

Michell Milestone AE comprehensive study guide

Module 1 – Intro to Flight

1. First manned flight was Chinese sailors attached to kites.
2. First powered flight with humans was hot air balloons. Nothing can stop UV damage to the balloon panels.
3. Montgolfier brothers created manned hot air balloons
4. Daniel Bernoulli studied the relationship between pressure and fluids in motion which led to the theory of airfoil lift. As the fluid accelerates the pressure decreases.
5. Isaac Newton three laws of motion – it was the understanding of these laws that allowed people to design rockets
 - a. Object at rest stays at rest unless acted on by outside force
 - b. A force acting on an object moves that object in the direction of the applied force
 - c. Every action has an equal and opposite reaction – this law is used to understand that rockets expel gas to move the rocket in the opposite direction and how lift acts against gravity.
6. Angle of attack is the angle of the plane. An increase in the angle causes an increase in the amount of lift.
7. Four forces acting on an airplane in flight... lift and thrust are artificial and drag and gravity are natural.
8. The Three Axes:
 - a. Vertical axis – rotate tail side to side – nose goes right and left – this is called yaw and is controlled by the rudder pedals
 - b. Lateral axis – rotate tail up and down – nose goes up and down – this is called the pitch and is controlled by the elevators or stabilator using the yoke
 - c. Longitudinal axis – pushing up or down on the wingtips – tips the plane side to side – this is called a roll and is controlled by the ailerons using the yoke.
9. Flaps increase lift so you use them when slowing down to land so you can fly slower but still have enough lift not to crash.
10. UAVs – Global Hawk, MQ-9, Ikhana

Module 2 Aircraft Systems and Airports

1. A reciprocating engine is also a combustion engine. It needs a magneto to provide electricity to the spark plugs. This way if the airplane shuts down, the engine can still operate. Cylinder arrangements are In-line, V, horizontally opposed and radial. Modern engines convert chemical energy to mechanical energy. Types of gasoline mixture: stoichiometric ratio is 15 parts air to 1 part gas. This burns all the fuel. Rich mixture is used when it's cold using more gas to air and lean mixture uses less gas to air and is better when engine is hot, but this causes the engine to run too hot and can't be used for long. Optimum ratio is 12 parts air to 1 part gas so the engine doesn't overheat. The Pilot controls this ratio from the cockpit.
2. Carburetor heat helps stop ice build up in the carburetor.

3. The glass cockpit gives you improved pilot efficiency and airplane safety. It features electronic instruments and displays.
4. When an airplane engine starts moving, the movement of the pistons draws air into the engine.
5. Oil is used in an airplane engine to lubricate and carry away heat.
6. Flight instruments
 - a. Altimeter – monitors pressure to know how high you are. Works off air pressure and is set just before take-off to local air pressure. Standard air pressure at sea level is 29.92 inches of mercury.
 - b. Vertical Velocity Indicator – rate of climb or ascent. Works off air pressure.
 - c. Airspeed indicator – Airplane's speedometer. Measures speed in knots. Works off air pressure
 - d. Gyroscope – the rotating wheel or rotor will spin at high speeds and resists changes and forces applied to it. It gives information about direction, banking, and attitude.
7. Parts of the GPS (Global Positioning System) unit includes: satellite, data center and ground station.
8. The Master switch controls most of the airplane accessories including the radio and lights.
9. True airspeed is the actual airspeed.
10. A precision compass is used to set the heading indicator in the plane.
11. Jet engines are more reliable because they have fewer moving parts.

Module 3 Air Environment

1. Layers of the Earth's atmosphere in order from the surface are: Troposphere, Stratosphere, Mesosphere, Thermosphere.
2. Ozonosphere: shields us from uv and infrared radiation, extends 10-30 miles, sun's radiation interacts with oxygen causing it to pick up a third atom.
3. The sun controls earth's weather. The heat from the sun is called radiation and it is good and bad. Air is made of 21% oxygen and 78% nitrogen.
4. The Earth has two movements: rotation and revolution.
5. The Earth has seasons because of the 23 degree tilt, sun's uneven heating of the Earth, and the Earth's rotation and revolution.
6. The Jet Stream is important when pilots plan flights, is stronger and dips south in the winter, wind speed is usually 120-150mph, moves **WEST** to east.
7. Wind is air in motion. It causes microbursts. This is a downdraft or column of sinking air that diverges in many directions as it nears or hits the ground. These winds can reach speeds of 100-150 mph. Planes are vulnerable to microbursts during take-off and landing. They happen very quickly.
8. Clouds: Cumulus are fat, formed by convection, associated with turbulence and good weather; Stratus are layered, and Cirrus are wispy.
9. Fronts

- a. Cold front brings cold air in
 - b. Stationary front – not enough force to move anything
 - c. Occluded fronts – involve three air masses
10. Hurricanes are listed on the Saffir-Simpson Hurricane Damage Potential Scale.

Module 4 Rockets

1. Greek named Hero developed the first rocket engine
2. Chinese developed gunpowder for fireworks in 1st century AD
3. Roger Bacon improved gunpowder and increased rocket range
4. William Congreve increased rocket range and they were fired on Fort McHenry in 1812 while Francis Scott Key wrote the Star-Spangled Banner. They were successful in war because many could be fired. Increased rocket range from 200 to 3000 yards.
5. William Hale developed Spin Stabilization which improves accuracy. It is where escaping exhaust gas causes the rocket to spin helping it to be more stable.
6. Tsiolkovsky 1903 suggested use of liquid propellants for greater range.
7. Robert Goddard – Father of Modern Rocketry
8. Space Race – Missiles started the space program. Missiles like Redstone, Atlas, and Titan were used to launch satellites and astronauts into space and were called launch vehicles. A launch vehicle is the rocket system that lifts a spacecraft into orbit.
9. The first American space flight lasted about 15 minutes with Alan Shepard. He was the first American in space.
10. NASA – National Aeronautics and Space Administration – for peaceful exploration of space for the benefit of all humankind.
11. NASA Space Missions
 - a. Mercury Missions – US manned space flight. John Glenn first American to orbit the Earth.
 - b. Gemini Missions – Carried two crew members. Gemini for twins.
 - c. Apollo Missions – Sending men to the moon. Saturn V launch vehicle sent Neil Armstrong to the moon in Apollo 11 1969.
 - d. Skylab – first US Space Station. Saturn V was used to launch Skylab into space 1973.
 - e. Space Shuttles – (STS) – used solid rocket boosters and three main engines to launch it.
12. Rocket Systems
 - a. Airframes – shape of the rocket, light-weight but strong
 - b. Guidance – brain of the rocket. Gets the rocket where it needs to go. It guides the rocket on a desired trajectory. Using a radio link with the mission controllers, the rocket trajectory can be changed.
 - c. Control - keeps the rocket stable
 - d. Propulsion – everything directly related to propelling the rocket. Propellant consists of fuel and oxidizer.
13. Germany developed the V-2 rocket to use during WWII

14. After WWII Wernher von Braun headed up the US rocket program.
15. Launching rockets through tubes for greater accuracy by Froissart led to bazookas.
16. Land Speed Records
 - a. Thrust SCC (super sonic car) – jet powered, British team first to break land sound barrier in 1997 going 763 mph. Driver was Andy Green
 - b. Bloodhound SCC – designed with the largest hybrid rocket in UK, made to go 1,000mph, Andy Green driver.
 - c. Blue Flame set the land speed record in 1970 going 622
17. The Ansari X Prize designed to encourage private space flight. Conceived by Peter Diamandis with award of 10 million dollars. It was won by Scaled Composites in 2004.
18. Virgin Galactic developed SpaceShip Two to take the general public on sub-orbital flights for \$200,000.
19. First satellite launched by US was Explorer 1 in 1958. Explorer 6 gave us our first photographs of Earth from space.

Module 5 Space Environment

1. Space is a place. It is a region beyond Earth's atmosphere with little molecular activity. It is part of the universe which includes everything: stars, planets, galaxies, animals, and humans.
2. A group of unrelated stars is a constellation.
3. If the Sun were hollow, 1 million earths would fit inside.
4. Kelvin is the unit of measurement based on the temperature of absolute zero. The temperature at which all molecules stop moving.
5. Galaxies have three shapes: elliptical, spiral, and irregular. Our galaxy is the Milky Way.
6. Stars
 - a. Magnitude measures the brightness of a star
 - b. A star dies when it runs out of fuel and it collapses
 - c. A protostar becomes a star when its core gets dense and hot enough to start hydrogen fusion. A star burns hydrogen for fuel.
 - d. The mass of a star determines how long it will live. Heavier stars have shorter lives.
 - e. Once hydrogen fusion is occurring and the star stops growing it is in main sequence phase.
 - f. High mass stars die in an explosion and is called a supernova. The core of the supernova will be a neutron star or black hole.
 - g. A pulsar is a pulsating star emitting electromagnetic emissions in a set pattern
7. The Sun is 93 million miles from the Earth or 1 AU (astronomical unit. A solar eclipse happens when the moon is between the Earth and Sun.
8. The moon has a weak gravitational pull. No atmosphere, wind, or air on the moon and therefore no sound. It has 1/6 the Earth's gravity and it has very extreme temperatures.
9. Asteroids – chunks of rock most are found between Mars and Jupiter.

10. Van Allen Belts are radiation belts around the Earth. This was discovered by the satellite Explorer 1.
11. Comets – dirty snowballs with tails.
12. Solar System – 8 planets and dwarf planet (Pluto). Mercury is smallest and closest to Sun. Venus is Earth's sister being close in size and distance to Earth. It is the Evening Star because it is the brightest planet. Earth has 4 seasons and sustains life. Mars is the Red Planet because of iron. Mars day is same as Earth day. Mars has 4 seasons and an atmosphere. It has two moon and is most favored for life. Jupiter is a gas giant, largest planet, and has giant storms. It has a lot of hydrogen gas. Highly compressed hydrogen causes it to emit 70% more heat than it absorbs. Saturn is second largest. It is less dense than water and could float. It has rings made of rocks, dust and ice. Uranus spins on its side. It is bluish-green from methane gas. It has 42 years of daylight and then 42 years of night. Neptune is the windy planet. Neptune's moon Triton rotates backwards. Jupiter and Saturn have high densities.
13. Unprotected humans in space would become unconscious in 15 seconds, form bubbles in the bloodstream, and air in the lungs would rush out.
14. Space suits have changed a great deal over the years.
15. Astronauts get the equivalent of 8 chest x-rays in one day being on the international space station.
16. In 2008 the NASA spacecraft Phoenix Lander confirmed water on Mars in LCROSS mission.
17. Hottest stars are blue and white, coolest stars are orange and red.
18. A light year is the distance light travels in one year.

Module 6 Spacecraft

1. Russians launched Sputnik in 1957, the first manmade, artificial satellite in 1957. The US launched its first satellite in 1958. Russians and Americans both went into space 1961.
2. Earth's natural satellite is the moon. Kepler used this term to describe the moons of Jupiter.
3. First communication satellite was in 1958 but only lasted for 13 days. In 1962 Telstar 1 was the first commercial satellite.
4. Navigational satellites developed in the 1960s. **Global Navigation Satellite Systems (GNSS)** is the term for navigational satellites.
5. Satellites collect information called telemetry and send it back to the ground station.
6. LANDSAT satellites locate natural resources and monitor conditions on Earth
7. Weather satellites help with weather information for daily decisions. Weather reports come from Geostationary Operational Environmental Satellites (GOES). They show pictures of the Earth. Tiros 1 satellite took a picture of a hurricane the same day it was launched.
8. Satellites temperature control is by insulation and heaters. They incinerate during re-entry after about 20 years.

9. First man in space and to orbit the Earth was Russian Yuri Gagarin, first person to walk in space was Russian Alexei Leonov in 1965. First American to walk in space was Ed White in 1965. First American woman in space was Sally Ride. First female mission commander was Eileen Collins in 1999. 1961 both Russians and Americans went into space.
10. Since 1957 about 40 countries have launched satellites into space.
11. Apollo 11 had the first man, Neil Armstrong, to walk on the moon in 1969. Its mission was to put an American on the moon.
12. Geocentric Theory – Ptolemy – all things revolved around the Earth. He was wrong.
13. Heliocentric Theory – Copernicus – all things revolve around the Sun. He was right.
14. NASA Spin-offs – firefighter equipment, medical advances, temper foam, vision screening, ear thermometer and invisible braces. Tang was NOT a spin-off.
15. Gravity and speed affects the shape of an orbit of an object.