopilot with different configurations and for different use case. Identify the suitable protocol for GPS system based on the location of operation.	5 Hours

		and its function, Protocol for GPS system, Different types of GPS system		
5	Introductio n to rubber band powered plane and assembly	Introduction to rubber band powered plane to understand the working principal of Fixed wing drones. Assembly of the rubber band plane from the kit provided by the organisation. Flying test of all rubber band powered plane and categorising the most efficient design.	Practically assemble a rubber band plane and test by themselves and improvise the design. Candidates can get through the complete concept of fixed wing drone flying.	8 Hours
6	Drone Simulator Training	Drone piloting simulator training will be provided with the assistance of staffs. Drone manoeuvring will be practiced i.e Pitch, Roll, Yaw and Throttle. Basic stick control method will be provided to control the	Practice the drone piloting in software so that they can operate the drone without any damages or crashing the drone on field.	6 hours

		drone.		
7	Assembly of QUADCOPTER and flying test of it.	The students will be provided with all the components needed to assemble a quadcopter, all components will be tested by the students. After testing of components, the assembly of quadcopter will be discussed and sub- system like soldering, thermal paste, 3MM tape etc. The connection for the components will be explained and candidates can perform the connection. Programming of drone using Ground Control Software (GCS) will be discussed. Flight test of the quadcopter will be tested by the staffs for ensuring the flying capability of drone. The after the complete testing	Build their own drone in the design they prefer. On field piloting practice is provided. Control of GCS to operate the drone in autonomous mode is learnt.	15 Hours

		of drone candidates can Practice flying of drone with the help of staffs assisting them. Basic manuvering of drone will be practiced. The operation of drone in autonomous mode will be discussion with the usage of GCS.		
8	Conclusion	The topics discussion and training session will be concluded by the staff and way forward of drones will be discussed.	The way forward of drone industry will be discussed.	1 Hour

TABLE 3: OVERALL COURSE LEARNING OUTCOME ASSESSMENT CRITERIA AND USECASES		
LEARNING OUTCOME	**ASSESSMENT CRITERIA**	**USECASES**
Participants can understand complete working of drone, Advantages of the drone technology in different sectors. Participants gain knowledge about flight dynamics of drone.	Segregation of drone category for different applications. Selection of different payloads for different applications. Calculation of thrust to weight ratio Design of optimised drone frame	**Use Case 1:** Segregation of drone category for different applications. **Scenario:** Different categories of drone will be produced and participants have to match the application and drone based on application. **Task:** Viva examination will

		be conducted for the participants where they will be asked to match the applications with drone. **Use case 2:** Selection of different payloads for different applications. **Scenario:** The payloads like thermal camera, Lidar, Multi spectral camera, Hyper spectral camera will be displayed and applications like agricultural growth identification, Elevation estimation, Mapping will be displayed and participants has to match the application with the payloads. **Task:** Viva examination related to payloads and application can be conducted. **Use Case 3:** Calculation of thrust to weight ratio **Scenario :** The participants will be given an numerical problem to solve and they can apply the formula and solve the problem and identify the optimal thrust required for the drone

		in different altitudes. **Task:** A series of numerical and concept based test will be conducted for the participants and solve the question paper. **Use Case 4:** Design of optimised drone frame. **Scenario:** The participants have to pictorially represent the creative design of drone with an improved efficiency in thrust production and minimal drag production. **Task:** The participants have to draw or design using CAD to represent the drone frame design and its improved performance changes made by the design.
Participants can gain knowledge in DGCA rules and regulations and operate the drone. Participants gain knowledge about type certification and Remote pilot certificate.	Segregation of different zones of airspace DGCA rules for drone altitude in INDIA Type certification rules for drone Categories or remote pilot certificate and validation in INDIA	**Use case 1:** Segregation of different zones of airspace. **Scenario:** The participants will be asked to define the different fly zone in India and conditions of, Random locations zone identification will be asked. **Task:** The participants have

		to locate the red, yellow and red zone ill be identified in Digital sky platform. **Use case 2:** DGCA rules for drone altitude in INDIA. **Scenario:** The participants will be questioned about the rules and regulation according to DGCA in India. **Task:** A series of DGCA rules-based test will be conducted for the participants and solve the question paper. **Use Case 3:** Type certification rules for drone **Scenario:** The rules regarding type certification of drone with basic design requirements will be questioned to the students. **Task:** A series of DGCA Type certification-based test will be conducted for the participants and solve the question paper. **Use Case 4:** Categories or remote pilot certificate and validation in INDIA. **Scenario:** The particpants will

		be questioned regarding the pilot certification and categories in India. Along with that the validation process will be explained. **Task:** A series of DGCA remote pilot-based test will be conducted for the participants and solve the question paper.
Participants will gain knowledge of technical parts of drone and in-depth knowledge of components in drone. Participants enhance knowledge in Autopilot configuration and software programming of Autopilot.	Components selection for different configuration of drone to produce different thrust ratios. Wiring diagram of drone components representation. Function of autopilot in drone.	**Use case 1:** Components selection for different configuration of drone to produce different thrust ratios. **Scenario:** Participants will provide with different components and with different configurations and they must segregate the components according to the possible combination. **Task:** Participants can attend practical test on selection of components for drone to maximise the performance and reduce the current consumption.
		Use Case 2: Wiring diagram of

		drone components representation. **Scenario:** Participants must draw flow chart for components in drone and map the signal flow and current flow of the drone. **Task:** Participants can attend practical test on components mapping and assembly of components. Use Case 3: Function of autopilot in drone. **Scenario:** The autopilot will be provided with the ground control station and complete setup has to be performed by the participants. **Task:** Practical test will be conducted for programming the autopilot and final ready to fly condition of the drone will be tested.
Participants will gain knowledge on Assembly of Fixed wing (Rubber Band Powered plane). Participants will try Assembly of Quadcopter and calibration of sensors.	Aerodynamic concept behind flying of rubber band powered plane. Flying principal behind quadcopter drone and lift production due to propeller rotation. Identification of heading of drone while the drone	**Use Case 1:** Aerodynamic concept behind flying of rubber band powered plane. **Scenario:** The rubber band powered plane's wing design will be provided, and the

Participants can identify the Colour coding of arms in drone while flying the drone.	is flying and perform emergency recovery.	angle must be varied and stall angle has to be identified. **Task:** The calculation for drag calculation has to be identified and then stall angle has to be determined. **Use Case 2:** Flying principal behind quadcopter drone and lift production due to propeller rotation. **Scenario:** The simulation and mathematical calculation software's will be provided, and the participants has to simulate the stall angle of the plane. **Task:** The calculation of stall angle must be calculated with the design of wing air foil design and improve the aspect ratio**.** **Use Case 3:** Identification of heading of drone while the drone is flying and perform emergency recovery. **Scenario:** Testing equipment's will with motors to identify the thrust with various propeller will be provided.

		Task: Participants has to test the motors and thrust production and identify the thrust needed for the drone to operate. **Use Case 3:** Identification of heading of drone while the drone is flying and perform emergency recovery. **Scenario:** The drone will be flying, and the heading of the drone will be changed by the operator then the participant has to correct the heading based on the colour coding and direction of the drone. **Task:** The participants has to instruct the operator to give input commands and then based on that the direction of the drone has to be identified by them.
Flying practice of drone and understanding about PID tunning of drone. Participants can free fly for a certain amount of time in a closed	Flying of drone piloting in Drone simulation software. Flying practice test of drone in different shape formation. Realtime PID tuning of drone to improvise	**Use case 1:** Flying of drone piloting in Drone simulation software. **Scenario:** **The drone simulator software and the transmitter for it will be given**

environment.	performance. Yaw correction estimation in GPS denied condition flying practice.	**and tested for practicing of piloting.** **Task:** Practical test of drone piloting in simulator platform. **Use Case 2:** Flying practice test of drone in different shape formation. **Scenario:** The drone will be provided to the participants and the 8 formation, circular inclination, Circular declination etc... will be tested. **Task:** The practical test on drone flying skill will be tested. **Use case 3:** Realtime PID tuning of drone to improvise performance. **Scenario:** The drone PID tuning decides the behaviour of drone, So the drone will be flying in the air, and the participants has to change the value of all parameters to improve the capability of drone. **Task:** The practical test of

		software usable capability of participants if tested. **Use Case 4:** Yaw correction estimation in GPS denied condition flying practice. **Scenario:** The GPS system in drone will be removed and the drone will be set to manual mode so the participants has to learn flying of drone in case of any sensor failure in the drone. **Task:** Practical test of the emergency recovery capability of drone by the participants is tested

TABLE 4: LIST OF FINAL PROJECTS (20 PROJECTS THAT COMPREHENSIVELY COVER ALL THE LEARNING OUTCOME)	
SL.NO	**FINAL PROJECT**
1	Design and Fabrication of drone frame assembly
2	Design and simulation of maximum load withstand capability of drone
3	Fabrication of variable pitch propeller
4	Design and fabrication of BLDC motor
5	Fabrication of VTOL drone
6	Simulation and numerical Calculation of propeller balance point.
7	Manufacturing of drone using Rapid prototyping method.
8	Manufacturing of mapping drone
9	Wind mill inspection using drone
10	Agriculture spraying using drone
11	Logistics delivery drone
12	Man carrying drone (Drone Taxi)
13	Surveillance drone
14	Firefighting drone

15	Military combat mission drone
16	3D scanning drone
17	Anti drone system
18	Test bench for calculation of Centre of Gravity of drone
19	Test bench for motor thrust calculation and vibration
20	Improvision of Power system using hybrid technology in drone