Operational Flying SYLLABUS

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Volume 4: Operational Flying

Chapter 1: Air Power

Today, we see air power as a significant part of any military operation involving ground and naval forces.

The RAF's definition of air power is:
"the ability to use platforms operating in or passing through the air for military purposes."

[Platform – manned or unmanned aircraft (fixed and rotary wing), guided missiles and space vehicles].

Section 1.1: Strengths of Air Power

Height – aircraft have the ability to observe and control activities on the ground.

Speed – fast modern-day aircraft can be sent to any part of the world very quickly. High speeds mean less time spent on missions, and so more can be carried out. It also means less time exposed to hostile fire.

Reach – 70% of the world is covered by water, 30% by land and 100% by air, so air power has the greatest reach. Air power is also unaffected by mountains or large stretches of water. Air-to-air refuelling has extended this, enabling strikes at distant targets. Also they can fly around countries with over-fly restrictions.

These 3 are considered air power's primary strengths, but together they produce additional advantages.

All Encompassing – air power can pose simultaneous threats across a far wider geographical area than land or sea forces.

Flexibility – modern aircraft can perform a wide variety of tasks and can change between them with comparative ease, sometimes all in the same mission.

Response – aircraft can be deployed in a very short period of time, to counter threats to allies or deter aggression.

Concentration – speed, reach and flexibility mean air power can be concentrated where and when it is need most. This means massive firepower can be concentrated on crucial targets, and may be the key to operational success.

Section 1.2: Limitations of Air Power

Air power is never a complete solution to military problems.

Airborne Time – aircraft cannot stay airborne forever. Air-to-air refuelling (AAR) has increased this, but aircraft need re-arming, re-crewing and servicing, which can't be done in flight. For it to be long lasting, missions need to be repeated.

Limited Payloads – this is compensated for by the high sortie rate of fast aircraft.

Fragility – aircraft are built to be light and so carry very little armour protection; even low-levels of damage can bring it down, but they can be difficult targets to hit.

Section 1.3: Other Considerations

Cost – military aircraft must be at the cutting edge of technology – very expensive!

Dependency On Bases – base support is vital. Armies have field depots, navies have harbours, and aircraft need runways. The last is why aircraft are seen as more dependent on their bases than the others. Air power is only as effective as its base. But pilots fly from home – a small advantage.

Sensitivity To Light And Weather – bad light and weather make great difficulties for aircraft. However, technological advantages have helped with this and even turned it to advantage – night missions, conducted under cover of darkness, and those in adverse weather conditions are a major step forward.

Sensitivity To Technology – small advances in surface-to-air defence technology can have a major (negative) impact on the offensive capabilities of an aircraft. Equally, benefits such as "stealth" can increase these capabilities. The situation will always be a balance determined by the rate of technological advancement and its overall direction.

Chapter 2: Applications Of Air Power

Air power has advanced rapidly, and its flexibility has increased significantly. So, decisions concerning national security carry a lot more options now than they used to.

Section 2.1: Preserving Peace

Air power can be used to help preserve and strengthen international security in 2 ways:

Promoting International Relations – speed of response in a disaster, such as floods, famines or earthquakes, is vital to save lives. Military aircraft can deliver rapid relief in the early stages, delivering loads into rough field strips with a minimum of ground equipment. In floods or difficult terrain (mountains and such), supplies from the air may be the only or best option.

Providing Reassurance – air power can provide surveillance and reconnaissance to avert threats to peace and reassure nations that they aren't about to be attacked, and to monitor arms agreements and peace treaties.

=> **The Open Skies Agreement** – this treaty allows surveillance aircraft to roam freely over nations who have signed, and will play an important role in fostering security and stability in Europe.

Section 2.2: Managing International Crisis

The ability of air power to project military might rapidly over long distances make it ideal in managing an international crisis. It has several roles:

- **Warning** – air power can give prior warning of an intended act of aggression, allowing preparations to take place (Cuban Missiles Crisis). Advanced Airborne (Early) Warning and Control Systems (AWACS) such as the E-3D Sentry can provide vital information on the actions of potential aggressors.

- **Signalling** – air power activities can give clear political signals to nations about your intentions. Increased alert states and more intense peacetime training missions clearly indicate a willingness to fight.

- **Supporting Friends** – air power can provide prompt and long-range physical support to allies.

- **International Rescue** – air power has demonstrated repeatedly its vast ability to mount rescue operations in crisis situations, which, however, tend to involve high risk and demand the most careful planning.

- **Inject Stability** – air power can place land forces into hostile areas of civil disorder or local military conflict, to help inject some control and stability.

- **Deterrence** – deploying air power to high-tension areas can deter potential aggressors from further action.

- **Punishment** – air power cam conduct precise punishment, short of all-out war, such as responding to terrorism. Attacking the actual terrorists may not be possible, but punishing their supporters gives a clear message.

Section 2.3: Wartime Applications

If crisis management fails and the situation turns into armed conflict, air power can make a very positive contribution in many different ways.

- **Surveillance** – wartime observation of the enemy is essential for the planning and successful execution of military operations. Discovering an enemy's intentions allows effective counter measures to be taken, minimising risk and loss of life.

- **Destruction** – an enormous, and obvious, application. The ability to concentrate massive firepower gives air power enormous potential for destruction. Advance destruction of enemy units makes it easier for land and sea forces to do their jobs.

- **Control By Force** – anyone facing an opponent with strong air power has to accept that they are vulnerable to attack at any time, and that any conflict can easily escalate into open war. Limited, but effective use of air power can force countries into settling negotiations and accepting peace – little destruction!

- **Denial** – air power can deny an enemy the ability to use its own land, sea and air power effectively, such as the Battle of Britain.

- **Diversion And Delay** – concentrating air attacks on sensitive targets can force an enemy into using precious resources in defensive duties rather than offensive operations. Air attacks can also slow an enemy's advance, allowing more time for organising defences, and even delay an enemy's retreat, giving more attack opportunities and preventing their escape (so they can't attack you again).

- **Demoralisation** – air attacks sap morale, almost irrespective of damage done, due to constant threat of attack and so on.

Section 2.4: Air Strategy

Planning the best course of action, air power can be seen as a series of air operations.

Categories of air operations – there are basically 3:

- **Combat Air Operations** – those using air power, in combat situations, to achieve specific objectives.

- **Combat-Support Air Operations** – non-combat flying operations that support the effective fighting capability of air, land and sea forces.

- **Ground Combat-Support Operations** – basically non-flying operations needed to support air operations.

Chapter 3: Combat Air Operations

Section 3.1: Counter-Air Operations

These are combat operations against an enemy's ability to wage war in the air. Facing enemy air power, one priority is to gain some degree of control of the air. There are 3 basic levels of control in the air:

- **Favourable Air Situation** – reached when an enemy's air forces are unlikely to prevent your land, sea and air operations from being successful.

- **Air Superiority** – reached when your air forces are notably more dominant than your enemy's. In this situation, your operations will not be stopped by the enemy's air power.

- **Air Supremacy** – the degree of air superiority where the opposing air forces are incapable of offering effective interference.

The Offence Defence Balance

Offensive Counter Air

Purpose – to destroy, disrupt or limit enemy air power as close to its home base as possible, including:

1. **Suppression of Enemy Air Defences** – attacks or electronic warfare used to reduce the enemy's effectiveness and air defences. Targets include radar sites, surface-to-air missiles and anti-aircraft artillery batteries. ALARM - designed to destroy ground-based air defence radars by homing in onto radar transmissions and following them.

2. **Fighter Sweep** – offensive action by fighter aircraft to seek out and destroy enemy aircraft in an area of operation, made more effective by linking with air-to-surface attacks; the air-to-surface attack force draws the enemy into the air to be destroyed by the fighter sweep force. Infrared seeking ASRAAM and heat seeking Sidewinder (fire-and-forget).

3. **Escort** – the assignment of aircraft to protect another aircraft during a mission. Escort fighters present a counter threat to the enemy's air defence fighters.

4. **Airfield Attack** – airfields are static and full of highly valued targets. Attacks can diminish the enemy's sortie rate so they can no longer offer effective resistance. Attacks on runways are only temporary delays to an enemy's ability to get airborne as their surfaces are easily repaired.

Defensive Counter-Air

Include measures taken to reduce the effectiveness of hostile air action, often involving minimising damage sustained (passive) and inflicting maximum damage to attacking forces (active).

Active Air Defence

Elements of an air defence system:

a) ***A Detection System*** to identify and track the enemy. This might include visual sightings, infrared or acoustic monitoring, line-of-sight radars (land based, maritime and airborne), over-the-horizon radars and space-based systems.

b) ***A Command, Control and Information System*** linking detection and weapons systems to make best use of available assets. Info from detection systems must be organised into a recognisable air picture to enable decisions to be made about the correct level of response.

c) ***A Weapon System*** to destroy attacking enemy aircraft using fighter aircraft and surface-to-air defences.

Fighter aircraft have limited endurance but are flexible and re-usable, are far better at positively identifying targets before engagement and can switch to other tasks as needed.

Surface-to-air defences use missiles and anti-aircraft artillery are single-role systems and have little flexibility, on the other hand.

Section 3.2: Anti-Surface Operations

These involve the use of air power to deter, contain or defeat the enemy's land and sea forces, including:

- **Air Interdiction** – operations to damage or destroy an enemy's fighting capability before it is used against you. Targets could be deep in enemy territory, such as rail yards, bridges, road junctions, waterway systems, etc.

- **Battlefield Air Interdiction** – aimed at delaying or destroying an enemy's forces before they can attack friendly forces, i.e. by cutting them off from supply lines and re-enforcements. (Air Interdiction on the Battlefield)

- **Close Air Support** – similar to Battlefield Air Interdiction but used for destroying enemy forces that are close to friendly forces and so requires very careful co-ordination with ground forces.

- **Maritime Air Operations** – these work in close co-operation with Naval forces to detect and attack surface or sub-surface targets. The "Sea Eagle" missile is a computer controlled, fire and forget, sea-skimming anti-ship weapon, giving the launch aircraft a long range, covert attack capability.

Section 3.3: Strategic Air Offensive

This is aimed at undermining the enemy's ability and will to continue fighting by attacking industrial, political and economical targets rather than direct action against their military forces. There are two basic types:

1) ***Nuclear Operations*** – NATO (the North Atlantic Treaty Organisation) considers nuclear weapons last resort, not war-fighting weapons, so the authority to decide to use them rests, not with the military, but at the highest political level.
2) ***Conventional Operations*** – all non-nuclear actions taken against an enemy to *send signals about your willingness to fight, to punish small-scale aggression* or *as an integrated part of a planned campaign*. Modern weapons have such great accuracy and destructive power, so allows significant results with relatively few sorties. In the Gulf War, stealth technology proved extremely effective in strategic air offensive operations.

Chapter 4: Combat-support Air Operations

These are non-combat flying operations designed to improve or support the effectiveness of military forces.

Section 4.1: Air Transport

For armed forces with worldwide commitments, mobility is essential. It can make up for a lack of numbers by allowing available forces to be rapidly deployed, supplied or evacuated, and air transport is vital in this since their speed and high sortie rate means that large volumes of cargo and numbers of personnel can be transported very quickly.

However, air transport aircraft tend to be unarmed, slower and less manoeuvrable than fighter aircraft. Thus, they need a **Favourable Air Situation** in which to operate. Air Transport Operations have 5 main roles:

i. ***Scheduled Services*** move personnel and supplies normally along airways and, when required, over long distances.

ii. ***Airborne Operations*** involve the movement of combat forces and their equipment into a specified area by air, and can use both fixed-wing aircraft and helicopters, and they include parachute assaults, helicopter assault and air landings.

iii. ***Special Air Operations*** may be conducted at any time during a conflict and involves clandestine, covert and psychological activities.

iv. ***Air Logistic Support Operations*** are air operations conducted to move personnel, equipment, fuel and ammunition into a war zone – i.e. all the things needed to keep the war machine working.

v. ***Aeromedical Evacuation*** involves the movement of patients to and from medical facilities by air transport.

Section 4.2: Air-To-Air Refuelling (AAR)

This is the transfer of fuel from one aircraft to another in flight. This can be used to support virtually all types of aircraft in almost all air power situations. It can extend the range, payload, time-on-task and flexibility of virtually all aircraft. AAR operations have two roles/divisions:

a) ***Towline*** – tanker aircraft fly a set pattern (typically a racetrack) in a pre-arranged position. Aircraft needing fuel must plan their routes to pass this position and take on fuel as required.

b) ***Trail*** – this can be either tankers escorting the receiver aircraft to their destination, transferring fuel as needed, or by planning to meet aircraft at predetermined positions along the route.

However AAR has important limitations. In-flight refuelling takes a certain amount of *time*, during which both the tanker and receiver aircraft are very *vulnerable to enemy attack*. Moreover, there is a *limit* to the number of aircraft being refuelled at one time, making the task of refuelling a multi-aircraft formation long and potentially dangerous. So, AAR operations should, where possible, take place outside hostile airspace.

Section 4.3: Aerospace Reconnaissance Operations

These involve the collection of information from airborne, ground and space-based sensors on the activities, forces and resources of an enemy or potential enemy. This is vital for the planning of all military operations and for target identification. Long-range reconnaissance aircraft can also deter potential aggressors by letting them know that their moves are being monitored. AEW (Airborne Early Warning) and AWACS (Airborne Warning And Control Systems) are defined as air surveillance and control provided by airborne vehicles equipped with search and height-finding radar and communications equipment for controlling weapon systems. AEW can provide valuable information on an enemy's air activity and their potential to attack. AWACS can, in addition, provide positive control and direction to both offensive and defensive air operations.

Interpretation.
The usefulness of the picture built up by air recon depends on the speed and skill with which the information is interpreted; speed because out-of-date information is more harmful than useful, particularly for targeting purposes, and skill for a wrong interpretation is worse than no information at all.

Section 4.4: Search And Rescue Operations (SAR)

These are defined as air search and rescue operations involving the use of aircraft (usually helicopters) to locate and rescue personnel in distress and, particularly, rescuing downed aircrew. In a war situation, rescuing downed aircrew not only allows them to keep fighting but also denies the enemy a potential source of intelligence from captured aircrew.

SAR helicopters and long-range rescue aircraft tend to be unarmed and so are vulnerable to attack. In these circumstances, mounting combat SAR operations may be necessary, involving combat forces to provide covering fire for the rescue aircraft. These operations can be costly, as an enemy may know the area in which the aircraft has crashed and so will deploy their own forces there, but they do provide/promote high morale among aircrew.

Section 4.5: Electronic Warfare Operations

These involve the military use of electronics both to prevent or interrupt hostile use of radio, radar and infrared devices, and to ensure the effective use of similar devices by friendly forces. They can be used to confuse the enemy and to improve the success rate of friendly operations.

Electronic warfare involves the *search, interpretation and identification* of enemy transmissions, and also electronic counter measures used to deceive and confuse the enemy,

such as using clouds of "chaff" to counter missiles like the radar-guided anti-ship missile **Exocet** used in the Falklands campaign by the Argentineans.

Chaff consists of thousands of pieces of radar reflective strips, which are designed to give strong radar reflections in an attempt to confuse the missile's radar and hide the real target. Other techniques involve re-transmitting received radar signals to confuse enemy radar operators by giving the impression that there are several targets.

Chapter 5: Ground Combat-Support

These are non-flying operations required to provide direct support for air operations.

Any war is impossible without the means to sustain it – bases must be well defended and resupplied, personnel must be well organised and may require training, and equipment must be repaired and maintained.

Section 5.1: Active Defence

Active Air Defence

This not only involves the protection of air bases from air attack, but forms part of the counter-air campaign by inflicting as much damage as possible on the enemy air forces (thus stopping the enemy from using them against you), (see Chapter 3).

Active Ground Defence

The aim of this should be to prevent attack rather than to respond to it. It would be the responsibility of all the people on a threatened air base to organise their own active ground defences. As such, all air force personnel should be well trained and practised in active ground defence procedures.

Active ground defences should include creating a ground defence area around the base that can be:

a) Patrolled using military forces;

b) Cleared of obstacles that may be used by an attacking force to provide cover;

c) Protected with remote detection systems;

d) Guarded by military forces operating from the protection of bunkers or sangars (defensive guard positions using sandbags or other materials).

Section 5.2: Passive Defence

These are measures taken wherever possible to reduce the effectiveness of hostile air attacks (minimising damage, etc), including:

i. ***Dispersal*** – This generally offers the best protection against air attack. In practice, the greater the number of locations, the greater the targeting difficulties faced by an attacker. Vital assets that cannot be adequately protected should be dispersed.

ii. ***Deception*** – Concealment of installations and equipment can often confuse an enemy and make it difficult for their weapon systems to acquire targets. Visual concealment may be camouflage or applying tone-down techniques. Tactical deception would also

include the deployment of decoys, varying unit procedures, obscuring the use of buildings and using radar reflectors to distort enemy navigational and bombing radar.

iii. ***Physical Protection*** – Every airfield has key personnel, equipment and facilities which would need protecting in a time of war, the level of which is decided by the unit commander and may range from hardened aircraft shelters (HAS) to the sand bagging of windows and doors, depending on operational priorities.

iv. ***Resilience*** – It is realistic to assume that a base will receive at least some damage, no matter its defences. So, to ensure that operations are not disrupted too much, each base must have the capability to restore essential services as rapidly as possible. Examples are:

- Bomb disposal personnel, who must be able to remove unexploded ordnance (military materials) after an air raid to avoid further damage;

- Rapid repair capabilities, essential for runway and taxiway surfaces to stop disruption of air operations;

- Skilled personnel to restore essential base services (e.g. electricity, water, fuel supplies, communications, etc), which, if out of action for too long, would weaken defences and expose the base, and its personnel, to further attacks;

- Duplication of essential facilities and equipment, so that a single hit will not halt operations. Minimum operating strips can be identified on runways and taxiways; taxi tracks can be built to nearby stretches of straight road; and auxiliary runways can be built to minimum standards (saving time and money), and be reserved for wartime use only (therefore less peacetime maintenance required, also, etc).

Section 5.3: Training

Effective training is the key to successful operations. This is especially true for air forces, as the air is a particularly difficult environment in which to operate. Technology is an important factor in the effectiveness of air power, but is of little good if the aircrew don't have the necessary skills to be able to use it properly.

Similarly, ground branches involve highly demanding skills that can be critically important to air operations, both in peace and war. Training must therefore be rigorous and realistic, which is generally achieved by large-scale exercises designed as far as possible to replicate wartime conditions and are likely to include extra problems such as disrupted communications, degraded command and control, and realistic opposing forces.

Section 5.4: Logistics

This is the science of planning and carrying out the movement and maintenance of all aspects of a fighting force (i.e. what you need, when and where you need it). At all levels of war, logistics is a major concern of any commander. Lack of logistic capabilities may cause a commander to delay or even cancel vital operations, which could lead ultimately to defeat.

The full scope of logistics includes:

- The design and development, storage, transport, maintenance, evacuation and distribution of material;

- The movement, evacuation and medical care of personnel;

- The construction, maintenance and operation of facilities.

Logistics will dictate the scale, pace, scope and effectiveness of any air operation. If men and equipment are not in the right place at the right time – if equipment is not properly maintained – if aircraft are not refuelled and rearmed – if wounded personnel do not receive appropriate medical care – then any military operation is doomed to fail.

Section 5.5: Glossary Of Terms

AAR - Air-to-Air refuelling. Transfer of fuel from one aircraft to another while in flight.

AEW - Airborne Early Warning. Long-range radar carried on board aircraft to give as much warning as possible of approaching aircraft.

ALARM - Air-Launched Anti-Radar Missile. Missile carried by aircraft to detect radar transmissions from ground based equipment and follow them down to their source.

ASRAAM - Advanced Short-Range Air-to-Air Missile. Heat seeking missile used against other aircraft in air combat.

AWACS - Airborne Warning And Control Systems.

Covert - Secret, disguised.

Command and Control - System of communication to enable information to be received, decisions to be made and instructions to be carried out.

Clandestine - Under-cover, secret.

Defence - Resistance against attack (protective, not aggressive).

Fire and Forget - Once fired, the weapon is fully autonomous (self governing), allowing the pilot and aircraft to carry out other activities.

HAS - Hardened Aircraft Shelter. Facility to store aircraft, built to withstand bomb blasts.

Heat-seeking - The capability to detect and follow sources of heat - an aircraft's engines or airframe.

Maritime - Connected with the sea.

Offensive - Aggressive, intended for use in attack.

Over the horizon - Beyond the visible horizon; region only accessible to particular types of radar.

Overt - Openly-done, unconcealed.

Reconnaissance - Operations to discover an enemy's position and strength to help plan strategy.

Sortie - An operational flight by one aircraft.

Stand off - Capability to attack an enemy from a distance. An aircraft does not have to fly over the target.

Stealth - Technology to reduce radar reflections to make a craft more difficult to detect.

Strategic - Actions designed to disorganise the enemy's internal economy and warmaking potential.

Surveillance - Close observation.

Tactical - Actions in support of military or naval operations in a limited theatre of operations.

END OF COURSE!

SUMMARY

Chapter 1: Air Power

- RAF's Definition of Air Power:

"The ability to use platforms operating in or passing through the air for military purposes".

- The Strengths of Air Power:
  - Height
  - Speed
  - Reach

  These 3 are considered air power's primary strengths, and are the basis for other advantages.
  - All Encompassing
  - Flexibility
  - Response
  - Concentration
- The Limitations of Air Power:
  - Airborne Time
  - Limited Payloads
  - Fragility
- Other Considerations of Air Power:
  - Cost
  - Dependency on Bases
  - Sensitivity to Light and Weather
  - Sensitivity to Technology

Chapter 2: Applications of Air Power

- Preserving Peace:
  - Promoting International Relations
  - Providing Reassurance (i.e. the Open Skies Treaty)
- Managing International Crisis:
  - Warning
  - Signalling
  - Supporting Friends
  - International Rescue
  - Inject Stability
  - Deterrence
  - Punishment
- Wartime Applications:
  - Surveillance
  - Destruction
  - Control By Force
  - Denial
  - Diversion and Delay
  - Demoralisation
- Air Strategy:
  - Combat Air Operations
  - Combat-Support Air Operations
  - Ground Combat-Support Operations

Chapter 3: Combat Air Operations

- Counter-Air Operations:
  - Levels of Control in the Air

        - ❖ Favourable Air Situation
        - ❖ Air Superiority
        - ❖ Air Supremacy
    - ➢ The Offence-Defence Balance
        - ❖ Offensive Counter Air
            - o Suppression of Enemy Air Defences
            - o Fighter Sweep
            - o Escort
            - o Airfield Attack
        - ❖ Defensive Counter Air
            - o Active Air Defence
              (Detection System; Command, Control and Information System; Weapon System)
- Anti-Surface Operations:
    - ➢ Air Interdiction
    - ➢ Battlefield Air Interdiction
    - ➢ Close Air Support
    - ➢ Maritime Air Operations
- Strategic Air Offensive:
    - ➢ Nuclear Operations
    - ➢ Conventional Operations

Chapter 4: Combat-Support Air Operations

- Air Transport:
    - ➢ Scheduled Services
    - ➢ Airborne Operations
    - ➢ Special Air Operations
    - ➢ Air Logistic Support Operations
    - ➢ Aeromedical Evacuation
- Air-to-Air Refuelling (AAR):
    - ➢ Towline
    - ➢ Trail
- Aerospace Reconnaissance Operations
    - ➢ Interpretation
- Search and Rescue Operations (SAR)
- Electronic Warfare
    - ➢ Chaff

Chapter 5: Ground-Combat Support Operations

- Active Defence
    - ➢ Active Air Defence
    - ➢ Active Ground Defence
- Passive Defence
    - ➢ Dispersal
    - ➢ Deception
    - ➢ Physical Protection
    - ➢ Resilience
- Training
- Logistics and Glossary of Terms