FLIGHT INSTRUCTOR'S EXERCISE BRIEFING GUIDE

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 practise with the aid of pilot's notes.

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 probate 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 form 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 firefighting 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 startup, causing excess fuel to collect in exhaust systems.
   b. Fractured fuel and oil lines under pressure leaking onto hot exhaust systems.
   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

i. Explain what causes fires.

ii. Discuss the various types of fire extinguishers and their application.

3. DESCRIPTION OF THE GROUND/AIR EXERCISE

APPLICABLE PROCEDURES AND CHECKLISTS

DEMONSTRATION	OBSERVATION	
1. ON THE GROUND		
i. Simulate an engine fire during start up.	THROTTLE	Closed
	MIXTURE	Idle Cut-off (ICO)
	FUEL SELECTOR	Off
	FUEL PUMP	Off
	IGNITION	Off
	ENGINE FIRE EXT.	Operate (if installed)
	RADIO CALL	Inform ATC
	PARK BRAKE	On
	BATTERY MASTER	Off
	PASSENGERS	Evacuate
	HAND FIRE EXT.	Operate

ii. Simulate a cabin or electrical fire whilst taxying. 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.

a. *Propeller which can feather*:

THROTTLE	Closed
PROPELLER	Feather (if applicable)
MIXTURE	Idle Cut-Off (ICO)
FUEL SELECTOR	Off
FUEL PUMP	Off
IGNITION	Off
ENGINE FIRE EXT.	Operate (if applicable)
RADIO CALL	Inform ATC
CABIN AIR SUPPLY	Closed
BATTERY MASTER	Off
EXTINGUISH FIRE	Off
FORCED LANDING PROCEDURES	Complete

b. *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 Idle cut off")

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 carburetor 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: Determine source of smoke.

1. If electrical:

ELECTRICS	All off
FIRE EXT.	Use applicable type
CABIN VENTS	Open to remove smoke
ATC PROCEDURE	Carry out radio failure

LAND AS SOON AS POSSIBLE

2. If not electrical:

FIRE EXT.	
CABIN VENTS	Open/closed depending on source and severity of smoke.

RADIO CALL

LAND AS SOON AS POSSIBLE

3. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

i. Carry out firefighting 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.

4. 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.

5. 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.

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 taxying 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.

STARTING AND WARMING UP

When demonstrating the startup 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.

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

A. SKETCH AND EXPLAIN THE FOLLOWING DEFINITIONS:

- i. Bernoulli's theories
- ii. Airfoil section
- iii. Chord line
- iv. Mean Camber line
- v. Relative airflow
- vi. Angle of Attack.

B. EXPLAIN THE FUNCTION OF FLAP TYPE FLIGHT CONTROLS AND THEIR EFFECT RELATED TO THE ABOVE PRINCIPLES.

C. DISCUSS THE LIFT FORMULA IN DETAIL.

D. WITH THE AID OF A SKETCH/MODEL EXPLAIN:

- i. The planes of movement for each flight control relative to their axes.
- ii. Factors affecting control effectiveness.
- iii. Discuss skidding, slipping and weather cocking.

E. DISCUSS NEWTON'S LAWS WITH SPECIFIC REFERENCE TO EACH FLIGHT CONTROL.

F. 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)

G. 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.

H. 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.

I. 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.

J. 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 tail plane, total drag increase and dragline lowered – resulting in pitching moment.
v. Undercarriage.

K. WORKING OF THE TRIMMER – DISCUSS.

L. 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.)

M. VENTILATION AND CABIN HEAT.

N. RADIO STACK.

3. 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.

4. SIMILARITY TO PREVIOUS EXERCISES

i. Method of look out.

ii. Orientation in General Flying area.

iii. Engine start-up and shut-down procedures.

5. 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.

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:
iii. Applicable procedures and checklists.
    a. Aircraft handling techniques: - Demonstration and Observation.
    b. Consideration of airmanship and engine handling, marshalling signals, rules of taxying as per CARs.
    c. Similarity to previous exercises.
    d. 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 taxy.
    ii. During taxying.
    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. Weather cocking.
    ii. Use of controls during head, tail- and crosswind conditions.

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 taxying speed, i.e. head- and tailwinds.

3. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

i. Taxying checks.
ii. Lookout.
iii. Zig-Zag Taxying (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.

4. SIMILARITY TO PREVIOUS EXERCISES

i. Effects of controls.

5. DE-BRIEFING AFTER FLIGHT

1. <u>Briefly recap on the exercise and emphasise the important aspects applicable to:-</u>
   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 taxying.
   vi. Engine handling.
2. <u>Discuss the common faults students usually make.</u>
   i. Students tend to taxy 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 taxying.

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 taxying over grass and tar.
vi. Releasing the brakes before closing the throttle prior commencing the taxy.
vii. Harsh braking when stopping the aircraft.
viii. Forgetting to check the windsock during taxying to confirm that he is taxying 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 taxy in centre of taxyway – how to keep nose wheel on taxy-line.
xi. Incorrect position of controls when taxying 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.

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 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 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

A. NEWTON'S LAWS

B. 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.

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 (Vmd).
v. Speed – minimum power (Vmp).
vi. Effect of flap/landing gear.
vii. Effect of weight.
viii. Effect of altitude.

C. 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

D. BALANCE OF FORCES

i. Couples.
ii. Effect of tail plane.

E. AIRCRAFT STABILITY:

1. 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 tail plane and elevators − usually negative lift on tail plane.

iii. Example of longitudinal balance provided by the tail plane:

a. Main plane and tail plane at different angles of attack – for purposes of explanation assume main plane at +4º and tail plane at +2º, angles of attack.

b. When the aircraft is disturbed by a gust, it will assume a different attitude, but will remain temporarily on its original flight path due to inertia.

c. For a change of 2º nose up. Main plane moves 4º + 2º = 50% change in angle of attack. Tail plane moves 2º + 2º = 100% change in angle of attack.

d. Therefore the greater proportional increase in lift over the tail plane will cause it to rise, resulting in a lowering of the aircraft nose and thereby return the aircraft to the original trimmed position.

2. Lateral and Directional Stability

Because roll affects 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

i. Weather cocking stability – vertical tail plane (tailfin) and fuselage area behind CG.

F. 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.

G. EFFECT OF INERTIA

Attitude changes require a time lapse before equilibrium is reached.

H. EFFECT OF POWER CHANGES

– Pitching, yawing and rolling.

I. 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.

J. 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.

CONCLUSION

By referring to the Owner's 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. 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.

4. SIMILARITY TO PREVIOUS EXERCISES

i. Familiarisation period.

ii. Effects of control.

iii. Further effects of controls.

5. 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.

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

A. NEWTON'S LAWS – Inertia as applicable to:
   i. Initiating a climb.
   ii. Attitude changes during a climb.
   iii. Levelling off from a climb.

B. FORCES ACTING ON THE AIRCRAFT

With the aid of a diagram explain the following:

a) 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.

b) LIFT (L)

i. Formula.
ii. Speed/attitude relationship

c) 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.

d) DRAG (D)

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

C. COMBINE THE THRUST/DRAG GRAPHS AND DISCUSS

i. MAXIMUM RATE OF CLIMB (MROC).

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.

MROC 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: Rate of climb (FPM) = 33,000 x (Pa-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 (MAOC)

DEFINITION

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

MAOC SPEED

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

Formula: Sin of the climb angle = (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.

D. EFFECT OF WIND ON THE CLIMB

E. AIRCRAFT WEIGHT AND BALANCE

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

F. DISCUSS THE EFFECT OF SLIPSTREAM / TORQUE DURING CLIMBING

G. 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.

CRUISE CLIMB 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 ±7%, with an increase in forward speed of 25%.

CONCLUSION

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. 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.

4. SIMILARITY TO PREVIOUS EXERCISES

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

5. 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.

3. 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 carburetor heat.

iv. Throttle over-boost / over-revving.

v. Warming engine every 1000ft minimum.

4. SIMILARITY TO PREVIOUS EXERCISES

i. Effect of controls.

ii. Straight and level.

5. 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. <u>Discuss the common faults students usually make.</u>

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. <u>Discuss the student’s actual faults</u>

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.

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

Descending falls into two categories:

- Power off – gliding.
- Power on.

A. NEWTON'S LAWS

As applicable to:

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

B. FORCES IN THE GLIDE/DESCENT

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

WEIGHT (W)

i. Couples.
ii. Nose down – 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 = (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.

C. 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 of glide angle = (T – D)/W*

For power off = 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.

D. AIRCRAFT WEIGHT AND BALANCE

i. Effect of weight on the glide.

ii. Effect of balance (C of G movement).

E. EFFECT OF SLIPSTREAM AND TORQUE DURING THE GLIDE

F. CRUISE DESCENT

3. 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 carburetor heat.
iv. Throttle over-boost / over-revving.
v. Warming engine every 1000ft minimum.

4. SIMILARITY TO PREVIOUS EXERCISES

i. Effect of controls.

ii. Straight and level.

5. 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.

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 instill 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.

3. 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.

4. 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.

Next page: Debriefing

5. 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'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.

EXERCISE 9

TURNING

1. AIM

DEFINITION

A medium turn is a change of direction at a bank angle of 30º 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 an 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.
    iv. Lift, weight and formula.
    v. Discuss load factor:
        Formula: Lift/Weight = 1/COS (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. CONSIDERATIONS OF AIRMANSHIP AND ENGINE 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

i. Same as straight climbs and descents.

4. SIMILARITY TO PREVIOUS EXERCISES

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

5. 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.

DESCENDING AND CLIMBING TURNS

1. AIM

DEFINITION

DESCENDING TURNS

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

CLIMBING TURNS

A climbing turn is a change of direction at a bank angle of 15º, 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).

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 –

Vs1 & Vs0 + 10 knots;

Vs1 & Vs0 + 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 slower airspeeds. Do not raise the flaps if the airspeed is below Vs1 – 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. Manoeuvering 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 30º 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 manoeuvers, 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. CONSIDERATIONS OF AIRMANSHIP AND ENGINE 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

i. Same as straight climbs and descents.

4. SIMILARITY TO PREVIOUS EXERCISES

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

5. DE BRIEFING AFTER FLIGHT

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

   i. Straight and level flight at Vs1 and Vs0 − the instructor to point out the relationship between the lower than normal power setting, speed (Vs1 and Vs0) and higher nose attitude required to maintain altitude − **Power + Attitude = Performance**.
   ii. Slow flight in the turn where the bank angle is confined to 15º, 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 (Vs1).
   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 up-draughts / down-draughts 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.

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.

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

A. RECAP ON:

Exercise 4, Para 2.1 (i) and (ii) − Effects of Controls.

B. NEWTON'S LAWS:

Inertia.

C. 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.

D. DISCUSS:

i. Symptoms of the approaching stall.
ii. Characteristics at the stall.
iv. Recovery procedure.
v. Effect of power on recovery.

E. DISCUSS THE EFFECT OF WEIGHT:

i. Greater Mass.
ii. Distribution of mass in aircraft.

F. DISCUSS FACTORS AFFECTING THE STALL:

ii. Manoeuvres – g-loading.
iii. Aircraft Configurations
iv. Thrust and Slipstream
v. Airfoil Sections:
   a. Shape.
   b. Icing.
   c. Damage.

G. ADVANCED STALLING

i. **Wing Tip Stalling**
   a. Reason for: Power – slipstream.
      Flaps.
   b. Prevention of: Washout.
      Change of wing section.
      Other devices.

ii. **High Speed Stalling / G Loading**
   a. Inertia.
   b. Turning.

iii. **Autorotation**

3. 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. Over-boost / over-rev.
iii. Use of carburetor heat.

iv. Use of power; Mixture, Pitch, Throttle and temperature and pressures.
v. Use of cowl flaps.
vi. Fuel management.

d. SIMILARITY TO PREVIOUS EXERISES

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

5. 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. <u>Discuss the student's actual faults</u>

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.

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.

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 precess 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 assists 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 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 tail plane..... 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.
c. 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. 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 (pitch) gyro plus roll = Anti-Spin yaw.

    A (roll) gyro plus pitch = 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. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

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

ENGINE CONSIDERATIONS

i. As per aircraft manual.

4. 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.

5. DE-BRIEFING AFTER FLIGHT

1. <u>Briefly recap on the exercise and emphasise the important aspects:</u>
    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. <u>Discuss the common faults students usually make:</u>
    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. <u>Discuss student’s actual faults</u>

    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.

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

A. 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.

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.

B. BECOMING AIRBORNE
    i. Speed – depending on flap used.
    ii. Attitude – flight path.
    iii. Undercarriage – where applicable.

C. 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. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

A. HOLDING POINT OF RUNWAY
    i. Holding position, visibility, safety and surface wind considerations.
    ii. Before take-off checks.
    iii. Lookout.
    iv. Radio procedures.

B. LINING UP ON RUNWAY
    i. Use maximum runway length available.
    ii. Aligning aircraft with centreline.
    iii. Reference point to keep straight.
    iv. Windsock check.

C. 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.

D. 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.
   vii. 500 ft agl. – commence climbing turn onto crosswind leg.

E. CROSSWING LEG
   i. Allowance for drift.
   ii. Turn onto downwind leg.

F. 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.

G. 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.

4. DE-BRIEFING AFTER FLIGHT

1. <u>Briefly recap on the exercise and emphasise the important aspects applicable to:</u>

   Taking-off into wind:
   i. Lining up and the take-off run.
   ii. Becoming airborne and climbing away.
   iii. Crosswind leg.
   iv. Engine failure after take-of from the circuit.
   v. Vital actions and circuit and R/T procedure.
   vi. Effect of wind.

2. <u>Discuss the common faults students usually make.</u>
   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 takeoff 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. <u>Discuss student's actual faults</u>

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.

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

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 Vref speeds (Vref = 1.3 x Vs0 or Vs1 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 taxying.
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 Vref 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). Effect 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 (Vapp) and Vref 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 Vref+5 knots but with reported wind speeds in excess of 10 knots the recommendation is a correction of ½ the steady wind above 10 knots + 100% of the gust value, with a total maximum correction of 15 knots.

b. For example; with a Vref of 63 knots and a headwind of 20 gusting 25 knots the Vapp would become 63+5+5 knots = 73 knots

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 Vref for the Vapp.

Allowance B:

a. Adjust approach (Vapp) and Vref airspeed by adding a wind additive of the greater of the following (not to exceed 10 knots): 5 knots; ½ 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.

Vs1 is 48kts.

Vref (1.3 x Vs1) = 63kts.

Wind additive the greater of the following but not more than 10kts:

5kts; or

½ the steady wind in excess of 15 knots = 2.5kts (5÷2 = 2.5); or the gust factor which is 10kts.

Thus wind additive = 10kts.

New approach speed + wind additive = 85kts.

New Vref = 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 procedure

3. 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. Taxying
   a. The after landing run – high speed taxying.
   b. Use of brakes.
iii. Straight and level flight.
   a. Maintaining straight and level flight.
   b. Turning.
   c. Descending.
   d. Descending turns.

4. DE-BRIEFING AFTER FLIGHT

1. BRIEFLY RECAP ON THE EXERCISE.

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

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

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

A. NEWTON'S LAWS

B. AERODYNAMIC AND MECHANICAL CONSIDERATIONS APPLICABLE TO AIRCRAFT TYPE

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

C. 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.

D. 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. 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.

4. SIMILARITY TO PREVIOUS EXERCISES

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

5. DE-BRIEFING AFTER FLIGHT

1. Briefly Recap On The Exercise And Emphasise The Important Aspects Applicable To:

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.
v. The corrective action required.

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.

3. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

i. Ensure that loose harnesses ate 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.

4. 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.

EXERCISE 15

ADVANCED TURNING (45° - 60°)

1. AIM

DEFINITION

A steep turn is a change of direction at a bank angle of at least 45º 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 the 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 coordination 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

a. NEWTON'S LAWS

b. REVISE

i. Further effect of ailerons.

ii. Adverse aileron yaw.

iii. Use of rudder for balance.

c. FORCES IN THE TURN

i. Revision on forces during straight and level fight.

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.

d. DISCUSS

i. Turn rate.

ii. Turn radius.

e. 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.

f. EFFECT OF SLIPSTREAM AND TORQUE DURING THE TURN

3. 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.

4. 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.

5. DE-BRIEFING AFTER FLIGHT

A. 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.

B. DISCUSS THE COMMON FAULTS STUDENTS USUALLY MAKE.

i. Lookout before rolling into a turn.

ii. Most students have difficulty in coordinating 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.

C. 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.

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

A. NEWTON'S LAWS

B. 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.

C. 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.

D. DISCUSS:

i. Turn rate.

ii. Turn radius.

E. POWER

Discuss the effect of engine power on the maximum rate turn.

F. 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. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

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 loosing 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 fro 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.

4. SIMILARITY AFTER FLIGHT

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.

5. DE-BRIEFING AFTER FLIGHT

A. 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.

B. DISCUSS THE COMMON FAULTS STUDENTS USUALLY MAKE.

i. Lookout before rolling into the turn.

ii. Most students have difficulty in coordinating 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.

C. 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.

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. The 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

A. EXPLAIN THE FORCES IN THE GLIDE

B. REFER TO THE APPROPRIATE GRAPH AND DISCUSS
   i. Gliding for endurance.
   ii. Gliding for range.

C. DISCUSS THE EFFECT ON THE GLIDE OF:
   i. Weight.
   ii. Flaps and undercarriage.
   iii. Propeller pitch.

iv. Speed.
v. Wind.
    a. on the glide angle.
    b. on planning the descent.
vi. Wind gradient.

D. SPEED
i. Conversion of speed into height after engine failure.
ii. Correct glide speed for aircraft configuration.

E. FIELDS
i. Discuss the choice of field, with reference to;
    a. Surface conditions best suited to a 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.

F. FAULT
i. Causes of engine failure.
ii. Attempting in-flight restart.
iii. May-Day call.

G. FLAPS
i. Use of flaps and undercarriage.

H. 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. 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.
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 EVERY 500 or 1000 ft, depending on engine type.
    d. Richen mixture while descending.
    e. Ensure carburetor heat control is ‘FULL ON’ during the gliding phase of the practice forced landing (If applicable).

4. 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.

5. DE-BRIEFING AFTER FLIGHT

A. 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.

B. DISCUSS THE COMMON FAULTS STUDENTS USUALLY MAKE:

i. Forced landing poorly planned.
ii. Students forgetful on procedures.
iii. Losing sight of the selected field during the descent.

C. 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.

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
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. 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 (±100ft).

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.

4. 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.

5. DE-BRIEFING AFTER FLIGHT

A. 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.

B. 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.

C. 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.

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

A. 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.

B. SLOW SAFE CRUISE TECHNIQUE

Apply procedures detailed in aircraft manual.

C. LOW FLYING TECHNIQUE

Review exercise 17A.

D. PRINCIPLES APPLICABLE TO THE SHORT LANDING

Review technique detailed in Exercise 13.

E. INSPECTION OF LANDING PATH

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

F. 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.

G. 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. CONSIDERATIONS OF AIRMANSHIP AND ENGINE HANDLING

AIRMANSHIP

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

4. 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.

5. DE-BRIEFING AFTER FLIGHT

A. 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.

B. 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.

C. DISCUSS THE STUDENT'S ACTUAL FAULTS.

For each fault the instructor must indicate:

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

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.

2. PRINCIPLES INVOLVED

A. 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 NOTAMs, AICs 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 CARs and CATS.

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 – Signaling 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 Licence.
- 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.

B. 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.

C. 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.

D. POSITION IDENTIFICATION

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

E. LOG KEEPING

Discuss the reason for accurate log keeping in respect of:

i. Times over/abeam pinpoints.

ii. Headings.

iii. Groundspeed.

iv. ETAs.

v. Fuel endurance etc.

F. 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 ETAs.

iv. Use of on-track pinpoints to assist heading keeping.

G. 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 ETAs.

H. 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.

I. 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.

J. 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 lose time.
    b. To avoid bad weather, high ground or restricted areas.
vi. Procedure when lost.
vii. Procedure at turning point.
viii. Procedure at destination.

K. 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. 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.

4. 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.

5. DE-BRIEFING AFTER FLIGHT

A. 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.

B. 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.

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, 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.

2. PRINCIPLES INVOLVED

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

A. LOW LEVEL NAVIGATION

i. At low level the vertical height and shape of a ground feature is of more importance than its appearance in plain 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, 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.

B. NEWTON'S LAWS

C. 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.

D. SLOW SAFE CRUISING CONFIGURATION

i. Airframe and engine limitations.

ii. Optimum speeds.

E. WEATHER CONSIDERATIONS

i. Precipitation.

ii. Icing.

iii. Visibility (into/out of sun, smog, rain, dust, twilight, etc.).

F. 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 or 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. 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.

4. 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.

5. 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.

EXERCISE 18C

USE OF RADIO NAVIGATION AIDS UNDER VFR

1. LONG BRIEFING

OBJECTIVES:

A. USE OF VHF OMNI RANGE (VOR):
   i. Availability of VOR stations, AIP.
   ii. Signal reception range.
   iii. Selection and identification.
   iv. Radials and method of numbering.
   v. Use of omni bearing selector (OBS).
   vi. To-From indication and station passage.
   vii. Selection, interception and maintaining a radial.
   viii. Use of two stations to determine position.

B. USE OF AUTOMATIC DIRECTION FINDING EQUIPMENT (ADF):
   i. Availability of NDB stations, AIP.
   ii. Signal reception range.
   iii. Selection and identification.
   iv. Orientation in relation to NDB.
   v. Homing to NDB.

C. USE OF VHF DIRECTION FINDING (VHF/DF):
   i. Availability, AIP.
   ii. R/T Procedures.
   iii. Obtaining flight related information (QDM's and QTE'S).

D. USE OF RADAR FACILITIES:
   i. Availability and provision of service; AIS.
   ii. Types of service.
   iii. R/T procedures and use of transponder.
   iv. Mode selection.
   v. Emergency codes.

E. USE OF DISTANCE MEASURING EQUIPMENT (DME):
   i. Availability, AIP.
   ii. Operating modes.
   ii. Slant range.

F. USE OF AERO NAVIGATION SYSTEMS, SATELLITE NAVIGATION SYSTEMS (RNAV-SATNAV):
   i. Availability.
   ii. Operating modes.
   iii. Limitations.

The following chapter, with Exercise 19 – Instrument Flying, is not required for NPL or PPL. However, PPL holders may also be trained to qualify for an instrument rating. The following chapter has the instructions for the basic briefing requirements.

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.

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 MANOEVRES
    - 3.1 Straight and level flight.

a. Airspeed.
b. Air density.
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 AICs
8.1 Charts.
a. Legend.
b. Limitations and significance of items e.g. MSA.
8.2 AIP.
8.3 NOTAMs.
8.4 AICs.
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.