

**Government of Karnataka****DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION**

Program	Electronics & Communication Engineering	Semester	5
Course Code	20EC51I	Type of Course L:T:P	104: 52: 312
Specialization	Drone Technologies	Credits	24
CIE Marks	240	SEE Marks	160

Introduction:

Unmanned Aerial Vehicles aka Drones have become one of the fastest trending and growing technologies in the history of mankind. The nature of these vehicles being easy to deploy, expendable and customizability features and relatively affordable when compared to manned aircrafts makes it the preferred option for various industries. The acceptance of drones to traditional industries such as surveillance, agriculture, delivery, surveying and many more has revolutionized entire industries by providing much accurate performance and greater results.

Drone being a true sunrise industry is currently in its infancy and requires a lot of research, development and testing before it is widely accepted and deployed. Drones being a multidisciplinary domain requires skilled talent from every engineering domain. With more than 60% of the applications of drones yet to be found and implemented, there lies a huge potential untapped in this industry. According to a few reports, the drone industry in India is expected to reach a whopping 68 billion dollars by 2027. This opens up a lot of opportunities to the youth who can get trained and can excel in this field of technology.

Pre-requisite

Before the start of this specialization course, you will have prerequisite knowledge gained in the first two years on the following subjects:

1st year -Engineering Mathematics, Communication Skills, Computer Aided Engineering Graphics, Statistics & Analysis, Basic IT Skills, Fundamentals of Electrical and Electronics Engineering, Project Management skills, Digital Electronics

2nd year- Analog Electronics, Logic Design using Verilog, Communication Systems, Electronic Measurements and Testing Techniques, PCB Design & Fabrication, Wireless Communication, Embedded C Programming, Industrial Automation, in this year of study, you shall be applying your previous years learning along with specialized field of study into projects and real-world applications.

Instruction to course coordinator.

1. Each Specialized field of study is restricted to a Cohort of 20 students which could include students from other relevant programs.
2. One faculty from the Core Discipline shall be the Cohort Owner, who for teaching and learning in allied disciplines can work with faculty from other disciplines or industry experts.
3. The course shall be delivered in boot camp mode spanning over 12 weeks of study, weekly developmental assessments and culminating in a mini capstone.

4. The industry session shall be addressed by industry experts (in contact mode/online / recorded video mode) in the discipline only.
5. The cohort owner shall be responsible to identify experts from the relevant field and organize industry session as per schedule.
6. Cohort owner shall plan and accompany the cohort for industrial/mines/site/showroom/service Centre visits.
7. Cohort owner shall maintain and document the industrial assignments, weekly assessments, practices and mini project.
8. The cohort owner shall coordinate with faculties across programs needed for their course to ensure seamless delivery as per time table
9. The cohort owner along with classroom can augment or use for supplementally teaching on line courses available although reliable and good quality online platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademy, SWAYAM etc.
10. Report should be maintained for industrial/field visit, such report shall be considered as industrial assignment.

Course outcomes: On successful completion of the course, the students will be able to,

C01	Explain the Concept of UAV, its components and its known applications.
C02	Identify the type of drone and design a drone for a given application/specification.
C03	Build, Comply, Configure and Test the drone for a given design specification.
C04	Plan & Estimate the different Payload Configurations, redesign (if required) and Integrate with the given drone.
C05	Apply the Regulations/Laws to legally fly a drone, Identify the problem if any and troubleshoot to obtain the desired result/outcome.

Detailed course plan

Week	C O	P O	Days	1 st session (9 am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
1	Learning Outcomes			❖ Learn the different types of unmanned vehicles. ❖ Understand the basic fundamentals of flight							
	1,2	1,5	1	<ul style="list-style-type: none"> Introduction, History, UV types -UGV,UAV,USV,UUVV Drones in India Applications Future scope 	2		2	UAV Types, <ul style="list-style-type: none"> Based on configuration, Based on weight, Based on altitude, Based on kit types 	2		1
	1,2	1,3,7	2	<ul style="list-style-type: none"> Principles, Newton's laws, Degrees of freedom Stick movements 	2		2	Design Brief-1 (Make a Paper Plane) <i>Description</i> <ul style="list-style-type: none"> Aerodynamics Flight force- Thrust, weight, drag, lift. 	1	1	1
	1,3	1,3,4	3	<ul style="list-style-type: none"> Flight modes Basic maneuvers Take-off, pitch, roll, yaw, land 	1	1	2	Practicals <ul style="list-style-type: none"> Simulator kit – To Do software simulation on take off and landing Transmitter setup Model configuration Calibration 	1		2
	2,4,5	2,3,5	4	Design Lab (Design software Introduction/Familiarisation-1) + Rules (Introduction to regulations)	1	1	2	Problem Statement (Design Thinking)		1	2
			5	Developmental Assessment				Assessment Review and corrective action			3

	5	7	6	<div>Industry class</div> <div>(Aeronuts)</div> <div>Aerodynamics of Airplanes - wingspan, drag, drag coefficient, long range gliders, etc</div> <div>+</div> <div>Flying session</div> <div>(Take-off & Landing)</div>	1		3	Weekly Assignment(1PM-2PM)			1
2	Learning Outcomes			<div>❖ Learn the basics to control and fly a drone</div> <div>❖ Use nano drone and explain its features</div> <div>❖ Understand the micro controllers and processors</div>							
	1,3	4	1	<div>Assignment review</div> <div>+</div> <div>Simulator Session - pitch and roll</div>		3	1	<div><div><div>• Introduction to nano drone</div><div>➤ Features</div><div>➤ Components</div></div></div>	1		2
	2,3	3,4	2	<div><div><div>• Nano drone setup</div><div>• Configuration</div><div>• Binding Tx and Rx in nano drone</div></div></div>	1		3	<div><div>Design Brief-2</div><div>(scenario of -Crowd Safety/Event security etc.)</div><div>Description</div><div><div><div>• Flight planning</div><div>• Pre-flight checks</div><div>• Drone flight</div></div></div></div>	1	1	1
	1	4	3	<div>Micro controllers</div> <div>VS</div> <div>Micro Processors</div> <div>Uses, pros & cons</div>	1	1	2	<div><div>Practicals</div><div><div><div>• Intro to Arduino</div><div>• Sensors</div><div>• Program structure</div><div>• Basic logics on using the above for any given case study</div></div></div></div>	1		2
	2,5	2,5	4	<div>Design Lab</div> <div>(Design software introduction/Familiarisation - 2)</div> <div>+</div> <div>Rules</div> <div>(Regulating Departments)</div>	2		2	<div><div>Problem Statement</div><div>Customer issues on</div><div><div><div>• pain points</div><div>• surveys on it.</div></div></div></div>		1	2

			5	Developmental Assessment				Assessment Review and corrective action			3
	5	7	6	Industry class (Drona Aviation) Pluto, sensors, gyros, number of iterations of drone, micro processors and micro controllers + Flying Session (Pitch & Roll)	1		3	Weekly Assignment			1
3	Learning outcomes			❖ Understand the basic of an Arduino ❖ Learn to integrate sensors onto the nano drone							
	1,2	1	1	Assignment review + Simulator Session- track flight		3	1	<ul style="list-style-type: none"> Pluto IDE(Integrated development environment) - software for drone Port nos- its use in connecting different computers Baud rate 	1		2
	2,3	1,4	2	Design Brief-3 <i>Description-</i> Mission based Analog sensor integration <ul style="list-style-type: none"> Sensor Selection Sensor Integration 	1		3	<ul style="list-style-type: none"> Sensor Configuration Testing Debugging 	1		2
	3	4	3	Practicals Test Flight with nano drone			4	Practicals Test flight with nano drone			3
	2,5	2,5	4	Design Lab (Nano Frame) + Pilot Licensing (Training and licensing)	2		2	Problem Statement Business Plans-Potential Solutions, Market research	1		2
			5	CIE 1 – Written and Practice Test				Assessment Review and corrective action			3
	5	7	6	Industry class (Go RC) Goradio control, Planes, investors, market research , etc +	1		3	Weekly Assignment(1PM-2PM)			1

				Flying session (Track flight)							
4	Learning Outcomes			❖ Understand the working off all components of an electric propulsion system of a drone							
	2,3	3,4	1	Assignment review + Simulator Session -obstacle landing		3	1	<ul style="list-style-type: none"> • Propulsion systems <ul style="list-style-type: none"> ➢ Types, ➢ Wiring schematic 	1		2
	1,2,3	4	2	<ul style="list-style-type: none"> • Motor <ul style="list-style-type: none"> ➢ Size, Power rating ➢ Material used 	1	1	2	<ul style="list-style-type: none"> • Propellers <ul style="list-style-type: none"> ➢ size, types, materials 	1		2
	2,3,4	1,4	3	<ul style="list-style-type: none"> • ESC(Electronic Speed Controller) <ul style="list-style-type: none"> ➢ Rating, ➢ Protocol, ➢ setup 	1		3	<ul style="list-style-type: none"> • Battery <ul style="list-style-type: none"> ➢ Power output,leads ➢ Charger ➢ Modes, setup, safety ➢ PDB(Power Distribution Board) ➢ Voltage regulation, Power rating 	1	1	1
	3,5	2,4	4	Design Lab (Propellers) + Drone Requirements (Planning,Guide,NPNT[no permission no takeoff], Check List)	2		2	Problem Statemen (Requirement gathering of customer/Research)	1		2
			5	Developmental Assessment				Assessment Review and corrective action			3
	5	7	6	Industry class (Fly Camp) batteries , Lipo,nicd,Li-ion,etc, business + Flying session (Obstacle Landing) Operate nano drone through mobile phone	2		2	Weekly Assignment (1PM – 2PM)			1
5	Learning Outcomes			❖ Understand the math and relation between the components of the propulsion system using a thrust stand							
	1,2	1,4	1	Assignment review + Simulator Session – regular flight		3	1	<ul style="list-style-type: none"> • Introduction to thrust stand • Its Basic features 	1		2

	1,3	4,6	2	<ul style="list-style-type: none"> • Thrust stand setup • Load cell- sensor indicates the weight, which is used to know the thrust requirement for flight • RPM Probe • Base 	1	3	Practicals <ul style="list-style-type: none"> • Thrust stand experiments- (with this motor, the thrust required for any type of drone is calculated. ex.Quadcopter,Hexacopter) • Thrust calculations 	1	2
	2,3	3,4,6	3	Practicals <ul style="list-style-type: none"> • Thrust stand experiments <ul style="list-style-type: none"> ➤ Efficiency calculation[output power/Input power]- To obtain flight time calculation , etc. 	1	1 2	Design Brief-4 (System Design/Power house) <i>Description</i> -Propulsion (ex.Hexacopter Calculations for 2kg of thrust can carry how much of the payload)	1	2
	3,5	2,7	4	Design Lab (motor mount) + Rules (Drone Certification)	2	2	Problem Statement (Ideation) Brain storming /ideas for a start up	1	2
			5	CIE 2 – Written and Practice Test			Assessment Review and corrective action		3
	5	7	6	Industry class (Asteria) Talk about flycamp as startup, their mistakes, their success stories,etc + Flying session (physical Transmitter module for control) nano drone	2	2	Weekly Assignment (1 PM-2PM)		1
6	Learning Outcomes			❖ Understand the working & details of all other electronic components in an industry grade drone					
	1	1	1	<u>Assignment review</u> ± Simulator Session- Take-off & Landing	3	1	<ul style="list-style-type: none"> • Frame <ul style="list-style-type: none"> ➤ Size, Configuration ➤ Material 	2	1
	1,4	1,4	2	<ul style="list-style-type: none"> • FC(flight controller) • Gyroscope, accelerometer, GPS, 	2	2	<ul style="list-style-type: none"> • RX <ul style="list-style-type: none"> ➤ Protocol, channels, 	1	2

				<ul style="list-style-type: none"> GCS(Ground control station) mission planner- software and its uses Ardu pilot(firmware/autopilot system)- flight controller software 				<ul style="list-style-type: none"> TX <ul style="list-style-type: none"> ➤ Binding, setup FPV(First person view) <ul style="list-style-type: none"> ➤ Camera, VTX(video TX),antenna Telemetry <ul style="list-style-type: none"> • Frequency, pairing, power 			
	4,5	2,3	3	Design Brief-5 (Search and Rescue) <i>Description- Payload Selection</i>	1	1	2	<ul style="list-style-type: none"> Payloads 3D arms Magnetometer Dropping mechanisms OR sense & avoid 	1		2
	,35	2,3	4	Design Lab (Arm holder)-arms connected to the body ex. Folding arm, fixed arm + Rules (Radio Telephony)	2		2	Problem Statement (System architecture) Ex. Drone ecosystem for dropping mechanism. (Pilot study – Natural disaster : mobile app-cloud computing-drone-medicine dropped to destination etc)	1		2
			5	Developmental Assessment				Assessment Review and corrective action			3
	5	7	6	Industry class (Z-motion) + Flying session (Take-off & Landing)	2		2	Weekly Assignment (1PM-2PM)			1
7	Learning Outcomes.			❖ Learn to setup, test and fix all critical components							
	2,3	3,4	1	Assignment review + Simulator Session- first person view		3	1	<ul style="list-style-type: none"> Vehicle Setup and configuration <ul style="list-style-type: none"> ➤ Ex. vehicle set up has to be done <ul style="list-style-type: none"> ○ Before connecting drone to mission planner Type of drones for vehicle setup 	1		2
	3	4	2	<ul style="list-style-type: none"> Tools- To assemble the drone Assembly procedure 	1		3	Practicals <ul style="list-style-type: none"> Transmission system Setup, Propulsion testing (for flight controller) 	1		2

	3,5	4	3	Practicals <ul style="list-style-type: none">Configuration of Transmission system	1	1	2	<ul style="list-style-type: none">Fault findingTroubleshooting	1		2
	4,5	2,4	4	Design Lab (Antenna holders) controller, telemetry, video antennas + Rules (Weather & Meteorology)	2		2	Problem Statement (Concept and Feasibility of ideation done previously) Market survey, demand etc	1		2
			5	CIE 3 – Written and Practice Test				Assessment Review and corrective action			3
	5	7	6	Industry class (RedwingLabs) debugging, fault tolerance + Flying session (FPV)	2		2	Weekly Assignment (1PM – 2PM)			1
8	Learning Outcomes.			❖ Understand how to setup a drone on the ground control softwares and prepare for flight							
	2	5	1	Assignment review + Simulator Session - Pitch & Roll		3	1	Design Brief-6 (Safety & privacy) (For using Drone used for a purpose safely) VVIP Police security	1		2
	4,5	4	2	<ul style="list-style-type: none">Failsafe types<ul style="list-style-type: none">➤ setup➤ Ground test	1		3	Practicals <ul style="list-style-type: none">Test flightbasic hoveringManeuvers			3
	3,5	3,4	3	Practicals PID Tuning – Rate setup (Process to make the drone fly with vibrations)	1		3	Practicals <ul style="list-style-type: none">GPS featuresGSC SetupWay point navigationReturn to home	1		2

	4,5	2,6	4	Design Lab (Landing gear) + Rules (Airspace structure)	2	2	Problem Statement (Prototyping- before final drone do prototype in different materials, processes etc. with feedback)	1	2
			5	Developmental Assessment			Assessment Review and corrective action		3
	5	7	6	Industry class (Poeir Jets) designing aspects. etc + Flying session (Pitch & Roll)	2	2	Weekly Assignment (1PM-2PM)		1
9	Learning Outcomes.			❖ Learn to select and integrate different payloads on drones and test flight it					
	4,5	3	1	Assignment review + Simulator Session- Hover Yaw		3	Payload Selection	1	2
	1,3	1,4	2	Introduction to Companion computers (customization)	1	3	Use Arduino/raspberry pi (ex. obstacle sensor is connected to Arduino & in turn connected to flight controller)	1	2
	2,4	1,4	3	Practicals Sensor integration	1	1	<ul style="list-style-type: none"> Payload Testing Payload configuration 	1	2
	5,2		4	Design Lab (Payload 1) + Rules (Emergency Procedures)	2	2	Problem Statement (Test, feedback)	1	2
			5	CIE 4 – Written and Practice Test			Assessment Review and corrective action		3
	5	7	6	Industry class (Skylark) PIDs, expos rates filtering, etc	2	2	Weekly Assignment(1PM-2PM)		1

				+ Flying session (Hover Yaw)							
10	Learning Outcomes			❖ Can maintain and conduct test flights							
	4	4	1	Assignment review + Simulator Session - applying Brake		3	1	<ul style="list-style-type: none"> Basic tuning Test Flight 	1		2
	3	3	2	Practicals Test Flight			4	Practicals <ul style="list-style-type: none"> Overhaul Flight 	1		2
	5	2,5	3	Troubleshoot /Test	1	1	2	<ul style="list-style-type: none"> Flight / feedback Disassembly Feedback on the entire 	1		2
	4,5	2,5	4	Design Lab (Payload 2) + Ethics (Danger of UAVs)	2		2	Problem Statement (Cost of using various payloads)			3
			5	Developmental Assessment				Assessment Review and corrective action			3
	5	7	6	Industry class (Tsalla) projects involving 3D mapping, obstacle avoidance and such that involve on board computation on the edge + Flying session (Breaking system)	2		2	Weekly Assignment (1PM-2PM)			1
	Learning Outcomes			❖ Implement additional skills required for manufacturing and overhaul							
11	2,3	3	1	Assignment review + Simulator Session – Bank turns		3	1	<ul style="list-style-type: none"> Design for Manufacturing Prototyping Methods -Explain all rapid prototyping methods . ex. 3D 	1		2

								printing, Laser cutting, CNC Cutting etc.			
	2	5	2	<ul style="list-style-type: none">Flight log analysisBlack box extraction	1		3	Practicals Flight simulation	1		2
	5	5	3	Design Lab (Frame 1) + Ethics (Safety and Privacy)	1	1	2	Future scope	1		2
	5	6,7	4	CC-1 Industry Contact class for troubleshooting	1		3	Problem Statement (Process creation) All operational processes that need to be created like :Purchase, Hiring, accounting, customer management ,etc.	1		2
			5	CIE 5 – Written and Practice Test				Assessment Review and corrective action			3
	5	7	6	Industry class (DFI) DFI and future of drones in India + Flying session (Bank turns)	2		2	Weekly Assignment(1PM-2PM)			1
12	Learning Outcomes.			1. Know Government schemes to encourage Drone industry 2.Learn about few top drone companies in India							
	5	3	1	Assignment review + Simulator Session – Auto mission		3	1	Government funds	1	1	1
	5	6	2	Indian drone firms	1	1	2	<ul style="list-style-type: none">Government schemesStudent competitionsDrone related events to encourage Drone Industry.	1	1	1

	2,5	2,5	3	Design Lab (Frame 2) + Ethics (Do's and Don'ts)	1	1	2	Problem Statement (Documentation of the project done by each team)	1	2
	5	7	4	CC-2 Industry Contact class	1		3	CC-3 Industry Contact class	1	2
			5	Developmental Assessment				Assessment Review and corrective action		3
	5	1,5	6	Industry class (Aarav) NPNT and swamitva scheme + Flying session (Auto Mission)	2		2	Weekly Assignment(1PM-2PM)		1
13										
			1	Internship a) Secondary research on various industries and their operations to identify at least 3 companies along with the areas of work interest and develop an internship plan that clearly highlights expectations from the industry during the internship.				Project a) Identification of the problem statement (from at least 3 known problems) the students would like to work as part of the project – either as provided by faculty or as identified by the student. Document the impact the project will have from a technical, social and business perspective.		40
			2	b) Design and develop a cover letter for an internship request to all 3 identified companies and the resume to be submitted to potential companies.				b) Design and develop the project solution or methodology to be used to solve at least one of the problems identified.		
			3	c) Prepare for an internship interview to highlight your interests, areas of study, career aspirations and personnel competence – including the areas of learning you expect to learn during internships Review				c) Prepare a project plan that will include a schedule, WBS, Budget and known risks along with strategies to mitigate them to ensure the project achieves the desired outcome		
			4							
			5							
			6							

NOTE:**1. Kit usage/week:**

- Simulator kit : all weeks
- Nano kit : week 2,3
- Thrust stand kit : week 4,5
- Industrial drone kit : 6,7,8,9,10,11

2. Open-source Design Software can be used for DESIGN LAB Every week – freeCAD/ Onshape/CAD Builder etc.**3. Cohort owner can further divide the cohort of 20 into sub Teams(4-5 teams) and assign them different project designs ,that will be carried forward every week under DESIGN BRIEF,PROBLEM STATEMENT and other relevant sessions .**

for example:

- Delivery
- Crop spraying
- Aerial cinematography
- Survey and mapping
- Surveillance

REFERENCES.

Sl. No	Description
1	Theory, design, and applications of unmanned aerial vehicles – A.R.Jha , CRC Press.
2	Aviation Law and Drones: Unmanned Aircraft and the future of Aviation. – David Hodgkinson and Rebecca Johnston – Routledge Publications.
3	Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation – Daniel Tal , Jon Altschuld, Wiley Publications.
4	Drones (The Ultimate Guide) – Ben Rupert, CreateSpace Independent Publishing house.
5	Basics of Unmanned Aerial Vehicles - Garvit Pandya , Notion Press.

6	Aerodynamics for Engineering Students- <u>Houghton</u> , Elsevier Publications.
7	Quadcopters and Drones: A Beginner's Guide to Successfully Flying and Choosing the Right Drone - Mark Smith, CreateSpace Independent Publishing Platform.
8	Guide to Drone Operations - Russ Flahive , Todd Kishpaugh, independently published.
9	UAS/Drone - Unmanned Aircraft Systems – Pilot Logbook: For drone pilot and operator - Charles D Marden, independently published..
10	Make: Drones: Teach an Arduino to Fly - David Mcgriffy , O'Reilly publications.

CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1- Written and practice test	4	30
Week 5	CIE 2- Written and practice test	4	30
Week 7	CIE 3- Written and practice test	4	30
Week 9	CIE 4- Written and practice test	4	30
Week 11	CIE 5- Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard)		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods

Assessment framework for CIE (1 to 5)

Note : Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam - 4 hours

Programme	Electronics & Communication Engineering	Semester	V
Course	Drone Technologies	Max Marks	30
Course Code	20EC511	Duration	4 hours
Name of the course coordinator			

Note: Answer one full question from each section.

Qn.No	Question	CL L3/L4	CO	PO	Marks
Section-1 (Theory) - 10 marks					
1.a)	Write an arduino program to make the nano drone take off automatically when it detects a clap and lands when it detects 2 claps	L3	CO3	1,2,3,4	5
b)	Fill in a Design Thinking template for a solution for "Drones for bank security" .	L4	CO2	1,2,3	5
2.a)	Sketch the wiring schematic diagram of a simple hexacopter with automatic folding landing gears	L3	CO2	1,2,3	5
b)	In mode 2, If the roll stick reflects as the pitch output and if the pitch stick reflects as the yaw output, how would you solve this issue?	L4	CO5	1,2,3,4	3
c)	Write down 5 problems faced by farmers and mention at least 3 solutions that can be implemented using drones to solve these issues.	L3	CO1	1,2,3	2
Section-2 (Practical) - 20 marks					
3)	Write and execute an arduino program to make the nano drone land when the humidity of the environment increase by 30%	L3	1,2,3,4,5	1,2,3,4,5	20
4)	Design a single piece 2" brushed hexacopter frame .	L4	1,2,3	1,2,3,4,5	20

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory)

Programme :	Electronics & Communication Engineering				
Semester :	V				
Course :	Drone Technologies				
Course Code :	20EC511				
			Max Marks :	100	
			Duration :	3 Hrs	
Instruction to the Candidate: Answer one full question from each section.					
Q.No	Question	CL	CO	Marks	
Section-1					
1.a)	Illustrate all necessary sensors in a flight controller and mentions its importance.	L3	1	10	
b)	Distinguish between a bull nose and a tapered tip propeller (any 3)	L4		10	
2.a)	Distinguish between a companion computer and a flight controller(any 5)	L4		10	
b)	Explain in detail the application of drones for e-commerce delivery	L3		10	
Section-2					
3.a)	What type of UAV would use select for a long endurance surveillance mission and why?	L3	2	10	
b)	Analyse any 5 pre-arm check errors and explain how to fix those issues.	L4		10	
4.a)	Sketch the schematic of the transmission system of a drone and ground station including a control, FPV and telemetry system.	L3		10	
b)	Mention 5 drone companies and explain their product and targetted market.	L4		10	
Section- 3					
5.a)	Draw the schematic of a PID cotroller and mention the formula for error calculation	L3	3	10	
b)	Analyse any 3 failsafe triggers and its responses.	L4		10	
6.a)	Mention 3 rapid prototyping machinery and its benefits.	L3		10	
b)	Illustrate any 5 flight modes available on ardupilot and its uses.	L4		10	
Section-4					
7.a)	What would be the difference in performance between a quad-blade and a bi-blade propeller of the same size and type?	L4	4	10	
b)	Mention 3 payloads that a first responder would require during an emergency	L3		10	
8.a)	What current capacity will you charge a 3S 2500mAh 50C battery at 2C and what would be the max current outout of the battery?	L4		10	

b)	Calculate the rpm of a 1750kv running from a 6S battery discharged upto 30% of its capacity	L3		10
Section-5				
9.a)	How will you solve the vibration issue if the blackbox shows a low frequency oscillation on 10% throttle on the pitch axis?	L4	5	10
b)	Explain in detail all preflight checks needed before a flight in a yellow zone.	L3		10
10.a)	How would you diagnose the issue of the receiver inputs not being detected even though the receiver and transmitter is bound to each other	L4		10
b)	Mention the sub systems and procedures needed to check during a maintenance cycle.	L3		10

Scheme of Evaluation for SEE 2

Sl. No	Description	Marks
	a) Write and execute a code on a raspberrypi which can make the drone stop when the ultrasonic sensor detects an obstacle under 1 meter b) Design a co-axial motor mount for a 2306 motor having 16mm diameter 3 mounting holes with a 6" tri blade propeller c) Estimate the endurance of a X8 setup with a 1800Kv motor and 5000Ah 6S Li-ion battery and having the all up weight of 2500g d) Configure the drone on mission planner to fly to 3 different waypoints at different altitudes and speed	
1	Code development	20
2	Thrust and endurance calculation	20
3	Design validation	20
4	Configuration and setup	20
5	Viva voce	20

Equipment / Software List with specification for a batch of 20 students.

Sl No	Equipment's	Specification	Quantity
1	Simulator Kit	Transmitter, Battery, Charger, Case, Cable, Drone piloting simulator software.	1
2	Nano drone Kit	Nano drone, Battery, Battery Charger, Propeller spares, Sensors.	1
3	Thrust stand	Thrust stand, Motors, Propellers, Speed controllers, Battery, Chargers.	1
4	Industrial drone	Frame, Motors, Propellers, Speed controllers, Flight controllers, GPS, Telemetry, Transmitter, Receiver, Battery, Charger, Tools, VRX, FPV Camera. Antenna, VTX, Node MCU, Raspberry Pi Kit, LORA, 3D Printer, Filament.	1
5	Prototype kit	3D Printer, Filament, Tools, Open-source design software.	1