

FLIGHT INSTRUCTOR'S MANUAL OF TRAINING PROCEDURES

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EXERCISE 1

AIRCRAFT SYSTEMS

Progressive instruction should be given so that by the time the student is ready for solo he should be familiar with:

- i. The fuel and oil systems.
- ii. The pneumatic system.
- iii. The electrical system.
- iv. The flight and engine instruments.
- v. The handling and use of radio/navigation equipment.
- vi. Fire extinguishing methods.
- vii. The hydraulic system.
- viii. The heating and ventilation system.
- ix. Ice and rain protection –
 - a. Engine.
 - b. Airframe.
- x. Flight an engine control systems.

CHECK LISTS AND DRILLS

The student must learn all check lists and drills thoroughly so that his actions on the ground and in the air become instinctive. He should be able to locate all controls, indicators and switches without having to look for them; to this end the student should seat himself in the aircraft and practice with the aid of pilot's notes.

EMERGENCY DRILLS

When teaching emergency drills, emphasize seconds will count when an emergency arises. Do not give the impression that such emergencies are commonplace, and stress the fact that since emergencies are rare, the unexpected nature of the occurrence demands an instinctive drill which needs to be practised at intervals to ensure that no time is lost through momentary confusion or indecision. The following drills must be thoroughly learned:-

- i. Action in the event of fire in the air and on the ground.
- ii. Emergency communication procedures.

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EXERCISE 1E

EMERGENCY DRILLS

When teaching emergency drills, emphasize seconds will count when an emergency arises. Do not give the impression that such emergencies are commonplace, and stress the fact that since emergencies are rare, the unexpected nature of the occurrence demands and instinctive drill which needs to be practiced at intervals to ensure that no time is lost through momentary confusion or indecision. The following drills must be thoroughly learned: -

- i. Action in the event of fire in the air and on the ground.
- ii. Emergency communication procedures.

ACTION IN THE EVENT OF FIRE

1. AIM

Fire is an extremely rare occurrence in the modern aircraft, but it is essential that the pilot has a thorough knowledge of the procedures to be adopted in his particular aircraft to extinguish a fire both on the ground and in the air.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the probable causes for various types of aircraft fires, as well as the technical principles involved in extinguishing those fires.
- ii. Ensure that the student has a thorough knowledge in the use of the aircraft's fire extinguishing equipment.
- iii. The ground/air exercise briefing:
 - a. Appropriate procedures and checklists.
 - b. Engine fire analysis and preventative measures.
 - c. Use of fire extinguishing equipment in air and on ground.
 - d. Removal of smoke from aircraft cabin.
 - e. Side slipping technique to keep flames from cabin area.
 - f. Preparation of aircraft and passengers for forced landing.
 - g. Appropriate radio call – "May-Day" or "Pan-Pan".
 - h. Engine considerations, safety and airmanship.
- iv. De-briefing after simulated exercise on ground and in air.

WHY IS IT BEING TAUGHT

To give the student confidence in his ability to assess the type of fire occurring and to ensure that he carries out the correct fire fighting drill, thereby preventing possible damage to the aircraft and injury to occupants.

HOW THE EXERCISE APPLIES TO FLYING

The fire may occur either in the air or on the ground, and may be due to any of the following reasons:

- i. On the ground:
 - a. Over-priming the engine on start up, causing excess fuel to collect in exhaust systems.
 - b. Fractured fuel and oil lines under pressure leaking onto hot exhaust systems.

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- c. During re-fuelling operations a fire may occur due to incorrect grounding of re-fuelling equipment.
 - d. Fire in electrical system or radio equipment.
 - e. Cockpit/cabin interior fire due to electrical fault/passenger smoking.
- ii. In the Air:
- a. Fractured fuel and oil lines under pressure leaking onto hot exhaust systems.
 - b. Internal mechanical damage to the engine causing a fire in the exhaust manifold.
 - c. Fire in the induction system of the engine.
 - d. Fire in the electrical system or radio equipment.
 - e. Cabin fire.

2. PRINCIPLES INVOLVED

- 1. EXPLAIN WHAT CAUSES FIRES.
- 2. DISCUSS VARIOUS TYPES OF FIRE EXTINGUISHERS AND THEIR APPLICATION.

3. DESCRIPTION OF THE GROUND/AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

DEMONSTRATION

OBSERVATION

1. ON THE GROUND

- | | |
|---|---|
| i. Simulate an engine fire during start up. | <p>THROTTLE Closed</p> <p>MIXTURE Idle Cut-off (ICO)</p> <p>FUEL SELECTOR Off</p> <p>FUEL PUMP Off</p> <p>IGNITION Off</p> <p>ENGINE FIRE EXT. Operate</p> <p>(if installed)</p> <p>RADIO CALL Inform ATC</p> <p>PARK BRAKE On</p> <p>BATTERY MASTER Off</p> <p>PASSENGERS Evacuate</p> <p>HAND FIRE EXT. Operate</p> |
| ii. Simulate a cabin or electrical fire whilst taxiing. | Carry out the same drill as above, after stopping the aircraft and applying the park brake. |

2. IN THE AIR

- | | |
|---|--|
| i. Simulate an engine fire during flight. | <p>i. Propeller which can feather:</p> <p>THROTTLE Closed</p> <p>PROPELLER Feather</p> <p>(if applicable)</p> <p>MIXTURE Idle Cut-Off (ICO)</p> <p>FUEL SELECTOR Off</p> <p>FUEL PUMP Off</p> <p>IGNITION Off</p> |
|---|--|

- | | | |
|---|---|--|
| | ENGINE FIRE EXT.
(if applicable) | Operate |
| | RADIO CALL | Inform ATC |
| | CABIN AIR SUPPLY | Closed |
| | BATTERY MASTER | Off |
| | EXTINGUISH FIRE | Off |
| | FORCED LANDING
PROCEDURES | Complete |
| ii. Propeller which cannot feather or fixed pitch propeller | THROTTLE | Closed |
| | LOWER THE A/C NOSE
TRIM FOR BEST GLIDE SPEED
(Then proceed with same drill as above from "mixture") | |
| | NOTE: In modern aircraft with the exhaust outlets situated below the engine and out of sight of the pilot, it may not be possible to assess whether the engine fire is an induction or exhaust fire. | |
| | It may then be advisable to use the exhaust fire extinguishing method which has been detailed above. However, should an induction fire be identified, OPEN THE THROTTLE FULLY during the engine shut down, procedure to use up the fuel in the carburettor and fuel lines as quickly as possible. | |
| | The above procedures are representative of most aircraft but the PILOT MUST FOLLOW THE PROCEDURES DETAILED IN THE PARTICULAR AIRCRAFT MANUAL. | |
| iii. Simulate a cabin and/or electrical fire whilst in flight | Cabin smoke or fire: | |
| | i. Determine source of smoke. | |
| | ii. If electrical: | |
| | ELECTRICAL | All off |
| | FIRE EXT. | Use applicable type |
| | CABIN VENTS | Open to remove smoke |
| | ATC PROCEDURE | Carry out radio failure |
| | LAND AS SOON AS POSSIBLE | |
| | iii. If not electrical: | |
| | FIRE EXT. | |
| | CABIN VENTS | Open/closed depending on source and severity of smoke. |
| | RADIO CALL | |
| | LAND AS SOON AS POSSIBLE | |

b. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Carry out fire fighting drill in methodical manner.
- ii. Advise ATC if possible.
- iii. Prepare for possible forced landing or emergency landing.
- iv. Assess cause of engine or cabin fire.

ENGINE CONSIDERATIONS

- i. Cause of engine fire.
- ii. Use of engine fire extinguisher (if installed).
- iii. Induction or exhaust fire – assess if possible.
- iv. Do not restart after engine fire.

c. SIMILARITY TO PREVIOUS EXERCISES

- i. Forced landing and precautionary landing procedures.
- ii. Straight glides and gliding turns.
- iii. Glide approach and landing.
- iv. Side slipping.
- v. Knowledge and use of checklists.

d. DE-BRIEFING AFTER FLIGHT

- i. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - a. The correct procedures when a fire has started.
 - b. Evacuation procedures.
 - c. The use of fire extinguishers.
- ii. Discuss the common faults students usually make:
 - a. Students may forget recognised procedures.
 - b. They tend to rush and in the process forget certain checklist items.
- iii. Discuss the student's actual faults
For each fault the instructor must indicate:
 - a. The symptoms of the fault.
 - b. The cause of the fault.
 - c. The result the fault could have led to.
 - d. The corrective action required.

e. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

EXERCISE 2

PREPARATION FOR FLIGHT AND ACTION AFTER FLIGHT

1. AIM

To learn thorough preparation for flight and action after flight.

2. INSTRUCTIONAL GUIDE

FLYING CLOTHING

The importance of wearing the appropriate flying clothing must be impressed on the student. Any discomfort will affect his flying.

FLIGHT AUTHORIZATION AND AIRCRAFT ACCEPTANCE

The use of the authorization book must be explained and the student should be shown how to complete these documents before and after flight. At this stage the student should not be overburdened with pre-flight planning details and only the more important points, such as the weather, aerodrome control requirements and the aircraft state should be mentioned.

EXTERNAL CHECKS

The instructor should point out:-

- i. The positioning of the aircraft for starting – state of ground, direction in relating to buildings, other aircraft and wind direction and speed, etc.
- ii. The precautionary presence of fire extinguishers.
- iii. Chocks in position (if required).
- iv. The importance of checking the immediate taxiing path for obstructions which cannot be seen from the cockpit.
- v. A detailed pre-flight check of the aircraft is carried out, as prescribed in the aircraft manual. The instructor should supervise all pre-flight checks of the aircraft, as the instructor is legally pilot-in-command of the aircraft.

INTERNAL CHECKS

On entering the cockpit, check that the student knows how to fasten and adjust his safety harness and see that he then adjusts his seat and rudder pedals to the most convenient positions so that he can apply full rudder and/or brake without having to strain. If unable to reach his rudders fully, ensure that the pupil uses a back cushion throughout his training. After these preliminaries the internal checks, as listed in the aircraft manual, should be done. During these checks the student should be kept actively engaged; this helps him to learn the internal checks, and make him more familiar with the cockpit.

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STARTING AND WARMING UP

When demonstrating the start up procedures, the signals between the pilot and ground crew should be explained and the various safety precautions emphasized, where applicable. The student should be allowed to start the engine for his first flight, as this small achievement can make him more receptive to further instruction. During the warm-up period the student should be kept aware of the engine instrument readings and alert to any activity in the immediate vicinity of his aircraft.

POWER CHECKS

When carrying out power checks:-

- i. The aircraft should, whenever possible, be headed into wind and at all times if the wind exceeds 15 knots.
- ii. The control column or wheel should be held as applicable for the aircraft type.
- iii. Power and systems check as per recommended procedure.

RUNNING DOWN AND SWITCHING OFF

It should be pointed out that the handling of High-performance engines necessitates a correct running down and stopping procedure to prolong the life of the engine and ensure reliability. Carry out the running down and stopping procedure as laid down in the expanded checklist. Explain to the student the danger of leaving the ignition and master switches on.

LEAVING THE AIRCRAFT

Explain the use of flying control locking mechanisms and point out the advisability of leaving the door or windows closed in wet weather and slightly open in extremely hot or cold weather. Explain the reason for releasing the parking brake after the chocks have been inserted. After vacating the cockpit, carry out a post flight inspection of the aircraft and explain that this is done to check for any signs of leaking fluid or other indications of unserviceability (bird strikes, etc.) Propellers should be dressed.

COMPLETION OF AUTHORIZATION BOOK AND FLYING RECORDS

Make sure the student knows how to record his flying times in the Authorization Book and the method of reporting defects.

NOTE:

The student cannot be expected to remember all the detail involved in this lesson. He should therefore continuously be supervised and checked as unobtrusively as possible, until he becomes proficient.

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EXERCISE 3

AIR EXPERIENCE

1. AIM

To introduce the student to the sensation of flying and the totally new aspect of the ground when seen from the air.

2. INSTRUCTIONAL GUIDE

No flying instruction should be given during the exercise, but this does not detract from its potential usefulness. During this flight the instructor can make his initial assessment of the student's in-flight temperament and decide on a tentative manner of approach for subsequent instruction, the student becomes still more familiar with the aircraft and its operation by watching the instructor, and also becomes accustomed to the new environment and the novel sensations associated with flight, the flight should be made in the vicinity of the aerodrome and local flying area so that local prominent landmarks can be pointed out. After the student has settled down and is taking an active interest, his attention can be drawn to items such as the attitude and airspeed. If the student shows signs of becoming airsick, the flight should be discontinued and if he is sick, do not reveal any annoyance or show undue concern, but make light of the incident and assure him that his behaviour is not uncommon in the early stages.

NB. This flight is for the benefit of the student and not a pleasure trip for the instructor. Nor is it an opportunity for the instructor to demonstrate to the pupil his ability to handle the aircraft to its limits.

The impressions of the first flight can have a definite bearing on the student's subsequent interest, enthusiasm and ability to learn.

Many students may have had some form of air experience on some type of aircraft. The instructor should ascertain for himself the amount of experience a student may have acquired and use this period accordingly.

Introduce the importance of keeping a good look-out and reporting the position of other aircraft by the clock-code method.

Hold the students attention throughout the flight by referring to checks and procedures where applicable.

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EXERCISE 4

EFFECTS OF CONTROLS

1. AIM

DEFINITION

This exercise is an introduction to the aircraft's controls, their method of operation and how these controls affect the aircraft during flight.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the principles involved.
- ii. The air exercise briefing:
- iii. Applicable procedures and Check Lists.
 - a. Aircraft handling techniques: Demonstration and Observation.
 - b. Consideration of Airmanship and Engine handling.
 - c. Similarity to previous exercises.
 - d. De-briefing after flight.

WHY IT IS BEING TAUGHT

To give the student a good understanding and thorough knowledge of the principles involved in the use of the basic flight controls.

HOW THE EXERCISE APPLIES TO FLYING

- i. These controls are used in all flying.
- ii. The inter-relationship between these controls will be shown in later exercises.

2. PRINCIPLES INVOLVED

1.
 - i. Sketch and explain the following definitions:
Bernoulli's theories, aerofoil section, chord line, mean camber line, relative airflow and angle of attack.
 - ii. Explain the function of flap type flight controls and their effect related to the above principles.
2. Discuss the lift formula in detail.
3.
 - i. With the aid of a sketch/model explain the planes of movement for each flight control relative to their axes.
 - ii. Factors affecting control effectiveness.
 - iii. Discuss skidding, slipping and weather cocking.
4. Discuss Newton's Laws with specific reference to each flight control.
5. Discuss the Primary effect of:
 - i. Elevators – direction of movement and airspeed changes.
 - ii. Rudder – direction of movement.
 - iii. Ailerons – direction of movement.
(Adverse Aileron Yaw – as discussed in 6)

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6. Adverse Aileron Yaw:
 - i. Newton's Law – for each action there is an equal and opposite reaction.
 - ii. Lift/Drag relationship.
 - iii. Total Drag graph to indicate the effect of speed on induced drag – reason for demonstration at low speed.
 - iv. Pressure distribution around a wing. Reason for use of:
 - a. Differential ailerons.
 - b. Frise ailerons.
 - v. Use of rudder during aileron application for balance.
7. Discuss the further effects of:
 - i. Elevators – none.
 - ii. Ailerons – continuous roll, turn, slip, weathercock, resulting in spiral dive.
 - iii. Rudder – continuous yaw, skid roll, turn, resulting in spiral dive.
8. Recovery from a spiral dive:
 - i. Power – throttle closed.
 - ii. Wings level and balance.
 - iii. Nose position – attain climb attitude.
 - iv. Power – open throttle as required.
9. Discuss the effects of:
 - i. Airspeed.
 - ii. Slipstream.
 - iii. Power changes – couples, torque and slipstream effects.
 - iv. Flaps – movement of centre of pressure, downwash over tailplane, total drag increase and dragline lowered – resulting in pitching moment.
 - v. Undercarriage.
10. Working of the trimmer – discuss.
11. Engine controls:
 - i. Throttle.
 - ii. Pitch.
 - iii. Mixture – operation and idle cut off.
 - iv. Carburettor Heat.
 - v. Cowl flaps.
 - vi. Primer – correct priming (over priming – danger of fire.)
 - vii. Ventilation and cabin heat.
 - viii. Radio stack.

3. DESCRIPTION OF AIR EXERCISE

- a. **APPLICABLE PROCEDURES AND CHECKLISTS**
- b. **AIRCRAFT HANDLING TECHNIQUES:-**

DEMONSTRATION

OBSERVATION

NOTE:
A/C responds continuously until control is returned to

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neutral position. Smooth progressive control movements desired.

1. EFFECT OF FLYING CONTROLS

- i. Demonstrate the primary effect of each control from straight and level flight at cruise power. (Momentary Application).

ELEVATORS:-

- i. Lookout.
- ii. Fore and aft movement of the control column.
- iii. Direction of nose movement relative to aircraft.
- iv. Airspeed changes.
- v. Direction of nose movement relative to the horizon.

AILERONS:-

- i. Lookout.
- ii. Lateral movement of the control column.
- iii. Direction of wing movement relative to the aircraft.
- iv. Direction of nose movement relative to the horizon/turning.

RUDDER:-

- i. Lookout.
- ii. Rudder pedal movements.
- iii. Nose movement – yawing.

Relationship of the rate and amount of movement of the flying controls to the movement of the aircraft.

- ii. Demonstrate the primary effects in a banked attitude.

The effect is in relation to the aircraft axis and not the horizon.

- iii. Adverse aileron yaw. Set power applicable to aircraft type.

- a. Demonstrate from straight and level flight at slow speed, rolling the aircraft with ailerons only (Hold rudder pedals neutral).
- b. Repeat the exercise using rudder to counteract the effect of adverse aileron yaw (co-ordinated turn).

- i. Lookout.
- ii. Select reference point on horizon.
- iii. Apply aileron input.
- iv. Note that nose yaws initially to the opposite side of the roll.

ELEVATORS – No further effect.

AILERONS:-

- iv. Demonstrate the further effects from straight and level flight, at cruise power. (At this stage do not allow the spiral to develop in too steep an attitude as this may lead to air sickness and may also frighten the pupil).

- i. Lookout.
- ii. Primary effect – roll and turn.
- iii. Further effect from being banked, is slip and yaw, leading to increased bank and spiral descent due to weather cocking effect.
- iv. Note: Angle of bank steepens, airspeed

increases, low nose attitude and high rate of descent occurs – spiral dive.

- v. Recovery from spiral descent:
 - a. Close throttle fully.
 - b. Simultaneously co-ordinated movement of rudder and control column to opposite side of spiral.
 - c. Centralise ailerons and rudder when wings are level with horizon, balancing with rudder.
 - d. Recover from dive – ease back on control column.
 - e. When the nose moves through the horizon, apply climb power.

RUDDER:-

- v. Demonstrate – that by taking off power in a spiral the height lost in recovery can be minimised. Applying power for the climb away, take care not to exceed the engine limitations.
- i. Primary effect – yaw with secondary roll.
- ii. Further effect from being banked, is slip and yaw leading to increased bank and spiral descent due to weather cocking effect.
- iii. Recovery as for spiral dive.

Note: this exercise is to demonstrate the correct use of the flight controls:

Change.
Check.
Hold.

2. EFFECT OF AIRSPEED

Demonstrate the effect of airspeed on the controls at low and high speeds at a constant power setting, i.e. throttle closed. For high speed demonstration, descend at best glide speed plus 30%; then descend at best glide speed for low speed demonstration.

HIGH AIRSPEED:-

- i. Firm feel.
- ii. Increased effectiveness of controls. Relatively small movements result in large changes in attitude.

LOW AIRSPEED:-

- i. Reduced feel.
- ii. Reduced control effectiveness especially aileron. Large control movements result in small changes of attitude.

3. EFFECT OF SLIP STREAM

Demonstrate the effect on the controls at a high power setting, climbing at best angle of climb and then at a reduced power setting at the same speed whilst descending.

REDUCED SLIP STREAM:-

- i. Reduced feel.
- ii. All controls relatively ineffective. Large movement for comparatively small changes of attitude.

INCREASED SLIP STREAM:-

- i. Firmer feel on rudder and elevator. Ailerons unchanged.

4. EFFECT OF TRIM

- i. The student maintains a constant attitude while each trimmer is moved in turn. The student then adjusts the trimmers until the control forces are removed. Use cruise power.

- ii. Larger rudder and elevator effectiveness. Smaller movements for comparatively large changes of attitudes. Ailerons unchanged. (The feel of ailerons is a good indication of airspeed).

- i. Increasing load on rudder or elevator.
- ii. Sense of trim control movements.
- iii. Adjustment to relieve control forces.
- iv. Thus aircraft remains in the selected attitude when accurately trimmed.

NOTE:

Demonstrate that the initial adjustment to the aircraft attitude should be made by the primary controls and that the trimmers should then be adjusted until no force is required on the controls to maintain attitude:- Change, Check, Hold and Trim. During this demonstration, ensure that the student has his hands and feet resting lightly on the controls, otherwise he may fail to identify the zero force trim setting.

- ii. Effect of power changes on trim.

- i. Lookout.
- ii. Note nose attitude and heading.
- iii. Reduce power to 55%.
- iv. Maintain nose attitude and heading.
- v. Note increased back pressure required on control column to maintain nose attitude.
- vi. Note rudder input required for balanced flight
- vii. Re-trim elevator and rudder.
- viii. Regain cruise power and repeat sequences (i.-vii.) above.

5. EFFECT OF THROTTLE, PROPELLER CONTROL AND MIXTURE CONTROL

EFFECT OF THROTTLE:-

- i. Sense of throttle movement.
- ii. Boost (power) changes.
- iii.

EFFECT OF PROPELLER CONTROL:-

- i. Sense of control movement.
- ii. R.P.M. changes.
- iii. At very low boost settings, the throttle controls the RPM as well as the boost and the propeller control is relatively ineffective.

EFFECT OF MIXTURE CONTROL:-

- i. At high altitudes engines run rough when the mixture is too rich.
- ii. Too lean a mixture will cause an RPM drop.
- iii. If leaned off further, the engine will surge and cut out.

SEQUENCE OF CHANGING MIXTURE, BOOST AND PITCH:-

- i. Increase power: Mixture richen – Pitch increase – Throttle open.
- ii. Decrease power: Throttle close – Pitch reduce – Mixture adjust.

6. EFFECT OF POWER

Demonstrate the effects of power changes.

INCREASING POWER:-

- i. At 55% power, trim the aircraft to fly hands and feet off. Then increase the power to climb power.
- ii. At climb power, trim the aircraft hands and feet off. Now close the throttle.

- i. Yaw due to slipstream.
- ii. Nose rises because of couple changes and increased lift.

DECREASING POWER:-

- i. Yaw.
- ii. Nose drops.

7. EFFECT OF FLAP AND UNDERCARRIAGE

Using a power setting that will not allow the speed to exceed V_{fe} (maximum flap extend speed), trim the aircraft for straight and level flight, hands and feet off. Re-trim level after initial observation of flap effect.

- i. Lower optimum flap.
 - i. Note attitude and airspeed before lowering flap.
 - ii. Flap selected (maximum speed V_{fe}) – note pitch attitude change.
 - iii. When countered by elevators:
 - a. Trim change.
 - b. Lower airspeed.
- ii. Re-trim aircraft for level flight, then lower full flap.
 - i. Note pitch attitude change.
 - ii. Note airspeed change.
 - iii. Note trim change.
- iii. Raise flaps to optimum.
 - i. Note attitude and airspeed before raising flap to optimum.
 - ii. Flap raised to optimum:
 - iii. Slight sink.
 - iv. Note pitch change.
 - v. When countered by elevators:
 - vi. Trim change.
 - vii. Increasing airspeed.
- iv. Raise flaps fully.
 - i. Observations the same as for raising flaps to optimum setting.
 - ii. Observe change in sink and change of trim.

- v. Use power setting that will not exceed V_{I_0} (maximum undercarriage extend speed) and trim for straight and level.
 - a. Lower undercarriage (maximum speed V_{I_0}).
 - i. Note attitude changes.
 - ii. Trim change.
 - iii. Lower airspeed.
- vi. Retract undercarriage.
 - i. Note attitude change.
 - ii. Increase in airspeed.
 - iii. Trim change.

8. EFFECT OF CARBURETOR HEAT CONTROL

- Demonstrate this effect on the ground and in the air.
- i. Change in power. (Note engine instruments),
 - ii. Increase in fuel consumption.
 - iii. Explain when and how to use the control and precautions to be undertaken.

9. LOOK OUT

Demonstrate "clock-code method" of scanning for other aircraft.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Look out – 'clock code method'.
- ii. Stress attitude flying from the initial stages.
- iii. Small movements are required when using the flight controls.
- iv. Orientation in the General Flying area.
- v. Recovery from spiral dive.

ENGINE CONSIDERATIONS

- i. Throttle handling.
- ii. Correct use of mixture, pitch and carburettor heat controls.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Method of look out.
- ii. Orientation in General Flying area.
- iii. Engine start-up and shut-down procedures.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects
The instructor must remember that this exercise forms the foundation upon which the student is to build all his subsequent flying training. The instructor must not rush through the exercises, and he must continually ask himself the question why is it being taught?

- i. Primary effect of controls – to introduce the student to the planes of movement of an aircraft, relative to the aircraft and to the horizon. Also point out that movement in all the three planes is possible at the same time by the combined and simultaneous use of all the flight controls.
- ii. Adverse Aileron Yaw – To introduce the student to balanced flight through the combined use of rudder and aileron.
- iii. Further effect of controls – To introduce the student to the correct use of the flight controls i.e.: Change, Check and Hold.
- iv. Effect of Airspeed – To point out the response of the aircraft and the feel of the flight controls at various speeds.
- v. The effect of slipstream – Using the knowledge gained in exercise (iv) the student can roughly determine the aircraft's speed by relating to the feel effectiveness of the ailerons, which will be directly proportional to the aircraft's airspeed due to their position outside the propeller slipstream area.
- vi. The effect of power changes – To anticipate the resultant trim change effects and to correct accordingly.
- vii. The effect of power changes – To anticipate the resultant pitch and yaw and to correct accordingly.
- viii. Effect of trim – To teach the student the correct use of the trimmer, the instructor must also point out the factors which will necessitate a trim change, i.e. attitude changes and power changes. The results in a further development of the procedure for the use of flight controls namely:- Change, check, hold and trim, i.e. First acquired the attitude necessary, then relieve any control pressures with the trimmer.
- ix. Engine controls – To demonstrate the effect each control has upon the aeroplane's performance and also the correct method of use.

2. Discuss the common faults students usually make

- i. The most common fault is that the student is tense and therefore does not hold the controls correctly. Several attempts are often necessary to convince the student that a light touch is essential. We apply pressures to the controls to make changes.
- ii. Not following the correct procedure for the use of the flight controls:- Change, Check, Hold and Trim.
- iii. Common instructional faults:-
 - a. Insufficient pre-flight preparation resulting in a mass of information being passed over to the student which he usually finds impossible to absorb.
 - b. Too rushed with insufficient time allowed for the student to appreciate the feel of the aircraft.

3. Discuss the student's actual faults

For each fault the instructor must indicate:-

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

f. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

EXERCISE 5

TAXYING

1. AIM

DEFINITION

Taxying is the process whereby the aircraft is controlled on the ground under its own power by the independent or combined use of rudder pedals, brakes, flying controls and engine thrust.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and checklists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Consideration of airmanship and engine handling, marshalling signals, rules of taxiing – as per CAR's.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IS IT BEING TAUGHT

To give the student a good understanding and thorough Knowledge of the principles involved thereby enabling him to correctly and safely manoeuvre the aircraft on the ground.

HOW THE EXERCISE APPLIES TO FLYING

To all manoeuvres of the aircraft under its own power on the ground.

2. PRINCIPLES INVOLVED

1. NEWTONS LAWS AS APPLICABLE TO:

- i. Starting to taxi.
- ii. During taxiing.
- iii. Stopping.

2. DIRECTIONAL CONTROL USING:

- i. Rudder Pedals – steerable nose wheel or tail wheel.
- ii. Differential braking.
- iii. Combination of (i) and (ii).

3. THE EFFECT OF WIND

- i. Weathercocking.
- ii. Use of controls during head, tail- and crosswind conditions.

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4. HIGH SPEED TAXYING – ADDITIONAL PRINCIPLES
 - i. Slipstream effect.
 - ii. Torque effect.
 - iii. Asymmetric blade effect.
 - iv. Gyroscopic effect – applicable to tail wheel aircraft types.
 - v. Ground loop.
 - vi. Control effectiveness – rudder surface.
Principles (i- iv) are to be discussed under:
 - a. Acceleration.
 - b. Deceleration.

5. DISCUSS 4(i.-iv.) IN CONJUNCTION WITH THE EFFECT OF WIND FOR:
 - i. Crosswind take-offs.
 - ii. Crosswind landing roll.
 - iii. Discuss maximum crosswind component.

6. EXPLAIN THE EFFECT OF:
 - i. Surface conditions (i.e. tarmac, grass, sand etc.).
 - ii. Gradient – up, down and side slopes.
 - iii. Wet and dry runway surface conditions.
 - iv. Surface wind on taxiing speed, i.e. head- and tailwinds.

3. DESCRIPTION OF AIR EXERCISE

- a. **APPLICABLE PROCEDURES AND CHECKLISTS**
- b. **AIRCRAFT HANDLING TECHNIQUES**

DEMONSTRATION

1. STARTING AND STOPPING

- i. Demonstrate starting and stopping in a straight line. (When clear of dispersal).

OBSERVATION

STARTING:-

- i. Control column positioned as applicable.
- ii. Foot brakes on.
- iii. Throttle closed.
- iv. Parking brake released.
- v. Look out.
- vi. Foot brakes released.
- vii. Open throttle to overcome inertia.
- viii. Throttle back slightly – effect of inertia.
- ix. Dangers of misuse of power and elevator.

STOPPING:-

- i. Close throttle.
- ii. Control column positioned as applicable.
- iii. Rudder bar central.
- iv. Intermittent braking .
- v. Parking brake on only after aircraft has stopped moving.
- vi. Throttle – holding R.P.M.

2. CONTROL OF DIRECTION AND TURNING

- i. Demonstrate into wind or down wind.
 - i. Look out.
 - ii. Use rudder to induce turn.
 - iii. When desired rate to turn is achieved. Centralise rudder to prevent increase rate of turn.
 - iv. Anticipation.
- ii. Demonstrate in a crosswind.
 - i. Weathercock tendency.
 - ii. Turns into wind tend to tighten up.
 - iii. Aircraft is less willing to turn downwind.
- iii. Demonstrate for quartering wind.
 - i. Flight controls to be held relative to wind.

3. CONTROL OF SPEED

- i. Smooth use of throttle and judgment of speed
- ii. Control of speed with:-
 - a. Power.
 - b. Brake if going to fast with throttle closed.
- iii. Factors effecting speed:-
 - a. Surface gradient.
 - b. Nature of surface.
 - c. Wind.
- iv. Avoid taxiing too fast.
- v. Anticipation.

4. TURNING IN CONFINED SPACES

- i. Low speed.
- ii. Use:-
 - a. Rudder.
 - b. Rudder and power.
 - c. Rudder, power and brakes.
- iii. Avoid turning on a locked wheel; damage to tail wheel/nose wheel.
- iv. Check that the tail is free from obstacles.

5. LEAVING PARKING AREA

- i. Checks completed.
- ii. Taxi clearance.
- iii. Control column as required.
- iv. Foot brakes on.
- v. Throttle closed.
- vi. Parking brake released.
- vii. Look out.
- viii. Foot brakes released.
- ix. Brakes tested as soon as possible.
- x. Marshalls signals – pilot's responsibility.
- xi. Complete taxi checks as required.

6. GROUNDLOOP RECOVERY

(Applicable to tail wheel type aircraft) At low speed demonstrate a ground loop.

- i. Recovery action:- Full opposite rudder. Differential braking if necessary.
- ii. Demonstrate effect of power on recovery action. Explain why only used in recovering from ground loop to the right.

7. HIGH SPEED TAXYING

(See Exercise 12)

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Taxiing checks.
- ii. Lookout.
- iii. Zig-Zag Taxiing (applicable to tail wheel aircraft).
- iv. Speed control and braking techniques.
- v. Right of Way Rules.
- vi. Radio – procedure, frequency, listening out.
- vii. Marshalling signals.
- viii. Instructions to ground crew.

ENGINE CONSIDERATIONS

- i. Throttle handling.
- ii. Mixture.
- iii. Temperature and pressures.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Effects of controls.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects applicable to:-

- i. Speed control use of brakes.
- ii. Directional control.
- iii. Weathercocking.
- iv. Effect of wind and correct use of the flight controls.
- v. Factors affecting the speed of the aircraft during taxiing.
- vi. Engine handling.

2. Discuss the common faults students usually make.

- i. Students tend to taxi too fast, especially as they gain confidence.
- ii. Many students are careless about look out, and clearing the blind spot created by the nose of the aircraft (tail wheel). Stress look out before turning while taxiing.
- iii. Incorrect speed control due to the use of power against brakes.
- iv. Feet incorrectly positioned on the rudder pedals.
- v. Difficulty in the use of differential braking, and different power required when taxiing over grass and tar.
- vi. Releasing the brakes before closing the throttle prior commencing the taxi.
- vii. Harsh braking when stopping the aircraft.
- viii. Forgetting to check the windsock during taxiing to confirm that he is taxiing to the correct runway, and for correct positioning of the flight controls.
- ix. Over activeness on rudders for directional control causing excessive snaking.
- x. Emphasise to taxi in centre of taxiway – how to keep nose wheel on taxi-line.
- xi. Incorrect position of controls when taxiing in strong wind.

3. Discuss the student's actual faults

For each fault the instructor must indicate:-

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

f. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

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EXERCISE 6

STRAIGHT AND LEVEL FLIGHT

1. AIM

DEFINITION

Straight and level flight is that condition of flight whereby the aircraft is flown in balance at a constant altitude and direction at varying speeds, power settings and configurations, with reference to both visual and instrument attitude indications.

WHAT THE INSTRUCTORS ARE TO TEACH

- i. Discuss the principles involved
- ii. The air exercise briefing:
 - a. Applicable procedures and checklists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To give the student a good understanding and thorough knowledge of the principles required to fly the aircraft straight and level at different attitudes, trim and power settings at various speeds and aircraft configurations.

HOW THE EXERCISE APPLIES TO FLYING

- i. Navigation.
- ii. Instrument flying.
- iii. It forms the basis for attitude flying which is important throughout all flying.
- iv. Range and endurance.
- v. Circuit work.

2. PRINCIPLES INVOLVED

1. NEWTON'S LAWS
2. FORCES ACTING ON AN AIRCRAFT
With the aid of a diagram explain the following:

WEIGHT (W)

- i. Effect of gravity.

LIFT (L)

- i. Equal and opposite to weight.
- ii. Formula.
- iii. Speed/attitude relationship.

THRUST (T)

Refer to the appropriate graph and explain:

- i. The power/speed curve – power available.
- ii. The effect of altitude on power available.

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- iii. Discuss the effects of density altitude.

DRAG (D)

With the aid of a graph discuss:

- i. Induced drag.
- ii. Profile drag.
- iii. Total drag – total thrust required.
- iv. Speed – minimum drag (V_{md}).
- v. Speed – minimum power (V_{mp}).
- vi. Effect of flap/landing gear.
- vii. Effect of weight.
- viii. Effect of altitude.

3. COMBINE THRUST / DRAG GRAPHS

Explain:

- i. Max/min speed for straight and level flight.
- ii. Selected airspeeds for straight and level flight – adjustments in power as well as attitude.
- iii. Two airspeeds for one power setting – ‘on the step’.
- iv. Effect of altitude.
- v. Effect of flap/landing gear

4. BALANCE OF FORCES

- i. Couples.
- ii. Effect of tailplane.

5. AIRCRAFT STABILITY

LONGITUDINAL STABILITY

The main factors which longitudinal stability is governed by:-

- i. Relative position of CG/CP:
 - CG at most forward limit – stable.
 - CG as it moves aft – stability decreases.
- ii. Design of the tailplane and elevators – usually negative lift on tailplane.
- iii. Example of longitudinal balance provided by the tailplane:
 - a. Main plane and tail plane at different angles of attack – for purposes of explanation assume main plane at $+4^\circ$ and tailplane at $+2^\circ$, angles of attack.
 - b. When the aircraft is disturbed by a gust, it will assume a different attitude, but will remain temporarily on it's original flight path due to inertia.
 - c. For a change of 2° nose up. Mainplane moves $4^\circ + 2^\circ = 50\%$ change in angle of attack. Tailplane moves $2^\circ + 2^\circ = 100\%$ change in angle of attack.
 - d. Therefore the greater proportional increase in lift over the tailplane will cause it to rise, resulting in a lowering of the aircraft nose and thereby return the aircraft to the original trimmed position.

LATERAL AND DIRECTIONAL STABILITY

Because roll effects yaw and roll, lateral and directional stability are inter-related.

LATERAL STABILITY

- i. Geometric dihedral.
- ii. High wing/Low wing
- iii. Pendulum effect – high wing relationship to CG.
- iv. De-stabilizing
 - a. Slipstream
 - b. Flaps

DIRECTIONAL STABILITY

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6. i. Weathercocking stability – vertical tailplane (tailfin) and fuselage area behind CG.
AIRCRAFT WEIGHT AND BALANCE

- i. Refer to aircraft manual for loading diagram.
- ii. Discuss the dangers of overloading.
- iii. Discuss balance and C.G. movement.

7. EFFECT OF INERTIA

Attitude changes require a time lapse before equilibrium is reached.

7. EFFECT OF POWER CHANGES

–Pitching, yawing and rolling.

9. FLYING FOR RANGE

- To cover the greatest distance through the air for the fuel available.
- To achieve this requires a compromise between:

- i. Airframe considerations – best lift/drag ratio speed plus selection of best altitude.
- ii. Engine consideration e.g. (full throttle height on certain A/C) mixture control. Low RPM.
- iii. Weather considerations – effect of wind.

10. FLYING FOR ENDURANCE

The requirement is to remain airborne at the appropriate power to ensure the least rate of fuel consumption. With piston engine aircraft, endurance decreases with altitude due to the fact that the engine must work harder to allow the aircraft to be flown at a greater true airspeed in air of reduced density, to develop the same amount of lift.

DEDUCTION

By referring to the Owners Manual it will be noticed that very little difference exists between flying for range and flying for endurance in low powered piston engine aircraft. Usually safety and weather considerations would take preference.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AIRCRAFT HANDLING TECHNIQUES

DEMONSTRATION

STRAIGHT AND LEVEL FLIGHT AT VARIOUS POWER SETTINGS

1. Demonstrate straight and level flight at cruise power and cruise speed.

OBSERVATION

LOOK-OUT

STRAIGHT (Rudder and aileron consideration)

- i. Select a prominent marker directly ahead of the aircraft.
- ii. This marker will remain ahead of the aircraft if:
 - a. Aircraft remains in balance.
 - b. Glare shield remains parallel to the horizon.

- c. Each wingtip remains equiv.-distant above/below the horizon.
- d. Drift considerations.
- iii. Trim as required.
- iv. Instrument indications.

LEVEL (Elevator)

- i. Indicate distance between the top of the glare shield and the horizon that is required to maintain level flight e.g. "Four Finger Position"
- ii. The "Four Finger Position" is only valid for:
 - a. Speed – Cruise speed.
 - b. Power – Cruise power.
- iii. Trim as required.
- iv. Instrument indications.

2. Demonstrate the effect of power changes from the cruise power setting.

- i. Look-out.
- ii. Note: Maintaining direction i.e. STRAIGHT FLIGHT maintaining level flight.
Attitude – "Four Finger Position".
Speed – Cruise speed.
Power – Cruise Power.
Configuration – Clean.
- iii. Instrument indication.
- iv. Increase power to cruise power and adjust attitude and balance requirements as speed increases, to maintain original straight and level flight, and trim. NOTE: Practice further power changes, (i.e. minimum through maximum) but do not allow the aircraft's altitude to change before making the attitude adjustment, i.e. anticipate the power/speed/attitude requirements.

3. Demonstrate the effect of flap changes on straight and level flight.

- i. Look-out.
- ii. Note:
 - a. Maintaining direction i.e. straight flight.
 - b. Maintaining Level Flight –
Attitude – "Four Finger Position".
Power – Cruise power.
Speed – Cruise speed.
Configuration – Flaps up.
- iii. Select optimum/Intermediate flap setting while maintaining attitude:- Observe Vfe and anticipate pitch changes.
- iv. To maintain:
 - a. Straight flight – no deviation.
 - b. Level flight – adjust attitude, trim and note:
Attitude – lower than "Four Finger Positions".
Power – cruise power.
Speed – lower than cruise speed.

- Configuration – Optimum/Intermediate flap.
- v. Instrument indications.
 - vi. Select further flap while maintaining attitude: Anticipate pitch changes – Aircraft climbs/descends.
 - vii. To maintain:
 - a. Straight flight – no deviation.
 - b. Level flight: Adjust attitude, trim and note:-
 - Attitude – lower than before.
 - Power – cruise power.
 - Speed – lower than previous speed.
 - Configuration – finally full flap.
 - viii. Instrument indications.
 - ix. Select flaps up in stages following same procedures as for flap extension.
 - x. The aircraft should eventually accelerate to the higher airspeed, but this condition of flight i.e. low airspeed at cruise power is not recommended because of safety, economy and engine considerations.
 - xi. The recommended acceleration procedure is: Maintain climb/max power. Maintain altitude. Accelerate to required speed. Set power as required for the speed. Trim as required.

NOTE: Practice further flap extensions and retractions, but do not allow the aircraft's altitude to change before making the attitude adjustment, i.e. anticipate the flap/attitude requirement.

4. Demonstrate of the possibility of 2 different airspeeds at the same power setting, whilst maintaining straight and level flight, i.e. the effect of being on the wrong side of the drag curve.

- Demonstrate first at higher airspeed.
- i. Look-out.
 - ii. Attitude and instrument indications as for straight and level flight .
 - iii. Note airspeed and power setting and configuration (clean).

Demonstrate now at lower airspeed with original power setting.

- i. Reduce power to idle.
- ii. Maintain height by changing nose attitude and note decreasing airspeed.
- iii. Allow airspeed to decrease to below V_{md} (IAS for minimum drag).
- iv. Increase power to the same setting as for the original higher airspeed.
- v. Note instrument indications in straight and level flight.
- vi. Note reduced airspeed and pronounced high nose attitude.

5. Flying for Economy/Range

As per aircraft manual.

c. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

- i. Stress method of LOOKOUT, attitude flying and instrument scan.
- ii. Orientation in the general flying area.
- iii. Trimming.
- iv. Flying the aircraft in a relaxed manner.
- v. Emphasise smooth control movements at all times.
- vi. Fuel management.

ENGINE CONSIDERATIONS

- i. Method of reducing and increasing power.
- ii. Rate of throttle movement.
 - a. Overboost/over-rev.
 - b. Backfire.
- iii. Mixture control.
- iv. Temperatures and pressures.

d. **SIMILARITY TO PREVIOUS EXERCISES**

- i. Familiarisation period.
- ii. Effects of control.
- iii. Further effects of controls.

e. **DE-BRIEFING AFTER FLIGHT**

1. Briefly recap on the exercise and emphasise the most important aspects applicable to:
 - i. Straight and level flight at cruise power:
 - a. The instructor must point out the relationship between the power setting (cruise power), speed (cruise speed), nose attitude (for straight and level at cruise).
 - ii. Straight and level at various power settings:
 - a. Again point out the power setting, IAS and nose attitude each time the power is changed.
 - b. Emphasise that the straight and level attitudes as in (i) can only be attained at the correct speed/power for cruise.
 - iii. Straight and level with flap:

Notice change in nose attitude.

 - a. Anticipation of pitch, attitude and airspeed changes is required to perform this exercise smoothly. Note that lowering flaps always results in a lower nose attitude.
 - iv. One power setting for two different speeds:
 - a. This exercise demonstrates the importance of keeping the climb power on during straight and level flight until the cruising speed is reached.
2. Discuss the most common faults students usually make:
 - i. Many students tend to fly unbalanced. This is almost invariably due to wings not being laterally level. The result is then the student uses rudder thus crossing the controls in attempting to keep straight.
 - ii. Students often require much prompting before they will satisfactorily eliminate yaw whilst changing power.

- iii. Do not allow the student to use the trimmer for attitude changes. However, after any attitude change the aircraft should be re-trimmed as required.
- iv. The procedure for the flight controls as discussed during effect of controls was – Change, Check, Hold and Trim. For straight and level flight and subsequent exercise where specific attitude changes are required the following procedure must be executed correctly – Change, Hold, Trim, Adjust, Check and Trim.
- v. Students have difficulty in determining whether a pre-selected marker is dead ahead of the aircraft or not. The instructor must ensure that the student is sitting up straight in his seat before aligning the correct point on the glare shield with the prescribed marker ahead of the aircraft on the horizon.
- vi. Inadequate lookout may be the result of over-concentration on accuracy. Encourage the student to strike a sensible balance.

3. Discuss the student's actual faults

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

f. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

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EXERCISE 7

CLIMBING

1. AIM

DEFINITION

Climbing is a condition of flight whereby an aircraft gains potential energy by virtue of elevation, due to the expenditure of propulsive energy above that required to maintain level flight.

Therefore, climbing flight is a steady process during which additional propulsive energy is converted into potential energy. Climbing performance also involves a flight condition whereby the aircraft is in equilibrium as altitude is gained at a specified airspeed with the aircraft in balance.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the principles involved.
- ii. The air exercise briefing:
 - a. Applicable Procedures and checklists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Considerations of Airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

HOW THE EXERCISE APPLIES TO FLYING

- i. Navigation.
- ii. General flying.
- iii. Take-off and overshoot.
- iv. Spinning and aerobatics.

2. PRINCIPLES INVOLVED

1. NEWTON'S LAWS – Inertia as applicable to:
 - i. Initiating a climb.
 - ii. Attitude changes during a climb.
 - iii. Levelling off from a climb.
2. FORCES ACTING ON THE AIRCRAFT
With the aid of a diagram explain the following:

WEIGHT (W)

- i. A component of weight will be acting backwards along the flight path resulting in additional aerodynamic drag.
- ii. Discuss the effect of changes in weight.

LIFT (L)

- i. Formula.
- ii. Speed/attitude relationship.

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THRUST (T)

With the aid of a graph explain:

- i. Power available curve (Pa).
- ii. The effect of altitude on the power available curve.
- iii. Propeller efficiency with airspeed.

DRAG (D)

- i. Total drag – Total power required (Pr).
- ii. Effect of altitude.

3. COMBINE THE THRUST/DRAG GRAPHS AND DISCUSS

- i. MAXIMUM RATE OF CLIMB.

DEFINITION

Maximum height gained in a given time. Rate of climb is the vertical component of the flight path velocity and depends upon the flight speed and the inclination of the flight path.

SPEED

That speed where the largest difference exists between Pa and Pr. This speed is higher than for minimum drag due to propeller efficiency.

Formula: $\text{Rate of climb (FPM)} = 33,000 \times \frac{\text{Pa} - \text{Pr}}{W}$

- ii. EFFECT OF FLAP

For a given airspeed the section of optimum flap will give added lift with only a small increase in drag. Therefore, it is possible to obtain the original amount of lift at a lower airspeed. The rate of climb is a function of both angle and airspeed, and because of the lower airspeed with flaps down, the rate of climb will always be reduced.

- iii. BEST ANGLE OF CLIMB

DEFINITION

Maximum height gained in relation to minimum distance travelled – concerns obstacle clearance.

SPEED

Usually lower than the best rate of climb speed, and for some aircraft the use of optimum flap is recommended.

Formula: $\text{Sin of the climb angle} = \frac{T - D}{W}$

- iv. ABSOLUTE CEILING

The gradual closing of the curves for Pa and Pr as altitude is gained will eventually mean that there will be no excess Pa for climbing when the aircraft reaches its absolute altitude.

4. EFFECT OF WIND ON THE CLIMB

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5. AIRCRAFT WEIGHT AND BALANCE

- i. Discuss the effect of overloading on the climb performance.
- ii. Discuss balance (CG movement).

6. DISCUSS THE EFFECT OF SLIPSTREAM / TORQUE DURING CLIMBING

7. CRUISE CLIMB

DEFINITION

To obtain a reasonable rate of climb as well as to travel at a higher forward speed. Used for cross-country flights.

SPEED

For most light aircraft, an increase in forward speed of ± 20 m.p.h. above the best rate of climb speed will usually lead to a reduction in the rate of climb of $\pm 7\%$, with an increase in forward speed of 25%.

DEDUCTION

Subject to the prevailing wind, operating altitude to be used and the length of the flight, this method of climbing may result in greater advantages over normal climb techniques.

3. **DESCRIPTION OF AIR EXERCISE**

a. **APPLICABLE PROCEDURES AND CHECKLISTS**

b. **AIRCRAFT HANDLING TECHNIQUES**

DEMONSTRATION

OBSERVATION

1. **THE NORMAL STRAIGHT CLIMB**

- i. From straight and level flight at cruise power, demonstrate the climb using climb power at the best rate of climb speed.
- ii. Look-out
- iii. Indicate the conditions for straight and level flight:
 - a. Straight flight:
Reference point/heading. An aircraft remains in balance – glareshield parallel to the horizon, each wingtip remains equi-distant above the horizon. Drift considerations.
 - b. Level flight:
Attitude – “Four Finger Position”
Speed – Cruise.
Power – Cruise.
Configuration Clean.
 - c. Trim as required.
 - d. Instrument indications.
 - e. Engine considerations.
- iii. To initiate the climb apply climb power, and anticipate:
 - a. Aircraft yaw.
 - b. Aircraft nose pitches towards the cockpit.

- iv. To maintain straight flight:
 - a. Apply rudder as required, and trim.
 - v. To attain the climb attitude:
 - a. As climb power is applied raise the nose to the anticipated climb attitude: Change, Check, Hold, Trim.
 - b. Allow the airspeed to stabilise. If required: Adjust nose, Check, Hold, Re-trim
 - c. Note the considerations for the climb:
 - Attitude – for the best rate of climb.
 - Power – best rate of climb.
 - Speed – climb.
 - Configuration – clean.
 - vi. Instrument indications.
 - vii. Engine considerations.
- ii. Maintaining the climb.
 - i. Lookout. Lower the nose at regular intervals to clear the blind spot.
 - ii. Engine considerations:
 - a. Maintain climb power up to full throttle height, thereafter maintain full throttle power.
 - b. Lean out mixture as altitude is gained.
 - c. Cooling.
 - iii. Note decrease in rate of climb with increase in altitude above full throttle height.
- iii. Levelling off from the climb.
 - i. Lookout. Maintain straight flight reference Point / Heading balance.
 - ii. Progressively lower the nose to the level flight attitude.
 - iii. Maintain level attitude and allow speed to increase to the cruise speed before setting cruise power.
 - iv. Conform to all the requirements for straight and level flight.
 - v. Trim as required.
 - vi. Instrument indications.
 - vii. Engine considerations.
- iv. Levelling off from the climb, at a selected altitude.
 - i. Lookout.
 - ii. Maintain straight flight.
 - a. Reference point / heading.
 - b. Balance.
 - c. Wingtips equi-distant from horizon.
 - d. Drift considerations.
 - iii. To initiate the level off.
 - a. Anticipate the level off requirements i.e. 10% of rate of climb.
 - b. Progressively lower the nose into the level flight attitude, anticipating the attitude changes during the speed increase phase.
 - c. Be aware of the level-off altitude and adjust attitude to attain and maintain this altitude.

- iv. Maintain altitude and allow the speed to increase to cruise speed before setting cruise power.
- v. Conform to all the requirements for straight and level flight.
- vi. Trim as required.
- vii. Instrument indications.
- viii. Engine considerations.

2. DEMONSTRATE THE EFFECT OF POWER CHANGES FROM THE CLIMB POWER SETTING

- i. Lookout.
- ii. Maintain straight flight.
Reference point / heading.
Balance.
Wingtips equi-distant from horizon.
Drift considerations.
- iii. Note the consideration for the climb.
Attitude – for the best rate of climb.
Power – best rate of climb.
Speed – climb.
Configuration – clean.
- iv. Instrument indications:-
Note rate of climb.
- v. Engine considerations.
- vi. Decrease power to cruise power while maintaining attitude, anticipate yaw and pitch.
 - a. Aircraft yaws.
 - b. Speed decreases.
- vii. To maintain:-
 - a. Straight flight:
Apply rudder as required, and trim.
 - b. Climb at best rate of climb speed:
Adjust attitude by lowering the nose.
Trim and note:
Attitude – lower than for BRC.
Speed – Best rate of climb.
Power – cruise.
Configuration – clean.
 - c. Instrument indications.
Decrease in rate of climb.
 - d. Engine considerations.
- viii. Increase power to climb power and adjust the attitude to maintain speed.

NOTE: Practice further power changes (maximum through minimum), but do not allow the speed to change before making the attitude adjustment i.e. anticipate the changes due to power/speed/attitude relationship.

SUMMARY: To maintain the required speed any change in power will affect the nose attitude as well as the rate of climb. The lower the power, the lower the nose attitude and rate of climb and vice versa.

**3. DEMONSTRATE THE EFFECT OF
DIFFERENT FLAP SETTINGS WHILE
MAINTAINING THE STRAIGHT CLIMB
(Best rate)**

- | | |
|---|--|
| <p>i. Select optimum/intermediate flap (Observe Vfe).</p> | <p>i. Lookout.
ii. Maintain straight flight.
 a. Reference point/heading.
 b. Balance.
 c. Wingtips equi-distant from horizon.
iii. Note the considerations for the best rate of climb:
 Attitude – lower than for BRC.
 Speed – Best rate of climb.
 Power – cruise.
 Configuration – clean.
iv. Instrument indications:
 Note rate of climb.
v. Select flap, anticipate pitch changes, and maintain attitude:
 Speed decreases.
vi. To maintain:
 a. Straight flight.
 No noticeable change.
 b. Climb, with optimum/ intermediate flap setting.
 Adjust attitude to attain correct speed for the flap setting (as per aircraft manual), trim and note:
 Attitude – as for flap setting speed.
 Speed – as for flap setting.
 Power – climb.
 Configuration – optimum/intermediate flap.
 c. Instrument indications:
 Note decrease in rate of climb.
vii. Engine considerations.</p> |
| <p>ii. From optimum/intermediate flap, lower full flap.</p> | <p>i. Emphasise the same considerations as above, with special reference to:
 a. Nose attitude/speed.
 b. Rate of climb/descent.</p> |
| <p>iii. From the full flap configuration, raise all the flaps in one stage.</p> | <p>i. Before raising flap note altimeter reading and rate of climb.
ii. During flap retraction adjust the attitude to maintain the appropriate flap position. Note of climb/descent indications.
iii. Note large trim requirements to remain in trim.
iv. Note height lost during recovery.</p> |
| <p>iv. Demonstrate the correct way to extend and retract flaps.</p> | <p>i. During a flap extension and retraction cycle, changes in position occur, adjust the attitude to the anticipated position required to obtain</p> |

- ii. speed (or the appropriate flap position).
Raise the flaps from the full flap position, as prescribed in the aircraft manual – Note the height lost during the recovery.

4. **BEST ANGLE OF CLIMB**

Demonstrate using power, speed and configuration as per aircraft manual.

- i. Lookout.
- ii. Maintain straight flight.
- iii. Reference point/Heading and Balance.
- iv. Note the considerations for the normal climb.
- v. Instrument indications, note rate of climb.
- vi. Engine considerations.
- vii. Make the appropriate power, speed and configuration changes as required for the best angle of climb.
- viii. To maintain:
 - a. Straight flight.
Adjust and trim as required
 - b. Climb as for best angle.
Adjust attitude to attain appropriate speed for the flap setting, trim and note:
Attitude – as for best angle speed.
Speed – best angle of climb.
Power – as required.
 - c. Instrument indications, rate of climb less than for best rate of climb.
 - d. Engine considerations.
- ix. Summary:
Although the rate of climb is lower than for the best rate of climb conditions, due to the configuration and lower IAS the angle of climb will be steeper i.e. more height gained in relation to distance covered.

5. **THE CRUISE CLIMB**

From the normal straight climb adjust the speed and power as required for a cruise climb. (As per aircraft manual).

- i. Lookout.
- ii. Maintain straight flight.
Reference point/Heading and Balance.
Wingtips equal-distant from horizon.
Drift considerations.
- iii. Note the considerations for the normal climb:
Attitude – as for best rate of climb speed.
Speed – best angle of climb.
Power – climb.
Configuration – clean instrument.
- iv. Instrument indications.
Note rate of climb.
- v. Engine considerations.
- vi. Make the appropriate power and speed changes.
- vii. To Maintain:
 - a. Straight Flight.
Adjust and trim as required and better visibility.
 - b. Cruise Climb.

Adjust attitude to attain the correct speed, trim and note:
 Attitude – lower than best rate climb.
 Speed – cruise climb.
 Power – cruise climb.
 Configuration – as required.

- c. Instrument indications.
 Rate of climb is less than for best rate of climb.
- d. Engine considerations.
 Improved cooling.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Lookout.
- ii. Vertical and horizontal limits of General Flying Area.
- iii. Visibility considerations – sun and cloud.
- iv. Trimming – use following sequence:
 - a. Change aircraft attitude with elevator.
 - b. Check aircraft nose movement when new desired attitude is obtained.
 - c. Hold aircraft nose position in new attitude until the approximate speed is achieved.
 - d. Adjust aircraft nose attitude until correct speed is obtained.
 - e. Re-trim aircraft for hands and feet off.
- v. Concentrate on attitude flying.

ENGINE CONSIDERATIONS

- i. Mixture control during climb.
- ii. Pitch setting for climb.
- iii. Throttle – power limitations and settings as per aircraft manual.
- iv. Temperatures and pressures – use of cowl flaps if applicable.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Effects of controls – Primary and Secondary.
- ii. Straight and level flight.
- iii. Attitude flying.
- iv. Trimming.
- v. Engine Handling.

e. DE-BRIEFING AFTER FLIGHT

- 1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Initiating the climb. The student must anticipate the pitch and yaw changes resulting from the application of the climbing power, and apply the necessary corrections to maintain heading and balance. During the attitude change from straight and level into the straight climb the importance of the correct procedure must be pointed out: Change, Check, Hold, Adjust, and Trim.
 - ii. Maintaining the climb.
 - a. During the phase the frontal visibility may be reduced. In order to ensure a very good lookout, the nose may have to be lowered periodically during the climb.

- b. For aircraft without a rudder trim a constant application of the rudder is required to maintain heading and balance.
 - c. Due to the high power setting and low IAS the possibility of overheating the engine increases relative to the duration of the climb. Constant attention to engine temperatures, oil pressures and fuel-mixture becomes an important consideration.
 - iii. Levelling off at a predetermined attitude.
 - a. Anticipation for levelling off from the climb is calculated at one tenth of the rate of climb.
 - b. Follow the correct procedure of change, check, hold, trim, adjust, check, hold and trim.
 - c. Allow the speed to build up to the cruising speed before throttling back to cruise power.
 - iv. The effect of power on the climb.
 - a. The aim of this exercise is to familiarise the student with the feel of the aircraft at reduced power and to develop the required anticipation and correct procedure to cope with such a situation.
 - b. Always maintain the required speed regardless of rate of climb, and beware of stalling the aircraft.
 - v. The effect of flaps on the climb.
 - a. During Exercise 4 the primary and further effect of flap was demonstrated to indicate the need to anticipate and correct for the resultant pitch changes.
 - b. During the climb the necessity to maintain the correct speed results in changes in nose attitude and rate of climb.
 - vi. Best rate of climb.
 - a. This nose attitude will always be referred to as the climb attitude and must be memorized for further reference.
 - vii. Best angle of climb.
 - a. Used for obstacle clearance, therefore emphasis on correct speed, configuration and nose attitude is vital.
 - viii. Effect of altitude / temperature.
2. Discuss the common faults students usually make:
- i. When initiating the climb most students tend to be in too much of a hurry in not allowing the speed to settle down before adjusting the nose attitude. This results in 'chasing' the speed and numerous attitude changes before the correct climb attitude and speed is attained.
 - ii. Emphasise the importance of attitude flying with an instrument check for speed only after the aircraft is stabilised in the climb. Some students tend to pay too much attention to the instrument.
 - iii. A common fault is for student to be in too much of a hurry to trim the aircraft. Follow the correct procedure before trimming; Change, check, hold, adjust, trim, check, hold and then trim.
 - iv. During the climb a constant rudder application is required (no rudder trim) to maintain the heading. Most students tend to forget this, and tend to fly with one wing low in an effort to remain on heading.
 - v. Good lookout and a constant check on engine instruments are vital during the climb. Many students seem to have a constant scan but 'see' nothing. The instructor must make a point of asking what certain instrument readings are, after the student has completed his panel scan.

- vi. At reduced power most students maintain the nose attitude with no regard to speed. During a prolonged climb, this fault, combined with a disregard to balance (rudder application), constitutes the ideal ingredients for an entry into an incipient spin.
 - vii. In the beginning many students find the nose position for the best angle of the climb too high for their liking, as the nose is lowered the speed increases and the effectiveness of the exercise decreases accordingly.
 - viii. While levelling from the climb into straight and level flight the change of nose attitude must be progressive so as to allow the speed to build up. Only when the cruise speed is reached should the attitude have reached the straight and level position. A common fault is to change from the climb attitude directly to the straight and level without allowing for speed increases. This results in a loss in height.
3. Discuss the student's actual faults
For each fault the instructor must indicate:
- i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result the fault could have led to.
 - iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

EXERCISE 8

DESCENDING

1. AIM

DEFINITION

Descending is a reduction in altitude at a specified airspeed and/or rate of descent using the appropriate power settings, with the aircraft in balance maintaining a constant heading, with reference to both visual and instrument attitude indications.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and checklists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To give the student a thorough understanding of all the principles involved in descending, thereby enabling the student to execute an accurate descent in the correct manner.

HOW THE EXERCISE APPLIES TO FLYING

- i. Returning from the GF area.
- ii. Descending in the circuit.
- iii. Navigational descents.
- iv. Instrument letdowns.
- v. Maximum rate of descent.
- vi. Range descent – varying distance.
- vii. Endurance descent – varying time.

2. PRINCIPLES INVOLVED

Two types: Power off – gliding.
 Power on.

1. NEWTON'S LAWS

As applicable to:

- i. Initiating a glide – inertia.
- ii. During a glide – equilibrium.
- iii. Levelling off from a glide – inertia.

2. FORCES IN THE GLIDE/DESCENT

Recap on the forces during straight and level flight including couples. Remove the thrust and discuss:

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WEIGHT (W)

- i. Couples.
- ii. Nosedown – Pitch.

LIFT (L)

- i. Formula.
- ii. Equal and opposite to weight.
- iii. Speed/Attitude relationship.

THRUST (T)

- i. Power off – resultant of weight and lift.
- ii. Path of glide = $\frac{T - D}{W}$
- iii. Effect of power during the descent related to:
 - a. Angle of descent.
 - b. Rate of descent.
 - c. Speed/Attitude relationship.

DRAG (D)

- i. Discuss graph for total drag.
- ii. Effect of variations in drag on the glide angle:
 - a. Speed.
 - b. Aircraft configuration.
 - c. Propeller pitch.

8. REFER TO THE APPROPRIATE GRAPHS AND DISCUSS

i. MINIMUM GLIDE ANGLE

DEFINITION

To produce the greatest proportion of glide distance to height lost and will result in the maximum range glide.

FORMULA: $\sin \text{ of glide angle} = \frac{T - D}{W}$

For power off = $\frac{D}{W}$

SPEED

This relationship shows that the minimum angle of glide is obtained at minimum total drag. This coincides with maximum lift/drag ratio.

ii. MINIMUM RATE OF DESCENT

DEFINITION

Without any power this will occur at the angle of attack and airspeed which together produce a condition of the minimum power required resulting in a minimum rate of descent and maximum airborne time.

FORMULA: Rule of thumb – 75% of airspeed required for minimum angle of descent.

SPEED

Minimum power required speed.

iii. EFFECT OF WIND ON THE GLIDE

Glide angle – from cockpit.
from ground observer.

Glide distance – Headwind/Tailwind.

9. AIRCRAFT WEIGHT AND BALANCE

- i. Effect of weight on the glide.
- ii. Effect of balance (C of G movement).

10. EFFECT OF SLIPSTREAM AND TORQUE DURING THE GLIDE

11. CRUISE DESCENT

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AIRCRAFT HANDLING TECHNIQUES

DEMONSTRATION

OBSERVATION

1. THE POWER OFF STRAIGHT GLIDE

- | | |
|---|--|
| <ul style="list-style-type: none"> i. Initiate the glide from straight and level flight by closing the throttle. | <ul style="list-style-type: none"> i. Lookout. ii. Indicate the conditions for straight and level flight: <ul style="list-style-type: none"> a. Straight flight.
Flying towards a marker. Aircraft remains in balance. Glare shield parallel to the horizon. Each wingtip remains equidistant above/below the horizon. Drift correction. b. Level flight.
Attitude – ‘Four Finger Position’.
Power – Cruise.
Speed – Cruise.
Configuration – Clean. c. Trim as required. d. Instrument indications. e. Engine considerations. iii. To initiate the glide, apply carb heat as required and close the throttle. Anticipate pitch and yaw, and maintain balance and attitude. iv. To maintain: <ul style="list-style-type: none"> a. Straight flight. |
|---|--|

- Apply rudder as required and trim.
 - v. To attain the glide:
 - a. Allow the airspeed to decrease while maintaining level attitude.
 - b. Five knots before the required glide speed, lower the nose to the anticipated attitude for the glide: Change, Hold, Trim.
 - c. Note airspeed while maintaining attitude:
To correct airspeed:
Adjust attitude, Check, Hold, Trim.
 - d. Note the considerations for the glide:
Attitude – Glide attitude.
Power – Off.
Speed – Best glide.
Configuration – Clean.
 - vi. Instrument indications.
 - vii. Engine consideration.
- ii. Maintaining the glide.
- i. Lookout.
 - ii. Maintain:
 - a. Straight flight.
Reference point/heading.
Balance – trim as required.
Wingtips equidistant from horizon.
Drift considerations.
 - b. Glide.
Attitude/speed relationship.
 - iii. Instrument indications.
Note rate of descent for power off.
 - iv. Engine considerations.
 - a. Carb heat – as required.
 - b. Richen mixture progressively.
 - c. Note engine temperature decrease.
Warm up as follows:
 - i. Apply climb power (± 4 seconds).
 - ii. Anticipation yaw, maintain direction and balance.
 - iii. Adjust attitude, maintain same speed.
- To re-attain the glide.
- a. Close throttle.
 - b. Maintaining direction and balance.
 - c. Resume gliding attitude.
- Repeat this procedure at regular intervals (e.g. every 1000ft).
- iii. Levelling off from a glide.
- i. Lookout.
 - ii. Maintain straight flight.
 - a. Reference point/heading.
 - b. Balance – trim as required.
 - c. Wingtips equidistant from horizon.
 - d. Drift considerations.
 - iii. To initiate the level off.
 - a. Apply climb power. Anticipate yaw and pitch and maintain balance while

- progressively rotating the nose to the level flight attitude, anticipating the speed/attitude relationship.
 - b. Upon regaining level flight and cruise speed, conform to the requirements for straight and level flight:
Straight flight.
Reference point/heading.
Balance – trim as required.
Wingtips equidistant from horizon.
Drift considerations.
Level flight.
Attitude – ‘Four Finger Position’.
Power – Set cruise power.
Speed – Cruise.
Configuration – Clean.
 - c. Trim as required.
 - iv. Instrument indications.
 - v. Engine considerations.
- iv. Levelling off from the glide at a pre-selected altitude.
- i. Lookout.
 - ii. Maintain straight flight.
 - a. Reference point/heading.
 - b. Balance – trim as required.
 - c. Wingtips equidistant from horizon.
 - d. Drift considerations.
 - iii. To initiate the level off.
 - a. Anticipate the level off requirements i.e. 10% of rate of descent.
 - b. Apply climb power, anticipate yaw and pitch and maintain balance while progressively rotating the nose into the level flight attitude, anticipating the attitude changes during the speed increase phase.
 - c. Be aware of the level-off altitude and adjust attitude to attain and maintain this altitude.
- v. Initiating a straight climb from the straight glide.
- i. Lookout.
 - ii. Maintain straight flight.
 - a. Reference point/heading.
 - b. Balance – trim as required.
 - c. Wingtips equidistant from horizon.
 - d. Drift considerations.
 - iii. To initiate the climb.
 - a. Apply climb power, anticipate yaw and pitch and maintain balance while progressively rotating the nose into the climb attitude, anticipating the progressive attitude changes to maintain/obtain the climb speed.
 - b. Upon attaining the climb attitude, conform to the requirements for the straight climb.
Straight Flight.
Reference point/heading.
Balance – trim as required.

Wingtips equidistant from horizon.
Drift considerations.
Climb – Best Rate.
Attitude – As for Best ROC.
Speed – Best Rate.
Power – Climb.
Configuration – Clean.

- iv. Instrument indications.
- v. Engine considerations as for the climb.

2. **THE EFFECT OF POWER ON THE GLIDE**

Demonstrate the effect of power changes while maintaining the recommended speed.

- i. Lookout.
- ii. Maintain straight flight.
 - a. Reference point/heading.
 - b. Balance – trim as required.
 - c. Wingtips equi-distant from horizon.
 - d. Drift considerations.
- iii. Note the considerations for the glide.
 - Attitude – Glide attitude.
 - Speed – Best glide.
 - Power – Off.
 - Configuration – Clean.
- iv. Instrument indications.
 - Note rate of descent.
- v. Engine considerations.
- vi. Increase power to ± 1800 rpm while maintaining attitude. Anticipate yaw and pitch.
 - a. Speed increases.
- vii. To maintain:
 - a. Straight Flight.
 - Note rudder application and trim.
 - b. Glide, at best glide speed.
 - Adjust attitude, trim and note.
 - Attitude – higher than for power off glide.
 - Power – 1800RPM.
 - Speed – best glide speed.
 - Configuration – Clean.
 - c. Instrument indications.
 - Rate of descent – less than power off glide.
 - d. Engine considerations.

NOTE: Practice further power changes (minimum through maximum), but do not allow the speed to change before making the attitude adjustment i.e. anticipate the power/speed/attitude relationship.

3. **THE EFFECT OF DIFFERENT FLAP SETTINGS WHILE MAINTAINING THE STRAIGHT POWER OFF GLIDE**

- i. During a normal power off glide, lower optimum/intermediate flap.

SUMMARY: To maintain the required speed, any change of power will affect the attitude as well as the rate of descent. The lower the power, the lower the nose attitude and the higher the rate of descent.

- i. Lookout.
- ii. Maintain straight flight.
 - a. Reference point/heading.

- b. Balance – trim as required.
 - c. Wingtips equidistant from horizon.
 - d. Drift considerations.
 - iii. Note the considerations for the glide.
Attitude – Glide attitude.
Speed – Best glide.
Power – Off.
Configuration – Clean.
 - iv. Instrument indications.
Note rate of descent.
 - v. Engine considerations.
 - vi. Select flap, anticipate the pitching moment and maintain attitude:-
 - a. Speed decreases.
 - vii. To maintain:
 - a. Straight Flight.
No influence.
 - b. The glide with optimum/intermediate flap. Adjust attitude to attain correct speed for the flap setting, (as per aircraft manual) trim and note:
Attitude – as for flap setting speed.
Speed – as for flap setting.
Power – off.
Configuration – Optimum / intermediate flap.
 - viii. Instrument indications.
Note increase in rate of descent.
 - ix. Engine considerations.
- ii. From optimum/intermediate flap, lower full flap.
 - i. Emphasise the same considerations as above, with special reference to:
 - a. Attitude / speed relationship.
 - b. Rate of descent increase.
 - c. Trim changes.
- iii. Lower the undercarriage.
 - i. Emphasise the same considerations as above, with special reference to:
 - a. Attitude / speed relationship.
 - b. Rate of descent increase.
 - c. Trim changes.
- iv. From a power off glide with full flap and undercarriage down, raise the flaps and undercarriage in stages.
 - i. Emphasise the same considerations as before, with special reference to:
 - a. Attitude / speed relationship.
 - b. Rate of descent increases.
 - c. Trim changes.
 - ii. Engine consideration.
- v. From a power glide with full flap and undercarriage down, initiate a straight climb raising the flaps and undercarriage (As per aircraft manual).
 - i. Lookout.
 - ii. Maintain straight flight.
 - a. Reference point/heading.
 - b. Balance – trim as required.
 - c. Wingtips equidistant from horizon.
 - d. Drift considerations.
 - iii. To initiate the climb.
 - a. Apply climb power, anticipate yaw and pitch moment and maintain balance

- while progressively rotating the nose into the climb attitude.
- b. Directly after applying climb power retract flaps and gear as per aircraft manual.
- c. Note: To keep in phase with the attitude/speed relationship, the rotation rate is much slower than for the initiation of a straight climb (clean) from a straight glide. The rotation rate is dependant upon the flap retraction rate.
- d. After establishing the climb attitude, conform to the requirements for the straight climb:
Straight Flight.
Reference point/heading.
Balance – Trim as required.
Wingtips equidistant from horizon.
Drift considerations.
Climb – Best rate.
Attitude – as for best ROC.
Speed – best rate.
Power – climb.
Configuration – clean.
- e. Trim as required.
- iv. Instrument indications.
- v. Engine considerations as for the climb.

4. EFFECT OF AIRSPEED ON THE STRAIGHT POWER OFF GLIDE

Start the demonstration with a glide at recommended best gliding speed and compare this situation with glide speeds proportionately lower and higher than the best glide speed. Commence each glide at the same height and over the same point. Demonstrate in zero wind conditions.

- i. Note the gliding distance at the best glide speed.
- ii. Note the glide distances at both higher and lower speeds. Compare the three descent paths and discuss gliding (power off) for range/endurance.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Lookout.
- ii. Trim.
- iii. Nose attitude / speed relationship (attitude flying) controlled by the elevators.
- iv. Rate of descent controlled by the power.

ENGINE CONSIDERATIONS

- i. Mixture richened during descent.
- ii. Temps and Pressures.
- iii. Use of carburettor heat.
- iv. Throttle overboost / over-revving.
- v. Warming engine every 1000ft minimum.

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d. SIMILARITY TO PREVIOUS EXERCISES

- i. Effect of controls.
- ii. Straight and level.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Initiating the glide. As for the climb the student must anticipate the pitch and yaw changes resulting from the power being removed. Secondly, the aircraft must maintain straight and level flight until the required glide speed is attained before lowering the nose into the glide attitude. Again emphasise the correct procedure of change, check, hold, adjust, check, hold and trim.
 - ii. Maintaining the glide:
 - a. Maintain a constant good lookout. For aircraft without a rudder trim a constant application of the left rudder is required to maintain heading and balance.
 - b. Due to the reduced power the engine cools down very fast requiring a clear-up every 500' – 1000'. For the clear-up follow the procedure as discussed in 'Initiating a straight climb from the glide'. Maintain this attitude for 5-10 seconds before reducing the power, regaining the gliding attitude, while maintaining the correct speed throughout.
 - c. Richen the mixture as required during the descent.
 - iii. Levelling off from the glide at a predetermined altitude:
 - a. Anticipation for levelling off is calculated at one tenth of the rate of descent.
 - b. Students must be prepared to anticipate the large pitch up moment as power is applied. Many students are caught unawares and usually end up in the climb attitude before 'catching' the pitch-up movement.
 - c. Follow the correct procedure of change, check, hold, adjust, check, hold and trim.
 - d. Allow the speed to build up to the cruising speed before setting cruise power.
 - iv. Initiating a straight climb from a glide:
 - a. Anticipate pitch changes.
 - b. Maintain correct speed, heading and balance.
 - v. The effect of power on the glide:
 - a. Point out the relationship between power/nose attitude/speed.
 - b. Trim changes.
 - vi. The effect of flap on the glide:
 - a. To maintain the correct gliding speed with flap the instructor must point out the large changes (lowering) in nose position as flap is increased. This results in large increases in the rate of descent.
 - b. With full flap, increase the rate of descent by progressively lowering the nose position. Indicate the large increase in the rate of descent

relative to the small increase in the speed. Also point out the fast bleed-off in speed when the correct glide attitude (for the flap setting) is resumed.

- c. To prepare the student for circuits and landings allow him to practice gliding with flap and power settings as for final approach so that he can familiarise himself with the speed/attitude relationship.
- vii. From a descent with flap and undercarriage down, initiate a straight climb while raising flaps and undercarriage:
 - a. Most important aspect is the correct sequence of events namely power, rotate to climb attitude, clean-up flaps and gear throughout.
 - b. Maintain heading and balance.
- 2. Discuss the common faults students usually make.
 - i. When initiating the glide a tendency exists to lower the nose into the glide attitude as the power is reduced. This results in too high a glide speed with high rates of descent.
 - ii. Most students forget the carb heat.
 - iii. Speed control. If the student tends to vary his nose position, which causes variations in speed, the chances are good that his problem is caused by trying to pay too much attention to instrument indications and disregarding attitude flying.
 - iv. Balance control. If no rudder trim is fitted the pilot must constantly apply the correct amount of left rudder.
 - v. During the warm-up the speed must be maintained throughout. This is also a very good co-ordination exercise.
 - vi. The flap must not be used as a speed-brake during the glide. It is not there to control the speed with, but to control the rate of descent.
 - vii. Most students are not prepared for the large pitch-up moment when power is applied during the levelling off exercise.
 - viii. Point out the dangers of trying to 'stretch the glide' – i.e. the reason for gliding at the recommended airspeeds.
 - ix. Only a very thorough briefing can result in the go-around procedure being executed correctly. The whole exercise is based upon the correct sequence of events being followed.

3. Discuss the student's actual faults

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

f. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

SIDE SLIPPING

1. AIM

DEFINITION

An aircraft may be considered to be side slipping when it's flight path is at an angle to the heading of the aircraft's nose and is achieved by a cross-controlled condition of flight applied during a straight glide or gliding turn.

According to the definition there are three definite types of sideslip which have to be discussed, namely:

- i. Nose yawed.
- ii. Slipping turns.
- iii. Nose straight.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable Procedures and Check lists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Considerations of Airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To accustom the student pilot to side slipping the aircraft, and instil confidence in handling the aircraft with Maximum deflection of the flight controls, and to have a complete understanding of the theory which eventually determines:

- i. The aircraft configuration.
- ii. The IAS – attitude relationship (position of static vent).
- iii. The effect of ailerons and rudder.
- iv. The effect of wind (head, tail and crosswind.)

HOW THE EXERCISE APPLIES TO FLYING

- i To get rid of excess height during an approach.
- ii Crosswind landing.
- iii Engine fire – to divert flames and smoke from cabin.
- iv Flap failure.

2. PRINCIPLES INVOLVED

- i. Forces in a glide.
- ii. Forces in a turn.
- iii. Newton's laws.
- iv. Forces during a side slip.
- v. Lift/drag relationship.
- vi. Wind effect – crosswind and gradient.
- vii. Airspeed indicator errors.
- viii. Effect of flaps – downwash over elevator and rudder reduces effective.

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3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AIRCRAFT HANDLING TECHNIQUES:-

DEMONSTRATION

1. SLIDE-SLIP WHILE MAINTAINING TRACK –
NOSE YAWED

ELEVATORS:-

- i. Establish the aircraft in a normal straight glide, without flaps and properly trimmed , gliding into the wind.
 - ii. Lookout.
 - iii. Engine consideration for descending.
 - iv. Select a ground feature (into wind) directly ahead of the aircraft to aid in maintaining direction (i.e. road or railway).
 - v. Note the rate of descent in the straight glide.
 - vi. Note the IAS- nose attitude relationship.
 - Entry:
 - a. Slowly apply aileron in the direction of the required sideslip.
 - b. Maintain direction along ground feature by applying (top rudder) to prevent the aircraft nose yawing in the direction of the side slip.
 - c. Maintain the normal gliding nose attitude with elevators, note difference in IAS reading at that nose attitude, as well as increased rate of descend.
 - vii. During the sideslip:
 - a. Note the path of descent is at an angle to the heading of the nose.
 - b. To increase rate of descent, continuously apply further aileron in direction of sideslip and additional opposite rudder (top rudder) to prevent the nose yawing, whilst maintaining nose attitude with elevators.
 - c. The side slip limit has been reached when full opposite rudder (top rudder) has been applied and any further aileron input will cause the aircraft to turn in the direction of the side slip.
- Note:
- i. Continuously increasing rate of descent as controls are applied further.
 - ii. IAS/nose attitude relationship for side slips to different sides (due to pilot/static vent position).
 - iii. Positive control application required to maintain the side slip condition.
 - iv. Recovery from the side slip.
 - a. Simultaneously and smoothly centralise rudder and ailerons, levelling

- the aircraft laterally, whilst using the elevators to maintain the normal straight glide nose attitude.
- b. Note that the normal indicated glide speed is regained, because the correct gliding attitude has been maintained. Note loss of height during side slip.
- c. Engine considerations.

2. SIDE SLIP WHILE TURNING – SLIPPING TURNS

- i. Establish the aircraft in a normal gliding turn without flaps then enter a slipping turn.
 - i. Look out.
 - ii. Engine considerations.
 - iii. Note the rate of descent.
 - iv. Note the IAS/nose attitude relationship.
 - v. Entry:
 - a. Apply aileron in the direction of the bank.
 - b. Simultaneously, apply sufficient top rudder to prevent the nose from yawing too rapidly towards the lower wing, in addition also preventing an increase in the rate of turn.
 - c. Maintain the gliding turn attitude.
 - vi. During the slipping.
 - a. Regulate the rate of turn with ailerons and rudder.
 - b. Maintain required nose attitude.
 - c. Note:
 - i. Higher rate of descent .
 - ii. IAS/nose attitude relationship.
 - iii. Positive application of flight control required.
 - vii. Recovery from the slipping turn:
 - a. Simultaneously and smoothly reduce rudder and aileron application until the balanced gliding turn is regained.
 - b. Note normal indicated gliding speed regained.
 - c. Engine considerations.

3. SIDESLIP WHILE MAINTAINING TRACK – NOSE STRAIGHT

- i. To be demonstrated from a normal power off glide or from a power-assisted descent in a crosswind condition.
 - i. Look out.
 - ii. Engine considerations.
 - iii. Select a line feature with the wind blowing across it and align the aircraft with this feature.
 - iv. Entry:
 - a. Slowly apply ailerons into wind simultaneously applying sufficient opposite rudder (top rudder) to prevent the aircraft nose from yawing away from the line feature.
 - b. Maintain the desired attitude with the elevators – note the IAS error is now negligible.

- v. During the sideslip:
 - a. Maintain directional control by simultaneous release or application of both rudder and aileron, as determined by the aircraft descending along the line feature.
 - b. With careful manipulation of the sideslip recovery phase a crosswind landing may be successfully carried out from this manoeuvre.
- vi. Recovery from the sideslip:
 - a. Simultaneously and smoothly centralise rudder and ailerons, levelling the aircraft laterally, whilst using the elevators to maintain the normal straight glide nose attitude and simultaneously applying the appropriate drift correction to remain tracking along the line feature.
 - b. With careful manipulation of the sideslip recovery phase a crosswind landing may be successfully carried out from this manoeuvre.

c CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Lookout.
- ii. Correct use of controls.
- iii. Aircraft limitations.

ENGINE CONSIDERATIONS

- i. Temperature and pressures.
- ii. Mixture control.
- iii. Engine warm-up.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Gliding and gliding turns.
- ii. Further effect of controls.
- iii. Entry to incipient/full off a gliding turn.
- iv. Cross-wind landings.
- v. Flapless landings.

e DE-BRIEFING AFTER FLIGHT

- 1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. The correct way of entering the side slip.
 - ii. The aspect of the more rudder on aileron input the higher the rate of descent.
 - iii. The recovery from the sideslip.

2. Discuss the common faults students usually make

- i. When initiating a side slip they find it difficult to do it in a straight line.
- ii. Speed control generally is of a poor standard due to the awkward flight condition.
- iii. During the recovery the aircraft yaws too much because of poor yaw anticipation of the student.
- iv. A student during his initial attempts at side slip may cause tenseness on the controls and resulting over controlling and lack of co-ordination.

3. Discuss the student actual faults

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

f. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

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EXERCISE 9

TURNING

1. AIM

DEFINITION

A medium turn is a change of direction at a bank angle of 30° whilst maintaining balance and altitude

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and checklists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Considerations of Airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight .

WHY IT IS BEING TAUGHT

To enable the student to understand the reasons for certain observations and effects which must be applied to execute and accurate medium turn, and with emphasis on the use of the horizon as an external reference for the correct judgement of attitude and angle of bank.

HOW THE EXERCISE APPLIES TO FLYING

- i. To change direction in flight.
- ii. Improves co-ordination between control column and rudders .
- iii. In the circuit.
- iv. Navigation turning points.
- v. Advanced flying – aerobatics.
- vi. Leading into steep and maximum rate turns.
- vii. Instrument flying exercises and letdowns – accurate rates of turn.

2. PRINCIPLES INVOLVED

- 1. NEWTON'S LAWS, as applicable to:
 - i. Commencing the turn.
 - ii. Maintaining the turn.
 - iii. Rolling out of the turn.
- 2. RECAP ON:
 - i. Further effect of ailerons.
 - ii. Adverse aileron yaw.
 - iii. Use of rudder for balance.
- 3. FORCES IN THE TURN
 - i. Recap on forces during straight and level flight:
 - ii. Lift, weight and formula.
 - iii. Discuss forces in a turn.

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- iv. Lift, weight and formula.
 - v. Discuss load factor:
Formula: $\frac{\text{Lift}}{\text{Weight}} = \frac{1}{\cos(\text{Bank angle})}$
 - vi. Discuss power available/power required curve for turning.
4. DISCUSS:
- i. Turn rate.
 - ii. Turn radius.
5. EXPLAIN THE EFFECT OF WIND ON THE TURN
6. DISCUSS, IN RELATION TO THE TURN:
- i. Effect of the aircraft weight.
 - ii. Effect of balance (skid and slip).
 - iii. Aircraft attitude.
 - iv. Density altitude.
7. DISCUSS THE EFFECT OF:
- i. Slipstream.
 - ii. Torque.

3. DESCRIPTION OF AIR EXERCISE

- a. APPLICABLE PROCEDURES AND CHECKLISTS
- b. AIRCRAFT HANDLING TECHNIQUES:-

DEMONSTRATION

1. LEVEL TURN

- i. From straight and level flight at cruise power, Execute a 30° angle of bank medium turn.

OBSERVATION

- i. Before entry:
 - a. Trim for straight and level.
 - b. Lookout.
 - c. Note airspeed before entry.
- ii. Entry:
 - a. Roll into turn – refer to visual horizon and/or instrument indication.
 - b. Control co-ordination-aileron and rudder together.
 - c. Pitch attitude controlled with elevator.
 - d. Upon reaching required angle of bank (30°) and nose attitude, check and hold.
- iii. In the turn.
 - a. Lookout.
 - b. Maintain a constant angle of bank, attitude and balance.
 - c. Maintain constant nose attitude.
 - d. Note slightly lower airspeed.
 - e. Note instrument indications.
 - f. Do not trim in turn.
- iv. Recovery:
 - a. Rolling out of turn – refer to visual

- horizon and/or instruments indications.
 - b. Control coordination – aileron and rudder together.
 - c. Pitch attitude controlled with elevator.
 - d. Check straight and level – refer to visual and/or instrument indications – note airspeed.
 - ii. Turn to the opposite direction.
 - i. Lookout.
 - ii. Pre-entry and entry procedures same as previous.
 - iii. In tandem-seat trainer, no difference noted in nose position. However, in side-by-side seat trainer, indicate the change in nose position relative to the horizon (or same angle of bank).
 - iii. Carry out turns onto pre-selected points/headings.
 - i. Lookout.
 - ii. Pre-entry and entry procedure same as above.
 - iii. Rolling out – anticipate recovery on point/heading.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Lookout – clear of other aircraft and cloud.
- ii. Trimmed for straight and level flight – not to be trimmed during the turn.
- iii. Use of visual horizon for nose attitude and bank angle, confirmed by instrument indications.
- iv. Co-ordination of controls throughout exercise – balance.

ENGINE CONSIDERATIONS

- i. Temperature and pressures.
- ii. Throttle set for cruise power.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Straight and level flight.
- ii. Effect of controls – adverse aileron yaw and rudder usage.
- iii. Use of trimmers.

e. DE-BRIEFING AFTER FLIGHT

- 1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Rolling into the level turn:
 - a. Before commencing the turn the aircraft must have the correct speed and also be correctly trimmed.
 - b. Co-ordination between aileron/rudder/elevator is essential.
 - c. Follow the correct procedure for each flight control application: Change, check, hold, adjust. Do not trim.

- ii. Maintaining the turn:
 - a. Constant good lookout.
 - b. Maintain the nose attitude using outside visual references only with angle of bank.
 - c. Corrections according to the artificial horizon.
- iii. Rolling out of the turn:
 - a. Co-ordination between aileron/rudder/elevator is essential.
 - b. Follow the correct procedure for flight control application.
 - c. During the roll-out use outside references for nose attitude indications. As the wings approach the laterally level position, the nose position for straight and level should slowly be gained by gradually relaxing rearward pressure on the control column while the wings are being rolled level.
- iv. The turn in the opposite direction:
 - a. Memorise the correct nose position as per visual references according to the horizon.

2. Discuss the common faults students usually make

- i. Lookout before rolling into the turn.
- ii. Most students have difficulty in co-ordinating the simultaneous use of all the flight controls during the roll-in and roll-out of the turn.
- iii. The roll-in and roll-out must be a even smooth rate of roll.
- iv. Use visual references for nose position with a cross-check on the AH for angle of bank. Excessive attention on instruments is a common fault leading to fluctuations of the nose position with resultant attitude fluctuation.
- v. Fluctuations in angle of bank with nose position remaining constant.
- vi. Fluctuations in nose position with angle of bank remaining constant.

3. Discuss the student's actual faults

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

f. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

DESCENDING AND CLIMBING TURNS

1. AIM

DEFINITION

A descending turn is a change of direction at a bank angle of 15° , aircraft in balance and descending.

CLIMBING TURNS

A climbing turn is a change of direction at a bank angle of 15° , aircraft in balance and climbing.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and checklist.
 - b. Aircraft handling technique:- Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To give the student a good understanding and thorough knowledge of the principles required to:

- i. Roll into the climbing/descending turn.
- ii. Maintaining the climbing/descending turn.
- iii. Rolling out of the climbing/descending turn.

HOW THE EXERCISE APPLIES TO FLYING

- i. General flying exercises.
- ii. Circuit and landing.
- iii. Navigation.
- iv. Instrument Flying procedures.

2. PRINCIPLES INVOLVED

- i. Same as for medium level turns.
- ii. Factors affecting bank angle:
 - a. Outer wing speed/inner wing speed.
 - b. Difference in angle of attack between inner and outer wing.
 - c. Effect of torque/slipstream.
- iii. Power Available & Required (in climb turn only).

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AIRCRAFT HANDLING TECHNIQUES:-

DEMONSTRATION

OBSERVATION

1. DESCENDING TURN

- | | |
|--|---|
| <p>i. From a straight glide, enter a descending turn at 15° angle of bank, whilst maintaining recommended gliding speed.</p> | <p>i. Note attitude and rate of descent before entry.</p> <p>ii. Lookout before commencing turn.</p> <p>iii. Engine considerations.</p> <p>iv. Entry and recovery similar to that for a medium turn.</p> <p style="margin-left: 20px;">a. Maintain constant angle of bank.</p> <p style="margin-left: 20px;">b. Constant airspeed.</p> <p style="margin-left: 20px;">c. Check balance (slip and skid).</p> <p style="margin-left: 20px;">d. Note increase rate of descent.</p> <p style="margin-left: 40px;">1) Note attitude required for the descending turn.</p> <p style="margin-left: 40px;">2) Tendency for aircraft to roll out of turn (hold on bank).</p> <p style="margin-left: 40px;">3) Instrument indications.</p> <p style="margin-left: 40px;">4) Engine temperatures and pressures.</p> <p>v. Recover from gliding turn to a straight glide.</p> <p>vi. Repeat exercise to opposite side and note attitude.</p> <p>vii. Repeat exercise rolling out onto pre-selected heading/ground feature.</p> |
| <p>ii. Lower flaps in stages during the gliding turn and repeat above exercise at flaps down gliding speed.</p> | <p>i. During flap extension adjust nose attitude/airspeed to recommended flap down gliding speed.</p> <p>ii. Note change in:</p> <p style="margin-left: 20px;">a. Nose attitude.</p> <p style="margin-left: 20px;">b. Rate of descent.</p> <p style="margin-left: 20px;">c. Instrument indications.</p> <p>iii. Maintain the gliding turn and adjust nose attitude/airspeed to recommended flapless gliding speed whilst retracting the flaps.</p> |
| <p>iii. Repeat exercise using partial power at recommended descent speed.</p> | <p>i. During the gliding turn, apply partial power</p> <p>ii. Note changes in:</p> <p style="margin-left: 20px;">a. Note attitude.</p> <p style="margin-left: 20px;">b. Rate of descent.</p> <p style="margin-left: 20px;">c. Instrument indications.</p> <p>iii. Note:</p> <p style="margin-left: 20px;">a. Throttle (power) controls the rate of descent.</p> <p style="margin-left: 20px;">b. Control column (elevator) controls the speed.</p> <p>iv. Recover as before, reducing power to that required for a normal gliding turn.</p> |

2. CLIMBING TURN

- i. From a straight climb, enter a climbing turn at 15° angle of bank, whilst maintaining recommended climbing speed.
- iii. Lower optimum climb flap in the climbing turn and repeat above exercise at optimum flap climbing.
- i. Note attitude and rate of climb before entry.
- ii. Lookout before commencing turn.
- iii. Engine consideration.
- iv. Entry and recovery similar to that for descending turn.
- v. In the turn:
 - a. Maintain constant angle of bank.
 - b. Constant airspeed.
 - c. Check balance (slip & skid).
 - d. Note decreased rate of climb and change in attitude required to maintain climb speed.
 - e. Tendency for aircraft to roll into the turn (over bank) – Note
 - f. Instrument indications.
 - g. Engine temps and pressures.
 - h. Discuss the effect of over banking during the climb which will affect speed and the rate of climb.
- vi. Recover from the climbing turn into a straight climb.
- vii. Repeat exercise to opposite side and note attitude.
- viii. Repeat exercise rolling out onto pre-selected heading/ground features.
- i. During flap extension adjust nose attitude/airspeed to recommended optimum flap climb speed.
- ii. Note change in:
 - a. Nose attitude.
 - b. Rate of climb.
 - c. Instrument indications.
- v. Maintain the climbing turn and adjust nose attitude/airspeed to recommended flapless climb speed during the flap retraction phase.

c.

HANDLING

AIRMANSHIP

- i. Lookout – clear of other aircraft and cloud.
- ii. Maintain aircraft in-trim at all times.
- iii. Use visual horizon for obtaining nose attitude and bank angles in turns and confirm with instrument indication.
- iv. Co-ordination of controls throughout exercise.
 - a. Balance – slip and skid.
 - b. Speed control during flap extension and retraction.

ENGINE CONSIDERATIONS

CONSIDERATIONS OF AIRMANSHP AND ENGINE

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- i. Same as straight climbs and descents.

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d. SIMILARITY TO PREVIOUS EXERCISES

- i. Effect of controls.
- ii. Straight climbs and descents.
- iii. Medium turns.

e. DE BRIEFING AFTER FLIGHT

- 1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Descending turns.
 - a. The procedures and techniques for rolling into the descending turn and out of the descending turn as basically the same as for the medium turn.
 - b. The aircraft tends to constantly roll out of turn.
 - ii. Climbing Turns.
 - a. The procedures and techniques for rolling into the climbing turn and out of the climbing turn are basically the same as for the med turn.
 - b. The aircraft tends to constantly roll into the turn. This tendency is very marked for climbing turns to the left resulting in excessive bank angle causing a reduction in the rate of climb.
- 2. Discuss the common faults students usually make.
 - i. Insufficient lookout.
 - ii. With the reduced airflow over the rudder during the glide, (due to the low airspeed and removal of the slipstream) a much larger rudder input is required when rolling into and out of the descending turn to counteract the adverse aileron yaw.
 - iii. Most students are caught out by the excessive over bank tendency during a climbing turn to the left. This usually also affects the speed of the aircraft as well as the rate of climb.

3. Discuss the student's actual faults

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

EXERCISE 10A

SLOW FLIGHT

1. AIM

To enable the student to fly the aircraft at the lower speed range safely and accurately, and to control the aircraft in balance while returning to normal airspeeds.

DEFINITION

Any speed below the normal operating range of the aircraft.

WHY IT IS BEING TAUGHT

To give the student a good understanding and thorough knowledge of the principles required to fly at the lower speed range of the aircraft at different attitude, trim and power settings at various speeds and configurations.

2. LONG BRIEFING

i. Objectives:

- a. Aeroplane Handling Characteristics during Slow Flight at –
 - V_{s1} & $V_{s0} + 10$ knots;
 - V_{s1} & $V_{s0} + 5$ Knots;
- b. Slow Flight During Instructor Induced distractions;
- c. Effect of going around from an approach or landing in configurations where application of engine power causes a strong 'nose-up' movement requiring a large trim change;

ii. Considerations:

a. The effect of controls during Slow Flight

The ailerons can be very ineffective at slow airspeeds. Furthermore, in a slow airspeed/high angle-of-attack situation, adverse yaw (described in exercise 9) is far more pronounced, especially with large aileron deflections, i.e. when rolling into or out of a turn.

The rudder is also less effective at slow airspeed and coarser use of the rudder pedals may be necessary.

The elevator/stabilator is the most powerful of the three primary flying controls. As well as controlling the attitude, the tail plane or stabilator provides stability in pitch. The elevator or stabilator is, of course, less effective at slow airspeeds. In addition the high angle of attack of the wing can produce a considerable 'downwash' over the tail, altering its angle of attack and therefore the lift force produced by the tail plane. The effect of downwash is generally more noticeable on a high-wing aircraft than a low-wing aircraft.

The slipstream will alter the feel and effectiveness for the rudder and the elevator/stabilator (except on a 'T'-tail aircraft where the elevator is outside the slipstream). At slow airspeeds the helix of the slipstream is much tighter around the fuselage and its effect more pronounced. Changes in power setting at slow airspeeds will have a more noticeable yawing effect, which the pilot will have to anticipate and correct.

Raising and lowering of flap is another factor to consider more carefully during slow flight. The change in drag (and therefore change in airspeed) is more critical at these

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slower airspeeds. Do not raise the flaps if the airspeed is below V_{s1} – the flaps-up stalling airspeed (i.e. the bottom of the green arc on the ASI).

All control movements should be smooth and coordinated. Harsh and excessive control movements must be avoided.

b. Maneuvering in Slow Flight

During the flight at slow airspeed, maintaining the selected airspeed and balanced flight are all-important. Any change in power setting will have a pronounced yawing effect, which the pilot must anticipate and correct. Similarly, when turning the increased adverse yaw needs to be compensated for by the pilot.

We return to the maxim that Power + Attitude = Performance. To fly level, the required power is set and the attitude adjusted to attain the target airspeed. It may be necessary to make small adjustments to the power and attitude to stay level at the selected airspeed. An excess of power will cause the aircraft to climb, while too little power will cause the aircraft to descend. Attitude is controlling airspeed; power is controlling height/altitude.

During a turn, the small loss of airspeed normally acceptable is no longer safe so, the aircraft is pitched nose-down to maintain airspeed and power is added (during a level turn) to stop the aircraft descending. During slow flight, turns are normally made at no more than 30° angle of bank due to the increase in stalling speed as angle of bank increases emphasize awareness and caution.

It is worth repeating that during all these maneuvers, keeping the aircraft in balance using the rudder and maintenance of the selected airspeed through attitude is all-important.

c. Distractions During Slow Flight

The danger of flying too slowly often manifests itself when the pilot is distracted from the primary task of flying the aircraft by some secondary factor (i.e. radio calls, talking to passengers, map reading, positioning in the circuit etc.) The instructor is to simulate a number of distractions to demonstrate the importance of making the actual flying of the aircraft the **Number One** priority at all times.

iii. Airmanship.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AIRCRAFT HANDLING TECHNIQUES:-

DEMONSTRATION

OBSERVATION

1. CONTROLLED FLIGHT AT LOW AIRSPEED
(DEMONSTRATION AT $V_{s1} + 10$ KTS)

i. From straight and level flight.

- i. Maintain a lookout whilst reducing power and maintaining altitude, heading and balance.
- ii. Re-trim in stages and when $V_{s1} + 10$ knots is established, adjust power as necessary to maintain airspeed and altitude.
- iii. Note the attitude and reduced response from the flying controls.

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- iv. Altitude loss is corrected by use of the elevators together with increasing the power.
 - v. Student practice.
- ii. Climbing Flight.
 - i. From controlled straight and level flight $V_{s1} + 10$ knots.
 - ii. Nominate a particular climb rate.
 - iii. Lookout.
 - iv. Gradually increase power whilst maintaining speed, heading and balance
 - v. Stabilise the power setting when the selected rate of climb has been achieved.
- iii. Turning flight.
 - i. From level slow flight at $V_{s1} + 10$ knots, lookout and enter a medium level turn without increasing power. Note loss of speed when altitude is maintained. Re-enter a medium banked turn, increasing power maintaining constant speed and altitude.
 - ii. Note the higher pitch attitude and the need to use elevators and power to correct any altitude loss.
 - iii. Student practice.
- iv. Descending flight.
 - i. From controlled straight and level flight at $V_{s1} + 10$ knots.
 - ii. Nominate a rate of descent.
 - iii. Lookout and check a clear area along the descent path.
 - iv. Gradually decrease power whilst maintaining speed, heading and balance.
 - v. Stabilise the power setting when the selected rate of descent has been achieved.
 - vi. Return to straight and level slow flight by maintaining speed and increasing power until the descent rate is zero.
 - vii. Heading and balance should be maintained throughout.
 - viii. Student practice.

Student practice: Following the completion of the slow flight demonstrations and practice as described above, the student should be given the opportunity of practicing slow flight at $V_{s0} + 10$ knots with the flaps lowered. Manoeuvres should include straight and level, level turns, straight climbs and descents, and climbing and descending turns.

During this period the instructor will introduce pilot distractions.

2. CONTROLLED FLIGHT AT LOW AIRSPEED (DEMONSTRATION AT $V_{s1} + 5$ KTS)

- i. From straight and level flight.
 - i. Maintain a lookout whilst reducing power and maintaining altitude, heading and balance.
 - ii. Re-trim in stages and when $V_{s1} + 5$ knots is established, adjust power as necessary to maintain airspeed and altitude.
 - iii. Student practice.

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- ii. Climbing flight.
 - i. From controlled straight and level flight $V_{s1} + 5$ knots.
 - ii. Nominate a particular climb rate.
 - iii. Lookout.
 - iv. Gradually increase power whilst maintaining speed, heading and balance.
 - v. Stabilise the power setting when the selected rate of climb has been achieved.
- iii. Turning flight.
 - i. From level slow flight at $V_{s1} + 5$ knots, lookout and enter a medium level turn without increasing power.
 - ii. Note how quickly the airspeed lowers when altitude is maintained in the turn.
 - iii. Return to straight slow flight.
 - iv. Lookout and re-enter a medium turn whilst increasing power to maintain airspeed and altitude.
 - v. Student practice.
- iv. Descending flight.
 - i. From controlled straight and level flight at $V_{s1} + 5$ knots, nominate a rate of descent.
 - ii. Lookout and select a clear area along the descent path.
 - iii. Gradually decrease power whilst maintaining airspeed, heading and balance.
 - iv. Stabilise the power setting when the selected rate of descent has been achieved.
 - v. Re-trim.
 - iv. Student practice.

Student practice: The student should now practice level flight, level turns, straight climbs and descents and climbing and descending turns without flap and descents and climbing and descending turns with flap down at $V_{s0} + 5$ knots.

Note 1: At the end of this period the symptoms of the stall can be demonstrated. Only a small forward movement of the control column is necessary to return the aircraft to a condition of controlled slow flight.

Note 2: If a demonstration of the effects of applying full power when the aircraft is trimmed with flaps down in the landing configuration has not yet been carried out, then it must be demonstrated at this stage.

Emphasize the effect of going around in configurations where applications of engine power causes a strong pitch-up moment and the need to contain this pitch-up, e.g. the use of a reference (level) attitude initially with incremental attitude changes as each stage of flap is retracted. Emphasize application of these pitch attitudes to the go-around.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Lookout – clear of other aircraft and cloud.
- ii. Maintain aircraft in-trim at all times.

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- iii. Use visual horizon for obtaining nose attitude and bank angles in turns and confirm with instrument indication.
- iv. Co-ordination of controls throughout exercise:
 - a. Balance – slip and skid.
 - b. Speed control during flap extension and retraction.

ENGINE CONSIDERATIONS

- i. Same as straight climbs and descents.

d SIMILARITY TO PREVIOUS EXERCISES

- i. Effect of controls.
- ii. Straight climbs and descents.
- iii. Medium turns.
- iv. Climbing and Descending turns.

e DE BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Straight and level flight at V_{s1} and V_{s0} – the instructor to point out the relationship between the lower than normal power setting, speed (V_{s1} and V_{s0}) and higher nose attitude required to maintain altitude – Power + Attitude = Performance.
 - ii. Slow flight in the turn where the bank angle is confined to 15° , and the power is increased to maintain altitude due to the increase in stalling speed as bank angle is increased.
 - iii. The pronounced yawing effect from slipstream and torque with power changes.
 - iv. The relative effectiveness of the primary controls at slow speed. The ailerons least effective, rudder requiring greater movement and the elevator/stabilator the most effective.
 - v. The danger of retracting flap at lower airspeeds – DO NOT raise the flaps if airspeed is at the bottom of the green arc (V_{s1}).
 - vi. Maintaining the aircraft in balance is all-important.
 - vii. Beware of distractions e.g. radio calls, map reading, etc. Flying the aircraft is the number one priority.
2. Discuss the common faults students usually make
 - i. The student will normally tend to concentrate on the airspeed which in one sense is beneficial, but as the object of the total exercise is complete control over airspeed, altitude, heading and balance he must learn to scan the various instruments whilst also maintaining a careful lookout.
 - ii. In this respect it should be pointed out that once the correct power setting has been achieved, the maintenance of a constant attitude will also result in a constant airspeed, unless the aircraft is allowed to become unbalanced or updraughts/downdraughts are present.
 - iii. Balance, particularly when the aircraft is being flown at high power and low airspeed will create a much larger problem than when the aircraft is being flown at normal operational speeds, and it may be necessary in the early stages for the instructor to fly the aircraft in relation to pitch and lateral level and leave the student the single task of maintaining balance by use of rudder.

NOTE: Slow flight, all forms of stalls and recovery from spins at the incipient stage are those exercises included in the mandatory two hours of stall/spin awareness and avoidance training which is now part of the private pilot license course.

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3. Discuss the student's actual faults

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

f. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

EXERCISE 10B

STALLING

1. AIM

DEFINITION

Stalling is a condition of flight which occurs when the angle between the wing and the relative airflow exceeds the critical angle of attack, causing the airflow over the surfaces of the wing to break away resulting in a loss of lift, loss of altitude and a pitching moment. An aircraft could stall at any airspeed, any attitude, any power setting, any configuration and at any weight or loading.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and checklists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Consideration of airmanship and engine handling.
 - d. Similarity to previous exercise.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To give the student a good understanding and thorough knowledge of the principles required to:

- i. Recognise the symptoms of an approaching stall.
- ii. The characteristics of the stall.
- iii. The recovery procedure, with emphasis on recovering with the minimum loss of altitude.

HOW THE EXERCISE APPLIES TO FLYING

This is an abnormal condition of flight which may occur during flight manoeuvres entailing slow flight, high angle of attack and high speed/high loadings.

2. PRINCIPLES INVOLVED

1. RECAP ON:
Exercise 4, Para 2.1 (i) and (ii) – Effects of Controls.
2. NEWTON'S LAWS
Inertia.
3. DISCUSS THE FORCES AND COUPLES ON AN AIRCRAFT APPROACHING THE STALL:

LIFT
 - i. Formula.
 - ii. Boundary Layer flow – adverse pressure gradient.
 - iii. Movement of Centre of Pressure (C.P.) with angle of attack.
 - iv. Airflow at Critical Angle of Attack.
 - v. Basic stalling speed as per aircraft manual.

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4. DISCUSS:
 - i. Symptoms of the approaching stall.
 - ii. Characteristics at the stall.
 - iv. Recovery procedure.
 - v. Effect of power on recovery.
5. DISCUSS THE EFFECT OF WEIGHT:
 - i. Greater Mass.
 - ii. Distribution of mass in aircraft.
6. DISCUSS FACTORS AFFECTING THE STALL:
 - ii. MANOEUVRES – g-loading.
 - iii. AIRCRAFT CONFIGURATIONS
 - iv. THRUST AND SLIPSTREAM
 - v. AEROFOIL SECTIONS:
 - a. Shape.
 - b. Icing.
 - c. Damage.
7. ADVANCED STALLING
 - i. WING TIP STALLING
 - a. Reason for: Power – slipstream.
Flaps.
 - b. Prevention of: Washout.
Change of wing section.
Other device.
 - ii. HIGH SPEED STALLING/ G LOADING
 - a. Inertia.
 - b. Turning.
 - iii. AUTOROTATION

3. DESCRIPTION OF AIR EXERCISE

- a. **APPLICABLE PROCEDURES AND CHECKLISTS**
- b. **AIRCRAFT HANDLING TECHNIQUES:-**

DEMONSTRATION

OBSERVATION

1. THE STUDENT'S FIRST STALL

- | | |
|---|---|
| <ol style="list-style-type: none"> i. Stall the aircraft from straight and level flight and recover without power. | <ol style="list-style-type: none"> i. Lookout/Area. ii. Complete pre-stall checks (HASELL). iii. Inspection Turn. iv. Not violent or unpleasant. v. Control easily regained. |
|---|---|

2. ENTRY AND SYMPTOMS OF THE STALL

- i. Demonstrate another stall from straight and level flight (1g) and detail the symptoms.

- i. Entry:
 - a. Complete pre-stall checks and inspection turn (HELL).
 - b. Close throttle (carb. Heat as required), maintain direction and altitude.
 - c. Remain in trim up to recovery speed.
- ii. Symptoms of the approaching stall:

Attitude – nose position.
 Speed – decreasing.
 Control – effectiveness.
 Stalling warning.
 Buffeting.
- iii. Fully developed stall:
 - a. Sink – Loss of altitude.
 - b. Pitching moment.

NOTE: Speed/altitude.

- ii. Now let the student have ample practice at handling the aircraft on and just before the stall.

3. EFFECT OF POWER ON RECOVERY

- i. Demonstrate a stall form straight and level flight, recovering without power.

- i. Lookout/Area.
- ii. Entry:
 - a. Complete pre-stall checks and inspection turn.
 - b. Close throttle (carb heat as required), maintain direction and height.
 - c. Note symptoms of approaching stall.
 - d. Note altitude and speed at moment of stall.
 - e. Remain in trim up to recovery speed.
- iii. Recovery:
 - a. Move control column just sufficiently forward to unstall the aircraft and maintain direction.
 - b. Once flying airspeed is achieved and the aircraft is accelerating, rotate the nose towards the climb attitude.
 - c. As the nose moves through the horizon apply full power
 - d. Note height loss.
- iv. Climb away and complete after take-off checks.
- v. Level off at the entry attitude and establish straight and level flight.

- ii. Demonstrate a stall from straight and level flight, and recover with power.

- i. Lookout/Area.
- ii. Entry:
 - a. Complete pre-stall checks and inspection turn.
 - b. Close throttle (carb heat as required) – maintaining direction and altitude.
 - c. Note symptoms of approaching stall.
 - d. Note altitude and speed at moment of stall.
- iii. Recovery:
 - a. Move the control column centrally forward simultaneously applying full power.
 - b. When stalling symptoms cease rotate smoothly to the climb attitude.
 - c. Note altitude loss.
- iv. Climbing away: Complete after take-off checks.
- v. Level off at the entry altitude and establish straight and level flight.
- vi. Note amount of movement of control column needed to regain control.
- vii. Compare altitude loss during this exercise with the altitude lost during recovery without power.

4. RECOVERY WHEN WING DROPS

- i. Demonstrate a stall form straight and level using a low power setting. Use standard recovery method.

- i. Lookout.
- ii. Entry:
 - a. Complete pre-stall checks.
 - b. Select a low power setting, prevent yaw, keep wings level and maintain altitude.
 - c. Note symptoms of approaching stall. Apply sufficient rudder in appropriate direction to induce a wing drop.
 - d. Note altitude and speed at moment of stall (speed lower than before due to use of power as well as higher nose attitude).
- iii. Recovery when wing drops:
 - a. Simultaneously apply: Sufficient opposite rudder to prevent further yaw. Control column centrally forward until symptoms cease; full power; sufficient opposite rudder to prevent further yaw.
 - b. Use ailerons to level wings when flying speed regained whilst maintaining balance.
 - c. Ease out of resultant descent and complete after take-off checks one established in the climb.
- iv. Regain entry altitude.

- ii. Demonstrate a stall from straight and level using a small amount of power up to the stall. Attempt to level the wings with aileron at the stall.

Note: To demonstrate how the use of aileron may aggravate the wing drop. It may be found that on certain aircraft a convincing demonstration cannot be made as the dropped wing may be picked up with aileron. In such cases, the demonstration may have to be made with flaps down to prove that the use of aileron at stall recovery can aggravate the wing drop.

- i. Entry procedure as per 4(i).
- ii. Recovery when wing drops.
 - a. Simultaneously apply: Opposite aileron to pick up the dropped wing. Control column sufficiently forward to unstall the wings. Apply full power.
- iii. Note:
 - a. Aileron input tends to aggravate the wing drop.
 - b. Emphasise the importance of using rudder.

5. EFFECT OF POWER ON THE STALL

- i. Demonstrate a stall from straight and level using an appropriate power setting up to the stall.

- i. Lookout.
- ii. Entry:
 - a. Complete pre-stall checks.
 - b. Maintain throttle setting at cruise power and ease nose up, keeping straight.
- iii. Symptoms of the approaching stall:
 - Attitude – Nose position higher.
 - Speed – Decreasing slower.
 - Control effectiveness – elevator and rudder more effective.
 - Stall warning – shorter duration.
 - Buffeting – Less noticeable.
- iv. Symptoms at the stall;
 - a. Sink – Less.
 - b. Pitching moment – more abrupt.
 - c. Tendency to drop a wing.
 - d. Note: Speed. Less altitude loss than for a power off stall.
- v. Standard recovery technique. Complete after take-off checks – clean up once established in the climb.

6. EFFECT OF FLAP ON THE STALL

- i. Demonstrate stalls from straight and level with Optimum flap and then with full flap, using no power. During the recovery, do not exceed the maximum flap extension speed.

- i. Lookout.
- ii. Entry:
- iii. Symptoms approaching the stall:
 - Attitude – compare with power off stall.
 - Speed – decreases rapidly.
 - Control effectiveness – note effectiveness of elevator and rudder.
 - Stall warning – shorter duration.
 - Buffeting – less pronounced or absent.
- iv. Symptoms at the stall
 - a. Sink – more pronounced.
 - b. Pitching moment – more pronounced.
 - c. Tendency of possible wing drop.

- d. Note: Speed – lower attitude.
 - v. Follow standard recovery technique.
- Complete after take-off checks – Clean up once established in the climb

7. RECOVERY FROM THE INCIPIENT STALL

- i. From straight and level demonstrate recovery upon recognition of approach to stall symptoms
 - i. Standard entry procedure.
 - ii. Symptoms of the approaching stall.
Note: Nose attitude.
 - iii. Follow standard recovery technique.
Note: Small control column movement to regain control. Less altitude loss.

8. STALL UNDER APPROACH CONDITIONS

- i. Simulate approach conditions using appropriate power and flap setting for aircraft type.
 - i. Standard entry procedure.
 - ii. Symptoms of the approaching stall.
Note: Nose attitude.
Control effectiveness.
 - iii. Symptoms at the stall.
Note: Lower stalling speed.
 - iv. Follow standard recovery technique.
Note:
 - a. Importance of recovery in the incipient stage – because of the danger of stalling on the approach.
 - b. Pronounced tendency to drop a wing.

9. STALL AT HIGHER SPEEDS

- i. Demonstrate from a power off straight glide.
 - i. Increase speed ± 15 knots and trim.
 - ii. Rapidly rotate into the climb attitude (attempt to exceed 1g).
 - iii. Note the speed at which the stall warning/buffet occurs.
 - iv. Follow standard recovery technique.
Note:
 - a. Higher stalling speed.
 - b. Smaller control column movement to unstall (reduction of back pressure may be sufficient).
 - c. Pronounced tendency to drop a wing.

10. STALL DURING A TURN

- i. Demonstrate from a medium turn.
 - i. Progressively increase bank to $\pm 60^\circ$ and simultaneously increase back pressure until stall warning/buffet is experienced. It may be necessary to gain altitude).
 - ii. Note the speed at which the stall warning/buffet occurs.
 - iii. Follow standard recovery technique.
Note:
 - a. Higher stalling speed.
 - b. Smaller control column movement to unstall (Reduction of back pressure may be sufficient).
 - c. Pronounced tendency to drop a wing.

c. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP: HASELL CHECK

- H HEIGHT – Recovery complete at minimum 2000 ft agl.
- A AIRFRAME – U/C and flap position.
- S SECURITY – Harness tight, seats locked, gyros caged, loose articles stowed.
- E ENGINE – Mixture and pitch and fuel: Pumps and selection as required. Cowl flaps as required. Temperatures and pressures.
- L LOCATION – As listed in 1 below.
- L LOOKOUT – As listed in 2 below.

HASELL checks shortened to HELL for subsequent use in the same location:

- H HEIGHT – Recovery complete at minimum 2000ft agl.
- E ENGINE.
- L LOCATION – As listed in 1 below.
- L LOOKOUT – As listed in 2 below.

1. LOCATION: In relation to ground position to ensure you are:

- i. In the General Flying Area.
- ii. Not over a built-up area.
- iii. Not over high ground.
- iv. Not over rough terrain.
- v. Not over large expanses of water.
- vi. Not over an airfield or in an air corridor.
- vii. Have chosen a possible forced landing field.
- viii. That you have remained in the area inspected.

Note: The student must keep all these points in mind while doing an inspection turn but need not mention them all.

2. INSPECTION TURN: Minimum of 30° bank angle for 360° :

- i. Other aircraft.
- ii. Sufficient separation from cloud.
- iii. A good position relative to the sun.
- iv. Emphasis must be on lookout and not accuracy of the turn.

3. GENERAL

- i. Trim: Aircraft to be maintained in trim up to the recovery speed.
- ii. Reassure the student to prevent nervousness.
- iii. Positive, quick recovery, beware of negative loading.
- iv. Beware of secondary stall.
- v. Nose position for the use of power in recovery.
- vi. Use rudder only until the aircraft is unstalled, then centralise as for normal balance.

ENGINE CONSIDERATIONS

- i. Throttle – Use smooth movements.
- ii. overboost/over-rev.
- iii. Use of carburettor heat.
- iv. Use of power; Mixture, Pitch, Throttle and temperature and pressures.

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- v. Use of cowl flaps.
- vi. Fuel management.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Effects of controls.
- ii. Straight and level flight.
- iii. Medium turns.
- iv. Climbing and descending turns.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise (the important aspects applicable to:
 - i. HASELL and HELL checks.
 - ii. Entry and symptoms of the stall:
 - a. As the power is decreased the speed must be allowed to bleed off slowly by maintaining straight and level flight.
 - b. For each configuration the aircraft will react differently when approaching the stall. To simplify this discussion the instructor must use the same framework and only point out the differences between the stalls. It is essential that the student knows the framework.
Symptoms of approaching stall:
Nose position.
Speed.
Control effectiveness.
Stall warning / buffeting.
Symptoms at the stall:
Speed.
Sink-loss of altitude.
Pitching moment.
 - c. Apply above framework when discussing the effect of power on the stall, the effect of flap on the stall, high speed stalls, stall under approach conditions and stall during turns.
 - iii. Recovery from the stall.
 - a. Correct procedure to be followed.
 - b. Effect of power on recovery.
 - c. Recovery when wing drops.
 - d. Recovery from the incipient stall.
 - iv. For the pre-solo stalling exercises the instructor should do the HASELL checks and not be too concerned if the student has difficulty with them.
2. Discuss the common faults students usually make
 - i. Most students are usually tense when introduced to stalling. The instructor must take care and recover as gently as possible from the first few stalls in order to put the student at ease. Allow the student to recover from his stalls at the incipient stage until he gains confidence.
 - ii. Students tend to place the aircraft directly into the climb attitude as soon as the power is reduced. This results in a rapid entry into the stall which may catch the student unprepared for the recovery due to a rapid speed reduction.

- iii. A common fault is to pull the nose up too high for the stall. Simply maintain altitude by progressively increasing the nose attitude until the aircraft stalls. For power off entries the nose attitude at the stall will coincide very much with that of a straight climb.
- iv. Most students tend to stop a wing-drop at the stall with ailerons (must use rudder).
- v. To prevent the student from wandering off the heading during the stall exercises commence the entry using a prominent feature on the horizon directly ahead of the aircraft.
- vi. During the recovery the nose must not be lowered lower than the gliding attitude, also apply power (throttle movement positive and smoothly simultaneously with the lowering of the nose). Often students have difficulty in estimating the amount of control movement required to recover from the stall.
- vii. During the pull-out, after the recovery, care must be taken not to enter into a secondary stall due to pulling back too harshly on the control column.
- viii. Some students are so relieved after the recovery action, that they completely forget to complete the after T/O checks. If the stall was executed with flaps this will result in the flaps being left at optimum.
- ix. The stall exercise is only completed after the entry altitude is regained.
- x. Complete the HASELL checks at the start of the exercise and HELL checks before each subsequent stall. Do not rush through them. Instructors must set the example.

3. Discuss the student's actual faults

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result of the fault could have led to.
- iv. The corrective action required.

f. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

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EXERCISE 11

SPINNING & SPIN AVOIDANCE

1. AIM

DEFINITION

A spin is a condition of flight where the aircraft is in autorotation which causes yawing, rolling and pitching moments and results in the aircraft following a spiral path at a steady rate of descent.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and checklists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

- i. Safety factor – if the controls are mishandled during aerobatics or any other phase of flight, a spin is in the worst situation that may result, other than major structural failure due to overstressing the aircraft. If the student is able to recover from a spin, he may safely be authorised to do solo general flying.
- ii. It improves the student's confidence and co-ordination.

HOW THE EXERCISE APPLIES TO FLYING

During aerobatics or when flying close to the stall during any phase of flight, the aircraft may not always be handled carefully. A stall may result, which could be followed by a spin.

2. PRINCIPLES INVOLVED

1. THIS LESSON IS BASED ON A DELIBERATELY INDUCED, ERECT SPIN

2. AUTOROTATION

- i. Discuss deliberately induced autorotation.
- ii. Emphasise that an aircraft in autorotation rolls, pitches and yaws.

3. PROPERTIES OF A GYROSCOPE

- i. Rigidity – depends upon:
 - a. Speed of rotation.
 - b. Mass of rotor.
 - c. Distance of mass from axis of rotation.
- ii. Precession – when a force is applied to a rotating body, the movement observed appears to have been caused by a force applied 90° around the rim from the actual point of application in the direction of rotation. This is known as gyroscopic precession.

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4. THE AIRCRAFT AS A GYROSCOPE

- i. The A gyro is the aircraft rolling plane.
- ii. The B gyro is the aircraft pitching plane.
- iii. The C gyro is the aircraft yawing plane.

5. MOMENTS OF INERTIA

An aircraft yawing may be likened to a gyroscope in the yawing plane.
If a rolling velocity in the same direction as the direction of yaw is applied to the aircraft, the rolling force will be precessed to give a nose up pitch.
This pitch up is a moment of inertia.

6. AUTOROTATION AND GYROSCOPIC PRECESSION

The value of the C (yawing gyro) is higher than that of A (rolling gyro), since C relates to the distribution of mass around a normal axis, and thus includes the mass of both the wings and the fuselage. A (rolling gyro) relates to the distribution of mass around the longitudinal axis. As the mass of the fuselage is close to the longitudinal axis, its effect is not great.

When yaw and roll are to the same side, as in autorotation the inertial pitching movement will be nose up, due to the value of C being higher than that of A. The angle of attack will tend to increase, thereby keeping the aircraft in autorotation, and when all the forces and moments acting on the aircraft reach a state of equilibrium, the aircraft settles into a steady spin.

7. THE BALANCE OF FORCES

Describe the balance of forces in a steady spin.

8. YAWING MOMENTS

Without a yawing movement there will be no pitch, thus anything which increases the yaw is PRO-SPIN and anything which reduces the yaw is ANTI-SPIN and will assist in the recovery from the spin.

The aircraft will be subject to yawing moments of two types:

- i. Aerodynamic:
 - a. Autorotation Pro-Spin.
 - b. Applied rudder Pro-Spin.
 - c. Weather cocking – damping of yaw by rudder and fuselage Anti-Spin.
- ii. Inertial yawing moments:
 - a. B-gyro plus roll Anti-Spin.
 - b. A-gyro plus pitch Pro-Spin.

This is the basis of the $\frac{B}{A}$ ratio.

The larger this ratio is, the stronger the anti-spin moments will be, resulting in the aircraft being reluctant to spin and also recovering more easily.

9. PITCHING MOVEMENT

i. Aerodynamic:

- a. Positive longitudinal static stability Anti-Spin.
- b. Effect of the tailplane Anti-Spin.
- c. Autorotation Pro-Spin.
- d. Elevator Pro-Spin.

ii. Inertial pitching moments:

- a. C-gyro plus roll Pro-Spin.
- b. A-gyro plus yaw Anti-Spin.

The C-gyro, having the greatest mass distribution about its axis, is normally the largest.

iii. Centrifugal flattening moment:

This may be demonstrated with a pointer held at an angle of 45° to the ground and spun rapidly in the horizontal plane – the pointer will tend to spin flat. This moment is pro-spin.

10. ROLLING MOMENTS

i. Aerodynamic:

- a. Autorotation Pro-Spin.
- b. Angle of attack difference Pro-Spin.
- c. Speed of wings Pro-Spin.
- d. Sweepback and sideslip Pro-Spin.

ii. Inertia:

- a. C-gyro plus pitch..... Anti-Spin.
- b. B-gyro plus yaw Pro-Spin.

C-gyro normally stronger, therefore anti-spin.

11. BALANCE OF THE MOMENTS:

The rate of rotation, wing tilt, incidence, rate of descent, sideslip and the radius of a spinning aircraft is determined by the balance achieved by the forces in the spin and the effect of the aerodynamic and inertial moments.

i. Yawing moments.

In aircraft types where the B ratio is larger than A, the inertial moment will be anti-spin. However, the aerodynamic yawing moment is usually very strong due to the applied rudder. This moment is pro-spin and is normally necessary to keep the aircraft in a steady spin.

ii. Pitching moments.

The aerodynamic moments are anti-spin, but with the elevator deflected upwards they become pro-spin. The resultant of the inertial moments is also pro-spin. The balance between these two moments gives the incidence at which the aircraft spins.

- iii. Rolling moments.

The aerodynamic moments are strong pro-spin, while the resultant of the inertial moments are anti-spin. This gives a pro-spin characteristic. Therefore autorotation is necessary to spin as it is the yaw and roll which gives the pitching moment.

12. ENTRY

- i. Wing drop at the stall.
- ii. Autorotation.
- iii. Position of flying controls (Full up elevator / Full Rudder in direction of spin).
- iv. Engine considerations (Power assisted or power off).

13. IN THE SPIN

- i. Position of flying controls (maintain aerodynamic inputs).
- ii. Spinning characteristics of the aircraft type.

14. RECOVERY

- i. Confirm throttle fully closed.
- ii. Control use.

Anything which will reduce the yaw will be anti-spin. Anything which will reduce the roll will eventually reduce the pitch and will, therefore, be anti-spin.
Yaw plus roll = nose up pitch.
The yaw moment is the most important, but not the only means available to the pilot to aid the recovery from the spin. In most basic trainers the aerodynamic factors in a spin are strong and so full opposite rudder, followed by the control column being moved forward until the spin stops, will recover the aircraft from the spin, at which point the rudders must be centralised to avoid a spin entry in the opposite direction and the throttle closed.
This procedure means that the rudder will not be blanked off by the elevator during the initial stages of the recovery.
- iii. Effect of ailerons.

$B \text{ (pitch) gyro plus roll} = \text{Anti-Spin yaw.}$
 $A \text{ (roll) gyro plus pitch} = \text{Pro-Spin yaw.}$
In aircraft with large B/A ratios, the application of aileron into the direction of the spin will assist recovery.

This is because an increase in the rate of roll of the pitching gyro makes the yawing moment out of spin, stronger. In aircraft where the B/A ratio is less than one (i.e. greater mass distribution about the longitudinal axis than about the lateral axis), the A-gyro is strongest, and the effects described above will be reversed, A (roll) plus pitch – Pro-Spin yaw.

15. WHAT HAPPENS DURING THE RECOVERY

If a full opposite rudder is applied, the aircraft does not stop yawing immediately. However, as the control column is pushed forward, the C (yawing) gyro, plus the nose down pitch will give an increased rate of roll, indicating an incipient recovery. In addition, the outer wing recovers from the stall first, giving an additional increase in the rate of roll.
The result is that the spin will seem to tighten up just before the recovery.

Note: Refer to the CL vs Angle of Attack graph.

16. THE GYROSCOPIC EFFECTS OF THE PROPELLER WITH POWER ON

Where the propeller turns clockwise as viewed from the cockpit, an increase in power during the spin will cause the spin to flatten if spinning to the left and to pitch nose down if spinning to the right.

17. EFFECT OF FLAP

Discuss the effect of flap on the spin.

18. EFFECT OF MASS AND BALANCE

Discuss the effect of mass and balance distribution on the spin.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AIRCRAFT HANDLING TECHNIQUES:-

DEMONSTRATION

OBSERVATION

1. THE STUDENT'S FIRST SPIN

- i. The considerations are the same as those for the student's first stall, so the first spin should, therefore, be done at the end of the lesson preceding that on which spinning is to be taught. This spin should consist of not more than two turns. To give the student as little time for thought and worry it helps if he is kept busy with flying the aircraft and doing all the necessary actions right up to the moment of the entry.

- i. Lookout.
- ii. Complete pre-stall checks (HASSELL).
- iii. Inspection turn.
- iv. No a violent manoeuvre.
- v. Ease of recovery.
- vi. Check position frequently in relation to landmarks during the exercise.

2. SPINS FROM STRAIGHT AND LEVEL FLIGHT

- i. Demonstrate spins in both directions (lead with rudder in direction of intended spin).

- i. Lookout.
- ii. Pre-stall checks (HASELL).
- iii. Entry:
 - a. As for normal power-off stall.
 - b. Just prior to the stall, simultaneously apply full rudder in the direction of the desired spin and move the control column fully back.
 - c. Ensure throttle fully closed.
 - d. Carb heat as required.
- iv. In the spin:
 - a. Ailerons neutral.
 - b. Rudder – full on.
 - c. Control column – fully back.

Note:

 - a. High rate of descent – altimeter/VSI.
 - b. Direction of turn needle – position of ball.
 - c. No continuous increase in airspeed.

- v. Standard recovery:
 - a. Verify: Power off, Ailerons neutral, Flaps up, Direction of spin.
 - b. Opposite rudder – full on.
 - c. Brief pause.
 - d. Control column – forward of neutral until spin stops.
 - e. Centralise controls.
 - f. Wings level and balance.
 - g. Recover from dive.
 - h. Nose through horizon – power on.
 - vi. Climb away:
 - a. Climb power set.
 - b. After take-off checks.
 - c. Note large loss of altitude.
 - d. Climb back to entry altitude.
 - e. Carry out HELL checks.
- H – Height – Return to entry attitude.
 E – Engine T's & P's (specific to A/C type).
 L – Locality – Remain in
 L – Lookout – Traffic
 Sun/cloud
 Forced landing field

3. SPIN FROM A LEVEL TURN

- i. From a steep level turn at a low power setting, tighten the turn until the aircraft spins.
 - i. Lookout.
 - ii. HASELL checks.
 - iii. Application – danger of misusing the controls when turning.
 - iv. Aircraft flicks into spin.
 - v. Aircraft spins.
 - vi. Direction of spin not always same as direction of entry turn.
 - vii. Recovery:
 - a. Standard spin recovery.

4. SPIN FROM A DESCENDING TURN

- i. From a gliding turn at a low airspeed, misuse the rudder in the direction of the turn. Simultaneously prevent any increase in bank with opposing aileron and move the control column back to maintain the nose position until the aircraft spins.
 - i. Lookout.
 - ii. HASELL checks.
 - iii. Application – misuse of controls and allowing the speed to fall off in gliding turns.
 - iv. Attitude appears normal by external reference.
 - v. Aircraft spins into the turn.
 - vi. Standard spin recovery.
- ii. From a slipping turn without power, misuse the aileron in the direction of the turn and with opposing rudder prevent any increase in bank and move the control column back to maintain the nose position until the aircraft spins.
 - i. Lookout.
 - ii. HASELL checks.
 - iii. Aircraft spins out of the turn.
 - iv. Normal spin recovery.
 - v. Importance of correct handling of controls in slipping turns near the ground.

5. **INCIPIENT SPINS FORM A CLIMBING TURN**

- i. Demonstrate incipient spins to both sides, off climbing turns to both sides, at a reduced power setting.
 - i. Lookout.
 - ii. HASELL checks.
 - iii. Entry:
 - a. Place the aircraft in a balanced climbing turn (15° bank) and trim for attitude.
 - b. Reduce power slightly for demonstration.
 - c. Allow the airspeed to bleed off.
 - iv. Approaching the stall:
 - a. Slowly apply rudder in direction of required incipient spin.
 - b. Simultaneously counteracting the rolling motion caused by the rudder input by applying opposite aileron.
 - c. Maintain the back pressure on the control column to induce the stall.
 - d. Recognition of the stall – discuss.

NOTE: The wing with the down going aileron has the higher angle of attack, will therefore stall first and thereby influence the direction of the incipient spin.

- v. Recovery action:
SIMULTANEOUSLY
 - a. Apply sufficient opposite rudder to control the yaw, thereafter centralise the rudder.
 - b. Move the control column smartly forward of neutral to unstall the wings and centralise the ailerons.
 - c. Use of power – note:
To minimise the loss of height in the recovery full power must be applied if the recovery action is to be in time to prevent an entry into a full spin.

NOTE: If a spin occurs, the throttle must be closed immediately, followed by standard spin recovery.

- vi. Climb away:
 - a. Climb power set.
 - b. After take-off checks.
 - c. Note altitude loss (if any).

c. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

- i. Pre-stall checks: HASELL.
- ii. Orientation problem – Verify direction of spin before commencing action.
- iii. Correct use of controls.
- iv. Do not open throttle in dive during the recovery.
- v. Climb away after recovery – after take-off checks.

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ENGINE CONSIDERATIONS

- i. As per aircraft manual.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Effects of controls.
- ii. straight and level flight.
- iii. Climbing & Climbing turns.
- iv. Descending & Descending turns.
- v. Turning.
- vi. Stalling.
- vii. Steep turns.

e. DE-BRIEFING AFTER FLIGHT

- 1. Briefly recap on the exercise and emphasise the important aspects:
 - i. Spinning is a frequent cause of air-sickness and the lesson should be discontinued if any signs of illness appear.
 - ii. The student must appreciate that a spin results from a stall (regardless of attitude or loading) which is accompanied by a yaw or roll, and he should ultimately be able to recognise the conditions which may lead to an unintentional spin in time to take preventative action.
 - iii. The points of difference between a spin and a spiral dive should be made clear.
 - iv. The importance of a thorough lookout before each spin must be emphasised.
 - v. To avoid misunderstanding during recovery, words for e.g. "Recover now" should always be used when telling the student to recover. The student should acknowledge "Recovering now", when he starts recovery.
 - vi. Prolonged spinning can cause disorientation and mental confusion; practices should therefore be carried out in good visibility. Disorientation in prolonged spins can be largely overcome by watching the horizon through the canopy/windscreen rather than watching the ground rotate through the windscreen.
- 2. Discuss the common faults students usually make:
 - i. Many students forget to throttle back after entering a spin flight condition in which power is being used.
 - ii. The student often attempts to identify the behaviour of the aircraft from the position of the controls.
- 3. Discuss student's actual faults

For each fault the instructor must indicate:

 - i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result the fault could have led to.
 - iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

EXERCISE 12

THE TAKE-OFF AND CLIMB TO THE DOWNWIND POSITION

1. AIM

DEFINITION

The take-off is considered to start when the aircraft is accelerated under its own take-off power on the ground until flying speed is reached, whereupon the aircraft is rotated and leaves the ground. The speed is now allowed to increase up to the safety speed, at which speed the aircraft is rotated into the climbing attitude.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and checklists.
 - b. Aircraft handling techniques: Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To give the student a good understanding and thorough knowledge of the principles required to:

- i. Control the aircraft on the ground before becoming airborne.
- ii. Take account of the different considerations applicable to take-offs under varying weather conditions.

HOW THE EXERCISE APPLIES TO FLYING

- i. Normal take-off.
- ii. Short take-off.
- iii. First solo.

2. PRINCIPLES INVOLVED

1. GROUND RUN
 - i. Re-cap on Newton's Law 1 and 2.
 - ii. Forces whilst on the ground – Thrust, Drag and Weight.
 - iii. Thrust – at maximum power available.
 - iv. Effect of power:
 - a. Slipstream.
 - b. Torque.
 - c. Gyroscopic.
 - d. Asymmetric Blade Thrust.
 - v. Drag:
 - a. Elevator stabiliser position.
 - b. Tail up movement – applicable to tail wheel aircraft.
 - c. Surface friction between tyres and runway.
 - vi. Flaps – discuss the various flap settings which may be used for take-off.

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- vii. Wind:
 - a. Headwind.
 - b. Crosswind.
 - c. Tailwind.
 - viii. Aircraft take-off graphs:
 - a. Density altitude considerations.
 - b. Aircraft weight.
 - c. Runway surface and gradient (upslope / downslope).
 - d. Runway length and obstacle clearance considerations.
2. BECOMING AIRBORNE
 - i. Speed – depending on flap used.
 - ii. Attitude – flight path.
 - iii. Undercarriage – where applicable.
 3. TRANSITION TO AND CLIMBING AWAY
 - i. Speed – depending on flap used.
 - ii. Power – per aircraft manual.
 - iii. Attitude – flight path.
 - iv. After take-off checks.

3. DESCRIPTION OF AIR EXERCISE

- a. **APPLICABLE PROCEDURES AND CHECKLISTS**
- b. **AIRCRAFT HANDLING TECHNIQUES:-**

DEMONSTRATION

1. TAKE-OFF INTO WIND

- i. Lining up.
- ii. Take-off run.

OBSERVATION

- i. Holding point position – safety and surface wind considerations.
- ii. Before takeoff and power checks.
- iii. Lookout – approaches and runway clear.
- iv. ATC/radio call.
- v. Lining up on runway (use max. length available):
 - a. Nose wheel/tail wheel straight – apply wheel brakes.
 - b. Compass/DI aligned with runway direction.
 - c. Reference point to keep straight on.
 - d. Windsock check (confirms with ATC wind).
 - e. Control column position: neutral for nose wheel aircraft. Full back for tail wheel aircraft. Ailerons in central position.
- vi. Take-off run:
 - a. Release wheel brakes.
 - b. Open throttle smoothly to takeoff power – check temps and pressures.
 - c. Keep straight on runway by use of rudder – anticipate swing.
 - d. When take-off power set, move control column to neutral position in tail wheel

- aircraft.
 - e. As airspeed increases, move control column progressively forward in tail wheel aircraft – anticipating swing when tail comes up.
 - f. Check nose attitude in tail wheel aircraft.
 - g. Control direction with rudder.
 - h. Note airspeed build-up and monitor engine instruments.
 - i. Note increasing and firmer feel of controls.
 - iii. Becoming airborne and climbing away.
 - i. Becoming airborne:
 - a. Confirm take-off speed on ASI.
 - b. Note feel at lift-off speed.
 - c. Apply gentle back pressure on the control column.
 - d. Maintain wings level and direction on reference point.
 - e. When positively clear of ground, maintain an attitude slightly lower than the climb attitude to attain the initial climbing speed.
 - f. Upon attaining the initial climbing speed, rotate the aircraft into the climbing attitude.
 - ii. Climbing away:
 - a. Note positive rate of climb on altimeter.
 - b. Brakes – ON then OFF. Select undercarriage UP if applicable.
 - c. Maintain runway heading, balance and climb speed.
 - d. At a minimum of 300ft agl. – complete after take-off checks.
 - e. Lookout.
 - f. At a minimum of 500 ft agl – commence climbing turn at 15° angle of bank through 90° onto the crosswind leg.
 - g. Trim.
 - iv. Crosswind leg.
 - i. Allow for drift on crosswind leg.
 - ii. Continue climbing to 1000ft agl.
 - iii. 1000ft agl.:
 - a. Lookout.
 - b. Level off, maintaining heading.
 - c. Allow speed to increase to desired circuit speed.
 - d. Reduce power as required to maintain desired speed.
 - e. Re-trim aircraft.
 - f. When in suitable position lookout and commence 30° angle bank medium turn through 90° onto the downwind leg.

v. Crosswind leg.

(Alternate procedure for low powered aircraft or where ATC/safety considerations dictate).

- i. Maintain crosswind leg by allowing for drift.
- ii. Continue climb to 700 ft agl. Minimum.
- iii. From a suitable position – lookout, and commence a 15° angle of bank climbing turn onto the downwind leg, planning to reach the circuit height on or before rolling out onto the down wind leg.
- iv. Maintain downwind heading and altitude while allowing the speed to build up to required circuit speed.
- v. Select required power for circuit speed.
- vi. Trim.

2. **CROSSWIND TAKE-OFF**

- i. Note – do not exceed maximum allowable crosswind component for aircraft type.

Procedures are the same for take-off into wind, except:

- i. Aileron into wind as required.
- ii. Prevent weathercock tendency.
- iii. Do not allow aircraft to become prematurely airborne.
- iv. Use of ailerons during take-off run.
- v. Lift-off at slightly higher than normal speed (add 5 knots/MPH to take-off speed).
- vi. Allowance for drift when airborne (throughout the circuit).

3. **ENGINE FAILURE AFTER TAKE OFF**

- i. Demonstrate simulated engine failure after take-off.

- i. Only towards a relatively safe area.
- ii. Advise ATC that exercise is simulated.
- iii. Close throttle. Speed/Field/Fault/Flap.
 - a. Speed – adjust attitude of aircraft to maintain recommended gliding speed.
 - b. Field – Select landing area. Preferable to not alter heading more than 30° either side of extended runway centreline.
 - c. Fault – Fuel: selection and fuel pump ON.
 - d. Flap – As required to make the field.
- iv. Flaps – optimum setting.
- v. Finals – SIMULATE ONLY: (Time permitting).
 - a. Ignition – off.
 - b. Fuel – off.
 - c. Door – open.
- vi. Climb out – overshoot procedure as normal. Make climb out shallow to avoid possible interference with aircraft above.
- vii. Advise ATC exercise completed.

c. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

1. HOLDING POINT OF RUNWAY

- i. Holding position, visibility, safety and surface wind considerations.
- ii. Before take-off checks.

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- iii. Lookout.
 - iv. Radio procedures.
- 2. LINING UP ON RUNWAY
 - i. Use maximum runway length available.
 - ii. Aligning aircraft with centreline.
 - iii. Reference point to keep straight.
 - iv. Windsock check.
- 3. TAKE-OFF RUN
 - i. Use of controls:
 - a. Throttle – smooth application.
 - b. Rudder – increasing effectiveness during take-off run.
 - c. Elevators.
 - d. Ailerons.
 - ii. Confirm build-up of airspeed on ASI.
- 4. BECOMING AIRBORNE
 - i. Nose attitude after rotation.
 - ii. Safety speed.
 - iii. Rudder at low speed.
 - iv. Undercarriage – if applicable.
 - v. Transition to climb.
 - vi. 300 ft agl. after take-off checks.
 - v. 500 ft agl. – commence climbing turn onto crosswind leg.
- 5. CROSSWIND LEG
 - i. Allowance for drift.
 - ii. Turn onto downwind leg.
- 6. CROSSWIND TAKE-OFF
 - i. Higher take-off speed required to ensure positive lift-off.
 - ii. Use of controls – ailerons.
 - iii. Allowance for drift after take-off.
- 7. ENGINE FAILURE AFTER TAKE-OFF
 - i. Selection of landing area.
 - ii. Checks and procedures.
 - iii. Climbing away (after simulated exercise).
 - iv. ATC notification.

ENGINE CONSIDERATIONS

- i. Engine control positions.
- ii. Power check before take-off:
 - a. RPM settings.
 - b. Temperatures and pressures.
 - c. Reducing power after take off – where applicable.

d. DE-BRIEFING AFTER FLIGHT

- 1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - Taking-off into wind:
 - i. Lining up and the take-off run.
 - ii. Becoming airborne and climbing away.

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- iii. Crosswind leg.
- iv. Engine failure after take-off from the circuit.
- v. Vital actions and circuit and R/T procedure.
- vi. Effect of wind.

2. Discuss the common faults students usually make.

- i. Insufficient knowledge of checklists and procedures.
- ii. Forgetting to check the approaches clear before lining up on the runway.
- iii. Not using maximum available runway or aligning DI with runway.
- iv. Rotating too rapidly into the climb attitude instead of rotating to just below the climb attitude, allowing the speed to build up to the required climb speed and rotating further into the climb attitude.
- v. Reciting the after take-off checks without actually going through the required actions.
- vi. Spending too much attention in the cockpit to complete the after take-off checks without sufficient attention to visual references outside for attitude and heading.
- vii. A tendency to over bank during the climbing turns onto crosswind for left hand circuits. This results in a decrease in the rate of climb and a lengthening of the crosswind leg causing excessive large circuits being flown. NB – opposite occurs in R/H circuit.
- viii. Insufficient correction for drift on the cross wind leg.
- ix. The high degree of concentration required from the student during his initial attempts at take-offs may cause tenseness on the controls and resulting in over-controlling and lack of co-ordination.

3. Discuss student's actual faults

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

e. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

EXERCISE 13

CIRCUIT, APPROACH AND LANDING

1. AIM

DEFINITION

The approach and landing phase may be considered to commence from after the turn onto the downwind leg to the touch down point on the runway and the completion of the landing roll.

- | | |
|-------------------------------|--|
| i. The Approach | May be defined as that part of the circuit from after the turn onto the downwind leg, to the touch down. |
| ii. The Final Approach | Is considered to start from a point where the aircraft is some distance downwind of the runway, in line with it, and approaching on a descending flight path. |
| iii. The Round-Out | Is the change of attitude made from the descent part of the approach to a path level with and slightly above the ground. |
| iv. The Hold-off or Float | Describes a subsequent period in which the aircraft is flown parallel to the ground, with increasing angle of attack and decreasing airspeed, until the aircraft touches the ground. |
| v. The Landing – (Touch-Down) | Is the ultimate development of the hold-off, where the aircraft gradually approaches the stall in the landing attitude, followed by the touch-down just before the stall. |
| vi. The Wheel Landing | Is a type of landing done in tail wheel aircraft where the main wheels are placed on the ground before the tail wheel. |

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and checklists.
 - b. Aircraft handling techniques: - Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To give the student a good understanding and thorough knowledge of the principles required to:

- i. Fly the aircraft in the circuit in an accurate manner.
- ii. Complete the before landing checks in the approved manner.

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- iii. Fly the approach and execute the landing in varying wind conditions, thus enabling the student to carry out short landings, flapless landings and crosswind landings.

HOW THE EXERCISE APPLIES TO FLYING

- i. First solo flight.
- ii. Landing the aircraft safely after each flight.
- iii. Landings with various flap settings.
- iv. Short landing technique.
- v. Forced landing with power – precautionary landing.
- vi. Force landing without power – after an actual engine failure.

2. PRINCIPLES INVOLVED

2.1. DEFINITIONS, PROCEDURES AND CHECKLISTS

2.2. DOWNWIND LEG

- i. Undercarriage extension – if applicable to type.
- ii. Flaps:
 - a. Flap extension speed.
 - b. Attitude.
 - c. Power required.
- iii. Downwind checks.

2.3. TURN ONTO BASE LEG

- i. Position relative to runway – wind effect.
- ii. Nose position.
- iii. Power setting.
- iv. Angle of bank - 30° medium level turn.

2.4. ON BASE LEG

- i. Drift considerations.
- ii. Base leg checks.
- iii. Power reduction to commence descent with/without power.
- iv. Flap setting.
- v. Speed on descent plus control of speed.
- vi. Attitude plus control of attitude.
- vii. Speed/attitude relationship.

2.5. TURNING FINAL

- i. Descending turn – angle of bank required.
- ii. Speed control.
- iii. Drift considerations.
- iv. Aligning aircraft with runway.

2.6. FINAL APPROACH

- i. Forces in descent with/without power.
- ii. Final flap setting – effect of flap.
- iii. Approach path – speed and height control.
- iv. Use of trimmer.
- v. What to do if –
 - a. Overshooting.
 - b. Undershooting.
- vi. Discuss use of V_{ref} speeds ($V_{ref} = 1.3 \times V_{s0}$ or V_{s1} depending upon configuration)

2.7. THE ROUND-OUT

- i. Lift formula and ground effect – coefficient of lift V^2 relationship.
- ii. Throttle control technique.

- iii. Speed dissipation.
- 2.8. THE HOLD-OFF AND NORMAL LANDING
 - i. Flight parallel to surface.
 - ii. Speed and angle of attack.
 - iii. Prevention of stalling onto runway.
 - iv. Normal landing.
 - v. Advantages of normal landing.
- 2.9. AFTER LANDING RUN
 - i. Throttle closed.
 - ii. Keeping straight – high speed taxiing.
 - iii. Causes of swing.
- 2.10. EFFECT OF WIND ON THE APPROACH AND LANDING
 - i. Head winds (i.e. wind down the runway):
 - a. Downwind leg.
 - b. Base leg.
 - c. Final approach.
 - d. Landing phase.
 - ii. Crosswind (i.e. wind at an angle to the runway) or Strong, Gusty Wind:
 - a. Downwind leg.
 - b. Base leg.
 - c. Final approach.
 - d. Landing phase.
 - e. Discuss the need for less or no flap and use of power till touchdown:
 - (1). Ailerons less effective at low speeds – the need to increase approach and V_{ref} speeds.
 - (2). Higher speeds results in lower nose attitude for landing therefore the need to use less flap or no flap – gives higher nose attitude at landing (touchdown on main wheels first) and faster response to power changes in gusty and wind shear conditions.
 - (3). Use of power till touchdown ensures good elevator and rudder responsiveness.
 - f. Discuss the need to close power immediately on touchdown:
 - (1). Possibility of coming airborne again.
 - (2). Affect on landing run.
 - iii. Tail wind (i.e. wind down the runway):
 - a. Downwind leg.
 - b. Base leg.
 - c. Final approach.
 - d. Landing phase.
 - e. Discuss effect of higher ground speed on landing run.
 - iv. Discuss allowances to be made to approach (V_{app}) and V_{ref} speeds in strong and gusty wind. Various calculation methods exist and the following are two examples of allowance to be made:

Allowance A:

- a. Approaches in calm conditions are normally made at $V_{ref}+5$ knots but with reported wind speeds in excess of 10 knots the recommendation is a correction of $\frac{1}{2}$ the steady wind above 10 knots + 100% of the gust value, with a total maximum correction of 15 knots.
- b. For example; with a V_{ref} of 63 knots and a headwind of 20 gusting 25 knots the V_{app} would become $63+5+5$ knots = 73 knots.

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- c. The steady wind correction should be bled off approaching the threshold but the gust factor carried into the landing round out.
- d. Note that **only** the wind and gust factors are added to the V_{ref} for the V_{app} .

Allowance B:

- a. Adjust approach (V_{app}) and V_{ref} airspeed by adding a wind additive of the greater of the following (not to exceed 10 knots): 5 knots; $\frac{1}{2}$ the steady wind in excess of 15 knots; or the gust factor.
- b. Practical example:
 Wind 20kts gusting 30kts.
 Aircraft is a Cherokee 140.
 Normal approach speed with two notches of flap is 75kts.
 V_{s1} is 48kts.
 $V_{ref} (1.3 \times V_{s1}) = 63kts$.
 Wind additive the greater of the following but not more than 10kts:
 5kts; or
 $\frac{1}{2}$ the steady wind in excess of 15 knots = 2.5kts ($5 \div 2 = 2.5$); or
 the gust factor which is 10kts.
 Thus wind additive = 10kts.
 New approach speed + wind additive = 85kts.
 New $V_{ref} = 73kts$.
- v. Wind gradient.
- vi. Wind gust effect (see par iv. above).

2.11. WHEEL LANDINGS (Applicable to tail wheel aircraft):

- i. Technique.
- ii. Advantages.

2.12. OVERSHOOT PROCEDURE

- i. Go-around procedure.
- ii. Missed approach procedure.

GO-AROUND PROCEDURE

- i. Apply go-around power – engine considerations.
- ii. Rotate into climb attitude – best angle of climb/rate of climb speed.
- iii. Flaps – select optimum climb setting.
- iv. Check altimeter for positive rate of climb.
- v. Undercarriage – Up (if applicable to aircraft type).
- vi. Accelerate to best angle of climb/rate of climb speed.
- vii. Trim aircraft.
- viii. 300 ft agl. after take-off checks.
- ix. Accelerate to best rate of climb speed.

2.13. TOUCH AND GO LANDINGS

- i. Keep straight on centreline of runway after touchdown.
- ii. Select; Flaps as required – confirm position. Trim as required.
Engine considerations – Carb. Heat etc.
- iii. Throttle – open smoothly to maximum power – temperatures and pressures.
- iv. Continue with normal takeoff and after take-off procedures.

3. DESCRIPTION OF AIR EXERCISE

a. APPLE PROCEDURES AND CHECKLISTS

b. AIRCRAFT HANDLING TECHNIQUES:-

DEMONSTRATION

OBSERVATION

1. DOWNWIND LEG

- i. Flying the aircraft on the downwind leg.

- i. Lookout and radio call.
- ii. Distance from runway – spacing.
- iii. Trim for straight and level flight at power setting required to maintain circuit speed.
- iv. Downwind checks.
- v. Keeping downwind track parallel to runway – effect of drift. Use of DI and reference point as aids.
- vi. Correct altitude and speed.
- vii. Distance from other aircraft in circuit.
- viii. Position to turn onto base leg – depending on type of approach intended.

2. ENGINE ASSISTED APPROACH AND LANDING

- i. Base leg.

- i. Carry out 30° angle of bank medium level turn from downwind to base leg.
- ii. Allow for drift.
- iii. Use of Carb Heat.
- iv. Base leg checks.
- v. When within a 45° approach cone to the extended runway centre line (called the 'Key Point'), reduce power as required for the approach. Maintain altitude until the speed reduces to the required speed for descending onto base leg/turn onto final (for aircraft configuration). Re-trim aircraft.
- vi. Importance of lookout for other aircraft on final and for aircraft doing other types of approaches.
- vii. Position and altitude – turn onto final approach at maximum 30° bank angle in the descending turn.
- viii. Ensure wings level on final approach at minimum of 500 ft agl.

- ii. Final Approach.

- i. Lookout and radio call.
- ii. Carb Heat set to "COLD"
- iii. Use of elevator to control airspeed.
- iv. Select final approach flap.
- v. Use of power to control rate of descent.
- vi. Speed – reduce to the final approach speed as soon as possible after turning onto final – trim aircraft.
- vii. Corrections for overshooting/undershooting.
- viii. Adjust approach to achieve required touch down point. Transition to V_{ref} speed.

iii. Flare.

iv. Hold-off or float.

v. The Landing (touch down).

vi. The Landing Run.

- ix. Engine considerations.
 - i. Judging round-out-height – discuss.
 - ii. Progressively close throttle.
 - iii. Fly aircraft parallel with runway at correct hold-off height – throttle closed completely.
- i. With throttle closed – maintain direction.
 - ii. Phase control column movement with the rate of sink, until in the landing attitude.
 - iii. Plan rate of sink during the hold-off to coincide with pre-selected touch down point.
 - iv. During the hold-off phase keep aircraft aligned with runway centre line using required aileron/rudder application.
- i. At the touch down point the aircraft is allowed to settle onto the runway in the landing attitude, just before the stall.
- i. Reference point to keep straight on – rudder/brakes as required.
 - ii. Control column as required for aircraft type.
 - iii. Decreasing rudder effectiveness with reduction in speed.
 - iv. Use of brakes to aid deceleration.
 - v. At the end of the landing run:
 - a. Taxi clear of runway and stop in a safe holding area (airmanship).
 - b. Set parking brake and holding RPM, with control column position as for aircraft type.
 - c. Complete after-landing checks.
 - d. Radio call and airmanship.

3. **THE TOUCH AND GO LANDING**

- i. After satisfactorily completing a landing allow the aircraft to decelerate to a safe speed before commencing a rolling take-off.
 - i. Flaps and trim settings as required for take-off (confirm position selected).
 - ii. Open throttle fully – maintain direction.
 - iii. Control column movement as required for correct attitude during take-off run.
 - iv. Keep straight.
- ii. Becoming airborne and climbing away.
 - i. As for normal take-off.

4. **GLIDE APPROACH AND LANDING**

- i. “1000ft agl. Key Point” – Position relative to the runway threshold on downwind leg (depending on wind strength) at which to close throttle – discuss touch down point and aiming point (initially $\frac{1}{3}$ in from touch down point) for glide approach.
- ii. Use of Carb Heat.
- iii. Adjust the base leg to position onto the final approach at the desired altitude, allowing for drift.
- iv. Maintain required base leg speed.

5. SHORT LANDING

- i. Fly a normal circuit.

- v. Use flap to regulate approach path while maintaining required approach speed.
- vi. Note angle of approach and rate of descent.
- vii. Discuss speed/rate of descent relationship.
- viii. Round-out – commenced higher because of greater attitude change and higher sink rate.
- ix. Hold-off – faster rate of sink after round-out because of lack of power.
- x. The touches-down – follow same technique as for normal landing.
- xi. Application to forced landing – discuss.

- i. Base leg as for engine-assisted approach.
- ii. Full flap on final approach.
- iii. Minimum approach speed in high drag configuration – note nose attitude.
- iv. Descent regulated with power.
- v. Pre-selected touch down point – Runway threshold.
- vi. Maintain minimum approach speed to selected touch down point.
- vii. Round-out and hold-off of shorter duration immediate touch down when throttle closed.
- viii. Touch-down firmer.
- ix. Use of brake – heavier application required.
- x. Short landing run.
- xi. Application to precautionary landings.

6. FLAPLESS APPROACH AND LANDING

- i. Fly a normal circuit but extend the downwind leg a little longer than for a normal landing.

- i. Position at which to turn onto base leg – discuss.
- ii. Speed control – discuss.
Power/speed relationship due to decreased drag.
- iii. Flatter approach path, higher nose attitude.
- iv. Weave aircraft to observe runway if aircraft nose obscures the runway.
- v. Speed at round-out (transition to V_{ref} speed):
 - a. Power on – as recommended.
 - b. Glide – as recommended.
- vi. Longer period of float and landing run – touch down near runway threshold essential.
- vii. Touch down – note nose attitude.
- viii. Application to flap failure, gusty, strong wind conditions and crosswind landings.
- ix. No steep turns to position onto final approach – higher stalling speed.

7. CROSSWIND LANDING

- i. Drift allowance on downwind leg.
- ii. Wind effect on base leg – lengthen or shorten.
- iii. Wind effect on turn onto final approach.
- iv. Use of less or no flap in gusty or very strong wind conditions.
- v. Drift allowance on final approach path – crab or slip method.
- vi. Round-out and fly onto the ground with a low controlled rate of descent maintaining some

- power until touchdown.
- vii. NOT SO STRONG CROSSWIND COMPONENT (use crab method) – Use of rudder to align aircraft with landing path just before touch down, and ailerons to keep aircraft laterally level.
- viii. STRONGER CROSSWIND COMPONENT (use slip method) – Use of rudder to keep aircraft aligned with runway centre line and aileron to keep wing down into wind to neutralize drift.
- ix. Weathercock tendency on landing run – use rudder and brake to prevent aircraft from swinging into wind.

8. WHEEL LANDING – APPLICABLE TO TAILWHEEL AIRCRAFT

- i. Normal approach and round-out. Discuss flap requirement.
- ii. Reduce power to allow the aircraft to touch down in a level flight attitude.
- iii. Prevent bouncing with a slight forward pressure on control column – discuss danger of, or larger movement of control.
- iv. Keep straight with rudder and as the speed decreases allow the tail wheel to settle on the ground.
- v. Stick right back when tail on the ground.
- vi. Application to strong, gusty or crosswind conditions.

9. OVERSHOOT PROCEDURE

- From final approach position.
- i. Go-around procedure.
 - i. Full power – engine considerations.
 - ii. Rotate aircraft to best angle of climb attitude.
 - iii. Clean up – flaps and undercarriage as per aircraft manual.
 - iv. Trim.
- ii. Missed approach.
 - i. Turn off runway centreline – climb parallel to runway centreline, keeping other traffic in sight.
 - ii. 300 ft agl. – After take-off checks completed.
 - iii. Climb to not less than 500 ft agl., before rejoining circuit according to traffic of ATC requirements.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. The first consideration in making a good landing is to make a good approach, and a good approach is the result of good circuit.
- ii. Lookout and radio procedures.
- iii. Planning and spacing in circuit.
- iv. Wind effect.
- v. Safety speeds.
- vi. Limiting speeds – flaps and undercarriage.

- vii. Bank angles in circuit.
- viii. Hammerheads – avoidance when turning final.
- ix. Approach path – applicable to various flap and power settings.
- x. Height judgement.
- xi. Smooth round-out.
- xii. Line up aircraft with runway centreline before touch down in a crosswind.
- xiii. Beware of landing too deep – go-around decision.
- xiv. Correction for aborted landing is as for a stall recovery.
- xv. The use of brakes after landing.
- xvi. Height and method of raising flaps/undercarriage during go-around.
- xvii. Before landing checks.

ENGINE CONSIDERATIONS

- i. As per aircraft manual.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Effects of Controls.
 - a. Changing power.
 - b. Undercarriage and flaps.
 - c. Technique of raising flaps during go-around procedure.
 - d. Engine handling.
- ii. Taxiing
 - a. The after landing run – high speed taxiing.
 - b. Use of brakes.
- iii. Straight and level flight.
 - a. Maintaining straight and level flight.
 - b. Turning.
 - c. Descending.
 - d. Descending turns.

e. DE-BRIEFING AFTER FLIGHT

- 1. Briefly recap on the exercise and emphasise the important aspects applicable to each type of landing under the following headings:
 - i. The approach.
 - ii. The final approach.
 - iii. The Round-out.
 - iv. The hold-off or landing.
 - v. The touch down or landing.
 - vi. The after-landing roll.
 - vii. The touch and go landing.
 - viii. The go-around procedure.
 - ix. Effect of crosswind, wind gradient and gusty conditions.
 - x. Lookout.
- 2. Discuss the common faults student usually make:
 - i. To fly a proper circuit requires an ability to be able to complete exercises 4 to 10A with a certain degree of skill. The instructor must not attempt exercises 12 and 13 until he is satisfied that the student can cope with these requirements.

- Most problems in the circuit can be related to insufficient skills in the basic flight manoeuvres.
- ii. Insufficient knowledge of the checks and procedures.
 - iii. Spending too much attention in the cockpit to complete the before landing checks without sufficient attention to the visual references outside for attitude and heading.
 - iv. Insufficient lookout in the circuit.
 - v. If too much time is taken in setting up the descent on the base leg the approach usually ends up being too high.
 - vi. Speed/attitude relationship on final approach. Do not “chase” the speed. Fly attitude and allow the speed to stabilize before correcting according to the ASI. Hold the threshold on a constant imaginary horizontal line on the windscreen and adjust power to maintain a constant IAS (this is a shortcut to “Power controls height/rate of descent and attitude controls airspeed” because, as for instance, attitude is lowered to increase airspeed, power needs to be increased to reduce rate of descent. Therefore increasing power to increase the airspeed would in turn result in the lowering of the attitude to maintain the threshold on the imaginary horizontal line on the windscreen).
 - vii. After turning onto final approach select the required landing flap and trim the aircraft. From this point on the power controls the rate of descent.
 - viii. A good approach makes a good landing. From a good approach the transition to the round-out requires only a small attitude change. Do not close the throttle until the round-out phase is complete.
3. Discuss the student’s actual faults
- For each fault the instructor must indicate:
- i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result the fault could have led to.
 - iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

EXERCISE 12 E & 13 E

EMERGENCIES

- a. Abandoned take off: Causes: Surging engine.
Inadequate Power.
Rough running engine.
Direction control loss.
Zero airspeed indication.
Loss of air pressure.
Door opens during T/off Roll.
Pedestrian crossing.
Animal/ Bird strike.
Aircraft not vacated runway ahead.
- Procedure: Throttle closed.
Brakes as required.
Vacate runway.
Advise ATC.
- b. Engine failure after take off: Lower nose.
Trim for best glide speed.
Select field 30° Left or Right of nose.
Flap as required.
Fuel pump on.
Change tanks.
Try power.
Shut down if unsuccessful.
Door open.
Passenger brace.
Sideslip if required to loose height.
May Day call if time permits.
Land at slowest safe airspeed.
- c. Aborted Landing/Go-Around: Causes: X-wind out of A/C limits.
X-wind out of pilot ability.
Runway incursion.
Approach;
 - Too high.
 - Too fast.
 - Too low.
 - Off centreline.A/C undercarriage malfunction.
Decision height not been 100' AGL.
Full power – Level out – move to right of runway.
Safe airspeed attained.
Retract flap to optimum for climb.
Climb straight ahead.
Carry out vital actions.

Advise ATC.
Request assistance if required.
Rejoin circuit.

- d. Missed Approach: Conform to published missed approach procedure for airfield and aircraft MOP.

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CROSSWIND TAKE-OFF AND LANDING

1. AIM

DEFINITION

The CROSSWIND TAKE-OFF is considered to start when the aircraft is accelerated under its own take-off power on the ground whilst using rudder, ailerons and brakes to counteract the effect of the crosswind until a slightly higher than normal lift-off speed is reached, hereupon the aircraft is positively rotated to leave the ground, and whilst the speed is increasing to the climb speed, the appropriate drift correction is applied.

Upon reaching the recommended climb speed the aircraft is further rotated into the climb attitude during which time corrections are again made for the effect of drift to ensure the track is a continuation of the take-off path.

THE CROSSWIND APPROACH may be considered to commence from after the turn onto the downwind leg to the touchdown point on the runway. On the approach, drift effect is counteracted by using the sideslip or crab method.

THE CROSSWIND LANDING progressed through the same stages of development, namely the round-out, hold-off or float and the actual touchdown, as in the case of a normal landing, except that a combination of rudder and ailerons is used to counteract the effect of the crosswind during the landing process.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved,
- ii. The air exercise briefing:
 - a. Applicable Procedures and Check lists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Considerations of Airmanship and engine handling.
 - d. Similarity to various exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To ensure that the student fully understands the techniques applicable to safely handle the aircraft in crosswind conditions.

- i. Use of rudder, ailerons and brakes.
- ii. Selection of correct flap setting (if applicable).
- iii. Allowing for crosswind effect while descending on base leg.
- iv. Effect of crosswind during ground run.
- v. Drift effect during climb out and approach.

HOW THE EXERCISE APPLIES TO FLYING

- i. Taking off and landing in a crosswind.
- ii. Correcting for drift while maintaining a desired track.

2. PRINCIPLES INVOLVED

1. NEWTON'S LAWS

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2. AERODYNAMIC AND MECHANICAL CONSIDERATIONSS APPLICABLE TO AIRCRAFT TYPE

- i. Torque effect.
- ii. Slipstream.
- iii. Gyroscopic tendencies.
- vi. Weather cocking effect.
- v. Control limitations.
- vi. Effect on undercarriage.

3. TAKE-OFF

- i. Control (aileron) input required.
- ii. Use of rudder and brake.
- iii. Considerations in addition to those required for taking off into wind – Exercise 12.

4. LANDING

- i. Control – use of aileron and rudder.
- ii. Use of controls and brakes after landing.
- iii. Considerations in additions to those required for landing into wind – Exercise 13.

3. **DESCRIPTION OF AIR EXERCISE**

a. **APPLICABLE PROCEDURES AND CHECKLISTS**

b. **AIRCRAFT HANDLING TECHNIQUES**

DEMONSTRATION

OBSERVATION

1. **CROSSWIND TAKE-OFF**

- i. Not to exceed allowable crosswind component for aircraft type.

Observations as for take-off into wind, except:

- i. Flap selection as for aircraft type.
- ii. Aileron input into wind as required for aircraft type.
- iii. Use of rudder to counteract cross-wind effect during take-off run.
- iv. Hold aircraft firmly on the ground.
- v. Use of ailerons during ground run.
- vi. Positive lift-off at slightly higher than normal lift-off speed.
- vii. When airborne, climb away allowing for drift to ensure track is a continuation of the take-off path.

2. **CROSSWIND LEG**

- i. Allow for drift effect.

3. **DOWNWIND LEG**

- i. Procedures as for a normal downwind discuss.
- ii. Assess amount of crosswind and decide on flap setting for landing (consult aircraft manual – normally as little as possible or flapless).
- iii. Maintain a track parallel to the runway by

4. **BASE LEG**
 - i. allowing for drift.
Procedures as for normal base leg – discuss.
5. **FINALS**
 - i. Select final landing flap.
 - ii. Allow for drift on final approach – crab of slip method.
 - iii. Use of rudder to align aircraft with landing path just before touchdown or if the crosswind is strong, during the latter phase of the approach, and ailerons to keep the aircraft from drifting – usually wing down into wind.
 - iv. Weathercock tendency on landing run – use rudder and brakes to prevent swinging into wind.
During last stages of landing roll and during subsequent taxiing, applying the necessary crosswind control application techniques.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Refer to same section of exercises 12 and 13 for details.
- ii. Emphasise the effect of the crosswind on the above.

ENGINE CONSIDERATIONS

- i. As per aircraft manual.
- ii. Refer to aircraft manual for undercarriage and flap limitations in crosswind conditions.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Taking off into wind.
- ii. The normal circuit.
- iii. The approach and landing.
- iv. Side slipping.
- v. Taxiing – high speed and the effects of weather cocking.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects applicable to:
Discuss the circuit under the following headings:
 - i. The take-off.
 - ii. The climb-out.
 - iii. The downwind leg.
 - iv. The base leg.
 - v. The final approach.
 - vi. The round out.
 - vii. The hold-off or float.
 - viii. The touch down or landing.
 - ix. The after-landing roll.
 - x. The touch and go landing.

- xi. The go-around procedure.
- 2. Discuss the common faults students usually make:
 - i. Insufficient allowance for drift.
 - ii. Student either under turns or hammerheads on turning finals.
 - iii. On landing he holds the aircraft too long off before touching down.
 - iv. Direction control loss after touch down (tail wheel A/C).
- 3. Discuss the student's actual faults:

For each fault the instructor must indicate;

 - i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result the fault could have led to.
 - iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

EXERCISE 14

FIRST SOLO

1. AIM

The student pilot only becomes really confident in his own ability to fly when he knows that he can do it without the aid of an instructor. There are, therefore obvious advantages in allowing him to go solo as soon as he is fit to do so.

The student's instructor must exercise very careful judgement in this matter and should arrange the pre- solo test with another experienced instructor only when the student has complied with all the statutory and practical flight requirements.

- i. Principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and checklists.
 - b. Aircraft handling techniques.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

2. PRINCIPLES INVOLVED

Statutory requirements:

- i. Valid Student Pilot's Licence.

This ensures that the student has met the following requirements:-

- a. Passed within the last 30 days the written Student Pilot Licence Air Law examination for the issue of the above licence.
 - b. Passed a written technical examination on the aircraft type.
 - c. Is able to use the aircraft radio with reasonable confidence.
 - d. Is medically fit to hold a Student Pilot's Licence.
- ii. Flight instruction.
 - a. The student must have satisfactorily completed training on sequences 1 to 13 of the flight instruction syllabus prescribed in Appendix 1.1 to the CATS-FCL 61.
 - b. The student pilot must have written authority from the instructor to undertake the solo flight and this authority must be made in writing in the student's presence, (i.e. Authorization Sheet).

NOTE: The student's first solo flight will normally come at the end of a period of dual circuits and landings and he should, therefore, only be given a short briefing on what to expect during his first solo flight.

Do not confuse him with a lot of detail which he already knows about, because he should not be undertaking his first solo flight if the instructor is not confident about sending him solo. Remember that the standard required for the first solo is safety before precision.

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3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AIRCRAFT HANDLING TECHNIQUES

DEMONSTRATION

i. Take-off and climb.

ii. The Circuit.

iii. The Approach.

iv. The Landing.

v. Emergencies.

OBSERVATION

The student should be able to maintain a straight path and fly off at a safe speed. His checks must be of a good standard and he must be able to keep a good lookout whilst performing these checks.

Although the circuit need not be precise in all respects, the student should be consistent in maintaining the approximate length of each leg and a satisfactory heading. Variations in altitude are acceptable providing he is able to detect and correct them and they are not large enough to cause marked difficulty in judging the approach.

The student should have good control of the speed particularly during the final turn and last stages of the approach. He should be able to anticipate the need for power adjustments and the necessity for going around again. These decisions must not be left until the last moment.

His landings must be safe with no consistent faults such as holding off too high. A series of good landings is not necessarily proof of readiness for solo unless the student has shown that he is also able to go-around again safely in the event of a mis-landing.

The student must have had practice at handling engine failure after take-off and should have had practice at making glide approaches in the unlikely event of engine failure in the circuit.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Ensure that loose harnesses are secure and that seats are properly locked.
- ii. Emphasise the need to keep a good lookout and radio listening watch as he will be alone in the aircraft.
- iii. Authorise him to do one circuit and landing, but should he feel the necessity to do a go-around on his final approach, he must not hesitate to do so.
- iv. Remind him to do all checks and procedures methodically.
- v. Point out that the aircraft should climb faster without the weight of the instructor.

- vi. Prior to leaving the aircraft the instructor should, at controlled airfields, advise ATC of the impending solo flight.
- vii. The instructor should observe the student's first solo flight and at a controlled airfield the instructor's whereabouts should be known to the controller.

ENGINE CONSIDERATIONS

- i. Engine control positions.
 - a. RPM settings.
 - b. Temperature and pressures.
 - c. Magneto check.
- ii. Power check before take-off.
- iii. Reducing power after take-off – where applicable.

d. SIMILARITY TO PREVIOUS EXERCISE

- i. Circuits and landings.

e. DE-BRIEFING AFTER FLIGHT

- i. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - a. Encourage the student to be critical of his flying.
 - b. Show the student how to make the necessary entry in his logbook.
 - c. Enter in the student's logbook the authority for him to fly solo in the circuit.
- ii. Discuss the common faults students usually make
 - a. Panicking if something goes wrong in the aircraft.
 - b. Not sticking to recognized procedures.
 - c. Student is so keen to land the aircraft that he touches down at too high a speed.
- iii. Discuss the student actual faults.

For each fault the instructor must indicate:

 - a. The symptoms of the fault.
 - b. The cause of the fault.
 - c. The result the fault could have led to.
 - d. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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EXERCISE 15

ADVANCED TURNING (45° - 60°)

1. AIM

DEFINITION

A steep turn is a change of direction at a bank angle of at least 45° whilst maintaining balance and altitude.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable Procedures and Check Lists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight .

WHY IT IS BEING TAUGHT

To teach the student to turn the aircraft at high rates as well as providing valuable practice in the co-ordination of the controls and developing confidence in the handling of the aircraft at sustained high g-loading.

HOW THE EXERCISE APPLIES TO FLYING

- i. To teach co-ordination.
- ii. Avoiding collision with other aircraft by turning quickly.
- iii. To practice stalling and recovering in turns.
- iv. Application to steep gliding turns.

2. PRINCIPLES INVOLVED

1. NEWTON'S LAWS

2. REVISE

- i. Further effect of ailerons.
- ii. Adverse aileron yaw.
- iii. Use of rudder for balance.

3. FORCES IN THE TURN

- i. Revision on forces during straight and level flight.
- ii. Discuss forces in a turn.
- iii. Discuss load factor in turns.
- iv. Review equilibrium.
- v. Discuss power available/power required curve for turning – drag.

4. DISCUSS

- i. Turn rate.
- ii. Turn radius.

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5. EFFECT OF AIRCRAFT WEIGHT AND BALANCE

- i. Effect of weight.
- ii. Effect of balance and movement of centre of gravity.
- iii. Effect of density altitude.

6. EFFECT OF SLIPSTREAM AND TORQUE DURING THE TURN

3. **DESCRIPTION OF AIR EXERCISE**

a. **APPLICABLE PROCEDURES AND CHECKLISTS**

b. **AIRCRAFT HANDLING TECHNIQUES**

DEMONSTRATION

OBSERVATION

1. **STEEP LEVEL TURNS**

- i. From straight and level flight demonstrate 45°/60° angle of bank turns in each direction, intentionally making and adjusting height errors.

- i. Engine considerations Mixture – richen.
Pitch – high RPM (if applicable).
Power – climb power.
- ii. Look out.
- iii. Minimum entry speed – normal cruise.
- iv. Entry:
 - a. Same as for medium turn.
 - b. After ±30° angle of bank, progressively apply required power, while maintaining the necessary back pressure on the control column to maintain height.
 - c. At 45°/60° angle of bank check and hold off further back increases, while maintaining balance.
- v. In the turn:
 - a. Nose and wing positions relative to natural horizon.
 - b. Angle of bank according to A/H and turn and bank indications.
 - c. High rate of turn and g-loading.
 - d. Balance.
 - e. Do not trim in the turn.
 - f. Decay in speed – note.
 - g. Corrections:
Angle of bank/nose position relationship.
 - h. Look out in turn.
- vi. Rolling out
 - a. Recovery as for medium turns.
 - b. At ±30° angle of bank slowly throttle back to normal cruise power whilst relaxing back pressure on control column to prevent gain in height.
 - c. Resume straight and level flight.
 - d. Engine considerations.

- ii. Now allow the student to practice turns in both directions, going in and recovery only. Apply 45° angle of bank progressively to 60° angle of bank (if applicable).
- iii. When the student is proficient, allow him to practice sustained 45°/60° angle of bank turns adjusting for height where necessary.
- i. Observations as above, except that correct entry and recovery and position of nose and wings relative to the natural horizon are more important than accurate height keeping.
- ii. In tandem-seat trainer, no difference noted in nose position in both directions. However, in side-by-side seat trainers, indicate the change in nose position relative to the horizon in each direction, for same angle of bank.
- i. Observations as explained in demonstration by instructor.

2. STALLING IN A TURN

From a steep turn at a low power setting

- i. Tighten the turn to the buffet and demonstrate recovery.
- ii. Repeat above exercise but tighten the turn beyond the buffet.
- i. Complete pre-stall checks – HASELL.
- ii. Throttle – set ± 50% power;
 - a. As for steep turn.
 - b. DO NOT increase power.
- iii. In the turn;
 - a. Maintain height and bank angle.
 - b. Maintain turn until symptoms of the approaching stall are recognised.
 - c. Note airspeed at the buffet.
- iv. Recover:
 - a. Relax the back pressure on the control column until buffet disappears.
 - b. Note: Turn can be continued only if bank angle is decreased and/or power is increased.
- v. Rolling out:
 - a. As for steep turn.
 - b. When straight and level flight is regained increase power to normal cruise.
- i. Aircraft flicks – note airspeed.
- ii. Recovery (As per incipient spin);
 - a. Relax back pressure on control column.
 - b. Power as required.
 - c. Level the aircraft.
 - d. If inverted, roll out to nearest horizon.
- iii. With aid of rudder, demonstrate that the aircraft can be flicked in either direction.
- iv. Demonstrate that if recovery is delayed, the aircraft may spin.

3. STEEP DESCENDING TURN

- i. Compare a descending turn at normal gliding speed to a steep descending turn.
- i. During a normal descending turn note: Airspeed.

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- Rate of descent.
- Rate of turn.
- Angle of bank.
- ii. From the normal descending turn, whilst maintaining the required nose position, progressively increase the angle of bank until the buffet occurs.
Note:
Airspeed.
Rate of descent.
Rate of turn.
Angle of bank.
- iii. Progressively lower the nose position to increase the airspeed and continue until the buffet stop.
- iv. During the descending turn at the higher speed note:
Rate of descent – increased.
Rate of turn – increased.
Angle of bank – higher.
– angles obtainable.
- v. On completion of the above demonstration, resume a normal descending turn.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Look out prior to entry and during the turn.
- ii. Orientation prior to entry and on recovery a good sense of direction will be developed.
- iii. Concentrate on attitudes in relation to horizon for judging angles of bank – do not use instruments to attain bank angle.
- iv. Develop smooth flying techniques, especially co-ordination of control column and rudder.
- v. Cockpit inspection for steep turns in excess of normal (45°/60° bank angles – HASELL).
- vi. Trim and stabilize aircraft before rolling into turns.

ENGINE CONSIDERATIONS

- i. Power setting for steep turns:
Mixture as required – richen.
Pitch – RPM for climb.
Throttle – climb power or full power.
- ii. Temperatures and pressures.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Straight and level flight
- ii. Medium Turns.
- iii. Descending turns
- iv. Stalling
- v. Effect of controls – adverse aileron yaw and rudder usage.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Rolling into the level turn.
 - a. Before commencing the turn the aircraft must have the correct speed and also be correctly trimmed.
 - b. Co-ordination between aileron/rudder/elevator is essential.
 - c. Follow the correct procedure for each flight control application; Change, check, hold, adjust, hold. Do not trim.
 - d. Memorise the correct nose attitude for future reference.
 - ii. Maintaining the turn.
 - a. Constant good lookout.
 - b. Maintain the nose attitude using outside visual references only with angle of bank corrections according to the artificial horizon.
 - iii. Rolling out of the turn.
 - a. Co-ordination between aileron/rudder/elevator is essential.
 - b. Follow the correct procedure for flight control application.
 - c. During the roll-out use outside references for nose attitude indications. As the wings approach the laterally level position, the nose position for straight and level should slowly be gained by gently relaxing backward pressure on the control column while the wings are being rolled level.
 - iv. The turn in the opposite direction.
 - a. Memorise the correct nose position as per visual references according to the horizon.
2. Discuss the common faults students usually make.
 - i. Lookout before rolling into a turn.
 - ii. Most students have difficulty in co-ordinating the simultaneous use of all the flight controls during the roll-in and roll-out of the turn.
 - iii. The roll-in/ out must be an even smooth rate of roll.
 - iv. Use visual references for nose position with a cross-check on the A/H for angle of bank. Excessive attention on instruments is a common fault leading to fluctuations of the nose position with resultant attitude fluctuation.
 - v. Fluctuations in angle of bank with nose position remaining constant.
 - vi. Fluctuations in nose position with angle of bank remaining constant.
3. Discuss the student's actual faults.

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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THE MAXIMUM RATE TURN

1. AIM

DEFINITION

The maximum rate turn is a change of direction at a maximum bank angle, thereby turning through the maximum number of degrees in the shortest possible time, whilst maintaining balance and altitude.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable Procedures and Check lists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Considerations of Airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To give the student the mechanical and aerodynamic consideration involved in turning an aircraft at the maximum rate, thereby improving his/her co-ordination, judgement, flying ability and self confidence whilst flying the aircraft to its limits.

HOW THE EXERCISE APPLIES TO FLYING

- i. To teach co-ordination.
- ii. To take rapid avoiding action – collisions.

2. PRINCIPLES INVOLVED

1. NEWTON'S LAWS

2. REVISE:

- i. Centripetal force.
- ii. Coefficient of lift and angle of attack.
- iii. Radius and rate of turn formula.
- iv. Radius of turn graph – Theoretical and practical applications.
- v. Effect of decreasing speed and angle of attack.
- vi. Load, factor in the turn.
- vii. Stalling in the turn.

3. CONTROL APPLICATION FOR MAXIMUM RATE TURN:

- i. Rolling in – Adverse aileron yaw.
Further effect of ailerons.
Use of rudder.
- ii. In the turn – Drag.
Lift.
Balance.
- iii. Rolling out – Rate of roll.
Adverse aileron yaw.
Use of rudder.
- iv. Flaps – effect of flap on the maximum rate turn.

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4. DISCUSS:
 - i. Turn rate.
 - ii. Turn radius.
5. POWER

Discuss the effect of engine power on the maximum rate turn.
6. EFFECT OF AIRCRAFT WEIGHT AND BALANCE
 - i. Effect of weight.
 - ii. Effect of balance and movement of centre of gravity.
 - iii. Effect of density altitude.

3. DESCRIPTION OF AIR EXERCISE

- a. APPLICABLE PROCEDURES AND CHECKLISTS
- b. AIRCRAFT HANDLING TECHNIQUES

DEMONSTRATION

MAXIMUM RATE TURNS

- i. Demonstrate up to the stall buffet at various power settings.
- Slow cruise power.

OBSERVATION

- i. Complete pre-stall checks – HASELL.
- ii. Power – set slow cruise (e.g. $\pm 50\%$ power).
- iii. Speed – slow cruise.
- iv. Select landmark on horizon directly behind the aircraft.
- v. Note time.
- vi. Entry:
 - a. Lookout .
 - b. Roll rapidly to $\pm 45^\circ$ angle of bank and maintain attitude.
- vii. During turn:
 - a. Maintain attitude whilst progressively increasing the angle of bank.
 - b. Note speed at which buffet occurs.
 - c. Note rate of turn, and note also that when the turn is tightened into the buffet, the rate of turn decreases. Therefore, the maximum rate of turn occurs just before the buffet.
 - d. Note nose position relative to the natural horizon.
 - e. Instrument cross-check for angle of bank and attitude
 - f. Horizon marker in sight – anticipate roll-out.
- viii. Roll-out:
 - a. Roll rapidly out of the turn onto the marker with reference to the natural horizon while maintaining altitude and balance.
 - b. Wings level – note time.
 - c. Set normal cruise power.

- ii. Compare to previous demonstration:
 - a. Using normal cruise power.
 - b. Using full power.
- iii. From straight and level flight at cruise power allow student to practice maximum rate turns to both sides through 180°/360° opening the throttle fully while rapidly rolling into turn, maintaining altitude. Recover from turns rapidly onto pre-selected horizon landmark or heading.
- i. Entry as for previous demonstration increasing power as required and note at the higher power settings:
 - a. Increased angle of bank.
 - b. Increased rate of turn.
 - c. Higher stalling speed.
- ii. Amount of available power determines:
 - a. Maximum angle of bank.
 - b. Maximum rate of turn for aircraft is quickly
- i. Aircraft inertia – anticipate.
- ii. Maximum rate of turn for aircraft is quickly attained. Used in emergency (avoiding collision).

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

- i. Lookout and orientation prior to the turn and especially during the turn.
- ii. Control handling to be positive, but not rough.
- iii. Aim to be able to accomplish this turn to perfection.
- iv. Do not stall the aircraft during the turn as this may either result in losing valuable time through not turning or flicking out of the turn.
- v. Reduction in bank before correcting for height deviations.
- vi. With large aileron application, large rudder applications will be needed, whilst rolling into and out of the turn.

ENGINE CONSIDERATIONS

- i. Power setting for maximum rate turn:
Mixture as required – richen.
Pitch – RPM as for climb.
Throttle – full power.
- ii. Temperatures and pressures.
- iii. In emergency over boosting of engine may be permissible for duration of turn – consult aircraft manual for engine limitations.

d. SIMILARITY AFTER FLIGHT

- 1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Steep turns.
 - ii. Stalling in the steep turn.
 - iii. Increased g-loading effects.
 - iv. Further effect of controls – adverse aileron yaw.
 - v. Control column pressure varying with speed for constant angle of attack – as in loop.
 - vi. Amount of rudder necessary to balance aircraft high rate of roll – as in straight roll.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Rolling into the level turn.
 - a. Before commencing the turn the aircraft must have the correct speed and also be correctly trimmed.
 - b. Co-ordination between aileron/rudder/elevator is essential.
 - c. Follow the correct procedure for each flight control application; Change, check, hold, adjust, hold. Do not trim.
 - d. Memorise the correct nose attitude for future reference.
 - ii. Maintaining the turn.
 - a. Constant good lookout.
 - b. Maintain the nose attitude using outside visual references only with angle of bank corrections according to the artificial horizon.
 - iii. Rolling out of the turn.
 - a. Constant good lookout.
 - b. Follow the correct procedure for flight control application.
 - c. During the roll-out use outside references for nose attitude indications. As the wings approach the laterally level position, the nose position for straight and level should slowly be gained by gently relaxing backward pressure on the control column while the wings are being rolled level.
 - iv. The turn in the opposite direction.
 - a. Memorise the correct nose position as per visual references according to the horizon.
2. Discuss the common faults students usually make.
 - i. Lookout before rolling into the turn.
 - ii. Most students have difficulty in co-ordinating the simultaneous use of all the flight controls during the roll-in and roll-out of the turn.
 - iii. The roll-in and roll-out must be at a smooth rate of roll.
 - iv. Use visual references for nose position with a cross-check on the A/H for angle of bank. Excessive attention on instruments is a common fault leading to fluctuations of the nose position with resultant attitude fluctuations.
 - v. Fluctuations in angle of bank with nose position remaining constant.
 - vi. Fluctuations in nose position with angle of bank remaining constant.
3. Discuss the student's actual faults.

For each fault the instructor must indicate:

 - i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result the fault could have led to.
 - iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

EXERCISE 16

FORCED LANDING WITHOUT POWER

1. AIM

DEFINITION

A forced landing is a landing carried out without power on a location not contemplated when the flight began.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and Check Lists.
 - b. Aircraft handling techniques: Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To provide the student with a complete understanding of the theoretical and practical knowledge that in the event of an engine failure he must choose the best available landing area, and execute a safe approach and landing with minimum damage to the aircraft and injury to occupant's. However, in the case of a simulated forced landing a go-around must be executed from a safe attitude.

This will require an understanding of the theory determining:

- i. The speed at which to glide.
- ii. Which aircraft configuration to use at what stage in the glide.
- iii. What effect bank will have on conservation of height.
- iv. The effect of wind on the descent.
- v. What effect the weight of the aircraft will have on the gliding endurance.
- vi. What effect propeller pitch setting will have on the glide.

HOW THE EXERCISE APPLIES TO FLYING

A forced landing without power can happen at any time due to:

- i. Running out of fuel – bad fuel management.
- ii. Mechanical defects of engine or airframe.

2. PRINCIPLES INVOLVED

1. EXPLAIN THE FORCES IN THE GLIDE
2. REFER TO THE APPROPRIATE GRAPH AND DISCUSS
 - i. Gliding for endurance.
 - ii. Gliding for range.
3. DISCUSS THE EFFECT ON THE GLIDE OF:
 - i. Weight.
 - ii. Flaps and undercarriage.

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- iii. Propeller pitch.
 - iv. Speed.
 - v. Wind.
 - a. on the glide angle.
 - b. on planning the descent.
 - vi. Wind gradient.
4. SPEED
- i. Conversion of speed into height after engine failure.
 - ii. Correct glide speed for aircraft configuration.
5. FIELDS
- i. Discuss the choice of field, with reference to;
 - a. Surface conditions best suited to forced landing.
 - b. Surface wind effect.
 - c. Size of Field.
 - ii. Planning of the descent – judgement of 1000 ft agl “Key Point” on base leg of descent to final approach.
 - iii. Keep field in view at all time.
6. FAULT
- i. Causes of engine failure.
 - ii. Attempting in-flight restart.
 - iii. May-Day call.
7. FLAPS
- i. Use of flaps and undercarriage.
8. FINAL APPROACH PROCEDURES
- i. Passenger briefing and opening of doors/emergency exits.
 - ii. Planning of final approach:
 - a. Use of flaps.
 - b. Undercarriage – up or down depending on circumstances.
 - iii. Methods of losing excess height on final:
 - a. Flap selection.
 - b. Hammerhead approach.
 - c. Sideslip/slipping turn onto final.
 - d. S-turns on final approach.
 - e. Increasing final approach speed to dive off excess height, not to exceed flap limiting speed.
 - iv. Judgment of touch down point.
 - v. Safety precautions – all electric, fuel etc, OFF.
9. LANDING
- i. Touchdown technique.
 - ii. Stopping aircraft:
 - a. Wheel brakes (if undercarriage down).
 - b. Ground looping aircraft.
 - c. Retracting undercarriage during landing roll.
10. AFTER LANDING
- i. Evacuation of aircraft.
 - ii. Reporting of forced landing to ATC/Police.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AIRCRAFT HANDLING TECHNIQUES

DEMONSTRATION

OBSERVATION

1. FORCED LANDING WITHOUT POWER

Select a suitable field and from straight and level flight at minimum 3000 ft agl, close the throttle, thereby simulating engine failure.

- i. Look out.
- ii. Assess surface wind situation.

2. SPEED

- i. Convert speed into height, or maintain altitude.
- ii. Attain best glide speed.
- iii. Throttle closed.
- iv. Carb. heat – full ON (if applicable).
- v. Trim aircraft.
- vi. Change to another fuel tank with fuel in it. Fuel pump ON.

3. FIELD SELECTION

- i. Selection of suitable forced landing area e.g.:
 - a. Airfield.
 - b. Obstruction free road.
 - c. Cultivated land.
 - d. Suitable open terrain.

LOOK OUT

- i. Select suitable force landing area according to prevailing conditions and circumstances, considering:
 - a. Size and shape of area.
 - b. Surface condition.
 - c. Surface wind strength and direction.
 - d. Approximate elevation of field.
 - e. Obstacles in overshoot and undershoot areas.
- ii. ONCE FIELD HAS BEEN SELECTED DO NOT CHANGE YOUR MIND.

4. PLANNING DESCENT

- i. Turn towards selected field:
 - a. Plan descent according to altitude available, aiming to achieve normal glide approach base leg position, i.e. "Key point" 1000 ft agl. on base leg, from where a normal glide approach and landing is usually made.
- ii. DO NOT LOOSE SIGHT OF FIELD
- iii. Descent should be a gently curved circuit, using turns in the circuit to regulate position for loss of height, but ensuring aircraft slightly high when turning on final approach.
- iv. PRACTICE FORCED LANDING
 - a. Warm up engine every 500 or 1000 ft loss of attitude.
 - b. Monitor engine temps/pressures.

- v. On downwind or equivalent leg, carry out normal downwind checks and prepare for landing, brief passengers.
- vi. Look out.

5. **FAULT ANALYSIS**

While position aircraft in forced landing circuit.

- i. Check:
 - a. Fuel system – selection and contents, pump on, primer locked.
 - b. Engine systems – ignition oil pressure, carb. heat, mixture setting, etc.
 - c. Electrical system.
- ii. Re-start – attempt to restart engine using normal in flight starting procedure.
- iii. Re-start unsuccessful:
 - a. “May-Day” call.
 - b. Switch off all fuel, engine and electrical services (as applicable).
- iv. PRACTICE FORCED LANDING
 - a. Warm up engine as discussed.
 - b. Monitor temperatures and pressures.

6. **FLAPS AND UNDERCARRIAGE**

- i. Flaps – use optimum flap as required whilst positioning in circuit.
- ii. Undercarriage – early decision required as to whether or not to force land with undercarriage in up or down position. Decision will depend on terrain but undercarriage may be lowered if certain of getting in on recognised airfield.
- iii. PRACTICE FORCED LANDING
 - Lower undercarriage during normal landing checks.

- 7. **KEY POINT** – 1000 ft agl. Position on base leg from where a normal glide approach would be attempted.

- i. Passenger briefing – review.
- ii. Forced landing checks – ensure:
 - a. Fuel off.
 - b. Ignition off.
 - c. Harness tight.
 - d. Cabin door/emergency exit open.
 - e. Master switch – off for after final flap setting / undercarriage extension completed if applicable to type).

8. **FINAL APPROACH**

- i. From ‘Key point’ 1000 ft agl. on base leg, execute a gliding turn onto final.
- ii. Plan to be slightly higher than for a normal approach when turning finals.
- iii. Plan to land $\frac{1}{3}$ of the way into the runway with optimum flap but when sure of getting in, adjust descent to bring touchdown point closer to ‘runway’ threshold.
- iv. Methods of adjusting approach and losing

height:

- a. Flaps.
- b. Increasing speed – after full flap extension (do not exceed Max Vfe).
- c. Side slipping – exercise caution if flaps lowered. Some aircraft types does not allow sideslip with any amount of flap.
- d. Propeller pitch – full fine.
- e. Slipping turns.
- f. Hammerhead/S-turns on final approach – ensure wings level \pm 400ft agl.
- g. Any combination of above. Bank angle should not be more than 30° below 500ft agl.
- h. PRACTICE FORCED LANDING
 1. Procedure for going around – refer to exercise 13 for details.
 2. Go-around procedure to be executed at safe height of 200 ft agl.

NOTE: The student pilot is only allowed to land the aircraft solo at a licensed airfield.

9. **TOUCHDOWN AND LANDING**

- i. Hold off as long as practical.
- ii. Brakes – use as conditions dictate.
- iii. Emergency stopping;
 - a. When speed is still high – retract undercarriage if possible.
 - b. When speed is relatively low – carry out controlled ground loop.

10. **AFTER LANDING**

- i. Evacuation of occupants.
- ii. Aircraft security.
- iii. Report incident by radio or telephone to ATC and Police.

c. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

- i. Selection of landing area – depending on conditions.
- ii. Planning of circuit to achieve 1000 ft agl “Key point” on base leg.
- iii. Aim to fly a ‘normal’ downwind and base leg. If possible.
- iv. Possible non-standard circuit pattern may be executed to ensure 1000 ft agl. key point on base leg.
- v. Assessment of wind effect on circuit pattern.
- vi. Importance of keeping field in sight at all times.
- vii. Analysis of reasons for engine failure.
- viii. Radio call – ‘May-Day’ and subsequent reporting of forced landing.
- ix. Gliding speed/attitude relationship.
- x. Use of optimum/drag flaps to control height loss.
- xi. Undercarriage position for landing – discuss.
- xii. Plan to be high on final approach and discuss methods of losing excess height.

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- xiii. Passenger briefing and forced landing checks.
- xiv. Practice forced landing – go-around procedure.
- xv. Methods of stopping the aircraft after touchdown – discuss.
- xvi. Evacuation of passengers.

ENGINE CONSIDERATIONS

- i. Causes of possible engine failure
 - a. Fuel starvation – poor fuel management, running out of fuel.
 - b. Ignition switch accidentally turned off.
 - c. Mixture too weak or too rich.
 - d. Carburettor icing.
 - e. Major mechanical defect in engine.
 - f. Overheating of engine.
- ii. In practice forced landing, simulate engine failure by:
 - a. CLOSING THE THROTTLE – smoothly.
 - b. DO NOT – CUT THE MIXTURE
 - TURN OFF THE FUEL
 - SWITCH OFF THE IGNITION
 - c. WARM UP ENGINE EVER 500 or 1000 ft, depending on engine type.
 - d. Richen mixture while descending.
 - e. Ensure carburettor heat control is 'FULL ON' during the gliding phase of the practice forced landing (If applicable).

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Straight glides and gliding turns.
- ii. Glide approach and landings (various flap settings).
- iii. Circuits and landings.
- iv. Engine failure after take-off.
- v. Go-around procedure (for practice forced landing).
- vi. Precautionary landing – analysis of engine problem and briefing of passengers.

e. DE-BRIEFING AFTER FLIGHT

- 1. Briefly recap on the exercise and emphasise the important applicable to:
 - i. The importance of achieving the correct gliding speed.
 - ii. Proper planning of the descent.
 - iii. Student must not deviate from laid down procedures.
- 2. Discuss the common faults students usually make:
 - i. Forced landing poorly planned.
 - ii. Students forgetful on procedures.
 - iii. Loosing sight of the selected field during the descent.
- 3. Discuss the student's actual faults.
For each fault the instructor must indicate:
 - i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result the fault could have led to.
 - iv. The corrective action required.

- f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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EXERCISE 17A

LOW FLYING

1. AIM

DEFINITION

Low flying is a condition of flight between ground level and 500 feet agl. where movements past objects on the ground as well as the effects of wind drift, may be appreciated.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and check Lists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

Due to the necessity of having to occasionally operate the aircraft at minimum level (such as under low cloud with poor visibility), the exercise requires a high standard of flying, self discipline and decision making ability than is required when operating at normal flight altitudes.

These requirements can only be met if the student has a complete understanding of the theory which will eventually determine:

- i. The aircraft configuration – the visibility and aircraft altitude above the terrain will determine the safe speed at which to fly.
- ii. The route to follow – divert, turn back or continue to destination.
- iii. The effect of wind.
- iv. The effect of speed and inertia.
- v. The effect of turbulence at low altitudes.
- vi. The effect of precipitation:
 - a. Reduction in forward visibility.
 - b. Possible icing problems – airframe and engine.
 - c. Rain on the windscreen causes refraction and diffusion of light waves, thereby distorting visibility. The pilot may be misled into thinking he/she is higher than he/she actually is.
- vii. Low flying map reading techniques.

HOW THE EXERCISE APPLIES TO FLYING

- i. Low level navigation.
- ii. Precautionary landing.
- iii. Bad weather circuit and landing.

2. PRINCIPLES INVOLVED

All the principles applicable to previous exercises, with the emphasis on:

1. NEWTON'S LAWS

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2. EFFECT OF WIND
 - i. Headwind.
 - ii. Tailwind.
 - iii. Crosswind.
 - iv. Wind shear.
 - v. Turbulence.
 - vi. Mountain waves.
3. SLOW SAFE CRUISING CONFIGURATION
 - i. Airframe and engine limitations.
 - ii. Optimum speeds.
4. WEATHER CONSIDERATIONS
 - i. Precipitation.
 - ii. Icing.
 - iii. Visibility.
5. LOW FLYING MAP READING TECHNIQUE

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AIRCRAFT HANDLING TECHNIQUES:-

DEMONSTRATION

OBSERVATION

1. ACTIONS PRIOR TO DECENDING

- i. Look out.
- ii. Complete the following checks:
 - Fuel – contents, select fullest tank and not endurance.
 - Engine – power setting requirements, temperatures and pressures.
 - Instruments – Align D.I. with compass, QNH set on altimeter.
 - Radio – Call to ATC (if applicable) and nav aids set.
 - Security – Harness tight loose articles stowed.

2. DESCENDING TO MINIMUM SAFE ALTITUDE

- i. With reference to power settings and IAS, show student apparent increase in ground speed due to rapid movement of ground features past the aircraft.

3. EFFECT OF SPEED AND INERTIA

This is ideally demonstrated in no-wind conditions. Demonstrate at as high a speed as possible, consistent with safety.

- i. From straight and level flight.

- i. Lookout.
- ii. Establish required low flying configuration – engine and airframe.
- iii. Select safe low flying altitude.
- iv. Select prominent ground feature directly ahead of the aircraft, which the aircraft will be able to

ii. During a turn.

- v. clear safely (i.e. tree, windmill, etc.).
- v. Aim the aircraft slightly to the right of the selected object and when at a suitable distance from the object, rapidly rotate the aircraft into the climbing attitude, applying climb power, keeping the object in sight.
- vi. Note how the aircraft mushes towards the object, due to inertia, before climbing away.
- i. Lookout.
- ii. Establish required low flying configuration – engine and airframe.
- iii. Select safe low flying altitude.
- iv. Select prominent ground feature directly ahead of the aircraft, high the aircraft will be able to clear safely (i.e. windmill, tree, etc.).
- v. Aim the aircraft slightly to one side of the object and when at a suitable safe distance from the object, simultaneously applying power while keeping the object in sight.
- vi. Note how the aircraft mushes towards the object, due to inertia, before continuing in the new direction.

CONCLUSION: It will be necessary to take the effect of inertia into account when avoiding obstacles.

4. **THE EFFECT OF WIND**

i. Crosswind effect.

- i. Position the aircraft to track along a ground feature that is 90° to the wind.
- ii. Note the drift angle is more clearly observed at lower levels.
- iii. Note the aircraft's track over the terrain.
- iv. Look out.
- v. Commence a medium turn into wind and continue turning through 180° - balanced turn.
- vi. Roll out parallel to the ground feature and note the aircraft's distance from it.
- vii. Repeat the exercise, but commence the turn downwind. Roll out after 180° and note the aircraft's distance from the ground feature.

APPLICATION: When flying a bad weather circuit in crosswind conditions, apply the appropriate corrections to position the aircraft in the circuit pattern.

ii. Turning downwind.

- i. Head the aircraft directly into wind.
- ii. Lookout.
- iii. Commence a balanced medium turn through 180°.
- iv. Visual contact with the ground gives the impression of slipping into the turn.
NOTE: Do not attempt to correct for the slip.
- v. Roll out downwind and note the increased groundspeed for a constant indicated airspeed.

NOTE: Do not reduce power.

ii. Turning into wind.

- i. Head the aircraft directly downwind.
- ii. Look out.
- iii. Commence a balanced medium turn through 180°.
- iv. Visual contact with the ground gives an impression of “skidding out” during the turn.
NOTE: Do not attempt to correct the apparent skid.
- v. Roll out into wind and note the reduced groundspeed for a constant indicated airspeed.

CONCLUSION: It will be necessary to take the effect of drift into account when turning to avoid obstacles.

5. EFFECT OF TURBULENCE DURING LOW FLYING

- i. More marked over uneven ground, trees, hills and near thunderstorms.
- ii. Beware of strong downdrafts, as well as in the vicinity of thunderstorms.
- iii. Whenever practical avoid possible areas of turbulence during low flying.
- iv. Before or on encountering turbulence:
 - a. Repeat low flying checks.
 - b. Increase altitude if practical.
 - c. Counteract downdraft by increasing power.
 - d. In strong downdrafts where full power cannot counter the effect of the downdraft, turn out of the downdraft.

6. BAD WEATHER LOW FLYING

Whilst flying at medium level, describe to the student an assumed bad weather situation which will necessitate the demonstration of:

i. A simulated bad weather circuit and landing either at base or onto a suitable field.

- i. Obtain ATC clearance (actual or simulated).
- ii. Complete field approach checks.
- iii. Approaching the circuit area, prepare the aircraft for slow safe cruising.
- iv. Keep a good lookout and radio listening watch.
- v. Join the circuit as instructed by ATC. At uncontrolled airfields or simulated landing areas, comply with the statutory radio and joining procedures.
- vi. Position onto downwind, maintaining sight of the runway. Complete before landing checks.
- vii. Maintain visual contact with the runway and commence a turn to position the aircraft onto final approach, from where the appropriate type of landing may be carried out.

ii. A precautionary landing.

- i. Decide upon an appropriate landing area.
- ii. Complete field approach checks.
- iii. Follow procedures as described in Exercise 17B.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Look out – for terrain features and other aircraft.
- ii. Trim aircraft nose up so that a slight forward pressure has to be maintained on control column. Should concentration lapse, aircraft will tend to fly up and away from the terrain.
- iii. Maintain safe distance below base of low cloud ($\pm 100\text{ft}$).
- iv. Low flying checks.
- v. Anticipation – plan ahead taking into consideration the effect of inertia and wind.
- vi. Orientation – maintain an awareness of position at all times.
- vii. Check the surrounding weather conditions continuously for possible deterioration.
- viii. Comply with ATC requirements where applicable.
- ix. Comply with low flying regulations.

ENGINE CONSIDERATIONS

- i. Fuel management.
- ii. Power setting:
 Mixture as required.
 Pitch - high RPM as for climb.
 Throttle – as required.
- iii. Use of aircraft lighting according to flight conditions – cockpit and external lights.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Straight at level flight at various airspeeds.
- ii. Medium and steep turns.
- iii. Use of various flap settings.
- iv. Circuits and landings.
- v. Short landing.
- vi. Climbing and descending.

e. DE-BRIEFING AFTER FLIGHT

- 1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Judgement of height above the ground.
 - ii. Anticipation of inertia.
 - iii. Anticipation of turn radius.
 - iv. Effect of drift at low level.
- 2. Discuss the common faults students usually make:
 - i. Poor height control.
 - ii. Poor anticipation of turn radius.
 - iii. Students may find it difficult to anticipate drift control and they may have a tendency to cause the aircraft to skid during turns.
- 3. Discuss the student's actual faults.

For each fault the instructor must indicate:

 - i. The symptoms of the fault.
 - ii. The cause of the fault.

- iii. The result the fault could have led to.
- iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

EXERCISE 17B

PRECAUTIONARY LANDING

1. AIM

DEFINITION

A precautionary landing is one not contemplated before the flight commenced, but where engine power may be available thus providing the pilot with the opportunity of selecting and inspecting a suitable landing area before executing a landing.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable Procedures and check lists.
 - b. Aircraft handling techniques – Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To enable the student to safely land the aircraft on possible unprepared surfaces and to achieve this goal he will have to gain a complete understanding of the theory determining:

- i. The aircraft configuration for the precautionary landing.
- ii. The principles involved during low flying.
- iii. The circuit pattern involved during low flying.
- iv. The effect of wind.
- v. Selection and inspection of landing area.
- vi. Principles relating to a short landing.

HOW THE EXERCISE APPLIES TO FLYING

A precautionary landing may have to be carried out for a number of reasons, the most common being:

- i. Shortage of fuel.
- ii. Uncertainty of position.
- iii. Bad weather.
- iv. Poor in-flight navigation.
- v. Failing light – no night flying experience or no night flying facilities to destination.
- vi. Mechanical defects of engine and airframe.
- vii. On board emergencies i.e. passengers critically ill.

2. PRINCIPLES INVOLVED

1. CHOICE OF LANDING AREA

- i. Surface condition and obstructions.
- ii. Size of area available for landing. Should also be long enough for a possible take-off.
- iii. Wind direction and gradient.

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2. SLOW SAFE CRUISE TECHNIQUE

Apply procedures detailed in aircraft manual.

3. LOW FLYING TECHNIQUE

Review exercise 17A.

4. PRINCIPLES APPLICABLE TO THE SHORT LANDING

Review technique detailed in Exercise 13.

5. INSPECTION OF LANDING PATH

- i. High level inspection for general assessment.
- ii. Low level inspection for detailed assessment.

6. CIRCUIT PROCEDURES

- i. Field in sight – field approach checked; plan circuit pattern; timing in circuit.
- ii. Joining circuit – downwind checks; radio call (PAN-PAN if applicable); brief passengers.
- iii. Approach and landing – plan approach for short landing, emergency, landing briefing.

7. AFTER LANDING

- i. Inspection of taxiing path.
- ii. Shut down procedures.
- iii. Securing of aircraft.
- iv. Reporting of landing to nearest ATC or Police.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AIRCRAFT HANDLING TECHNIQUES

DEMONSTRATION

1. FORCED LANDING WITH POWER (PRECAUTIONARY)

- i. Simulate a bad weather situation with cloud base 500 ft agl.
- ii. Timing to be used to fly precise circuit.
- iii. For demonstration purposes, use airfield in GFA if possible.

OBSERVATION

Refer to Exercise 17A for low flying techniques, safety factors and aircraft configuration. Usually the slow safe cruise configuration is adopted.

2. FIELD

- i. Selection of suitable area:
 - a. Airfield.
 - b. Obstruction free road.
 - c. Cultivated land.
- i. Similar priorities as for forced landing without power, except that obstruction free roads may be considered first.
- ii. Look out for other aircraft and high

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- d. Suitable open terrain.
- e. Signs of habitation for after landing assistance.
- ii. Field in sight
 - a. Slow safe cruise configuration $\pm 100\text{ft}$ beneath cloud base.
 - b. Complete field approach checks.
 - c. Plan bad weather race course pattern circuit procedure according to conditions and select landmarks for orientation purposes.
 - d. Join overhead field or onto downwind leg as conditions dictate, beneath cloud base e.g. $\pm 400\text{ ft agl}$.
- iii. obstructions.
- iii. Assess weather situation continuously.

3. INSPECTION OF LANDING AREA

- i. Inspect proposed landing path from safe altitude using slow safe cruise configuration as per aircraft manual.
- ii. Check approaches and overshoot area are clear of obstacles from 'circuit' joining position – overhead or downwind.
- i. Low safe altitude $\pm 400\text{ ft agl}$.
- ii. From "circuit" joining position, confirm direction of best landing path.
- iii. Select landmarks for circuit orientation.
- iv. Fly over the field in direction of proposed landing path for the high level inspection ($\pm 400\text{ft agl}$. In this case).
- v. Align D.I. with magnetic compass heading and note 'runway' heading.
- vi. Fly a race course pattern crosswind leg using rate one turns onto reciprocal heading – downwind.
- vii. Normal downwind leg at $\pm 400\text{ ft agl}$. – allow for possible drift and keep landing path in sight at all times – very important. Note ground markers to assist with orientation.
- viii. Abeam threshold of proposed landing path, commence rate one turn onto race course pattern base leg to position for the low level inspection.
- ix. When approximately half way on the base leg commence a normal descending turn with power onto final approach, positioning to one side of the proposed landing path for better observation of approaches, surface and overshoot area (normally the right hand side allowing the pilot sitting on the left hand side of a side by side seating aircraft, a better unobstructed view).
- x. At a safe low attitude (e.g. $\pm 100\text{ ft}$), apply power for level flight in the slow safe cruise configuration.
- xi. Observe and note;
 - a. Direction of landing path (heading) – recheck D.I. with magnetic compass.
 - b. Surface condition of landing path.
 - c. Length of landing path.
 - d. Drift correction.
 - e. Undershoot and overshoot area for

- obstacles.
 - xii. After low level inspection run, climb straight ahead to 200 ft. agl. and commence a climbing rate one turn onto the downwind leg.
 - xiii. At least one low level inspection run should be done, unless the emergency dictates otherwise.
- 4. **DOWNWIND LEG**
 - i. Remain below cloud base (i.e. ± 400 ft agl.).
 - ii. Keep landing path in sight.
 - iii. Use ground markers to assist with orientation.
- 5. **BASE LEG**
 - i. Complete before landing checks – confirm U/C down (if applicable).
 - ii. Brief passengers as necessary.
 - iii. Radio call 'Pan-Pan', on appropriate frequency. When $\pm 45^\circ$ past the threshold of the landing path, commence a level medium turn onto base leg.
- 6. **FINAL APPROACH AND SHORT LANDING**
 - i. Continue with base leg turn.
 - ii. When approximately halfway on the base leg reduce power and commence a descending turn with power onto final approach, selecting additional flap as required.
 - iii. Wings level on final approach not lower than 300 ft agl.
- 7. **AFTER LANDING**
 - i. Select full flap early on final approach.
 - ii. Trim for short landing final approach speed.
 - iii. Adjust approach path with power.
 - iv. Emergency landing drill – as applicable in circumstances as per aircraft manual.
 - v. Carry out a short landing – see Exercise 13 for full details.
 - vi. PRACTICE PRECAUTIONARY LANDING – should this be simulated onto terrain not really suitable for actual landing then at a suitable safe height, carry out normal go-around procedure. See Exercise 13 for details.
- 7. **AFTER LANDING**
 - i. Inspection of taxi path.
 - ii. Aircraft security.
 - iii. Report incident by radio or telephone to ATC and Police.
 - iv. Note – Student not allowed taking off from other than licensed airfields in the case of carrying out a real precautionary landing in the future.

c. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

- i. Selection of landing area.
- ii. Possible non-standard circuit pattern, depending on conditions.

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- iii. Height of possible cloud base will determine circuit pattern.
- iv. Assessment of weather situation and wind effect.
- v. Inspection of proposed landing path for obstructions.
- vi. Use of race course circuit pattern where possible.
- vii. Short landing technique.
- viii. Radio call – 'PAN-PAN' and subsequent reporting of precautionary landing.

ENGINE CONSIDERATIONS

- i. Cause of possible engine malfunction:
 - a. Shortage of fuel – discuss additional procedure.
 - b. Faulty manipulation of fuel selector.
 - c. Ignition accidentally switched to one magneto.
 - d. Mixture too weak or too rich.
 - e. Carburettor icing.
 - f. Overheating of engine.
 - g. Mechanical defect.
- ii. Partial reduction of throttle setting due to engine malfunction.
- iii. Monitor engine temperatures and pressures.
- iv. Mixture to be richened while descending.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Descending with power.
- ii. Circuits and landings.
- iii. Engine assisted approach and landing with full flap.
- iv. Go-around procedure.
- v. Bad weather low flying techniques.
- vi. Slow safe cruise configuration.
- vii. Short landing procedure.

e. DE-BRIEFING AFTER FLIGHT

- 1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Planning of the circuit.
 - ii. Handling of the emergency.
 - iii. Method of choosing a field.
- 2. Discuss the common faults students usually make:
 - i. Student does not plan his circuit correctly.
 - ii. Speed control on finals is too high.
 - iii. Landing technique normally lacks polish.
- 3. Discuss the student's actual faults.
For each fault the instructor must indicate:
 - i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result of the fault could have led to.
 - iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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EXERCISE 18A

PILOT NAVIGATION

1. AIM

DEFINITION

Navigation is the process of directing the movement of an aircraft from one point to another.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the basic navigation principles enumerated in the Private Pilot's licence syllabus

Note: The student should have already received adequate ground instruction in the principles of pilot-navigation prior to undertaking the first dual navigation flight – the aim now is to teach him to apply this knowledge in the air.

- ii. The air exercise briefing:
 - a. Applicable procedures and check lists.
 - b. Preparation for a navigation flight, emphasising the following aspects:
 - Weather forecast
 - Map preparation, i.e. distance graduation, high terrain, etc.
 - Computation of compass heading, ground speed and flight times.
 - Assessment of safety heights and semi-circular rule.
 - Heading correction methods – drift problems.
 - Fuel required and reserves (refer to CAR's and CAT's).
 - Uses and limitations for en-route radio navigational aids.
 - Review of applicable VFR requirements and regulations.
 - Procedure when lost.
 - Use of take-off graphs and compilation of load sheet.
 - Diversion procedure.
 - Power settings to be used for navigation flights.
 - Pilot-navigation log and ATC flight plan.
 - c. Engine considerations, safety and airmanship.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To teach the student to fly from one place to another using simple pilot navigation techniques, whilst relying on the minimum of artificial aids.

HOW THE EXERCISE APPLIES TO FLYING

- i. The techniques taught should form the basis of all subsequent cross-country flights.
- ii. Low level navigation.
- iii. Night navigation flights.
- iv. Instrument navigation flights.

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2. PRINCIPLES INVOLVED

1. PRE-FLIGHT

- i. Selection and preparation of maps (i.e. track, distances, and pinpoints on 1:1,000,000/ 1:500,000 aeronautical topographical maps).
- ii. En-route safety heights and application of the semi-circular rule.
- iii. Use of airspace:
 - a. Refer to current NOTAM's, AIC's and the AIP for information regarding the proposed route to be flown (i.e. FAP; prohibited areas, FAR; restricted areas and FAD; danger areas).
 - b. Regulations applicable to flying in and the crossing of designated air corridors.
 - c. VFR rules for flight in ATA, TMA or CTA as well as the FIR.
- iv. Meteorological forecast: En-route weather.
Upper winds.
Destination weather.
Alternate airfield weather.
- v. Computation of headings, ground speed and flight times.
- vi. Fuel requirements and reserves – refer to CAR's and CATS's.
- vii. En-route radio aid frequencies, as well as ATC frequencies.
- viii. Preparation and completion of "Pre-flight/In-flight Navigation Log".
- ix. Preparation of ATC flight Plan.
- x. Aircraft safety equipment – Signalling strips.
First Aid Kit.
Other applicable emergency equipment.
- xi. Check validity of aircraft documentation:
 - Certificate of Airworthiness.
 - Certificate of Registration.
 - Certificate of Safety.
 - Aircraft Radio Station License.
 - Journey Logbook.
 - Weight and balance.
 - Certificate of Release to Service.
- xii. Compilation of all relevant aeronautical information for the navex:
 - VHF Radio frequencies – ATA, CTR, TMA, CTA, etc.
 - Navaid frequencies and morse code identification information.
 - Airfield elevation, runways, co-ordinates, joining procedures, reporting points inbound/outbound, etc.

2. MAP READING TECHNIQUES

- i. The value and reliability of a pinpoint depends mostly on whether it is unique in relation to its surroundings. The value of certain types of pinpoints may change with seasonal or weather conditions (discuss this with example), Dry dams, river courses, etc.
- ii. The student often becomes confused by attempting to correlate an excessive amount of detail – he should be told to use only the more prominent pinpoints in conjunction with the flight plan and D.R. calculations, and to avoid continuous map reading involving the location and identification of minor features.
- iii. It is usual to "read" from the map to the ground, but when uncertain of position, correlate ground features to features on the map.
- iv. Align the track line on the map with the longitudinal axis of the aircraft in order to prevent orientation problems.

3. DEDUCED RECKONING NAVIGATION TECHNIQUES

Mental DR navigation is the ability to visualise the aircraft's position in relation to landmarks, etc. and to be able to maintain a mental plot of the aircraft's progress throughout the flight.

4. POSITION IDENTIFICATION

The student must use basic map reading techniques, as well as the time factor to positively identify any desired position or destination.

5. LOG KEEPING

Discuss the reason for accurate log keeping in respect of:

- i. Times over/abeam pinpoints.
- ii. Headings.
- iii. Groundspeed.
- iv. ETA's.
- v. Fuel endurance etc.

6. HEADING KEEPING

- i. Use of magnetic compass, including turning errors and acceleration/deceleration errors.
- ii. Use of D.I. and its limitations.
- iii. Effect of inaccurate heading keeping on ETA's.
- iv. Use of on-track pinpoints to assist heading keeping.

7. ALTITUDE CONTROL

- i. Altimeter settings with regard to:
 - Transition altitude.
 - Transition level.
 - Flight level (standard QNH).
 - Airfield QNH.
- ii. Effect of fluctuations in altitude on groundspeed and ETA's.

8. TRACK ERROR ESTIMATION AND CORRECTION TECHNIQUES

- i. 5°/10° drift lines on either side of track.
- ii. The One-in-Sixty method.
- iii. Double-track method.
- iv. Track crawling method.

8. USE OF RADIO AIDS

All bearings should be carefully checked for validity, especially when there is a large discrepancy in relation to the flight plan requirement:

- i. ATC procedures – applicable frequencies for en-route air-space and airfields.
- ii. Use of ADF – QDM, QDR and cross bearings.
- iii. Use of VOR/DME – radials and distances.

10. REVIEW AND DISCUSS

- i. Procedures for setting heading.
- ii. Procedures for determining drift and drift correction methods.
- iii. Check point procedures.
- iv. Radio failure procedures.
- v. Dog leg procedure:
 - a. To loose time.
 - b. To avoid bad weather, high ground or restricted areas.
- vi. Procedure when lost.
- vii. Procedure at turning point.
- viii. Procedure at destination.

11. NIGHT NAVIGATION

- i. Greater emphasis must be placed on a comprehensive flight plan as the opportunities for map reading are limited.
- ii. Under suitable conditions, prominent geographical features may be seen and the light patterns of large towns may be positively identified.
- iii. Radio aids assume greater importance at night because of the limitations of map reading, but they must be used with discretion due to night effect.

3. **DESCRIPTION OF AIR EXERCISE**

a. **APPLICABLE PROCEDURES AND CHECKLISTS**

b. **AIRCRAFT HANDLING TECHNIQUES**

DEMONSTRATION

1. **SETTING HEADING PROCEDURE**

After take-off, climb and position the aircraft so as to arrive over the initial set heading point at the correct altitude (or flight level), airspeed, with cruising power set and the D.I. aligned with the desired magnetic compass heading.

2. **MAP READING**

OBSERVATION

- i. Time – log take-off time as well as initial set heading time.
- ii. Heading – check general direction and orientate track line on map with desired track.
- iii. ETA's – calculate and log ETA's up to first checkpoint as well as ETA for final destination on this leg.
- iv. Endurance- check fuel contents and log remaining endurance.
- v. Radio call.
- i. Orientation of map (i.e. along longitudinal axis of aircraft).
- ii. Read from map to ground and back to map.
- iii. Anticipate desired pin points by mental D.R. calculations.
- iv. Distance estimations affected by altitude (i.e. the distance between the aircraft's position and a recognised ground feature as affected by altitude).
- v. The co-ordinated use of distance features

3. IN TRANSIT

- vi. as an estimate of present position.
- vi. Reliance on mental DR techniques in featureless country.
- vii. Relative value of ground features unique in relation to its surroundings.
- i. Check and align D.I. with magnetic compass at least once every 10 minutes.
- ii. Do not alter heading until certain of position.
- iii. Log time of alteration of heading.
- iv. Periodically check engine instruments and carb heat control.
- v. Maintain a constant altitude or flight level.
- vi. Maintain a good look out.
- vii. Demonstrate magnetic compass turning and acceleration/deceleration errors.

4. TRACK ERROR ESTIMATION AND CORRECTION TECHNIQUES

- i. The 10° drift line and double track error methods.

- i. Used to indicate the direct angular track error.
- ii. To regain the track, alter the heading by twice the angular track error and maintain this heading for a time equal to the initial time flown to the point of correction. When track is regained, fly the original heading plus the initial angular track error to compensate for further drift.
- iii. Used for heading changes to regain track when only up to half the distance to the destination has been flown.
- iv. If required to fly parallel to the track, alter heading by an amount equal to the track error only.

- ii. The One-in-Sixty method.

Track error:

$$= \frac{\text{Dist off track}}{\text{Dist travelled}} \times \frac{60}{1}$$

- i. Track error in degrees is calculated from the distance off track and the distance covered.
- ii. This method is practical over any distance.
- iii. May be used:
 - a. To fly parallel to the track.
 - b. To regain the original track.
 - c. To fly direct to the destination along a new track plotted from the drifted position.
- iv. Airspeed correction can be applied to:
 - a. Compensate for gain/loss in ground speed.
 - b. Gain or loss in time while regaining track.

Note: An early decision to compensate for drift will assist in avoiding the use of more power to increase airspeed whilst regaining track, in order to

- iii. Track crawling method

maintain the desired ETA.

- v. Accuracy of timing is essential.
- i. From overhead the departure point or check point, turn onto the required track and select a prominent feature on the horizon directly ahead of the aircraft.
- ii. Fly towards the selected feature, ensuring the aircraft does not deviate from the required track, thereby automatically compensating for drift.
- iii. When approaching the feature, select another distant prominent feature on the track ahead of the aircraft.
- iv. The aircraft will be on track when it passes overhead the selected prominent features.
- v. Repeat this procedure until overhead the destination.

5. CHECK POINT PROCEDURES

- i. Time.
- ii. Heading – if necessary, correct for drift.
- iii. Calculation of ground speed.
- iv. Revise ETA for next check point (also destination).
- v. Check temps, pressures and note remaining endurance.

6. RADIO AIDS Use of ADF/VOR.

- i. Identification of coding (morse code).
- ii. Approximate idea of position obtained from bearing interpretation (QDM, QDR).
- iii. Simultaneous bearings to obtain a fix.
- iv. Homing procedures.

7. DOG LEG PROCEDURE

- i. Weather or terrain avoidance.
- ii. ATC requirement – to loose time.
- iii. To adjust ETA.

- i. Lookout – assess proposed dog leg terrain is suitable.
- ii. Calculate required headings for procedures by adding and subtracting sixty degrees from the present heading.
- iii. Roll onto first required heading using medium turn. Upon rolling out on the new heading note the exact time.
- iv. After the appropriate time has elapsed, turn onto the second heading of the dog leg and note the time.
- v. Maintain the second heading for exactly the same time as for the first leg of the dog leg, then turn back onto to the original heading.
- vi. During this procedure, the aircraft will drift according to time and not distance covered along the track.

8. PROCEDURE WHEN LOST

- i. After ETA has elapsed, maintain aircraft heading (compass and D.I. synchronised) for

Time permitting, complete as many of the following procedures as possible, bearing in mind

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10% of flying time since time of last fix.

- ii. Whilst carrying out above procedure, check full situation and calculate endurance.

the possibility of having to carry out a precautionary landing:

- i. Check in-flight navigation log for possible errors.
- ii. Use available radio aids to determine position (ADF/VOR/GPS).
- iii. Circle of uncertainty centred on destination – radius 10% of distance from last fix.
- iv. Square search procedure – if necessary.
- v. Radio calls for assistance.
- vi. Precautionary landing if required.

9. LOCATION OF DESTINATION

- i. Time – if en-route check point times have been accurate, the destination E.T.A. is important in locating the destination.
- ii. Map read more carefully when approaching destination correlating all information.
- iii. Use of funnel effect and line features for positive identification of destination.
- iv. Be prepared to possibly make large change of heading when destination is actually located.
- v. If the destination is a turning point:
 - a. Look out.
 - b. Log keeping – ATA.
 - c. Ascertain direction of next leg in relation to ground features.
 - d. Over turning point, climb or descent to next flight level/altitude, turning the long way round to the next heading.
 - e. Apply the standard procedures for setting heading.

10. LANDING AT DESTINATION

- i. Approaching the airfield:
 - a. Complete field approach checks.
 - b. Comply with ATC instructions at controlled airfields.
- ii. For uncontrolled and non-radio airfield, comply with the following procedures extracted from the AIC's:
 - a. Select the appropriate common VFR frequency (TIBA) and listen out for other aircraft.
 - b. Approach the airfield at 2000 ft agl.
 - c. Look out for other aircraft.
 - d. When approximately 5nm from the airfield broadcast position, altitude and intentions, using the name of the airfield.
 - e. Observe the signals area/windsock when overhead.
 - f. Plan for a standard left hand circuit (unless otherwise advised) and descend to circuit height (1000 ft agl) on the dead side in order to cross the upwind end of the active runway at 90° to it.
 - g. LOOK OUT FOR OTHER

- AIRCRAFT.
- h. Turn downwind and broadcast position on downwind, base leg and final approach.
 - i. At all times carry out normal circuit checks.

11. NIGHT NAVIGATION

- i. Review minimum equipment requirements in CAR's/CAT's.
- ii. Discuss night forced landing techniques.
- i. Look out.
- ii. Limited use of map reading.
- iii. Importance of constant instrument cross-check due to possibility of disorientation.
- iv. Importance of compliance with safety height.
- v. Distances are deceptive – discuss.
- vi. Use and identification of town light patterns for fixing position.
- vii. Use and limitations of radio aids.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Look out.
- ii. Radio calls.
- iii. Log keeping.
- iv. Maintaining altitude heading and airspeed.
- v. Compliance with navigation procedures: when
 - a. Setting heading.
 - b. Check points.
 - c. Radio failure.
 - d. Procedure when lost.
 - e. Turning points.
- vi. Align D.I. with magnetic compass at least every 10 minutes.
- vii. Weather consideration – maintain visual contact with the ground.
- viii. Map orientation and awareness of position.
- ix. Use of D.R. navigational techniques.

ENGINE HANDLING

- i. Power settings for range and endurance – refer to aircraft manual.
- ii. Temperatures and pressures.
- iii. Fuel management techniques for navigation flights – refer to aircraft manual.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Take-off and landing.
- ii. Climbing and descending.
- iii. Straight and Level flight.
- iv. Turning.
- v. Circuit procedures.
- vi. Precautionary landings.
- vii. Lost procedures.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise with emphasis on the following:
 - i. The need for thorough flight planning while taking weather conditions into consideration.
 - ii. Setting heading procedures.
 - iii. Selecting pinpoint positions.
 - iv. Calculation of drift and estimates.
 - v. Map reading.
 - vi. Log keeping during flight.
 - vii. Radio procedures.
 - viii. Look out.
 - ix. Accurate flying throughout.
 - x. Fuel management.
 - xi. En-route engine and instrument checks.
2. Discuss the student's actual faults.

For each fault the instructor must indicate:

 - i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result the fault could have led to.
 - iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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EXERCISE 18B

NAVIGATION AT LOWER LEVELS/REDUCED VISIBILITY

1. AIM

DEFINITION

Low flying is a condition of flight between ground level and 500 ft agl. where movement past objects on the ground as well as the effects of wind drift, may be appreciated.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and check Lists.
 - b. Aircraft handling techniques: - Demonstration and Observation.
 - c. Considerations of Airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

Due to the necessity of having to occasionally operate the aircraft at minimum level (such as under low cloud with poor visibility), the exercise requires a high standard of flying, self discipline and decision making ability than is required when operating at normal flight altitudes.

These requirements can only be met if the student has a complete understanding of the theory which will eventually determine:

- i. The aircraft configuration – the visibility and aircraft altitude above the terrain will determine the safe speed at which to fly.
- ii. The routes to follow – divert, turn back or continue to destination.
- iii. The effect of wind.
- iv. The effect of speed and inertia.
- v. The effect of turbulence at low altitudes.
- vi. The effect of precipitation:
 - a. Reduction in forward visibility.
 - b. Possible icing problems – airframe and engine.
 - c. Rain on the windscreen causes refraction and diffusion of light waves, thereby distorting visibility. The pilot may be misled into thinking he is higher than he actually is.
- vii. Low flying map reading techniques.

HOW THE EXERCISE APPLIES TO FLYING

- i. Low level navigation.
- ii. Precautionary landing.
- iii. Bad weather circuit and landing.

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2. PRINCIPLES INVOLVED

All the principles applicable to previous exercises, with the emphasis on:

1. LOW LEVEL NAVIGATION

- i. At low level the vertical height and shape of a ground feature is of more importance than its appearance in plan view.
- ii. Small, but unique features are often of greater use than large, more common ones.
- iii. Features are more easily missed while at low level, because they are in view for only a short time, especially those near the track.
- iv. The appearance of a check feature must, therefore, be anticipated and, to this end, a careful pre-flight study of the map is most important.
- v. Should a pinpoint be missed, a search should not be made for it but the flight continued and the next pinpoint anticipated. However, if a series of pinpoints are missed, altitude will have to be gained in order to ascertain position.

2. NEWTON'S LAWS

3. EFFECT OF WIND

- i. Headwind.
- ii. Tailwind.
- iii. Crosswind.
- iv. Wind shear.
- v. Turbulence.
- vi. Mountain waves.
- vii. Downdrafts in the vicinity of thunderstorms/microbursts.

4. SLOW SAFE CRUISING CONFIGURATION

- i. Airframe and engine limitations.
- ii. Optimum speeds.

5. WEATHER CONSIDERATIONS

- i. Precipitation.
- ii. Icing.
- iii. Visibility (into/out of sun, smog, rain, dust, twilight, etc.).

6. LOW FLYING MAP READING TECHNIQUE

- i. Proper map preparation with essential navigation information written next to tracks e.g. heading, minimum fuel, etc. (navigation logs cannot be used as with high level navigation).
- ii. Proper marking of tracks with timing marks rather than distance marks.
- iii. Changed aspect and relative importance of terrain features, as well as apparent speed in relation to the ground.
- iv. Limited field of vision.
- v. Terrain features only visible for a relatively limited time so therefore;
 - a. Anticipation – effect of inertia and wind.
 - b. Quick recognition of features.
 - c. Careful pre-flight map study.
 - d. Over-riding importance of look out and horizon scan.
 - e. Discuss use of positively identifiable line features to reach destination.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AIRCRAFT HANDLING TECHNIQUES

DEMONSTRATION

1. LOW LEVEL NAVIGATION

- i. Comply with CAR's/CAT's requirements.
- ii. Review procedures and check list for low flying.

2. ACTIONS PRIOR TO DESCENDING

3. DESCENDING TO MINIMUM SAFE ATTITUDE

4. EFFECT OF SPEED AND INERTIA

This is ideally demonstrated in no-wind conditions. Demonstrate at as high a speed as possible, consistent with safety.

- i. From straight and level flight.

OBSERVATION

- i. Note changed aspect and relative importance or terrain features, as well as apparent speed in relation to the ground.
- ii. Limited field of vision.
- iii. Terrain features only visible for a relatively limited time so therefore;
 - a. Anticipation – effect of inertia and wind.
 - b. Quick recognition of features.
 - c. Careful pre-flight map study.
 - d. Over-riding importance of look out and horizon scan.
 - e. Discuss use of positively identifiable line features to reach destination.
- i. Look out.
- ii. Complete the following checks:

Fuel - contents select fullest tank and note endurance.

Engine - Power setting requirements, temperatures and pressures.

Instruments - Align D.I. with compass, QNH set on altimeter

Radio - Call to ATC (if applicable) and nav aid set.

Security - Harness tight, loose articles stowed.
- i. Refer to power settings and IAS, show student apparent increase in ground speed due to rapid movement of ground features past the aircraft.
- i. Look out.
- ii. Establish required low flying configuration engine and airframe.
- iii. Select safe low flying altitude.
- iv. Select prominent ground feature directly

ii. During a turn.

- ahead of the aircraft which the aircraft will be able to clear safely (i.e. tree, windmill etc).
- v. Aim the aircraft slightly to the right of the selected object and when at a suitable distance from the object, rapidly rotate the aircraft into the climbing attitude, applying climb power, keeping the object in sight.
- vi. Note how the aircraft mushes towards the object, due to inertia, before climbing away.
- i. Look out.
- ii. Establish required low flying configuration – engine and airframe.
- iii. Select safe low flying altitude.
- iv. Select prominent ground feature directly ahead of the aircraft that the aircraft will be able to clear safely (i.e. windmill, tree etc.).
- v. Aim the aircraft slightly to one side of the object and when at a suitable safe distance from the object, bank rapidly away from the object, simultaneously applying power while keeping the object in sight.
- vi. Note how the aircraft mushes towards the object, due to inertia, before continuing in the new direction.

CONCLUSION: It will be necessary to take the effect of inertia into account when avoiding obstacles.

5. **THE EFFECT OF WIND**

i. Crosswind effect.

- i. Position the aircraft to track along a ground feature that is 90° to the wind.
- ii. Note the drift angle is more clearly observed at lower levels.
- iii. Note the aircraft's track over the terrain.
- iv. Look out.
- v. Commence a medium turn into wind and continue turning through 180° - balanced turn.
- vi. Roll out parallel to the ground feature and note the aircraft's distance from it.
- vii. Repeat the exercise, but commence the turn downwind. Roll out after 180° and note the aircraft's distance from the ground feature.

APPLICATION: When flying a bad weather circuit in crosswind conditions and to position the aircraft in the circuit pattern.

ii. Turning downwind.

- i. Head the aircraft directly into wind.
- ii. Lookout.
- iii. Commence a balanced medium turn through 180°.
- iv. Visual contact with the ground gives the impression of slipping into the turn.

Note: Do not attempt to correct for the apparent slip.

- v. Roll out downwind and note the increased groundspeed for a constant indicated airspeed.

Note: Do not reduce power.

iii. Turning into wind

- i. Head the aircraft directly downwind.
- ii. Look out.
- iii. Commence a balanced medium turn through 180°.
- iv. Visual contact with the ground gives an impression of "skidding out" during the turn.

Note: Do not attempt to correct for the apparent skid.

- v. Roll out into wind and note the reduced groundspeed for a constant indicated airspeed.

CONCLUSION: It will be necessary to take the effect of drift into account when turning to avoid obstacles.

6. **EFFECT OF TURBULENCE DURING LOW FLYING**

- i. More marked over uneven ground, trees, hills and near thunderstorms.
- ii. Beware of strong downdrafts downwind of hills and mountains, as well as in the vicinity of thunderstorms.
- iii. Whenever practical avoid possible areas of turbulence during low flying,
- iv. Before or encountering turbulence:
 - a. Repeat low flying checks.
 - b. Increase altitude if practical.
 - c. Counteract downdraft by increasing power.
 - d. In strong downdrafts where full power cannot counter the effect of the downdraft, turn out of the downdraft.

7. **BAD WEATHER LOW FLYING**

Whilst flying at minimum level, describe to the student an assumed bad weather situation which will necessitate the demonstration of:

- i. A simulated bad weather circuit and landing either at base or onto a suitable field.

- i. Obtain ATC clearance (actual or simulated).
- ii. Complete field approach check.
- iii. Approaching the circuit area, prepare the aircraft for slow safe cruising.
- iv. Keep a good look out and radio listening watch.
- v. Join the circuit as instructed by ATC. At uncontrolled airfields or simulated landing areas, comply with the statutory radio and joining procedures.
- vi. Position onto downwind, maintaining sight of the runway. Complete before landing checks.
- vii. Maintain visual contact with the runway

and commence a turn to position the aircraft onto final approach, from where the appropriate type of landing may be carried out.

ii. A Precautionary landing.

- i. Decide upon an appropriate landing area.
- ii. Complete field approach checks.
- iii. Follow procedures as described in Exercise 17.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Look out – for terrain features and other aircraft.
- ii. Trim aircraft nose up so that a slight forward pressure has to be maintained on control column. Should concentration lapse, aircraft will tend to fly up and away from terrain.
- iii. Maintain safe distance below base of low cloud.
- iv. Low flying checks.
- v. Anticipation – plan ahead taking into consideration the effect of inertia and wind.
- vi. Orientation – maintain an awareness of position at all times.
- vii. Check the surrounding weather conditions continuously for possible deterioration.
- viii. Comply with ATC requirements where applicable.
- ix. Comply with low flying regulations.

ENGINE CONSIDERATIONS

- i. Fuel management.
- ii. Power setting:
 - Mixture as required.
 - Pitch – high RPM as for climb.
 - Throttle – as required to maintain safe speed appropriate to aircraft configuration.
- iii. Use of aircraft lighting according to flight conditions cockpit and external lights.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Straight at level flight at various airspeeds.
- ii. Medium and steep turns.
- iii. Use of various flap settings.
- iv. Circuits and landings.
- v. Short landing.
- vi. Climbing and descending.
- vii. Slow Flight as in Exercise 10A.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Judgement of height above the ground.
 - ii. Anticipation of inertia.
 - iii. Anticipation of turn radius.
 - iv. Effect of drift at low level.
2. Discuss the common faults students usually make.

- i. Poor height control.
- ii. Poor anticipation of turn radius.
- iii. Students may find it difficult to anticipate drift control and they may have a tendency to cause the aircraft to skid during turns – discuss the importance of maintaining a balanced turn.

3. Discuss the student's actual faults

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to
- iv. The corrective action required.

f. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

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EXERCISE 18C

USE OF RADIO NAVIGATION AIDS UNDER VFR

LONG BRIEFING

Objectives:

- a. Use of VHF Omni Range (VOR):
 - Availability of VOR stations, AIP.
 - Signal reception range.
 - Selection and identification.
 - Radials and method of numbering.
 - Use of omni bearing selector (OBS).
 - To-From indication and station passage.
 - Selection, interception and maintaining a radial.
 - Use of two stations to determine position.
- b. Use of automatic direction finding equipment (ADF):
 - Availability of NDB stations, AIP.
 - Signal reception range.
 - Selection and identification.
 - Orientation in relation to NDB.
 - Homing to NDB.
- c. Use of VHF direction finding (VHF/DF):
 - Availability, AIP.
 - R/T Procedures.
 - Obtaining flight related information (QDM's and QTE'S).
- d. Use of radar facilities:
 - Availability and provision of service; AIS.
 - Types of service.
 - R/T procedures and use of transponder.
 - Mode selection.
 - Emergency codes.
- e. Use of Distance Measuring Equipment (DME):
 - Availability, AIP.
 - Operating modes.
 - Slant range.
- f. Use of Aero Navigation systems, satellite navigation systems (RNAV-SATNAV):
 - Availability.
 - Operating modes.
 - Limitations.

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AIR EXERCISE

- a. Use of VHF Omni Range (VOR):
 - Availability, AIP, frequencies.
 - Selection and identification.
 - Omni bearing selector (OBS).
 - To/from indications – orientation.
 - Course deviation indicator (CDI).
 - Determination of radial.
 - Intercepting and maintaining a radial.
 - VOR passage.
 - Obtaining a fix from two VOR's.
- b. Use of automatic direction finding equipment (ADF).
 - Non directional beacons (NDBs).
 - Availability, AIP, frequencies.
 - Selection and identification.
 - Orientation relative to the beacon.
 - Homing.
- c. Use of VHF direction finding (VHF/DF).
 - Availability, AIP, frequencies.
 - R/T procedures and ATC liaison.
 - Obtaining a QDM and homing.
- d. Use of en-route/terminal radar:
 - Availability, AIP.
 - Procedures and ATC liaison.
 - Pilot's responsibilities.
 - Secondary surveillance radar.
 - Transponders.
 - Code selection.
 - Interrogation and reply.
- e. Use of distance measuring equipment (DME):
 - Station selection and identification.
 - Modes of operation.
- f. Use of Aero Navigation systems, satellite navigation systems (RNAV-SATNAV):
 - Setting up.
 - Operation.
 - Interpretation.

EXERCISE 19

INSTRUMENT FLYING

1. AIM

The aim of this series of lessons under Exercise 19 is to give guidance to instructors of what to teach a student for the Night and Instrument Rating.

DEFINITION

Instrument flying is the process whereby the aircraft is controlled and navigated in flight solely by reference to instruments.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Physiological factors associated with instrument flight.
- ii. Aerodynamic factors related to instrument flight.
- iii. Flight instruments and their limitations.
- iv. Aircraft control.
- v. Avionics and their use in instrument flying.
- vi. The use of Aerad/Jeppesen/AIP, NOTAM'S and AIC's.
- vii. Weather.
- viii. Types of airspace.
- ix. Flight planning and filing of flight plans.
- x. Operating in the IFR environment.
- xi. IFR emergencies.

WHY IS IT BEING TAUGHT

To give the student a good understanding and a thorough knowledge of the principles required to fly the aircraft with sole reference to the instruments in an IFR environment.

HOW THE EXERCISE APPLIES TO FLYING

- i. Night flying.
- ii. Control of the aircraft in IFR conditions.
- iii. Navigational.
- iv. Instrument approach procedures.

INTRODUCTION

This chapter was written to provide guidance for the instructor when teaching instrument flying for the Night Rating, Commercial Pilot's Licence and Instrument Rating.

The guidance applies to teaching in the aircraft as well as in a simulator or flight procedures trainer. Ideally the training should be carried out in both the aircraft and simulator. The advantages of using a simulator are enormous. For one, the transfer of knowledge in a simulator is so much greater because of the lack of noise, air conditioned comfort, the facility of "freezing" the simulator, no delays due to weather and traffic. The level of safety is of course unparalleled. Every Instrument Instructor is urged to make as much use of a simulator for training as possible.

There are of course many ways of teaching the same thing and this guide should not be looked upon as being definitive in that respect but as providing a basis from which an instructor can work. The guide can also be used as a "checklist" to ensure that the minimum requirements have been taught.

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The bulk of the theory syllabus printed on the first few pages should have been covered when the student attended an Instrument Rating course at a ground school. The syllabus is included here for revision purposes, as the student will in all likelihood have forgotten a large percentage of what was learned at the ground school. The instructor will cover most aspects in the long briefing for each lesson, but whatever is not covered should be taught or revised during the course of practical training, as a suggestion, formal lectures could be presented to groups of students.

The time suggested for each lesson is to give the new instructor some guidance. There will be many occasions where the suggested time is going to be inadequate due to a student being slow to learn. There will also be occasions when the student is able to progress very quickly.

The flight time of 45 hours on the aircraft and simulator is suggested as being a realistic figure because of the requirements to be trained on all approach aids.

The syllabus specifies navigation training to be included in the Instrument Rating course. It is also a tremendous confidence builder for the student who has completed his training and now has the opportunity to put everything together. These lessons have even more impact if the instructor selects a day that requires flying in IMC.

2. PRINCIPLES INVOLVED

1. PHYSIOLOGICAL FACTORS RELATED TO INSTRUMENT FLYING

- 1.1 Adjustment to the flight environment:
 - a. Ground habits vs. flight habits.
 - b. Individual differences.
 - c. Importance of physiological factors to the instrument pilot.
- 1.2 Reactions of the body to pressure changes:
 - a. Aerotitis.
 - b. Aero sinusitis.
- 1.3 Reactions of the body to changes in oxygen partial pressure:
 - a. Hypoxia.
 - b. Carbon monoxide.
 - c. Alcohol.
 - d. Hyperventilation.
 - e. Drugs.
- 1.4 Sensations of instrument flying:
 - a. Body senses.
 - b. Spatial disorientation.
 - c. Illusions.

2. AERODYNAMIC FACTORS RELATED TO INSTRUMENT FLIGHT.

- 2.1 Fundamental aerodynamics:
 - a. Airfoils and relative airflow.
 - b. Angle of attack.
 - c. Lift/Weight, thrust/drag.
 - d. Stalls.

3. APPLICATION OF FUNDAMENTALS TO BASIC MANOEUVRES

- 3.1 Straight and level flight.
 - a. Airspeed.
 - b. Air density.

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- c. Aircraft weight.
 - 3.2 Climbs and descents.
 - a. Power, airspeed and vertical speed.
 - b. Power, airspeed and elevator control.
 - 3.3 Turns.
 - a. Skidding / slipping.
 - b. Co-ordination.
 - 3.4 Trim.
- 4. FLIGHT INSTRUMENTS
 - 4.1 Source of power.
 - 4.2 Function.
 - 4.3 Construction.
 - 4.4 Operation.
 - 4.5 Limitations.
- 5. AIRCRAFT CONTROL
 - 5.1 Attitude instrument flying.
 - a. Scanning.
 - b. Interpretation.
 - c. Control.
 - 5.2 Analysis of basic manoeuvres.
 - a. Straight and level.
 - b. Climbs and descents.
 - c. Turns.
 - d. Climbing and descending turns.
- 6. BASIC RADIO
 - 6.1 Radio waves, frequency assignment and characteristics.
 - 6.2 Ground facilities and radio class designations.
 - a. VORTAC.
 - b. Marker beacons.
 - c. NDB and locators.
 - d. Direction finders.
 - e. ILS.
 - f. Radar.
 - 6.3 Airborne equipment.
 - i. Antennae and power sources.
 - ii. Navigation receivers.
 - a. ADF.
 - b. VOR / ILS.
 - c. DME / TACAN.
 - d. OMEGA / VLF.
 - e. DECCA.
 - f. GPS.
 - 6.4 Communications receivers.
 - i. Tuning.
 - ii. Use.
 - iii. Basic troubleshooting in the event of failure.
- 7. WEATHER AVOIDANCE
 - 7.1 Weather radar.

- 7.2 Storm scope.
- 8. THE USE OF AERAD, JEPPESEN, AIP, NOTAMs AND AIC's
 - 8.1 Charts.
 - a. Legend.
 - b. Limitations and significance of items eg. MSA.
 - 8.2 AIP.
 - 8.3 NOTAM's.
 - 8.4 AIC's.
 - 8.5 Basic construction of Instrument Approaches.
- 9. WEATHER
 - 9.1 Winds and general circulation.
 - 9.2 Air masses.
 - 9.3 Frontal systems.
 - 9.4 Icing.
 - 9.5 Turbulence.
 - 9.6 Thunderstorms.
 - 9.7 Obtaining a forecast.
 - 9.8 Other sources of weather information.
- 10. AIRSPACE
 - 10.1 ICAO classification of airspace.
 - 10.2 Controlled airspaces:
 - a. ATZ / ATA.
 - b. CTR.
 - c. CTA.
 - 10.3 Uncontrolled airspace.
 - 10.4 Restricted airspace.
- 11. FLIGHT PLANNING
 - 11.1 Choosing the route.
 - 11.2 Choosing the altitude.
 - 11.3 Choosing alternates.
 - 11.4 Fuel planning.
 - 11.5 Weight and balance.
- 12. OPERATING IN THE IFR ENVIRONMENT
 - 12.1 Start Up.
 - 12.2 Taxi.
 - 12.3 Departure Clearance – setting of aids etc. SID's, Non Standard etc.
 - 12.4 En-route navigation etc.
 - 12.5 Updating weather information.
 - 12.6 Descent planning.
 - 12.7 Holding – OCT's and EAT's.
 - 12.8 Arrival – STAR's, Radar Vectors, Procedural. Setting of aids etc.
 - 12.9 Approach – Precision, Non-precision, Circle to land.
 - 12.10 Missed approach – Alternate courses of action.
- 13. IFR EMERGENCIES
 - 13.1 Vacuum pump failure.
 - 13.2 Pitot/Static failure.

- 13.3 Instrument failure.
- 13.4 Electrical failure.
- 13.5 Radio failure.
- 13.6 Engine failure.
- 13.7 Ground facility failure.
- 13.8 Low on fuel.
- 13.9 Adverse weather conditions.
- 13.10 Declaring an emergency.

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LESSON 1

FULL PANEL MANOEUVRES – PART 1

1. AIM

The aim of this lesson is to teach the student how to interpret the instruments on the instrument panel and to demonstrate that the attitudes observed in visual flight can be determined from the flight instruments.

DEFINITION

The basic manoeuvres, such as climbing, straight and level, descending and turning, which are normally carried out with reference to the natural horizon, are done with sole reference to the normal flight instruments in the aircraft.

2. WHAT THE INSTRUCTOR IS TO TEACH

- i. Physiological factors relating to instrument flying.
- ii. Aerodynamic factors relating to instrument flying.
- iii. The flight instruments, their limitations and layout.
- iv. Basic scanning techniques.
- v. Performance instruments and control/displacement instruments and how attitude \pm power gives performance.
- vi. The relationship between the horizon and the basic manoeuvres.
- vii. The relationship between the Artificial Horizon (A/H) and the same basic manoeuvres.
- viii. Importance of **Change, Check, Hold, Adjust and Trim (CCHAT)**.

3. WHY IS IT BEING TAUGHT

To enable the student to appreciate the relationship between attitudes of the aircraft as displayed on the Artificial Horizon and the various basic manoeuvres. Failure to master this basic lesson will hamper the student's progress in all future lessons on instrument flying.

HOW THIS EXERCISE APPLIES TO FLYING

All instrument flying requires an ability to carry out the basic manoeuvres with sole reference to the flight instruments.

4. THE AIR EXERCISE

DEMONSTRATION

OBSERVATION

i. PREFLIGHT INSPECTION

- i. Normal pre-flight but with particular emphasis on lights, antennae, and anti/de-icing equipment.

ii. BEFORE AND AFTER START CHECKS

- i. Stress importance of instrument and avionics checks.

iii. INSTRUMENT CHECKS DONE DURING TAXY.

- i. These are absolutely vital.

iv. **PRE-TAKE-OFF CHECKS AND BRIEFING**

- i. Normal checks and run up. Pay particular attention to alternator and vacuum. Check altimeter against published threshold altitude. Introduce the student to the departure clearance. A plan of action for the possibility of an engine failure must have been discussed. Point out that the avionics etc. must be set for the clearance.

v. **DEMONSTRATION OF FALSE SENSE OF TURNING AND CLIMBING.**

- i. Have the student close his eyes and look down. Lower the right wing very gently and then positively roll the wings level whilst raising the nose without changing the power. The student will normally believe that he has entered a turn to the left.
- ii. From straight and level flight have the student close his eyes and lower his head. Enter a medium turn to the left using a positive entry, and then very gently turn to the right whilst applying consistent back pressure to the control column. The student will believe that he is in a climbing turn to the left.

vi. **PITCH CONTROL**

Control instruments:
Artificial Horizon (A/H).
Power indicator.

Performance instruments:
Altimeter.
Airspeed indicator.
VSI.
Turn Co-ordinator.
Direction Indicator.

- i. Place the aircraft in the straight and level attitude using the visual horizon at normal cruise power.

Emphasize CCHA. Point out the attitude on the A/H. Pitch the nose up one width of the index aircraft above the horizon. Note the outside indications of the pitch change. Then note the change in performance. Now return the aircraft to the straight and level attitude using the A/H and confirm using the outside references. Note the indications on the performance instruments. Once the aircraft has stabilized at the original speed, lower the nose one width of the index aircraft below the horizon on the A/H. Note the outside indications and note the performance instruments. Return the aircraft to straight and level using the instruments, CCHAT. Emphasize very small movements on the A/H will cause large changes in performance. For this reason control pressures rather than control movements are required.

vii. **BANK CONTROL**

The Control Instruments:
Artificial Horizon.
Power indicator.
The performance Instruments;
Direction indicator.

- i. From the straight and level attitude, bank the aircraft 20° as shown on the A/H. (CCHA). Note the outside indications. Note that the aircraft will lose altitude unless the attitude is changed. Note the performance

Turn co-ordinator.
Altimeter and ASI.

instruments for turning viz. turn co-ordinator and the direction indicator. Note that the aircraft is not normally trimmed in a turn. Roll the wings level then bank the aircraft 20° in the opposite direction. Note all the performance instruments. Point out the A/H shows bank immediately and clearly.

N.B. Now that the student knows how to control the aircraft in pitch and bank, place the aircraft in different attitudes and have the student regain straight and level on a given heading at normal cruise speed. Leave the power constant. Help the student develop his scan by pointing to the instruments in a logical sequence for the maneuver being conducted. Make sure the student does not tense up. Make sure that the student trims the aircraft correctly. The control and performance instruments should be pointed out as required by the instructor.

viii. STRAIGHT AND LEVEL AT VARIOUS SPEEDS.

- i. Have the student reduce power about 500 RPM or about 5 inches of manifold pressure and maintain altitude. Remind the student of the need to prevent yaw with rudder as the power is reduced. Point out the higher nose attitude required as the speed reduces. Point out the need to monitor the performance instruments so as to ensure that the correct attitude is set for the lower speed. CCHAT. Stress the importance of trimming correctly. Help the student with the correct scan.
- ii. Have the student return to straight and level at normal cruise power.
- iii. Have student apply climb power and maintain altitude. Point out the need for rudder to prevent yaw as the power is increased, as well as the correct method of increasing power. Help the student with the necessary scan. Point out the new attitude and performance.

Emphasize that if an altitude adjustment of 100 ft. or less is required, a change in pitch attitude will be sufficient to regain the target altitude. More than this will probably require a power change if the airspeed is to remain reasonably constant.

ix. TURN THROUGH 180 DEGREES.

- i. From straight and level at normal cruise speed have the student bank 10° to 15° to the left and whilst maintaining altitude note the A/H and performance instruments. Return to straight and level flight then repeat to the right.

x. TURN ONTO SPECIFIC HEADINGS

- i. Have the student turn onto specific headings. Point out the requirement to start rolling out of the turn about ½ the bank angle in degrees before reaching the heading. Watch for tenseness.

xi. CLIMBING

- i. On a given heading have the student place the aircraft in a climb visually. Point out the outside then the inside indications of a

- climb.
 - ii. Increase Power then change the Attitude, check the Speed then Trim the aircraft. (PAST and CCHAT). Make sure that the student increases the power in the correct order and prevents yaw with the rudder.
 - iii. Have the student level-off at a given altitude. Point out the need to start levelling the aircraft at 10% of the rate of climb in feet before the aircraft reaches the given altitude.
 - iv. Regain cruise. Attitude, Speed, Power then Trim (ASPT). Ensure the student reduces power in the correct order and prevents yaw with the rudder.
- xii. **DESCENT**
 - i. On a given heading have the student initiate a descent visually. Point out the outside then the inside indications of a descent. Power, Attitude, Speed and then Trim (PAST).
 - ii. Have the student level-off at a given altitude. Point out the need to start levelling the aircraft at about 10% of the rate of descent in feet before reaching the desired altitude. Power, Attitude, Speed and then Trim. (PAST and CCHAT).
 - iii. Have the student climb 500ft., level-off and then descend 500ft. at given speeds and on specified headings.
- xiii. **CRUISE TO AIRFIELD**
 - i. Have the student practice straight and level flight and show him how to set the D/I to the compass.

5. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

- a. The instructor must ensure that an adequate lookout is maintained particularly whilst the student is under the hood.
- b. It is absolutely essential that the D.I. is synchronized with the compass about every 10 to 15 min.

ENGINE CONSIDERATIONS

- a. Watch out for overheating during climbing.
- b. Make sure that the student knows how to increase and decrease power in the correct order.
- c. Consider the use of cowl flaps during climbs and descents, if fitted.
- d. The workload for the student is very high and in all probability the engine instruments will not be looked at. It is most important that the student develop his scan to include these instruments from the first lesson.

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6. SIMILARITY TO PREVIOUS EXERCISES

The visual indications will be pointed out together with the instrument indications for what should be easy well practiced and understood visual manoeuvres for the student.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various manoeuvres with special emphasis on the following points:

- a. Correct scan.
- b. The need to anticipate leveling off during climbs and descents.
- c. The importance of CCHAT.
- d. The importance of not dwelling on one instrument at the expense of the others.
- e. The need to be relaxed.
- f. The importance of flying attitude and not chasing speed etc.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- a. The symptoms of the faults.
- b. The cause of the faults.
- c. The potential outcome of persisting with the fault.
- d. The necessary action required to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 2

FULL PANEL MANOEUVRES – PART 2

1. AIM

This lesson is taught so that the student will know how to achieve the necessary performance from the aircraft while flying with sole reference to instruments.

DEFINITION

The aircraft is flown mostly with sole reference to instruments with special emphasis on specific performance.

2. WHAT THE INSTRUCTOR IS TO TEACH

- 2.1 Aerodynamic factors relating to:
 - i. Straight and level at various speeds.
 - ii. Straight and level with gear and flap extend.
 - iii. Climbing at various rates of climb and speeds.
 - iv. Descending at various rates of descent and speeds.
 - v. Turning at various rates of turn and speeds:
 - a. Rate one turns.
 - b. Steep turns.
 - vi. The go-around procedure.
- 2.2 Recap on scanning methods
 - i. T-scan.
 - ii. Radial scan.
 - iii. Selective radial scan.
- 2.3 Copying of a basic clearance
 - i. Emphasise the need for a good scan, being relaxed yet alert, CCHAT and Power + Attitude = Performance.

3. WHY IS IT BEING TAUGHT

To enable the student to control the aircraft with sole reference to the aircraft 's instruments in preparation for the night rating.

4. THE AIR EXERCISE

- i. DEPARTURE
 - i. Have the student copy a basic clearance eg. Straight ahead toft. then left onto heading
- ii. CLIMB AND CRUISE TO THE GENERAL FLYING AREA
 - i. Have student revise the basics from Lesson 1.
- iii. STRAIGHT AND LEVEL. PRIMARY PERFORMANCE FROM THE ALTIMETER AND VSI.
 - i. Have the student set up normal cruise. Now have the student reduce the speed to flap limiting speed whilst holding the altitude

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- constant. Extend flap in stages. Note the new attitude and speed for each stage of flap assuming the power was left constant.
- ii. Point out the need to trim and CCHAT. Point out that more power will be required if the speed is to be kept constant (increase in drag).
 - iii. Have the student retract the flaps in stages at a constant altitude.
- vi. **RATE 1 TURN**
- i. Have the student do a 10° banked turn through 360° at a constant altitude. Follow this with a rate 1 turn. Note the different bank angles, rates of turn and different pitch attitudes required. Point out the slight change in speed when the power is left constant.
- v. **MEDIUM TURN**
THE PRIMARY PERFORMANCE INSTRUMENTS ARE THE D/I AND ALTIMETER.
- i. Before the turn ask the student approximately what pitch attitude will be required and what will happen to the speed if the power is left constant.
 - ii. Have the student do a 360° turn at 30° bank. Point out the need to start the roll out much earlier because of the higher rate of turn. This will be about ½ the angle of bank in degrees before reaching the desired heading.
- vi. **STEEP TURN**
THE PRIMARY PERFORMANCE INSTRUMENTS ARE THE ASI, D.I. AND ALTIMETER.
- i. With 45° angle of bank required, a much higher pitch attitude and a larger increase in power is required to keep the speed constant. Commence the roll out even earlier than for a medium turn.
- vii. **CLIMBING**
THE PRIMARY PERFORMANCE INSTRUMENTS ARE THE VSI AND ASI.
- i. Have the student climb at different speeds. Point out the different attitudes and rates of climb with normal power set.
 - ii. Have the student climb at different speeds. Point out the different attitudes and rates of climb with normal climb power set.
- viii. **DESCENDING**
THE PRIMARY PERFORMANCE INSTRUMENTS ARE THE VSI AND ASI.
- i. Have the student descend at different speeds. Point out the different attitudes and rates of descent for the same power.
 - ii. Have the student descend at 500 fpm. Note the attitude and speed

- ix. **CLIMBING AND DESCENDING TURNS**
 - i. Have the student climb at a given speed and turn on to a given heading.
 - ii. Ask the student to descend at a given speed and turn on to a given heading. Point out the change in rates of climb and descent when bank is applied.
- x. **GOING AROUND**
 - i. Have student slow the aircraft to approach speed with flaps extended and descend at 500 fpm. Carry out the go-around manoeuvre retracting flaps and climbing straight ahead.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. The instructor must maintain an adequate lookout.

ENGINE CONSIDERATIONS

- i. Watch out for overheating during the climb and excessive cooling during the descent.
- ii. Ensure that the student increases and decreases power in the correct order
- iii. Consider the use of cowl flaps if fitted and required
- iv. Emphasize the need to apply rudder as power is being increased or decreased

6. SIMILARITY TO PREVIOUS EXERCISES

The exercises are the same as what the student has been doing visually in the past.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various manoeuvres with special emphasis on the following points:

- i. Correct scan.
- ii. The need to anticipate leveling-off during climbs and descents and the need to anticipate rolling out of turns so that the desired heading is achieved.
- iii. Emphasize the importance of CCHAT.
- iv. Emphasize the importance of not dwelling on one instrument .
- v. The need to be relaxed.
- vi. The importance of flying attitude and not chasing speed etc.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the faults.
- ii. The cause of the faults.
- iii. The potential outcome of persisting with the fault.
- iv. The necessary action required to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS FOR THE NEXT LESSON

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LESSON 3

FULL PANEL MANOEUVRES – PART 3

1. AIM

This lesson is taught so that the student will be able to control the aircraft in the event of the aircraft stalling and be able to do timed turns in preparation for night flight.

DEFINITION

More advanced manoeuvres are flown in the aircraft with sole reference to the instruments

2. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 1:00 hr.)

- 2.1 Aerodynamic factors relating to:
 - i. Stability.
 - ii. Stalling.
 - iii. Descending and climbing turns.
- 2.2 Recap on scanning methods:
 - i. Timed turns i.e. 3° per second.

3. WHY IT IS BEING TAUGHT

To enable the student to recover from stalls and carry out timed turns with sole reference to the instruments in preparation for night flying.

4. THE AIR EXERCISE

- i. TAXI
 - i. Student must carry out taxi checks correctly.
- ii. DEPARTURE
 - i. Give the student a basic clearance.
- iii. CLIMB AND CRUISE TO THE GENERAL FLYING AREA
 - i. Revise the basic from the first two lessons with emphasis on correct scanning.
- iv. STABILITY
 - i. Show the student that if the aircraft is trimmed for straight and level flight at a particular speed, a reduction in power of 1" of M.P. or 100 RPM will cause the aircraft to descend at 100 fpm at the trimmed airspeed and that re-trimming will not usually be required. It follows that 5" M.P. or 500 rpm will cause about 500 fpm R.O.D. The restoration of the power to the original setting will cause the nose to pitch up and the aircraft will cruise at the original speed in straight and level flight.
 - ii. Allow the student to try descending at 500 fpm by reducing the power by 5" M.P. or 500 RPM as appropriate. Ask the student to return to straight and level flight by

v. **STALLS – CLEAN**

- i. increasing the power by the same amount. Have the student carry out the HASELL checks ending with a steep turn while the instructor looks out. Have the student stall in clean configuration, point out that he must apply carb heat and maintain balance with the rudder. Emphasise that the student simply has to maintain altitude by increasing the back pressure on the control column and that he does not have to put the aircraft in a very nose high attitude in order to stall it.
- ii. The recovery is standard but watch for too much forward elevator which will contribute to a large loss of altitude.

The manoeuvre is considered completed only when the aircraft is back at the starting altitude and heading with the after take-off checks completed.

vi. **STALLS WITH FLAP**

vii. **STALLS IN THE APPROACH CONFIGURATION**

- i. Have the student stall the aircraft with various flap settings until proficient.
- i. After HASELL checks have the student extend approach flap and gear and stall the aircraft with approach power. Point out the greater tendency to drop a wing with power. Practice as required.

viii. **STALLS IN A TURN**

- i. After HASELL checks have the student stall the aircraft in a turn. Practice as required.

ix. **TIMED TURNS**

- i. Have the student do a rate one turn at a constant altitude through 360° without timing. When the student is comfortable repeat the exercise with the stop watch. Point out that the watch should be started as the aircraft is banked and that the wings should have levelled as the time is up. Point out that every 45° the watch should have moved through 15 sec. The bank angle may have to be varied to maintain this relationship. Practice until proficient.

x. **DESCENDING TURNS**

- i. Have the student enter a descending turn. This is easiest if the power is reduced about 4" M.P. or 400 RPM. i.e. slightly less than a straight descent. Point out the need to begin recovery about 10% of ROD before desired altitude is reached and about ½ the bank angle before the heading is reached.

xi. CLIMBING TURNS

- i. Have student enter a climbing turn onto a given heading and climb to a given altitude. Point out the required attitude and power for a given climb speed. The usual lead is required to affect a smooth recovery.

Practice climbing and descending turns until reasonably proficient.

xii. APPROACH

- i. If the student is coping well, use the opportunity to practice “radar vectors” onto final approach. Watch out for fatigue.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Watch for a tendency to forget the HASELL checks.
- ii. Watch for a tendency to use aileron instead of rudder when a wing drops.

ENGINE HANDLING

- i. Watch for a tendency to forget the carb. heat either on or off.
- ii. Pay attention to engine temperatures and pressures as the aircraft will be climbing at low speed for a good deal of the lesson.
- iii. Watch for incorrect sequence of increasing and reducing power.

6. SIMILARITY TO PREVIOUS EXERCISES

The stalls are carried out in the same fashion as visually, the emphasis is on recovery with a minimum loss of height. The rest of the lesson is really a recap on the previous two exercises with the introduction of another element in the form of time during the turn.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various manoeuvres with special emphasis on the following points:

- i. Correct scan.
- ii. The importance of the effects of power changes on the aircraft’s performance.
- iii. The importance of HASELL checks during this sort of manoeuvre.
- iv. The importance of recognizing and impending stall and the recovering before the stall occurs.
- v. The importance of integrating the stop watches in the scan.

8. DISCUSS THE STUDENT’S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the faults.
- ii. The cause of the faults.
- iii. The potential outcome of persisting with the fault.
- iv. The necessary action required to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 4

FULL PANEL MANOEUVRES – PART 4

1. AIM

The aim of this lesson is to teach the student to recover from unusual attitudes while flying on instruments.

DEFINITION

The aircraft is flown with sole reference to instruments with particular emphasis on being able to recover from awkward attitudes. This lesson includes an introduction to limited panel.

2. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 1:00 hr.)

2.1 Aerodynamic factors relating to:

- i. Spiral dives.
- ii. Incipient spins.
- iii. The limitations of instruments.
- iv. The use of the limited panel instruments.

2.2 Recap on scanning methods:

- i. Timed turns i.e. 3° per sec.

3. WHY IT IS BEING TAUGHT

This is taught so that the student will be able to recover (using the instruments for reference) from any unusual attitudes that the aircraft may enter as a result of inattention on the pilot's part or other factors like turbulence.

4. THE AIR EXERCISE

- | | |
|---|---|
| <p>i. <u>TAXI</u></p> <p>ii. <u>DEPARTURE</u></p> <p>iii. <u>CRUISE TO G.F.A.</u></p> <p>iv. <u>UNUSUAL ATTITUDES</u></p> | <p>i. Ensure that the student checks the instruments while taxiing.</p> <p>i. Give the student a more complex departure clearance involving headings and various altitude limitations.</p> <p>i. Blank out the A/H during the cruise. Point out how changes in attitude are determined from the pressure instruments. Point out that these instruments lag the aircraft's attitude and that small corrections to attitude should be made. Follow up with small trim movements.</p> <p>i. Have the student close his eyes and look down. Do a level turn for about 60° then gradually roll into a turn in the opposite direction and induce a spiral dive. Allow the speed to increase substantially and ask</p> |
|---|---|

- ii. student to recover.
- ii. Have the student close his eyes and look down. Do a level turn of about 60° then gradually roll into a turn in the opposite direction and induce a spiral dive. Allow the speed to increase substantially and ask student to recover.

Continue with these exercises until the student is proficient, but watch for airsickness.

- iii. Have the student recover from high nose attitude and low airspeed situations until proficient.
- v. **TIMED TURNS**
 - i. Have the student do a rate one timed turn on full panel. Point out the importance of the turn co-ordinator and the position of the indicator to achieve the rate one turn.
 - ii. Blank out the A/H and D/I and ask student to do a 360° timed turn on limited panel. Practice left and right turns until proficient.
- vi. **INCIPIENT SPINS (FULL PANEL)**
 - i. After doing HASELL checks demonstrate an incipient spin off a climbing turn pointing out the instrument indications. Effect the normal recovery. Have the student carry out the exercise left and right until proficient.
- vii. **CRUISE TO AIRFIELD**
 - i. Use this opportunity to practice straight and level flight on limited panel. Have the student descend to circuit altitude on limited panel. Have student complete the rest of the circuit visually.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Ensure that the HASELL checks are done correctly before the incipient spins.
- ii. Ensure that an adequate lookout is maintained at all times.

ENGINE HANDLING

- i. Watch for overheating during climbs.
- ii. Ensure student changes power in the correct order.
- iii. Make sure that the student is including the engine instruments in his scan. This can be checked by making him point to the instruments every time he looks at them.

6. SIMILARITY TO PREVIOUS EXERCISES

- i. The exercise with the exception of limited panel is carried out as under visual flight.
- ii. The limited panel flight manoeuvres are carried out using pressure instruments to indicate pitch attitude and are the same as for full panel except there is only one gyro instrument in use and as a result the flight is unlikely to be as accurate.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various manoeuvres with particular emphasis on the following points:

- i. Correct scan.
- ii. The importance of CCHAT.
- iii. The need to trim correctly.
- iv. The importance of realizing that the pressure instruments have a certain amount of lag and speed and altitude should not be “changed”.

8. DISCUSS THE STUDENT’S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the faults.
- ii. The cause of the faults.
- iii. The potential outcome of persisting with the fault.
- iv. The necessary action required to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 5

FULL PANEL MANOEUVRES – PART 5

1. AIM

The aim of this lesson is to teach the student how to control the aircraft when flying in instrument conditions if one or more of the instruments has failed.

DEFINITION

The basic manoeuvres are carried out using limited panel as if the vacuum pump had failed i.e. using the Turn Co-ordinator or Turn and Slip Indicator.

2. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 1:00 hr.)

- i. Explain how to recognize instrument failure and the insidious nature of this failure.
- ii. Recap on how gyro instruments topple.
- iii. Recap on the use of pressure instruments to recognise pitch attitude.
- iv. Recap on the use of the Turn Co-ordinator and the Turn and Slip Indicator.
- v. Recap on the aerodynamic forces associated with a spiral dive.

3. WHY IT IS BEING TAUGHT

To enable the student to control the aircraft when some of the gyro instruments fail or topple.

4. THE AIR EXERCISE

Control inputs when flying on limited panel will be made with reference to the performance Instruments. This is clearly not an ideal situation and the instructor must emphasize that control inputs must be smooth and gradual. A control input must be made and the student must wait and see what performance results before another control input is made. Flying under these conditions is essentially trail and error and CCHAT is most important.

- | | |
|-------------------------|--|
| i. <u>START</u> | i. Introduce student to the concept of "Start Clearance". The student should also be competent at carrying out the avionics checks at this point. |
| ii. <u>TAXI</u> | i. The student should not need any prompting to do the instrument checks. |
| iii. <u>CLEARANCE</u> | i. The student should be able to copy basic clearances without too much difficulty. |
| iv. <u>TAKE-OFF</u> | i. At the instructor's discretion the student may be allowed to attempt a take-off under the hood from about 30kts thus simulating poor visibility. |
| v. <u>CRUISE TO GFA</u> | i. On reaching the cruising level cover the A/H and D/I simulating vacuum pump failure. Have the student fly to the GFA on limited panel. Point out that a more rapid scan will be |

vi. **TIME TURNS**

- required.
- i. Have student carry out a timed turn through 360° at a given altitude. Then a series of 90°, 120° and 180° turns until proficient.
- ii. When rolling out of a turn using the turn coordinator as apposed to a turn and slip indicator a turn in the opposite direction will be indicated because the instrument reacts to both roll and yaw.
- iii. If a student is unsure of the direction to turn in, point out that looking at the numbers on the face of the ADF indicator will solve the problem or turn LEFT for LESS. The ADF face can be used to establish the timing required as the numbers are usually displayed at 30° intervals and 30° correspond to 10 secs.
- iv. Turns of 10° and less should be made rate ½ turns and the timing counted e.g. for a turn of 10° a turn of 6 secs at ½ rate turn and can be counted as “one and two and three and four and five and six.

vii. **CLIMBING AND DESCENDING**

- i. From properly trimmed straight and level flight have the student reduce power sufficiently to set up 500 fpm. descent. All that will be required is a small power reduction of about 5” M.P. or 500 RPM. The aircraft may be returned to level flight with the minimum effort by simply increasing the power to the original straight and level setting. The descent will be a lot more difficult if the speed is changed during the descent. It is therefore wise to establish the aircraft at the required speed before the descent is commenced.
- ii. The climb is commenced by raising the nose and adding power as the correct speed is approached. Point out that unless the aircraft had a lot of excess thrust available while in cruise it will be necessary to reduce the speed to the usual climb speed. This will of course require a pitch change and the aircraft must be re-trimmed. When the desired altitude is reached make sure that the student allows the aircraft to accelerate to the desired speed before the power is reduced.

viii. **CLIMBING AND DESCENDING TURNS**

- i. Have the student enter a timed descending turn through 360° and lose a 1000 ft, at 500 fpm. Point out that a slightly smaller power reduction than that for a straight descent will be required due to the inclined lift vector etc. This is a difficult manoeuvre to do accurately and the instructor should expect perfection.
- ii. Have the student enter a climbing turn ideally at 500 fpm (although many aircraft cannot reach this figure at altitude) through 360° and

ix. STALL

- gain a 1000 ft. The exercise requires a lot of co-ordination.
- i. Have the student do the HASELL checks ending with the instructor doing the lookout turn.
 - ii. The instructor should demonstrate the approach to a stall. The emphasis must be on recognizing the impending stall and taking corrective action before it develops. A minimum loss of height must be stressed.

When flying on limited panel the student must know that he has an emergency situation on his hands and that he should never be closer than the stall warning to the stall.

- iii. During the recovery process, point out that the ASI reverses its trend as the nose of the aircraft cuts the horizon. This is the only real clue that the student will have as to the attitude. At this point it will be necessary to check forward on the control column to avoid an excessively high nose attitude while climbing to the original altitude.
- iv. Have the student practice the approach to stalls in various configurations until he is proficient.

x. RETURN TO AIRFIELD

- i. Have the student practice reducing and increasing speed during the flight to the departure field. This exercise should be carried out using limited and full panel.
- ii. Give the student simulated radar vectors onto final approach.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. The HASELL checks must be carried out.
- ii. An adequate lookout must be maintained.

ENGINE HANDLING

- i. The engine temperature and pressure gauges must be included in the scan.
- ii. Power must be increased and decreased in the correct order.
- iii. Cowl flaps must not be forgotten.
- iv. There is a need to apply as the power is increased or decreased.

6. SIMILARITY TO PREVIOUS EXERCISES

These exercises which have been carried out on full panel are repeated using limited panel.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various exercises with particular emphasis on the following points:

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- i. Correct scan.
- ii. The use of the pressure instruments to determine the aircraft's altitude.
- iii. Emphasize the importance of CCHAT.
- iv. Point out that there is a tendency to reduce the workload.
- v. The aircraft must be trimmed correctly to reduce the workload.
- vi. It is vital that the student learns to relax.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the faults.
- ii. The cause of the faults.
- iii. The potential outcome of persisting with the fault.
- iv. The necessary action required to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

LESSON 6

FULL PANEL MANOEUVRES – PART 6

1. AIM

This aim of this lesson is to consolidate what has been learned in the previous lesson and to learn to recover from unusual attitudes.

DEFINITION

More advanced manoeuvres are flown with sole reference to less than the normal complement of flight instruments.

2. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 1:00 hr.)

2.1 Aerodynamic factors relating to:

- i. Recap on Spiral dives.
- ii. Recap on Spinning.
- iii. Recap on Incipient spinning.
- iv. Recap on the insidious nature of instrument failure.
- v. Explain how an aircraft may end up in an unusual attitude.

2.2 Recap on scanning methods:

- i. The compass including errors for compass turns.
- ii. The method of flying with an altimeter failure.

3. WHY IT IS BEING TAUGHT

To enable the student to recover from unusual attitudes if some of the gyro instrument had failed or toppled.

4. THE AIR EXERCISE

- | | |
|----------------------------|--|
| i. <u>START</u> | i. The student should ask the instructor for "Start Clearance". Avionics must be correctly tested. |
| ii. <u>TAXI</u> | i. The student will carry out the necessary instrument checks without prompting. |
| iii. <u>CLEARANCE</u> | i. The content of the clearance could include intermediate altitudes with a number of heading changes, etc. |
| iv. <u>TAKE-OFF</u> | i. The student may be allowed to again attempt a take-off under the hood from about 30 kts simulating poor visibility. |
| v. <u>CLIMB AND CRUISE</u> | i. The student should be given the opportunity to practice limited panel flying. |
| vi. <u>COMPASS TURNS</u> | i. Allow the student to carry out a visual turn onto North or South using the compass. Point out |

the need to overshoot North by about 30° and undershoot South by the same amount. Allow the student to carry out a few turns onto North and South using the compass. Allow the student to carry out some turns onto east and west using the compass.

vii. AWKWARD ATTITUDES

- i. Have the student close his eyes and look down whilst the aircraft is placed in a spiral dive. Have the student recover using limited panel, if the speed is increasing the throttle must be closed, then the wings levelled followed by back pressure on the control column to ease out of the dive. No attempt should be made to ease out of the dive until the wings are level, as back pressure on control column in a bank will tighten the turn with a larger aerodynamic load. A clue to the position of the nose relative to the horizon is the trend of the ASI i.e. as the speed stops increasing and begins to decrease the nose will have past through the horizon. The throttle should be opened and the aircraft climbed back to the original altitude.

Practice as required until proficient at recovery from spiral dives. Watch for nausea.

- ii. Have the student look down and close his eyes whilst placing the aircraft in a low speed climbing turn. Ask the student to recover on limited panel. Point out that power must be added if the speed is low, followed by lowering the nose to increase the speed whilst levelling the wings. As the ASI reverses its trend the nose will have crossed the horizon. At this point the student should return the aircraft to the original altitude.

Practice as required and watch for nausea.

viii. ALTIMETER FAILURE

- i. Have the student climb or descend 1000ft. with a full panel and a simulated altimeter failure using the VSI and timing.

ix. INCIPIENT SPINS

- i. Demonstrate an incipient spin on full panel and have student practice until proficient.

x. RETURN TO AIRFIELD

- i. Practice full panel flight during the return to the airfield with simulated radar vectors onto final approach.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Lookout cannot be over emphasized.
- ii. HASELL checks should be covered before practicing the recovery from low speed awkward attitudes.

ENGINE HANDLING

- i. Ensure that the engine does not over-rev during spiral dives.
- ii. Engine temperatures and pressures should be checked by the student without the instructor prompting him.

6. SIMILARITY TO PREVIOUS EXERCISES

These exercises have been carried out on full panel and are repeated using limited panel.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various exercises with particular emphasis on the following points:

- i. Trimming the aircraft correctly to reduce the work load.
- ii. Flying on limited panel is taught as an emergency measure and must be practiced constantly if the student is to remain proficient.
- iii. Emphasize that the student must make an effort to know what combination of power and attitude will give the required performance.
- iv. Point out that as the student tires, he is likely to make bigger and bigger control inputs leading to greater excursions from the desired heading and altitudes.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the faults.
- ii. The cause of the faults.
- iii. The potential outcome of persisting with the fault.
- iv. The necessary action required to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 7

INTRODUCTION TO NAVIGATION AIDS

1. AIM

The aim of this lesson is to introduce the student to the ADF and the VOR.

DEFINITION

The VOR and ADF are used to assist the student in fixing a position and as homing aids while flying at night.

2. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 1:00 hr.)

- i. How the ADF and VOR work.
- ii. How the ADF and VOR can be used as homing aids.
- iii. How to use the ADF and VOR to fix a position.
- iv. Various limitations and errors of the ADF and VOR. e.g. VOR line of sight and scalloping, ADF night effects, mountain effect and coastal effect.
- v. **STRESS THAT NO AID SHOULD BE USED WITHOUT IDENTIFYING THE STATION!**
- vi. An introduction to Radio Navigation Charts i.e. Jeppesen, Aerad and AIP charts.

3. WHY IT IS BEING TAUGHT

To enable the student to work out where he is in flight using the instruments in the aircraft and based on this information ensure that he is at or above the minimum safe altitude for the area.

4. THE AIR EXERCISE

- | | |
|------------------------------|--|
| i. <u>START AND TAXY</u> | i. This is as in earlier lessons. |
| ii. <u>ATC CLEARANCE</u> | i. Include homing to an ADF or VOR station. Ensure that the station is tuned and identified before departure where possible, i.e. the VOR cannot always be received on the ground. |
| iii. <u>CLIMB AND CRUISE</u> | <ol style="list-style-type: none">i. Have the student tune and identify an NDB station. Then have the student home towards the station.ii. Have the student tune and identify a VOR station and home towards it.iii. Once the student is proficient at these exercises take control of the aircraft and teach the student how to fix his position using two VOR's or ADF's or a combination of the two.iv. Once the student has mastered the basic steps required to fix the position of the aircraft, hand control of the aircraft back to him and allow him to practice fixing his position whilst flying the aircraft. |

These exercises are absolutely vital in developing the student's mental picture of his geographical position. At this point in the training the student must be taught how to establish what the minimum safe altitude in that area is. Controlled Flight into Terrain (CFIT) as a result on not being aware of position and the minimum safe altitude, has claimed many lives.

- iv. **DESCENT AND CRUISE**
 - i. Once again the instructor can simulate an approach with radar vectors. At this point the instructor should consider having the student carry out the R/T.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. All beacons must be identified before being used for navigation purposes.
- ii. It is vital that the student develops an awareness of his position and the minimum safe altitude in that area.
- iii. Lookout is very important.
- iv. The student should be introduced to the concept of refusing an ATC clearance if he cannot comply with it or feels unhappy with it.

ENGINE HANDLING

- i. Engine temperature and pressure gauges must be monitored.
- ii. The student should be proficient at setting power and using cowl flaps.

6. SIMILARITY TO PREVIOUS EXERCISES

The student will be developing the skills developed during his PPL navigation training with regard to the ADF and the VOR. The use of instruments in previous lessons on full panel.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various exercises with particular emphasis on the following points:

- i. Identifying beacons before using them.
- ii. Knowing the aircraft's approximate position at all times (situational awareness).
- iii. Knowing what the minimum safe altitude in that position is.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the faults.
- ii. The cause of the faults.

- iii. The potential outcome of persisting with the fault.
- iv. The necessary action required to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 8

CONSOLIDATION

1. AIM

The aim of this exercise is to give the student an opportunity to practice all the manoeuvres learned to date in preparation for the Night Instrument test.

DEFINITION

The consolidation lesson allows the student to polish the basic instrument flying skills that he had developed to date in preparation for the instrument test required for the night rating.

2. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 1:00 hr.)

- i. Discussion on all basic instrument manoeuvres.
- ii. Discussion on all advanced manoeuvres.
- iii. Discussion on all limited panel manoeuvres.
- iv. Discussion on the use of ADF and VOR.

3. WHY IT IS BEING TAUGHT

To enable the student to determine what areas of instrument flying need practice before the test.

4. THE AIR EXERCISE

- | | |
|------------------------------|---|
| i. <u>START</u> | i. As in past lessons. |
| ii. <u>TAXY</u> | i. As in past lessons. |
| iii. <u>ATC</u> | i. Give the student a clearance that requires homing towards a beacon with an intermediate level of altitude then later climbing to an assigned altitude. |
| iv. <u>CLIMB</u> | i. As in the past complying with the ATC clearance. |
| v. <u>CRUISE</u> | i. Have the student cruise at normal cruise for a few minutes then reduce to minimum safe cruise speed for a few minutes increasing to normal cruise again. |
| vi. <u>STEEP TURNS</u> | i. Have the student carry out both left and right steep turns onto given headings. |
| vii. <u>STALL</u> | i. Have the student carry out stall in various configurations with full and limited panel until proficient. |
| viii. <u>INCIPIENT SPINS</u> | i. Have the student demonstrate entry and recovery to one or more incipient spins if applicable. |

- | | |
|--|---|
| ix. <u>UNUSUAL ATTITUDES</u> | i. Have the student recover from one or two unusual attitudes or as required using full and limited panel. |
| x. <u>TIMED TURNS</u> | i. Have the student carry out one or two rate one timed turns or until proficient. |
| xi. <u>RETURN TO FIELD</u> | i. Have student home towards a beacon to see that he understands what is required using both the VOR and ADF if possible.
ii. Have the student fix his position approximately using one or both of the navigational aids. |
| xii. <u>APPROACH</u> | i. Give the student simulated radar vectors onto final approach |

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

The student should be displaying a high standard of airmanship at this stage of his training. All the points covered in the previous exercises should be second nature to the trainee.

ENGINE HANDLING

These exercises will have been carried out often during the student's training.

6. SIMILARITY TO PREVIOUS EXERCISES

All these exercises will have been carried out often during the student's training.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on all the exercises flown with particular emphasis on the following points:

- i. Correct scan.
- ii. Student must be relaxed.
- iii. The student must anticipate leveling the aircraft by approximately 10% of the rate of descent or climb.
- iv. The aircraft must be trimmed correctly.
- v. The student should be developing a mental picture of his position relative to the various ADF and VOR beacons in the area.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the faults.
- ii. The cause of the faults.
- iii. The potential outcome of persisting with the fault.
- iv. The necessary action required to correct the fault.

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9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

LESSON 9

INSTRUMENT TEST FOR THE NIGHT RATING

1. AIM

The aim of this lesson is to ensure that the student has reached the required level of proficiency to fly the aircraft with sole reference to instruments for the night rating. The test must be done by and independent instructor.

DEFINITION

This lesson is the test required by the authorities to ensure that the student meets the required standard of instrument flying.

2. GUIDELINES FOR THE TESTING OFFICER (Briefing of 30 min)

- i. The testing officer must brief the student thoroughly on what is required of him during this test.
- ii. The limitations are laid down in the test form and the student should operate within these limits. What is more important however is that where the student goes outside these limits he must demonstrate the ability to return to the correct altitude, heading etc.
- iii. The testing officer should be satisfied that the student is always in control of the aircraft and that safety will not be compromised.

3. DE-BRIEFING AFTER THE FLIGHT

The testing officer should discuss the student's actual faults and for each fault he must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of persisting with the fault.
- iv. The action required to correct the fault.
- v. If the student is not going to continue with instrument training, the instructor should point out that he must make a point of receiving recurrent instrument training because his current level of proficiency will deteriorate fairly quickly. Professional pilots have to undergo an instrument rating check every 6 months and they fly regularly!

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LESSON 10

USING THE ADF FOR TRACKING - PART 1

1. AIM

The aim of this exercise is to teach the student how to intercept and follow a specific track to an NDB station i.e. a QDM.

DEFINITION

Using the ADF for tracking under IFR requires that the specified track is intercepted and followed while flying the aircraft with sole reference to instruments.

2. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 1:00 hr.)

- i. The principles of operation of the ADF.
- ii. The parallel method of intercepting a QDM.
- iii. Any other method of intercepting QDM's.
- iv. Drift correction procedures.

The parallel method of interception is suggested as a starting point because it is a simple straight forward, all be it a long winded, method of intercepting the required track. In the event of disorientation or having to intercept a track on limited panel the student will have a method of interception requiring a minimum of thinking. Once this has been mastered any other method will be grasped easily.

3. WHY IT IS BEING TAUGHT

This exercise is taught so that the student will be able to manoeuvre the aircraft onto a given track and be able to compensate for drift while on the track. This is a pre-requisite for accurate navigation in IMC and for the NDB approach.

4. THE AIR EXERCISE

The start, taxi, take-off and climb will be the same as in earlier lessons. The clearance should preferably not include interception a QDM at this stage. It is vital that the student learns to check the ADF for correct functioning before commencing the flight. Generally at least two stations with substantially different frequencies should be identified and checked for correct bearing indications.

i. INTERCEPTING A QDM

- i. Give the student the QDM. Guide the student through the various steps required for the intercept. i.e.:
 - a. Check DI against compass.
 - b. Tune and identify the ADF station.
 - c. Turn onto the same heading as QDM.
 - d. Note where the ADF needle points.
 - e. Turn in the required direction for the intercept.
 - f. When the ADF needle points to the intercept, turn the aircraft onto the correct heading.
- ii. Have the student practice intercepting QDM's until proficient.

ii. DRIFT CORRECTION

- i. Introduce the student to the concept of

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- iii. **OTHER METHODS**
 - i. correcting for drift.
If appropriate any other method of intercept could be shown when the student has grasped the parallel method of intercepting a QDM.
- iv. **RETURN TO THE AIRFIELD**
 - i. Give the student a QDM to follow if there is an appropriate beacon near or at the airfield.

5. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

- i. All beacons must be identified before using them. It is vital that the instructor gets this point home as soon as possible.
- ii. The instructor must maintain a good lookout.

ENGINE CONSIDERATIONS

- i. The engine temperature and pressure gauges must be monitored.
- ii. Mixture control must not be forgotten.
- iii. Cowl flaps.

6. **SIMILARITY TO PREVIOUS EXERCISES**

The exercise is similar to straight and level flight, but with directional guidance from the ADF.

7. **DE-BRIEFING AFTER THE FLIGHT**

Briefly recap on the various exercises with particular emphasis on the following points:

- i. The need to synchronize the D.I. to the compass at regular intervals.
- ii. No navigational aid must ever be used without identifying it.
- iii. The student must develop a mental picture of his position relative to the NDB.
- iv. The student must anticipate the turn onto the correct heading to avoid flying through the QDM.
- v. The tendency to home to the station rather than correct for drift must be discouraged at an early stage.
- vi. Emphasize that it is vital that the student fly a heading and does not chase the ADF needle.

8. **DISCUSS THE STUDENT'S ACTUAL FAULTS**

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of persisting with the fault.
- iv. The action required to correct the fault.

9. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

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LESSON 11

USING THE ADF FOR TRACKING – PART 2

1. AIM

The aim of this exercise is to teach the student to track away from an NDB station on a given track i.e. a QDR.

DEFINITION

A magnetic track is maintained while flying away from a beacon (QDR) with sole reference to the instruments in the aircraft.

2. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 30 min.)

- i. The parallel method of intercepting a QDR.
- ii. Any other method of intercepting a QDR.
- iii. Drift correction procedure.

3. WHY IT IS BEING TAUGHT

This exercise is taught so that the student will be able to intercept and follow a magnetic track away from an NDB. This form of navigation is required for both en-route navigation and for some NDB approaches.

4. THE AIR EXERCISE

i. DEPARTURE

- i. The departure clearance should if possible include a QDM.

ii. INTERCEPTING A QDR (parallel method)

- i. Give the student a QDR to intercept.
- ii. Guide the student through the steps i.e.:
 - a. Synchronize the D.I and the compass.
 - b. Tune and identify the NDB.
 - c. Turn onto the heading of the QDR.
 - d. Check the position and work out the required intercept angle.
 - e. Have the student practice until competent.

iii. OTHER METHODS OF INTERCEPTING A QDR

- i. Use any other method to intercept a QDR

iv. DRIFT CORRECTION

- i. Teach student how to correct for drift.

v. RETURN TO AIRFIELD

- i. If possible use this time to practice intercepting QDM's and QDR's.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. No NDB must be used without identifying the station.
- ii. A good lookout must be maintained.

ENGINE HANDLING

- i. Engine temperatures and pressures must be monitored by the student.
- ii. Mixture setting and cowl flap operation should be accomplished without the instructor having to prompt the student.

6. SIMILARITY TO PREVIOUS EXERCISES

This is similar to the previous exercise except that a track from the station is intercepted and maintained.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various manoeuvres with special emphasis on the following points:

- i. Setting the D.I to the compass heading.
- ii. Identifying the NDB station before using it.
- iii. Correcting for drift.
- iv. Emphasize the need to fly a heading and not to chase the needle.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the faults.
- ii. The cause of the faults.
- iii. The potential outcome of not correcting the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

LESSON 12

INTERCEPTING AND MAINTAINING VOR RADIALS

1. AIM

The aim of this lesson is to teach the student how to intercept and follow a radial towards and away from the VOR station.

DEFINITION

Flight is carried out with sole reference to instruments and using the VOR system for track guidance.

2. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 30 min.)

- i. The principles of operation of the VOR.
- ii. The limitations of the VOR system.
- iii. Methods of intercepting a given radial.
- iv. Drift correction procedure.

3. WHY THIS LESSON IS TAUGHT

This lesson is taught so that the student will be able to fly the aircraft with sole reference to instruments as well as be able to navigate the aircraft using the VOR both en-route and during the VOR approach.

4. THE AIR EXERCISE

It is important for the instructor to teach the student how to test the VOR receiver for accuracy and correct functioning. As a guide in an aircraft fitted with two VOR receivers, they should both be tuned to the same station and the displayed radials with the needles centred and TO in the window, should be within 4° of each other on the ground. Where reception of a VOR is impossible on the ground, the same method may be used in the air but the radials should be within 6° of each other. When an aircraft is fitted with a single VOR installation, the testing becomes a little vague as we don't have VOT's at all stations in Africa. As a suggestion the coding of the station should be checked, the radial checked for reasonableness and the 10° full deflection check can be checked.

A problem that students usually experience is one of chasing the VOR needle and ADF for that matter. This problem may be overcome by teaching the student to find a reference heading and adjust from the heading. The reference heading is a heading that will keep the VOR needle stationary. The position of the needle as long as it does not show full scale deflection, is immaterial. Once a heading to keep the needle still is found a turn to intercept the radial is made and as soon as the needle centres the aircraft is turned back to the reference heading.

i. DEPARTURE

- i. The student should be given a departure clearance that requires intercepting a QDR or a QDM for practice purposes.

ii. CRUISE

- i. Once established in the cruise, the student should be shown how to intercept a specified VOR radial inbound to a station. Once again it is absolutely vital that a VOR station is not used without identifying it.
- ii. Have the student practice intercepting radials until proficient.

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- iii. Show the student how to intercept a VOR radial outbound from a station. Once again stressing the need for identification.
- iv. Introduce the student to drift correction whilst using the VOR for navigation purposes.

iii. **RETURN TO AIRFIELD**

- i. Where possible give the student VOR radials to intercept and follow

5. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

- i. It is absolutely vital that the importance of identifying the VOR station is emphasized from the beginning.
- ii. The instructor must of course maintain a sharp lookout throughout all exercises.

ENGINE HANDLING

Nothing new is required in this regard except that the student will tend to forget to monitor the engine temperatures and pressures as a result of the increased workload from trying to follow the VOR.

6. **SIMILARITY TO PREVIOUS EXERCISES**

This is similar to all previous exercises with the exception that the navigation is carried out with reference to VOR's.

7. **DE-BRIEFING AFTER THE FLIGHT**

Briefly recap on the various manoeuvres with special emphasis on the following:

- i. The tendency to expect the VOR needle to move as the heading is changed (like it does with the ADF) and when it does not, the student will tend to turn more.
- ii. The student will have a tendency to chase the VOR needle when correcting for drift. It must be stressed early on that a reference heading should be established and all adjustments for drift should take place around this heading.

v **DISCUSS THE STUDENT'S ACTUAL FAULTS**

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of not correcting the fault.
- iv. The action necessary to correct the fault.

9. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

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LESSON 13

VOR AND ADF CONSOLIDATION

1. AIM

The aim of this lesson is to give the student sufficient practice at intercepting QDM's, QDR's and VOR radials to ensure that the procedures have been grasped before moving onto the next lesson.

DEFINITION

Tracking using the VOR and ADF is practised.

2. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 30 min.)

- i. Recap on the intercepting of QDM's and QDR's as well as VOR radials.
- ii. Recap on the drift correction procedure for the ADF.
- iii. Recap on the drift correction procedure for the VOR.

3. WHY IT IS BEING TAUGHT

This lesson is designed to give the student practice in the procedures used to navigate using the VOR and ADF.

4. THE AIR EXERCISE

i. DEPARTURE

- i. The departure clearance should include a QDM, QDR or a VOR radial in this and all future lessons. Introduce the student to frequency changes i.e. these could be made on a second VHF radio if not appropriate to change the frequency on the primary VHF radio.

ii. CRUISE

- i. Use this phase of flight and the rest of the lesson in the general flying area to give the student as much practice as possible in intercepting and tracking QDM's, QDR's and VOR radials.
- ii. The student could be shown what the indications of flying over or abeam VOR and NDB stations if they are appropriately positioned navigation aids.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Identifying aids.
- ii. Instructor lookout.
- iii. Listening to the radio for traffic etc.
- iv. Knowing minimum safe altitude in the area.

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ENGINE HANDLING

This is the same as for previous exercises.

6. SIMILARITY TO PREVIOUS EXERCISES

This is similar to and covers most of the earlier exercises using the full panel.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various manoeuvres with particular emphasis on the following points:

- i. The student must develop a keen sense of knowing where he/she is and what the minimum safe altitude in that area is.
- ii. The need to be relaxed.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of not correcting the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

LESSON 14

NDB HOLDING PATTERNS

1. AIM

The aim of this exercise is to teach the student how to enter and remain in a holding pattern based on the NDB.

DEFINITION

The NDB holding pattern is a procedure used to keep an aircraft in a specific area for a period of time using the NDB as the navigation aid.

2. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 30 min.)

The instructor should use the approach charts that the student will be using for his training in explaining what is required in the various points mentioned below:

- i. Why holding patterns are necessary
- ii. How holding patterns are constructed
- iii. The various entries into holding patterns and how to determine which entry to use.
- iv. The timing required in the holding pattern
- v. Drift correction in the holding pattern
- vi. Drift correction in the holding pattern
- vii. Minimum holding altitudes
- viii. How to minimize fuel consumption
- ix. The concepts of Expected Approach and Onward clearance times
- x. The various actions that a pilot should follow when crossing a navigation aid e.g.:
 - a. TIME – the stop watch should be started.
 - b. TURN – turn the aircraft onto the correct heading.
 - c. THROTTLE – reduce power to holding power if not yet done.
 - d. TWIST/TUNE – the inbound track should be dialled in when using the VOR for holding purposes but could be learned now. Tune applies to tuning the correct navaid frequency if applicable.
 - e. TALK - it is vital that the student learns that the radio work should not be done at the expense of flying and navigation.

3. WHY IT IS BEING TAUGHT

This exercise is taught to ensure that the student will be able to determine which entry is to be used and then enter and fly the holding pattern based on an NDB. The holding pattern is a vital part of procedural instrument flying.

4. THE AIR EXERCISE

i. CRUISE

- i. While flying towards the NDB the instructor should help the student determine the entry and establish exactly what he is going to do on reaching the beacon.
- ii. Allow the student to enter the holding pattern and fly not more than two holds.
- iii. On reaching the NDB again leave the hold and have the student track out on a QDR. Give the student headings to position for

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- another entry. In order to reduce the workload for the student, the instructor could fly the aircraft while the student works out what entry is required.
- iv. The above procedure should be repeated to expose the student to the 3 entries with a limited amount of holding practice.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. The instructor must keep an exceptionally sharp lookout whilst operating in the vicinity of a navigation aid especially when flying outside controlled airspace.
- ii. Radio calls become very important particularly when operating outside controlled airspace.
- iii. Minimum holding altitudes must be discussed when determining the entry to be used.
- iv. The appropriate timing must be discussed and adhered to.
- v. The NDB station must be identified regularly.
- vi. The D/I must be reset regularly.

ENGINE HANDLING

- i. The student should reduce power three minutes prior to reaching the holding fix so that the fix is crossed at or below the maximum allowed or ideal holding speed.
- ii. The engine power and mixture must be set to ensure that minimum fuel is burned while “wasting time” in the holding patterns.

6. SIMILARITY TO PREVIOUS EXERCISES

This exercise requires a high standard of general instrument flying as covered in previous lessons.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various manoeuvres carried out with particular reference to the following points:

- i. The importance of briefing the instructor as to what the student is going to do. This becomes very important in a multi-crew environment but in the case of single pilot operations will force the student to plan what is going to be done.
- ii. The importance of staying in the holding area while entering the holding pattern.
- iii. The importance of timing and minimum holding altitudes.
- iv. The importance of checking that the D.I. and compass are synchronized.
- v. The importance of identifying the NDB regularly as there are no flags on the ADF to indicate failure of the system.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of not correcting the fault.
- iv. The action necessary to correct the fault.

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9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

LESSON 15

THE NDB APPROACH – PART 1

1. AIM

The aim of this exercise is to teach the student how to carry out an NDB approach with sole reference to instruments.

DEFINITION

The NDB approach is a series of manoeuvres carried out with sole reference to the instruments in the aircraft whereby the aircraft descends from the minimum en-route altitude to a point, where if visual, the pilot is able to carry out a landing and if not, can safely carry out a missed approach and divert to an alternate airfield.

2. WHY IT IS BEING TAUGHT

This manoeuvre is taught so that the student will be able to safely carry out an approach in IMC using the ADF as the sole means of navigation in the aircraft.

3. WHAT THE INSTRUCTOR IS TO TEACH

It is assumed that the student has had the necessary briefing on weather minima and interpretation of the JEPPESEN, AERAD, CAR's/CAT's, AIP's, AIC's and NOTAM's applicable to IFR operations:

- i. What factors are accounted for in constructing an instrument approach procedure.
- ii. How to read an approach chart. It is suggested that the instructor break the approach into the various segments i.e. initial approach, intermediate approach, final approach and the missed approach phase. The various aspects should then be considered with reference to the actual approach to be flown that day i.e. MSA, entries, timing, speeds, effects of wind, landing checks, identifying beacons, setting the D.I., what to expect when breaking out of cloud, the go-around and missed approach procedure and what course of action will be followed then.
- iii. How to plan the approach.
- iv. How the student should brief himself as to how the approach is to be flown if flying alone or the other crew member in a multi-crew situation.
- v. How to interpret and fly the missed approach portion of the approach.
- vi. Fuel planning and monitoring.
- vii. The various radio calls to be made.
- viii. The sequence that should be followed when crossing over the NDB for example Time, Turn, Throttle, Twist/Tune and Talk.

4. THE AIR EXERCISE

This exercise should be carried out in controlled airspace with a flight plan and all the correct ATC procedures i.e. start clearance, etc. This exercise will need to be repeated until the student has a good grasp of how to fly an NDB approach.

i. THE POSITIONING FLIGHT

- i. The aircraft should be positioned sufficiently far away from the NDB that the student will have sufficient time available to brief the instructor on how the approach is to be flown.
- ii. It is once again suggested that the instructor fly the aircraft while the student

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ii. THE APPROACH

- i. does the planning and the briefing.
The instructor will obtain the necessary clearance for the approach as well as the weather details.
- ii. Due to the high workload the landing checklist will often be forgotten.
- iii. The inbound QDM is often ignored.
- iv. Students often forget to descend.

iii. THE MISSED APPROACH

- i. The missed approach should be flown and the holding pattern be entered where the student can once again brief the instructor on what he is going to do.
- ii. The go-around should be done very smartly with emphasis on getting away from the ground ASAP.

iv. THE LANDING

- i. The approach should end with a landing rather than another missed approach.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Altitude awareness cannot be over emphasized.
- ii. Fuel planning and remaining fuel must be a high priority.
- iii. Weather awareness is vital.
- iv. The student should be asking himself the following three question.
- v. The NDB must be identified regularly.
- vi. Regularly apply the following:
 - Where am I?
 - Where am I going?
 - What must I do next?
- vii. The D.I. must be checked against the compass.
- viii. The QNH must be obtained and set correctly.

ENGINE HANDLING

- i. Fuel must be conserved.
- ii. Engine temperatures can become very low during the approach.
- iii. Power must be increased in the correct order and at the correct rate during the go-around.
- iv. Cowl flaps must be open for the go-around.

6. SIMILARITY TO PREVIOUS EXERCISES

This exercise is very similar to the previous exercise where holding patterns were flown.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various manoeuvres flown with particular reference to the following points:

- i. The planning and briefing of how the approach is to be carried out.
- ii. The timing of the outbound leg.
- iii. The speeds used.
- iv. The rates of descent.

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- v. The go-around procedure.
- vi. The missed approach procedure.
- vii. The landing checks.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of not correcting the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 16

THE NDB APPROACH – PART 2

1. AIM

The aim of this lesson is to consolidate what has been learned about holding patterns and the NDB approaches.

DEFINITION

The NDB approach is a series of manoeuvres carried out to transition from flight in IMC to a landing or missed approach.

2. WHY IT IS BEING TAUGHT

This lesson allows the student to consolidate what has been learned as well as learn some new concepts.

3. WHAT THE INSTRUCTOR IS TO TEACH

- i. The concept of a visual descent point.
- ii. The use of DME to determine the VDP.
- iii. The procedure turn approach.
- iv. Calculation the timing on the outbound leg.

4. THE AIR EXERCISE

i. EXPECTED APPROACH TIME

- i. Give the student an expected approach time that would require 2 to 3 holds. Consider flying the aircraft for a while whilst the student works out the wind direction, and how the hold is to be adjusted so as to reach the fix at the correct time.

ii. PROCEDURE TURN APPROACH

- i. The aircraft should be positioned for a sector 1 or 2 entry so that a procedure turn approach can be carried out.
- ii. The instructor must ensure that the student does the necessary planning and that the briefing is done.
- iii. The student is likely to need reminding that a descent will probably be required on the outbound leg.

iii. THE VISUAL DESCENT POINT

- i. The student should be shown that if the runway is not in view by the VDP, a landing off the approach becomes unlikely, and in most cases extremely unsafe, because the high rate of descent required will lead to an unstabilised approach.
- ii. A missed approach may be commenced at the VDP but no turn may be commenced until the missed approach point has been reached.

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The demonstration of the importance of a VDP will enable the instructor to emphasize the need to descend to MDA smartly if the approach is to be a success (the need to be level already at MDA prior to reaching MAP). Students often don't realize the importance of descending to MSA smartly because they invariably carry out a missed approach during training and don't get to see that they would probably not have been able to have landed off the approach on reaching MDA at the MAP.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Identifying the station before and during the approach.
- ii. Altitude awareness.
- iii. Knowing what to do next.
- iv. Briefing the Instructor.
- v. Listening out on the radio.
- vi. Checking the D.I. against the compass.
- vii. Knowing the weather at the alternate and the fuel state.
- viii. The QNH must be obtained and set.

ENGINE HANDLING

- i. Watch for excessive cooling during the descent.
- ii. Watch for incorrect order of increasing power.
- iii. Watch for overheating during the go around.
- iv. Watch for mixture not being enriched during the descent.

6. SIMILARITY TO PREVIOUS EXERCISES

This exercise is based on past exercises with the exception of the procedure turn and the VDP.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the exercises flown with particular emphasis on the following points:

- i. The correct timing to and for the procedure turn so that the inbound turn coincides with the normal base turn.
- ii. The importance of descending to MDA smartly.
- iii. The importance of thinking ahead.
- iv. The importance of planning how the approach is to be flown.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of not correcting the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 17

THE VOR HOLDING PATTERN

1. AIM

The aim of this lesson is to teach the student how to fly a holding pattern based on the VOR.

DEFINITION

The VOR holding pattern is a procedure used to keep an aircraft in a particular area for a period of time.

2. WHY IT IS BEING TAUGHT

This exercise is taught so that the student will be able to enter and fly a VOR holding pattern with sole reference to instruments.

3. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 1:00 hr.)

- i. A brief recap on the operation and limitations of the VOR.
- ii. The differences between the VOR holding procedure and the NDB.
- iii. The method of identifying station passage and abeam positions using the VOR holding pattern with sole reference to instruments.
- iv. Briefly recap on entry procedures and how to determine them.

4. THE AIR EXERCISE

i. POSITIONING THE AIRCRAFT

- i. The aircraft should be positioned so as to give the student sufficient time to work out the required entry procedure.
- ii. Ensure that the student does follow the correct procedure over the VOR e.g. **TTTTT**.
- iii. Once a hold has been flown have the student track out on a specified radial and do a different entry.
- iv. The instructor must ensure that the heading being steered when flying inbound will allow the required inbound track to be intercepted. This requires that the student compares the actual radial with the required radial.
- v. When all the entries have been practiced the instructor could end the lesson with a VOR approach.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. The VOR must be identified before use.
- ii. The student must fly headings rather than chase the VOR needle.
- iii. Altitude awareness is of most importance.

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- iv. Timing and turning in the correct direction are vital.
- v. Listen out on the radio.
- vi. Obtain the necessary clearances.
- vii. Obtain and set QNH.

ENGINE HANDLING

This is as for the NDB holding and approach.

6. SIMILARITY TO PREVIOUS EXERCISES

This exercise is very similar to the NDB holding and approach lessons using the VOR as the navigation aid. A major difference is the fact that the VOR has a warning flag to indicate failure of the station.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various manoeuvres flown with particular emphasis on the following points:

- i. It is extremely likely to set the wrong course in the VOR window. The value of the TO/FROM flag.
- ii. When turning inbound, the student who does not make an effort to ensure that the heading being flown will at least take him back to the VOR, (if the correct inbound track has not been intercepted) is in danger of holding abeam the beacon in a strong wind.
- iii. There will be a strong tendency to chase the VOR needle but the instructor must ensure that the student learns to steer a reference heading that keeps the needle motionless and then adjusts from this heading to centralize the CDI needle.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of not correcting the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 18

THE VOR APPROACH – PART 1

1. AIM

The aim of this lesson is to teach the student how to carry out a VOR approach.

DEFINITION

The VOR approach is defined as being the series of manoeuvres necessary to transition from the minimum safe altitude to a landing or a missed approach when operating in Instrument meteorological conditions.

2. WHY IT IS BEING TAUGHT

This lesson is taught so that the student will be able to carry out an approach while operating in IMC with sole reference to the instruments in the aircraft using the VOR for navigation purposes.

3. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 1:00 hr)

- i. How to read a VOR approach chart.
- ii. The similarities and differences between the VOR and NDB approach charts.
- iii. A revision of the procedure turn approach.
- iv. Recap on the EAT and the OCT.

4. THE AIR EXERCISE

From this point onwards the instructor must ensure that the student learns to cope with the radio work. It is absolutely vital that the student learns that an approach in controlled airspace cannot be commenced without a clearance to do so. It is also imperative that the instructor should ensure that the student knows what the weather at the alternate is and exactly how much fuel remains.

i. EXPECTED APPROACH TIME

- i. Give the student an expected approach time requiring a suitable number of holds.

ii. POSITIONING THE AIRCRAFT

- i. The student should use this time to plan how the approach is to be flown and to obtain the weather.
- ii. The student must brief the instructor on what he is going to do.
- iii. The instructor should allow as many approaches and missed approaches as possible including the procedure turn approach.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Student must obtain the necessary clearance for the approach.
- ii. Altitude awareness.
- iii. Weather awareness.

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- iv. Cockpit organization is vital.
- v. The effects of wind on the approach.
- vi. The instructor must maintain a good lookout.
- vii. Fuel awareness.
- viii. Planning the approach and the briefing cannot be overemphasized.
- ix. Obtain and set the correct QNH.

ENGINE HANDLING

- i. Watch for excessive cooling during descents.
- ii. Watch for overheating during climb and missed approaches.
- iii. Ensure that the aircraft is flown to conserve fuel while holding for the approach.

6. SIMILARITY TO PREVIOUS EXERCISES

This exercise is similar to the NDB holding and approach procedures as well as the VOR holding procedure.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various manoeuvres flown with special emphasis on the following points:

- i. Cockpit organization and neatness.
- ii. Fuel planning.
- iii. Weather alertness.
- iv. Planning of the descent.
- v. Executing the go-around and missed approach procedure correctly and smartly.
- vi. The procedure turn approach.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of not correcting the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

LESSON 19

THE VOR APPROACH – PART 2

1. AIM

The aim of this lesson is to give the student time to consolidate the VOR approach.

DEFINITION

The VOR approach is defined as being the series of manoeuvres carried out when transitioning from the en route phase of flight to the landing or missed approach using the VOR for navigation.

2. WHY IT IS BEING TAUGHT

This lesson allows the student with enough time to consolidate the VOR approach before moving onto other Non-Precision Approaches.

3. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 1:00 hr.)

- i. Recap on the VDP.
- ii. Recap on the correct timing for the outbound leg.
- iii. Recap on drift adjustment.

4. THE AIR EXERCISE

i. THE VOR APPROACH

- i. The student should be able to obtain the clearance and set the altimeter etc. with little or no help from the instructor.
- ii. The instructor should allow practice until reasonably proficient at the various approaches i.e. full approach and the procedure turn approach.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. The instructor must ensure that the student knows where he is and what he is supposed to be doing next.
- ii. The missed approach must be carried out correctly with a minimum of delay.
- iii. Altimeter setting must be obtained and set correctly.
- iv. The DI must be set correctly.
- v. The necessary clearances must be obtained with little or no prompting from the instructor.

ENGINE HANDLING

This should all be done correctly by the student with little or no prompting from the instructor.

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6. SIMILARITY TO PREVIOUS EXERCISES

This exercise is a continuation from the previous one.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various manoeuvres flown with special emphasis to the following points:

- i. Cockpit organization and neatness.
- ii. Fuel planning.
- iii. Weather alertness.
- iv. Planning of the descent.
- v. Executing the go-around and missed approach procedure correctly and smartly.
- vi. The procedure turn approach.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of not correcting the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

LESSON 20

OTHER NON PRECISION APPROACHES

1. AIM

The aim of this exercise is to teach the student how to fly other types of non-precision approaches like the VOR/DME, VOR/NDB approach and localiser only approaches.

DEFINITION

Other non-precision approaches may be defined as being approaches with the basic track guidance being provided by the NDB and VOR but with extra information from other sources leading to improved accuracy.

2. WHY IT IS BEING TAUGHT

This exercise is taught so that the student will be able to carry out non-precision approaches utilizing additional aids which will usually result in a lower MDA.

3. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 1:30hr.)

- i. Recap on the operation and limitations of DME.
- ii. The operation and limitations of the localiser.
- iii. Where to find localiser only minima.
- iv. How to interpret a chart with these approach aids.

4. THE AIR EXERCISE

i. HOLDING

- i. The instructor can introduce DME by requiring that the student fly a holding pattern with DME limits e.g. hold on the 270 radial, right turns between 10 and 15 DME or hold on a QDM of 150 between 12 and 17 DME.
- ii. The instructor should consider using this exercise to revise EAT's.

ii. THE VOR/DME APPROACH

The key to a successful approach is to work out the slope of the descent path required to cross the DME distances at the required altitudes. This descent part is normally around 3° or 300 ft. per nm. and as a rough guide 5 x IAS (more precisely this is 5 x the groundspeed) will give the required ROD e.g. a final approach speed of 90kts would require a ROD of about $90 \times 5 = 450$ fpm. Knowing approximately what power setting will give this figure in the approach configuration will reduce the work for the pilot considerably.

- i. The instructor must insist on proper planning and briefing for the approach. Particular attention must be paid to DME distances versus altitudes. During the first approach the instructor could call the altitudes as the various distances are passed and it is required that the student do this on his own the next time.

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iii. **THE VOR/NDB APPROACH**

- i. This type of approach usually requires that a specified radial is flown during the descent to a specified altitude which must be maintained until an NDB or bearing to an NDB is crossed. Planning is of great importance as is the briefing on how the approach is to be flown.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. The nav aids must be identified before being used.
- ii. The approach must be planned and briefed upon.
- iii. Clearances must be obtained.
- iv. Weather awareness and fuel awareness cannot be overstressed.
- v. The QHN must be obtained and set.
- vi. The compass and DI must be synchronized regularly.

ENGINE HANDLING

- i. Fuel conservation must be considered.
- ii. Temperatures during the descent and go-around must be monitored.
- iii. Cowl flaps must be considered.

6. SIMILARITY TO PREVIOUS EXERCISES

This exercise builds on the already known VOR and NDB approaches.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various exercises flown with special emphasis on the following points:

- i. Knowing the aircraft's performance so that the required ROD in the approach configuration can easily be achieved.
- ii. Planning the approach.
- iii. Staying ahead of the aircraft.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of not correcting the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 21

THE ILS APPROACHES

1. AIM

The aim of this exercise is to teach the student to fly and ILS approach and carry out a missed approach.

DEFINITION

The ILS approach is a series of manoeuvres carried out with sole reference to the instruments in the aircraft where directional and vertical guidance is provided to the pilot on the ILS instrument.

2. WHY IT IS BEING TAUGHT

This exercise is taught so that the student will be able to fly and ILS approach enabling an approach to be flown to much lower minima. The ILS approach when combined with radar vectors are the quickest and most accurate type of approach increasing traffic flow.

3. WHAT THE INSTRUCTOR IS TO TEACH

- i. The principles of operation of the ILS system.
- ii. The limitations of the ILS system.
- iii. How to read and interpret an ILS approach chart.
- iv. How to determine the approximate rate of descent required.
- v. Drift correction procedure.
- vi. Various types of precision approach lighting.
- vii. What conditions must be met for the approach to be continued visually to landing.
- viii. What lights should be visible at DH/DA.
- ix. The significance of the marker beacons.
- x. The significance of the Outer Marker (OM) crossing altitude.
- xi. The criteria for going around if the approach become unstabilised.
- xii. How to use the NDB or VOR to determine how close the aircraft is to the localiser.
- xiii. Recap on how the wind changes with altitude.

4. THE AIR EXERCISE

i. THE FIRST APPROACH

- i. It is suggested that the instructor fly the first ILS approach whilst pointing out the indications on the various instruments.
- ii. The instructor must stress that the ILS indicator needles must never be chased. The ILS approach is flown by flying a ROD which is controlled with power and any small adjustments through very small pitch changes.
- iii. It is vital that the instructor emphasize the need to check the published Outer Marker crossing altitude with the actual OM crossing altitude. At this point it is suggested that the student be made to make a call such as "Outer marker 2575 ft. altimeter and instruments checked."

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The importance of a call like this cannot be over emphasized as this is the last time that the pilot can check that the correct QNH has been set and that the correct glide slope is being followed. The student should read the published OM crossing altitude and compare this with the actual crossing altitude as the OM is crossed. It should be pointed out that once the OM has been passed a mandatory go-around should be made if the ILS needles ever show more than half scale deflection.

ii. **THE SECOND AND THIRD APPROACHES**

i. The instructor should talk the student through these approaches.

iii. **THE FOURTH AND FIFTH APPROACHES**

i. The student should be able to fly the approach with minimal assistance. The instructor may ease the workload by doing the radio work until the student is clearly in control of this type of approach.

As most airfields with ILS approaches have radar, most approaches will be carried out using radar vectors. The instructor should give the student practice at flying a procedural ILS approach before the ILS training can be considered to be completed.

5. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

The instructor should emphasize the following points:

- i. The importance of planning the approach.
- ii. The need to check the OM crossing altitude.
- iii. The importance of executing a smart positive go-around manoeuvre.
- iv. The importance of going around if any or both the ILS needles are more than half scale deflection from the centre at the OM or after.

ENGINE HANDLING

- i. The student should be reminded that the M.P. will increase about 1 inch per 1000 ft. of altitude lost in the descent and that it will probably be necessary to reduce power slightly in order to keep the ROD constant.
- ii. Engine temperatures and pressures must be monitored throughout the approach and missed approach.

6. **SIMILARITY TO PREVIOUS EXERCISES**

This exercise is very similar to the VOR approach with the exception that vertical guidance is provided in addition to directional guidance.

7. **DE-BRIEFING AFTER THE FLIGHT**

Briefly recap on the exercise with particular emphasis on the following points:

- i. The importance of the OM check altitude.
- ii. Using the ADF or VOR for guidance in relation to the localizer.
- iii. Flying an approximate ROD and headings and not chasing the needles.
- iv. The OBS should be set to the inbound track even though it is disconnected when the localizer frequency is selected as it serves as a reminder of the inbound track.

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8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of persisting with the fault.
- iv. The action necessary action required to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 22

THE NDB APPROACH ON LIMITED PANEL

1. AIM

The aim of this exercise is to teach the student how to fly an NDB approach when an instrument failure has occurred.

DEFINITION

This exercise is defined as being the series of manoeuvres necessary to transition from the minimum safe altitude to a landing or missed approach when operating the aircraft in IMC with one or more instruments failed.

2. WHY IT IS BEING TAUGHT

This lesson is taught so that the student will be able to carry out an NDB approach when one or more instruments have failed. As an example the failure of the vacuum pump will usually result in the failure of the A/H and the DI. Other failures like a pitot/static system failure will also require special techniques in order to complete the flight safely.

3. WHAT THE INSTRUCTOR IS TO TEACH

- i. The various failures that can occur.
- ii. How to recognize these failures.
- iii. How to cope with the failures.
- iv. How and when to declare an emergency.
- v. Recap on how to intercept a QDM/QDR using the parallel method.
- vi. Discuss the dangers of flying with instrument failure.
- vii. Flying the Circle to Land manoeuvre and the dangers of this manoeuvre.
- viii. Explain how the missed approach is flown from a Circle to Land manoeuvre.

4. THE AIR EXERCISE

i. INTERCEPTING A QDM/QDR

- i. This is probably best taught using the parallel method of intercepting a QDM/QDR as the potential for mistakes through trying to calculate the required intercept heading using other methods is larger when the workload of flying with instrument failures is considered.
- ii. The student should be given sufficient practice at this task until reasonably proficient.

ii. TURNING

- i. The student should be given a few turning exercises on limited panel using a stopwatch.
- ii. The student should practice compass turns at this point. The instructor should remind the student of ONUS and have him turn onto appropriate headings until this method of turning has been mastered

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iii. THE NDB APPROACH

- i. Ensure that the student is far enough from the NDB so as to have sufficient time to plan and brief on the approach remembering the vastly increased workload when flying with instrument failure.
- ii. It is suggested that the student be given a simulated vacuum pump failure thus requiring that the A/H and the DI be covered.
- iii. The student could possibly turn onto the appropriate heading initially using the compass and once established in the holding pattern it is easiest to time the turns.

The instructor should go to great lengths to point out that this type of manoeuvre is extremely hazardous as the workload is high. An approach of this nature should be used as a last resort i.e. if a diversion to VFR weather can be made, then that course of action is far more appropriate than trying to do an approach with instrument failure. The student must be briefed on the importance of covering the failed instruments (in a real situation) as they could very easily be followed at the wrong moment, and having them uncovered increases the mental workload as much time will be wasted trying to resolve the conflicting information being presented to him/her.

The instructor must point out that to remain proficient at instrument flying a lot of practice is required and particularly in the case of limited panel flying.

iv. THE CIRCLE TO LAND MANOEUVRE

- i. This lesson leads itself to teaching the manoeuvre because in real life the student is likely to be flying an approach on limited panel that may require flying the missed approach procedure.
- ii. On reaching the appropriate circle to land minima for the approach, have the student fly a circle to land manoeuvre. Make sure that the student does not leave MDA until he is in a position to carry out the approach onto the landing runway using a normal rate of descent.
- iii. As a guide to positioning the aircraft onto final approach in poor visibility the student should aim for the runway lights at the threshold of the runway on the circuit side.
- iv. This will ensure that the student will not fly through the runway centreline.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Altitude awareness.
- ii. Weather awareness.
- iii. Planning of the approach.
- iv. Fuel awareness.
- v. The Circle to Land MDA must not be left until a normal approach can be made.

ENGINE HANDLING

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- i. Excessive cooling and overheating must be anticipated
- ii. The high workload of flying on limited panel must not detract from monitoring the engine instruments.

6. SIMILARITY TO PREVIOUS EXERCISES

This exercise combines limited panel flying with an NDB approach. Quite clearly the student could use other aids such as DME etc. to carry out an approach with instrument failure. The circle to land part of the exercise is very similar to a bad weather circuit.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the exercise with particular emphasis on the following points.

- i. The students must not rush this approach.
- ii. The student must be sure of a successful approach i.e. the weather must be above minimums.
- iii. The student must declare an emergency.
- iv. There is often a tendency to fly a wide circuit during the circle to land manoeuvre together with a tendency to leave MDA too early.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of persisting with the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 23

THE VOR APPROACH ON LIMITED PANEL

1. AIM

The aim of this exercise is to teach the student how to carry out a VOR approach when one or more instruments have failed.

DEFINITION

The VOR approach on limited panel is defined as being the series of manoeuvres required to transition from the en-route phase of flight to a landing or a missed approach when one or more of the instruments are not working.

2. WHY THIS LESSON IS BEING TAUGHT

This lesson is taught so that the student will be able to control the aircraft and carry out an approach safely with one or more instruments unserviceable.

3. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 45 min.)

- i. Recap on instrument failures.
- ii. Recap on the recognition of instrument failures.
- iii. Recap on managing the aircraft with these failures.
- iv. Recap on how to declare an emergency with ATC.

4. THE AIR EXERCISE

i. INTERCEPTING RADIALS

- i. The instructor should give the student time to practice intercepting radials while flying on limited panel.

ii. THE VOR APPROACH

- i. The instructor must ensure that the student is far enough from the beacon and that there is sufficient time for orientation and planning.
- ii. The instructor could possibly allow the student to fly different entries to the holding pattern before commencing the approach.
- iii. The instructor can consider teaching the student to go-around and carry out the missed approach but it must be emphasized that this sort of flying involves an emergency and the student should not be flying an approach where the weather is on minimum.

iii. THE CIRCLE TO LAND MISSED APPROACH PROCEDURE

- i. Have the student carry out a circle to land manoeuvre and at an appropriate point have the student carry out the correct missed approach procedure on full panel.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. The student should be aware of altitudes.
- ii. Weather awareness.
- iii. Radio work.
- iv. Setting the correct QNH.
- v. Fuel awareness.
- vi. The failed instruments must be covered.
- vii. An emergency must be declared.
- viii. Diversion to better weather should be considered.

ENGINE HANDLING

Excessive engine cooling and overheating is possible as the student will probably be inclined to forget the engine instruments due to the high workload when flying with some malfunctioning instruments.

6. SIMILARITY TO PREVIOUS EXERCISES

This exercise combines the principles of the VOR approach on full panel as well as flight with limited panel.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the exercise with particular emphasis on the following points:

- i. This is an emergency procedure and requires a lot of practice to remain proficient.
- ii. The student should always consider diverting to better weather.
- iii. Orientation when flying on limited panel can be difficult and the flying must under no circumstances be rushed.
- iv. Planning and briefing are extremely important.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of persisting with the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 24

THE ILS APPROACH ON LIMITED PANEL

1. AIM

The aim of this exercise is to teach the student how to carry out an ILS approach when one or more instruments have failed.

DEFINITION

The ILS approach on limited panel is defined as being the series of manoeuvres required to transition from en-route flight to a landing or a missed approach when one or more of the flight instruments have failed.

2. WHY THIS LESSON IS BEING TAUGHT

This exercise is taught so that the student will be able to safely carry out an ILS approach with one or more flight instruments failed.

3. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 45 min.)

- i. Recap on the operation and limitations of the ILS system.
- ii. Recap on types of instrument failure and recognition thereof.
- iii. Recap on the dangers of flying on limited panel.
- iv. Recap on the necessity and method of declaring an emergency.

4. THE AIR EXERCISE

1. THE ILS APPROACH

- i. The aircraft should be flown so as to provide plenty of time to become established on the localiser. Knowledge of the power setting required for the correct rate of descent will be invaluable in the event that the A/H is inoperative. The instructor could consider failing the A/H and or DI for this exercise.
- ii. The instructor should consider having the student simulate declaring an emergency.
- iii. The exercise could be used for more circle to land practice if required.

The instructor may use the opportunity to have the student fly a missed approach on limited panel but again it must be pointed out that flying on limited panel is an emergency procedure and the student must realize that at any time the remaining gyro instruments could fail.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. The student must declare an emergency.
- ii. The student must maintain a high standard of altitude awareness.
- iii. The approach must be planned carefully so as to ensure success on the first attempt.
- iv. Weather awareness must be high.
- v. Fuel awareness must be high.

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- vi Failure to identify the navigation aids before use.

ENGINE HANDLING

- i. Knowledge of power settings would go a long way to reducing the workload for the pilot.
- ii. This is a high workload situation and it is very easy to forget to monitor the engine instruments.
- iii. Excessive cooling during the descent must be guarded against.

6. SIMILARITY TO PREVIOUS EXERCISES

This exercise is a combination of the normal ILS and limited panel exercise.

7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the various manoeuvres flown with special emphasis on the following points:

- i. Slow scan.
- ii. Failure to monitor engine instruments.
- iii. Failure to obtain necessary clearance for the approach.
- iv. Chasing the needles.
- v. The importance of thinking ahead.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of persisting with the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

LESSON 25

DME ARC APPROACHES

1. AIM

The aim of this exercise is to teach the student how to fly an approach that commences with a DME ARC with sole reference.

DEFINITION

This exercise may be defined as the series of manoeuvres required to transition from the en-route phase of flight to the applicable approach by following a given DME ARC.

2. WHY THIS LESSON IS BEING TAUGHT

This exercise is taught so that the student will be able to follow a DME ARC from a specified point until established on the VOR or ILS approach with sole reference to the instruments. There are a large number of approaches in the USA and Africa based on flying a DME ARC. This transition to final approach is a lot quicker than following the full procedure from overhead a facility and is particularly useful in a non-radar environment. There are some approaches based entirely on flying a DME ARC to MDA, and in the case of a missed approach, a DME arc is followed.

3. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 1:00hr.)

- i. The theory of flying the curved approach using the VOR and DME i.e. a series of tangents to the depicted circle are flown. The error from a true circle will be less than 0.1nm if the heading is changed every 10°.
- ii. The significance of lead in radials.
- iii. How to read and interpret the approach chart.

4. THE AIR EXERCISE

i. POSITIONING FOR THE ARC

- i. The instructor should have the student proceed to the VOR on e.g. the 182° radial. At a distance of say 15 DME have the student turn through 90° to follow the DME ARC. For this example assume the procedure requires following the 15 DME ARC clockwise to intercept the inbound radial of 282° for a VOR approach.
- ii. Allow a little distance to ensure that the aircraft does not go through the ARC during the turn e.g. at 100 kts G/S a ½ nm lead should suffice. The aircraft must be turned left through about 90° to the inbound track.

ii. FOLLOWING THE ARC

- i. As the heading of 272° is approached, the aircraft being still outside of the arc roll out of the turn early to give an intercept angle of about 20°. If the aircraft has flown through the arc continue the turn until an intercept angle is established. The OBS must now be set. Determine the required radial for the approach from the chart e.g. 282°. Use radial

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- ending in 2 for the arc.
- ii. Set the OBS to read e.g. 012° and adjust the heading to read 282° i.e. 90° to the set radial. The VOR CDI will initially show 5° or ½ scale deflection. As the aircraft is flown the CDI will move towards the centre then out to the right as the set radial is crossed. When the CDI shows ½ scale out to the right, the aircraft will be 5° passed the selected radial. The heading flown at 90° to the selected radial is known as the tangent heading.
- iii. This procedure is followed until the 282° radial is approached when the aircraft is turned right onto a heading of approximately 102° to follow the radial inbound for the approach.

iii. **WIND CORRECTION**

- i. If as the selected radials are crossed it is observed that the distance is less than the desired 15nm the aircraft is drifting toward the VOR and the heading should be adjusted to compensate for the wind. If the distance is increasing the heading should be adjusted towards the VOR.

This procedure may be used for both precision and non-precision approaches. If there is no procedure published at the instructor's home base it should be possible to improvise by adapting the current VOR or ILS approach in such a way that the student can practice this manoeuvre.

iv. **THE LANDING OR MISSED APPROACH**

- i. The instructor could use this opportunity to practice the circle to land manoeuvre or carry out a missed approach with practice as required until this manoeuvre is satisfactory.

5. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

- i. The student must have a mental picture of the procedure.
- ii. The student must be aware of altitude requirements.
- iii. The student must plan the approach properly.
- iv. The QNH must be set correctly.
- v. The necessary clearance for the approach must be obtained.

ENGINE HANDLING

- i. The student should be fully aware of all engine indications.
- ii. The student should be able to manage all aspects of engine handling without prompting from the instructor.
- iii. Fuel conservation should be a high priority for the student especially during holding.

6. **SIMILARITY TO PREVIOUS EXERCISES**

This exercise is new in many respects but is similar to VOR tracking and the VOR and ILS approaches as well as the basic flying such as straight and level etc.

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7. DE-BRIEFING AFTER THE FLIGHT

Briefly recap on the manoeuvres flown with special emphasis on the following points:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential of continuing with the fault.
- iv. The action necessary to correct the fault.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of continuing the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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LESSON 26

IFR EMERGENCIES

1. AIM

The aim of this exercise is to prepare the student for any emergency that may be experienced whilst flying under IFR.

DEFINITION

An IFR emergency may be defined as being any emergency which occurs whilst flying under Instrument Flight Rules.

2. WHY IT IS BEING TAUGHT

This exercise is taught so that the student will have a basic knowledge from which to work in the event that an emergency occurs while flying IFR.

3. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 2:00 hr.)

- i. Radio failure procedures.
- ii. Revise instrument failure recognition.
- iii. Discuss severe weather procedures.
- iv. Discuss engine failure procedures.
- v. Discuss navigation radio failure.
- vi. Discuss low fuel procedures.
- vii. Discuss the declaring of an emergency.
- viii. Discuss electrical failure.
- ix. Discuss how an approach can be shortened in a dire emergency.

4. THE AIR EXERCISE

This exercise should be used as a final session for the student to consolidate the general flying aspects of instrument flying before the flight test. As a suggestion the following exercises should be covered in the aircraft with all the emergencies in a simulator.

- i. STEEP TURNS
- ii. STALLS ON FULL AND LIMITED PANEL
- iii. TIMED TURNS WITH BOTH FULL AND LIMITED PANEL
- iv. TIMED CLIMBING AND DESCENDING TURNS ON LIMITED AND FULL PANEL
- v. RECOVERY FROM UNUSUAL ATTITUDES
- vi. OPERATION AT MINIMUMSPEED ON FULL PANEL
- vii. ANY OTHER EXERCISE AT THE INSTRUCTOR'S DISCRETION

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5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

The student should not require any instructor input by this stage.

ENGINE HANDLING

The student should not need any prompting with regard to the correct monitoring and handling of the engine.

6. SIMILARITY TO PREVIOUS EXERCISES

This exercise will cover all the general flying aspects covered during this course.

7. DE-BRIEFING AFTER THE FLIGHT

The instructor should recap on the manoeuvres flown with the particular emphasis on the following points:

- i. Accuracy.
- ii. Completion of the exercise to the required standard.
- iii. There must be no doubt as to the student's ability to control the aircraft on instruments.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must point out:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The potential outcome of persisting with the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

LESSON 27

THE IFR NAVIGATION EXERCISE

1. AIM

The aim of this exercise is to consolidate all that the student has learned to date as well as ensure that he is able to operate the aircraft in the ATC environment without the instructor's help. This exercise should be flown in IMC if at all possible to give the student the necessary confidence that he/she can operate under IFR in weather.

DEFINITION

This exercise may be defined as being the series of manoeuvres required to fly an aircraft from the departure field to the destination field in IMC under IFR.

2. WHY IT IS BEING TAUGHT

This exercise is taught so that the student is able to consolidate what has been learned to date and to give him or her confidence that they can operate in the IFR environment.

3. WHAT THE INSTRUCTOR IS TO TEACH (Briefing of 3:00 hr.)

- i. Explain how SID's and STAR's are flown.
- ii. Revise the requirements for the meteorological reports.
- iii. Revise flight planning as applicable to the intended route.
- iv. Revise fuel planning.
- v. Revise load sheet requirements.
- vi. Revise descent planning.

4. THE AIR EXERCISE

The route should be planned in such a way that the student is able to fly SID's and STAR's and any approach that the instructor feels needs practice. The route should ideally be a triangular route of at least 300 nm to ensure sufficient time for the student to practice en-route navigation and exposure to ATC. The instructor should aim to provide the minimum support to the student to ensure that he or she can cope alone as by this stage the student's training will almost be complete.

5. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

The student should display a high standard of airmanship and situational awareness. The points to be considered in particular include those mentioned in the previous exercises.

ENGINE HANDLING

The student should not need any prompting from the instructor on any aspect of engine handling.

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6. SIMILARITY TO PREVIOUS EXERCISES

This exercise essentially covers all the previous exercises.

7. DE-BRIEFING AFTER THE FLIGHT

The flight should be discussed with special emphasis on the following points:

- i. Planning.
- ii. ATC.
- iii. The SID's and STAR's.
- iv. The approaches.
- v. En-route procedures.

8. DISCUSS THE STUDENT'S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The dangers of persisting with the fault.
- iv. The action necessary to correct the fault.

9. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

LESSON 28

CONSOLIDATION

1. AIM

The aim of this lesson is to give the student an opportunity to practice any manoeuvre that he feels unhappy with, before the final Instrument Rating test. It is also an opportunity for the instructor to boost the student's confidence with appropriate remarks.

2. PREPARING THE STUDENT FOR THE TEST

- i. The instructor must ensure that the student has a letter of recommendation signed by a Grade 1 or 2 instructor.
- ii. The student must have an up to date Jeppesen or Aerad Flight Guide as well as a set of NOTAM's and AIC's.
- iii. All the required documentation must be in the aircraft.
- iv. The student should have a flight plan and flight log forms as well as a test form.
- v. The student should obtain the weather forecast for the airport where the test is to be carried out as well as the NOTAM's in force for the airfields in question.
- vi. The student must have all personal equipment on board at least one hour before the appointed time for the test.
- vii. The aircraft should be fuelled etc. and ready for the flight test.
- viii. The instructor should make sure that the student has completed the required instrument time and has his logbook with him.
- ix. The instructor must ensure that the student knows how to use the flight guide and how to use and interpret the applicable NOTAM's and AIC's as well as be able to file flight plans, etc.

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LESSON 29

THE INSTRUMENT FLIGHT TEST

This should be a formality if the training and ground briefing has been done thoroughly. It is most important to make the student realize that he/she has a rating that can get him into a lot of trouble very quickly if the “rules of the game” are not followed strictly i.e. planning is a must before every flight and when in doubt rather don’t do it!

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THE INSTRUMENT RATING SYLLABUS

Lesson	Description	Hours	
		Briefing	A/C or Sim
1.	Basic manoeuvres on full panel	2.00	1.00
2.	Full panel manoeuvres part 2	0.45	1.00
3.	Full panel manoeuvres part 3	1.00	1.00
4.	Full panel manoeuvres part 4	1.00	1.15
5.	Limited panel manoeuvres part 1	0.45	1.15
6.	Limited panel manoeuvres part 2	1.00	1.15
7.	Introduction to navigation aids	1.00	1.15
8.	Consolidation	1.00	1.00
9.	Instrument test for night rating	<u>.30</u>	<u>1.00</u>
		<u>9.00</u>	<u>10.00</u>
10.	ADF tracking	1.00	1.15
11.	ADF tracking part 2	0.30	1.15
12.	Intercepting VOR radials	1.00	1.15
13.	VOR and ADF consolidation	0.30	1.30
14.	NDB holding patterns	1.00	1.15
15.	NDB approach	1.45	1.30
16.	NDB approach part 2	1.00	1.30
17.	VOR holding pattern	1.00	1.15
18.	VOR approach	1.00	1.30
19.	VOR approach part 2	1.00	1.30
20.	Other non-precision approaches	1.30	1.30
21.	ILS approaches	1.30	2.00
22.	NDB approach – limited panel	1.00	1.45
23.	VOR approach – limited panel	0.45	1.30
24.	DME ARC approached	0.45	1.30
25.	IFR Navigation	1.00	1.30
26.	Consolidation	2.00	1.30
27.	Instrument rating test	3.00	6.00
28.		0.30	2.00
29.		<u>1.00</u>	<u>2.00</u>
		<u>22.45</u>	<u>35.00</u>
	Totals:	<u>31.45</u>	<u>45.00</u>

This syllabus is clearly just a guideline and some students may require a lot more than the time associated with each lesson. This will be very apparent if a simulator is not used. Another factor is the distance from the training airfield to the facilities required for the approach.

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EXERCISE 20

NIGHT FLYING

1. AIM

DEFINITION

Night flying comprises all flying done in the period between 15 minutes after sunset to 15 minutes before sunrise and involves a combination of instrument- and visual flying.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable Procedures and check Lists.
 - b. Aircraft handling techniques:- Demonstration and Observation.
 - c. Considerations of Airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To ensure that the student is proficient to conduct with confidence a flight at night.

HOW THE EXERCISE APPLIES TO FLYING

All day flight manoeuvres may be performed at night, although good airmanship precludes those likely to cause disorientation or those which compromise safety due to a lack of visual ground references.

2. PRINCIPLES INVOLVED

i. LEGAL REQUIREMENTS

- a. Licence qualification – No person shall act as pilot-in-command of an aircraft by night unless he or she is the holder of a valid private pilot's licence with a valid night flight rating or the holder of a valid higher licence.
- b. Airfield facilities – pilot's responsibility:
Except in an emergency, no aircraft shall take-off or land by night unless the aerodrome of take-off or landing is equipped for night flying. The pilot-in-command shall be responsible for ensuring that night flying facilities are available for take-off or landing.

ii. USE OF AIDS

- a. Airfield lighting – beacon, hazard, taxiway and runway lights.
- b. Types of VASI's and PAPI's and use thereof.
- c. Aircraft instruments, radio equipment and aircraft lighting.

iii. EMERGENCY PROCEDURES

- a. Radio failure:
 - 1) Controlled airfield.
 - 2) Uncontrolled airfield.

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- b. Aircraft electrical system failure:
 - 1) Partial system failure – priority usage of remaining system.
 - 2) Total system failure – alternate system (if any) applicable to night flying airmanship (discuss).
- c. Engine failure:
 - 1) In circuit area – discuss relationship to day situation.
 - 2) Away from circuit area – discuss factors applicable to night forced landing.
- iv. PHYSICAL AND PSYCHOLOGICAL
 - a. Explanation of vertigo and special disorientation.
 - b. Optical illusions:
 - 1) Judgement of distance at night.
 - 2) Necessity of visual scan to provide perspective.
 - c. Factors affecting night vision – external and internal lighting.
- v. NIGHT FLYING TECHNIQUE

Principles applicable to day flying exercise are generally applicable to night flying.
- vi. INSTRUMENT FLYING APPLICATION

Discuss application of instrument flying to night flying.

3. DESCRIPTION OF AIR EXERCISE

- a. APPLICABLE PROCEDURES AND CHECKLISTS
- b. AEROPLANE HANDLING TECHNIQUES:-

DEMONSTRATION

Pre-flight inspection

OBSERVATION

As for day flying, plus:

- i. Ensure student has good knowledge of electrical system and knows position of all switches, CB's.
- ii. Applicable navigation aids.
- iii. Serviceable torch for each crew member.
- iv. Check that parking and taxiing area is clear of obstructions.
- v. All required lights serviceable.

1. START-UP PROCEDURE

As for day flying, plus:

- i. Ensure sufficient holding RPM to charge battery.
- ii. After start checks to include aircraft lighting.

2. TAXYING

- i. Look out.
- ii. Judgement of taxiing speed at night.
- iii. Use of aircraft taxiing and landing lights.
- iv. Instrument check during taxiing.
- v. Maintain constant visual such to avoid light

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- vi. fixation.
 - vii. Note position of illuminated windsock.
 - viii. Complete taxi checks as for day.
 - ix. Holding position prior to run-up, same as for day.
 - ix. Before take-off checks same as for day.
3. **LINING UP AND TAKE-OFF RUN**
- i. Look out – approach and runway clear.
 - ii. Radio call.
 - iii. Lining up:
 - a. Tail/nose wheel straight.
 - b. Compass/DI aligned with runway QDM.
 - c. Reference point is the last visible flare or horizon light.
 - d. Position ailerons for take-off and estimate drift correction to be applied after take-off according to wind.
 - iv. Maintain direction during take-off run by means of flare path, with glances at DI.
 - v. Lift-off speed – slightly higher than normal.
4. **BECOMING AIRBORNE**
- At lift-off speed:
- i. Transfer attention to Artificial Horizon (A/H) and rotate aircraft to pre-determined attitude for best angle of climb speed.
 - ii. Maintain this attitude on the Artificial Horizon (A/H) and refer to altimeter and VSI for positive rate of climb.
5. **CLIMB AWAY**
- i. Confirm continuous positive rate of climb.
 - ii. Apply brake – select U/C up if applicable.
 - iii. Establish recommended climb speed.
 - iv. Allow for the drift – if applicable.
 - v. Maintain instrument scan.
 - vi. At a minimum of 300ft agl. – complete after take-off checks.
 - vii. At a minimum of 500ft agl. use instruments or visual aids, or both according to prevailing conditions.
6. **CROSSWIND LEG**
- i. As for normal day circuit – use 15° bank angle in climbing turn and visually check position of runway lights in relation to aircraft.
7. **DOWNWIND LEG AT CIRCUIT ATTITUDE**
- As for day flying, but:
- i. Fly downwind leg parallel to flare path using DI/visual references, but keep slightly closer to the runway in case of engine failure. Note position.
 - ii. Do not converge with flare path – maintain desired distance from flare path, allowing for drift.
 - iii. References for circuit positioning and turn onto base leg are relative to aircraft and flare

- path only. Use 30° bank angle to turn onto base leg, maintaining circuit height.
- iv. Note: During first night flying exercise student must be shown airfield and surrounding area light pattern.
8. **BASE LEG**
- i. Same technique as for day flying, but avoid the common error of unintentionally delaying approach which could lead to a hammerhead turn onto final. Look out for other aircraft.
9. **FINAL APPROACH**
- i. Line up on extended line of flare path.
- ii. A normal engine-assisted approach should be carried out, aiming to touch down between the second and third flares (i.e. when using standard flare path on normal length runway).
- iii. Judgement of approach path:
- a. As for normal day flying.
Note: First night circuit and approach demonstration to be as precise as possible.
- b. On second circuit, position aircraft on approach path to enable the following deviations from the ideal approach path to be demonstrated:
- i. Aircraft undershooting – spacing between runway lights appears to decrease.
- ii. Aircraft overshooting – spacing between runway lights appears to increase.
- iii. Demonstrate approach using approach path indicator (e.g. VASI's or PAPI's)
10. **LANDING**
- i. At approximately 150ft agl. align aircraft to the correct side of the flare path.
- ii. For direction – aim at the furthest visible flare.
- iii. For height judgement – do not fixate on only one flare, but rather allow the eyes to continuously “run-along” 3 to 4 flares ahead of the aircraft.
- iv. Round out, hold off and touch down. Use same technique as for day landing, judging hold off height by flares ahead, and phasing control column movement with the rate of sink. As the flare path becomes “flatter” place the aircraft in the landing attitude and gradually reduce power until the wheels touch the ground, at which moment the throttle is fully closed.
- v. Landing with aircraft landing light – use

same technique as above, but look parallel to light beam whilst waiting for ground features to appear.

11. **LANDING RUN**
 - i. Direction to be maintained by reference to last visible flare.
 - ii. Control column positioned as for type.
 - iii. Decreasing rudder effectiveness.
 - iv. Use of brakes.
12. **CLEARING RUNWAY**
 - i. Same as for day flying.
 - ii. Radio call when clear of runway.
 - iii. When clear of runway:
 - a. Set park brake.
 - b. Set holding RPM – sufficient to operate generator/alternator.
 - c. Control column positioned for aircraft type.
 - d. Complete after landing checks.
13. **TOUCH AND GO LANDING**
 - i. Same as for day – except on instruments during climb out.
14. **OVERSHOOT PROCEDURE**
 - i. Proceed as in exercise on instrument flying.
 - ii. Position aircraft to one side of flare path to not obscure other aircraft taking off or climbing out.
15. **NIGHT NAVIGATION**
 - i. See Exercise 18.

NOTE: The basic flying technique taught to the student should prepare the student for night flying using limited facilities, i.e.:

- i. Single flare path.
- ii. No other airfield lighting, landing or navigation aids.
- iii. Restricted landing distance available (medium length runway).
- iv. Restricted visual horizon.
- v. No aircraft landing light.

The basic technique may be modified should additional aids, such as a double flare path and VASI's or PAPI's, be available.

c. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

- i. Taxi slowly at night and exercise caution due to the deceptiveness of speed and distance.
- ii. All airmanship factors used in day flying are usually applicable to night flying.
- iii. In normal VFR weather conditions, use a sensible combination of instrument and unusual flying techniques.
- iv. Be familiar with the positions of all switches and controls in the cockpit.
- v. Thorough knowledge of all ATC light signals.

ENGINE CONSIDERATIONS

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- i. Same as in day flying.
- ii. Ensure engine RPM is at all time sufficient to charge aircraft battery – especially when parked with engine running.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Basic instrument flying techniques.
- ii. Day circuit and landings.

e. DE-BRIEFING AFTER FLIGHT

Briefly recap on the exercise and emphasise the important aspects applicable to each type of landing under the following heading:

- i. The approach.
- ii. The final approach.
- iii. The round-out.
- iv. The hold-off or float.
- v. The touch down or landing.
- vi. The after landing roll.
- vii. The touch and go landing.
- viii. The go-around procedure.
- ix. Effect of wind.
- x. Effect of wind gradient and gusty conditions.
- xi. Lookout.

f. DISCUSS THE COMMON FAULTS STUDENTS USUALLY MAKE

- i. If too much time is taken in setting up the descent on the base-leg the approach usually ends up being too high.
- ii. Speed/altitude relationship on final approach. Do not “chase” the speed. Fly attitude and allow the speed to stabilize before correcting according to the ASI.
- iii. After turning onto final approach select the required landing flap and trim the aircraft, from this point on the power controls the rate of descent.
- iv. A good approach makes a good landing. From a good approach the transition to the round-out requires only a small attitude change. Do not close the throttle until the round-out phase is complete.

g. DISCUSS THE STUDENT’S ACTUAL FAULTS

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

h. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

EXERCISE 21

AEROBATICS

The term aerobatics is used to cover all manoeuvres of the aeroplane that are intentionally performed but are not, in themselves, an essential part of normal flying. Aerobatics give the student confidence in himself and his aeroplane as they teach him how to use the controls in any attitude of the aeroplane and how to recover from unusual positions.

1. NOTE: During the exercise on aerobatics, it is taken that:
 - i. The propeller turns clockwise when viewed from the cockpit.
 - ii. Where the aeroplane is fitted with a constant speed propeller, climb power is set and left set for the manoeuvre or series of manoeuvres.
 - iii. Where the aeroplane is fitted with a fixed pitch propeller, the pilot will exercise caution not to exceed the limiting engine R.P.M. when diving.
2. The following aerobatic manoeuvres are covered:
 - i. Loop.
 - ii. Stall turn.
 - iii. Slow roll.
 - iv. Barrel roll.
 - v. Half roll off the top of a loop.
 - vi. Horizontal figure of eight.
 - vii. Half roll entry into horizontal figure of eight.
 - viii. Half roll to inverted flight.

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AEROBATICS

LOOP

1. AIM

DEFINITION

A loop is the ultimate further effect of the elevator whereby the aeroplane is flown through 360° in the vertical plane, without change in direction.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable Procedures and Check lists.
 - b. Aeroplane handling techniques:- Demonstration and Observation.
 - c. Consideration of airmanship and engine handling.
 - d. De-briefing after flight.

WHY IT IS BEING TAUGHT

So that the student fully understands the principles involved, thereby enabling correct execution of the manoeuvre in the air.

HOW THE EXERCISE APPLIES TO FLYING

- i. It accustoms the student to abnormal loadings on his body.
- ii. It is a confidence building manoeuvre.

2. PRINCIPLES INVOLVED

1. NEWTON'S LAWS
2. CENTRIPETAL FORCE
3. LOAD FACTORS AND STALLING SPEED
4. SPEED
 - i. Why a high speed is necessary for the manoeuvre
5. DIVE AND POWER REQUIRED
6. LOOP PROPPER
 - i. What happens to speed, load factor and stalling speed during the manoeuvre.
 - ii. Slipstream.
 - iii. Control effectiveness.
7. EFFECT OF:
 - i. Density altitude.
 - ii. Mass.

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- iii. Drag.
- iv. Power.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLIST

b. AEROPLANE HANDLING TECHNIQUES:-

DEMONSTRATION

OBSERVATION

1. THE LOOP

- i. Look out.
- ii. Complete aerobatic checks – HASELL.
- iii. Set climb power if C.S.U is fitted.
- iv. Set trimmers for straight and level flight and leave as set.
- v. Select line feature and points references on the ground.
- vi. Enter loop by carrying out wing-over entry into dive while lining up on line feature.
- vii. In dive – check engine RPM if fixed pitch propeller is fitted.
- viii. Note changing rudder and elevator forces as speed increases.
- ix. Ease out of the dive just before target speed for the manoeuvre.
- x. Apply full power as the nose cuts the horizon if a fixed pitch propeller is fitted. Changing rudder forces – slip or skid.
- xi. Check wings level as the nose cuts the horizon and again when vertical, inverted and in the dive.
- xii. Note changing rudder forces with decreasing speed – adjust control column pressure to fly aeroplane around the loop.
- xiii. Increasing backward pressure on the control column to ease aeroplane over the top of the loop.
- xiv. “Second” horizon – check wings level.
- xv. Smooth control movements at low speed.
- xvi. Check direction with “second” line feature.
- xvii. Relaxation on control movements at low speeds.
- xviii. Check engine R.P.M. if fixed pitch propeller is fitted.
- xix. Note changing rudder force – slip or skid.
- xx. Check direction with line feature.
- xxi. Climb away – check climb power.
- xxii. Minimum height for the aeroplane to be at an even keel is 2000ft agl.

c. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

- i. HASELL check.
- ii. Lookout and inspection turn.
- iii. Safety height – CAR's and local rules.
- iv. Stalling – recovery reviewed.
- v. Negative “g” experience.
- vi. Loading on pilot's body – blacking out.
- vii. Orientation during manoeuvre.
- viii. Position of wings throughout manoeuvre.

ENGINE CONSIDERATIONS

- i. Aerobatic power settings – climb power and limiting R.P.M.
- ii. Throttle use, especially when fixed pitch propeller is fitted.
- iii. Over boost/over-rev.
- iv. Temperature and pressures.
- v. Engine cut-out during manoeuvre. Importance of closing throttle (fire hazard if carburettor fitted).

d. **SIMILARITY TO PREVIOUS EXERCISES**

- i. Effect of controls.
- ii. Further effect of rudder.
- iii. Effect of slipstream, airspeed and torque reaction.
- iv. Stalling.
- v. Climbing and descending.

e. **DE-BRIEFING AFTER FLIGHT**

1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Maintaining wings level throughout the manoeuvre.
 - ii. Correct speed at commencement of the manoeuvre.
2. Discuss the common faults students usually make:
 - i. Exceeding maximum permissible R.P.M. when aeroplane is fitted with a fixed pitch propeller.
 - ii. During the manoeuvre the control inputs must be smooth.
3. Discuss the student's actual faults:

For each fault the instructor must indicate:

 - i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result the fault could have led to.
 - iv. The corrective action required.

f. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

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AEROBATICS

STALL TURN

1. AIM

DEFINITION

A stall turn is a method of changing direction through 180°, using the minimum amount of space in the horizontal plane, during which the speed decreases below the normal straight and level stalling speed.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and check lists.
 - b. Aeroplane handling techniques:- Demonstration and Observation.
 - c. Consideration of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

HOW THE EXERCISE APPLIES TO FLYING

To teach the student to handle the aeroplane at very low airspeed, whilst changing direction through 180°.

WHY IT IS BEING TAUGHT

- i. Teaches the student co-ordination.
- ii. It is a confidence building manoeuvre.
- iii. Handling the aircraft at very low airspeeds.
- iv. To teach the student to accurately perform the stall turn manoeuvre.

2. PRINCIPLES INVOLVED

1. Discuss:
 - i. Aerodynamic factors affecting the stall turn.
 - ii. Flight below normal straight and level stalling speed.
 - iii. Pitching to the vertical plane during the approach and recovery phases of the manoeuvre.
2. Turn – Rudder application:
 - i. Slipstream.
 - ii. Torque.
 - iii. Further effect of rudder.
 - iv. Gyroscopic effect.
 - v. Weathercock effect.
 - vi. Change of direction through 180°.
3. DIVE – Recovery.
4. DISCUSS:

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- i. Manoeuvre executed to opposite side.
- ii. Factors affecting power and speed.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AEROPLANE HANDLING TECHNIQUES:-

DEMONSTRATION

OBSERVATION

1. STALL TURN TO THE LEFT SIDE

- i. Lookout.
- ii. Complete aerobatic checks – HASELL.
- iii. Set climb power if C.S.U. is fitted.
- iv. Set trimmers for straight and level flight.
- v. Select line feature for reference.
- vi. From a wing-over dive to the recommended entry speed – check RPM if fixed pitch propeller is fitted.
- vii. Pull up to the vertical attitude – apply full power.
- viii. Use the wing tips for attitude reference to the horizon.
- ix. When in a steep vertical attitude, slight forward movement of control column will prevent aeroplane falling on its back or stalling.
- x. As stalling speed is reached, progressively apply left rudder.
- xi. Use opposite aileron to check any rolling tendency.
- xii. After turning through 180° and aeroplane enters a steep dive, close throttle and anticipate rudder movement to check the yaw.
- xiii. Vertical dive – check on line feature – monitor R.P.M.
- xiv. Ease out of the dive to straight and level.
- xv. Restore power to straight and level.
- xvi. Minimum height for the aeroplane to be at even keel is 2000ft agl.

2. STALL TURN TO THE RIGHT SIDE

- i. Same as for stall turn to left side, except more positive use of rudder will be required owing to slipstream effect.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. HASELL check.
- ii. Lookout and inspection turns.
- iii. Safety height – CAR's and local rules.
- iv. Stalling – recovery reviewed.
- v. Negative “g” effects.
- vi. Loading on pilot's body.
- vii. Orientation during manoeuvre.

ENGINE CONSIDERATIONS

- i. Aerobatic power setting – climb power and limiting R.P.M.
- ii. Throttle use, especially when fixed pitch propeller is fitted.
- iii. Over boost/over-rev.
- iv. Temperature and pressures.
- vi. Engine cut-out during manoeuvre. Importance of closing throttle (fire hazard if carburettor fitted).

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Effect of controls.
- ii. Further effect of rudder.
- iii. Effect of slipstream, airspeed and torque reaction.
- iv. Stalling.
- v. Climbing and descending.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Correct speed at commencement of the manoeuvre
 - ii. Correct use of rudder.
2. Discuss the common faults students usually make:
 - i. Exceeding maximum permissible R.P.M. when aeroplane is fitted with a fixed pitch propeller.
3. Discuss the student's actual faults:
 - i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result of the faults.
 - iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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AEROBATICS

SLOW ROLL (AXIAL)

1. AIM

DEFINITION

An aeroplane is said to slow roll when, starting and ending in straight and level flight, it is rotated around its longitudinal axis through 360° whilst maintaining altitude.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable Procedures and Checklists.
 - b. Aeroplane handling techniques:- Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity of previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To teach the student how to initiate and maintain a constant rate of roll and how to recover accurately to straight and level flight, as well as the principles involved in the slow roll and any adverse conditions that may result, including their corrective action such as:

- i. Aileron overbalance.
- ii. Aileron snatch.
- iii. IAS and aeroplane limitations.

HOW THE EXERCISE APPLIES TO FLYING

- i. This is the basic aerobatic manoeuvre in the rolling plane.
- ii. It is used in combination with manoeuvres in other planes, i.e. Barrel Roll, Roll off the Top, Half Roll Pull through.

2. PRINCIPLES INVOLVED

- i. NEWTON'S LAWS
- ii. PLANE OF MOVEMENT
 - a. Perfect Roll
- iii. RATE OF ROLL
 - a. Aileron effectiveness and rolling moment – use of rudder.
 - b. Damping in roll.
 - c. Effect of forward speed (V) and density altitude.
- iv. ADVERSE AILERON YAW
- v. RECOVERY
 - a. To straight and level flight.

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- vi. b. Effect of momentum during recovery.
DISCUSS:

With reference to applicable aeroplane type, discuss the planes of movement and application of previously mentioned principles to slow rolls at lower and higher speeds.

vii. **ADVERSE CONDITIONS AND CORRECTION**

- a. Aileron overbalance.
- b. Aileron snatch.
- c. Airframe limitations in roll (Manoeuvre Envelope) and possible consequences.

viii. **FACTORS AFFECTING THE SLOW ROLL**

- a. Torque.
- b. Slipstream.
- c. Power.

3. DESCRIPTION OF AIR EXERCISE

a. **APPLICABLE PROCEDURES AND CHECKLISTS**

b. **AEROPLANE HANDLING TECHNIQUES:-**

DEMONSTRATION

OBSERVATION

1. SLOW ROLL (AXIAL)

- i. Look out.
- ii. Complete aerobatic checks – HASELL.
- iii. Set climb power if C.S.U is fitted.
- iv. Set trimmers for straight and level flight.
- v. Select reference point $\pm 45^\circ$ to one side.
- vi. Wing-over to the reference point.
- vii. Dive until the recommended speed for the manoeuvre is achieved – check RPM if fixed pitch propeller is fitted.
- viii. Raise nose to just above the horizon ($\pm 20^\circ$), apply full power and check climb attitude before rolling.
- ix. Smoothly but firmly apply aileron in direction of roll and some rudder in the same direction to compensate for adverse aileron yaw.
- x. As aeroplane rolls to the vertical, apply top rudder as necessary and whilst applying aileron to control rate of roll, move control column forward.
- xi. Whilst inverted, use rudder to keep straight on reference point, apply maximum aileron if necessary and ensure control column forward to prevent nose dropping below the horizon.
- xii. Observe engine limitations in inverted flight.
- xiii. As the aeroplane rolls to the vertical again, apply top rudder to prevent “scooping” and whilst continuing to apply full aileron, move the control column rearwards.
- xiv. When the straight and level attitude is once again reached, set power to that required.
- xv. Aim to obtain a constant rate of roll.
- xvi. Minimum height for the aeroplane to be on an

even keel is 2000ft agl.

c. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

- i. HASELL check.
- ii. Lookout and inspection turn.
- iii. Safety height – CAR's and local rules.
- iv. Limiting speeds – airframe.
- v. Orientation during manoeuvre.

ENGINE CONSIDERATIONS

- i. Aerobatic power settings – climb power and limiting RPM.
- ii. Engine temperature and pressures.
- iii. Action in event of engine failure.

d. **SIMILARITY TO PREVIOUS EXERCISES**

- i. Steep turns – inspection turn.
- ii. Wing-over for entry into manoeuvre.
- iii. Effect of controls – over/under controlling.
- iv. Straight and level flight.

e. **DE-BRIEFING AFTER FLIGHT**

- 1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Correct speed at commencement of the manoeuvre.
 - ii. Correct co-ordination of controls.
- 2. Discuss the common faults students usually make:
 - i. Aerobatic power settings – climb power and limiting RPM.
 - ii. Engine temperature and pressures.
 - iii. Action in event of engine failure.
- 3. Discuss student's actual faults:

For each fault the instructor must indicate:

 - i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result of the fault.
 - iv. The corrective action required.

f. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

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AEROBATICS

BARREL ROLL

1. AIM

DEFINITION

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and checklists.
 - b. Aeroplane handling techniques:- Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity of previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To enable the student to fully understand the principles involved thereby ensuring correct execution of the manoeuvre in the air.

HOW THE EXERCISE APPLIES TO FLYING

- i. Teaches the student co-ordination.
- ii. Confidence building manoeuvre.
- iii. Handling the aeroplane simultaneously in the rolling and looping planes.

2. PRINCIPLES INVOLVED

- i. NEWTON'S LAWS
- ii. CENTRIPETAL FORCE
- iii. PLANES OF MOVEMENT
 - a. Variation in size of the barrel roll.
- iv. RATE OF ROLL
 - a. Aileron application and rolling moment.
 - b. Effect of forward speed (V) and density.
- v. LOAD FACTOR AND STALLING SPEED
- vi. BARREL ROLL PROPER
 - a. What happens to speed, "g" loading and stalling speed during the manoeuvre.
 - b. Slipstream.
 - c. Control effectiveness.
- vii. EFFECT OF:
 - a. Density altitude.

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- b. Mass.
- c. Drag.
- d. Power.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AEROPLANE HANDLING TECHNIQUES:-

DEMONSTRATION

OBSERVATION

1. SLOW ROLL (AXIAL)

- i. Look out.
- ii. Complete aerobatic checks – HASELL.
- iii. Set climb power if C.S.U. is fitted.
- iv. Set trimmers for straight and level flight.
- v. Select a line feature and reference point $\pm 45^\circ$ to the right of the line feature (i.e. to execute a barrel roll to the left side).
- vi. To enter barrel roll, do a wing-over onto the selected reference point to the right of the line feature.
- vii. In the dive – check engine RPM if fixed pitch propeller is fitted.
- viii. Ease out of dive just before target speed for the manoeuvre is attained – ensure that wings are level with the horizon on selected reference point.
- ix. If fixed pitch propeller is fitted, apply full power as nose rises above the horizon.
- x. Simultaneously, apply aileron to the left to produce the roll, balancing with rudder, whilst maintaining a backward pressure on the control column (elevators) to ensure the aeroplane spirals round the selected line feature.
- xi. To keep rate of roll constant, aileron deflection will vary with speed – ensure that wings are level with the horizon when inverted at the 90° reference point.
- xii. Observe engine limitations in inverted flight.
- xiii. Adjust elevators to assist in maintaining a smooth roll – avoiding negative “g”.
- xiv. Continue until wings are about to become level and then smoothly centralize the controls.
- xv. Barrel roll should be completed at the same point on the horizon and at the same target speed, where the manoeuvre was commenced – check with line feature.
- xvi. Reduce power to that required.
- xvii. Minimum height for the aeroplane to be at an even keel 2000ft agl.

c. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

AIRMANSHIP

Refer to Loop and Slow Roll exercises.

ENGINE CONSIDERATIONS

Refer to Loop and Slow Roll exercises.

d. **SIMILARITY TO PREVIOUS EXERCISES**

Refer to previous aerobatic exercises.

e. **DE-BRIEFING AFTER FLIGHT**

1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Correct speed at commencement of the manoeuvre.
 - ii. Correct co-ordination of controls.
2. Discuss the common faults students usually make:
 - i. Overactive on the controls.
 - ii. Barrel roll not flown symmetrical.
3. Discuss the student's actual faults:
 - i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result the fault could have led to.
 - iv. The corrective action required.

f. **BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON**

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AEROBATICS

ROLL OFF THE TOP OF A LOOP (IMMELMANN TURN)

1. AIM

In this manoeuvre the aircraft is flown round the first half of a loop, commencing with extra speed. From the top of the loop the aeroplane is rolled, from the inverted position, in much the same way as in the second half of a slow roll. This aerobatic manoeuvre effectively changes the aeroplane's heading by 180°.

2. PRE-FLIGHT BRIEFING

Refer to information provided in aerobatic exercises on the Loop and Slow Roll.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AEROPLANE HANDLING TECHNIQUES:-

DEMONSTRATION

OBSERVATION

1. ROLL OF THE TOP OF A LOOP

- i. Lookout.
- ii. Complete aerobatic checks – HASELL.
- iii. Set climb power if C.S.U is fitted.
- iv. Set trimmers for straight and level flight.
- v. Select reference points for entry and completion of manoeuvre.
- vi. Commence manoeuvre as for loop except:
 - a. Steeper dive required.
 - b. Commence to ease out of the dive just before reaching target speed for the manoeuvre.
- vii. When inverted at the top of the loop:
 - a. Check looping moment before the nose cuts the horizon.
 - b. Commence roll – as per slow roll manoeuvre from inverted position to up-right position.
 - c. Co-ordinate rudder and elevator movements to bring nose onto the horizon reference point.
 - d. Use ailerons to maintain a constant rate of roll.
- viii. Check with reference point for 180° heading change.
- ix. Resume straight and level flight.
- x. Set power as required.
- xi. Minimum height for the aeroplane to be at an even keel is 2000ft agl.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

Refer to Loop and Slow Roll exercises.

d. SIMILARITY TO PREVIOUS EXERCISES

Refer to previous aerobatic exercises.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects applicable to:

- i. Correct speed at commencement of the manoeuvre.
- ii. Correct use of rudder.

2. Discuss the common faults students usually make:

- i. Exceeding maximum permissible R.P.M. when aeroplane is fitted with a fixed pitch propeller.

3. Discuss the student's actual faults:

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

AEROBATICS

HORIZONTAL FIGURE OF EIGHT (CUBAN EIGHT)

1. AIM

In this manoeuvre the aeroplane is flown around the first five-eighths of a loop, but at the commencement of the inverted 45° down line after the five-eighths loop, the aeroplane is rolled from the inverted to the upright position in order to finish in a 45° dive in the opposite direction to that at which the loop was entered, before entering a second loop and repeating the rolling manoeuvre on the 45° down line after the second five-eighths loop, thereby completing the manoeuvre on the same heading as the first loop entry.

2. PRE-FLIGHT BRIEFING

Refer to information provided in exercises on the Loop, Slow Roll and Roll off the Top of the Loop.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AEROPLANE HANDLING TECHNIQUES:-

DEMONSTRATION

OBSERVATION

1. HORIZONTAL FIGURE OF EIGHT

- i. Lookout.
- ii. Complete aerobatic checks – HASELL.
- iii. Carry out the same procedures and flying technique as applicable for the Loop, up to the position where the aeroplane is inverted at the top of the loop.
- iv. Allow the inverted aeroplane to enter the down side of the loop.
- v. When aeroplane's longitudinal axis is pointed 45° below the horizon with wings level and aligned with line feature, roll aeroplane to upright position.
- vi. Heading has now changed 180° from entry direction.
- vii. Continue dive in order to build up speed for entry into second half of manoeuvre.
- viii. Gain loop entry speed.
- ix. Fly aeroplane around the second loop until aeroplane's longitudinal axis is once again pointed 45° below the horizon – check wings level.
- x. Roll aeroplane to upright position.
- xi. Direction of the dive should be the same as that for entry into the first loop.
- xii. Recover to flight path required and set power accordingly.
- xiii. Minimum height for the aeroplane to be at an even keel is 2000ft agl.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

Refer to Loop and Roll off Top of Loop.

d. SIMILARITY TO PREVIOUS EXERCISES

Refer to previous aerobatic exercises.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects applicable to:

- i. Correct speed at commencement of the manoeuvre.
- ii. Correct use of rudder.

2. Discuss the common faults students usually make:

- i. Exceeding maximum permissible R.P.M. when aeroplane is fitted with a fixed pitch propeller.

3. Discuss the student's actual faults:

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

AEROBATICS

HALF ROLL ENTRY INTO HORIZONTAL FIGURE OF EIGHT (REVERSE CUBAN EIGHT)

1. AIM

In this manoeuvre the aeroplane is divided to obtain the speed for entry into a loop and when the aeroplane is climbing at an angle of 45° to the horizontal, the aeroplane is rolled to the inverted position whilst climbing. From this inverted position the aeroplane immediately enters the downside of the loop and when it has completed the loop and is once again climbing upright, having reversed direction, the aeroplane is again rolled inverted in the climb and the looping manoeuvre is repeated.

2. PRE-FLIGHT BRIEFING

Refer to information provided in aerobatic exercises on the Loop, Slow Roll and Roll off the Top of a Loop.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AEROPLANE HANDLING TECHNIQUES:-

DEMONSTRATION

OBSERVATION

1. HALF ROLL ENTRY INTO HORIZONTAL FIGURE OF EIGHT

- i. Lookout.
- ii. Complete aerobatic checks – HASELL.
- iii. Enter into the climb for a loop and when the aeroplane's longitudinal axis is at a climb angle of 45° to the horizon, check climbing rate and ensure wings level.
- iv. With speed at $\pm 2.5 V_{SO}$, roll in the climb into the inverted position – ensure wings level.
- v. Pull nose through the horizon to the angle of dive consistent with the downside of the loop.
- vi. Just before reaching recommended speed for the loop, start easing out of the dive.
- vii. Continue around bottom arc of the loop until the aeroplane's longitudinal axis is 45° to the horizon (i.e. 180° heading change prior to entry for the manoeuvre).
- viii. With speed at $\pm 2.5 V_{SO}$, roll in the climb into the inverted position – check wings level.
- ix. Repeat the second half of the manoeuvre as detailed in (v) to (vii) above.
- x. Aeroplane's heading should now be the same as that for entry into first half of the manoeuvre.
- xi. On completion of the manoeuvre, adjust flight path and power required.
- xii. Minimum height for the aeroplane to be at an even keel is 2000ft agl.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

Refer to Loop and Roll off the Top of the Loop.

d. SIMILARITY TO PREVIOUS EXERCISES

Refer to previous aerobatic exercises.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects applicable to:

- i. Correct speed at commencement of the manoeuvre.
- ii. Correct use of rudder.

2. Discuss the common faults students usually make:

- i. Exceeding maximum permissible R.P.M. when aeroplane is fitted with a fixed pitch propeller.

3. Discuss the student's actual faults:

For each fault the instructor must indicate:

- i. The symptoms of the fault.
- ii. The cause of the fault.
- iii. The result the fault could have led to.
- iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

AEROBATICS

HALF ROLL TO INVERTED FLIGHT AND RECOVERY

1. AIM

This manoeuvre involves the aeroplane being placed in an inverted straight and level flight position by means of a half-roll and eventually recovered to the up-right position by either another half-roll, thereby maintaining a constant altitude and heading, or recovery to straight and level flight at a lower altitude and 180° heading change.

2. PRE-FLIGHT BRIEFING

- i. Refer to information provided in aerobatic exercises on the Slow Roll and Loop.
- ii. Refer to aeroplane manual for inverted flight engine and airframe limitations.
- iii. Reverse loadings will cause the engine to cut during inverted flight unless special provision is made to prevent this. If no special provision has been made for inverted flight, the throttle should be closed and opened again when positive loading have been regained.
- iv. Unless the engine oil system is modified for inverted flight, there may be a drop in oil pressure with possible propeller overspeed (with constant speed unit) as well as the danger of oil drainage occurring should the engine time limit for inverted flight, be exceeded.
- v. Depending upon the aeroplane type, there is the possibility that adverse aileron yaw may be greater during inverted flight due to differential aileron movement increase instead of decreasing drag.
- vi. The student must be thoroughly briefed on what to expect in inverted flight and the duration of inverted flight should be progressively increased as the student adapts to it.

3. DESCRIPTION OF AIR EXERCISE

a. APPLICABLE PROCEDURES AND CHECKLISTS

b. AEROPLANE HANDLING TECHNIQUES:-

DEMONSTRATION

1. HALF ROLL TO INVERTED FLIGHT

OBSERVATION

- i. Lookout.
- ii. Complete aerobatic checks – HASELL.
- iii. Carry out the same procedures and flying technique as applicable for entry to Slow Roll up to the inverted position – check wings level when inverted.
- iv. Move control column to forward position when inverted.
- v. Note nose position in inverted flight to maintain altitude.
- vi. Observe engine oil system limitations.
- vii. Observe engine fuel system limitations – throttle back if inverted system is not installed.
- viii. Keep straight on line feature.
- ix. Carry out gently turns to left and right, observing effect of adverse aileron yaw (use of rudder).
Note – if engine is throttled back, turns will be done in inverted glide at speeds higher than that for normal glide.
- x. Minimum height for aeroplane to be at an even

2. **HALF ROLL TO UPRIGHT POSITION**
- i. keel is 2000ft agl.
 - ii. Carry out same procedure and flying technique as the completion of the Slow Roll.
 - iii. Note altitude and heading is the same as that for entry, even for aeroplane's not fitted with inverted flight systems.
 - iv. Minimum height for aeroplane to be at an even keel is 2000ft agl.
3. **PULL THROUGH TO UPRIGHT POSITION**
- i. Maintain inverted flight, keeping straight on line feature.
 - ii. Check wings level.
 - iii. Reduce speed to normal top-of-loop speed.
 - iv. Pull nose through the horizon to the angle of dive consistent with the downside of the loop – observe engine limitations.
 - v. Continue around the bottom arc of the loop on the line feature until the upright straight and level position is attained.
 - vi. Note loss of altitude and heading change of 180°.
 - vii. Minimum height for aeroplane to be at an even keel is 2000ft agl.

c. **CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING**

Refer to Loop and Slow Roll exercises as well as limitations for inverted flight in aeroplane manual.

d. **SIMILARITY TO PREVIOUS EXERCISES**

Refer to previous aerobatic exercises.

e. **DE-BRIEFING AFTER FLIGHT**

1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Correct speed at commencement of the manoeuvre.
 - ii. Correct use of rudder.
2. Discuss the common faults students usually make:
 - i. Exceeding maximum permissible R.P.M. when aeroplane is fitted with a fixed pitch propeller.
3. Discuss the student's actual faults:
For each fault the instructor must indicate:
 - i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result the fault could have led to.
 - iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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EXERCISE 23

ASSYMMETRIC FLIGHT

(TWIN-ENGINE AEROPLANE – LOSS OF POWER)

1. AIM

DEFINITION

Asymmetric flight is a condition of flight that will occur on a multi-engine aeroplane when an imbalance in power/thrust exists about the normal axis.

WHAT THE INSTRUCTOR IS TO TEACH

- i. Discuss the aerodynamic principles involved.
- ii. The air exercise briefing:
 - a. Applicable procedures and check lists.
 - b. Aeroplane handling techniques:- Demonstration and Observation.
 - c. Considerations of airmanship and engine handling.
 - d. Similarity to previous exercises.
 - e. De-briefing after flight.

WHY IT IS BEING TAUGHT

To train the student how to plan for and recognise the failure of one engine and to control the aeroplane safely during all phases of flight with one engine inoperative or partially inoperative; as well as a good understanding and a thorough knowledge of the principles involved in:

- i. The introduction to asymmetric flight.
- ii. Effects and recognition of engine failure in all phases of flight.
- iii. Methods of control and identification of the failed engine.
- iv. Effects of varying speed, mass and power.

HOW THE EXERCISE APPLIES TO FLYING

- i. Take-off and climb performance with one engine inoperative.
- ii. Cruise altitude and aeroplane cruise performance with one engine inoperative.
- iii. Approach and landing with one engine inoperative.
- iv. Missed approach and go-around performance with one engine inoperative.
- v. Considerations and use of flaps and undercarriage during single engine approach, landing and overshoot.

2. PRINCIPLES INVOLVED

i. FORCES ACTING ON THE AEROPLANE.

With the aid of a diagram explain the following:

- a. Forces and couples in symmetric flight.
- b. Forces and couples in asymmetric flight.
- c. Definition of the critical engine – Asymmetric blade effect.
- d. Force required to counteract the yawing moment created by an engine failure and particularly by the critical engine failure.

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ii. WITH THE AID OF A GRAPH EXPLAIN:

- a. Power available curve (Pa) – Two engines.
- b. Power required curve (Pr) – Two engines = Total drag.
- c. Effect of propeller efficiency at low speed and high RPM.
- d. Effects of altitude, supercharging/turbocharging and single engine ceiling.
- e. Power available single engine (Pase).
- f. Power required single engine (Prse).
- g. Loss of performance.
- h. How an aeroplane can be flown straight and level at two speeds with the same power setting, and show how these speeds converge as power is decrease. Explain the importance of this for single engine circuits as well as the overshoot.

iii. PERFORMANCE LOSS WITH ONE ENGINE INOPERATIVE

- a. Explaining the possibility of power/thrust degradation due to engine wear, and how propeller efficiency decreases at low speed, high RPM and high angle of attack, leaving a percentage of power/thrust on both engines for climbing.

- b. Compute Rate of Climb:

$$\text{Rate of Climb (FPM)} = \frac{33000 \times Pa - Pr}{\text{Weight}}$$

- c. Show that with the one engine inoperative:

$$\text{Rate of climb (FPM)} = \frac{33000 \times P_{ase} - P_{rse}}{\text{Weight}}$$

Percentage performance loss:

$$\frac{\text{Rate of climb (single engine)}}{\text{Rate of climb (all engines)}} \times 100$$

- d. Describe the effects of :
 - 1) Wind milling propeller.
 - 2) Flaps.
 - 3) Undercarriage.
 - 4) Cowl flaps.

iv. OPERATIONS

- a. DISCUSS AND EXPLAIN:

- 1) Weight, altitude and temperature (WAT) limitations.
- 2) Balance field length (BFL) and climb profile requirements.
- 3) Important speed definitions:

V_1 – Critical engine failure recognition speed.

V_r – Rotation/take-off speed at which rotation is initiated to attain the V_2 climb speed at or before a height of 35 ft above the runway has been reached.

V_2 – The actual climb speed at 35 ft above the runway surface as demonstrated in flight with one engine inoperative.

V_{ref} – The $1.3 \times V_{so}$ speed.

DESIGNATION	DESCRIPTION	AEROPLANE CONFIGURATION OR SIGNIFICANCE OF SPEED	A/S IND. MARKING
V_{s0}	Stalling Speed Landing Configuration.	Engines Zero thrust, propellers take-off position, landing gear extended, flaps in landing position, cowl flaps closed.	Low speed end of white arc.
V_{s1}	Stalling Speed Clean Configuration.	Engines zero thrust, propellers take-off position, landing gear and flaps retracted.	Low speed end of green arc.
V_{mc} V_{mca} V_{mcg}	Minimum Control Airspeed. Minimum Control Speed (Air). Minimum Control Speed (Ground).	Aircraft at MAUW, take-off maximum available power/thrust on operating engine, critical engine wind milling (or feathered if auto feather device is installed), landing gear retracted, flaps in take off position, CG at most rearward position with 5° bank towards live engine. Take-off or maximum available power/thrust on operating engine, critical engine wind milling (or feathered if auto feather device is installed), landing gear down, flaps in take-off position.	Red radial line
V_{sse}	International One Engine Inoperative Speed.	Minimum speed for intentionally rendering one engine inoperative in flight for pilot training.	
V_x	Best Angle-of-Climb Speed.	Speed which produces most altitude gain in given distance with both engines operating; Obstruction Clearance Speed.	
V_y	Best Rate-of-Climb Speed.	Speed which produces most altitude gain in a given time with both engines operating.	
V_{xse}	Best Angle-of-Climb Speed (Single Engine).	Speed which produces most altitude gain in a given distance with one engine inoperative.	
V_{yse}	Best Rate-of-Climb Speed (Single Engine).	Speed which produces most altitude gain in a given time with one engine inoperative.	Blue radial line
V_{le}	Maximum Landing Gear Extended Speed.	Maximum speed for safe flight with landing gear extended.	

V_{fe}	Maximum Flap Extended Speed.	Maximum speed with wing flaps in a prescribed extended position.	High speed end of white arc.
V_a	Design Manoeuvring Speed.	Speed below which structural damage will not occur as a result of full control deflection.	
V_{no}	Maximum Structural Cruising Speed.	Maximum speed for normal operation.	High speed end of green arc.
V_{ne}	Never Exceed Speed.	Maximum design speed without structural failure.	Red Line.

4) Principles, procedures and effect of the following during single engine operation:

- a) Possible hydraulic implications.
- b) Vacuum system considerations.
- c) Electrical implications.
- d) Operative engine considerations.

3. **DESCRIPTION OF AIR EXERCISE**

a. **APPLICABLE PROCEDURES AND CHECKLISTS**

- i. The take-off briefing/review with special reference to:
 - a. Engine failure before decision speed V_1 .
 - b. Engine failure after decision speed when airborne and:
 - 1) sufficient runway available to land back on, or
 - 2) insufficient runway available to land back on, as well as
 - 3) gear retraction.
 - c. Engine inoperative flight and ATC liaison.
- ii. Contents and wording of the take-off briefing/review.

Typical take-off briefing:

- a. The Abort
I will abort take-off in the event of a decision to stop at or before decision speed V_1 which is I will simultaneously close the throttles/thrust levers and apply sufficient braking to stop on the runway remaining. After decision speed V_1 , if sufficient runway is available, I will land back and stop.
- b. The one engine in operative flight path
After airborne I will continue to climb to and level out at feet, and comply with ATC instructions/published procedures.

iii. Engine failure procedure:

FLY THE AEROPLANE	
Simultaneously:	
Directional Control	Rudder/aileron
Altitude	Full power
Speed	V _{yse}
REDUCE DRAG	
Flaps	Optimum
Gear	UP (Positive climb)
Propeller	Identify Verify Rectify and Feather

AVIATE	
After take-off checks	Accomplish
LIVE ENGINE:	
Power/Thrust	Max. Continuous
Temps and Press	Monitor
Fuel	Balance
DEAD ENGINE:	
Mixture	Lean
Magneto's	Off
Cowl flaps	Closed
Electrical Loads	As applicable
NAVIGATE	
Land at nearest suitable airport	
COMMUNICATE	
Advise ATC	Problem and intentions
ENGINE FAILURE CHECKLIST COMPLETED	

NOTE: The items that are boxed must be done by recall. All other items must be done by checklist.

b. AEROPLANE HANDLING TECHNIQUES:-

DEMONSTRATION

OBSERVATION

1. EFFECTS AND RECOGNITION OF ENGINE FAILURE DURING LEVEL FLIGHT

- i. Look out.
- ii. Complete the HASELL checks.
- iii. Trim the aeroplane for straight and level flight at cruise power and speed.
- iv. Follow through on the flight controls.
- v. Gradually close one throttle and note:
The aeroplane will yaw, roll and a spiral descent towards the idling engine will occur.
- vi. Return to twin engine straight and level flight at cruise power/thrust and speed.

- vii. Close the other throttle and note that the same characteristics occur but in the opposite direction.
- viii. Return to twin engine straight and level flight at cruise power/thrust and speed. Repeat the previous actions, closing each throttle alternately and note the flight instrument indications associated with failure of one engine.
- ix. From straight or level flight, gently throttle back the left engine whilst using rudder to prevent yaw (ball in the centre) until maximum rudder deflection is reached, and ailerons to maintain lateral level (maximum of 5°). Use elevator and the power/thrust of the right engine to maintain altitude (if possible) if within the capabilities of the aeroplane performance.
Note that balanced flight and constant heading can be maintained.
- x. Return the aeroplane to twin engine straight and level flight and cruising power/thrust and speed.
- xi. Gently throttle back the right engine whilst using rudder to prevent yaw (ball in the centre) until maximum rudder deflection is reached, and ailerons to maintain lateral level (maximum of 5°). Use elevator and the power/thrust of the left engine to maintain altitude (if possible).
- xii. Return the aeroplane to twin engine straight and level flight, at cruising power/thrust and speed.

At this stage the student should practice maintaining balance, heading and altitude whilst the instructor closes each throttle alternately.

Note the “Dead Leg/Dead Engine” method of identifying which engine has failed.

The student will now practice the maintenance of balance, heading and altitude (if possible) whilst at the same time identifying which engine has been throttled back.

During this practice the engine instrument indications of a real engine failure (as against those seen by shutting down an engine with the mixture) will be itemised by the instructor. Point out the MP, RPM, Fuel Flow, Oil Press and Oil/Cyl Head temps and which will give a positive indication of engine failure. Flight and engine instrument indications are of particular importance during IMC or when only a partial power/thrust loss of one engine occurs.

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2. **EFFECTS AND RECOGNITION OF ENGINE FAILURE DURING TURNS**

- i. Lookout.
- ii. Complete the HASELL checks.
- iii. Enter a moderately banked left turn at normal cruising airspeed.
- iv. Close the right throttle and note:
When the outside engine fails the aeroplane will yaw and slowly roll out of the turn and enter a spiral descent in the opposite direction.
- v. Return to straight and level flight at cruising power/thrust and speed.
- vi. Re-enter a left turn. Close the left throttle and note:
When the inside engine fails the aeroplane will yaw and roll rapidly into direction of the turn. The bank angle will increase and a spiral descent will occur.
In both cases the visual indications will be yaw, followed by a roll and a spiral descent.
- vii. Return the aeroplane to twin engine straight and level flight at cruising power/thrust and speed.
- viii. Mask the throttle quadrant and close the throttles alternatively from moderately banked turns in both directions.

During each simulated engine failure the student must correctly identify which engine has failed whilst maintaining control of the aeroplane.

3. **EFFECT OF VARYING AIRSPEED AND POWER/THRUST**

- i. Varying the speed at a constant power/thrust.

- i. Lookout.
- ii. Fly straight and level at cruising power/thrust and speed.
- iii. Close the left throttle whilst preventing yaw with rudder. Use sufficient aileron to maintain lateral level and confirm a constant heading is being maintained.
- iv. Maintain altitude (if possible) and note the airspeed in asymmetric flight for the power/thrust setting used.
Note the amount of rudder deflection and control force required.
- v. Raise the aeroplane's nose and gradually reduce the airspeed to V_{yse} .
As the airspeed is decreased a larger amount of rudder will be needed to prevent yaw. Also note that a greater aileron deflection will be required to keep the wings level.
- vi. Return to twin engine straight and level flight at V_{yse} .

Summary: An engine failure at low airspeed will lead to the need for a large rudder

- ii. Varying the power/thrust at a constant airspeed.
High power/thrust and low speed.

- i. deflection if yaw is to be prevented.
- ii. Maintain V_{yse} and close one throttle.
- iii. Maintain balance and wings level.
- iii. Select climb power on the operative engine.

Note:

- a. More rudder deflection will be required to maintain balance.
- b. More aileron deflection will be required to keep the wings level.

- iv. Return to twin engine straight and level flight at cruise power/thrust and speed.

v.

Note: A reduction of airspeed or an increase of power will result in an increase of control deflection to maintain balance with the wings level.

The largest amount of control deflection and force will be required at a low airspeed and high power setting

- iii. Varying the power/thrust at a constant airspeed.
Lower power/thrust and high speed.

- i. From straight and level flight place the aeroplane in a trimmed descent at cruising speed and with a low power/thrust setting.
- ii. Follow through on the light controls.
- iii. Partially reduce the power/thrust of one engine and note:
Symptoms of asymmetry are less marked, leading to the possibility of partial power failure going unnoticed during a descent with low power/thrust settings.
- iv. Continue to reduce the power/thrust to idling on the selected engine and note:
Even when one engine fails completely the visual feel and instrument "asymmetric symptoms" are not very apparent, during a high airspeed and low power/thrust configuration.
- v. Return to twin engine straight and level flight at cruising power/thrust.

4. CRITICAL SPEED

Note:

Propeller will not be feathered during this demonstration.

- i. Lookout.
- ii. Complete HASELL checks.
- iii. Place the aeroplane in straight and level flight at approximately 3000' agl. for an aeroplane with non turbo-charged engines.
- iv. Raise the aeroplane's nose and reduce airspeed to V_{yse} . Select maximum permitted RPM and manifold pressure on both engines.
- v. Gradually close the left throttle and move the mixture control to idle cut-off whilst maintaining balance, heading and wings level. Slowly raise the aeroplane's nose and allow

the airspeed to reduce.

Note the airspeed at which a maximum rudder deflection is being applied and when directional control can no longer be maintained (i.e. 10° of heading change).

- vi. Lower the aeroplane's nose to increase airspeed, whilst decreasing the power on the operating engine until positive directional control is fully regained.

The lowest airspeed achieved before directional control was lost is the critical speed for this flight condition.

Note: If the aeroplane stalls before the critical speed is reached, try the demonstration with approach flap.

- vii. Demonstrate the above with different power/thrust and flap/gear combinations and show that there are an infinite number of critical speeds.
- viii. Demonstrate the configuration with zero thrust.

5. MINIMUM CONTROL SPEED V_{mca}

- i. Lookout.
- ii. Complete the HASELL checks.
- iii. Definition of V_{mca} – stress only one V_{mca} .
- iv. Aeroplane should be at:
 - a. Gross weight and most aft C of G.
 - b. Optimum flap.
 - c. Gear up.
- v. Throttle back critical engine (normally L/H engine) then mixture to idle cut-off.
- vi. Apply max continuous power to the other engine.
- vii. 5° bank into the live engine.

Note speed at which directional control is lost (i.e. 10° of heading change) and compare results with previous exercise.

6. EFFECT OF DRAG ON SINGLE ENGINE PERFORMANCE

- i. Lookout.
- ii. Trim aeroplane for straight and level flight at cruising power/thrust and speed, at approximately 3000' agl. with flaps and gear retracted.
- iii. Throttle back the critical engine.
- iv. Apply max continuous power/thrust to the other engine.
- v. Fly the aeroplane at V_{yse} .
- vi. Note rate of climb or descent.
- vii. Shut down and feather the critical engine as per flight manual.
- viii. Fly aeroplane at V_{yse} .
- ix. Note rate of climb or descent.
- x. Notice improvement in climb performance.
- xi. Lower the gear and maintain V_{yse} .
- xii. Note rate of climb or descent and compare to

- (vi).
- xiii. Lower approach flap whilst maintaining V_{yse} .
- xiv. Note rate of climb or descent and compare to (vi).
- xv. Performance with gear and approach flap should be more or less the same as with the propeller wind milling.
Student should now be aware of just how much drag the wind milling propeller produces. It can be stressed that as soon as the propeller is feathered, there would be an immediate improvement in the aeroplane's climb performance.
- xvi. Unfeather and restart the engine as per aircraft flight manual.

7. DETERMINATION OF ZERO THRUST

- i. Lookout.
- ii. Trim aeroplane for straight and level flight at approximately 3000' agl. with gear and flap retracted.
- iii. Throttle back the critical engine, shutdown and feather.
- iv. Fly aeroplane at V_{yse} . Note aeroplane's performance.
- v. Leave power /thrust on good engine as is. Unfeather the critical engine and apply power/thrust on this engine until performance is the same as in (iv).

This is the power/thrust setting for the particular aeroplane's weight at this specific altitude and IAS. Compare the power/thrust setting obtained to the manufacturer's recommended zero thrust setting.

Note: Zero thrust settings vary with variation in all the listed parameters and especially with variation in IAS.

8. ASYMMETRIC CIRCUITS AND LANDINGS. (GENERAL)

- i. Control and performance during an engine failure in the take-off phase.
- i. Lookout.
- ii. Take-off briefing/review.
- iii. Adopt normal cruising flight at approximately 3000' agl. and away from the circuit.
- iv. Lower the landing gear and set take-off flap.
- v. Reduce airspeed to the safety speed or V_{yse} (whichever is the higher).
- vi. Increase power (RPM and manifold pressure) on both engines to the maximum permitted.
- vii. Close one throttle, or move mixture control to cut off, in order to simulate engine failure.
Note: At the safety speed (or above), directional and lateral control can be safely maintained.
- viii. Complete engine failure drill.

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- ix. Raise the landing gear and flap. Select “zero thrust” on the idling engine.
- x. Adopt V_{yse} and re-trim.
- xi. Complete engine shutdown checklist (simulated).
- xii. Repeat entire exercise (i) to (xi) at V_{yse} minus 10 knots IAS.

Note: The climb performance and the significance of achieving at least the safety speed at lift-off before entering a positive climb.

ii. Asymmetric committal height.

- i. Lookout.
- ii. Establish the aeroplane into a descent with landing gear and landing flap lowered.
- iii. Set “zero thrust” on one engine.
- iv. Adopt a typical approach airspeed (below V_{yse}) for the aeroplane type.
- v. At a nominated altitude of at least 100 agl. adopt the missed approach procedure. Apply take-off power on the operating engine. Raise the flaps to optimum and once established in a positive rate of climb, raise the gear and the rest of the flaps.

Note the altitude loss between initiating the missed approach procedure and establishing a positive rate of climb.

- vi. Repeat the above demonstration commencing at V_{yse} , and note the smaller height loss involved between applying power and climbing away.

Note: The importance of selecting a safe height below which a missed approach should not be initiated, and the value of maintaining at least V_{yse} until this height is reached on an asymmetric approach. This height should not be below 300 ft agl.

9. **ENGINE FAILURE DURING THE TAKE-OFF PHASE**

- i. Engine Failure During Take-off
Note: This demonstration may only be shown providing ample distance is available and the take-off surface is suitable for firm braking action to be applied.

- i. Pre take-off checks completed.
- ii. Take-off briefing/review – indicating specific wording and content for a particular take-off.
- iii. Commence normal take-off.
- i. ATC liaison.
- ii. Shortly after full power/thrust has been applied, close one throttle to simulate engine failure.
- iii. Immediate Actions:
 - a. Simultaneously close the throttle of the operating engine.
 - b. Maintain direction by use of the rudder and if necessary differential braking

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ii. Engine Failure after airborne.

- c. action.
- c. Apply firm braking action compatible with available distance remaining.
- i. At a safe height, and at or above safety speed or V_{yse} (whichever is higher), close one throttle to simulate engine failure.
- ii. Immediate Actions:
 - a. Maximum power/thrust on the live engine. Throttle and RPM lever fully forward. Check mixture control in correct position.
 - b. Attitude to maintain a safe airspeed.
 - c. Select landing gear up.
 - d. Flaps retracted (if used on flap speed schedule).
 - e. Maintain directional control with rudder and aileron.
 - f. Use not more than 5° of bank towards the operating engine.
 - g. Identify failed engine whilst adopting V_{yse} .
 - h. Confirm which engine has failed by slowly closing the throttle of the identified engine.
 - i. Simulate the feathering procedure by using "touch drill" and selecting "zero thrust" on the idling engine.
 - j. Complete engine shutdown checklist (simulated).
- iii. Continue the climb on one engine to the desired circuit altitude.

Note: At least one single engine climb to the downwind position must be made.

Thereafter and in the interests of engine handling, the single engine climb may be discontinued after the student has clearly established full control and a positive rate of climb.

A different engine should be throttled back for each practice.

10. **CIRCUIT, APPROACH AND LANDING ON ASYMMETRIC POWER.**

i. Downwind Leg.

- i. ATC liaison
- ii. At an early stage on the downwind leg, close one throttle and simulate engine failure.
- iii. Accomplish engine failure procedure.
- iv. Maintain a constant heading, altitude and a safe airspeed, increasing the power/thrust on the operating engine as necessary.
- v. Simulate feathering procedure using "Touch Drill" and select "zero thrust" on the idling

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engine.

For the purpose of this exercise assume rectification is not possible.

- vi. Continue the circuit on one engine:
Maintain aeroplane in trim.
Maintain altitude power/thrust as required.
Complete pre-landing checks.
- vii. If excess power is available to overcome landing gear drag and maintain altitude, it will normally be advisable to select landing gear down during the pre-landing checks.
If marginal or insufficient power is available to maintain altitude, leave the selection of landing gear down during the pre-landing checks.

If manual lowering of the landing gear is required this should where-ever possible be commenced prior to turning onto the base leg.

ii. Base Leg.

- i. Nominate an "Asymmetric Committal Height" (normally not below 300' agl).
- ii. Maintain airspeed at or above V_{yse} .
- iii. Assess descent path distance to the runway threshold in relation to the wind strength, and if the situation permits, select the first stage of flap. If the power/thrust available is marginal leave the initial flap selection until later.
- iv. Adjust power/thrust and/or flap as necessary to commence the descent.
- v. Adjust the rate of descent to ensure a minimum height of 600' agl. for the turn onto the final approach. The wings must be level by 400' agl.

iii. The Final Approach.

- i. Maintain an approach speed (not below V_{yse}) until reaching Asymmetric Committal Height.
- ii. As Asymmetric Committal Height is approached check the following:
 - a. At Asymmetric Committal Height, adjust the approach path as necessary and select flap compatible with the situation.
 - b. Ensure gear is down.

Note: Landing flap must not be used until it is clearly established that the aeroplane will safely reach the runway threshold.

- iv. When below the Asymmetric Committal Height the airspeed should be gradually adjusted to arrive over the runway threshold at the required landing speed.

Note: In turbulent weather conditions, use an increased threshold speed if runway length permits. Use gust factor and adjust landing

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speed accordingly.
Final flap selection (as applicable).

iv. Landing.

- i. The normal landing procedure will apply, but a yaw towards the operating engine must be anticipated when the throttle is closed during a landing with the failed engine feathered. This is due to the drag from the operating engine when in the idling condition.

Note: When practising with “zero thrust” set, it will be necessary to close both throttles together just prior touch down.

v. Missed Approach Asymmetric Power.

- i. From the approach to land (at or above Asymmetric Committal Height), commence the overshoot procedure:
 - a. Go-around procedure.
 - i. Go-around power/thrust on live engine.
 - ii. Rotate to go-around attitude for V_{yse} .
 - iii. Flaps to optimum.
 - b. Missed approach procedure.
 - i. Position on dead side of the runway centreline, keeping other traffic in sight and/or,
 - ii. comply with ATC instructions or,
 - iii. Follow the published procedure.

At a safe height commence repositioning the aeroplane in the traffic pattern.

c. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

- i. Lookout – clear of other aircraft and cloud.
- ii. Minimum safety heights for actual engine shutdowns and asymmetric overshoots.
- iii. ATC liaison when carrying out asymmetric circuits and landings and other emergencies.
- iv. An inspection turn of at least 180° is required prior to conducting a critical speed demonstration.

ENGINE CONSIDERATIONS

- i. As per aeroplane flight manual.
- ii. Constantly monitor temperatures and pressures during single engine operations.
- iii. Engine overboosts/over-reving during engine failure identification.
- iv. Shock cooling during simulated engine failure.
- v. Warm up of an engine after unfeathering.

d. SIMILARITY TO PREVIOUS EXERCISES

- i. Straight and level.
- ii. Effects of controls.
- iii. Medium and steep turns.

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- iv. Climbing and descending turns.
- v. Use of various flap and power settings.
- vi. Circuits and landings.

e. DE-BRIEFING AFTER FLIGHT

1. Briefly recap on the exercise and emphasise the important aspects applicable to:
 - i. Engine handling and shutdown procedures.
 - ii. Weight and performance. Ensure the aeroplane is correctly loaded and not over its maximum take-off weight for the particular temperature and altitude.
 - iii. Engine failure procedures prior to and after lift off.
 - iv. Engine inoperative circuits and landings.
 - v. Asymmetric committal height and single engine overshoots.
2. Discuss the common faults students usually make:
 - i. Most students are told how difficult it is to fly a multi-engine aeroplane and are told to under no circumstances must they fly below V_{yse} on approach. Therefore, they tend to come in too fast causing the aeroplane to land too far down the runway.
 - ii. When carrying out the simulated engine failure procedure, the student tends to be too quick to identify the failed engine and sometimes identifies the incorrect engine or identifies the correct engine but due to haste tends to want to feather the other engine during "touch drills".
 - iii. During single engine operation on circuits and landings, the student tends to fly the aeroplane on the wrong side of the drag curve, thereby requiring additional power/thrust to maintain straight and level.
 - iv. Some students forget to centralise the rudder trim on final approach during single engine landings, consequently, when they close the throttle, this causes the aeroplane to yaw in the opposite direction.
 - v. During simulated engine failures just after take-off, some students are so busy trying to sort out this problem, that they omit to lookout and monitor terrain clearance.
 - vi. After the engine identification, feathering and shutdown procedures, some students forget to secure the engine by switching off magnetos, fuel/oil cocks, closing the cowl flaps and considering fuel cross feed.
3. Discuss the student's actual faults:

For each fault the instructor must indicate:

 - i. The symptoms of the fault.
 - ii. The cause of the fault.
 - iii. The result the fault could have lead to.
 - iv. The corrective action required.

f. BRIEFLY DISCUSS THE REQUIREMENTS OF THE NEXT LESSON

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PART 2

AIR EXERCISE BRIEFINGS

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NORMAL PROCEDURES CHECK LIST: -
PA28 140 / PA28 180

PRE FLIGHT INSPECTION – INTERNAL

- ⇒ Completed as per Pilot's Operating Handbook
- ⇒ Check Flight Folio Entries Agree with Hobbs & Tach Readings.

PRE FLIGHT INSPECTION – EXTERNAL

- ⇒ Completed as per Pilot's Operating Handbook
 - ⇒ Check All Lights Working
 - ⇒ Check Stall Warning Working
- Cherokee 180 – do not Remove Top Cowling.*

BEFORE START

- ⇒ Passenger Briefing Completed
- ⇒ Cockpit Preparation Completed
- ⇒ Seats & Harness Secured
- ⇒ Crew Briefing Completed
- ⇒ Master On-Radio on.
- ⇒ Alternator Off.
- ⇒ Call Apron for Start. State Intentions. Read Back
- ⇒ Radios off

START UP CHECKS

- ⇒ Handbrake On – (Toe Brakes on Stand by)
 - ⇒ Fuel Selected - Emptyest Tank
 - ⇒ Master Switch on
 - ⇒ Fuel Pump on – Pressure in Green
 - ⇒ Rotating Beacon on
 - ⇒ Mixture Full Rich
 - ⇒ Magnetos on 'Both'
 - ⇒ * In a/c with Start Button Select Magneto to 'Left'
 - ⇒ Prime throttle 3 Strokes for Cold Start (For Hot Start Prime Once Only)
 - ⇒ Call 'Clear Prop'
 - ⇒ Final Lookout
 - ⇒ Start
- When engine fires evenly, mags to "both" and oil pressure 30 secs.

AFTER START

- ⇒ Set Throttle 1000 RPM
- ⇒ Alternator on. Check charge
- ⇒ Fuel Pump Off – Check, Pressure Remains in

- 'Green'
- ⇒ Radios On: Check Frequency
- ⇒ Transponder Stand By and Set 2000
- ⇒ Intercom On – Set Squelch & Volume
- ⇒ Instruments Checked
 - AH Erect
 - DI Aligned to Compass
 - Fuel Gauges Agree with Actual Contents
 - Ampmeter Indicating Charge Below 30 amps
 - Suction Gauge Indicating
- ⇒ Circuit Breakers and Fuses Checked
- ⇒ Radio for Taxi Instructions and Read back

BEFORE TAKE OFF

(Prior to Entering the Runway)

- Fuel Pump
 - Friction Control Nipped
 - Mixture Control Full Rich
 - Trimmers
 - Flaps One Notch
 - Flight Controls Full & Free Checked
 - Hatches/Harnesses/Seats Secure
 - Speeds
 - Emergencies
 - Take-off Clearance
- On & Check Pressure
- Set
- Set -
- Elevators & Rudders
- Set
- Secure
- Review
- Review
- Obtained

WHEN CLEARED FOR TAKE-OFF

- W Wind – check direction and strength
- T Transponder on Alt
- D Taxi Forward onto Runway Centreline to ensure nose wheel Straight & a/c aligned with Centreline.
- Set DI to compass and verify heading agrees with runway in use.
- L Landing Light On

AFTER TAKE-OFF VITAL ACTIONS

- BUPNMF Checks (Above 300' AGL)
- B Brakes On-Off (NB: Toe Brakes)
- U Undercarriage (Fixed)
- P Power Set Full
- M Mixture Full Rich
- F Fuel Pump Off: Pressure in Green
- F Flap Retract
- = Trim For Best ROC 85 MPH
- E Electric – LL off
- I Engine temps / Press Instruments

ENGINE RUN UP/SYSTEMS CHECK

- Park Brake
 - Oil Press / Temp
 - Fuel Pump
 - Fuel Selector
 - Fuel Pump off
 - Throttle
 - Brakes
 - Oil Press/Temp
 - Carb. Heat
 - Mixture Control
 - Magnetos
 - Gyro Suction
- On
- Check in Green
- On
- Fulltest Tank
- Check pressure
- Set 2000 rpm
- Check Holding
- Check in Green
- Check / Then Off
- Lean/Then Full Rich
- Check / Then Both
- Check (4 ½ to 5 ½)

ENGINE RUN UP/SYSTEMS CHECK

Continued

- Oil Press/Temp
- Slow Idle
- Check in Green
- 650 to 750 rpm

DOWNWIND VITAL ACTIONS

- Radio Call
- BUMPPF Checks
- B Brakes On-Off Check Pressure / Park Brake off
- U Undercarriage (Fixed)
- M Mixture Full Rich
- P Power Set 2200 – 2300 RPM
- F Fuel Pump On – Pressure Green –
Fullest Tank Selected
- F Flap 1st Notch
= *Trim for Level Flight*

BASE LEG VITAL ACTIONS

- ⇒ Carburettor Heat On
- ⇒ Power Set 1700 RPM
- ⇒ Flap Select 2nd Notch
- ⇒ Airspeed 90 MPH
= *Trim*

FINAL APPROACH VITAL ACTIONS

- ⇒ Radio Call
- ⇒ Carburettor Heat Off
- ⇒ Landing Light On
- ⇒ Flaps as Required
- ⇒ Power as Required
= *Trim correct approach speed*

AFTER LANDING (RUNWAY VACATED)

- ⇒ Park Brake ON
- ⇒ Transponder OFF
- ⇒ Fuel Pump OFF
- ⇒ Landing Light OFF
- ⇒ Mixture LEANED FOR TAXI
- ⇒ Flaps RETRACT
- ⇒ Trim NEUTRAL
- ⇒ Power 1700 RPM
- ⇒ Magnetos CHECK L & R
- ⇒ Throttle 1000

Taxi to Dispersal (Parking) Refuel as Required

SHUTDOWN

- ⇒ Park Brake ON
- ⇒ Avionics OFF
- ⇒ Power 800 rpm
- ⇒ Magnetos DEADCUT (Not at Fuel Bay)
- ⇒ Power Set 1000 RPM
- ⇒ Mixture Idle CUT OFF
- ⇒ Electrics OFF
- ⇒ Magnetos OFF / KEY OUT
- ⇒ Master Switch OFF
- ⇒ Flight Controls SECURE (If Strong Wind)
- ⇒ Park Brake OFF
- ⇒ Chocks IN (If Supplied)

POST FLIGHT DUTIES

- Flight Folio Completed
- (Snags Recorded if Any)
- Controls Secured
- Post Flight Inspection
- Complete Authorisation Sheet
- Check Next Booking
- (De-Brief with Instructor)
- Complete Personal Log Book

AIR EXERCISE BRIEFING

EXERCISE 1: 1E : 2 : 3

EXERCISE 1	EXERCISE 1E	EXERCISE 2	EXERCISE 3
AIRCRAFT SYSTEMS	EMERGENCY DRILLS	PREPERATION FOR AND ACTION AFTER FLIGHT	AIR EXPERIENCE
<p><u>DURATION 2HRS : IN A/C ON THE GROUND</u></p> <ul style="list-style-type: none"> Use published pre-flight checklist from POH and conduct a thorough walk around A/C with the instructor explaining the reason for each check and how it affects the A/C in the air and on the ground. Stress the importance of proceeding anti-clockwise around the A/C to ensure no item is overlooked. <ul style="list-style-type: none"> ➢ Demonstrate how to step on and off the wing to enter the A/C ➢ Enter the cockpit and ➢ Discuss the 'flow' method of cockpit checks and the reasons for the checks. This must include the aircraft documentation and flight folio checks. Discuss the instrument panel layout, How each instrument operates and the differences between: <ul style="list-style-type: none"> ➢ Flight Instruments, ➢ Engine Instruments, ➢ Radios, ➢ Flight Controls, ➢ Electrical switches, ➢ Operation of park brake and toe brakes Discuss seat adjustment, use of seatbelts, necessity to sit at the correct height & use of cushion to assist visibility over the A/C nose cowl. Discuss use of fire extinguisher. Discuss first aid kit and strips. Discuss and demonstrate ventilation controls. Discuss and demonstrate door latching and unlatching from outside and from inside. 	<ul style="list-style-type: none"> Action in the event of fire in the air and on the ground. Discuss how to identify from smoke colour whether the fire is caused by Fuel / Oil / Electrical. Discuss the appropriate checklist for each as published in POH and AIC. Discuss "MAYDAY" and "PAN" call. Discuss the: <ul style="list-style-type: none"> ➢ Symptoms of the fault; ➢ The cause of the fault; ➢ The possible result of the fault; ➢ The corrective action required. Discuss use of fire extinguishers outside the aircraft and inside the aircraft. 	<ul style="list-style-type: none"> Flying clothing and footwear. Flight authorization and aircraft acceptance. Discuss the siting of the A/C for start and taxi. Detailed internal and external pre flight checks. Start and warm up. Power Checks. Actions for shutdown and leaving the aircraft. Completion of documents after flight. 	<p>This flight is to introduce the student to the sensation of flying and the totally new aspect of the ground when seen from the air.</p> <ul style="list-style-type: none"> ➢ Point out the sensation of speed in relation to the ground. ➢ The change in interpreting height and distance from objects. ➢ Use of horizon as primary attitude reference. The "4 Finger" attitude. ➢ Effects of turbulence on the A/C (if applicable). ➢ Importance of looking out for other aircraft using the clock code method. ➢ Demonstrate, with the student following through on the controls, how small control inputs affect the A/C attitude. ➢ Patter checks and procedures while you fly to focus the students attention where applicable. ➢ <u>Do not show off</u> ➢ Use the session to assess the individual students temperament and reaction to flying. ➢ Return to base immediately if the student shows any indication of nausea.
		<p style="text-align: center;"><u>IMPORTANT</u></p> <ul style="list-style-type: none"> It will not be possible for your student to remember or absorb all this information at once. Introduce most relevant items first and allow student to practice until proficient before moving on. Continuously supervise and check the students progress until proficient. 	

AIR EXERCISE BRIEFING

EX 4: EFFECTS OF CONTROLS

DEFINITION: This exercise is an introduction to the aircraft controls, how they operate and how they affect the aircraft in flight.

(By now your student will have completed cockpit and aircraft familiarization, the pre-flight checks and familiarization with the signing out process and an introductory flight.)

STEP ONE	STEP TWO	STEP THREE	STEP FOUR	STEP FIVE
<p><u>Air Exercise Briefing Summary</u></p> <p><u>Discuss:</u></p> <ul style="list-style-type: none"> Primary Flying Controls: <ul style="list-style-type: none"> Elevator Aileron Rudder Flaps Trim – Elev/Rudder Effect of air speed. Effect of slipstream Effect of torque Effect of configuration changes. Cockpit ventilation. Procedures to route to GFA. Procedures routing back to FAPA Use of Horizon “4 Finger Attitude” as the primary Attitude reference. <ul style="list-style-type: none"> Clock code method of looking out. 	<p><u>Sign Out / Taxi</u></p> <ul style="list-style-type: none"> <u>OPS NOTAMS:</u> <ul style="list-style-type: none"> RWY in use QNH Wind Velocity / Direction WX Forecast <u>SIGN OUT as per individual A/C</u> <ul style="list-style-type: none"> A/C Keys A/C Checklist Cushion if Required Student Account Number Previous Hobbs Entry NB: Student involvement. <u>PRE-FLIGHT CHECKS</u> <ul style="list-style-type: none"> As per checklist To be completed 15min prior to slot time if A/C on the ground. NB: Student involvement. <u>Start and Taxi</u> <ul style="list-style-type: none"> Apron Radio 122-85 for start, RWY in use QNH: GFA Sector. AFIS Radio 122-00 for taxi & T’off Engine start as per checklist. NB: Student involvement. <u>Departure Clearance:</u> <ul style="list-style-type: none"> GFA sector Procedure leaving circuit Procedure entering GFA Reporting points Sector Boundaries 	<p><u>Departure to GFA</u></p> <p>NB: Student follow through</p> <ul style="list-style-type: none"> Line up on RWY On RWY checks Take-off Climb out Routing to sector Climb to altitude in sector. Sector Boundaries Leveling off and setting up A/C for S&L Flight. 4 Finger attitude horizon reference point Trimmed “Hands Off” 	<p><u>Air Exercise Patter</u></p> <ul style="list-style-type: none"> Commence patter as per Patter Manual Lookout T’s & P’s “4 Finger” Attitude Easily recognisable reference point ahead of A/C Hands & Feet on, “follow me through” “You have control”, “I have Control” Corrective Patter <ul style="list-style-type: none"> Re-Demo Re-Try <p><u>Note:</u></p> <ul style="list-style-type: none"> Do not hurry the exercise. Ensure the student understands the need for smooth control inputs Ensure the student can hear you clearly (Turn down the radio volume so that unwanted radio chatter is just loud enough for you to recognize but not loud enough to override your patter). Remember – The cockpit is a poor class room. Ex 4 can take 2-3 lessons for the student to be competent. 	<p><u>Return to FAPA</u></p> <ul style="list-style-type: none"> Return to airfield <ul style="list-style-type: none"> Reference points & ground features Altitudes and radio calls Entering circuit Final Approach & Landing After Landing checks Parking and/or refueling Shutdown Flight folio record keeping Securing the aircraft Post Flight External check Completion of Flight authorization sheet Key return De-Brief File Entries & Signatures Next Lessons’ homework

REMEMBER:

- You have done this many times!
- Your student has **NEVER** done this.
- Don’t over load your student.
- Be patient – Repeat where necessary
- Don’t over patter.
- *Allow the student to fly!*

FLIGHT EXERCISE BRIEFING

EXERCISE 5 TAXYING

DEFINITION: Taxying is the process whereby the aircraft is controlled on the ground under its own power by the independent of combined use of rudder pedals, brakes, flying controls and engine thrust.

AIM: To teach the student the applicable procedures and checklists; aircraft handling techniques; considerations of airmanship, marshalling signals, right of way rules and engine handling.

STARTING	MANOEUVERING	STOPPING/PARKING
<ul style="list-style-type: none"> <u>WALKING TO THE AIRCRAFT</u> <ul style="list-style-type: none"> ➤ Check parking position. ➤ Check obstruction I.R.O. of taxiing to runway in use. ➤ Plan most viable route. <u>PRE-FLIGHT CHECKS AND ENGINE START AS PER POH & MOP</u> <u>OBTAIN TAXI INSTRUCTIONS</u> <u>LEAVING THE APRON AREA</u> <ul style="list-style-type: none"> ➤ Careful lookout all around for pedestrians, vehicles, fences, walls, poles, signboards, other taxiing and stationary aircraft. ➤ Apply sufficient power to move away from your parking place then reduce power, apply toe brakes sufficient to check brake pressure and effectiveness. ➤ Maintain elevator and ailerons neutral (or as required for prevailing wind conditions and surface conditions.) ➤ <u>APPLY SUFFICIENT POWER TO MAINTAIN A FAST WALKING PACE</u> – anticipate power reduction / increase ahead of downhill / uphill topography or stopping. ➤ Maintain direction using toe / foot movements on rudder pedals. <u>LOOKOUT AND AIRMANSHP</u> <ul style="list-style-type: none"> ➤ Maintain a vigilant lookout at all times and a “Listening watch” on the radio. 	<ul style="list-style-type: none"> <u>RIGHT OF WAY RULES</u> <ul style="list-style-type: none"> • Always pass oncoming traffic on the right (you sit in the L/H seat and have a clear view of your wingtip and separation from the oncoming traffic wingtip. • Give way to larger aircraft. • Stop if you are unsure and ask ATC for further guidance or instructions. • Do not cross a solid yellow line without stopping and looking. • Do not cross a holding point line without stopping and looking out. • Maintain taxiway centreline whenever possible. • Obey ATC instructions. • Listen out and fully read back. <u>USE OF CONTROLS</u> <ul style="list-style-type: none"> • <u>POWER:</u> <ul style="list-style-type: none"> ➤ Moving from grass to a hard surface, reduce power. ➤ Moving from a hard surface to a grass, increase power. ➤ Anticipate increasing power when moving uphill. ➤ Anticipate reducing power when moving downhill. ➤ When turning in a confined space do not use excessive power against brakes. ➤ Minimise high power settings when moving away from buildings – rather manhandle the aircraft to a point where propeller blast will not affect persons or aircraft behind – Don’t ‘jockey’ the throttle, try to maintain smooth inputs. • <u>ELEVATOR:</u> Hold control column fully back to protect the nosewheel OLEO, steering mechanism and propeller when taxiing on rough ground. • <u>AILERON:</u> Study POH for aileron position in strong wind. Turn away from wind from behind, turn into wind from the front. • <u>RUDDER:</u> Only apply full rudder deflection when absolutely necessary as this can stress the nose wheel OLEO and steering mechanism. In extreme cases shut down and use a tow bar if practical. • <u>BRAKES:</u> Always centralise rudder pedals and apply brakes evenly with light pressure and progressively increase the pressure as the aircraft slows. 	<ul style="list-style-type: none"> <u>VACATING THE RUNWAY</u> <ul style="list-style-type: none"> • Expedite vacating the runway onto the designated taxiway and continue forward on the taxiway until you are 100’ from the runway centreline. Turn 45° into wind centralise the rudder pedals and stop. Apply handbrake. <u>CARRY OUT AFTER LANDING CHECKS AS PER POH AND MOP.</u> <u>CONTINUE TAXI TO PARKING AREA OR AS DIRECTED.</u> <ul style="list-style-type: none"> • Maintain a vigilant lookout for other A/C vehicles, obstacles etc. • Maintain a listening watch on the radio in case of any command to stop or change direction. • Be particularly vigilant when crossing a runway or taxiway. Stop and Lookout. • When the parking area is visible plan your route to be able to park your aircraft with minimum power / control inputs. • Be very aware of pedestrians, children, other starting or taxiing traffic, workmen and obstruction. • Shutdown as per POH & MOP. Secure the aircraft (refuel as required). • Complete flight documents.

AIR EXERCISE BRIEFING

EX 6: STRAIGHT AND LEVEL FLIGHT

DEFINITION: Straight and level flight is that condition of flight whereby the aircraft is flown in balance at a constant altitude and direction at varying speeds, power settings and configurations with reference to both visual and instrument attitude indications.

HOW IT APPLIES TO FLYING

- 1) Navigation
- 2) Circuit Work
- 3) Forms the basis for attitude flying
- 4) Instrument Flying
- 5) Flying for range and endurance

STEP ONE	STEP TWO	STEP THREE	STEP FOUR
STRAIGHT & LEVEL ATTAINING & MAINTAINING	STRAIGHT & LEVEL REGAINING AFTER DISTURBANCE	STRAIGHT & LEVEL CONFIGURATION CHANGES	STRAIGHT & LEVEL INSTRUMENT INDICATIONS
<p style="text-align: center;"><u>AIRMANSHIP</u></p> <ul style="list-style-type: none"> Lookout <ul style="list-style-type: none"> ➢ Other Aircraft ➢ Orientation in GFA ➢ Trimmed "HANDS OFF" Smooth control inputs FREDAS checks <p>Briefly Discuss:</p> <p>1. Equilibrium</p> <ul style="list-style-type: none"> Thrust Drag Lift Weight <p>2. Correlation of:</p> <div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center;"> <p>PWR + ATT = PERFORMANCE</p> <p>POWER ATTITUDE SPEED TRIM</p> </div> <div style="font-size: 3em; margin: 0 10px;">}</div> <div style="text-align: center;"> <p>CHANGE CHECK HOLD ADJUST TRIM</p> </div> </div> <p>3. Lift Formula Correlation of:</p> <ul style="list-style-type: none"> AoA vs Airspeed. Changes in nose attitude. Use of Trim. <p>4. Horizon as Primary attitude reference</p> <ul style="list-style-type: none"> Use of distinct focus point ahead of A/C to maintain direction. Use of "Four Finger" attitude to maintain altitude. Use of trim <ul style="list-style-type: none"> ➢ Elevator ➢ Rudder 	<p style="text-align: center;"><u>WIND DRIFT</u></p> <ul style="list-style-type: none"> Identifying drift direction using horizon reference point as indicator. Application of co-ordinated aileron + rudder to turn into wind. Stabilising A/C in new attitude. Re-assessing drift correction. Adjustments as required. <p>Turbulence</p> <ul style="list-style-type: none"> Lateral and vertical disturbance. Use of horizon reference to restore A/C to original position. Use of elevator, aileron & rudder to achieve correction. Retrim if required. <p><u>ACHIEVING S&L AFTER CLIMB</u> Attitude, Speed, Power, Trim</p> <p><u>ACHIEVING S&L AFTER DESCENT</u> Power, Attitude, Speed, Trim</p>	<p style="text-align: center;"><u>POWER CHANGES</u></p> <ul style="list-style-type: none"> Effect of slipstream & Torque. Effect of speed changes. Effect of CL changes. Use of Trim. <p><u>Configuration Changes</u></p> <ul style="list-style-type: none"> Effect of flap <ul style="list-style-type: none"> ➢ Attitude Change ➢ CL change ➢ Speed Change (NB. Use constant power setting) Effect of flap & Power <p><u>Effect of Altitude & Density Altitude</u></p> <ul style="list-style-type: none"> Less power available. Terminal velocity change. Less lift. Higher nose attitude. More lift induces drag. Longer T'off distance required. Longer landing distance required. <p><u>Flying for endurance</u></p> <p><u>Flying for Range</u></p>	<p style="text-align: center;"><u>ATTITUDE INSTRUMENTS</u></p> <ul style="list-style-type: none"> Artificial horizon <ul style="list-style-type: none"> ➢ Indicates Pitch and Roll (bank) ➢ Indicates specific bank angle. Turn co-ordinator <ul style="list-style-type: none"> ➢ Indicates balance. ➢ Indicates rate of change of direction. Altimeter <ul style="list-style-type: none"> ➢ Indicates Altitude in 1000' & 100' VSI – Vertical speed indicator <ul style="list-style-type: none"> ➢ Indicates ROC ➢ Indicates ROD Airspeed Indicator <ul style="list-style-type: none"> ➢ Indicates speed of A/C through the air. ➢ Can be adjusted for Density altitude to indicate true airspeed. Tachometer (Revolutions per minute) <ul style="list-style-type: none"> ➢ Indicates speed of rotation of crankshaft. ➢ Indicates max RPM limit. ➢ May indicate RPM caution range.

AIR EXERCISE BRIEFING

EXERCISE 7 / EXERCISE 8 CLIMBING AND DESCENDING

CLIMBING DEFINITION:

Climbing is a condition of flight where the aircraft gains potential energy by virtue of elevation using excess power available above that required for level flight. The aircraft is in equilibrium at a specific airspeed and/or rate of climb, and in balance.

DESCENDING DEFINITION:

Descending is a reduction in altitude at a specified airspeed and/or rate of descent using the appropriate power settings, with the aircraft in balance maintaining a constant heading, with reference to both visual and instrument attitude indications.

HOW IT APPLIES TO FLYING:

- 1) Navigation 2) General Flying 3) Take off and go-around 4) Spinning and Aerobatics
5) Circuit Work 6) Instrument Flying

STAGE ONE: ENTERING THE CLIMB	STAGE TWO: LEVELING OUT FROM CLIMB: ENTRY INTO DESCENT		STAGE THREE: MAINTAINING DESCENT: LEVELING OUT
<div>ENTRY</div> <div>MAINTAINING</div> <div>SAFETY</div> <ul style="list-style-type: none">Lookout ahead, above and to either side.Check T's & P's. Fuel pump on.Use of mnemonics.PAST / CCHAT <div><div>POWER ATTITUDE SPEED TRIM</div><div>→ ←</div><div>CHANGE CHECK HOLD ADJUST TRIM</div></div> <div>CONTROL INPUTS</div> <p>From level FLT at 80% Power:-</p> <ul style="list-style-type: none">Apply full power.Raise the nose into the climb attitude.Check & Hold this attitude until the speed stabilises.Adjust the nose up to reduce speed or lower the nose to increase speed.Trim the A/C "Hands off"Monitor instruments for accuracy. <div>LOOKOUT: ± every 500' lower the nose briefly to check for traffic either side and above ahead of the A/C</div>	<div>LEVELING OUT</div> <div>SAFETY</div> <ul style="list-style-type: none">Lookout50 ft prior to selected altitude—Lower the nose into level flight.Allow the A/C to accelerate to cruise speed.Attitude – levelSpeed – cruisePower – set for cruiseTRIM – "Hands Off".	<div>START DESCENT</div> <div>SAFETY LOOKOUT</div> <ul style="list-style-type: none">Power – set power for descent.Attitude – maintain level flight until speed correct for descent.Speed – correct for descent lower the nose.Trim – maintain speed & trim "Hands Off".	<div>MAINTAINING</div> <div>LEVELING OFF</div> <div>SAFETY LOOKOUT</div> <ul style="list-style-type: none">Traffic ahead and below and to either side. <div>MAINTAIN DESCENT CONTROL INPUTS</div> <ul style="list-style-type: none">Keep straight towards a point on the ground using rudder & aileron co-ordination.Maintain rate of descent using power.Maintain speed using elevator.Monitor instruments for accuracy. <div>LEVELING OFF CONTROL INPUTS</div> <ul style="list-style-type: none">Carburetor heat off ± 100' ABOVE selected altitude.50' ABOVE selected altitude start applying full power and raise nose to level flight.Power – FullAttitude – Raise nose to level flight attitude.Speed – Allow to accelerate to cruise speed & reset power for cruise.Trim – "Hands Off"Monitor instruments for Accuracy.
	<div>INSTRUMENT INDICATIONS</div> <div><div>ASI</div><div>A/H</div><div>ALT</div><div>T/C</div><div>DI</div><div>VSI</div><div>RPM</div></div>		

FLIGHT EXERCISE BRIEFING

EXERCISE 9
TURNING

DEFINITION: A turn is a change of direction at a specified angle of bank, in level flight, climbing or descending, whilst in balance at a constant rate. (Medium level turns 30° AOB; Climbing & Descending turns 15° AOB; steep turns 45° + AOB)

HOW IT APPLIES TO FLYING:

- 1) To change direction in flight
- 2) In the circuit
- 3) Navigation turning points
- 4) Advanced turning – steep and maximum rate turns – minimum rate turns
- 5) Aerobatics
- 6) Instrument flying at night and in letdowns.

ENTRY	MAINTAINING	ROLLING OUT
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SAFETY:

- Check seats locked in position
- Check shoulder harness and straps tight.
- Check sufficient altitude and in correct G.F. Sector

ENGINE:

- Check fuel selected to fullest tank. Fuel pump on, then off when changing tanks.
- T's & P's in green.
- Throttle as required.

AIRFRAME

- Aircraft configured as required e.g flap, power, under carriage etc.

LOOKOUT

- From wingtip to wingtip & behind the aircraft in the direction of the turn.

CONTROL INPUTS

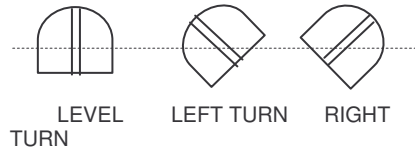
- Select a prominent point ahead of A/C as reference
- Using ailerons in co-ordination with rudder roll the A/C to the desired angle of bank and centralize aileron and rudder. In level turns apply control back pressure to maintain altitude (without trimming).
- Monitor instruments for accuracy.

Carry out a combination of visual & instrument checks

- Visual: (From L/H seat)

L/H Turn R/H Turn
Horizon Position Horizon position

EXAMPLE



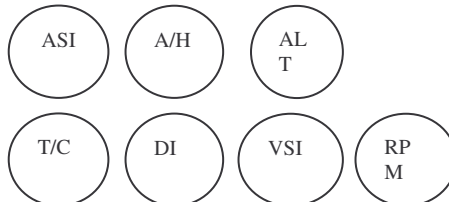
MEDIUM
LEVEL TURN 30° AOB

- Constant rate of change of direction along horizon.
- Constant angle of bank.
- Not climbing: not descending.
- Lookout in direction of turn.

INSTRUMENT CHECKS

- Check angle of bank on A/H
Look back at horizon.
- Check balance ball centered
Look back at horizon
- Check VSI & altimeter
Look back at horizon.

MONITOR INSTRUMENTS



ANTICIPATE

± 10° before reference point.

- Apply co-ordinated aileron and rudder,
- Roll wings level.
- Centralize aileron & rudder.
- Reduce back pressure to avoid climbing during rollout (4 finger)
- Set power and trim as required.

COMMON FAULTS

- Not centralizing rudder in co-ordination with aileron (or vice versa).
- Not maintaining AOB accurately –
Decreasing AOB: rate of direction change slows down.
Increasing AOB: rate of direction change increases.
- Not maintaining level flight during turn.
- Not anticipating the effect of slipstream & torque L/H & R/H turns.
- Leading into (and out of) turns using rudder – ball out.
- Un-co-ordinated aileron / rudder input.

FLIGHT EXERCISE BRIEFING

EXERCISE 10A **SLOW FLIGHT**

DEFINITION: Flight at any airspeed below the normal operating range of the aircraft

HOW IT APPLIES TO FLYING:

- 7) Maneuvering in the circuit.
- 8) Going around from an aborted landing approach.
- 9) Forced landing procedure.
- 10) Precautionary landing procedure.
- 11) Engine failure after take off.
- 12) Short field landing.
- 13) Sightseeing at low level.
- 14) Unmanned joining procedure

EFFECT OF CONTROLS: SLOW FLIGHT	MANOEUVERING	MANOEUVERING CONTINUE
<ul style="list-style-type: none"> Ailerons can be very ineffective. Adverse aileron yaw is far more pronounced. Rudder effectiveness reduced: may need greater deflection. Elevator less effective. Flying at a higher angle of attack can produce more down wash over the tail plane. Slipstream & torque effect is more pronounced – changes in power will have a more noticeable yawing effect. Raising & lowering flap is more critical – Do not raise flaps if the airspeed is below V_{s1}. (Speed at bottom of green arc). 	<ul style="list-style-type: none"> From S&L flight set up slow flight at $V_{s1} + 10$ mph. Applicable procedure & checks. Lookout Note the change in nose attitude and reduced control response. <p>CLIMBING from S&L $V_{s1} + 10$ mph configuration initiate a climb at a nominated rate and increase power to maintain the climb rate at $V_{s1} + 10$ knots. NOTE the control inputs required to stabilize the climb.</p> <p>TURNING from slow flight at $V_{s1} + 10$ mph enter a medium level turn (30° AOB).</p> <p>NOTE the decrease in airspeed & higher pitch attitude to maintain a level turn and use of power to maintain the turn.</p> <p>DESCENDING from slow flight at $V_{s1} + 10$ mph nominate a rate of descent. Reduce power and enter the descent. Stabilize at nominated ROD. Return to S&L $V_{s1} + 10$ knots.</p> <p>Heading / Speed / ROD / Balance To be maintained throughout.</p>	<p>Repeat previous manoeuvres at $V_{s1} + 5$ mph. NB 4000' AGL</p> <p>NOTE specifically almost continuous stall warning indications and necessity for carefully and smoothly applied control inputs to maneuver the aeroplane.</p> <p>Repeat the previous manoeuvres at $V_{s0} + 10$ & $V_{s0} + 5$ mph with two notches of flap</p> <p>NOTE specifically the lower nose attitude and absence of stall warning light.</p> <p>NB: Do not raise the flaps if the airspeed is below V_{s1} i.e. bottom of green arc.</p>
		CONCLUSION
		<ul style="list-style-type: none"> Point out the effectiveness of flap at low airspeed reducing the possibility of stalling. Stress the importance of smooth progressive control inputs to assist stability. Point out the inherent dangers of slow flight at low height above ground. Point out the impact turbulent conditions could have, maneuvering the A/C in slow flight.

FLIGHT EXERCISE BRIEFING

EXERCISE 10B STALLING

DEFINITION: Stalling is a condition of flight where the angle between the wing and the relative airflow reaches or exceeds the critical angle of attack causing the airflow to break away resulting in a loss of lift, loss of altitude and a pitching moment

An aircraft can stall at any airspeed, attitude, power setting, weight, loading or configuration.

AIM: To learn how to recognize the symptoms and characteristics of the stall and then the recovery procedure with minimum height loss.

DISCUSS: The parameters upon which the POH stall speed is derived.

ENTRY	SYMPTOMS AND CHARACTERISTICS	RECOVERY
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DOC NO: DP/FTD/TS/05/009	317	
REV NO: 07	DATE AMENDED: 26 October 2009	Flight Instructors Training Procedures

<p>Based on a power off, clean configuration stall from level flight, recovery with power.</p> <p><u>SAFETY</u> HASELL Checks:-</p> <ul style="list-style-type: none"> • <u>HEIGHT</u> Must be able to enter and recover onto an even keel by 2000' AGL. • <u>AIRFRAME</u> Flaps Retracted (Piper 140/180) • <u>SECURITY</u> Loose articles secured, seatbelts tight, Seats locked in position. • <u>ENGINE</u> T' and P's; Fuel pump on, select fullest tank. • <u>LOCALITY</u> Not in controlled airspace Not over built-up area. Not over gathering of people Not over mountains Not over large expanse of water Not over Airfield Must be in GFA • <u>LOOKOUT</u> Other A/C Position of sun. Position of wind. Position of GFA • <u>LANDING FIELD</u> Must identify a suitable field for a forced landing within easy gliding distance. • <u>LOOKOUT TURN</u> 360° change of direction or 180°. <p><u>ENTRY</u></p> <ul style="list-style-type: none"> • Carburetor heat on. • Reduce power to idle. • Maintain level flight by gradually raising the nose to maintain the same value of lift as speed decreases until the critical angle of attack is reached. • Ailerons neutral throughout. • Use rudder to maintain wings level. 	<p><u>SYMPTOMS</u></p> <ul style="list-style-type: none"> • High nose attitude • Low airspeed • Low noise level • Sloppy Controls • Stall warning • Buffet <p><u>CHARACTERISTICS</u></p> <ul style="list-style-type: none"> • Nose Down Pitching moment • Loss of altitude <p><u>IMPORTANT</u></p> <p>The following stalls are to be demonstrated and then flown by the student.</p> <ul style="list-style-type: none"> • Stall in approach configuration 1700rpm, 2 notches flap. • Stall during a steep turn at V_{so} +10. • Stall from a mishandled climbing turn to the right (power 2100 rpm, 15°AOB, speed 85mph – progressively increase aileron into the turn, hold off bank with opposing rudder and progressively raise the nose until the stall and the outside wing drops) • Stall power off, clean configuration and recover to level flight with full power as soon as the stall warning alarm is activated. • Discuss attitude differences and recovery techniques for each, noting the height loss in each. • Emphasis to be placed on achieving minimum height loss with each recovery without compromising safety and smoothness of control inputs. 	<ul style="list-style-type: none"> • Lower the nose by moving the control column briskly forward to the neutral position. • Maintain ailerons neutral. • Use rudder to correct any wing drop. • As airspeed increases to V_{ref} (1.3 x stall speed) raise the nose just above the horizon and ... <ul style="list-style-type: none"> ➤ Simultaneously apply full power. ➤ Climb back to entry altitude. ➤ Carry out after take-off checks. ➤ Carry out HELL checks. ➤ Note the height loss after recovery. <p><u>COMMON FAULTS</u></p> <ul style="list-style-type: none"> • Students preconceived fear of stalling. • Tenseness on controls. • Over controlling the nose up attitude entering the stall. • Using aileron to pick up wing drop. • Applying abrupt and steep nose down attitude in recovery and applying power with the nose down resulting in an excessive and unnecessary height loss. • Do not rush the checks. • Carry out after take-off checks. • Always climb back to entry altitude and carry out "HELL" checks and vital actions.
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FLIGHT EXERCISE BRIEFING

EXERCISE 11 SPINNING AND SPIN AVOIDANCE

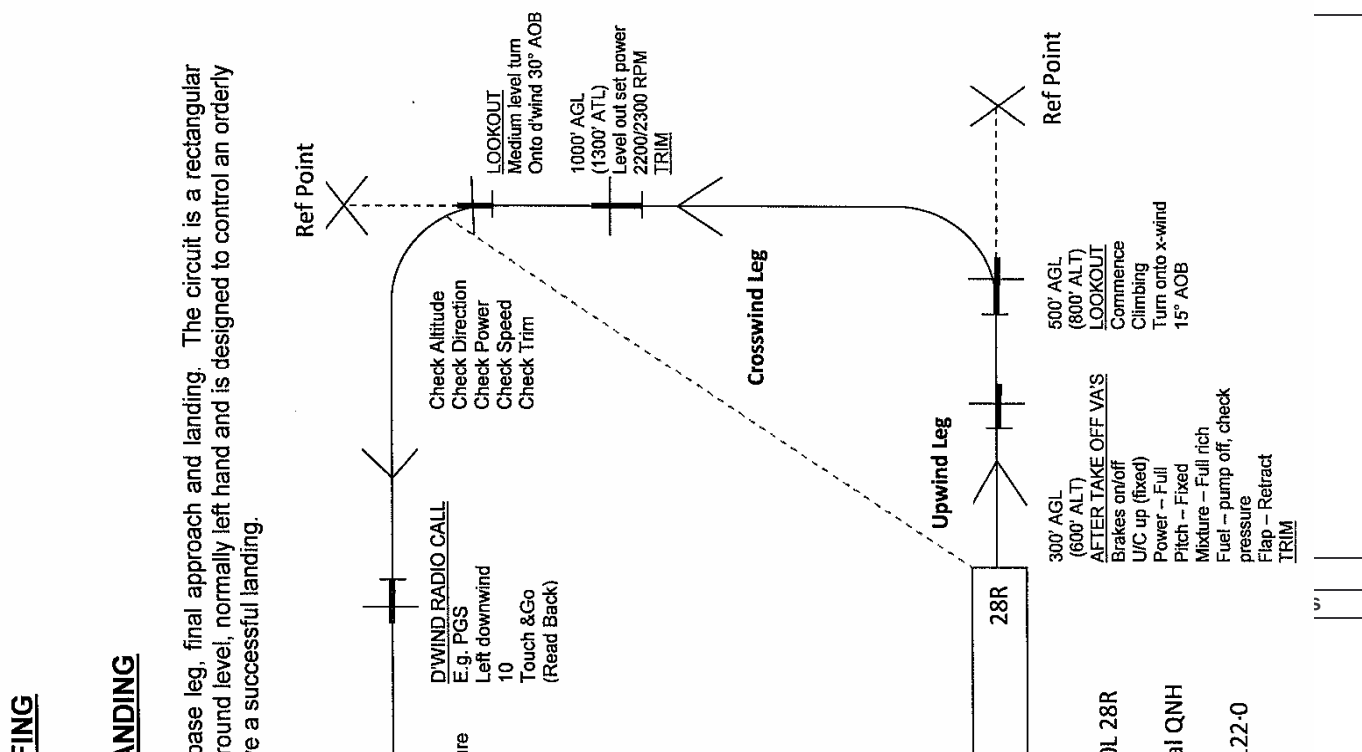
DEFINITION: A spin is the condition of flight where the aircraft is in autorotation which causes yawing, rolling and pitching moments resulting in the aircraft following a spiral path at a steady rate of descent.

AIM: To provide the student with the knowledge to recognise the conditions leading up to a spin and the correct application of controls to recover from the spin.

This improves the students confidence and co-ordination knowing that he/she can recover from the spin which is the worst aerodynamic situation resulting from mishandling the controls.

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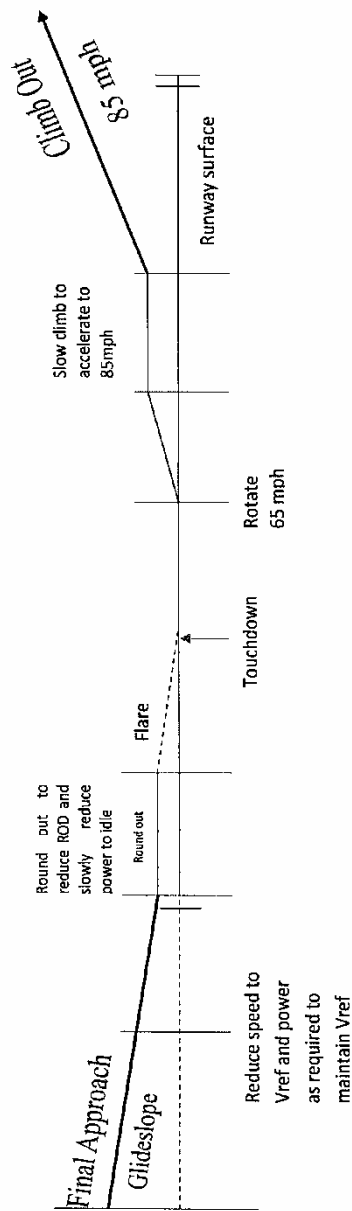
ENTRY	CHARACTERISTICS	RECOVERY
<p>IMPORTANT:</p> <p>This lesson is based on a deliberately induced erect spin to the left. (Piper Cherokee 140)</p> <p>SAFETY:</p> <ul style="list-style-type: none"> ➤ Calculate weight and Balance for utility category manoeuvre. ➤ Carry out HASELL checks ➤ Line up overhead a distinct line feature e.g. coastline. <p>Height is calculated according to the specific aircraft type spin characteristics.</p> <p><u>E.g. PA28.140 loses 500' for each rotation of spin.</u></p> <p>(A spitfire fighter loses 5000' for each rotation . A fighter jet can lose up to 20 000' before recovery)</p> <p>CONTROL INPUTS:</p> <ul style="list-style-type: none"> • Reduce speed in level flight, power off, clean configuration to ± 75 MPH • Simultaneously and abruptly apply <u>FULL LEFT RUDDER</u> and <u>FULL UP ELEVATOR</u> and hold the controls <u>FULLY</u> against the stops. • The aircraft will pitch nose up (STALL) and yaw (LEFT WING WILL STALL AND DROP) causing autorotation. <u>HOLD THE CONTROLS FULLY DEFLECTED.</u> 	<p>BASED ON CHEROKEE 140 TWO ROTATION SPIN</p> <ul style="list-style-type: none"> • Steep nose-up pitch initially followed by wing drop to the left. • Low airspeed. • Nose rapidly pitches down yawing towards the left wing as autorotation starts. • The first rotation accelerates as the first 360° change of direction is completed. • The second rotation is considerably faster with a near vertical nose down attitude. • The airspeed is relatively low. 	<p>Since the aircraft is stalled and yawed (Autorotation) we need to stop the yaw and unstall the aircraft.</p> <p>The following is based on the standard recovery procedure placarded in the Cherokee 140.</p> <ul style="list-style-type: none"> • Confirm power off. • Ailerons neutral. • Apply <u>FULL OPPOSITE RUDDER</u> to the direction of rotation and ... • Apply positive forward movement of the control column <u>TO THE CENTRE POSITION.</u> <p><u>Do not</u> apply control column fully forwards as this will induce inverted flight!</p> <ul style="list-style-type: none"> • As rotation stops centralise rudders and simultaneously ease the A/C out of the dive. • As the nose cuts the horizon check the airspeed is below 100mph and apply full power. • Climb back to entry altitude and carry out after take-off and HELL checks. <p>Note: The height loss</p>



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FLIGHT EXERCISE BRIEFING
EXERCISE 13
TOUCHDOWN PROFILE (TOUCH AND GO LANDING)

Approach – Hold off – Flare – Touchdown Profile
 Accelerate – Rotate – Accelerate to 85mph climb out
 (Page 2 of 3)



AIR EXERCISE BRIEFING
EXERCISE 12E: 13E
CIRCUIT EMERGENCIES
(Page 3 of 3)

TAKE-OFF EMERGENCIES	CROSS WIND/DOWNWIND EMERGENCIES	BASELEG EMERGENCIES	FINAL APPROACH EMERGENCIES	LANDING EMERGENCIES
<p><u>DURING TAKE-OFF ROLL</u></p> <ol style="list-style-type: none"> 1. Loss of directional control. 2. Power Loss. 3. U/S airspeed indicator. 4. Door opens. 5. Runway incursion; pedestrian, vehicle, aircraft, animals. 6. Throttle jams during touch and go. 7. Undercarriage collapse/ flat tyre. 8. Strong wind gust causing direction control loss. <p><u>AFTER AIRBORNE</u></p> <ol style="list-style-type: none"> 1. Engine failure* 2. Door opens. 3. Loss of fuel pressure. 4. Loss of oil pressure. 5. Flap won't retract. <p>* If the engine fails with sufficient runway ahead to land:-</p> <ol style="list-style-type: none"> 1. Adjust attitude for glide and speed. 2. Flap as required. 3. Land straight ahead. 4. Apply maximum safe braking. 5. Vacate runway if possible. 	<p><u>CROSSWIND</u></p> <ul style="list-style-type: none"> • Traffic conflict. • Stuck throttle. • Door opens. • Engine problems. <p><u>CORRECTIVE ACTION</u></p> <ul style="list-style-type: none"> • <u>Traffic Conflict</u> Give way to traffic ahead and to the right by spacing your aircraft to maintain safe separation. • <u>Stuck throttle</u> – use mixture control as the throttle. Make a full stop landing. • <u>Door Opens</u> If the door opens continue the circuit and make a full stop landing, vacate the runway and rectify the problem. Thereafter continue with training. • <u>With engine problems</u> request a priority landing on nearest safe runway into wind. <p><u>DOWNWIND</u></p> <p>As for crosswind plus –</p> <ul style="list-style-type: none"> • Flapless approach in PA28 140/180 set power to 2000RPM – maintain level flight until airspeed ± 90 – 100MPH TRIM for higher nose attitude with speed 90MPH – Continue the approach and land. 	<ul style="list-style-type: none"> • Traffic conflict. • Flap extension problems. • Stuck throttle. <p><u>CORRECTIVE ACTION</u></p> <ul style="list-style-type: none"> • <u>For traffic Conflict</u> Extend the downwind and re-position behind conflicting traffic on base leg. This may necessitate re-configuration of the power/speed/TRIM, until ready to join base leg. Being further away from the runway you will need to be higher at the start of the final approach. • <u>For flap problems</u> use power to control rate of descent and nose attitude to control airspeed. TRIM accurately. • <u>For stuck throttle</u> use mixture control as the throttle and aim to land deeper into the runway. 	<ul style="list-style-type: none"> • Traffic conflict. • Severe turbulence. • Flap extension problems. • Stuck throttle. • Runway blocked. • Direction control problems. • Height and speed control problems <p><u>CORRECTIVE ACTION</u></p> <p>Except for the stuck throttle and flap extension –</p> <p>Prepare to execute a go-around:</p> <ul style="list-style-type: none"> • Advise AFIS of your intentions. • At not lower than 200AGL initiate the go around by applying: <ul style="list-style-type: none"> ➢ Full power. ➢ Level out ➢ Move to the right of the runway centreline. ➢ Maintain visual contact with the runway at all times. ➢ Raise flap in increments to 1st notch. ➢ Climb ahead, carry out normal after take-off checks. ➢ Continue the circuit as normal. • Stuck throttle; use mixture control as the throttle. • Flap problems: fly flapless approach, or with partial flap extended as the situation dictates. 	<ul style="list-style-type: none"> • Severe wind shear / turbulence on short final. • Direction control loss after touchdown. • Ballooning. <p><u>CORRECTIVE ACTION</u></p> <ul style="list-style-type: none"> • With severe wind shear or turbulence prepare to land deeper into the runway and increase approach speed by not more than 10mph with zero flap, but not more than 20° flap. <ul style="list-style-type: none"> ➢ Consider going around and trying again as gusts may decrease on second attempt. ➢ Use a combination of crab and sideslip approach control techniques. • Handle direction control loss by either applying full power and going around or shutting down the engine and using maximum braking whichever is the safer. • Recover from ballooning by simultaneously applying full power, lowering the nose to level flight, acceleration to best climb, speed 85 mph and then climb away and re-enter the circuit.

FLIGHT EXERCISE BRIEFING

EXERCISE 15 ADVANCED TURNING

DEFINITION: A steep turn is a turn in which the bank angle exceeds 45°. It is a high performance manoeuvre which requires good co-ordination and positive control.

WHY? This manoeuvre is performed in a potentially dangerous situation: for e.g.: near traffic avoidance, or high ground.

AIRMANSHIP: Lookout, orientation, use reference points. Engine handling, firm and smooth control inputs.

ENTRY	MAINTAINING	ROLL OUT
<ul style="list-style-type: none"> Check T's and P's, fuel on fullest tank - fuel pump on. LOOKOUT – especially behind the A/C in direction of turn. Select reference point on horizon. Roll on bank with aileron. Balance with rudder. Apply sufficient back pressure to maintain a level turn. Add power progressively to maintain airspeed. <p>NOTE:</p> <ul style="list-style-type: none"> Start this exercise with medium level turns left and right. Then progress to 45° AOB Left and right turns. Then progress to 60° AOB turns left and right noting increase in loading to 2G and high speed stall warning. 	<ul style="list-style-type: none"> Lookout. Bank with ailerons. Balance with rudder. Height with elevator. Airspeed with power. Notice increase in downwards view. <p style="text-align: center;">If HEIGHT is GAINED:</p> <ul style="list-style-type: none"> Reduce back pressure and consider increasing the bank angle, don't over bank. <p style="text-align: center;">If HEIGHT is LOST:</p> <ul style="list-style-type: none"> Reduce bank angle. Raise nose with increased back pressure, and then re-apply bank. Lookout. Attitude. Instrument scan: AOB on AH; height on VSI/ALT; Scan with T.I; ASI; D.I; with constant outside attitude reference <p>Reference check attitude → instrument vice versa.</p>	<ul style="list-style-type: none"> Look out. Locate rollout ref point and anticipate by 10° - 30°. Roll off bank with ailerons. Balance with rudder. Release elevator back pressure to maintain height. Passing 30° of bank, reduce power to maintain the required airspeed for level flight. <p style="text-align: center;">COMMON FAULTS</p> <ul style="list-style-type: none"> No lookout. No co-ordination with aileron and rudder controls. Roll in and out must be smooth rate of roll. Use visual references for nose position with a cross check on AH for AOB. Head in cockpit. Change of AOB with nose position constant. Tend to spiral dive if roll in is too slow. To recover, close throttle, roll wings level, ease out of dive, climb away, start manoeuvre again.

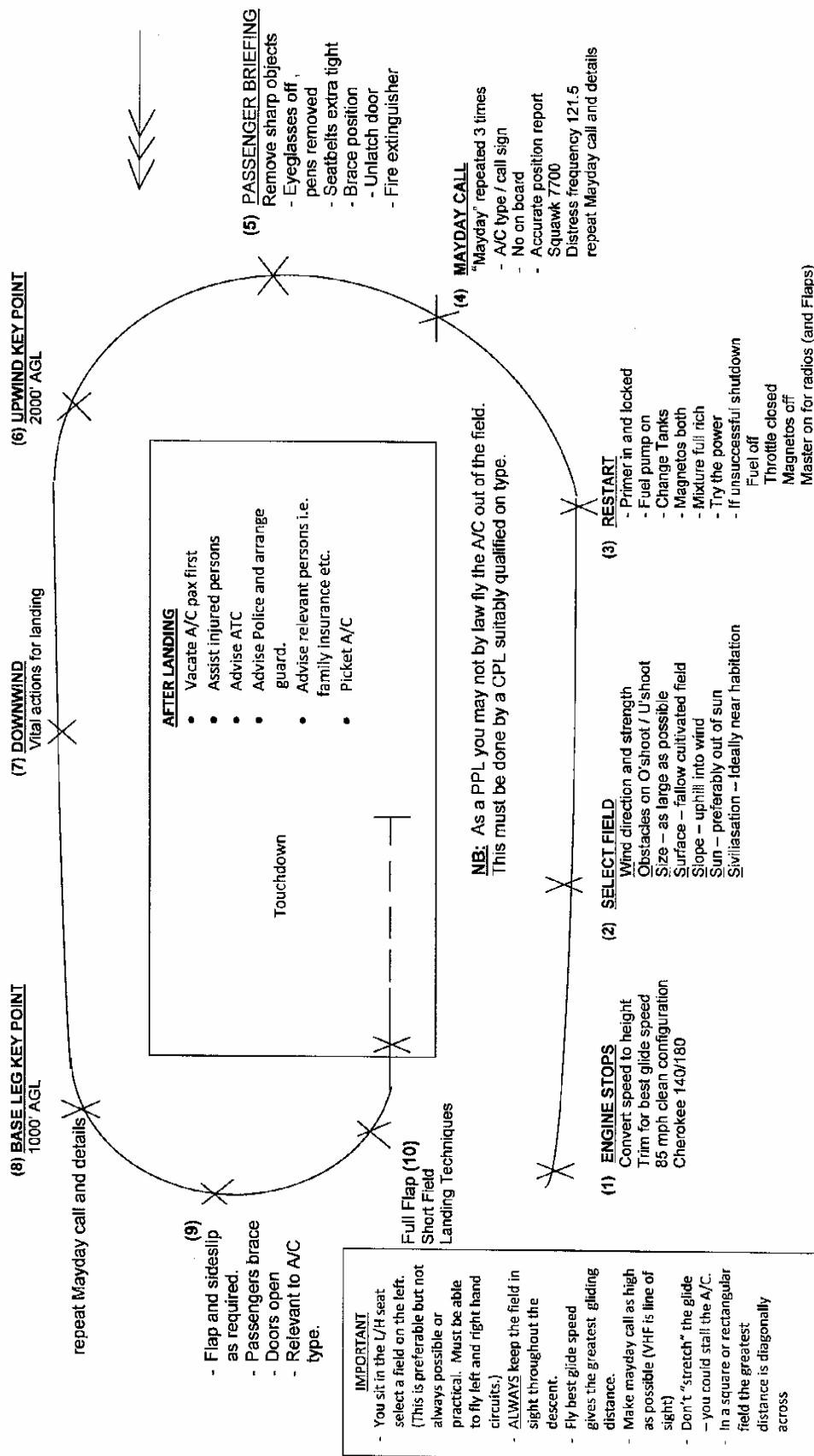
FLIGHT EXERCISE BRIEFING

EXERCISE 16 FORCED LANDING

DEFINITION:

A forced landing is a landing not contemplated before take off and one in which no power is available to select a landing path.

(NB: During training, once established on final approach knowing you will make the field, initiate the go-around at a safe height – recommend not below 200' AGL.)



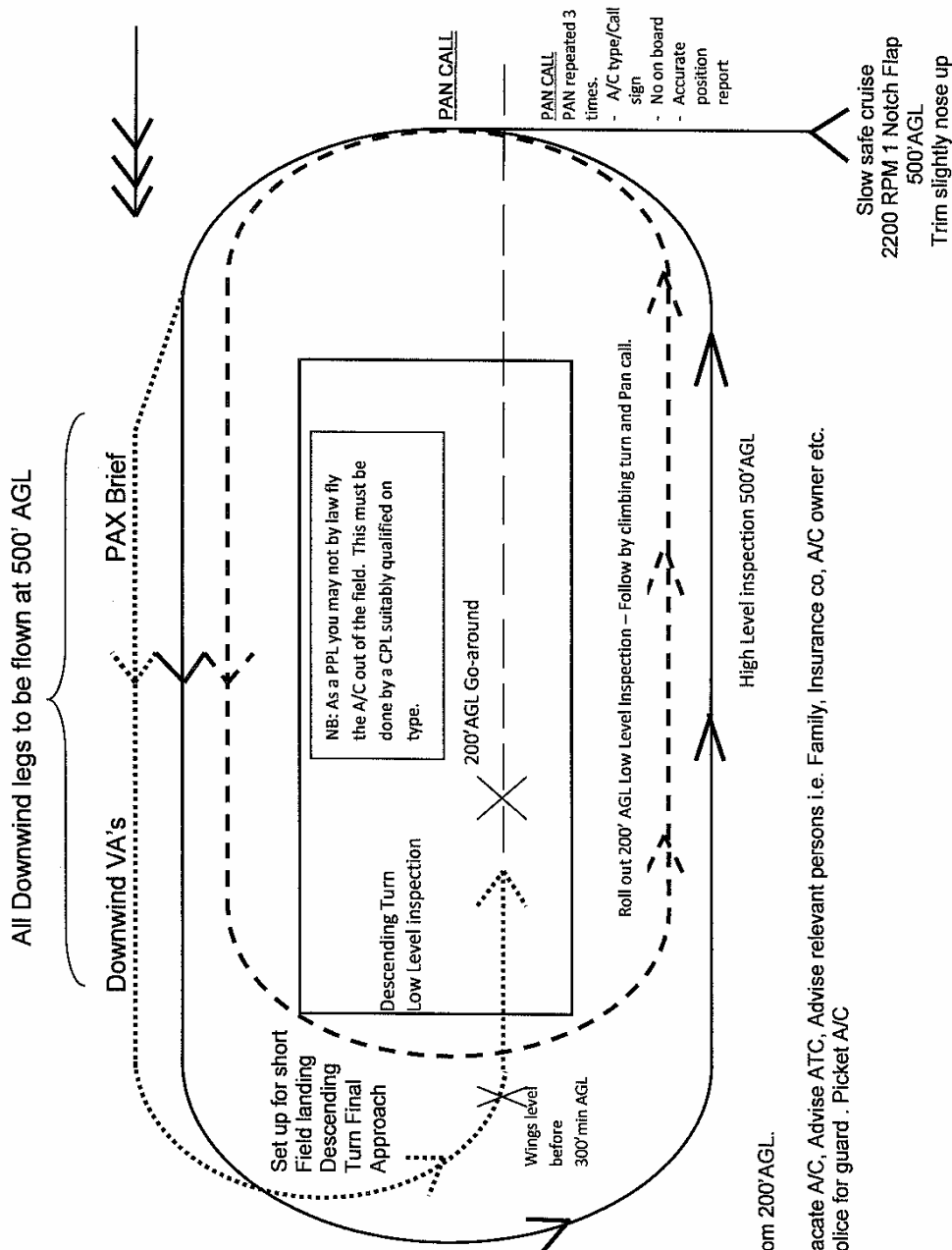
FLIGHT EXERCISE BRIEFING

EXERCISE 17 PRECAUTIONARY LANDING

DEFINITION: The precautionary landing is a landing not contemplated before take-off and is one in which you have partial or full power available in order to select a landing path.

WHY?

- Landing at unfamiliar runway.
- Deteriorating weather.
- Lost.
- Short of Fuel.
- Fading daylight not night rated.
- Engine problems.
- Crew incapacity.
- PAX incapacity.
- Engine or cabin fire



KEY:

Enter the circuit
+ High Level inspection 500' AGL

Low level inspection 200' AGL.

Descend
+ Short field landing. Go around from 200' AGL.

Touch down zone: After landing, vacate A/C, Advise ATC, Advise relevant persons i.e. Family, Insurance co, A/C owner etc.
Arrange with police for guard. Picket A/C

Go-Around