AC 101-3-1(2)
20 October 2022

Civil Aviation Authority of Singapore

Advisory Circular

APPROVALS FOR UNMANNED AIRCRAFT TRAINING

GENERAL

Advisory Circulars (ACs) are issued by the Director-General of Civil Aviation (DGCA) from time to time to provide practical guidance or certainty in respect of the statutory requirements for aviation safety. ACs contain information about standards, practices and procedures acceptable to CAAS. An AC may be used, in accordance with section 11 of the Air Navigation Act 1966 (ANA), to show that compliance with a statutory requirement has been achieved. The revision number of the AC is indicated in parenthesis in the suffix of the AC number.

PURPOSE

This AC provides guidance relating to an organisation seeking approvals to conduct unmanned aircraft (UA) basic training, UA pilot licence training or practical assessments / proficiency checks pursuant to the Air Navigation (101 – Unmanned Aircraft Operations) Regulations 2019 (“ANR-101”).

APPLICABILITY
This AC is applicable to an organisation seeking approval or have been approved to conduct UA basic training, UA pilot licence training or practical assessments / proficiency checks pursuant to ANR-101.

RELATED REGULATIONS
This AC relates specifically to Part 3 of the ANR-101.

RELATED ADVISORY CIRCULARS
Nil.

CANCELLATION
Revision (2) of this supersedes revision (1). In this revision, clarifications are made on the documents to be submitted for a UA basic training application, the requirements for authorisation of authorised flight examiners, the records to be periodically submitted to CAAS for a UA training and assessment organisation, and the recommended study guides for the development of UA pilot licence theory training.

EFFECTIVE DATE
This AC is effective from 20 October 2022.

OTHER REFERENCES
Nil.

1 INTRODUCTION

1.1 Pursuant to the ANR-101, a person must not provide UA basic training (UABT) unless that person holds a UABT approval. A person must also not provide any UA pilot licence (UAPL) training or conduct any practical assessment or proficiency check unless that person holds an Unmanned Aircraft Training and Assessment Organisation (UATO) approval.

1.2 The UABT is mandatory for UA users operating a UA with a total mass exceeding 1.5kg but not exceeding 7kg for recreation or education purpose. UABT provides the UA user with the relevant knowledge to operate their UA safely and responsibly.

1.3 The UAPL is mandatory for UA users operating a UA for non-recreation or non-education purposes or a UA with a total mass exceeding 7kg for all purposes. UAPL ensures that users have the necessary competency to operate the UAs safely.

UA BASIC TRAINING ORGANISATION (UABTO)

2 COMPONENTS OF UA BASIC TRAINING (UABT)

2.1 The UABT should be administered as an online course with a duration of approximately 2 hours, including the quiz. The UABTO should ensure that online UABT include, but not limited to, the following components:

(a) Means to secure user registration and login that is compliant to the Personal Data Protection Act (PDPA) (Refer to **Appendix 1**);

(b) Courseware (Refer to **Appendix 2**);

(c) A randomly generated 20 questions picked from a question bank that consist of at least 50 questions and corresponds with the module referenced in **Appendix 2**, to be administered.

(d) The quiz will only be considered completed when all 20 questions are correctly answered; and

(i) if a user answers a question incorrectly, a different question from the corresponding module in the question bank is generated; and

(ii) all questions from the question bank must be exhausted before recycling the same question.

(e) Means to provide trainees with a Certificate of Completion after successful completion of the quiz. The certificate should include the trainee's full name as per the NRIC (or other equivalent ID such as the passport), course title, date of completion of the UABT, name of UABTO, UABTO's Accountable Manager's signature and reference/serial number.

3 APPLICATION FOR UABT APPROVAL

3.1 An applicant should make an application for a UABT approval through the eSOMS (https://esoms.caas.gov.sg) at least 2 months before the intended date of commencement of the applicant's training operations and accompanied by the relevant application fee. Refer to **Appendix 6**.

3.2 The applicant is required to submit the following information as part of the application:

(a) ACRA BizFile / Certificate of incorporation

(b) CV of Accountable Manager (AM)

(c) A manual including:

(i) Description of organisational structure, including the roles and responsibilities of personnel involved in activities relating to the approval

(ii) Description of the UABT programme such as the training syllabus, modality of quiz, estimated duration for completion, modality of certificate issuance, intended training fee etc.

(iii) Description of the record keeping system such as the list of records to be retained, storage/retrieval/disposal procedures etc.

(iv) Description of the online system implementation such as platform compatibility, user process flow, quiz administration, payment details etc.

(v) Description of the quality of the online system, including a declaration of compliance to IM8 and Personal Data Protection Act

(d) E-learning script detailing the programme outline, on-screen graphics and text, voice over (if any), user interactions etc.

(e) Question bank that consist of a minimum of 50 questions

3.3 The AM is normally the chief executive officer (CEO) who by virtue of position has overall (including financial) responsibility to run the organisation. If the AM is not the CEO, he/she should have the overall responsibility to run the organisation and have direct access to the CEO.

3.4 The AM is responsible to:

(a) ensure that UABTO complies with the regulatory requirements set by CAAS; and

(b) ensure that sufficient funding is available to conduct activities to the approved standard.

4 RECORDS

4.1 The UABTO must maintain the following records for the specified retention period:

Records	**Minimum Retention period**
• Trainee's name, date of birth, contact address, contact number, email address and last 4 alphanumeric characters of the NRIC/FIN/Passport • Date and time of which trainee completed the training • Reference/serial number of the certificate issued	Five years after the trainee has completed the UABT

4.2 The UABTO should ensure that:

(a) the integrity of records is maintained;

(b) the records are not deleted or altered; and

(c) there is a backup system of the records to provide continuity.

4.3 The UABTO should provide CAAS with records minimally on a monthly basis or when required by CAAS.

5 VALIDITY OF UABT APPROVAL

5.1 The UABT approval will be valid for up to 1 year.

6 RENEWAL OF UABT APPROVAL

6.1 An application for renewal of the approval is to be made on the eSOMS (https://esoms.caas.gov.sg) at least 2 months before expiry of the approval and accompanied by the prescribed application fee. Refer to **Appendix 6**.

7 VARIATION OF UABT APPROVAL

7.1 The approved UABTO must notify CAAS if there are changes to the courseware or question bank.

7.2 If there are any changes to the online system, key personnel or ownership of the UABTO, the approved UABTO should also notify CAAS.

7.3 An application for variation of the UABT approval is to be made on the eSOMS (https://esoms.caas.gov.sg) and accompanied by the prescribed application fee. Approval by CAAS is required before the organisation can proceed with implementation of the change.

8 TRANSFERABILITY

8.1 A UABT approval granted to an organisation is not transferrable except as a result of a change in ownership. A new application is required in the event of a unique entity number (UEN) change.

UA TRAINING AND ASSESSMENT ORGANISATION (UATO)

9 APPLICATION FOR UATO APPROVAL

9.1 An applicant should make an application for a UATO approval through eSOMS (https://esoms.caas.gov.sg) at least 2 months before the intended date of commencement of the applicant's training operations and accompanied by the prescribed application fee. Refer to **Appendix 6**.

9.2 The applicant is required to submit the following information as part of the application:

(a) Organisation details

(i) Name of the organisation

(ii) Address of the organisation

(iii) ACRA BizFile

(b) Key personnel

(i) CV of Accountable Manager

(ii) CV of Head of Training

(iii) CV of Quality Manager

(c) List of instructors

(d) Letter of nomination of authorised flight examiners (UA) ("AFE(UA)")

(e) Scope of training and assessment (e.g. Class A Rotorcraft, Class A Aeroplane)

(f) An Exposition document including:

(i) Organisation details

(ii) Description of facilities and equipment to conduct training and assessment

(iii) System to ensure competency of instructors and AFE(UA)s

(iv) System for record keeping, document control and distribution

(v) Description of training curricula and policy

(vi) Quality assurance system

(g) Training course materials

(h) Intended pricing schedule for training courses to be offered

9.3 The UATO is required to demonstrate to CAAS that it has adequate staff, equipment, and infrastructure (e.g. sufficient classrooms and UA) to conduct UA flight training, practical assessment and proficiency checks. CAAS may conduct on-site inspections of the UATO's facilities to ascertain these aspects.

9.4 The UATO is not required to obtain an Operator Permit or a Class 1 Activity Permit to conduct practical training, assessments and proficiency checks which involves the flying of a UA. However, a Class 2 Activity Permit will be required if the UATO intends to fly the UA outdoors under any of the following conditions:

(a) Altitude exceeding 200 feet above mean sea level (AMSL);

(b) Within 5 kilometres of any aerodrome; or

(c) Within any restricted area, danger area or protected area, as published in the Government Gazette.

Note: The restricted areas, danger areas, protected areas and areas within 5 kilometres of an aerodrome are shown on the OneMap portal (www.onemap.sg).

10 KEY PERSONNEL

10.1 The UATO should employ fit and proper individuals for the following key roles:

(a) Accountable Manager (AM)

(b) Head of Training (HT)

(c) Quality Manager (QM)

10.2 The AM and QM should not be concurrently holding other training roles within the UATO.

10.3 The AM is normally the chief executive officer (CEO) who by virtue of position has overall (including in particular financial) responsibility to run the organisation. If the AM is not the CEO, he/she should have the overall responsibility to run the organisation and have direct access to the CEO.

10.4 The AM is responsible to:

(a) ensure that UATO complies with the regulatory requirements set by CAAS;

(b) ensure that sufficient funding is available to conduct activities to the approved standard; and

(c) nominating the other key personnel and AFE(UA).

10.5 The HT must have direct access to the AM and meet the following requirements:

(a) Hold a valid UAPL relevant to the scope of approval; and

(b) Is an instructor within the UATO.

10.6 The HT is responsible to:

(a) ensure satisfactory training as well as supervising the progress of individual trainees;

(b) ensure instructors meet the required standards and performance;

(c) ensure AFE(UA) maintains recency and adheres to the assessment standards required by CAAS; and

(d) ensure sufficient resources are available to perform the activities under the scope of approval granted to the UATO.

10.7 The QM must have direct access to the AM and meet the following requirements:

(a) At least 2 years' relevant experience in quality assurance; or

(b) Attended a quality assurance course acceptable to CAAS.

10.8 The QM is responsible for ensuring that the quality assurance system is properly implemented, maintained, continuously reviewed and improved.

11 INSTRUCTORS AND AUTHORISED FLIGHT EXAMINERS (UA)

11.1 Instructors employed by the UATO must meet the following requirements:

(a) Holds a valid UAPL relevant to the scope of approval;

(b) Competent to instruct; and

(c) Passed competency check conducted by CAAS or the AFE(UA).

11.2 The UATO will nominate an instructor to be authorised by CAAS as an AFE(UA). Upon authorisation by CAAS, the AFE(UA) will be responsible for the administration of practical assessment and proficiency checks on behalf of CAAS. The period of AFE(UA) authorisation is up to 24 months.

11.3 Each UATO should have 2 AFE(UA)s. CAAS will assess on a case-by-case basis should there be a need to have more to cope with the practical assessments.

11.4 To qualify for initial authorisation, the AFE(UA) nominee must meet the following requirements:

(a) Holds a valid UAPL relevant to the scope of approval and without limitations;

(b) At least 21 years old;

(c) Attended induction briefing by CAAS; and

(d) Passed practical evaluation by CAAS.

11.5 The AFE(UA) nominee should also have completed an internal AFE(UA) induction training conducted by the organisation.

11.6 To qualify for reauthorisation, the AFE(UA) must meet the following requirements;

(a) Holds a valid UAPL relevant to the scope of approval and without limitations;

(b) Maintains recency with:

(i) at least 12 practical assessments or proficiency checks during the validity of the existing authorisation; and

(ii) at least 2 practical assessments or proficiency checks within each 6-month period during the validity of the existing authorisation;

(c) Attend refresher briefing and pass practical evaluation by CAAS not earlier than 6 months before the date of expiry of the existing AFE(UA) authorisation;

11.7 The AFE(UA) should also maintain instructor currency within the period of AFE(UA) authorisation.

12 EXPOSITION DOCUMENT

12.1 The UATO must provide and maintain an exposition document containing guidance on the policies, processes and procedures for the personnel concerned, to enable them to adequately discharge their duties in providing training and assessment.

12.2 The exposition document should define the course syllabi to achieve the competency required for UAPL, and state the learning objectives and standards to be met for each phase of training. Refer to **Appendix 3** and **4** for UAPL learning outcomes.

12.3 The UATO should review the exposition document at least once a year to verify its clarity, implementations, effectiveness, accuracy and relevance. The review should minimally consider the following:

(a) Changes in the organisation's policies, procedures, practices and personnel;

(b) Changes to the content of training programmes;

(c) Changes resulting from new facilities and equipment;

(d) Changes to an approval document; and

(e) Changes to relevant regulations.

12.4 The UATO should have a system in place for the endorsement of changes and revision control to the exposition document. The system must also ensure effective distribution of the exposition document to all its personnel so that the latest version is always used.

12.5 Details on the contents of the exposition document can be found on **Appendix 5**.

13 FACILITIES AND EQUIPMENT

13.1 The UATO should be sufficiently equipped to enable adequate conduct of theory and practical training that is appropriate to the size and scope of the intended operations. These include the following:

(a) Classroom(s) for theory training;

(b) Adequate location(s) for practical training and assessment;

(c) Sufficient UA types for practical training relevant to the approval with varying mass (e.g. less than 7kg and more than 15kg) and stability augmentation (e.g. attitude mode, rates mode, GPS mode for mission planning and execution) for purpose of training;

(d) Course materials;

(e) Instructor / AFE(UA) guides;

(f) Flight simulators (if any); and

(g) Facilities to enable the following to be carried out adequately:

(i) Administrative functions;

(ii) Course development;

(iii) Maintenance of equipment; and

(iv) Records-keeping.

13.2 All equipment, including any UA, should be properly maintained in accordance with a maintenance plan before being used for practical training and assessment.

14 QUALITY ASSURANCE SYSTEM

14.1 The UATO should establish a quality assurance system that includes:

(a) an independent audit function to monitor training and evaluation standards, the integrity of practical assessments and proficiency checks, and compliance with procedures; and

(b) a feedback system of audit findings to the person(s) and ultimately to the AM to ensure timely implementation of effective corrective and preventive action.

14.2 The quality assurance system should ensure conformance to standards and procedures, adequacy of training and assessment activities conducted as described in the exposition document. Every process that assists the UATO to achieve its results shall be identified and the activities and procedures documented. The UATO should specify the basic structure of the quality assurance system applicable to all training and assessment activities conducted.

14.3 The quality assurance system should be documented in the exposition document that is regularly kept updated. Refer to **Appendix 5** for details.

15 RECORDS

15.1 The UATO must maintain the following records for the specified retention period:

Records	**Minimum Retention period**
Trainee training, evaluation, practical assessment and proficiency check	Five years after the training or assessment has been completed
Qualifications, training and evaluation of instructors and AFE(UA)s	Five years after instructor or AFE(UA) has relinquished his role in UATO
Changes to key personnel	Five years after the change

15.2 The UATO must ensure that:

(a) the records are complete such that there will be sufficient documentary evidence of each training action and for the reconstruction of the training history of each trainee, instructor or AFE(UA) in the organisation;

(b) the integrity of records is maintained by ensuring that the records are not removed or altered without authorisation; and

(c) there is a backup system of the records to provide continuity.

15.3 The UATO must maintain a personal record for every trainee, instructor and AFE(UA). The records should include:

(a) Personal particulars;

(b) A copy of UAPL if applicable; and

(c) Detailed records of:

(i) Qualifications, training and evaluation for instructor and AFE(UA);

(ii) Training and evaluation for trainees; and

(iii) Results of practical assessments and proficiency checks.

15.4 The UATO should provide CAAS with a list of trainings and practical assessments / proficiency checks conducted minimally on a monthly basis or when required by CAAS.

16 VALIDITY OF UATO APPROVAL

16.1 The UATO approval will be valid for up to 1 year.

17 RENEWAL OF UATO APPROVAL

17.1 An application for renewal of the UATO approval is to be made on the eSOMS (https://esoms.caas.gov.sg) at least 2 months before expiry of the approval and accompanied by the prescribed application fee. Refer to **Appendix 6**.

17.2 The applicant is required to submit the following information as part of the application:

(a) Latest revision of the exposition document if there are changes since the last issuance of the approval

(b) Latest revision of the training course materials if there are changes since the last issuance of the approval

(c) List of active instructors and AFE(UA)s

(d) List of courses conducted for past year

(e) List of practical assessments and proficiency checks conducted for past year

(f) Internal audit results for past year

17.3 An audit is required for the renewal of the UATO approval. CAAS will arrange for the audit once the required information and application fee are received.

18 VARIATION OF UATO APPROVAL

18.1 The UATO must notify CAAS of any variation that is significant to the operations of the UATO. These may include:

(a) changes in scope of training;

(b) inclusion of new training courses; or

(c) location of the facilities.

18.2 Amendments made to the exposition document such as changes to procedures or key personnel must also be submitted to CAAS for acceptance. The UATO must not implement any proposed amendments to the exposition document until that amendment has been accepted by CAAS.

18.3 An application for variation of the approval or amendments to the exposition document is to be made on the eSOMS (https://esoms.caas.gov.sg) and accompanied by the prescribed application fee. Approval by CAAS is required before the organisation can proceed with implementation of the change.

19 TRANSFERABILITY

19.1 A UATO approval granted to an organisation is not transferrable except as a result of a change in ownership. CAAS should be notified when there is a change in ownership. A new application is required in the event of a unique entity number (UEN) change.

APPENDIX 1 UABT SYSTEM SECURITY REQUIREMENTS

The design of the UABT should include robust security controls and measures to ensure the reliability and privacy of the system and the data that is stored, processed or accessed by the system.

The UABTO should fully comply with the Personal Data Protection Act (PDPA) for the collection, use and disclosure of personal data and notify CAAS upon detection of any confirmed IT security incident or security breach affecting the system or its data, and provide CAAS with any follow-up actions to be taken.

Reference on security best practices can be found on the CSA Go Safe for Business website (https://www.csa.gov.sg/gosafeonline/go-safe-for-business/smes).

APPENDIX 2 UABT LEARNING OUTCOMES

The UA basic training consists of 3 modules:

1. Air Law & Legislations
2. UAS General Knowledge
3. UAS Safety & Operations

AIR LAW & LEGISLATIONS		
Learning Objective		To equip trainee with relevant knowledge of the Air Navigation Act (ANA), ANR-101 and other associated advisory circulars for the safe and responsible operation of UA.
Knowledge Areas	**1.1**	Regulations applicable to different UA operations (recreation, education and non-recreation / non-education purposes)
	1.2	Permits required for different UA operations and where to apply for the permits
	1.3	UA registration and how to apply for registration
	1.4	UAPL and its associated classes, categories and ratings; and how to apply for UAPL
	1.5	User operating guidelines (Do's & Don'ts)
	1.6	"No-fly" zones with the use of onemap.sg
	1.7	Penalties upon contravening provisions of the ANA and ANR-101

UAS GENERAL KNOWLEDGE		
Learning Objective		To equip trainee with basic aeronautical and technical knowledge of UA including the functionality of various UAS components and systems.
Knowledge Areas	**2.1**	Different categories of UA (e.g. Aeroplane, Rotorcraft, Powered-lift, Airship, etc.)
	2.2	Different forces acting on an UA during manoeuvres and steady flight
	2.3	Components of different UA categories, and its functionality
	2.4	Critical systems of different UA categories, and how the systems interact with each other
	2.5	The common UA flight control modes (e.g. position hold, attitude hold, manual, way-point navigation etc.)
	2.6	Common radio-control (RC) modes (Mode 1, 2, 3 & 4)
	2.7	Critical specifications of UAS and their implication on performance
	2.8	Where to find the critical specifications of the UAS

UAS SAFETY & OPERATIONS		
Learning Objective		To equip trainee with necessary knowledge to ensure safe UAS operation, including required procedures and safeguards, and human performance affecting safe UA operations.
Knowledge Areas	**3.1**	Conducting flight checks (pre-flight, in-flight & post flight) and the best practices to conduct such flight checks
	3.2	Identifying hazards affecting UAS operation and how to mitigate potential risks (e.g. environment, weather, etc.)
	3.3	Different emergencies (e.g. low battery, loss of GPS, loss of command link etc.) and its recovery procedures
	3.4	Conducting periodic UAS maintenance and the best practices to conduct such inspections, maintenance and repair
	3.5	Safety issues of non-commercial-off-the shelf UAS and how to mitigate them
	3.6	Physiological factors affecting operator's performance in ensuring safe UA operations. (e.g. alcohol, sickness, fatigue, etc.)
	3.7	Psychological factors affecting UA performance (e.g. lack of flying experience, lack of carefulness and sense of responsibility, etc.)
	3.8	Correct scanning techniques when operating UA
	3.9	Visual illusions and sun blindness and its preventive actions

APPENDIX 3 UAPL THEORY KNOWLEDGE LEARNING OUTCOMES

The table below shows the knowledge areas, number of questions and duration of theory test.

Knowledge Area	Duration	No. of Questions	Passing Mark
General UAS Knowledge	1.5 hrs	50	75%
Principles of Flight			
Air Law			
Navigation and Meteorology			
Human Factors			
Safety and Operations			

The table below shows the recommended study guides to develop training materials.

Recommended Study Guides
1. Air Navigation Act 1966 (ANA) 2. Air Navigation (101 – Unmanned Aircraft Operations) Regulations 2019 (ANR-101) 3. All ANR-101 Advisory Circulars 4. The Complete Remote Pilot – Aviation Supplies & Academy (ASA) *By: Bob Gardner and David Ison* 5. The Droner's Manual – Aviation Supplies & Academy (ASA) *By: Kevin Jenkins* 6. Remote Pilot – Small Unmanned Aircraft Systems Study Guide (FAA-G-8082-22) *By: Federal Aviation Administration*

The following tables detail the learning outcomes for each knowledge area.

Syllabus Reference	Learning Outcome
010 00 00	**General UAS Knowledge**
010 01 00	**Introduction to UAS**
010 01 01	Define what is an Unmanned Aircraft System (UAS) and Unmanned Aircraft (UA)

010 01 02	Describe the different categories of UA and its operating principles:
	- Aeroplane
	- Rotorcraft
	  • Multi-rotor
	  • Helicopter
	- Powered-Lift
	- Airship

010 01 03	Explain the various applications of UAS (e.g. building inspection, agriculture, aerial mapping, surveillance etc.) and compare which category of UA is best suited for each application
010 02 00	**UAS Components and Systems**
010 02 01	Describe major systems of UAS and how the systems are integrated with each other: - Power and Electrical System - Propulsion System - Flight Control and Navigation System - Command and Control (C2) System - Ground Control System (including different remote controller modes)
010 02 02	Describe the functions of the different UAS components under each major system and compare the differences across the different categories of UA
010 02 03	Describe the operation of the UAS C2 link: - Understand the importance of radio-line-of-sight - Identify the causes of radio interference and loss link
010 02 04	Describe how to recognize and/or identify failed/damaged components (e.g. failed servo, propeller damage, etc.)

Syllabus Reference	Learning Outcome
020 00 00	**Principles of Flight**
020 01 00	**Aerodynamics**
020 01 01	Identify the four forces of flight: - Lift - Weight - Thrust - Drag
020 01 02	Describe aerofoil interaction with airflow - Lift generation / aerodynamic force - Angle of attack (AOA) - Ground effect
020 01 03	Describe aerodynamic stall: - Causes of stalls - Symptoms of stalls - Stall recovery
020 01 04	Describe aerodynamic spin: - Stages of spins - Spin recovery
020 01 05	Describe aerodynamic stability: - Centre of Gravity and Centre of Pressure, and how they affect stability - Static and dynamic stability
020 02 00	**Control of Motion (Aeroplane / Rotorcraft / Powered-lift / Airship)**
020 02 01	List the axes of motion and describe how an aircraft changes its attitude: - Lateral axis (pitch) - Longitudinal axis (roll) - Vertical axis (yaw)
020 02 02	Describe the function of the main control surfaces and the directions of deflection with respect to the axes of motion: - Ailerons - Elevator - Rudder
020 02 03	Understand the purpose of trimming the aircraft

Syllabus Reference	Learning Outcome
030 00 00	**Air Law**
030 01 00	**Air Navigation Act (ANA)**
030 01 01	Know the provisions stated in the ANA, including but not limited to: - Applicability of UAS provisions within the Act - Permit needed for certain overflight by unmanned aircraft - Absolute prohibition of carriage of dangerous materials on unmanned aircraft - Discharge from unmanned aircraft - Dangerous activity involving aircraft - Flying without satisfying safety requirements - Trespassing at aerodromes - Penalty for dangerous flying
030 01 02	State the penalties upon contravening provisions relating to UAS operations of the ANA
030 02 00	**Air Navigation (101 – Unmanned Aircraft Operations) Regulations**
030 02 01	Know the provisions stated in the ANR-101, including but not limited to: - Applicability of UAS provisions within the Regulations - Different purposes of UAS operations (recreation, education and non-recreation / non-education purposes) - State who requires UA registration - State who requires an Operator Permit, Class 1 Activity Permit, Class 2 Activity Permit and other permits - State who requires UA Pilot Licence - State who requires UA Basic Training
030 02 02	State the penalties upon contravening provisions relating to UAS operations of the ANR-101
030 03 00	**Airspace**
030 03 01	Understand how to use onemap.sg to identify the airspace restrictions in Singapore: - Areas within 5km of aerodromes - Danger Areas - Protected Areas under Section 7 Air Navigation Act - Prohibited Areas - Restricted Areas - Temporary Restricted Areas
030 04 00	**UA Registration**
030 04 01	Understand the UA Registration process
030 04 02	State the requirements for the de-registration of a UA
030 05 00	**Permits**
030 05 01	Understand the permit application process
030 05 02	Know the UA Operator Permit and Activity Permit conditions that are applicable to the UA pilot
030 06 00	**Pilot Competency**
030 06 01	State the requirements for the issuance and maintenance of a UAPL
030 06 02	State the associated UAPL classes, categories and ratings
030 06 03	State the responsibilities of a UAPL holder
030 06 04	State the requirements for the issuance of UA Basic Training Certificate

Syllabus Reference	Learning Outcome
040 00 00	**Navigation & Meteorology**
040 01 00	**Navigation**
040 01 01	Describe the geographic coordinate system used in basic navigation: - UTM map projection - Latitude and longitude
040 01 02	Describe the concept of Global Navigation Satellite System: - Basic principles of operation and common errors - Factors affecting accuracy of satellite navigation systems
040 01 03	State the examples of navigation systems: - Global Navigation Satellite System • Global Positioning System (GPS) • Global Orbiting Navigation Satellite System (GLONASS) • BeiDou • Galileo - Other forms of navigation systems • Local area differential GNSS (WADGNSS) • Classical DGNSS • Real Time Kinematics (RTK) • Wide Area Kinematics (WARTK)
040 01 04	Describe other forms of guidance systems, their operating principles and pros/cons: - Infra-red (IR) system - Vision-based system - Ultrasound system - Light Detection and Ranging (LIDAR) system
040 02 00	**Meteorology**
040 02 01	State atmospheric properties and their effects on UA performance: - Pressure - Temperature - Density - Humidity
040 02 02	Define basic altimetry terms: - Height - Elevation - Altitude - Above Mean Sea Level (AMSL) - Above Ground Level (AGL)
040 02 03	Describe the characteristics of the cloud types: - Cumulus (CU) - Cumulonimbus (CB)
040 02 04	Describe the different types of winds and their impact on UA ground speeds during operations: - Headwind - Tailwind - Crosswind
040 02 05	Describe how to obtain and interpret reliable weather information: - Meteorological Services Singapore (non-aviation) - Meteorological Terminal Air Report (METAR)

Syllabus Reference	Learning Outcome
050 00 00	**Human Factors**
050 01 00	**Human Factors in Aviation**
050 01 01	Understand the SHELL model
050 02 00	**Physiology – Vision**
050 02 01	Identify visual illusions during UAS operations and how to overcome them: - Autokinesis - Disorientation - Spatial Disorientation
050 02 02	Describe the effects of sun-blindness and how to overcome it
050 02 03	Describe correct visual scanning techniques
050 03 00	**Physiology – Medications and Psychoactive Substances**
050 03 01	Know the prohibition of use of psychoactive substances during UAS operations
050 03 02	Describe the effects of intoxication during UAS operations
050 03 03	Describe the effects of medications during UAS operations
050 04 00	**Psychology – Fatigue**
050 04 01	Identify the causes of fatigue
050 04 02	Describe the effects of fatigue on UAS operations
050 04 03	Describe fatigue management techniques
050 05 00	**Psychology – Stress**
050 05 01	Identify the causes of stress
050 05 02	Describe the effects of stress on UAS operations
050 05 03	Describe stress management techniques

Syllabus Reference	Learning Outcome
060 00 00	**Safety & Operations**
060 01 00	**Operational Risks and Hazards**
060 01 01	Define risk and hazard
060 01 02	Identify risk and hazards using the following models: - 5 risk elements (pilot, aircraft, environment, operation, situation) - PAVE model - IMSAFE checklist
060 01 03	Apply the general steps to perform risk assessment
060 02 00	**Situation Awareness, Decision Making and Communication**
060 02 01	Describe importance of maintaining situation awareness
060 02 02	Describe the importance of making sound aeronautical decisions: - 5 decision-making subject areas (pilot, aircraft, environment, operation, situation) - DECIDE model - Three P's
060 02 03	Describe the dangers of Get-Home-Itis and Completion Bias mindsets on UAS operations
060 02 04	Describe crew resource management (CRM) and how it can contribute to safety of UAS operations
060 02 05	Identify the 5 hazardous attitudes that may impact the safety of UAS operations: - Anti-authority - Impulsivity - Invulnerability - Macho - Resignation
060 03 00	**UAS Operations**
060 03 01	List the common phases and describe the checks conducted and/or considerations for each phase: - Flight planning and management considerations - Contingency/Emergency planning considerations - Pre-flight phase - In-flight phase - Post-flight phase
060 03 02	Explain the importance of contingency/emergency procedures and the common handling procedures: - Loss of GPS - Low power - Loss of C2 link - Loss of orientation/control - Stall (aeroplane) - Fly-away
060 03 03	Explain the importance of maintenance: - Know the difference between maintenance and flight checks - Know the importance of following original equipment manufacturer (OEM) guidelines when repairing UAS - Know the importance of keeping a maintenance log

APPENDIX 4 UAPL PRACTICAL TRAINING LEARNING OUTCOMES

Knowledge Area	Learning Outcome
General Knowledge of UAS Functions	The candidate should have adequate knowledge of the operating UAS as a whole which includes: - Be able to provide an overview of the UAS in general; - Be able to identify major components and explain its functions; and - Be able to identify and explain different indication lights / sounds and flight modes / abnormal conditions.
UAS Checks	The candidate should be proficient with the pre-flight (including assembly) and post-flight checks of the UA, referring to the Original Equipment Manufacturer (OEM) documents and UATO's training manual (if required).
Flight Manoeuvres via Manual Controls	<u>For rotorcraft (multi-rotors) UA:</u> The candidate should be able to demonstrate smooth and controlled flying while performing the following manoeuvres without GNSS assistance or assistance from any stabilisation systems: - Precision hovering at different orientations - Straight and level circuits - Climbing and descending circuits - Figure of '8' - Precision landing
	<u>For rotorcraft (helicopter) UA:</u> The candidate should be able to demonstrate smooth and controlled flying while performing the following manoeuvres without GNSS assistance or assistance from any stabilisation systems: - Precision hovering at different orientations - Straight and level circuits - Precision landing
	<u>For aeroplane UA:</u> The candidate should be able to demonstrate smooth and controlled flying while performing the following manoeuvres without GNSS assistance or assistance from any stabilisation systems: - Take-off - Straight and upright level flights - Straight and inverted level flights - Figure of '8' - Vertical loop - Precision landing
	<u>For powered-lift UA:</u> The candidate should be able to demonstrate smooth and controlled flying while performing the following manoeuvres without GNSS assistance or assistance from any stabilisation systems: - Precision hovering at different orientations - Transition from hover to forward flight and vice versa - Straight and level flights - Figure of '8' - Precision landing

Knowledge Area	Learning Outcome
	<u>For airship UA:</u> The candidate should be able to demonstrate smooth and controlled flying while performing the following manoeuvres without GNSS assistance or assistance from any stabilisation systems: - Precision hovering at different orientations - Straight and level circuits - Climbing and descending circuits - Figure of '8' - Precision landing
Mission Planning and Execution	The candidate should be proficient with mission planning procedures via ground control system and able to execute / modify the mission during flight.
Emergency Procedures	<u>For rotorcraft UA:</u> The candidate should be able to demonstrate procedures leading to the following manoeuvres in the event of emergencies: - Immediate landing - Abort landing - Emergency stop - Return to home
	<u>For aeroplane UA:</u> The candidate should be able to demonstrate procedures leading to the following manoeuvres in the event of emergencies: - Abort take-off - Abort landing - Stall recovery - Immediate landing
	<u>For powered-lift UA:</u> The candidate should be able to demonstrate procedures leading to the following manoeuvres in the event of emergencies: - Immediate landing - Abort of landing - Emergency stop - Return to home
	<u>For airship UA:</u> The candidate should be able to demonstrate procedures leading to the following manoeuvres in the event of emergencies: - Immediate landing - Abort of landing - Emergency stop - Return to home

APPENDIX 5 CONTENTS OF EXPOSITION DOCUMENT

S/N	Chapter
1	Cover page with the following: - Organisation name and logo - Document title, document number and revision number - Organisation's Unique Entity Number (UEN) / Registered Number - Organisation's Address - Document Approval Signature
2	Document header/footer for every page, except the cover page, with the following: - Document title, document number and revision number - Page number
3	Distribution list (if any)
4	Amendment page / revision control page with the following: - Brief description of amendment since last revision - Affected pages - Date of amendment - Name of drafter who made the amendment
5	Glossary of significant terms and definitions (if any)
6	Table of Contents
7	Preamble relating to use and authority of the document, including a description of the following: - The intent of the document and scope of training and assessment (e.g. UAPL Class A – Rotorcraft) - The aim of the course in terms of what the trainee is expected to be able to do as a result of the training, the level of performance, and the training constraints observed - The organisation's quality statement
8	Organisation details with the following: - Organisation policy (e.g. vision and mission) - Organisation structure, including the names and designations - Roles & responsibilities of minimally the following personnels: o Accountable Manager o Head of Training o Quality Manager o Authorised Flight Examiner (UA) o Instructor
9	Description, including pictures and specifications, of the facilities and equipment available such as: - Staff facilities for administrative work, courseware development, UA maintenance etc. - Classroom(s) for conduct of theory lessons and/or flight simulator training - Flying area(s) for conduct of practical lessons and assessment - UA models for conduct of practical lessons and assessment (include quantity available) - Flight simulators (if any)

S/N	Chapter

10	System to ensure competency of minimally the instructors and AFE(UA)s:
	- Induction training for new staff, which should minimally consist of familiarisation of the following:
	  o Exposition document
	  o Training materials and equipment manuals
	  o Guidebook for the conduct of training for instructors
	  o Guidebook for the conduct of assessment for AFE(UA)s
	- Currency training requirements for staff
	- Upgrade training requirements for staff who are out of currency

11	System for record keeping:
	- Records to be kept:
	  o Qualifications of staff
	  o Training records of staff
	  o Assessment records conducted by AFE(UA)
	  o Attendance records of trainees
	  o Training and evaluation records of trainees
	  o Feedback received from trainees and implementation of corrective action(s)
	  o Any other documents issued by UATO
	- Procedures to store/retrieve records, including assess rights and storage means

12	Description theory and practical training curricula, including: - Breakdown of training course programme - Reference(s) to training materials for trainees
13	Training policy describing the following: - Instructor-to-trainee ratio - Fatigue management system for instructors and AFE(UA)s - Fatigue management system for trainees - Wet weather programme
14	Policy regarding training effectiveness, including: - Procedures for trainee readiness evaluation - Procedures to correct unsatisfactory trainee progress - Feedback system for trainee to highlight training deficiencies
15	Scope of the quality assurance system with a description of quality plan, including: - Scope of audit - Audit schedule - Management review of audit results
16	Procedures for rectification of audit findings, including: - Root cause analysis - Identification and implementation of corrective actions - Verification of effectiveness of corrective actions.
17	Internal system for continuous improvement, including evaluation and analysis of experiences and trends concerning training standards.

APPENDIX 6 APPLICATION FEES FOR UABTO AND UATO

As reproduced from the second schedule of ANR-101:

UABT Approval

1) The fee for an application for the grant of a UABT approval is $350.
2) The fee for an application to renew a UABT approval is $150.
3) The fee for an application to vary a UABT approval is $200.

UATO Approval

1) The total of the following fees must be paid for an application for the grant of a UATO approval:
    a) for the first scope of work specified in the application is $2,300.
    b) for each additional scope of work specified in the application is $1,600.
2) The fee for an application to renew a UATO approval is $1,400.
3) The fee for an application to vary a UATO approval is $1,600.

APPENDIX 7 FREQUENTLY ASKED QUESTIONS

S/N	Question	Answer
1	Can my organisation hold both the UATO and UABT approvals?	Yes, an organisation can hold both approvals. However, please note that the applications for the grant of a UATO approval and for a UABT approval will be treated independently.
2	Is the UATO required to provide training for all UA categories (i.e. rotorcraft, aeroplane, powered-lift, airship)?	No, a UATO is only required to provide both training and practical assessment on at least one UA category. However, please note that under the Class A rotorcraft category, the UATO must provide training and practical assessment on both the multi-rotor and helicopter sub-categories.
3	What is the minimum mass of UA to be used for training and assessment for Class A categories?	All UATOs should have UA of different mass with one weighing at least 1kg, and one at least 15kg but not exceeding 25kg, to allow trainees to have an appreciation in the difference in flying and handling characteristics.
4	How many instructors and AFE(UA)s does a UATO need?	All UATOs should have only 2 AFE(UA)s each. However, there are no restrictions for the number of instructors. UATOs may write in to CAAS if they require more than 2 AFE(UA)s due to an increase in demand for practical assessments.
5	Can the UAPL of the instructors have any limitations within?	UAPL holders with limitations of up to 7kg for the class/category/rating can only conduct training for theory. UAPL holders without any limitations within their licences, which is relevant to the UATO's scope of work, can conduct training for both theory and practical.
6	Can the UAPL of the AFE(UA)s have any limitations within?	No, AFE(UA)s cannot have any limitations within their licences relevant to the UATO's scope of work.
7	Can the instructors and/or AFE(UA)s be working for multiple UATOs?	No, the instructors and AFE(UA)s should not be working for multiple UATOs.