

# **DRONE PILOT (JUNIOR)**

**NSQF LEVEL - 3**

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**TRADE PRACTICAL**

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**SECTOR: AEROSPACE & AVIATION**

**(As per revised syllabus July 2022 - 1200 Hrs)**



Directorate General of Training

**DIRECTORATE GENERAL OF TRAINING  
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP  
GOVERNMENT OF INDIA**



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**NATIONAL INSTRUCTIONAL  
MEDIA INSTITUTE, CHENNAI**

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**Post Box No. 3142, CTI Campus, Guindy, Chennai - 600 032**

**Sector : Aerospace & Aviation**

**Duration : 6 Months**

**Trades : Drone Pilot (Junior) - Trade Practical - NSQF Level- 3 (Revised 2022)**

**Developed & Published by**



**National Instructional Media Institute**

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## **FOREWORD**

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, by 2020 to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of Media Development Committee members of various stakeholders viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Drone Pilot (Junior) - Trade Practical NSQF Level - 3 (Revised 2022) in Aerospace & Aviation Sector under Six months pattern**. The NSQF Level - 3 (Revised 2022) Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 3 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 3 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these Instructional Media Packages IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

The Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind

Addl.Secretary / Directorate General of Training  
Ministry of Skill Development & Entrepreneurship  
Government of India.

New Delhi - 110 001

## PREFACE

The National Instructional Media Institute (NIMI) was established in 1986 at Chennai by then Directorate General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under Directorate General of Training, Ministry of Skill Development and Entrepreneurship) Government of India, with technical assistance from the Govt. of Federal Republic of Germany. The prime objective of this Institute is to develop and provide instructional materials for various trades as per the prescribed syllabus under the Craftsman and Apprenticeship Training Schemes.

The instructional materials are created keeping in mind, the main objective of Vocational Training under NCVT/NAC in India, which is to help an individual to master skills to do a job. The instructional materials are generated in the form of Instructional Media Packages (IMPs). An IMP consists of Theory book, Practical book, Test and Assignment book, Instructor Guide, Audio Visual Aid (Wall charts and Transparencies) and other support materials.

The trade practical book consists of series of exercises to be completed by the trainees in the workshop. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered. The trade theory book provides related theoretical knowledge required to enable the trainee to do a job. The test and assignments will enable the instructor to give assignments for the evaluation of the performance of a trainee. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also help him to assess the trainee's understanding. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirements, day to day lessons and demonstrations.

IMPs also deals with the complex skills required to be developed for effective team work. Necessary care has also been taken to include important skill areas of allied trades as prescribed in the syllabus.

The availability of a complete Instructional Media Package in an institute helps both the trainer and management to impart effective training.

The IMPs are the outcome of collective efforts of the staff members of NIMI and the members of the Media Development Committees specially drawn from Public and Private sector industries, various training institutes under the Directorate General of Training (DGT), Government and Private ITIs.

NIMI would like to take this opportunity to convey sincere thanks to the Directors of Employment & Training of various State Governments, Training Departments of Industries both in the Public and Private sectors, Officers of DGT and DGT field institutes, proof readers, individual media developers and coordinators, but for whose active support NIMI would not have been able to bring out this materials.

**Chennai - 600 032**

**EXECUTIVE DIRECTOR**

## **ACKNOWLEDGEMENT**

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisation to bring out this IMP (**Trade Practical**) for the trade of **Drone Pilot (Junior)** under the **Aerospace & Aviation Sector** for ITIs.

### **MEDIA DEVELOPMENT COMMITTEE MEMBERS**

Shri. Kamil Naqvi	-	CEO, Hayedrone Flying Academy Pvt.Ltd. Amroha, Uttar Pradesh.
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### **NIMI - COORDINATORS**

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Shri. S. Gopalakrishnan	-	Assistant Manager, NIMI - Chennai -32.

NIMI records its appreciation of the Data Entry, CAD, DTP Operators for their excellent and devoted services in the process of development of this Instructional Material.

NIMI also acknowledges with thanks, the invaluable efforts rendered by all other staff who have contributed for the development of this Instructional Material.

NIMI is grateful to all others who have directly or indirectly helped in developing this IMP.

# INTRODUCTION

## TRADE PRACTICAL

The trade practical manual is intended to be used in workshop . It consists of a series of practical exercises to be completed by the trainees during the course of the **Drone Pilot (Junior)** trade supplemented and supported by instructions/ informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in compliance with NSQF Level - 3 (Revised 2022). The manual is divided into Ten modules. The distribution of time for the practical in the Ten modules are given below.

- Module 1**      **Safety regulations and guidelines**
- Module 2**      **Identify and select different types of RPA**
- Module 3**      **Identify & select various parts of RPA**
- Module 4**      **Identify and compare the weather effects and analyze the performance of RPA.**
- Module 5**      **Perform installation, maintain and configuration of ground control station software.**
- Module 6**      **Perform preflight inspection and assembling of basic RPA**
- Module 7**      **Carryout basic training to fly RPA in flight simulator.**
- Module 8**      **Plan and organize training to fly RPA in controlled environments**
- Module 9**      **Perform and obtain training to fly RPA in uncontrolled airspace including VLOS and BVLOS flight.**
- Module 10**      **Apply emergency protocols to control and manage RPA flight**

The skill training in the shop floor is planned through a series of practical exercises centred around some practical project. However, there are few instances where the individual exercise does not form a part of project.

While developing the practical manual a sincere effort was made to prepare each exercise which will be easy to understand and carry out even by below average trainee. However the development team accept that there is a scope for further improvement. NIMI, looks forward to the suggestions from the experienced training faculty for improving the manual.

## TRADE THEORY

The manual of trade theory consists of theoretical information for the course of the Aeronautical Structure & Equipment Fitter Trade. The contents are sequenced according to the practical exercise contained in the manual on Trade practical. Attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This co-relation is maintained to help the trainees to develop the perceptual capabilities for performing the skills.

The Trade theory has to be taught and learnt along with the corresponding exercise contained in the manual on trade practical. The indicating about the corresponding practical exercise are given in every sheet of this manual.

It will be preferable to teach/learn the trade theory connected to each exercise atleast one class before performing the related skills in the shop floor. The trade theory is to be treated as an integrated part of each exercise.

The material is not the purpose of self learning and should be considered as supplementary to class room instruction.

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<b>Exercise No</b>	<b>Title of the Exercise</b>	<b>Learning Outcome</b>	<b>Page No</b>
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<b>Exercise No</b>	<b>Title of the Exercise</b>	<b>Learning Outcome</b>	<b>Page No.</b>
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## LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

S.No.	Learning Outcome	Ex.No
1	Interpret DGCA Safety Regulations & observe safety guidelines, ATC procedures & Radio Telephony, Weather and meteorology as a RPA Pilot in flying a RPA. AAS/N6301	1.1.01 - 1.1.15
2	Identify & select different types of RPA and illustrate Fundamentals of Flight (Aerodynamics) and Different Airframes in RPA flying. AAS/N9401	1.2.16 - 1.2.20
3	Identify & select various parts of RPA like assembling Electric motors, Batteries, Chargers, Connectors, Electronic Speed Controllers (ESC), Transmitters, Receivers, sensors and flight Controllers. AAS/N9402	1.3.21 - 1.3.32
4	Identify and compare the weather effects and analyze the performance of RPA. AAS/N6302	1.4.33 - 1.4.35
5	Perform installation, maintain and configuration of ground control station software. AAS/N6302	1.5.36 - 1.5.44
6	Perform preflight inspection and assembling of basic RPA parts like landing gears, propellers, antennas and any wire / electronics hanging outside. AAS/N6302	1.6.45 - 1.6.50
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9	Perform and obtain training to fly RPA in uncontrolled airspace including VLOS and BVLOS flight. AAS/N6302	1.9.69 - 1.9.76
10	Apply emergency protocols to control and manage RPA flight. AAS/N9404	1.10.77 -1.10.81

## SYLLABUS

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
Professional Skill 65 Hrs; Professional Knowledge 20 Hrs	Interpret DGCA Safety Regulations & observe safety guidelines, ATC procedures & Radio Telephony, Weather and meteorology as a RPA Pilot in flying a RPA. AAS/N6301	<ol style="list-style-type: none"> <li>1. Visit to various sections of the institute and identify location of various installations. (02 hrs.)</li> <li>2. Identify safety signs for danger, warning, caution &amp; personal safety message. (03 hrs.)</li> <li>3. Practice Use of Personal Protective Equipment (PPE). (02 hrs.)</li> <li>4. Practice elementary first aid. (03 hrs.)</li> <li>5. Practice Preventive measures for electrical accidents &amp; steps to be taken in such accidents. (04hrs.)</li> <li>6. Practice Use of Fire extinguishers. (04 hrs.)</li> <li>7. Practice workshop safety norms. (05hrs.)</li> <li>8. Identify safety rules while flying a RPA.(03hrs.)</li> <li>9. Practice DGCA safety regulations, Do's and Don'ts. (03hrs.)</li> <li>10. Recognize issues RPA pilots encounter including airspace, traffic patterns etc. (03hrs.)</li> <li>11. Practice Radio telephony using Standard radio terminology and RT Phraseology. (07hrs.)</li> <li>12. Communicate with virtual ATC including Position, Altitude Reporting etc. (07hrs.)</li> <li>13. Identify specific Flight Planning Procedures for specific RPA flights. (06hrs.)</li> <li>14. Recognize importance of Weather and meteorology in RPA flight. (06hrs.)</li> <li>15. Take METAR from mini weather station and MET office/ ATC before flying. (07hrs.)</li> </ol>	<p>Familiarization with the working of Industrial Training Institute system. Importance of safety and precautions to be taken in the industry/ shop floor.</p> <p>Introduction to PPEs. Introduction to First Aid. Importance of housekeeping &amp; good shop floor practices.</p> <p>Occupational Safety &amp; Health: Health, Safety and Environment guidelines, legislations &amp; regulations as applicable.</p> <p>Importance of adopting a "safety attitude" when is flying a RPA. Workshop safety norms and outdoor flying safety regulations.</p> <p>Regulations of DGCA, Civil Aviation Requirements: Classification, Basic Air Regulations, Salient points, Do's and Don'ts.</p> <p>Issues aircraft pilots encounter including airspace, traffic patterns, and safe attitudes.</p> <p>Understanding ATC operations Airspace Structure and Airspace Restrictions with knowledge of No RPA Zones Communicating with ATC including Position and Altitude Reporting Flight Planning Procedures Collision Avoidance Radio Telephony (RT) techniques Standard radio terminology and RT Phraseology Practice Session in Radio Communication.</p> <p>Weather and meteorology: The standard atmosphere, Measuring air pressure, Heat and temperature, Wind, Moisture, cloud formation</p> <p>Met Terminal Aviation Routine Weather Report (METAR). (20 Hrs.)</p>
Professional Skill 38 Hrs; Professional Knowledge 12 Hrs	Identify & select different types of RPA and illustrate Fundamentals of Flight (Aerodynamics) and Different Airframes in RPA flying. AAS/N9401	<ol style="list-style-type: none"> <li>16. Identify Different types of RPAS. (06 hrs.)</li> <li>17. Select basic components and RPAS. (07 hrs.)</li> <li>18. Fundamentals of flight aerodynamics (07 hrs.)</li> <li>19. Recognize basic principles of flying like Bernoulli's Principle etc. (08 hrs.)</li> <li>20. Apply principles of flight to RPAS. (10hrs.)</li> </ol>	<p>Different types of RPAS, Nomenclatures, and History of aerial RPAS, reputation, airframe, configurations, basic components, and current/future uses of RPAS.</p> <p>Introduction to aerodynamics, history of Flight, Newton's Laws of Motion, Bernoulli's Principle, four forces of Flight, three axes of Flight how they apply to RPA Flight. (12 Hrs)</p>

Professional Skill 78 Hrs; Professional Knowledge 20 Hrs	Identify & select various parts of RPA like assembling Electric motors, Batteries, Chargers, Connectors, Electronic Speed Controllers (ESC), Transmitters, Receivers, sensors and flight Controllers. AAS/N9402	<p>21. Identify each component in RPAS. (03hrs.)</p> <p>22. Perform assembling &amp; disassembling of RPAS. (07hrs.)</p> <p>23. Recognize multi rotor design, various configurations, airframe sizes and construction materials. (07hrs.)</p> <p>24. Identify different propeller designs and choose appropriate propeller. (06hrs.)</p> <p>25. Electricity fundamentals (Wattage, voltage, Amperage and their relationship) and soldering techniques. (10hrs.)</p> <p>26. Calculate motor ratings for load capabilities for a RPA build. (07hrs.)</p> <p>27. Identify parallel vs. serial arrangements of batteries. (07hrs.)</p> <p>28. Practice charging, cell balancing and explore various connectors. (10hrs.)</p> <p>29. Identify different role of FCs and ESCs. And its calibration (10hrs.)</p> <p>30. Recognize different sensors &amp; their applications in RPAS. (04hrs.)</p> <p>31. Identify GPS applications in RPA flying. (04hrs.)</p> <p>32. Identify different radio control systems, controllers, transmitters and receivers, Frequency bands and. (04hrs.)</p>	<p>History of helicopter design, early multi rotor design, various Configurations, airframe sizes and construction materials.</p> <p>History of propeller design, fixed-pitch and constant speed blades, airfoil design, size, pitch, and blade-count including balancing tips and construction materials.</p> <p>History of batteries, various makeup's, reactions and chemistry, parallel vs. serial arrangements, rechargeable batteries, Li-Po battery characteristics, charging, cell balancing and various connectors.</p> <p>AC/DC motor differences, amperage and voltage ratings, history of electric motors, brushed vs. brushless motors, Kv ratings, and calculations of motor capabilities for a RPA build.</p> <p>Introduction to the history radio control systems, controllers, transmitters and receivers, Frequency bands and programming transmitters.</p> <p>Introduction to role of ESCs, how they work, PWM, PPM, ESC calibration, Simon KV. BLHeli firmware options and BEC, OPTO, and UBEC.</p> <p>Introduction to role offlight controllers, how they work, Introduction to sensors, Sense-and-avoid technology, GPS, open source vs. closed source programming, and comparison of current FCs on the market. (20 Hrs.)</p>
Professional Skill 15Hrs; Professional Knowledge 06 Hrs	Identify and compare the weather effects and analyze the performance of RPA. AAS/N6302	<p>33. Identify the factors that influence the performance of the RPAS. (04 hrs.)</p> <p>34. Identify and learn measurement of atmosphere pressure, effect of obstructions on wind speed and direction. (05hrs.)</p> <p>35. Identify and learn measurement of temperature and humidity, Rain and solar radiation. (06 hrs.)</p>	<p>Introduction to measurement systems and sensors. To develop a basic understanding of the principles involved in measurements.</p> <p>To introduce the state-of-the-art sensors for various engineering applications. Different types of sensors operate in very different ways. Data on the weather qualities of each specific sensor must be obtained prior to implementation. Sensors and platforms; To enable the students to interface the sensors with RPA platforms. (06 hrs.)</p>
Professional Skill 38 Hrs; Professional Knowledge 12 Hrs	Perform installation, maintain and configuration of ground control station software. AAS/N6302	<p>36. Knowledge of GCS telemetry and Track RPA using telemetry. (02hrs.)</p> <p>37. Learn GCS features and possible flight plans using GCS. (03hrs.)</p> <p>38. Identify Flight mode operation, GUI parameters, Maps and user control operation. (03hrs.)</p>	<p>Introduction to telemetry, data tracking, mission planning, and 3D mapping and modeling. First-person-view (FPV) flying, safety and drone racing options.</p> <p>Introduction to ground control station software and its features. What is RPA Data? What Types of data are there?</p>

		<p>39. Autonomous Waypoint Navigation and Dynamic flight plan adjustment. (02 hrs.)</p> <p>40. Perform 3D mapping and modeling. (03 hrs.)</p> <p>41. Perform Geographic Map along with UAV location, UAV trajectory, camera view polygon, waypoints and flight plan. (04 hrs.)</p> <p>42. Collect and explore Flight data, Sensor data, Flight planning data, Airspace and weather data. (07hrs.)</p> <p>43. Platform Analytics: including performance figures on orders, missions, inspections, flights, pilots, and data. (07hrs.)</p> <p>44. Data Mapping and Navigation: with a graphical user interface to navigate across 2D/3D models, visualize on maps, and click through images. (07hrs.)</p>	<p>How to analyze and report on RPAData, RPA Imaging Data? Data &amp; Analytics: How to Report on Missions. The data collected from these RPA images can then be measured, analyzed, tracked, and compared over time. (12 hrs.)</p>
<p>Professional Skill 38 Hrs;</p> <p>Professional Knowledge 12 Hrs</p>	<p>Perform pre flight inspection and assembling of basic RPA parts like landing gears, propellers, antennas and any wire / electronics hanging outside. AAS/N6301</p>	<p>45. Learn all three inspection procedures. (02hrs.)</p> <p>46. Prepare the checklist immediately before piloting a RPA to ensure best practice for mission success. (03hrs.)</p> <p>47. Perform assembly of landing gears, propellers, antennas and electronics. (07hrs.)</p> <p>48. Remotely-piloted aircraft system (RPAS) controls, know your remote control, safety precautions, pre-flight checks, arming and disarming. (10hrs.)</p> <p>49. Method of RPA inspection charging the battery Cleaning the RPA Storage Maintenance resources and standards. (06hrs.)</p> <p>50. Perform assembly of Gimble, camera and base station hardware and software setup. (10hrs.)</p>	<p>Introduction to inspection procedures.</p> <p>History of propeller design, fixed-pitch and constant speed blades, airfoil design, size, pitch, and blade-count including balancing tips and construction materials.</p> <p>Knowledge about remote control, safety precautions, pre-flight checks, arming and disarming.</p> <p>Procedures of Charging the battery, importance of Cleaning the RPA Storage Maintenance resources and standards. (12 hrs)</p>
<p>Professional Skill 38 Hrs;</p> <p>Professional Knowledge 12 Hrs</p>	<p>Carryout basic training to fly RPA in flight simulator. AAS/N9403</p>	<p>51. Identify Basic operating features of a RPA flight simulator. (02hrs.)</p> <p>52. Select different aircrafts/RPAS and aerodromes. (03hrs.)</p> <p>53. Carry out Demo flight in RPA Flight Simulator with Pre-flight checks, start-up, Take-off RPA and carry out flight stage. (6 hrs.)</p> <p>54. Do Approach and safe landing, perform post flight checks and identify emergency, Loss of link, Loss of power, Control surface</p>	<p>Basic operating features of a RPA flight simulator, Howtoselect different aircrafts/RPAS and aerodromes, knowledge of Demo flight.</p> <p>Introduction to demonstrate solo flight training and Live RPA flying, Flight Operation, Flying a RPA in simulator training.</p> <p>Introduction to photogrammetry for stitching and analysis of RPA pictures. (12 hrs)</p>

		<p>failures etc. (03 hrs.)</p> <p>55. Perform Practical flying with and without instructor in RPA simulator. (07 hrs)</p> <p>56. Fly RPARPA in Simulator. RPA. (07 hrs)</p> <p>57. Carry out entire flying operations from pre-flight checks to after flight checks while flying RPA with instructor and solo flyingRPA. (07 Hrs)</p> <p>58. Demonstrate Handling in flight emergencies, fail safe mechanisms. (03 Hrs)</p>	
<p>Professional Skill 38 Hrs;</p> <p>Professional Knowledge 12 Hrs</p>	<p>Plan and organize training to fly RPA in controlled environments. AAS/N6302</p>	<p>59. Carry out First-person-view (FPV) flying. (02hrs.)</p> <p>60. RPA Understand the requirement of flying RPA in a controlled environment. (03hrs.)</p> <p>61. RPAS controls, safety precautions, pre-flight checks, takeoff, learn basic flight modes such as manual, stabilize, alt hold and land. (03hrs.)</p> <p>62. Practice flying the RPAS in left/right and forward/backward motion, square pattern, circle. (03hrs.)</p> <p>63. Practice flight mode such as takeoff, loiter, alt hold. (03hrs.)</p> <p>64. Learn to land in GPS failsafe, radio failsafe and battery failsafe. (03hrs.)</p> <p>65. Learn to upgrade the autopilot / system firmware and test the machine in a controlled environment. (12hrs.)</p> <p>66. Explore camera options, resolution and perform operation to full camera controls Pan/Tilt &amp; Zoom In/Out. (03hrs.)</p> <p>67. Plan &amp; estimate payload considerations, camera options, resolution etc. &amp;other pay load possibilities. (03hrs.)</p> <p>68. Identify different payloads including cameras like Lidar, Thermal, RGB, Hyper spectral etc. (03hrs.)</p>	<p>Introduction to demonstrate RPA flying operation, Flying a RPA in controlled environment with different modes of operation.</p> <p>Overview of the main quad copter parts, choosing a place to learn how to fly anRPA, how to get your RPA off the ground, flying your quad copter left/right and forwards/backwards, Beginner and Advanced RPA flying techniques.</p> <p>Introduction to Payload considerations, camera options, resolution, still photography, video photography, GPS modes, vibration and Jello effect, exposure settings, camera lenses, video Frame rate, image files, camera payloads, and other payload possibilities.</p>
<p>Professional Skill 17 Hrs;</p> <p>Professional Knowledge 07 Hrs</p>	<p>Perform and obtain training to fly RPA in uncontrolled airspace including VLOS and BVLOS flight. AAS/N6302</p>	<p>69. Apply knowledge of VLOS (visual line of sight) and BVLOS (Beyond Visual Line Of Sight) and identify safety practices for BVLOS and VLOS. (02hrs.)</p>	<p>What are VLOS, BVLOS, IFR, and VFR? Why do they affect RPA operations? What rules and restrictions apply to flights performed in 'visual line of sight' (VLOS) and 'beyond visual line of sight' (BVLOS)?</p>

		<p>70. Perform Secure Communication link between UAV and GCS. (01hr.)</p> <p>71. Identify &amp; select other payload possibilities. (01hr.)</p> <p>72. Identify different payloads including cameras like Lidar, Thermal, RGB, Hyper spectral etc. (03hrs.)</p> <p>73. Perform autonomous waypoint navigation (pre-defined as well as dynamically adjustable waypoints during flight). (03hrs.)</p> <p>74. Remotely Piloted mode for video-based navigation (RPV Mode). (01hrs.)</p> <p>75. Learn Geographic Map along with UAV location, UAV trajectory, camera view polygon, waypoints and flight plan. (03hrs.)</p> <p>76. Fly RPA for application specific including Surveillance, Agriculture and Inspection. (02hrs.)</p>	<p>Introduction of different payload like cameras, thermal cameras, Lidar sensor, RGB and Hyper spectral cameras. Payload connection and its operation procedure to for RPA Flight in a uncontrolled environment.</p> <p>How to choose a RPA based on the application different sectors like agriculture, inspection and etc. (07 hrs)</p>
<p>Professional Skill 55 Hrs;</p> <p>Professional Knowledge 07 Hrs</p>	<p>Apply emergency protocols to control and manage RPA flight. AAS/N9404</p>	<p>77. Identify emergency and handle it accordingly. (03Hrs.)</p> <p>78. Learn instrument flying rules using manual/ semi-autonomous flight modes. (05hrs.)</p> <p>79. Identify emergencies like Aircraft structural failure, loss of power – battery, motor, Loss of GPS and loss of lights at night. (03Hrs.)</p> <p>80. Maintain Visual Line of Sight (VLOS) with the aircraft for as long as possible. (03Hrs.)</p> <p>81. Learn where to fly and how to fly legally and how you fly it in uncontrolled airspace. (05Hrs.)</p>	<p>Introduction to the safety risks Guidelines to fly RPA, UAV Regulations in India,</p> <p>Personal Safety, UAV Operations &amp; Safety, Regulatory and regulations, Emergency identification and handling, In flight emergencies Loss of link, Fly-away(Straying), Loss of power, Control surface failures.</p>

## Visit to various sections of the institute and identify location of various installations

**Objectives:** At the end of this exercise you shall be able to

- visit the various sections/trade in your ITI and draw the layout of your ITI
- record the telephone numbers of the ITI office, hospitals, police station and fire station
- draw the layout of your section
- identify the locations that have electrical installations.

### PROCEDURE

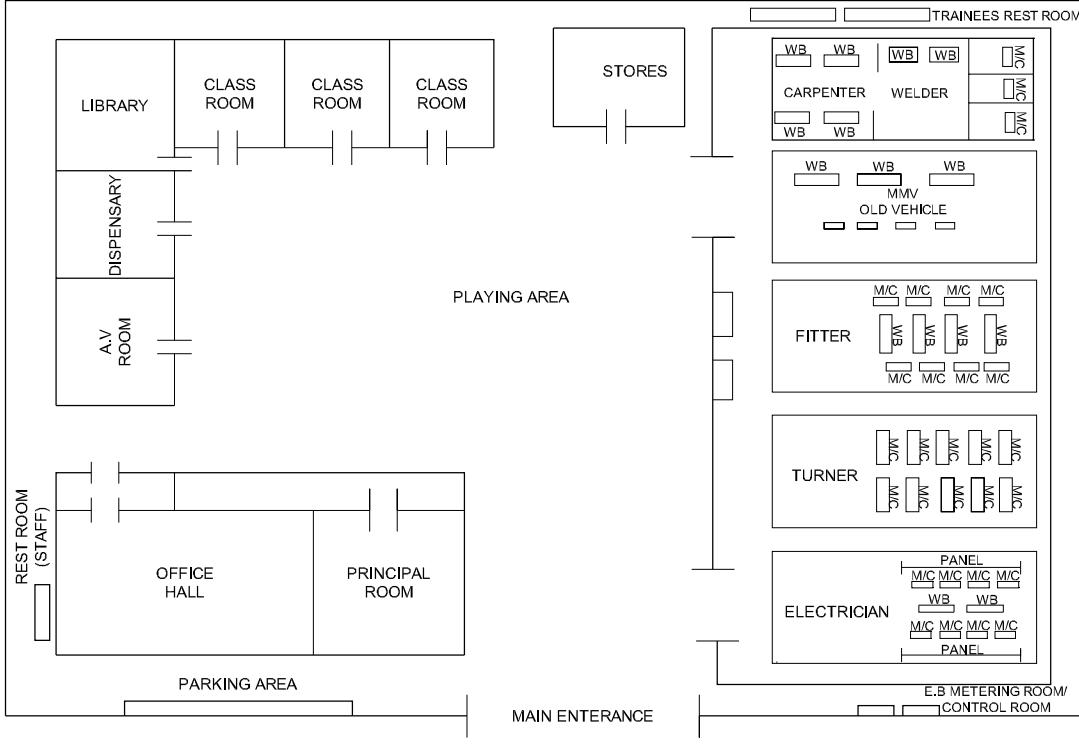
#### TASK 1: Visit various sections of the ITI and draw the layout of your ITI

Instructor will lead the new trainees to various sections of the ITI.

- 1 Visit the various sections in your ITI and identify the sections of the ITI. List the trades and record it in your note book.
- 2 Collect the information about the staff members in each trade.
- 3 Identify the location of the ITI with details about the railway and bus stations in the locality and note down the list of bus route numbers which ply near the ITI.
- 4 Collect the telephone numbers of the ITI office, nearest hospitals, nearest police station and the nearest fire station and record.
- 5 Draw the layout of your ITI showing various trades.

**Note :A Sample layout of the ITI (Fig 1) is given for your reference. Now draw the new layout of your ITI, with the trades/sections.**

Fig 1



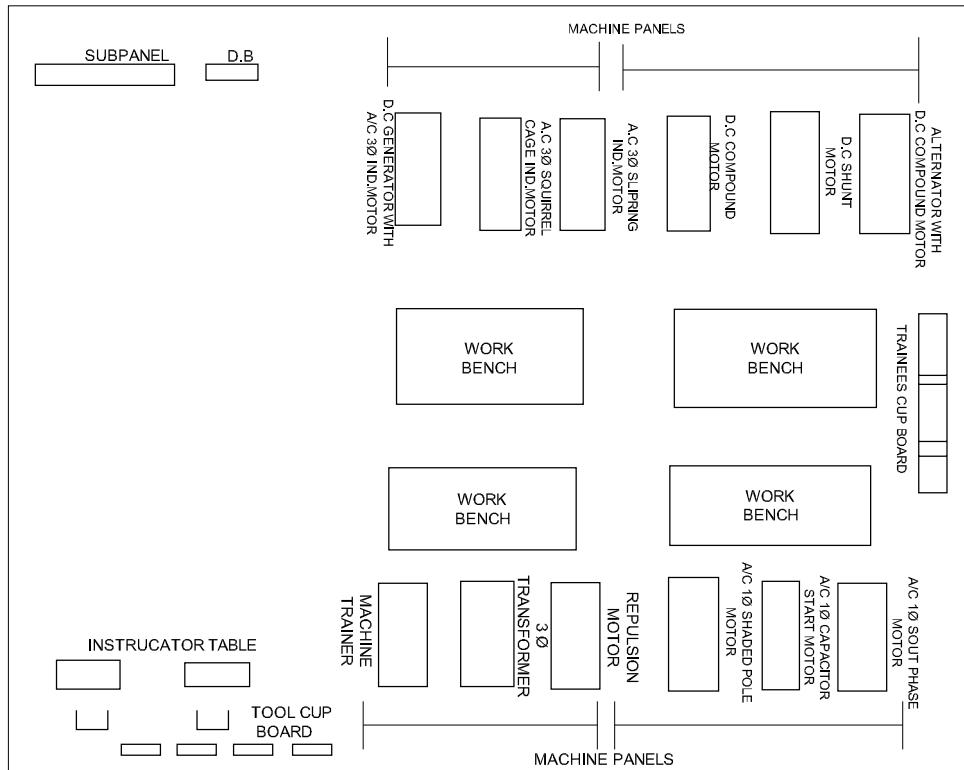
## TASK 2: Draw the layout of your section in the ITI

- 1 Draw the plan of your section to a suitable scale in a separate sheet of paper (A4 size).
- 2 Take the length and the breadth measurements of machine foundations, work benches, panels, wiring cubicles, doors, windows, furniture, etc.
- 3 Draw the layout of the machines, work benches, panels and furniture.

The section plan should be in the same scale as in step 1 as per the actual placement of the machine foundations, panels, furniture, work benches etc.

Note : The sample layout of a typical electrician trade section is given for your reference (Fig 2). You have to draw your section's layout using the sample as reference.

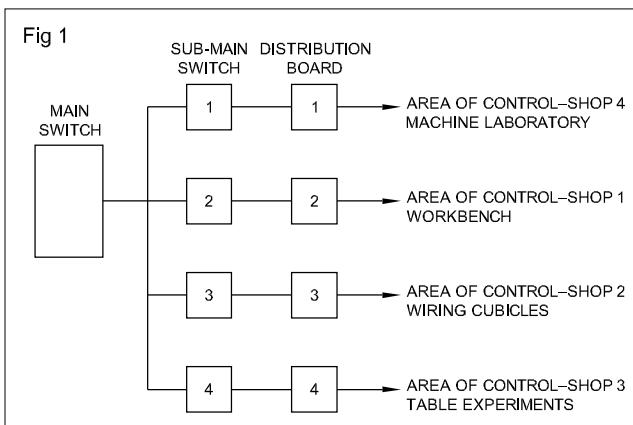
Fig 1



RPZ011011

## TASK 3: Identify the locations of electrical installations

- 1 Identify the main switch and mark its position in the layout. (Fig 3)
- 2 Identify each of the sub-main switches, the area of control in the section and mark them on the layout.
- 3 Identify 3 or 4 spots in various locations of the electrician sections layout and identify the respective sub-main switches.
- 4 Practice switching 'off' the control switches, depending upon the area of control, imagining that victim are electrocuted in a specific location/spot.



RPZ011014

## **Identify safety symbols and hazards**

**Objectives:** At the end of this exercise you shall be able to

- identify the safety symbols from the chart and their basic categories
- write their meaning and description mentioning where they are used
- identify road safety signs in traffic signals from the chart
- read and interpret different types of occupational hazards from the chart.

### **Requirements**

#### **Materials**

- |                                              |         |                              |         |
|----------------------------------------------|---------|------------------------------|---------|
| • Basic safety signs chart                   | - 1 No. | • Occupational hazards chart | - 1 No. |
| • Road safety signs and traffic signal chart | - 1 No. |                              |         |

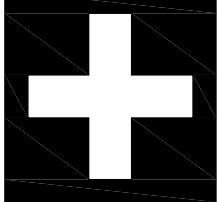
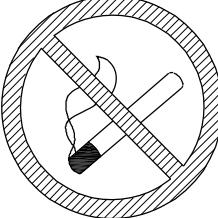
### **PROCEDURE**

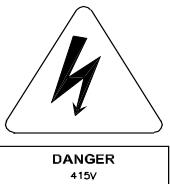
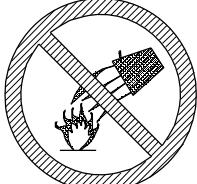
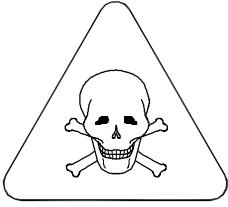
#### **TASK 1: Identify safety symbols and interpret what they mean with the help of their colour and shape**

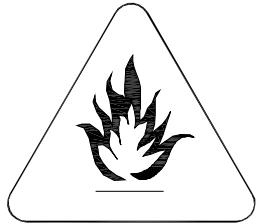
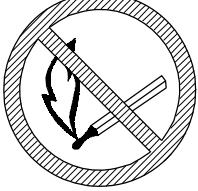
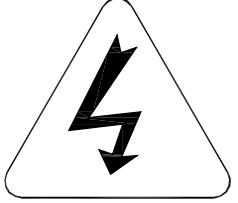
Instructor may provide charts with various safety signs for the road safety signs in traffic signals. Then, explain the categories meaning and colour. Ask the trainees to identify the signs and record it in Table 1.

- 1 Identify the signs and their categories from the chart.
- 2 Write the name, categories, meaning and description of each sign and its place of use in Table 1.

Table 1

No.	Safety signs	Name of the sign and category	Place of use
1			
2			
3			

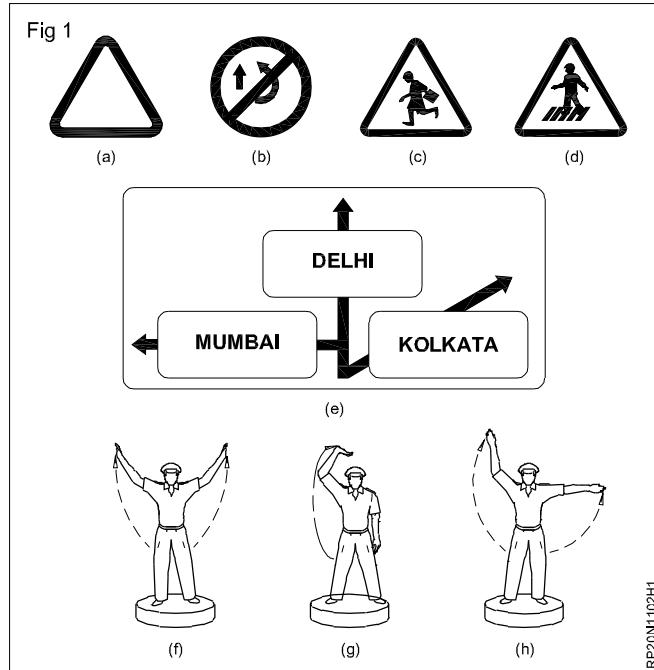
No.	Safety signs	Name of the sign and category	Place of use
4	 A triangular warning sign with a lightning bolt symbol inside. Below it is a rectangular box containing the text "DANGER" and "415V".		
5	 A circular prohibition sign with a diagonal cross over a lit fire. Below the sign is the text "DO NOT EXTINGUISH".		
6	 A circular information sign showing a profile of a human head with a thick black outline, indicating the need for head protection.		
7	 A triangular warning sign with a skull and crossbones symbol inside.		
8	 A circular information sign showing a profile of a human head wearing safety glasses, indicating the need for eye protection.		

No.	Safety signs	Name of the sign and category	Place of use
9			
10			
11			
12			
13			

## TASK 2 : Identify the road safety signs and traffic signal signs.

**Instructor will explain all the road safety signs and traffic signal signs**

- Identify the sign and give details of its kind and meaning in Table 2.
- Get it checked by the instructor



RP20NH102H1

Table2

Figure Number	Label	Kind of road sign	Name of the signal	Meaning of the sign
1	a			
2	b			
3	c			
4	d			
5	e			
6	f			
7	g			
8	h			

## TASK 3 : Read and interpret the different types of personal protective equipment (PPE) from the chart

**Instructor may brief the various types of occupational hazards and their causes.**

- Identify the occupational hazard matching it to the corresponding situation with the given potential in Table 3.
- Complete the details and get it checked by your instructor.

Table 3

Sl.No.	Source or potential harm	Type of occupational hazard
1	Noise	
2	Explosive	
3	Virus	
4	Sickness	
5	Smoking	
6	Non-control device	
7	No earthing	
8	Poor housekeeping	

-----

## Use of personal protective equipment

**Objectives:** At the end of this exercise you shall be able to

- read and interpret different types of Personal Protective Equipment (PPE) from the chart (or) real PPE
- identify and name the PPEs corresponding to the type of protection and write their uses.

### Requirements

#### Tools / Equipment

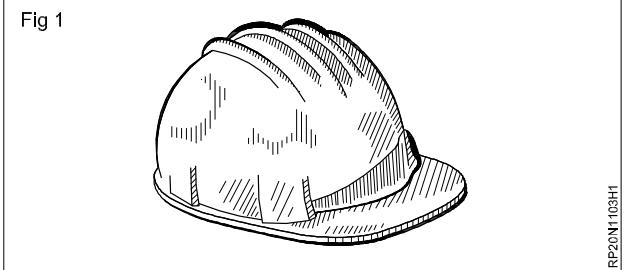
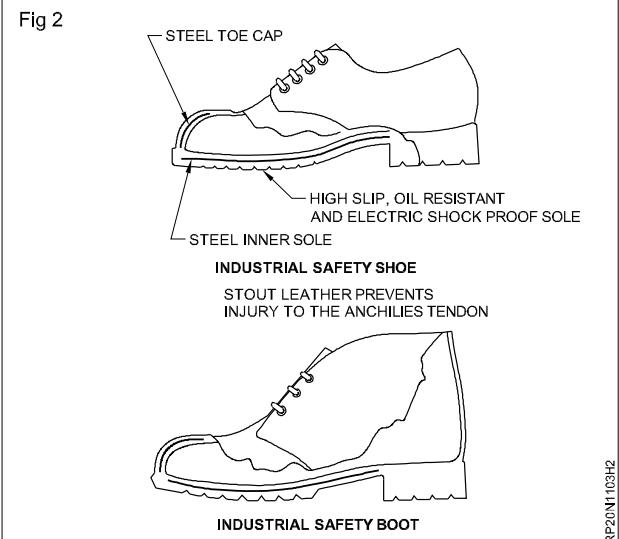
- Chart showing different types of PPEs - 1 No.
- Real PPEs(available in section) - as required.

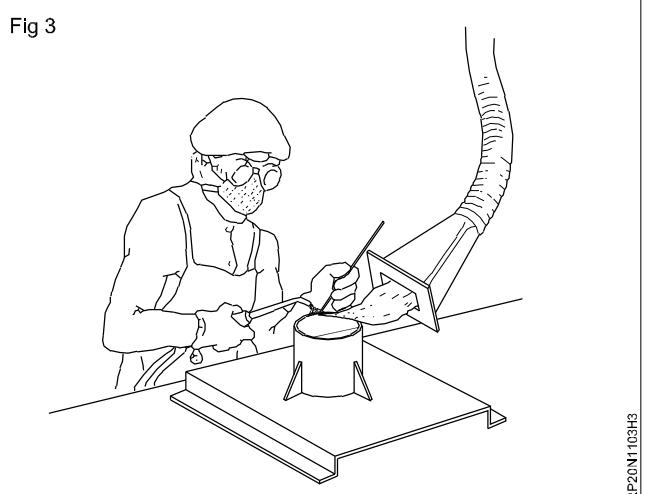
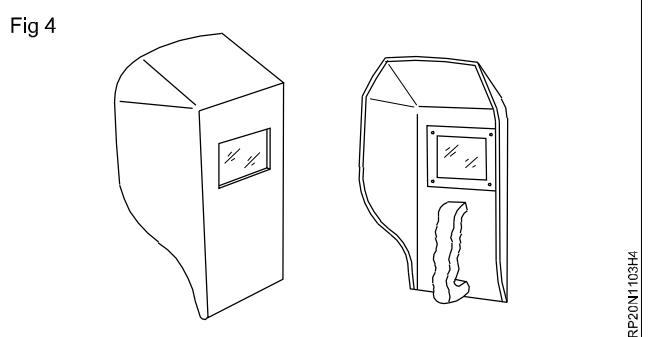
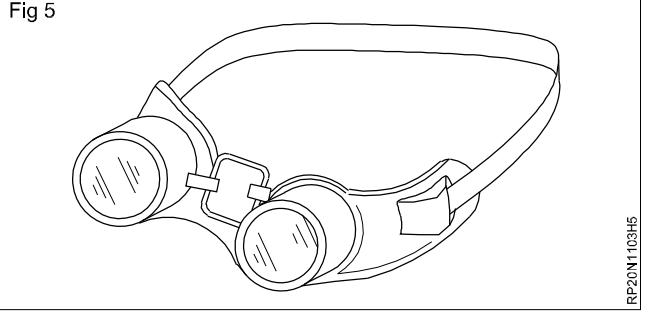
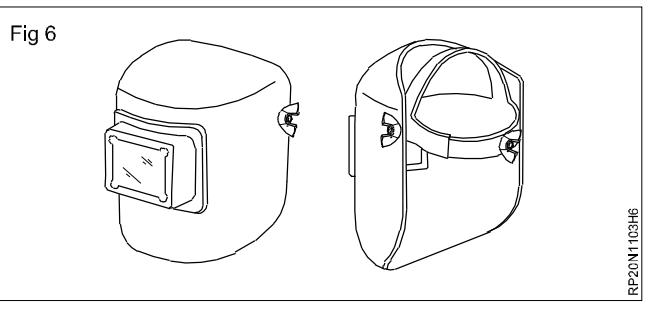
## PROCEDURE

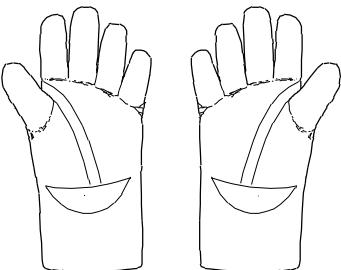
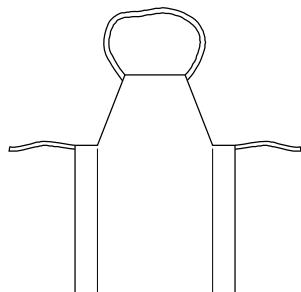
**Instructor may arrange the available different types of PPEs in the table or provide the chart showing the PPEs. Instructor may also explain the types of PPEs and their uses, and the hazards for which each type is used.**

- 1 Identify the different types of PPEs and write their names with the help of the chart and write in Table 1.
- 2 Write the type of protection and uses in the space provided against each PPE in Table 1.

Table 1

Sl. No.	Sketches	Name of PPE	Type of protection	Uses
1	 Fig 1			
2	 Fig 2			

Sl. No.	Sketches	Name of PPE	Type of protection	Uses
3	<p>Fig 3</p> 			
4	<p>Fig 4</p> 			
5	<p>Fig 5</p> 			
6	<p>Fig 6</p> 			

Sl. No.	Sketches	Name of PPE	Type of protection	Uses
7	<p>Fig 7</p>  <p>RP20NH103H7</p>			
8	<p>Fig 8</p>  <p>RP20NH103H8</p>			
9	<p>Fig 9</p>  <p>RP20NH103H9</p>			

3 Get it checked by your instructor.



## **Practice elementary first aid**

**Objective :** At the end of this exercise you shall be able to

- prepare the victim for elementary first aid.

### **Requirements**

#### **Equipment/Materials**

- Number of Persons (Instructor can divide the trainees into suitable Number of groups.) - 20 Nos.

## **PROCEDURE**

**Assumption:** For easy manageability, Instructor may divide the trainees into groups and ask each group to perform one method of resuscitation.

### **TASK 1: Prepare the victim before giving first-aid treatment**

- 1 Loosen the tight clothing as it may interfere with the victim's breathing. (Fig 1)
- 3 safely bring the victim to the level ground, taking the necessary safety measures. (Fig 3)

Fig 1



LOOSENING TIGHT CLOTHING

RF20N1104H1

- 2 Remove any foreign material or false teeth from the victim's mouth and keep the victim's mouth open. (Fig 2)

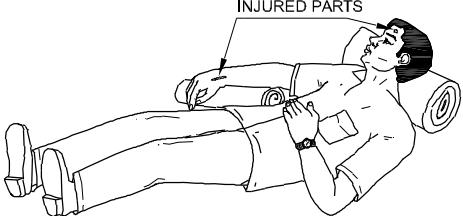
Fig 2



KEEP THE MOUTH OPEN

RF20N1104H2

Fig 3



SAFETY ON THE LEVEL GROUND

RF20N1104H3

**Do not waste too much time in loosening the clothes or trying to open the tightly closed mouth.**

- 4 Avoid violent operations to prevent injury of the victim's internal parts.

## Task 2: Prepare the victim for artificial respiration

**Observe the condition of electric shock victim.**

**If breathing has stopped, try to provide artificial respiration**

- 1 Send word for professional assistance. (If no other person is available, you stay with the victim and help as best as you can.)
- 2 Look for visible injury in the body and decide on the suitable method of artificial respiration.
  - In the case of injury/burns on the chest and/or belly follow the mouth to mouth method.
  - In case the mouth is closed tightly, use Schafer's or Holgen–Nelson method.
  - In the case of burn and injury in the back, follow Nelson's method.
- 3 Place the victim in the correct position before giving artificial respiration.

**All actions should be taken immediately.**

**Delay by even a few seconds may be dangerous.**

**Take extreme care to prevent injury to the victim's internal organs.**

- 4 Cover the victim with coat, sacks or improvise with your own method. Help to keep the victim's body warm.
- 5 Proceed to perform the suitable artificial respiration method.



## Preventive measures for electrical accidents and practice steps to be taken in such accidents

**Objectives:** At the end of this exercise, you shall be able to

- practice and follow preventive safety rules to avoid electrical accidents
- rescue the electric shock victim.

### Requirements

#### Materials

- |                                        |         |                |         |
|----------------------------------------|---------|----------------|---------|
| • Heavy insulated screwdriver 200 mm   | - 1 No. | • Wooden stool | - 1 No. |
| • Electrical safety chart (or) display | - 1 No. | • Ladder       | - 1 No. |
| • Gloves                               | - 1 No. | • Safety belt  | - 1 No. |
| • Rubber mat                           | - 1 No. |                |         |

### PROCEDURE

#### TASK 1: Practice and follow preventive safety rules to avoid electrical accidents

- 1 Do not work on live circuits. If unavoidable use rubber gloves or rubber mats.
  - 2 Do not touch bare conductors.
  - 3 Stand on a wooden stool or an insulated ladder while repairing live electrical circuits/appliances or replacing fused bulbs.
  - 4 Stand on rubber mats while working, operating switch panels, control gears, etc.
  - 5 Always use safety belts while working on poles or high-rise points.
  - 6 Use screwdrivers with wooden or PVC insulated handle when working on electrical circuits.
  - 7 Replace (or) remove fuses only after switching off the circuit switches.
  - 8 Open the main switch and make the circuit dead.
  - 9 Do not stretch your hands towards any moving part of the rotating machine and around moving shafts.
  - 10 Always use earth connection for all electrical appliances along with 3-pin sockets and plugs.
  - 11 Do not connect earthing to the water supply electrical lines.
  - 12 Do not use water on electrical equipment.
  - 13 Discharge static voltage in HV lines/equipment and capacitors before working on them.
  - 14 Keep the workshop floor clean and tools in good condition.
- 

#### TASK 2 : Rescue the electric shock victim

- 1 Proceed with treatment as early as possible without panic or becoming emotional.
- 2 Switch OFF the power or remove the plug or wrench the cable free.
- 3 Move the victim from contact with the live conductor by using dry non-conducting materials like wooden bars. (Fig 1 & 2)

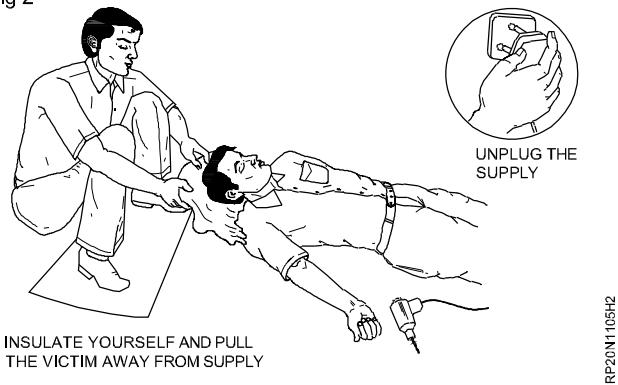
**Avoid direct contact with the victim. Wrap your hands with dry material if rubber gloves are not available. If you are uninsulated, do not touch the victim with your bare hands.**

Fig 1



RP20/N1105H1

Fig 2



4 Keep the patient warm and at mental rest.

**Ensure that there is good air circulation. Seek help to shift the patient to a safer place. If the victim is aloft, take steps to prevent him from falling.**

5 Loosen the clothing near the neck, chest and waist and place the victim in a relaxed position, if the victim is unconscious.

6 Keep the victim warm and comfortable. (Fig 3)

Fig 3



7 Send someone to call the doctor, in case of electric burns.

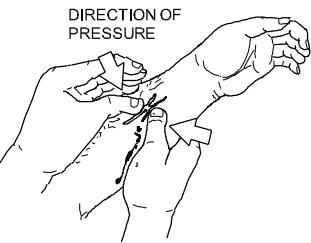
**If the victim has electrical burns due to shock, it may be very painful and is dangerous. If a large area of the body is burnt do not give treatment. Give first-aid as given in step 8**

- 8 Cover the burnt area with pure running water.
- 9 Clean the burnt area using a clean cloth/cotton.
- 10 Send someone to call the doctor immediately.

#### In case of severe bleeding

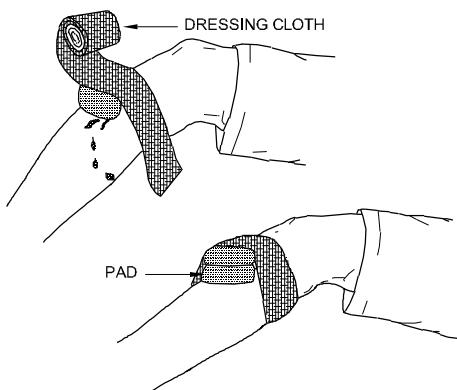
- 11 Lay the patient flat.
- 12 Raise the injured part above the body level. (If possible)
- 13 Apply pressure on the wound ,as long as necessary, to stop the bleeding. (Fig 4)

Fig 4



14 cover the injured area with a clean pad and bandage firmly, if it is a large wound. (Fig 5)

Fig 5



**If bleeding is severe, use more than one dressing.**

- 15 initiate right methods of artificial respiration, if the person is unconscious

## Use of fire extinguishers

**Objectives:** At the end of this exercise you shall be able to

- select fire extinguishers according to the type of the fire
- operate the fire extinguisher
- extinguish the fire.

### Requirements

#### Equipment/Machines

- |                                      |         |             |         |
|--------------------------------------|---------|-------------|---------|
| • Fire extinguishers-CO <sub>2</sub> | - 1 No. | • Cellphone | - 1 No. |
| • Scissors 100mm                     | - 1 No. |             |         |

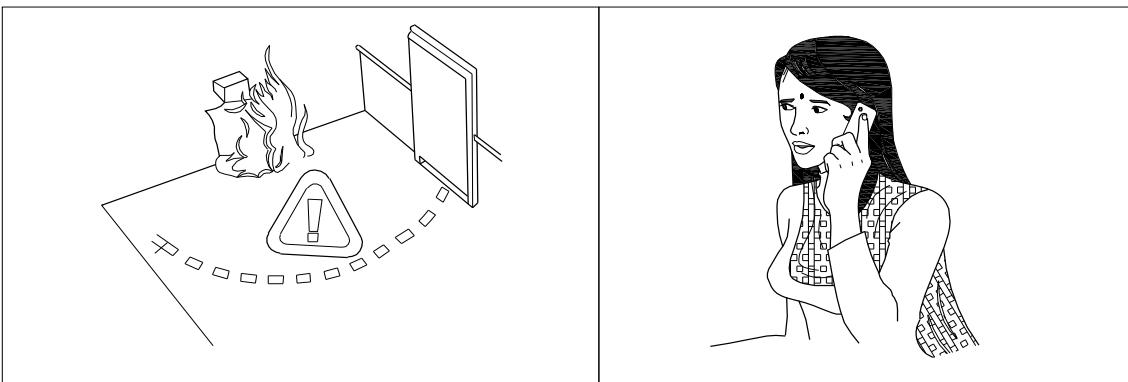
### PROCEDURE

- 1 Alert people in the surrounding area by shouting fire, fire, fire when you see fire (Fig 1a & b).
- 2 Inform fire service or arrange to inform them immediately (Fig 1c).
- 3 Open the emergency exit and ask the people inside the area to go away (Fig 1d).
- 4 Switch "OFF" all electrical power supply.

**Do not allow people to go near the fire.**

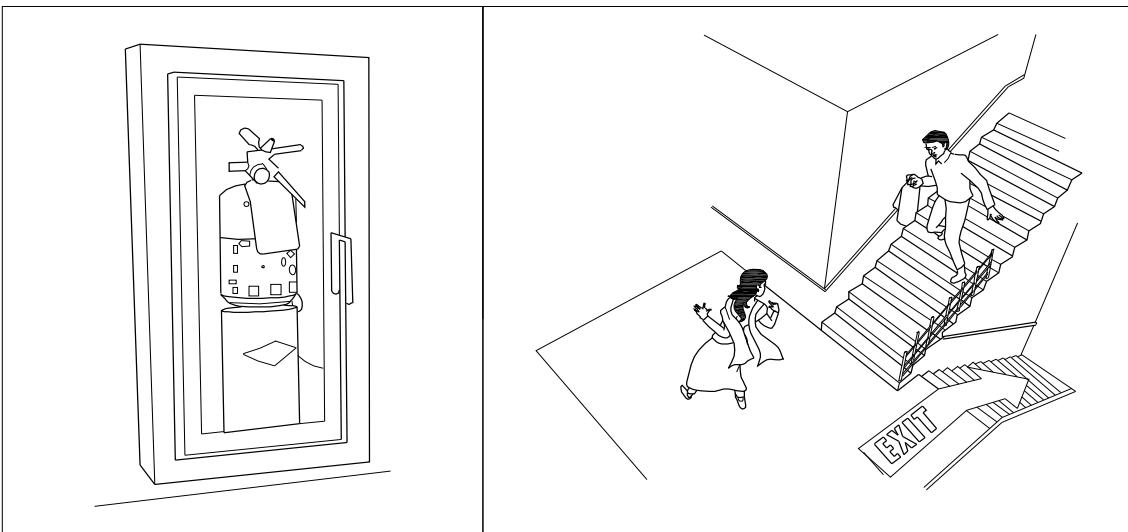
- 5 Analyze to identify the type of fire. Refer Table1.
- 6 Assume that it is type D fire (Electrical fire).

Fig 1



(a)

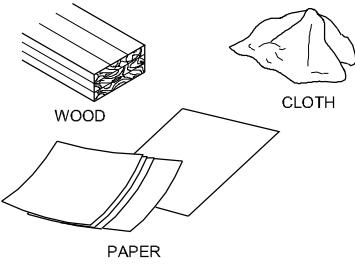
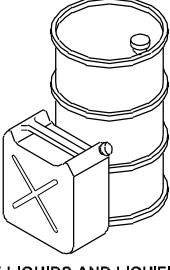
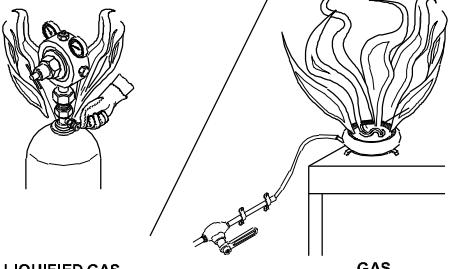
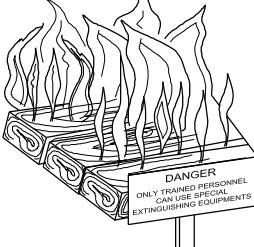
(c)



(b)

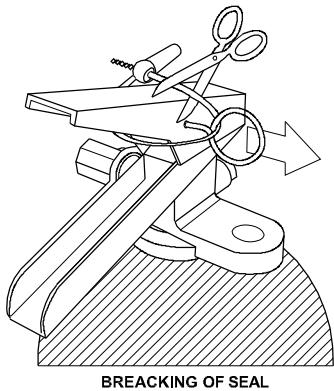
(d)

TABLE1

<p>Class 'A': Wood, paper, cloth, solid material</p>	<p>Fig 2</p> <p>CLASS 'A' FIRE</p>  <p>WOOD CLOTH PAPER</p> <p>RP20N1106H2</p>
<p>Class 'B': Oil-based fire (grease, gasoline,oil) and liquefiable solids</p>	<p>Fig 3</p> <p>CLASS 'B' FIRE</p>  <p>FLAMMABLE LIQUIDS AND LIQUIFIABLE SOLIDS</p> <p>RP20N1106H3</p>
<p>Class 'C': Gas and liquefied gases</p>	<p>Fig 4</p> <p>CLASS 'C' FIRE</p>  <p>LIQUEFIED GAS GAS</p> <p>RP20N1106H4</p>
<p>Class 'D': Metals and electrical equipment</p>	<p>Fig 5</p> <p>CLASS 'D' FIRE</p>  <p>METALS</p> <p>DANGER ONLY TRAINED PERSONNEL USE SPECIAL EXTINGUISHING EQUIPMENTS</p> <p>RP20N1106H5</p>

- 6 Select CO<sub>2</sub> (carbon dioxide) fire extinguisher.
- 7 Locate and take the CO<sub>2</sub> fire extinguisher. Check for its expiry date.
- 8 Break the seal. (Fig 6)

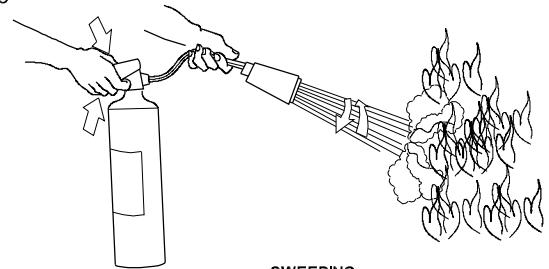
Fig 6



BREAKING OF SEAL

- 11 Slowly squeeze the handle lever to discharge the agent. (Fig 8)
- 12 Sweep from side to side approximately 15 cm over the fuel fire until the fire is put off. (Fig 9)

Fig 9

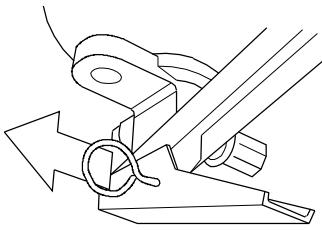


SWEEPING

RP20N1106H6

- 9 Pull the safety pin from the handle. (Fig 7) (the Pin is located at the top of the fire extinguisher.) (Fig 7)

Fig 7



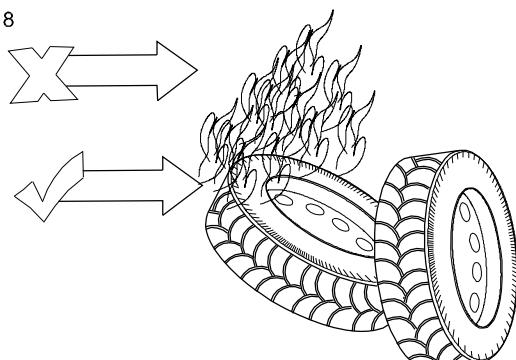
PULLING THE SAFETY PIN

RP20N1106H7

- 10 Aim the extinguisher nozzle or hose at the base of the fire. (This will remove the source of the fuel fire.) (Fig 8)

**Keep your self low.**

Fig 8



AIMING THE NOZZLE AT THE BASE OF THE FIRE

RP20N1106H8

**Fire extinguishers are manufactured for use from a distance.**

#### Caution

- While putting off fire, the fire may flare up.
- Do not panic so long as it is being put off promptly
- If the fire does not respond well even after you have used the fire extinguisher, move away from the fire point.
- Do not attempt to put out a fire when it emits toxic smoke. Leave it to the professionals.
- Remember that your life is more important than the property. So do not take risks.

**In order to remember the simple operation of fire extinguisher, remember P.A.S.S.**

**This will help to use the fire extinguisher.**

**P for pull**

**A for aim**

**S for squeeze**

**S for sweep**

## **Practice workshop safety norms**

---

**Objectives:** At the end of this exercise you shall be able to

- follow safety rules to avoid accidents.
- 

### **PROCEDURE**

#### **TASK 1: Important Safety Rules**

- 1 Listen carefully to the instructor and follow the instructions.
  - 2 Ask questions, especially if you don't fully understand.
  - 3 Do not touch a drone if you have not been shown how to operate it safely by your teacher.
  - 4 Always be patient; do not rush into practical tasks.
  - 5 Always use caution when operating a drone.
  - 6 Keep hands/hair and clothing away from moving/moving parts of the drone.
  - 7 Report any damage/fault to the machines/equipment. A damaged or defective part can cause an accident.
-

## Drone Pilot (Junior) - Safety regulations and guidelines

## Identify safety rules while flying an RPA

**Objectives:** At the end of this exercise you shall be able to

- record the precautions to be taken while working on a drone.
- explain and practice safety precautions when flying a drone.

## PROCEDURE

## TASK 1: Safety Precaution

- 1 Check that the drone is flown only in all permissions
- 2 Geographical Area or Permissible Attached Premises
- 3 Maintain all prescribed manuals and records

## General Safety:

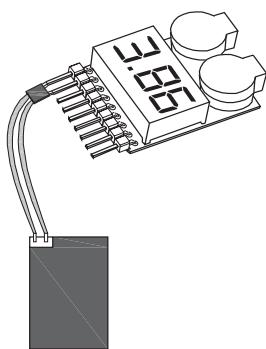
- 1 Cross check all connections like propeller fitting ties

Fig 1



- 2 Check Battery Voltage

Fig 2



RP20N1108H2

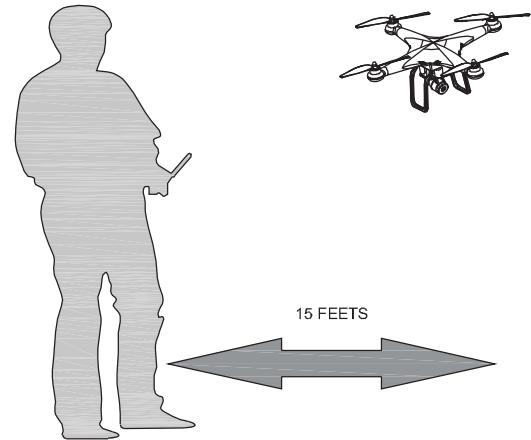
- 3 The pilot should be on the pitch side of the drone and the spectators should be behind the pilot.

Fig 3



- 4 The distance between the pilot and the drone should be 15 feet.

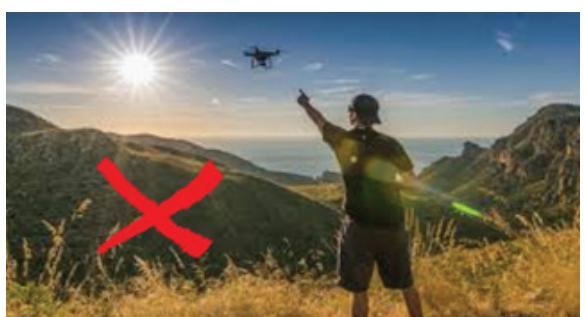
Fig 4



RP20N1108H4

- 5 The drone should not be higher than 10 feet from the surface of the earth initially

Fig 5



- 6 Don't Make Unnecessary Discussions While Flying a Drone.

Fig 6



- 7 Check all the aspects and use the checklist to mark before you fly. Whether all the aspects have been properly checked or not.

S.No.	Check List	
1	Check all solder joints well	<input type="checkbox"/>
2	Tighten all the screws	<input type="checkbox"/>
3	Flight Controller facing front	<input type="checkbox"/>
4	GPS/Compass facing front	<input type="checkbox"/>
5	Use foam on flight controller	<input type="checkbox"/>
6	Balance propellers	<input type="checkbox"/>
7	Tighten propellers adapters	<input type="checkbox"/>
8	Velcro on battery and velcro strap	<input type="checkbox"/>
9	Setup battery failsafe	<input type="checkbox"/>
10	Setup radio failsafe	<input type="checkbox"/>
11	Range test with radio/receiver	<input type="checkbox"/>
12	Make sure GPS is locked in before flying	<input type="checkbox"/>
13	Keep multirotor balanced	<input type="checkbox"/>
14	Check RTL/RTH	<input type="checkbox"/>

-----

## Practice DGCA safety regulations, Do's and Don'ts.

**Objectives:** At the end of this exercise you shall be able to

- practice DGCA safety regulations
- understand the Do's and Don'ts norms.

### Requirements

- |                          |        |
|--------------------------|--------|
| • DGCA Regulation Manual | -1 Nos |
| • Do's and Don'ts norms  | 1 Nos  |

## PROCEDURE

### TASK 1: General Safety Regulations

No person shall, act in any manner, either directly or indirectly, so as to –

- 1 Endanger safety and security of an unmanned aircraft system or unmanned aircraft system operation
- 2 Cause interference with the normal functioning of any facility established for the safe and secure operation of unmanned aircraft system

- 3 Obstruct or distract the functioning of any person entrusted with any responsibility towards ensuring safe and secure operation of unmanned aircraft system
- 4 Endanger safety and security of any person or property
- 5 Endanger safety and security of a manned aircraft or its operation

### TASK 2: Practice DGCA Do's and Don'ts norms.

#### Do's

Ensure your Drone (except Nano in uncontrolled airspace upto 50ft) is Digital Sky "No Permission- No Take off" (NPNT) Compliant.

- 1 Obtain Unique Identification Number (UIN) from DGCA for operating in controlled airspace and affix it on your drone.
- 2 Obtain Unmanned Aircraft Operator Permit (UAOP), if applicable from DGCA for commercial operations and keep it handy.
- 3 Obtain Permission before each flight through Digital Sky Platform.
- 4 Ensure drone is in good condition (not damaged) and fit for flying safely.
- 5 Keep an eye on interference: Interference can be from mobile devices or blockage of signals, do watch out when flying your drone.
- 6 Fly only during daylight (after sunrise to before sunset).
- 7 Fly in good weather: Good weather lets you not only fly your drone better but also keep track of it in the air.
- 8 Fly in visual line of sight (VLOS): Always be within visual range of your drone.
- 9 Follow Flying Guidelines.

10 Do your homework before spending the considerable money for a drone. Make sure you clearly understand all operational and regulatory aspects.

- 11 Be aware of Airspace Restrictions/ No Drone Zones.
- 12 Do stay away from airports and heliports.
- 13 Respect privacy of people.
- 14 Keep local police informed about your drone flying activity. If you are ever approached by police provide all requisite information.
- 15 Do log your flights and intimate concerned authorities (like DGCA, local police etc) of any incidents/ accidents.

#### Dont's

- 1 Don't fly a Nano drone above 50ft (15m) from the ground level.
- 2 Don't fly a Micro drone above 200ft (60m) from the ground level.
- 3 Don't fly drones more than 400ft (120m) from the ground level.
- 4 Don't fly drone near other aircraft (manned or unmanned).
- 5 Don't fly drone near airports and heliports.
- 6 Don't fly drone over groups of people, public events, or stadiums full of people without permission

- 7 Don't fly drone over government facilities/military bases or over/ near any no-drone zones.
  - 8 Don't fly drone over private property unless permission is given.
  - 9 Don't fly drone in controlled airspace near airports without filing flight plan or AAI/ADC permission (at least 24 hours before actual operation).
- 
- 10 Don't drop or carry hazardous material.
  - 11 Don't fly drone under the influence of drugs or alcohol.
  - 12 Don't fly drone from a moving vehicle, ship or aircraft.

**Recognise issues Drone pilots encounter including airspace, traffic patterns etc.**

**Objectives:** At the end of this exercise you shall be able to

- drone Sightings and Close Encounters.

**PROCEDURE****TASK 1: Drone Sightings and Close Encounters**

Drone sightings and close Encounters in the airspace are a recent challenge.

**Trainees identify the problems encountered while flying drones**

- 1 What problems are they facing in the airspace?
- 2 What are the problems they are facing in the traffic pattern?
- 3 What other issues are they facing?

-----

## Practice Radio telephony using Standard radio terminology and RT Phraseology.

**Objectives:** At the end of this exercise you shall be able to

- practice RT Phraseology
- practice the “Radiotelephony” with another trainee..

### PROCEDURE

#### TASK 1: Practice Radio telephony using Standard radio terminology

- 1 Practice the Radiotelephony with another trainee you can find.
- 2 Have your pen ready to write down information given to you
- 3 Don't hold the microphone tightly
- 4 Don't take shortcuts, but do be as concise as possible.
- 5 Try to relax, if you are stressed you will easily confuse what is said to you.
- 6 Don't abbreviate.
- 7 Listen before you transmit.
- 8 Think before keying your transmitter. Know what you want to say peak in a normal, conversational tone.
- 9 Be alert to the sounds or the lack of sounds in your receiver.
- 10 Be sure that you are within the performance range of your radio equipment and the ground station equipment.

**For the RT practical, instructor explain all about RT procedures, trainee should go for proper understanding of the processes involved, and also be in good RT practice in general with phraseology.**

Fill the below. (Table 1)

S.No.	Words	Meaning
1	Acknowledge	
2	Affirm	
3	Approved	
4	Break	
5	Break Break	
6	Cancel	
7	Check	
8	Cleared	
9	Confirm	
10	Contact	
11	Correct	

12	Correction	
13	Disregard	
14	How do you read	
15	I say again	
16	Correct	
17	Maintain	
18	Mayday	
19	Monitor	
20	Negative	
21	Over	
22	Out	
23	Pan pan	

#### Radio telephone Alphabet. (Table 2)

S.No.	Letter	Code Word	Pronunciation
1	A		
2	B		
3	C		
4	D		
5	E		
6	F		
7	G		
8	H		
9	I		
10	J		
11	K		
12	L		
13	M		
14	N		
15	O		
16	P		
17	Q		
18	R		

19	S		
20	T		
21	U		
22	V		
23	W		
24	X		
25	Y		
26	Z		

**Radiotelephony pronunciation of numbers shall be in the phonetic form as follows (Table 3)**

Numerical	Code Word
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Decimal	
Hundred	
Thousand	

-----

**Communicate with virtual ATC including Position, Altitude Reporting etc.**

**Objectives:** At the end of this exercise you shall be able to

- perform ATC.

**PROCEDURE****TASK 1 : Perform communication with ATC.****Reports should include the following items:**

- 1 Identification
- 2 Position
- 3 Time
- 4 Altitude or flight level
- 5 Type of flight plan
- 6 ETA and name of next reporting point
- 7 The name only of the next succeeding reporting point along the route of flight
- 8 Pertinent remarks

- 1 Make a report in the below mention points.
- 2 Get checked by instructor.

-----

**Identify specific Flight Planning Procedures for specific RPA flights.**

**Objectives:** At the end of this exercise you shall be able to

- **procedures for Flight Planning.**

**PROCEDURE**

- 1 Firstly, Instructor should comply to trainee with the provisions contained in ENR 1.10 of AIP-India. 13.6.11.2
  - 2 Explain the ICAO model flight plan format.
  - 3 Note down UIN of the RPA which is used as aircraft identification for the flight plan.
  - 4 Get the Additional information pertaining to RPA flights may be included under Item 18 of the flight plan. 13.6.11.3
  - 5 Fill the following additional information pertaining to RPA flights should be included in the flight plan:
    - a Category of RPAS
    - b Type of Operation (VLOS / BVLOS / BRLOS)
    - c Name of Operator and UAOP number
    - d Contact number of Remote Pilot
    - e Purpose of Flight
    - f Payload information
    - g Autonomous Flight Termination / Return Home capability
    - h Geo-fencing capability
    - i Detect and Avoid capability.
  - 6 Get the details checked by the instructor.
- - - - -

**Recognize importance of Weather and meteorology in RPA flight.**

**Objectives:** At the end of this exercise you shall be able to

- know about the role of weather and meteorology.

**Requirements**

- |                          |        |
|--------------------------|--------|
| • Handheld weather meter | -1 No  |
| • Weather station        | - 1 No |

**PROCEDURE**

The instructor shall emphasise the importance of weather and meteorology condition to the students.

- Day light is suitable for operating UAV
- Operating at night time is prohibited

- 1 Plan how to make flight attempts
- 2 All information guidance on meteorological condition
- 3 Operating trials regards to environment.

**Typical Weather Report Format**

Location			
Temp: Present temperature (°C)			
MinT			
MaxT			
Wind direction			
Wind speed (km/h)			
Wind gust (km/h)			
Rain_mm (in mm)			
Snow_cm (in cm)			
Total cloud cover (octa)			
Visibility			

-----

**Take METAR from mini weather station and MET office/ ATC before flying.**

**Objectives:** At the end of this exercise you shall be able to

- able to understand METAR Report.

**PROCEDURE****TASK 1: Collect the METAR report from MET office/ ATC**

METAR" is a format for writing weather report used by "aircraft pilots", meteorologists and for weather forecasting. It observes weather data at an airport at a specific time.

- 1 Before flying drone, trainee take METAR report from MET /ATC office.

- 2 METAR report should be as per the sequence mention in Table 1.
- 3 Report should be corrected by the instructor.

METAR code at all times in this order:

**Table 1****Place:****Date and Time:****Wind:****Visibility:****Phenomena:****Clouds:****Temperature:****Pressure**

-----

## Identify Different types of RPAS.

**Objectives:** At the end of this exercise you shall be able to

- determine Different types of Drones
- write the names of type of drone in table.

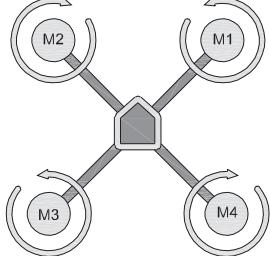
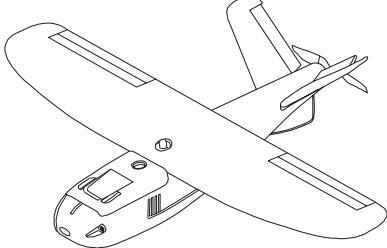
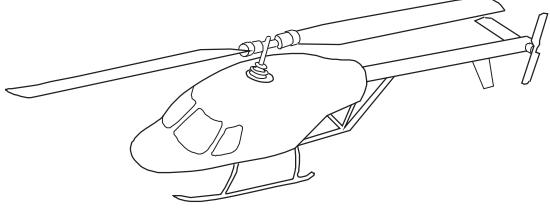
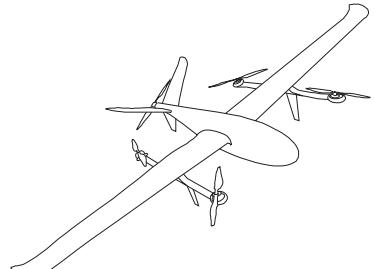
## PROCEDURE

### TASK 1: Determine Different types of Drones.

- 1 Identify the different types of drones and write their names with the help of the diagram in Table 1.
- 2 Get it checked by the instructor.

The instructor shall display the different types of Drones or diagram and explain how to identify Drones ask the trainees to note down the type of Drones in the Table 1.

TABLE 1

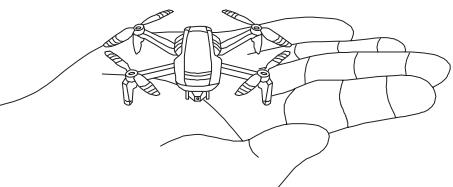
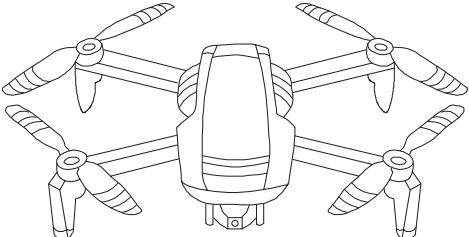
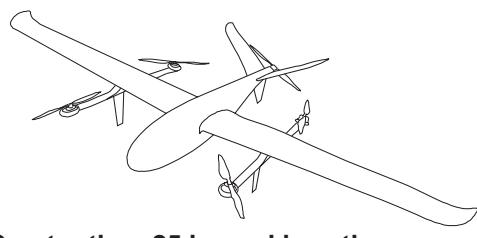
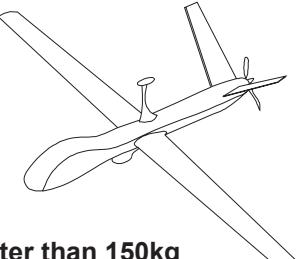
S.No.	Picture	Type
1		
2		
3		
4		

**TASK 2: Determine Different types of Drones** categories are specified by the DGCA Civil RPA in included with MTOW (including payload) as shown below:

- 1 Visuals the drone from the diagram.
- 2 Identify drone used for different types of drones.
- 3 Write the name of the drone and the corresponding type of drone in table 2.

Instructor may brief the various types of drones and their types.

**TABLE 2**

S.No.	Picture	Type
1	 <b>Less than or equal to 250 grams</b>	
2	 <b>Greater than 250 grams and less than or equal to 2kg</b>	
3	 <b>Greater than 2 kg and less than or equal to 25 kg</b>	
4	 <b>Greater than 25 kg and less than or equal to 150kg</b>	
5	 <b>Greater than 150kg</b>	

**Drone Pilot (Junior) - Identify and select different types of RPA****Select basic components and RPAS**

**Objectives:** At the end of this exercise you shall be able to

- select the proper type of Drones basic components
- record the specification of the drone in table.

**Requirements****Materials**

• Electronic Speed Controllers (ESC)	- 1 No	• Drone Frame	- 1 No
• BLDC Brushless Motor	- 1 No	• Drone Battery	- 1 No
• Propeller	- 1 No	• Balance Charger/Discharger	- 1 No
• Flight Controller	- 1 No	• Connector	- 1 No
• Transmitter and Receiver	- 1 No	• Landing Gear	- 1 No

**PROCEDURE****TASK 1: Select the proper drone basic components**

- 1 Read proper components for drone from table 1.
- 2 Identify and select basic components
- 3 Write the Specification and quantity of each selected components.
- 4 Fill up and get it checked by your instructor.

**Instructor provides different basic components.**

**TABLE 1**

S.NO	Components	Specification	Quantity
1	Drone Frame		
2	BLDC Brushless Motor		
3	Electronic Speed Controllers (ESC)		
4	Flight Controller		
5	Landing Gear		
6	Transmitter		
7	Propellers		
8	Receiver		
9	Drone Battery		
10	Battery Charger/Discharger Balance		
11	Connector (Male - Female)		

-----

## Fundamentals of flight aerodynamics

---

**Objectives:** At the end of this exercise you shall be able to

- **principal of Aerodynamic.**
- 

The principles of flight are the aerodynamics dealing with the motion of air and forces acting on an aircraft

- 1 Lift is the most apparent force, as its what we think of as giving an aircraft the ability to fly
- 2 Thrust provides a method with which to move the aircraft

- 3 Drag, and weight are those forces that act upon all aircraft in flight
- 4 Understanding how these forces work together and knowing how to control them with the use of power and flight controls are essential to flight

-----

## Recognize basic principles of flying like Bernoulli's Principle etc

**Objectives:** At the end of this exercise you shall be able to

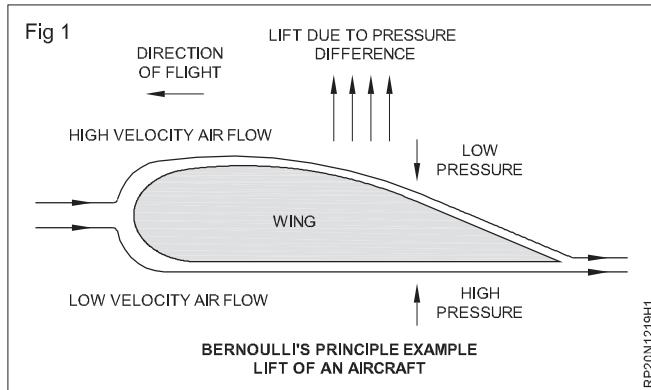
- statement of Bernoulli's Principle
- understand Newton's Laws of Motion
- identify the Four Forces of Flight.

### TASK 1: Bernoulli's Principle.

Instructor should explain the definition of Bernoulli's Principle

Write the formula for Bernoulli's principle:

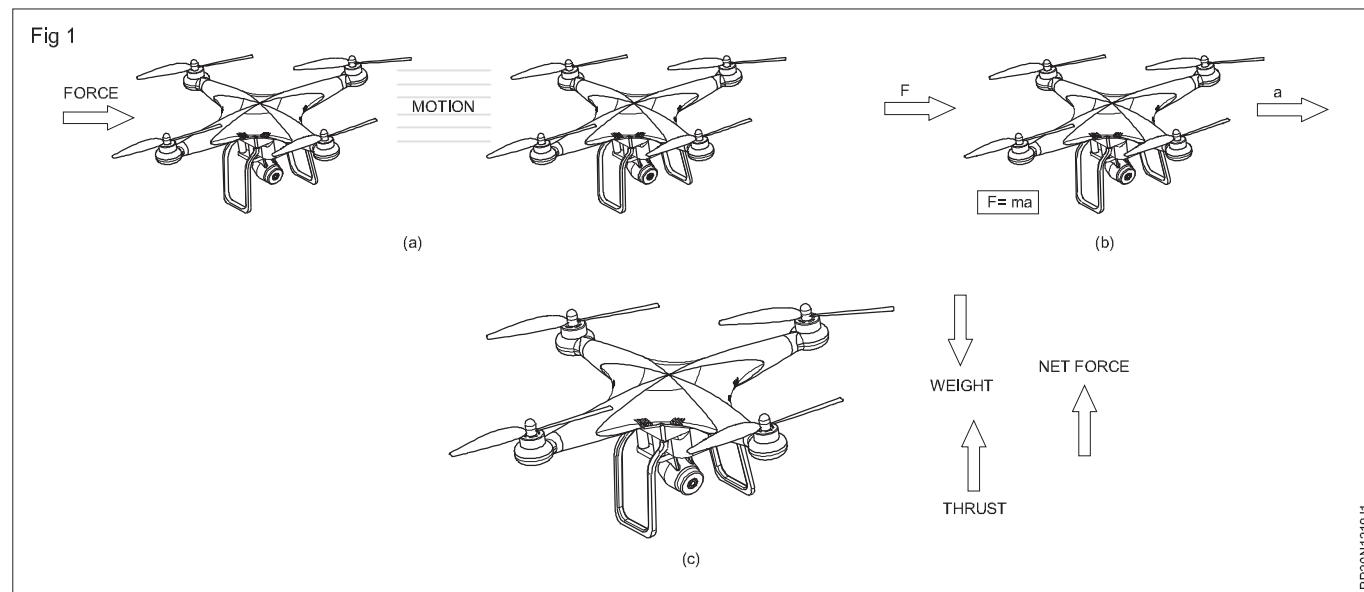
Space to write Formula



RP20N1219H1

### TASK 2 : Newton's Laws of Motion

- See the diagram in Fig 2.



- Write the definition of the Newton's Laws of Motion in table 1

**Table 1**

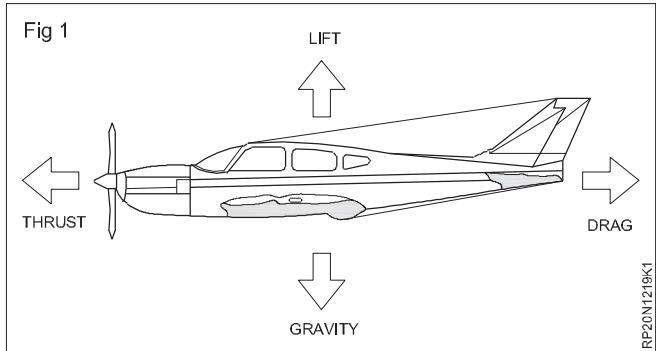
S.No.	Newton's Laws of Motion	Definition
1	First Law of Motion	
2	Second Law of Motion	
3	Third Law of Motion	

**TASK 3 : Four Forces of Flight**

- See the diagram in fig 3.
- Analyse the forces acting over a fixed wing drone and observe the direction of force acting.
- Write the direction of force in table 2.

**Four main forces stabilize the flight****TABLE 2**

Sl.No.	Forces	Direction
1	Lift	
2	Drag	
3	Weight	
4	Thrust	



RP20N1219K1

## Drone Pilot (Junior) - Identify and select different types of RPA

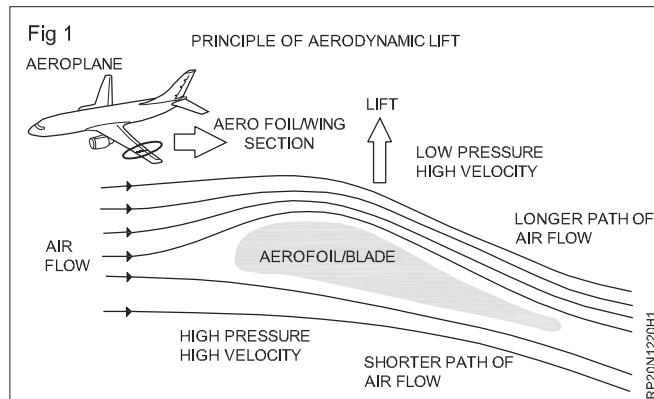
**Apply principles of flight to RPAS.**

**Objectives:** At the end of this exercise you shall be able to

- apply Bernoulli's Principle on drone
- newton's Laws of Motion
- identify the Four Forces of Flight.

**TASK 1: Apply Bernoulli's Principle on drone.**

The air velocity decreases and pressure increase at the bottom side of Drone propeller/aircraft wing.

**Lift**

- The vertical force acting on the drone is called lift

- This force is due to pressure differences across the drone (in the vertical direction). Hence, the speed, size, and shape of the propeller blade decide the amount of lift force.
- Lift is essential to lift the body against the gravity
- To create this force, all four propellers run at high speed to lift the drone.

**Drag**

- The force acting on the drone in the opposite direction of motion due to air resistance is called drag
- This may be because of pressure difference and viscosity of air
- To reduce the drag, the aerodynamic shape of the drone is selected

**TASK 2 : Newton's Laws of Motion.****Newton's First Law: Inertia**

The motion of an drone when a drone pilot changes the throttle setting of a motor.

**Newton's Second Law: Force**

A drone motion resulting from aerodynamic forces, the weight and thrust of the aircraft.

**Newton's Third Law: Action & Reaction**

The motion of lift from an airfoil, the air is deflected downward by the airfoil's action, and in reaction, the wing/propeller is pushed upward.

**TASK 3 : Apply Four Forces of Flight on drone**

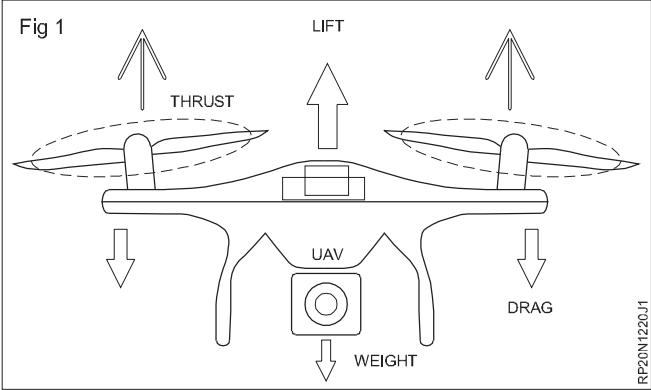
**Weight of drone = mass of drone × acceleration due to gravity**

**Thrust**

- The force acting on the drone in the direction of motion is called thrust. However, for drone dynamics, it is normal to the rotor plane.
- During hovering, the thrust is purely vertical. If thrust is inclined then the drone will tilt forward or backward.

- This force is essential to move the drone in the desired direction at equal speed to get desired motion, two propellers have been given high speed
- Due to the mass of the drone, the body mass force always acts in the direction of gravity
- Higher the weight of the drone, more power is required to lift and move the drone.

Fig 1



**Drone Pilot (Junior) - Identify & select various parts of RPA****Identify each component in RPAS.**

**Objectives:** At the end of this exercise you shall be able to

- select the appropriate type of drone original equipment
- enter the drone's uniqueness in the table.

<b>Requirements</b>			
<b>Material</b>			
• Electronic Speed Controllers	- 1 Nos	• Drone Frame	- 1 Nos
• BLDC Brushless Motor	- 1 Nos	• Drone Battery	- 1 Nos
• Propeller	- 1 Nos	• Balance Charger/Discharger	- 1 Nos
• Flight Controller	- 1 Nos	• Connector	- 1 Nos
• Transmitter and Receiver	- 1 Nos	• Landing Gear	- 1 Nos

**PROCEDURE****TASK 1: Select the Proper Drone Mechanism**

- 1 Read Proper equipment for drones from Table 1.
- 2 Identify and select the basic device
- 3 Enter the specification and quantity of each of the selected devices.
- 4 Fill it out and get it checked by your instructor.

**Provide various basic equipment to the trainee**

**TABLE 1**

S.No	Tools	Specification	quantity
1	Drone Frame		
2	Bldc Brushless Motor		
3	ESC		
4	Flight Controller		
5	Landing Gear		
6	Transmitter		
7	Propellers		
8	Receiver		
9	Drone Battery		
10	Battery Charger/Discharger Balance		
11	Connector (Male - Female)		

-----

## Perform assembling & disassembling of RPAS.

**Objectives:** At the end of this exercise you shall be able to

- soldering the ESCs in frame plate
- attach the motor at the arms
- set up the flight control board
- connection of all the basic components of drone parts
- attach landing gear
- prepare Assembling of Quad copter.

### Requirements

#### Tools/Instruments

- Soldering Iron 25watt, Paste, Desolder Wire, Soldering Stand, Solder Wire, Cutter and Tester - 1 No.
- 1.5mm Heat Shrink Sleeve Tube- Black –10cm - 1 No.
- XT60 Male-Female Connector Pair for Lipo Battery - 1 No.
- 3.5 mm Gold Plated Bullet Connector Male Female Set - 1 No.
- Digital Multi-meter
- Double-Sided Tape - 1 No
- Allen Key (Hex Key) 1.5, 2, 2.5, 3, 4 Sizes (mm) - 1 No.
- Silicone Wire16AWG 20cm - 1 No
- Glue gun - 1 No

#### Materials

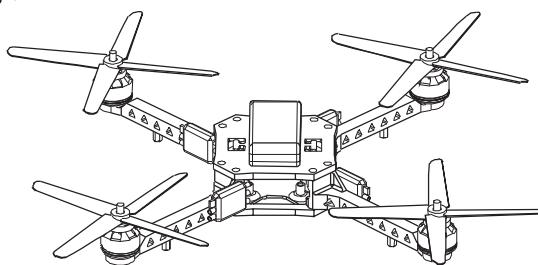
- Electronic SpeedControllers (ESC) 30A - 4 Nos.
- BLDC Brushless Motor 1000 KV - 4 Nos.
- Flight Controller with GPSMod-ule - 1 No.
- FS-iA6B Receiver - 4 No.
- F450 Quadcopter Frame 4-Axis - Inte-grated PCB Wiring - 1 m.
- Transmitter Fly-Sky FS-i6 2.4GHz - 1 No.
- 10x4.5 inch - 1045/1045R CW CCW Propeler Pair for Quadcopter - 2 pairs.
- Drone Battery 4200mAh 3S 35C (11.1 v) Lithium Polymer (LiPo) - 1 No.
- Professional Balance Charger/Discharger - 1 No.

### PROCEDURE

#### TASK 1 : Perform assembling of drones.

A completed Assembled quadcopter (4 motor) drone shown in Fig 1

Fig 1

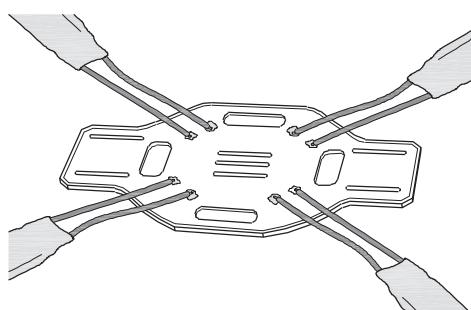


Use tags and fix the ESCs and Receiver to the arm.

Use tags and double tape to fix the flight controller and the Receiver to the bottom plate with familiarize with the parts and remote controls.

- 1 First take the bottom plate and do the Pre soldering to it.
- 2 next take the four ESC's and do soldering the 4 ESCs to the Bottom plate.(Fig 2).

Fig 2



RP20N1322H2

**Now check the all connections by using multimeter for any shortage connections.**

**Use hot glue to the soldering wires to prevent from short circuit.**

- 3 Take the connector XT60 and silicon wire make Battery wire. (Fig 3).

Fig 3



- 4 Soldering the battery wire to the Bottom plate.
- 5 Take the Power Module and do soldering it to the Bottom plate.
- 6 Take the motors attach them at the end of arms, Screws tightly with Allen key (Fig 4).

Fig 4



- 7 Attach the Four Arms to the Bottom plate and tight them with screws.(Fig 5).

Fig 5



- 8 Take the ESC's wires and connect them to the motor.
- 9 Take the flight controller and connect the four ESC-servo wires to the flight controller.(Fig 6).
- 10 Connect the Power Module and Receiver to the flight controller by using servo wire cables.(Fig 7).
- 11 Connect the GPS module to the flight controller. (Fig 8).
- 12 Finally cross check all the connections and Show to your instructor.

Fig 6

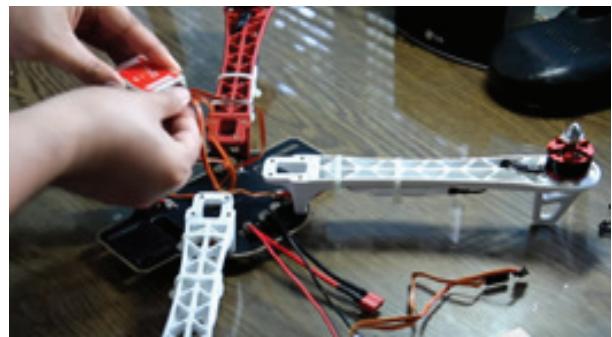


Fig 7

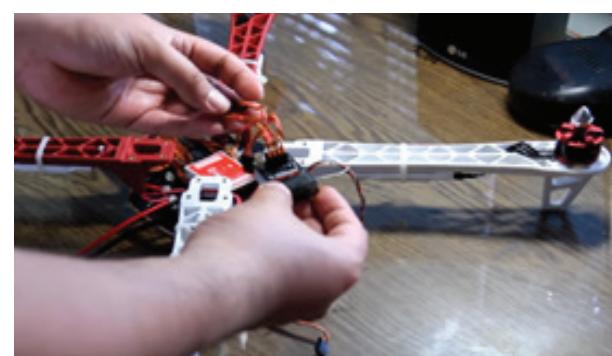
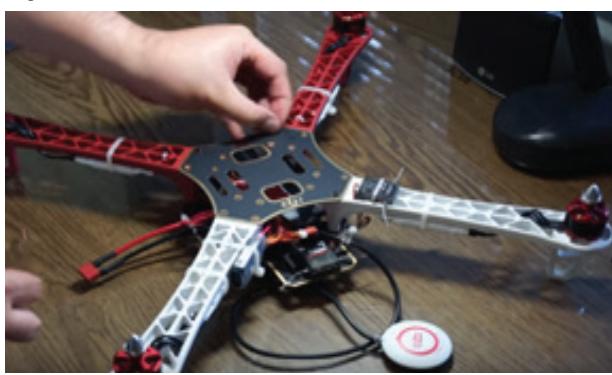


Fig 8



- 13 Fix the top plate.(Fig 9)

Fig 9



- 14 Attach the four landing gears at the bottom plate

- 15 Set up the GPS mount to the top plate using double sided tape.(Fig 10)

Fig 10



16 Connect the battery. (Fig 11)

Fig 11



17 In the end attach Clock-wise propellers with Clock-wise motors and counterclockwise propellers with counterclockwise motors.(Fig 12)

Fig 12



## TASK 2 : Perform disassembling of drones.

- 1 Take assembled drone, keep it on clean surface.
- 2 Carry Allen key, de-soldered, Cutter etc.
- 3 Firstly, we need to remove / dismantle the battery.

### Carefully remove the propeller.(Fig 1)

Fig 1



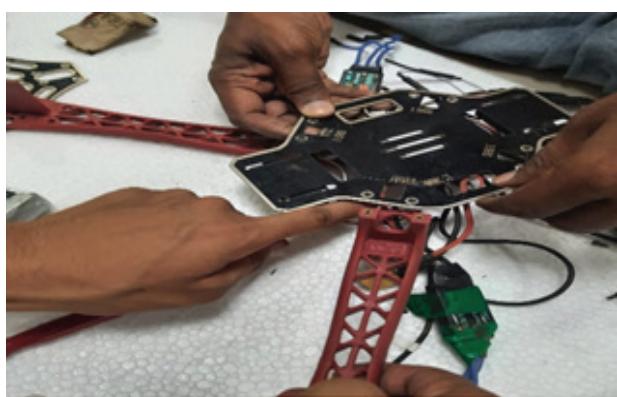
- 4 Remove all the tag wire which use to fix the components.
- 5 Disconnect the connection between motor to esc, Flight controller to ESCs, Receiver, GPS, GPS LED to Flight Controller. (Fig 2)

Fig 2



- 6 Remove the entire frame from bottom plate of drone frame.(Fig 3)

Fig 3



- 7 Perform de-soldering to disconnect the connection of ESCs to PDB.
- 8 Keep all the components / Spare parts of drone in the clean surface.(Fig 4)

Fig 4



## Recognize multi rotor design, various configurations, airframe sizes and construction materials.

**Objectives:** At the end of this exercise you shall be able to

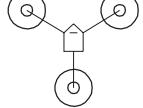
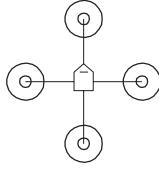
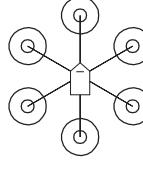
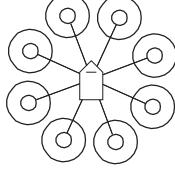
- identify types of various configurations.
- identify airframe sizes
- construction materials.

### PROCEDURE

#### TASK 1: Determine multi rotor design

- 1 Visuals the multi rotor designs from the diagram shown in table 1.
- 2 Identify type of the multi rotor design.
- 3 Write the name of the multi rotor design and the corresponding type of it in table 1.
- 4 Get it checked by the instructor.

TABLE 1

S.No	Multi Rotor Design	Number of Motors	Type
1			
2			
3			
4			
5			

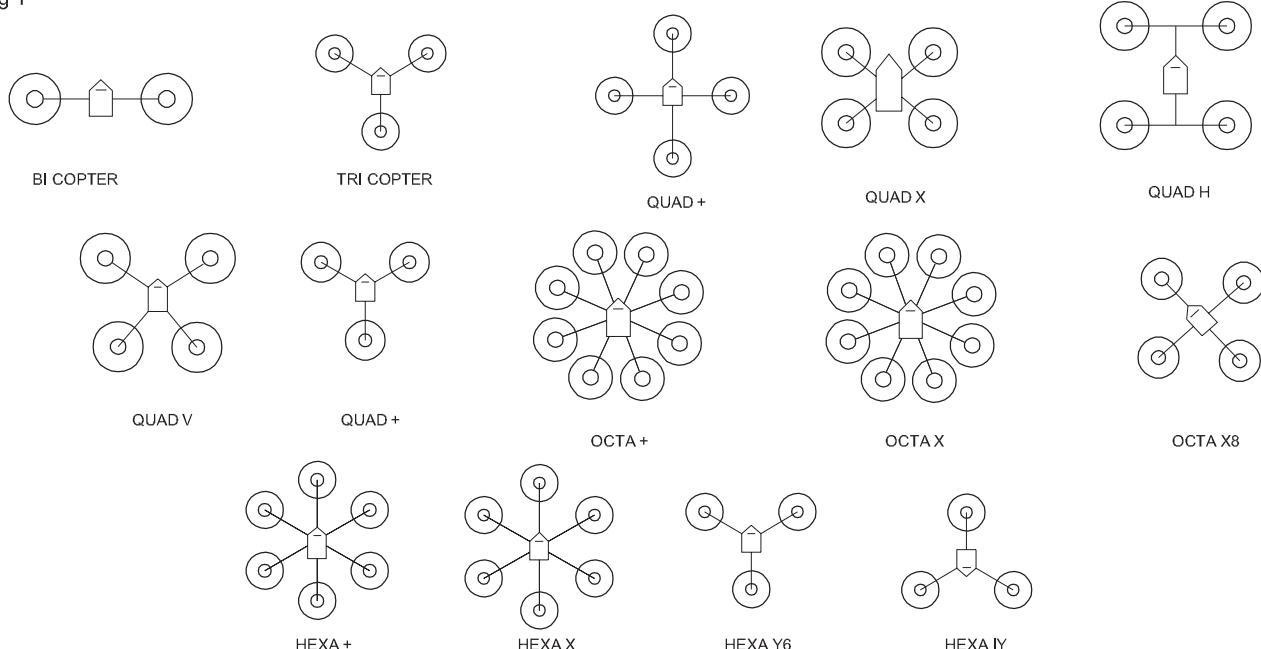
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## TASK 2: Various configurations

- 1 Visuals the drone from the diagram.
- 2 Identify drone used for different types of drones.
- 3 Write the name of the drone and the corresponding type of drone in table 2.

The instructor shall display the various configurations of multi rotor design and explain how to identify it, ask the trainees to note down the type of various configurations in the Table 2.

Fig 1



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## TASK 3: Production Airframe Dimensions.

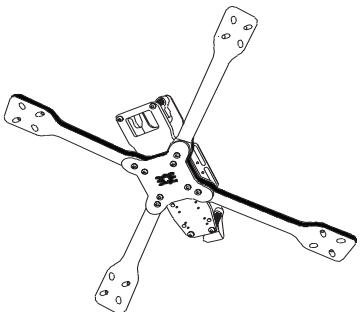
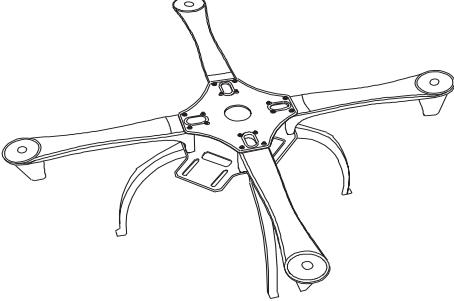
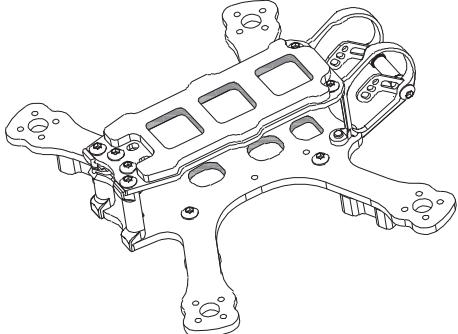
- 1 The frame is the supportive basic part for all mounted components.
- 2 Frame depends on the overall design & configuration part of the drone.
- 3 For airframe the main dimension is diagonal distance between two motors.
- 4 Trainee should measure the diagonal distance between two motors.
- 5 Note down the diagonal distance in the table 2

TABLE 2

S.No	Frame	Dimension

**TASK 4: Construction Materials.**

**TABLE 2**

S.No.	Drone Frame	Materials
1		
2		
3		
4		

-----

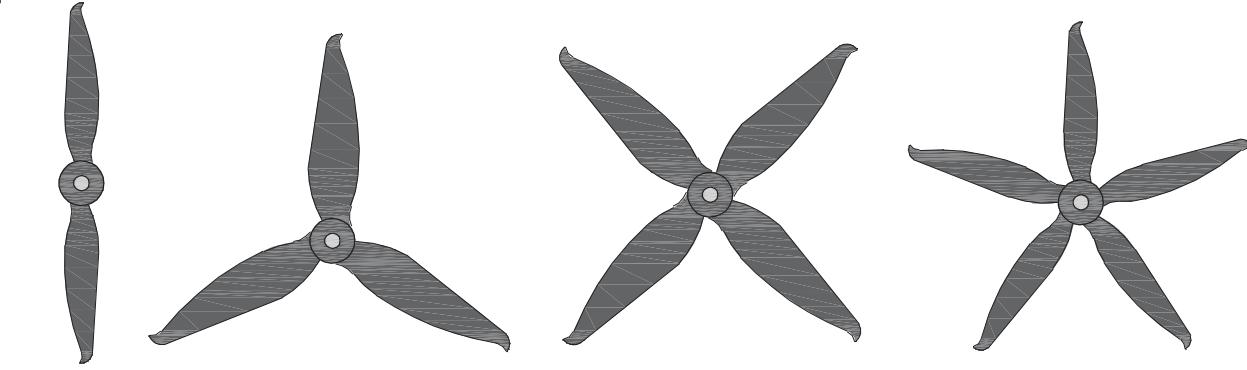
**Identify different propeller designs and choose appropriate propeller.****Objectives:** At the end of this exercise you shall be able to

- identify propeller designs configurations.

**PROCEDURE****TASK 1: Determine Different propeller designs.**

- 1 Visuals the drone propeller from the diagram.
- 2 Identify drone used for different types of drones.
- 3 Write the name of the drone and the corresponding type of drone in table 1.

Fig 1



2 BLADE PROP

3 BLADE PROP

4 BLADE PROP

5 BLADE PROP

RP20N1324H1

**TABLE 1**

S.No.	Number of Blades	Propeller Type
1		
2		
3		
4		

-----

**Electricity fundamentals (Wattage, voltage, Amperage and their relationship) and soldering techniques.**

**Objectives:** At the end of this exercise you shall be able to

- determine Electricity fundamentals
- perform soldering techniques
- inspect the soldered joints.

**Requirements****Tools/Instruments/Materials**

- Soldering kit - 1 Nos

**PROCEDURE****TASK 1 : Definition of Electricity fundamentals.****Current**

Current is rate of flow of negatively-charged particles, called electrons, through a predetermined cross-sectional area in a conductor.

flow of electrons in an electric circuit leads to the establishment of current.

**Formula**

$$I = \frac{dq}{dt}$$

q = relatively charged electrons (C)

Amp = C/sec

Often measured in millamps, mA

**Voltage**

Potential difference across two terminals in a circuit "across variable."

**Formula**

$$V = I \cdot R$$

**Wattage**

The wattage is to be current (in amps) multiplied by voltage (in volts).

**Formula**

$$\text{Amps (A)} \times \text{Volts (V)} \times \text{Power Factor} = \text{Watts (W)}$$

-----

**TASK 2 : Write the Electricity fundamentals relationship**

1 Instructor should explain about electricity fundamentals and trainee should note it down.

2 Trainee should note down the electricity relation in table 1

**TABLE 1**

S.No.	Fundamentals	ion
1		
2		
3		
4		

**TASK 3 : Perform soldering techniques.**

- 1 Select a 25W, 240V AC 50 Hz. soldering iron (Fig 1) and check that the iron has no physical damage, the body is well insulated from the element and is of the correct voltage and power rating
- 2 Check the bit to see whether the surface is smooth and clean
- 3 Connect the soldering iron to the supply and switch it 'ON'.
- 4 When the bit becomes sufficiently hot, apply a small quantity of rosin-cored solder, and tin the bit.
- 5 Wipe the bit gently on the cleaning pad to remove excess solder.
- 6 Clean the joint to be soldered with the help of sandpaper and wipe the dust with a wire brush.
- 7 Keep the soldering iron bit on the joint and heat it for Soldering.
- 8 Keep the rosin-cored solder on the wire joint and allow it to melt
- 9 Melt the solder with the heat of the bit and make sure that the solder flows freely and evenly on the joint.
- 10 Remove the soldering iron use cotton cloth to wipe off the excess solder from the surface of the joint when it is still hot
- 11 Allow the joint to cool naturally. Do not blow air for cooling.

## Calculate motor ratings for load capabilities for a RPA build.

**Objectives:** At the end of this exercise you shall be able to

- determine thrust to weight ratio
- calculate the motor ratings.

### Requirements

#### Tools/Instruments/Materials

- Motor, Esc - 1 No
- Battery - 1 No's

## PROCEDURE

### TASK 1: Calculate motor ratings

#### Motor Ratings

All brushless motors have the Kv ratings. It indicates the number of "revolutions per minute" (rpm) that a motor turns when 1V (one volt) is applied with no load attached to that motor. The Kv rating is the ratio of the motor without a load rpm to the peak voltage on the wires connected to the coils.

#### Drone thrust to weight ratio

- 1 Determine the optimal thrust of the drone motor, you need to pick one more important parameter: the thrust to weight ratio.

- 2 Find out the total weight of our drone
- 3 Then calculate thrust required for drone with the thrust to weight ratio 2.5:1
- 4 Divide the calculated thrust by the number of motors using to build drone.
- 5 Calculate the motor rating with the help of Table 1.

**After calculate the motor rating get it approved your instructor.**

TABLE 1

Number of Cells	Thrust	Motor Rating (Kv)
1-2S	250-500 g	
2-3S	1.2-1.5 kg	
3-4S	2-2.5 kg	
4-5S	2.5-3.5 kg	
5-6S	3.5-4.5kg	
6-8S	4.5-5kg	
8-10S	5-8kg	
10-12S	8-10kg	

-----

## Identify parallel vs. serial arrangements of batteries.

**Objectives:** At the end of this exercise you shall be able to

- identify serial arrangements of batteries
- identify parallel arrangements of batteries
- form series parallel combination circuits
- verify of series and parallel circuits.

### Requirements

#### Tools/Instruments

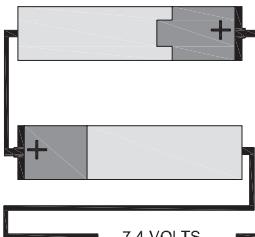
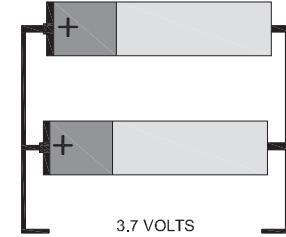
- Lipo Batteries - 1 No
- Multi meter - 1 No

## PROCEDURE

### TASK 1 : Identification of battery arrangement

1 Series connection is that components are connected end-to-end in a line to form a single path through which current can flow.

2 Parallel connection is that all components are connected across each other's leads.

S.No	Arrangements	
1	 <b>TWO 3.7 VOLT BATTERIES IN SERIES EQUALS 7.4 VOLTS</b>	
2	 <b>TWO 3.7 VOLT BATTERIES IN PARALLEL EQUALS 3.7 VOLTS</b>	

-----

## Practice charging, cell balancing and explore various connectors.

**Objectives:** At the end of this exercise you shall be able to

- connect battery with charger
- function of battery charger
- identify the battery information and type of battery
- cell balance charging
- identify the Connectors using in battery connection.

### Requirements

#### Tools/Instruments

- |                        |        |                   |        |
|------------------------|--------|-------------------|--------|
| • Lipo Battery Charger | - 1 No | • Balance Charger | - 1 No |
| • Lipo Battery         | - 1 No | • Multi meter     | - 1 No |

### PROCEDURE

#### TASK 1 : Practice Batteries charging.

- 1 Visually battery for inspect the outside body for any physical damage or bulging.

Once check manual by the battery manufacture pertaining to charging methods.

- 2 Connect battery adopter with charger and electricity plug
- 3 Connect the battery to the terminal of the charger: red is positive and black is negative. And JST wire of the battery.

**When connecting the battery charger to the battery, you should consult the information regarding the appropriate charging conditions depending on the charger.**

Fig 1



- 4 Switch "ON" electricity plug.
- 5 Use START/ENTER, DEC or INC key to set specific details fed into the battery from table 1.

- 6 The left side of the first line indicate the type of battery, left side of the second line indicates current. Instructor explain about balance charge functions
- 7 After setting the current and voltage, press START/ENTER key for more than 3 second to start the process.

Fig 2



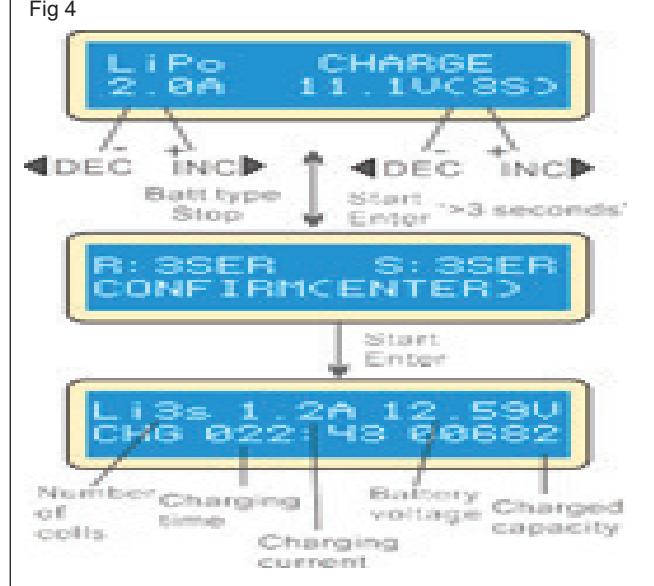
- 8 For change the values of parameters, please press START/ENTER key to make it blink and use DEC or INC to change the value. Then press START/ENTER key again to store the value.

Fig 3



- 9 Check on screen, "R" shows the number of cells detected by the charger and "S" is the number of cells set by you at previous screen.

Fig 4



10 If details correct press START/ENTER button, if not press BATT TYPE/STOP button to go back to previous screen to check number of cells of the battery pack.

11 Switch OFF the battery charger and disconnect the battery when fully charged.

**Avoid charging your battery beyond 100%**

Fig 5



Fill the values in the table 1.

TABLE 1

	No.of cells	Rated voltage (V)	Max. charge voltage (V)	Charge current (A)
Lipo	1S			
	2S			
	3S			
	4S			
	5S			
	6S			

## TASK 2 : Practice Batteries balancing charging.

- 1 Repeat above steps 1 to 4
- 2 While settings select Balance changing option in charger

- 3 Repeat remaining steps from above.

## TASK 3 : Type of battery Connector

The connector is used to connect your drone to a Battery. A high-amp, more reliable, and better-quality connection is perfect for applications that require a high current draw. There are different types of connectors using for connection.

S.No	Types of connectors	Ampere
1	Dean Connector	
2	XT60 Connector	
3	XT90 Connector	

## Identify different role of FCs and ESCs. And its calibration.

**Objectives:** At the end of this exercise you shall be able to

- identify the different role of ESCs.

### Requirements

#### Tools/Instruments

- Electronic Speed Controller, Tx, Battery - 1 No

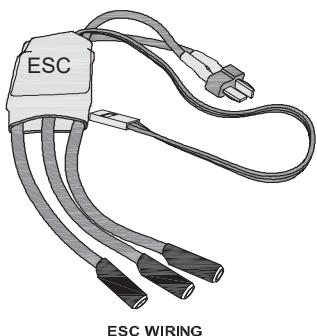
### PROCEDURE

#### TASK 1: identify the different role of ESCs

The speeds at which motors rotate are controlled by an electronic speed controller. It ensures that the motors rotate at the correct rates from start to finish. Without them, motors may spin out of control, potentially causing damage to the entire system.

Instructor should explain about ESC wiring.

Fig 1



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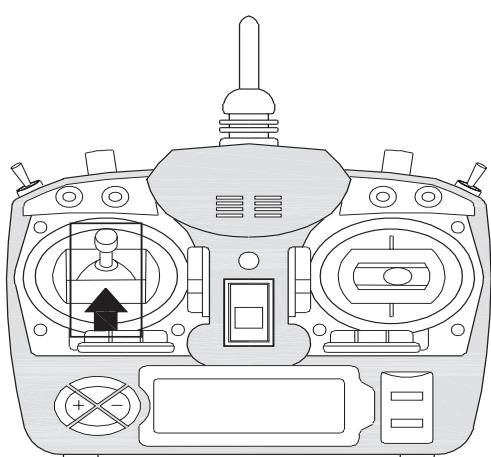
S.No.	Write down the different role of ESCs

#### TASK 2 : Manually Calibration ESCs

For easy manageability, Instructor may arrange the trainees in group of three and ask each group to perform calibration.

- 1 Firstly, connect one ESC three-wire cables into the throttle channel (mostly channel 3) of the RC receiver.

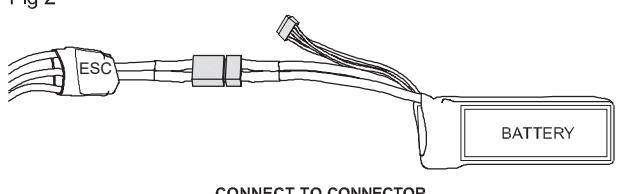
Fig 1



RP20N1329J1

- 2 Second trainee turns "ON" the transmitter and set throttle stick to maximum position (at 100%).
- 3 Third trainee, power to drone by connect the LiPo battery.
- 4 Listen a musical tone than one or two beeps.

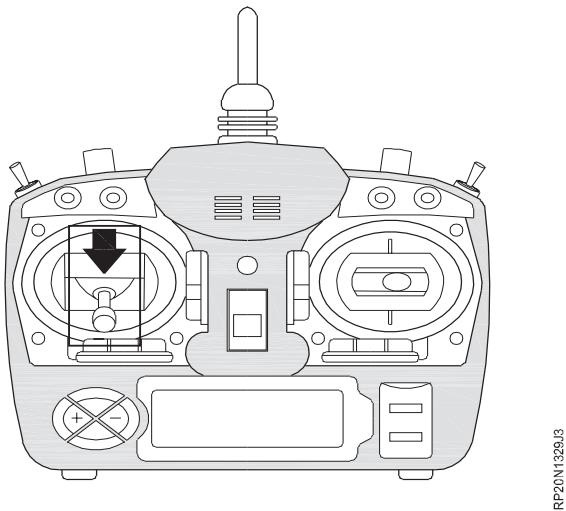
Fig 2



- 5 After the two beeps, pull the transmitter's throttle stick down to its minimum position (at 0%).

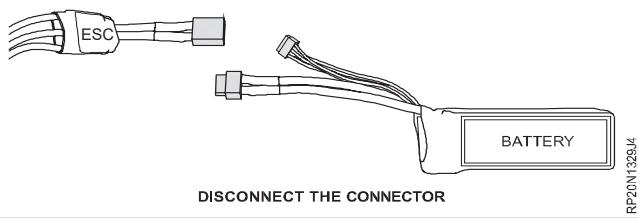
RP20N1329J2

Fig 3



- 6 Then a number of beeps and finally, a single long beep indicating the end points have been set and the ESC is calibrated.
- 7 Disconnect battery.

Fig 4



- 8 Repeat these steps for all other ESCs.
- 9 After calibration, recheck those motors should work in coordination with throttle stick i.e., as soon as the throttle stick is moved from its minimum position, motor should start rotating.
- 10 Make sure that all ESC's are calibrated and are working properly.
- 11 Get it checked by your instructor by Arm your Drone then, put throttle (10%) and check whether all motors are rotating at the same speed and start at the same time.
- 12 Disarm your drone.
- 13 If the motors do not all start at the same time and rotate at the same speed, the ESCs are still not properly calibrated so, repeat above step again.

## Recognize different sensors & their applications in RPAS.

**Objectives:** At the end of this exercise you shall be able to

- identify different sensors
- write the sensors applications in drones.

### PROCEDURE

#### TASK 1 : identify different sensors

- Visuals the sensor from the diagram.
- Identify sensor used for drones.
- Write the name of the sensor and the corresponding applications in table 1.

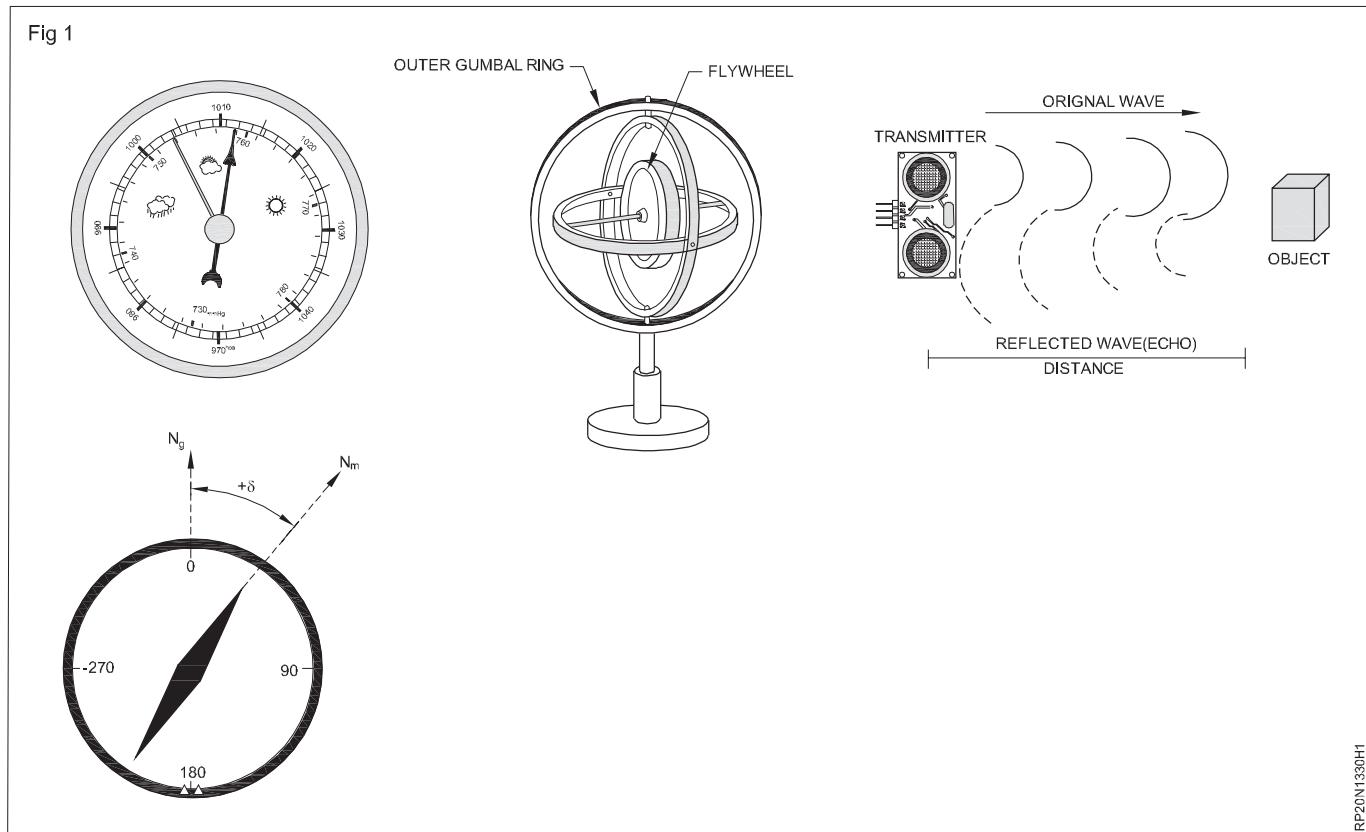


TABLE 1

S. No.	Name of Sensors	Applications
1		
2		
3		
4		
5		
6		
7		
8		

**Identify GPS applications in RPA flying.**

**Objectives:** At the end of this exercise you shall be able to

- perform sense-and-avoid technology.

**PROCEDURE**

**TASK 1 : GPS applications in drone flying.**

**Position Hold**

**Altitude Hold**

**Return to Home**

**Waypoint Navigation**

**Reporting**

-----

## Identify different radio control systems, controllers, transmitters and receivers, Frequency bands and.

**Objectives:** At the end of this exercise you shall be able to

- knowledge about Controllers
- determine different types of radio control systems
- write the names of type of radio control systems in table.

### PROCEDURE

#### TASK 1 : Identify different radio control.

- 1 Identify the different types of radio control systems from fig 1 and write their names with the help of the diagram in Table 1.
- 2 Get it checked by the instructor.



Jumper T16



Taranis X9D+ SE



FrSky Taranis QX 7



FlySky FS-i6



FrSky Horus X10



dk32-transmitter



Skydroid T12

TABLE 1

S. No	Radio Control	Frequency bands
1		
2		
3		
4		
5		
6		
7		

**Identify the factors that influence the performance of the RPAS.**

**Objectives:** At the end of this exercise you shall be able to

- monitoring the performance of the drone.

**PROCEDURE**

Parameters	Impact on performance on RPAS
Atmosphere Pressure	
Wind Speed	
Direction	
Temperature	
Humidity	
Rain	
Solar Radiation	

-----

**Identify and learn measurement of atmosphere pressure, effect of obstructions on wind speed and direction.**

**Objectives:** At the end of this exercise you shall be able to

- identify the measurement of atmosphere pressure
- measure the effect of obstructions on wind speed and direction.

**Requirements****Tools/Instruments**

- Handheld weather meter - 1 Nos
- Mini Weather station with sensors - 1 Nos

**PROCEDURE****TASK 1 : Measure the atmosphere pressure**

- 1 Take weather meter and go to field
- 2 Instructor explain about the weather meter functions
- 3 Switch on weather meter
- 4 The meter having a barometer showing the atmospheric pressure Range: 15- 115kPa
- 5 Trainee check the reading of meter with time and date and note it down.

**Value in weather meter**

**Atmospheric Pressure Range : 15- 115kPa**

**Wind Direction Sensor : North, East, West, South, North-East, East-South, North-West, South-West**

**Wind Speed Sensor Speed : 0 to 20m/S**

**System should have portable mechanical structure with all sensors mounted on it. LCD Display for real time data monitoring and USB interface for local storage and GSM connectivity for cloud storage,**

**Application Software for Dashboard for real time and remote monitoring and analysis.**

**TASK 2 : Effect of obstructions on wind speed and direction**

- 1 Use weather meter and note down reading
- 2 Fill the table with the meter reading at different atmospheric pressure
- 3 Note down effect of atmospheric pressure on wind speed and its direction

**TABLE 1**

S.NO	Atmospheric Pressure	Wind Speed	Wind Direction
1			
2			
3			
4			

**Identify and learn measurement of temperature and humidity, Rain and solar radiation.**

**Objectives:** At the end of this exercise you shall be able to

- identify the temperature and humidity, Rain and solar radiation
- record the value of temperature and humidity, Rain and solar radiation.

**Requirements****Tools/Instruments**

- Handheld weather meter - 1 Nos
- Mini Weather station with sensors - 1 Nos

**PROCEDURE****TASK 1 : Record the temperature and humidity, Rain and solar radiation.**

- 1 Take weather meter and go to field.
- 2 Switch on weather meter.
- 3 The meter having internal sensors records the maximum and minimum readings.
- 4 Trainee check the reading of meter with time and date and note it down.

**Value in weather meter**

**Air Temperature: 0°C to 100°C**

**Relative Humidity: 0% to 100 %RH**

**Solar Radiation Range: 0 to 2000W/m<sup>2</sup>**

**Air Quality Sensor (PM2.5): 10 - 500**

**Rainfall: Tipping bucket in mm**

**TABLE 1**

S.NO	Temperature	Humidity	Rain	Solar Radiation
1				
2				
3				
4				

-----

**Knowledge of GCS telemetry and Track RPA using telemetry.**

**Objectives:** At the end of this exercise you shall be able to

- collect the telemetry data
- analyse the telemetry data.

**PROCEDURE****TASK 1 : Knowledge of GCS telemetry.**

- 1 GCS mode can able to stream telemetry data.
  - 2 Open GCS Mobile app and connect online.
  - 3 Go to FCB screen.
  - 4 Once your GCS detects an active drone
  - 5 Select your drone to stream telemetry data to GCS applications such as Mission Planner.
- 

**TASK 2 : Track data using telemetry**

- 1 Connect telemetry with drone.
- 2 Fly drone with telemetry.
- 3 Record data.

S. No.	Write data using telemetry

-----

**Learn GCS features and possible flight plans using GCS.**

**Objectives:** At the end of this exercise you shall be able to

- able to select GCS.

**PROCEDURE****TASK 1 : Learn GCS features.**

- 1 GCS software can allow an operator to control a drone
  - 2 The software may also overlay real-time feeds from sensors and payloads such as video cameras
  - 3 Provide indicators of critical parameters such as altitude, battery life, and fuel remaining.
  - 4 Provide a real time picture of the vehicle's status and its progress through the mission
  - 5 Allow geo tagging of images captured by the drone,
  - 6 GCS software may also be integrated with post-processing software, allowing operators to quickly produce deliverables from the captured data.
- 

**TASK 2 : Develop flight plans using GCS.**

- 1 Install and configure the GCS
- 2 Mention, the vehicle type
- 3 Creating the flight plan
- 4 Tap and drag & drop to place the waypoints
- 5 Adjust various mission parameters.

Latitude	Longitude	Altitude	Airspeed

-----

**Identify Flight mode operation, GUI parameters, Maps and user control operation.**

---

**Objectives:** At the end of this exercise you shall be able to

- practice different flight modes
  - use GUI Parameters
  - inspect maps and user controls.

## PROCEDURE

## **TASK 1 : Identify Flight mode operation**

Write about the different flight mode use in drone

<b>Standard mode</b>	
<b>Heads free mode</b>	
<b>First person view</b>	
<b>Altitude Hold mode</b>	
<b>Loiter mode</b>	
<b>Stabilize mode</b>	
<b>Auto Return mode</b>	

## TASK 2 : GUI parameters.

## Write GUI parameters

### **TASK 3: Maps and user control operation.**

**Write about the control**

## **Autonomous Waypoint Navigation and Dynamic flight plan adjustment.**

**Objectives:** At the end of this exercise you shall be able to

- carryout the Autonomous Waypoint Navigation
- record the Dynamic flight plan adjustment.

### **Requirements**

#### **Tools/Instruments/Materials**

- Drone -1 No

## **PROCEDURE**

### **TASK 1 : Practice Autonomous Waypoint Navigation.**

- 1 Autonomous waypoint GPS navigation allows the drone to fly independently using pre-planned and pre-configured flight destinations or points in the drone's remote controller's navigation software.
  - 2 Waypoint GPS Navigation allows you to measure your position at the right place.
  - 3 The drone flies directly to the designated location, and the pilot on the ground can focus on operating the camera to capture aerial photos and videos.
  - 4 Drone follows the shortest route to each waypoint, saving battery and filming time
  - 5 It saves GPS coordinates (geotagging) for each photo, which is useful for creating 3D maps. Geotagged photos are associated with a geographic location.
- 

### **TASK 2 : Check Dynamic flight plan adjustment.**

- 1 Open flight plan.
  - 2 Instructor explain about the Flight plan.
  - 3 Trainee makes adjustment in flight plan.
-

**Perform 3D mapping and modeling.**

**Objectives:** At the end of this exercise you shall be able to

- perform 3D mapping
  - prepare modelling.

Requirements
Tools/Instruments
<ul style="list-style-type: none"><li>• Drone upto 18KM - 1 No.</li></ul>

## PROCEDURE

## **TASK 1 : Practice 3D mapping.**

- 1 Trainee go to the field with drone and mapping software.
  - 2 Switch ON your drone and connect with the mapping software.
  - 3 Plan Your Mission.
  - 4 Select the field for mapping purpose.
  - 5 Create a Flight Path.
  - 6 Fly and Capture Data.
  - 7 Upload and Process Data.
  - 8 Get Your Maps.

## **TASK 2: Prepare modelling.**

- |                         |                                            |
|-------------------------|--------------------------------------------|
| 1 Consider Conditions.  | 3 Capture Oblique Images.                  |
| 2 Capture Nadir Images. | 4 Process the Images and Create the Model. |

**Perform Geographic Map along with UAV location, UAV trajectory, camera view polygon, waypoints and flight plan.**

**Objectives:** At the end of this exercise you shall be able to

- make **Geographic Map**
  - record the details.

Requirements
<b>Tools/Instruments</b> <ul style="list-style-type: none"><li>• Drone upto 18KM - 1 No.</li></ul>

## PROCEDURE

## **TASK 1 : Create Geographic Map.**

- |                                                              |                                         |
|--------------------------------------------------------------|-----------------------------------------|
| 1 Trainee go to the field with drone and mapping software    | 5 Create a Flight Path                  |
| 2 Switch ON your drone and connect with the mapping software | 6 Fly and Capture Data                  |
| 3 Plan Your Mission                                          | 7 Upload and Process Data               |
| 4 Select the field for mapping purpose                       | 8 Get Your Maps                         |
|                                                              | Trainee note down below mention details |

**TABLE 1**

	Map	Details
UAV location		
UAV trajectory		
camera view polygon		
waypoints		
flight plan		

**Collect and explore Flight data, Sensor data, Flight planning data, Airspace and weather data.**

**Objectives:** At the end of this exercise you shall be able to

- prepare the Flight data, Sensor data, Flight planning data, Airspace and weather data
- record the data.

**Requirements****Tools/Instruments**

- Handheld weather meter - 1 No.
- Mini Weather station with sensors - 1 No.

**PROCEDURE****TASK 1 : Measure the data.**

- 1 Take trainee to drone flying field.
- 2 Instructor give weather meter and other sensors.
- 3 Trainee operate the meter and sensors.
- 4 Note down the data.

**TABLE 2**

Flight data.		
Sensor data.		
Flight planning data.		
Airspace.		
weather data.		

-----

**Platform Analytics: including performance figures on orders, missions, inspections, flights, pilots, and data.**

**Objectives:** At the end of this exercise you shall be able to

- determine performance.
- create data .

**PROCEDURE**

**TASK 1 : Analysis the performance.**

Orders		
Missions		
Inspections		
Flights		
Pilots		
Data		

-----

**Data Mapping and Navigation: with a graphical user interface to navigate across 2D/3D models, visualize on maps, and click through images.**

**Objectives:** At the end of this exercise you shall be able to

- perform the Data Mapping and Navigation
- visualize on maps
- navigate 2D/3D models.

**PROCEDURE****TASK 1 : Perform the Data Mapping and Navigation.**

- |                                     |                                                           |
|-------------------------------------|-----------------------------------------------------------|
| 1 Take image                        | 4 Navigate 2D/3D model                                    |
| 2 Create A detailed and precise map | Show the data mapping and navigation result to instructor |
| 3 Visualize the map                 |                                                           |

**Data Mapping and Navigation**

-----

**Learn all three inspection procedures.**

**Objectives:** At the end of this exercise you shall be able to

**PROCEDURE****TASK 1 : Practice the process of three inspection.**

- 1 Perform the inspection.
- 2 Record your observations in Table 1.
- 3 Listen the instruction provided by the instructor.

**Pre-Production****In-Line****Final**

-----

**Prepare the checklist immediately before piloting a RPA to ensure best practice for mission success.**

## PROCEDURE

**TASK 1: Make checklist for prepare for a successful operation.**

Trainee see table and prepare the checklist and show to instructor

**TABLE 1**

S.No.	
1	Functioning Drone <input type="checkbox"/>
2	Charged Remote Controller <input type="checkbox"/>
3	Charged Mobile Device <input type="checkbox"/>
4	Up to Date Firmware <input type="checkbox"/>
5	Batteries Charging <input type="checkbox"/>
6	SD Card with Adequate Space for your Images <input type="checkbox"/>
7	USB Cable for Your Mobile Phone or Tablet <input type="checkbox"/>
8	Enough Propellers for Your Drone <input type="checkbox"/>
9	Understanding of Your Field Connectivity <input type="checkbox"/>
10	Weather condition <input type="checkbox"/>
11	Cleared Airspace for Your Flight <input type="checkbox"/>

-----

**Perform assembly of landing gears, propellers, antennas and electronics.**

**Objectives:** At the end of this exercise you shall be able to

- connection of the components of drone parts
- attach the propeller at the motor

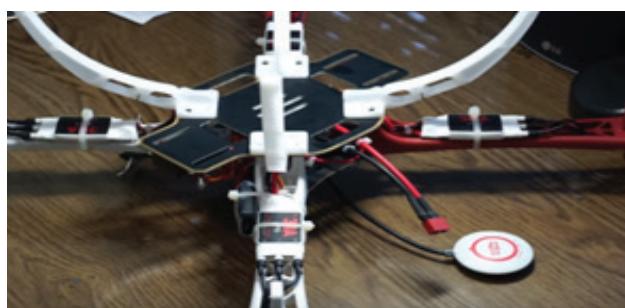
**Requirements****Tools/Instruments**

- |                 |         |
|-----------------|---------|
| • landing gears | - 1 Nos |
| • propellers    | - 1 Nos |
| • antennas      | - 1 Nos |
| • electronics   | - 1 Nos |

**PROCEDURE****TASK 1: Assemble the landing gears, propellers, antennas and electronics**

- 1 Take the landing gear attach them at the bottom of drone,
- 2 Screws tightly with Allen key.

Fig 1



3 Now attach the propellers to the motors.

4 Attach Clock-wise propellers with Clock-wise motors and counterclockwise propellers with counterclockwise motors.

Fig 2



5 Take the antenna and connect with the help of servo wires to the flight controller.

Fig 3



Fig 4



6 Connect the electronics to the flight controller by using servo wire cables.

Fig 5



## Drone Pilot (Junior) - Perform preflight inspection and assembling of basic RPA.

**Remotely-piloted aircraft system (RPAS) controls, know your remote control, safety precautions, pre-flight checks, arming and disarming.**

**Objectives:** At the end of this exercise you shall be able to

- determine the remote control
- perform safety precautions

### Requirements

#### Tools/Instruments

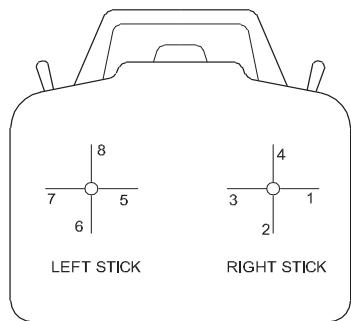
- Transmitter - 1 No.

### PROCEDURE

#### TASK 1 : Remotely-piloted aircraft system (RPAS) controls, know your remote control.

Drones are normally flying with a transmitter or a remote controller. The remote controller consists joysticks and buttons that assist various functions (Mode 2)

Fig 1



RPA0164BH1

**Note: Write command and control in box**

#### RIGHT STICK: Roll & Pitch

The right stick consists roll (side to side) and pitches (forward and backward) movements of the drone.

#### Roll Control

The right stick moves left and right makes the drone roll left and right sides respectively around longitudinal axis without changing the drone's altitude or position.

#### Pitch

The right stick moves up and down makes the drone pitch forward and backward sides respectively about a lateral axis.

**Write command and control in box**

#### LEFT STICK: Yaw & Throttle

The left stick consists the yaw (rotation) and throttle (altitude) movements of the drone.

#### Yaw

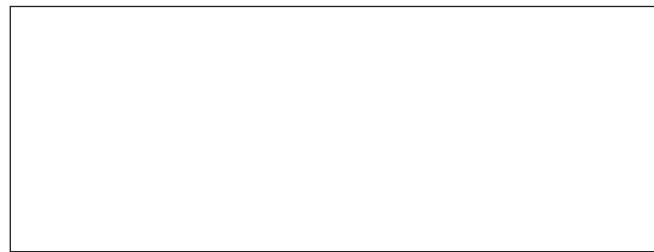
The left stick moves left and right makes the drone rotation clockwise or counter-clockwise respectively. This changes the drone nose into other directions without changes the drone current location.

**Write command and control in box**

**Write command and control in box**

## Throttle

The left stick moves up and down makes the drone changes its altitude.



Write command and control in box

## TASK 2 : Drone safety essentials.

- Do not fly above 400 feet.
- Never allow your drone to fly outside visual sightlines.
- Do not fly over groups of people, stadiums or within five miles of an airport.
- Never fly near emergency response sites.
- Do not fly near other aircraft.
- Never fly under the influence.

## TASK 3 : Pre-flight checks.

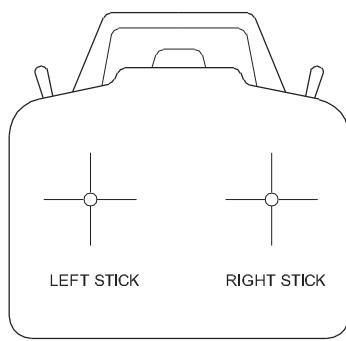
- 1 Check the flying conditions and the itinerary.
- 2 Secure the necessary documentation before drone operation.
- 3 Know and comply with specific drone operation laws in your area.
- 4 Ensure if the drone is fit for flight.
- 5 Always update your drone's firmware.

## TASK 4: Arming.

### Arming (Fig 2)

The drone will take-off and hover at an altitude of ten feet, to take off manually, move the left stick and right stick towards at the corner. Release both stick to its centre location as you get the wanted altitude, and the drone will hover there.

Fig 1

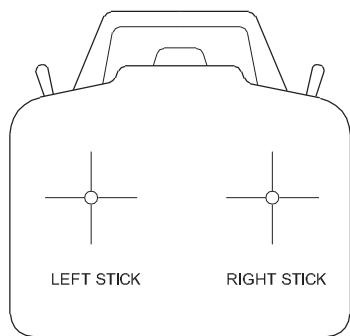


RP20N1648J1

### Disarming (Fig 3)

Disarming is process to land drone and stop the running motors. Pull the throttle all the way down and hold for 5 seconds to turn the propeller motors off.

Fig 2



RP20N1648J2

**Method of RPA inspection charging the battery Cleaning the RPA Storage Maintenance resources and standards.**

**Objectives:** At the end of this exercise you shall be able to

- inspect the drone
- charge the battery

**Requirements****Tools/Instruments**

- Battery - 1 No.

**PROCEDURE****TASK 1: Method of RPA inspection.**

- 1 Do a visual check of the drone and the controller to make sure there is no body damage or corrosion of parts.
  - 2 Get your batteries out of their storage bag, and check for any signs of corrosion or that tell-tale swelling that would indicate a bad battery.
  - 3 Charge up the batteries to a full charge.
  - 4 Do any firmware updates that may have come out while your drone was in storage.
  - 5 Run a test flight beforehand, to make sure everything is running smoothly.
- 

**TASK 2 : Charging the battery.****Ref Ex No: 28****TASK 3 : Cleaning the RPA Storage Maintenance resources and standards.**

- 1 Make group of 3-4 trainee
  - 2 Take them in store room
  - 3 Give task to clean the RPA Storage
  - 4 Maintain all the resources
  - 5 Check whether everything is clean
-

**Perform assembly of Gimble, camera and base station hardware and software setup.**

**Objectives:** At the end of this exercise you shall be able to

**Requirements****Tools/Instruments**

- |          |         |
|----------|---------|
| • Camera | - 1 No. |
| • Gimble | - 1 No. |

**PROCEDURE****TASK 1 : Assembly of Gimble and camera.**

- 1 The all the essential parts to assemble gimble Parts.
- 2 Build the Camera Cage.
- 3 Assemble the Outside Frame.
- 4 Install Pitch Motor and Bearings.
- 5 Install Yaw Motor.
- 6 Build Mounting Arm.
- 7 Solder the Motor Wires.
- 8 Connect Everything for Testing.
- 9 Mounting the Gimble.

- 10 Test whether it's working fine or not.

**Perform Software Setup****Building and download the firmware:**

- 1 Install the programming software.
- 2 Load the gimbal software in the programming environment.
- 3 Ensure your configuration is correct.
- 4 Upload the program.
- 5 Show to the instructor.

-----

**Identify Basic operating features of a RPA flight simulator.**

**Objectives:** At the end of this exercise you shall be able to

- know the basic operating features of a drone flight simulator
- illustrate the various features of a drone flight simulator.

**Requirements****Tools/Instruments**

- Real flight Simulator - 1 No.

**PROCEDURE****TASK 1 : Check Basic operating features of a drone flight simulator.**

- 1 Open Flight Simulator and check this features      2 Mark tick in below features list if available.  
availability

**TABLE 1**

S.No.	
1	Accurate flight model of drone <input type="checkbox"/>
2	Drone and pilot views <input type="checkbox"/>
3	Realistic scenarios <input type="checkbox"/>
4	Warnings for loss of VLOS and altitude restrictions <input type="checkbox"/>
5	Realistic lighting conditions <input type="checkbox"/>
6	Windows and Mac compatible <input type="checkbox"/>
7	High-end 3D graphics engine <input type="checkbox"/>
8	Real geological features and terrain. <input type="checkbox"/>
9	Able to run on older PCs due to basic level graphics, etc. <input type="checkbox"/>
10	Offers line-of-sight and FPV flight modes. <input type="checkbox"/>
11	Supports both acro mode and angle mode. <input type="checkbox"/>
12	Six pre-designed tracks or option to build your own. <input type="checkbox"/>
13	Customizable control responsiveness, drone weight, and camera speed. <input type="checkbox"/>
14	Drone flight simulator designed specifically for Multi-drone <input type="checkbox"/>
15	Good physics with a high degree of customizability for a life-like flight experience. <input type="checkbox"/>
16	A lot of present quad options, with the freedom to adjust parameters to replicate your own quad. <input type="checkbox"/>
17	Present tracks compel you to fly in and around obstacles. <input type="checkbox"/>
18	Customizable tracks give innumerable options of places and courses to fly. <input type="checkbox"/>
19	Multiplayer mode for fly <input type="checkbox"/>

-----

## Select different aircrafts/RPAS and aerodromes.

**Objectives:** At the end of this exercise you shall be able to

- visualise the drone
- select the proper aircrafts/drones.

## PROCEDURE

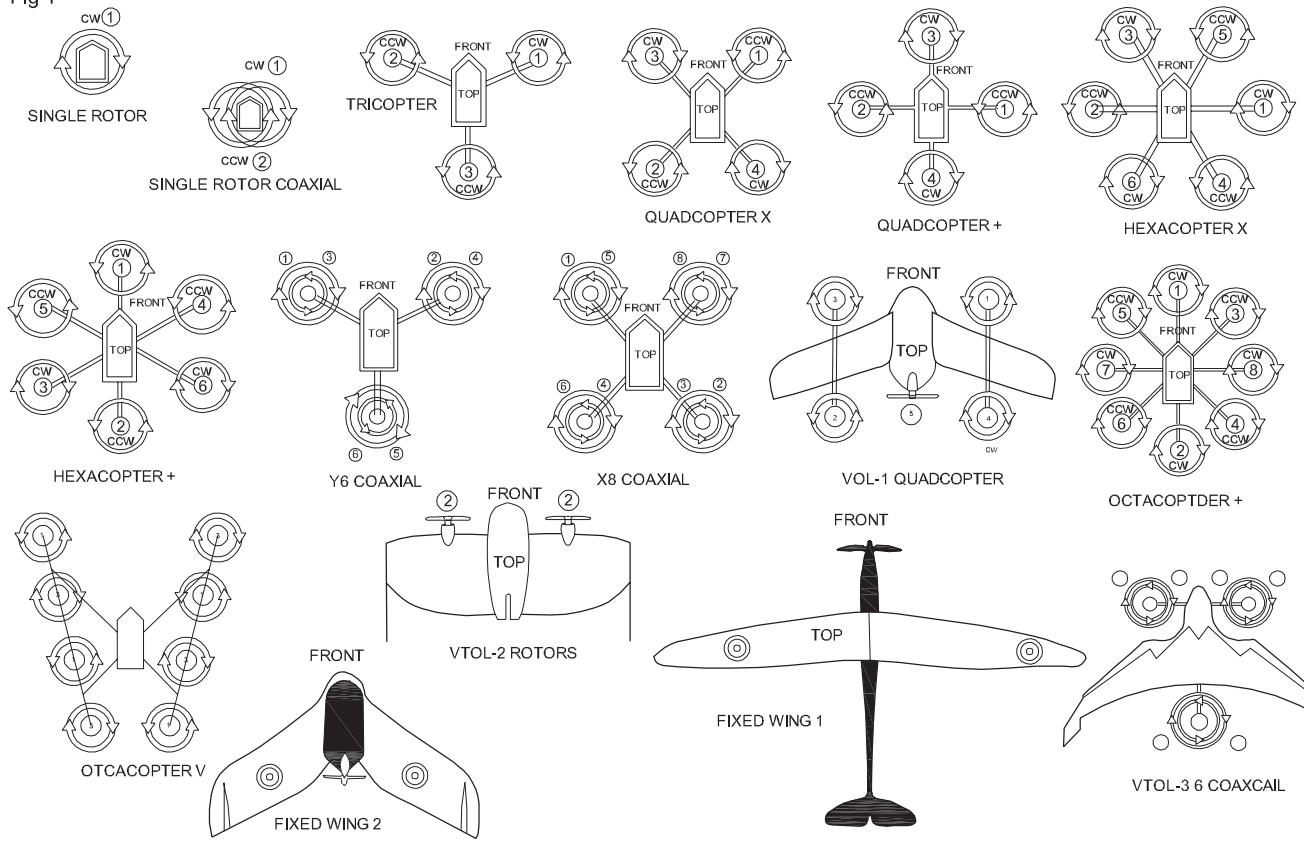
### TASK 1 : Select the different aircrafts/drones.

- 1 See properly different aircrafts/drones from Fig 1.
- 2 Identify and select basic components
- 3 Write the Specification and quantity of each selected components.

4 Fill up and get it checked by your instructor.

**Instructor explain about different aircrafts/drones**

Fig 1



RP201752H1

TABLE 1

S.No.	Name of aircrafts/drones	Specification

**Carry out Demo flight in RPA Flight Simulator with Pre-flight checks, start-up, Take-off RPA and carry out flight stage.**

**Objectives:** At the end of this exercise you shall be able to

- practice RPA Flight Simulator
- carry out all flight stage.

**Requirements****Tools/Instruments**

- Flight Simulator - 1 No

**PROCEDURE****TASK 1: Demo flight in RPA Flight Simulator.**

- 1 Instructor should connect remote with flight simulator and give flight demo
  - 2 Explain the Pre-flight checks, start-up, Take-off RPA and carry out flight stage.
-

**Do Approach and safe landing, perform post flight checks and identify emergency, Loss of link, Loss of power, Control surface failures etc.**

**Objectives:** At the end of this exercise you shall be able to

- perform Safe Landing
- check Post Flight
- identify the Emergency.

**PROCEDURE****TASK 1: Do Approach and safe landing perform POST-FLIGHT.**

- 1 Land or hand catch the Drone and power it off.
  - 2 Power off the transmitter box.
  - 3 quick check for damage, dirt and dead flies.
  - 4 Remove the propellers
  - 5 Remove the battery and check it for damage/ swelling.
  - 6 Remove the phone/tablet from the holder and store it and the transmitter box.
  - 7 Pack the Drone and battery.
  - 8 Make sure you haven't left anything behind before going from flying field.
- 

**TASK 2 : Identify emergency, Loss of link, Loss of power, Control surface failures etc.**

- 1 Fly drone and check the emergency.
- 2 Trainee note down detail in table.

**TABLE 1**

S.No.	Emergency	Cause
1		
2		
3		
4		

-----

**Perform Practical flying with and without instructor in RPA simulator.**

**Objectives:** At the end of this exercise you shall be able to

- demonstrate RPA simulator
  - practice in RPA simulator.

## Requirements

## Tools/Instruments

- Flight Simulator - 1 No

## PROCEDURE

## **TASK 1: Practical flying in RPA simulator.**

- 1 Instructor should connect the remote to the flight simulator and explain the flight.  
2 Give the trainee the task of flying in the flight simulator.

— — — — —

## Fly RPA in Simulator.

**Objectives:** At the end of this exercise you shall be able to

- practice in RPA simulator.

### Requirements

### Tools/Instruments

- Flight Simulator - 1 No

## PROCEDURE

### TASK 1 : Practice flying RPA in Simulator

- 1 Trainee connect the simulator
- 2 Practice flying in simulator

-----

**Carry out entire flying operations from pre-flight checks to after flight checks while flying RPA with instructor and solo flying RPA.**

**Objectives:** At the end of this exercise you shall be able to

- carryout preflight and after flight check.

**PROCEDURE****TASK 1 : Perform pre-flight checks.****PRE-FLIGHT**

- 1 Make sure the area you are going to fly in is safe and clean
- 2 Carefully unpack the Drone and the transmitter box, tablet, batteries and propellers onto a clean surface.
- 3 Put the battery into the Drone making sure it is seated correctly.
- 4 Attach a set of propellers to each motor.
- 5 Place the Drone on clean level ground.
- 6 Power on the transmitter box and then the Drone.
- 7 Open the drone App on your tablet /phone and verify you can see a live feed from the Drone.
- 8 Turn the volume and the brightness to full on your tablet.
- 9 Calibrate the compass.
- 10 Put the drone in P mode which is best to fly.

- 11 Move about 10 feet away from the drone.
- 12 Make sure a valid "Home Point" has been recorded.
- 13 Slowly increase the throttle and lift the Drone about 15 feet off the ground.

**After Flight Checks**

- 1 Land or hand catch the Drone and power it off.
- 2 Power off the transmitter box.
- 3 Quick check for damage, dirt and dead flies.
- 4 Remove the propellers
- 5 Remove the battery and check it for damage/swelling.
- 6 Remove the phone/tablet from the holder and store it and the transmitter box.
- 7 Pack the Drone and battery.
- 8 Make sure you haven't left anything behind before going from flying field.

-----

## Demonstrate Handling in flight emergencies, fail safe mechanisms.

**Objectives:** At the end of this exercise you shall be able to

- handling In flight emergencies
- perform fail safe mechanisms.

### PROCEDURE

#### TASK 1: Demonstrate Handling In flight emergencies.

- |                                                                                           |                                                                                          |
|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 1 ACTION IF DRONE CATCHES FIRE                                                            | Switched to "A" or ATTI mode to disable GPS                                              |
| EXECUTE Flight termination procedures                                                     | Pilot the UA to a safe landing area aircraft                                             |
| ATTEMPT to extinguish the fire                                                            | Perform a manual landing and shut down                                                   |
| ONCE EXTINGUISHED                                                                         |                                                                                          |
| USE non-alcoholic liquid to continue to cool                                              |                                                                                          |
| IF UNABLE TO EXTINGUISHED                                                                 | 4 ACTION IF DRONE BATTERY INDICATES LOW                                                  |
| CALL 101                                                                                  | Maintain visual contact with aircraft                                                    |
| 2 ACTION IF DRONE FLY AWAY                                                                | IMMEDIATELY return drone to you for landing                                              |
| MAINTAIN Visual Contact with Aircraft                                                     | IF DIS ORIENTED                                                                          |
| CONTACT ATC via two-way Radio                                                             | USE "HOME LOCK" to bring aircraft back for landing                                       |
| VERIFY Remote controller power is ON                                                      | IF STRONG WINDS PREVENT RETURN FLIGHT                                                    |
| Check GPS activate or not                                                                 | USE camera to locate suitable divert location                                            |
| IF UNABLE TO RE-ESTABLISH LINK                                                            | LAND drone                                                                               |
| CONTINUE to maintain Visual of aircraft                                                   |                                                                                          |
| UPDATE ATC with the drone position                                                        |                                                                                          |
| 3 ACTION IF DRONE LOSS OF GPS                                                             | 5 ACTION IF THERE IS A COLLISION IMMEDIATELY                                             |
| If GPS signal is lost in flight "RTH band intelligent flight mode will not be functional" | Release all control sticks                                                               |
| IF UA IS FLYING ERRATICALLY BUT STILL LINKED                                              | IF AIRCRAFT REGAIN STABILITY AND HOVERS:                                                 |
|                                                                                           | MANEUVER drone away from object                                                          |
|                                                                                           | RETURN for a safe landing and drone inspection                                           |
|                                                                                           | IF DRONE DOES NOT REGAIN STABILITY                                                       |
|                                                                                           | INITIATE manual motor shutdown to reduce speed of impact and protect people and property |

#### TASK 2 : Practice Fail Safe.

- 1 Place you drone on a stand if possible. If it's too large for a stand immobilize it by some other means such as tying a rope between the tail wheel and a post in the ground.
- 2 Turn on transmitter.
- 3 Verify control inputs are working and do ranges check.
- 4 Arm the motor.
- 5 Run up the motor to full throttle.
- 6 Give command pitch and roll.
- 7 Turn off the transmitter.
- 8 Verify the control surfaces and throttle move to their Fail-Safe positions.
- 9 Turn on the transmitter. Verify normal operation.

Instructor should explain about the importance of Fail Safe

**Carry out First-person-view (FPV) flying.**

**Objectives:** At the end of this exercise you shall be able to

- practice First-person-view (FPV) flying.

**PROCEDURE****TASK 1 : Carry out First-person-view (FPV) flying.****Instructor explain about FPV diagram**

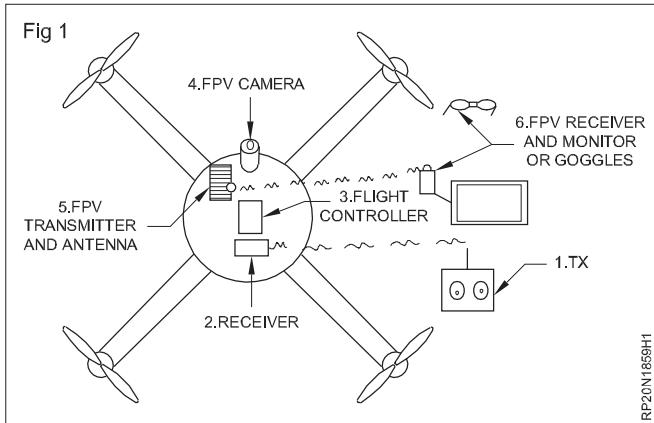
1 Instructor takes trainee on field with FPV drone.

**Need a 'visual observer' to ensure safety.**

2 Check all pre-flight procedure

3 Take an FPV goggle with an FOV of at least 35%, adjustable all resolution, glass optics and digital head tracking.

4 Fly FPV drone and practice.

**Instructor should explain about Safety Warnings Relating to FPV Flight.**

**RPA Understand the requirement of flying RPA in a controlled environment.**

---

**Objectives:** At the end of this exercise you shall be able to

- check the requirement of flying RPA in a controlled environment.
- 

**PROCEDURE****TASK 1 : Perform the condition for flying RPA.**

- 1 Drone in controlled airspace need clearance first from air traffic control.
  - 2 Request this authorization through the website or app.
  - 3 Need authorization from air traffic control, fly your drone using a shielded operation.
  - 4 The map can help for understand if there are any airspace restrictions where you want to fly.
-

**RPAS controls, safety precautions, pre-flight checks, takeoff, learn basic flight modes such as manual, stabilize, alt hold and land.**

---

**Objectives:** At the end of this exercise you shall be able to

- operate drone in different flight modes.
- 

### **PROCEDURE**

**TASK 1: RPAS controls, safety precautions, pre-flight checks**

**Ref Ex No 48**

-----

**TASK 2 : Learn basic flight modes such as manual, stabilize, alt hold and land**

Write about the flight mode

**Stabilized**

**Manual**

**Hold**

**Land**

-----

## Drone Pilot (Junior) - Plan and organize training to fly RPA in controlled environments.

### Practice flying the RPAS in left/right and forward/backward motion, square pattern, circle.

**Objectives:** At the end of this exercise you shall be able to

- practice Drone Pilot
- drone's performance at different speeds.

#### Requirements

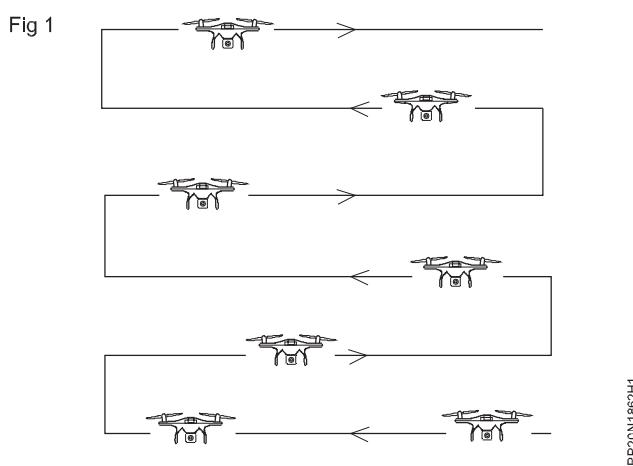
##### Tools/Instruments

- RPA and spare parts kit - 1 No

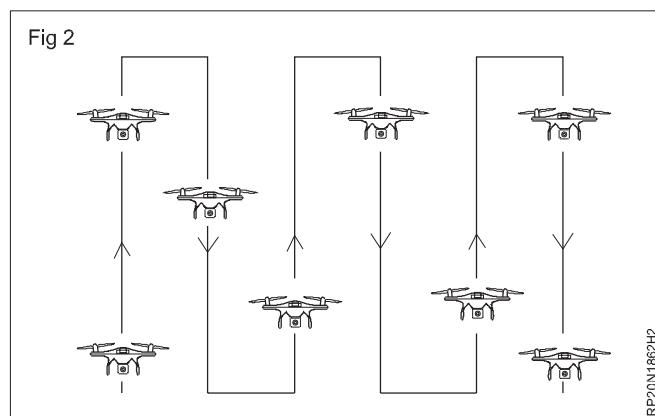
#### PROCEDURE

##### TASK 1: Practice flying the RPAS.

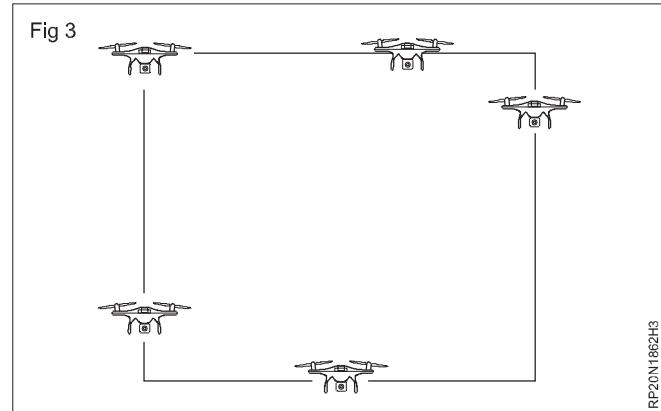
- 1 Draw left/right pattern using the roll control.



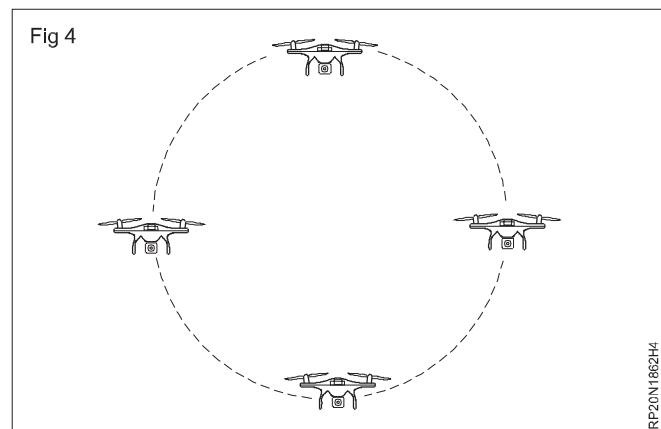
- 2 Draw forward/backward motion pattern using the pitch control



- 3 Draw a square using the pitch and roll controls (right stick)



- 4 Draw a circle using the yaw control (left stick) and pitch control (right stick)



**Practice flight mode such as takeoff, loiter, alt hold.**

**Objectives:** At the end of this exercise you shall be able to

- use different flight modes.

**PROCEDURE****TASK 1 : Practice flight mode.**

Takeoff

Loiter

Alt Hold

-----

**Learn to land in GPS failsafe, radio failsafe and battery failsafe.****Objectives:** At the end of this exercise you shall be able to

- practice to flying in GPS failsafe, radio failsafe and battery failsafe.

**Requirements****Tools/Instruments**

- Gps, Transmter, Battery - 1 No

**PROCEDURE****TASK 1 : Perform land in GPS failsafe.****GPS Failsafe**

- 1 A GPS failsafe apply if GPS 3D lock

- 2 The GPS failsafe response can be set to Land or switch to Alt Hold mode

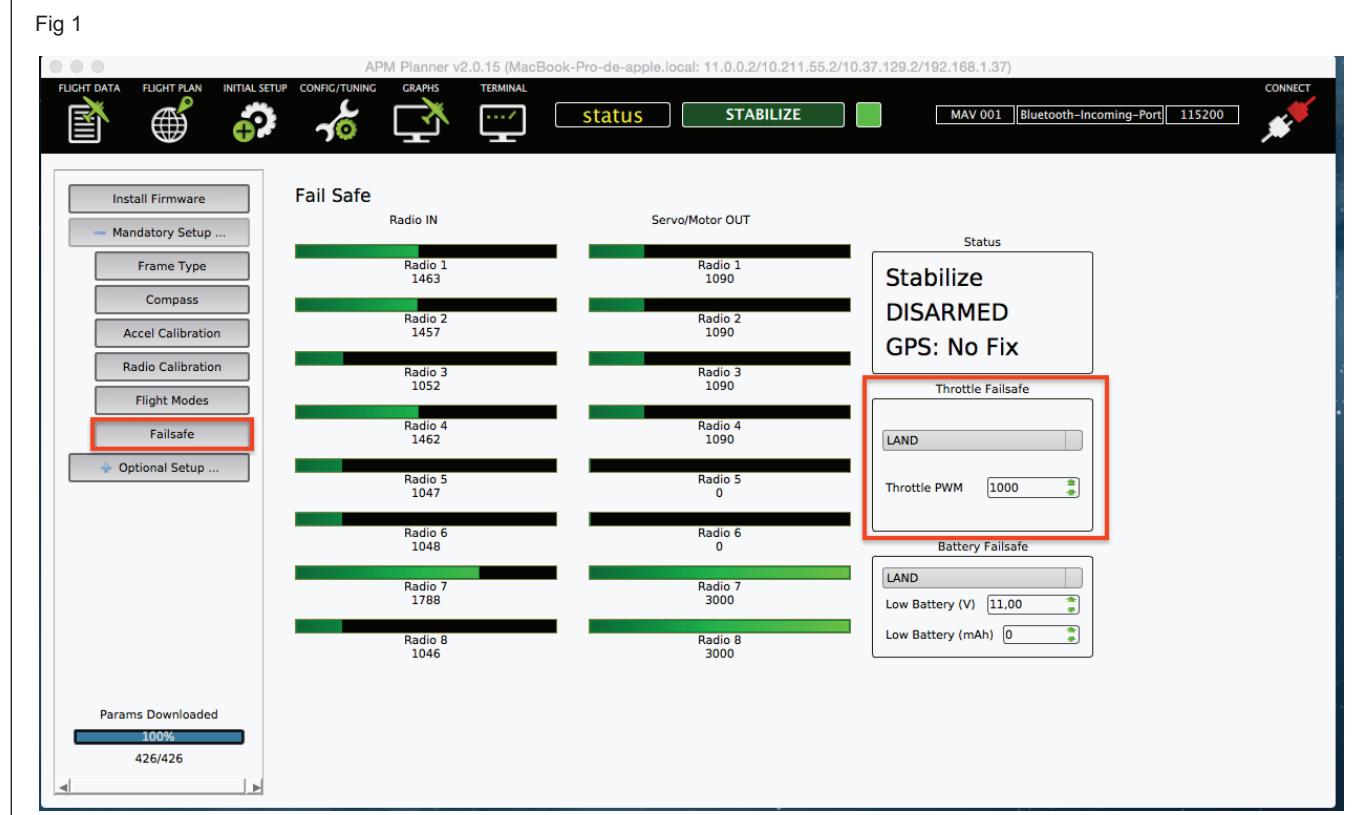
- 3 Retake manual control.

-----

**TASK 2 : Radio Failsafe.**

- 1 Power drone up and connect to the mission planner and select Initial Setup >> Mandatory Hardware >> Failsafe.

- 2 Set the Throttle Failsafe Option to LAND to force the vehicle to Land immediately if it loses RC contact.



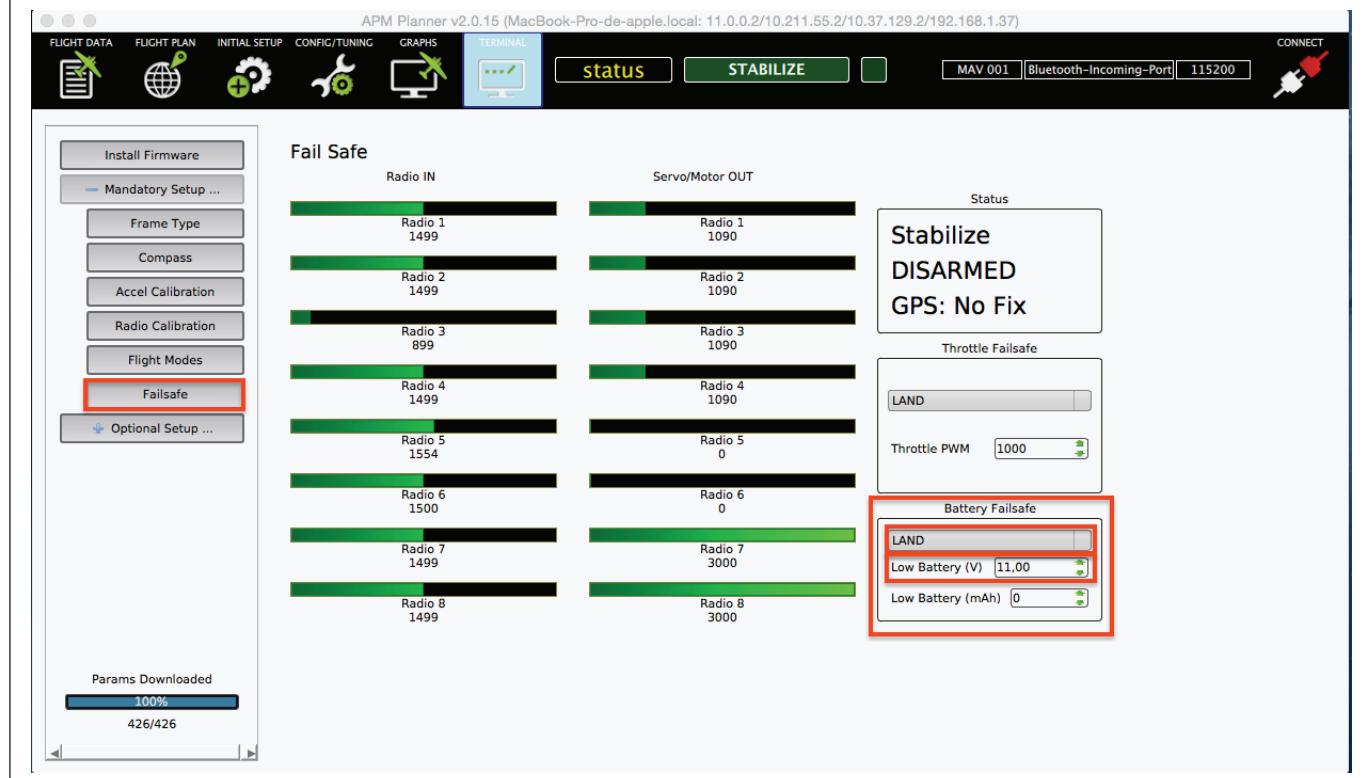
-----

### TASK 3 : Battery Failsafe.

- 1 Power drone up and connect to the mission planner and select Initial Setup >> Mandatory Hardware >> Failsafe.
- 2 In the Battery Failsafe square, select LAND as the flight mode and set the voltage which you would like to trigger the failsafe (10.5~11v recommended for 3 cells battery).

**Note: The use of a voltage sensing Power Module is mandatory**

Fig 2



**Learn to upgrade the autopilot / system firmware and test the machine in a controlled environment.**

---

**Objectives:** At the end of this exercise you shall be able to

- develop autopilot
  - operating the machine in a controlled environment.

## Requirements

## Material

- FCB, Laptop - 1 No

## PROCEDURE

**TASK 1 : Updates to the autopilot firmware include.**

- 1 Connect the necessary electronics cables.
  - 2 Open Autopilot.
  - 3 Go to the setting.
  - 4 Select update option.
  - 5 Connect the necessary electronics cables.

#### **TASK 2 : Test the machine in a controlled environment.**

- 1 Go to the controlled environment
  - 2 Switch “ON” machine
  - 3 Perform the test

**Explore camera options, resolution and perform operation to full camera controls Pan/Tilt & Zoom In/Out.****Objectives:** At the end of this exercise you shall be able to

- operate camera options.

<b>Requirements</b>	
<b>Tools/Instruments</b>	<b>Materials</b>
• HD Payload	- 1 No
	• HD Camera
	- 1 No

**PROCEDURE****TASK 1: Run camera option.**

- 1 Instructor explain about camera options
- 2 Listen attentively to the Trainee Instructor.
- 3 Take camera and explore all the options in setting.
- 4 Check resolution setting.
- 5 Check zoom in /out.

**Instructor provide camera with 1280X720, 5X Optical Zoom Video Resolution**

-----

**Plan & estimate payload considerations, camera options, resolution etc. & other pay load possibilities.****Objectives:** At the end of this exercise you shall be able to

- conduct payload considerations
- calculate payload.

**Requirements****Material**

- Drone camera - 1 No

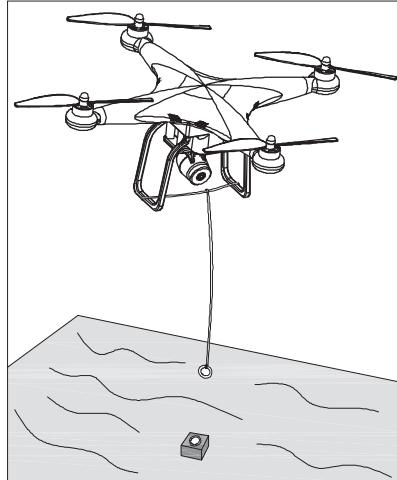
**PROCEDURE****TASK 1 : Execute payload considerations****Instructor divide Trainee into groups of three or four.**

- 1 Trainee perform tests to estimate the maximum mass of payload a drone can carry, both during take-off and while cruise.
- 2 Trainee take a drone and attached a rope at the bottom of the drone for fixing different weight (payload) as shown in Fig 1.
3. Determine how much weight the drone carry and how weight affects performance of drone note it down in table 1 and analyse data.

**Avoid wind**

- 4 Trainee will compare data from flights using different methods of carrying gradually increase the payloads.

Fig 1



RP20N1867H1

**TABLE 1**

	Drone only	Drone + Payload 1	Drone + Payload 2
<b>Payload Mass</b>			
<b>Total Mass</b>			
<b>Ability to Take Off</b>			

-----

**Identify different payloads including cameras like Lidar, Thermal, RGB, Hyper spectral etc .****Objectives:** At the end of this exercise you shall be able to

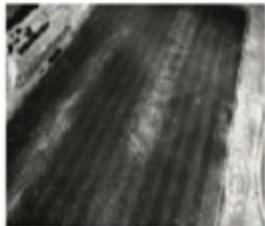
- check Different Payloads.

**PROCEDURE****TASK 1: Identify different payloads including cameras.**

- 1 Visuals the diagram.
- 2 Identify different payload.
- 3 Write the name in table 1.

Instructor may brief about the various cameras like Lidar, Thermal, RGB, Hyperspectral.

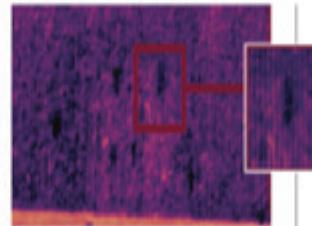
Fig 1



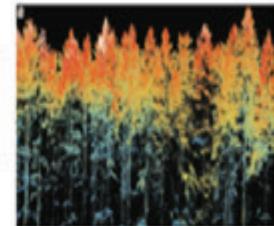
THERMAL CAMERAS



MULTISPECTRAL IMAGING



HYPERSPECTRAL IMAGING



LiDAR

**TABLE 1**

S.No.	Different Payloads	Specification

-----

**Apply knowledge of VLOS (visual line of sight) and BVLOS (Beyond Visual Line of Sight) and identify safety practices for BVLOS and VLOS.**

**Objectives:** At the end of this exercise you shall be able to

- determine BVLOS and VLOS
- perform safety for BVLOS and VLOS.

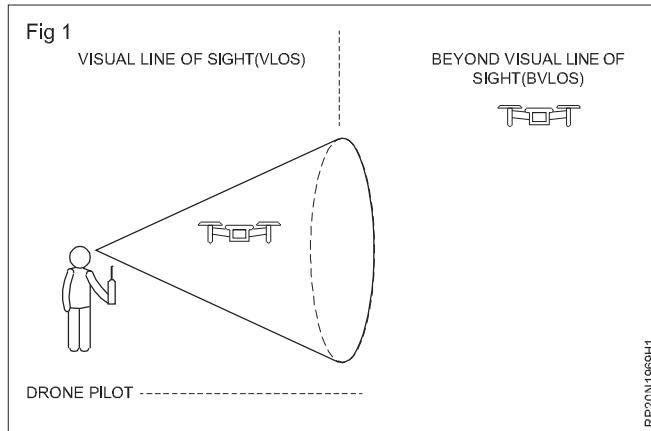
**PROCEDURE****TASK 1: VLOS (visual line of sight) and BVLOS (Beyond Visual Line Of Sight).****VLOS (Visual Line of Sight)**

Line-of-sight operations (VLOS) are a type of UAS operation in which a remote pilot maintains continuous unassisted line-of-sight contact with an unmanned aerial vehicle. (The aircraft should always be visible to the pilot with the naked eye)

A remote pilot that controls the trajectory of an unmanned aerial vehicle in relation to other aircraft, people, and obstacles to avoid collisions. The aircraft must not fly behind trees, buildings or other obstacles.

**BVLOS(Beyond Visual Line of Sight)**

BVLOS (sometimes called BLOS) stands for Beyond Visual Line of Sight Operations. This is when the drone flies without the pilot having a line of sight to the aircraft at all times. Instead, the pilot remotely operates his UAV using his Pilot Station (RPS)/Ground Control Station (GCS) instruments.



Use See and Avoid or Detect and Avoid (DAA) to avoid terrain, obstacles, or other aircraft.

**TASK 2 : Safety practices for BVLOS and VLOS.****Safety practices for BVLOS**

- 1 Use the Right Assistive and Detection Technology
- 2 Follow BVLOS Safety Protocol
- 3 BVLOS Drone Operator Training

**Safety practices for VLOS****The drone must be flown:**

- 1 Under direct visual line of sight (VLOS): 500m.
- 2 At an altitude not exceeding 150 m above the ground or water.
- 3 Outside of specified reserved areas (airport, environmental, security).

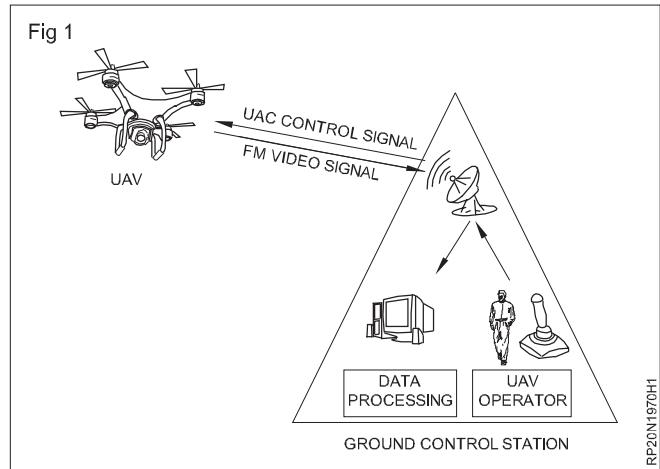
**Perform Secure Communication link between UAV and GCS.**

**Objectives:** At the end of this exercise you shall be able to

- connect UAV and GCS.

**PROCEDURE****TASK 1 : Make a connection between the UAV and the GCS**

- 1 Take the drone and switch it “ON”
- 2 Take the GCS and power it “ON”
- 3 Build a bond between them
- 4 Make sure both connect with the desired frequency
- 5 Test it



**Identify & select other payload possibilities.**

**Objectives:** At the end of this exercise you shall be able to

- measure the payload .

**Requirements****Tools/Instrument/Materials**

- Drone - 1 Nos

**PROCEDURE****TASK 1 : Payload calculation.**

Formula to calculate Payload.

$$\text{Payload} = \text{AUW} - \text{Drone Weight.}$$

Use the formula and calculate other payload possibility which drone can carry.

Fill the table and show it to the instructor.

**TABLE 1**

S.No.	AUW	Drone Weight	Payload
1			
2			
3			
4			

-----

**Identify different payloads including cameras like Lidar, Thermal, RGB, Hyper spectral etc.**

---

**Objectives:** At the end of this exercise you shall be able to

- check Different Payloads .
- 

Ref to Ex No 1.8.68

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**Perform autonomous waypoint navigation (pre-defined as well as dynamically adjustable waypoints during flight).**

---

**Objectives:** At the end of this exercise you shall be able to

- perform Autonomous Waypoint Navigation.
- 

**PROCEDURE****TASK 1 : Change waypoints during flight.**

- 1 Train Flying Drones and Set Up a Waypoint.
  - 2 Change Waypoints While Flying the Drone.
  - 3 Practice Adjusting Waypoints While Operating the Drone.
-

**Remotely Piloted mode for video-based navigation (RPV Mode).**

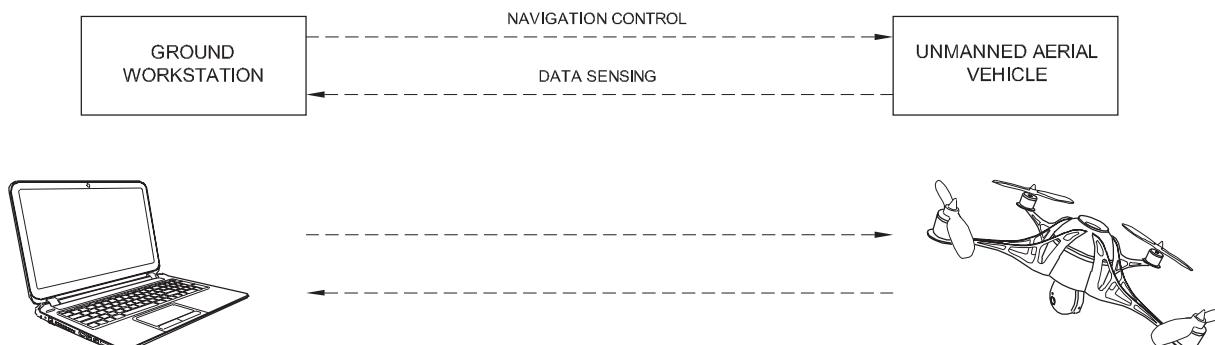
**Objectives:** At the end of this exercise you shall be able to

- practice RPV Mode.

**PROCEDURE****TASK 1 : Drive drone with RPV Mode.**

- 1 On-board camera that allows them to collect visual information about the environment.
- 2 A vision-based mathematical model was defined that describes the movement.
- 3 Compare a visual-based model compare with other methods.

Fig 1



RP20N1974/H1

**Learn Geographic Map along with UAV location, UAV trajectory, camera view polygon, waypoints and flight plan.**

**Objectives:** At the end of this exercise you shall be able to

- make Geographic Map
- record the details.

**Ref Ex No 41**

-----

**Fly RPA for application specific including Surveillance, Agriculture and Inspection.**

---

**Objectives:** At the end of this exercise you shall be able to

- practice for RPA with different applications.
- 

**PROCEDURE****TASK 1 : Select different application drone and fly**

Fly drone with different applications:

- 1 Surveillance.
  - 2 Agriculture.
  - 3 Inspection.
-

**Identify emergency and handle it accordingly.**

**Objectives:** At the end of this exercise you shall be able to

- dealing with flight emergencies
- execute a fail-safe mechanism.

**PROCEDURE**

**TASK 1 : Demonstrate Handling Inflight emergencies.**

**TABLE 1**

Emergency situations	Action
Action if drone catches fire	
Once extinguished	
If unable to extinguished	
Action if drone fly away	
Action if drone loss of gps	
Action if drone battery indicates low	
Action if there is a collision immediately	

-----

**Learn instrument flying rules using manual/ semi-autonomous flight modes.**

**Objectives:** At the end of this exercise you shall be able to

- manual/ Semi - Autonomous flight mode access.

**PROCEDURE****TASK 1 : Instrument Flying Rules Using Manual.**

Instructors take IFR manual and explain to the trainee

-----

**Identify emergencies like Aircraft structural failure, loss of power – battery, motor, Loss of GPS and loss of lights at night.**

**Objectives:** At the end of this exercise you shall be able to

- control the drone at night
- perform an emergency at night.

## PROCEDURE

### TASK 1 : Inspect the emergencies.

- 1 Find out the emergencies.
- 2 Enter your action by origin and write it in the table.
- 3 Fix it by instructor.

**TABLE 1**

Emergencies	Action
Aircraft structural failure	
Loss of power – battery	
Motor	
Loss of GPS	
Loss of lights in Night	

-----

**Maintain Visual Line of Sight (VLOS) with the aircraft for as long as possible.**

**Objectives:** At the end of this exercise you shall be able to

- able to do Visual Line of Sight.

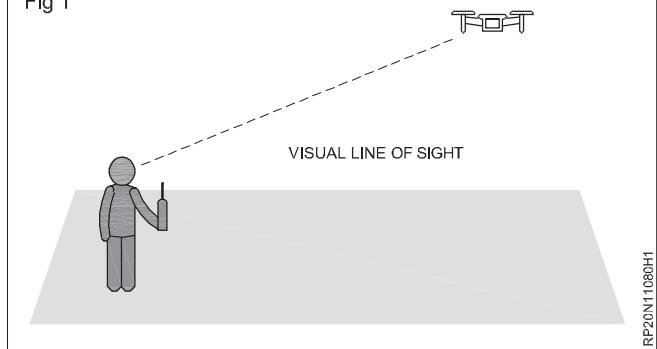
**Requirements****Tools/Instruments**

- Drone - 1 No

**PROCEDURE****TASK 1 : Maintain Visual Line of Sight.**

- 1 Operate Drone in field.
- 2 Take drone away at some distance.
- 3 Maintain VLOS.

Fig 1



**Learn where to fly and how to fly legally and how you fly it in uncontrolled airspace.**

**Objectives:** At the end of this exercise you shall be able to

- identify flying area
- legally flying
- fly in uncontrolled airspace.

**Requirements****Tools/Instruments**

- Drone - 1 No

**PROCEDURE****TASK 1 : Where to fly and how to fly legally.**

- 1 Read the airspace Map for Drones.
- 2 View the airspace marked in the green, yellow and red areas on the map.
- 3 Note the permitted range of flying drones in the table.

**TABLE 1**

Airspace Zone	Vertical Distance	Lateral Distance
Green Zone		
Yellow Zone		
Red Zone		

- 4 According to the airspace map, select the area to be legally flown into.
- 5 Fly your drone in uncontrolled airspace below 400 feet above the ground (AGL).

-----