Savitribai Phule Pune University
(Formerly University of Pune)
Board of Studies , Department of Technology
Aviation Technology
Curriculum Structure for M.Tech Program

Sr. No.	Subject Code	Subject Name	Credits	Teaching Scheme (Theory)	Teaching Scheme (Lab)
Semester (I)					
1	AVC1	Aerodynamics and Flight Dynamics	3	√	
2	AVC2	Propulsion	3	√	
3	AVC3	Meteorology	3	√	
4	AVC4	Navigation and Instruments	3	√	
5	AVC5	Structures, Safety and Systems	3	√	
6	AVL1	Lab Practice - 1	3		√
7	AVS1	Seminar 1	1		√
Semester (II)					
8	AVC6	PPLP1	3	√	
9	AVC7	PPLP2	3	√	
10	AVC8	IRP1	3	√	
11	AVC9	CPLP1	3	√	
12	AVC10	CPLP2	3	√	
13	AVL2	Lab Practice - 2	3		√
14	AVS2	Seminar - 2	1		√
Semester (III)					
15	AVC11	Soft Skills	3	√	
16	AVC12	FAA	3	√	
17	AVMP1	FAA Certification	8		√
Semester (IV)					
18	AVMP2	Final Project (Dissertation Submission)	18		√
		TOTAL CREDITS	70		

AUDIT COURSES				
Sr. No.	**Subject Code**	**Subject Name**	**Credits**	**Semester**
1	CYSA	Cyber Security	2	I
2	HRE101	Human Rights & Duties	1	II
3	HRE102/HRE103	Human Rights & Vulnerable Groups/Law Policy , Society & Enforcement mechanism	1	III

Notes:

1) Candidates are expected to perform minimum three (3) assignments for every Lab Practice, and submit report as a bona fide document to supervisor/course instructor. The assignment may be in the form of modeling/ simulation/ programming/ experimental investigation/ fieldwork

S.P.Pune University
Department of Technology
SYLLABUS FOR M TECH AVIATION

AERODYNAMICS

To introduce students to the way airplane generates lift for its flight. This process involves understanding pressure distribution created over the wings and which in turn give rise to forces and moments of Lift , Drag and pitching moment. This is covered in basic aerodynamics. Effects of compressibility take effect as airplane flies faster which are introduced after low speed aerodynamics. Atmosphere in which the airplane operates is discussed along with thermodynamics concepts for high speed regime.

Topics covered are as follows:

1. Fundamentals of physics: pressure, density, Temperature, streamlines, flow velocity, units .
2. Standard atmosphere: purpose,variation of pressure, density and temperature with altitude. Buoyancy equation.
3. Basic Aerodynamics: continuity, momentum and energy equation, Thermodynamics, Isentropic flow, speed of sound, incompressible flow, compressible flow and transonic flow. Viscous flow. Laminar and turbulent boundary layer, flow separation, skin friction. Bernoulli's and Euler's equation.

Reference Books:

1. Introduction to Flight by John D Anderson
2. Aerodynamics for Engineers by John Berting and Russel Cummings
3. Fundamentals of Flight by Richard Shevell
4. Introduction to Aircraft Aerodynamics by Cranfield College of Aeronautics
5. Aerodynamics for Engineering Students by Steven Collicott, E. L. Houghton, P.W. Carpenter and Dan Valentine (25 April 2012)

AIRCRAFT PROPULSION

Part I : Piston engine

1. Piston engine General - design type - Principle of the 4-stroke internal combustion engine – Piston engine thermodynamics and thermodynamic cycles
2. Engine systems: schematic construction and function of - Lubrication system,
   Air cooling –system, Ignition system, Engine fuel supply - carburetor and fuel injection,
3. air Engine performance - pressure / density altitude - performance as a function of pressure and temperature, Power augmentation devices - turbocharger, supercharger (construction and effect on engine performance)
4. Fuel - types, grades - detonation characteristics, octane rating - colour coding - additives - water content, ice formation - fuel density - alternate fuels, differences in specifications,
5. Fuel Mixture - rich and lean mixture - maximum power and fuel economy mixture setting

6. Propeller - fixed pitch and constant speed propeller - principles and operation of propellers on single and multi-engine aircraft - propeller efficiency as a function of airspeed - aircraft propeller operation: ground/ air, coarse/fine pitch limitations)

Part II: Turbine engine

1. Turbine engine - principles of operation - types of construction - turboprop - turbojet - turbofan
2. Engine construction - Air inlet - function - Compressor - function - construction and mode of operation - compressor stall and surge (cause and avoidance) - Diffuser - function - Combustion chamber - function, types and working principles - mixing ratios - fuel injectors - Turbine - function, construction and working principles , Jet pipe - function - different types - Pressure, temperature and airflow in a turbine engine - Reverse thrust - function, types and principles of operation
3. Jet Engine Thermodynamics – Brayton cycle – ideal and actual
4. Performance and thrust augmentation - water injection, principles of operation - use and system monitoring - Bleed air - effect of use of bleed air on thrust, exhaust temperature, RPM and pressure ratio - Auxiliary gearbox - function
5. Engine systems – Ignition, Fuel system, Lubrication, Fuel –
6. Thrust - thrust formula - flat rated engine - thrust as a function of airspeed, air density, pressure, temperature and RPM - power plant operation and monitoring

Reference Books:

1. Rolls Royce, The Jet Engine, Wiley Publication
2. JAA ATPL Theoretical Knowledge Manual – Powerplant, Jeppesen
3. James Powerplants, McGraw Hill

4. Tisdall, Aircraft Piston Engines, Shroff Publication
5. Herschel Smith, Aircraft Piston Engines, McGraw Hill
6. Wild, Thomas, Aircraft

FLIGHT DYNAMICS

To introduce students to develop understanding of flight of aeroplanes and manoeuvres. Calculations of parameters affecting the flight path are covered in detail since students are to go for flying training after the study of Aerodynamics and Flight Dynamics.

Topics covered are:

1. Airfoils, wings and other aerodynamic shapes.
2. Non dimensional analysis, Lift, Drag and Moment coefficients. 2 D and 3 D wings, Airfoil data, Compressibility correction, Drag divergence, Critical Mach number, Wave drag, Induced drag.
3. Drag polar, Equations of motion, Thrust and Drag required and available calculations.
4. Propeller driven engine, Jet engine. Thrust and power developed. Altitude effects.
5. NACA airfoils data tables.
6. Straight and level flight, gliding flight, climbing flight, rate of climb, time to climb, service and absolute ceiling.

7. Take off and landing performance. Breuget equation.
8. Range and endurance.
9. Turning flight, rate of turn and radius of turn. V-n diagram
10. Static and Dynamic stability in pitch. Criterion, contribution of wing, fuselage and tail.
11. Static and Dynamic stability in Roll and Yaw introduction.
12. Neutral point, Static margin.
13. Airplane Control, Elevetor angle required, trimming.

Reference Books:

1. Introduction to Flight by John D Anderson
2. Aerodynamics for Engineers by John Berting and Russel Cummings
3. Fundamentals of Flight by Richard Shevell

AIRCRAFT STRUCTURES

Students are made aware of construction of aircraft and structural limitations on flying and manoeuvring. Basics of strength of materials are covered. Aircraft construction of various components and loads experienced are covered. Common failures are explained.

Topics covered are:

1. Introduction to loads, free body diagram, stress and strain, Hooke's law.
2. Material properties and relation between stress and strain.
3. Tension, compression and shear. Axial loads and stresses in differently oriented planes.
4. Torsion.
5. Beams.
6. V-n Diagram
7. Fatigue and creep, Fatigue testing, Case study of Comet airplane.

Reference Books:

1. Elements of Strength of Material by Timoshenko and Young
2. Stability and Control by Perkins and Hage

AIRCRAFT SYSTEMS

1. To introduce students to the way various components of the aircraft are operated or the way various systems work the subject Aircraft Systems is introduced. The contents are designed in such a way that the students understand the systems fitted on small training aircraft which they are going to fly shortly and also give glimpses of what advanced systems are fitted on larger aeroplanes which they will fly in future.

2. Introduction to Aircraft Systems, purpose of the systems, how systems work together to achieve the desired result.

a) Different systems:- Flight Control System, Hydraulic System, Pneumatic system, Cabin Oxygen and Engine oxygen system, Landing Gear system, Electrical system, Deicing system, Cargo handling system, Braking system, APU, Aircraft Fuel System, Fire protection system,

b) Detailed layout of Flight control system, layout, components, trim tabs, artificial feel mechanism. Introduction to fly by wire system.

e) Detailed layout of Hydraulic systems, layout, components, Pumps, valves, actuators, feedback system, accumulators, Hydraulic fluids and associated hazards.

f) Detailed layout of pressurization and air-conditioning system, layout, components, Pumps, valves, actuators, feedback system, and associated hazards.

f) Landing gear system, components, function, checks, hazards.

g) Aircraft Fuel system, requirements of the system, components, layout and safety aspects.

Reference Books

1. Airplane handbooks of FAA on Fuel system
2. Airplane handbooks of FAA on Hydraulic system
3. Airplane handbooks of FAA on Airconditioning and pressurization system
4. Airplane handbooks of FAA on Landing gear system
5. Airplane handbooks of FAA on other systems

FLIGHT SAFETY

Students are made aware of importance of safety in every aspect of aviation. Flight, weather, maintenance, design and production aspects are discussed. Students are also made aware how to maintain safe environment.

The topics covered are:

1. Concept of safety and how it is all pervading, how everyone is involved in it.
2. Human factors affecting safety
3. Crew resource management
4. Case studies including Hudson landing

Reference Books: Aircraft Safety Accident investigations, Analyses and Applications by Shari Stamford Krause.

METEOROLOGY

Objectives:

1. Explain the basic atmospheric processes that produce weather.
2. Demonstrate proficiency in knowledge required for the DGCA.
3. Identify the weather hazards that pilots will encounter associated with flight.
4. Select the appropriate method to receive and analyze weather data.
5. Use meteorological information to conduct safe flight.

SYLLABUS

Introduction to earth's atmosphere, Composition of atmosphere, Characteristics of the atmosphere, The concept of ICAO STANDARD ATMOSPHERE, density and hypoxia

International Civil Aviation Organization (ICAO) and World Meteorological Organization (WMO) , their objectives and their role in aviation

Atmospheric Pressure and units of atmospheric Pressure, variation of atmospheric pressure with altitude, diurnal variation, horizontal variation of pressure , pressure gradient force, effect of temperature on pressure, Altimeter and altimeter settings, QFE, QNH, QFE

Principle of atmospheric temperature and temperature scales, measurement of temperature, variation of temperature with altitude, latitude, effect of land and sea on temperature, diurnal variation of temperature, seasonal variation, inversion

Moisture in atmosphere its measurement, saturation of atmosphere, relative humidity, dew point temperature, wet-bulb temperature, dews and frost, effect of cooling in the atmosphere, formation of clouds, fog and precipitation, visibility reduction phenomena

Effective Forces and wind, PGF, Coriolis force, Frictional force, Geostrophic and gradient winds, cross-isobar wind flow, cyclonic and anticyclonic wind, trough and ridge, land-sea breeze, mountain-valley breezes, katabatic-anabatic winds, jet-stream , thermal wind

Stability and instability of atmosphere, formation and types of clouds, identification of sky conditions

Air masses and fronts , concept of warm and cold fronts, weather associated with fronts, identification of front on weather charts

Turbulence and wind shear, Mountain wave turbulence, Clear air turbulence, effect of turbulence and wind shear on flight at high level and low level flight operation, wake turbulence, wind shear in frontal zone, wind shear and low level inversion

Ice accretion on aircraft, types of airframe icing, clear and rime icing, hoar frost, icing prevention, icing severity, icing in clouds

Thunderstorms, life cycle of thunderstorm, types of thunderstorm, thunderstorm as aviation hazard, Cyclonic storms/hurricanes

General circulation of atmosphere, Climate of India , Monsoon and Indian Monsoon, Climatology for Aviators , Seasons in India, western Disturbance, Northwester, Pre-monsoon, Post Monsoon, NE Monsoon

Weather Charts, significant weather charts, symbols and signs on analysed and prognostic charts

Meteorological Organization in India, Meteorological services to aviation, Meteorological briefing-documentation, Meteorological Services for International Air Navigation
Aviation Weather codes- METAR and SPECI , TAF, Sigmet, warnings , Local forecast, All type of Area Forecast, Take off and Landing forecast , Weather depiction charts, upper wind/temperature charts, significant weather prognostic charts, World Area Forecast System (WAFS) products.

Pilot Report (PIREP), Interpretation of satellite cloud imageries and interpretation of RADAR reports

Suggested Books on Aviation Meteorology

- Hand book on aviation Meteorology : Amazon .co.uk. Meteorological office Great Britain
- Aviation weather Textbook : Jeppeson
- Aviation weather by Peter Lester
- Meteorology and Flight : A pilot's guide to weather by Tom A. M. Bradbury
- Manual of Aviation Meteorology, Air services Australia,
- Aviation Weather: FAA AC 00-6A (FAA Handbooks)
- *Aviation Meteorology* has been written by K.H. Hack, Meteorologist
- Pilots weather by BRIAN Cosgrov
- Annex 3 - Meteorological Service for International Air Navigation- ICAO publication
- Essential of Meteorology: An invitation to the atmosphere by C. Donald Ahrens
- Forecaster Guide- India Meteorological department
- Tropical Meteorology by G. C. Asnani Vol. 1, 2, 3
- Weather analysis and forecasting Vol. 1 and 2 by Sverre Pettersson, MG Hills
- An Introduction to Meteorology by S. Pettersen
- The Monsoons by P.K. Das (National Book Trust, India)
- Tropical Meteorology by T.N. Krishnamurti
- Tropical Meteorology by H. Reihl (McGraw-Hill).
- Introduction to Theoretical Meteorology By S.L.Hess,
- An Introduction to Dynamic Meteorology By J.R. Holton, Academic Press.

- Dynamic Meteorology By Askel Wiin Nelson, WMO Publication
- WMO Training Manuals for class I & II, WMO (Publications)
- Monsoon Meteorology by C.P. Chang & T.N. Krishnmurti
- IMD Forecasting Manuals and Reports, IMD (Publications)
- Meteorology for Airman in India Part I – I Met D.
- Handbook of Meteorological Instruments – HMSO London
- Instructional Manuals on Various Instruments – IMD Publications
- Guide to Met Instruments and Methods of Observation – WMO.
- Compendium of Meteorology – WMO Publication Vol I – Synoptic Met.
- Meteorological Monograph – Synoptic Meteorology No1/1976 SW Monsoon - YP Rao. IMD Publication
- Manual on Meteorological Services for Aviation in India. Edition 2005.
- Jet Stream Meteorology - Reiter.
- India Meteorological Dept Manual on Meteorological Services for Aviation in India. 3rd edition 2006
- WMO Tech Notes on CAT, Mountain Waves, Icing, etc.
- WMO Tech Note No 95 on Aeronautical Met.

Manual of Meteorology for Aircrew . IAF Publication

AVIONICS NAVIGATION INSTRUMENTS

1. Aircraft Controls and Systems:
   Basic aircraft structure, shape, parts and function. Flight controls, trimmers.
   a. Electrical b. Hydraulical c. Pneumatic

2. Navigation:
   Introduction to Air-Navigation, Systems, Navigation aids and Operations
   a. From earth, other heavenly bodies (Sun, Moon, Planets etc). Earth axis and rotation. Earth's Latitude/ Longitude grid, units of measurements. Maps , Charts, Velocities, winds, Track, Bearing, Distance, speeds. Time and situational awareness for pilots. Magnetism, CDMVT and aircraft magnetic compass etc.
   b. Radio Instruments: NDB, ADF, VOR, DME, ILS, Radar (primary and secondary). Airborne and ground based equipment
   c. External navigation aids: GPS, GNSS
   d. Onboard navigation aids: INS, IRS, AHRS, FM (G)S etc
3. Flight Instruments: Analog and digital
   a. Pressure Instruments. Altimeter, Airspeed Indicator, Vertical Speed Indicator, Mach Meter.
   b. Gyro based instruments. Attitude Indicator, TSI, DG
   c. Magnetic Instruments. Compass
   d. Combined Gyro Magnetic Instruments. DG.
4. EFIS (Electronic Flight Instruments System). Digital Displays for flight Crew.
   a. ADC feeds

b. CRT / LCD display screens
c. PFD, ND, MFD, EICAS
d. AP, FD and FG

5. Radio Communication
   a. VHF Transmitter and Receiver
   b. HF- Long range. SELCAL
   c. ACARs, ADS: B
6. Engine (Propeller, Turbo Prop, Turbo Jet)
   a. Engine Instruments (Control and Performance)
   b. Power display Instruments, RPM, Torque, EPR, N1.
   c. Control Instruments. CHT, EGT and Vibration detection
7. Failure Warning and Alerting Systems
   A. Warning for Failures, Fire. Stall, Over and Under speed
   B. Indications: Audio, Video Textual, Tactile etc.
   C. TCAS, GPWS, Weather Radar
8. Related Topics: Airport Layout, Air Routes, Instrument Flight Procedures, Ground and Air procedures, Taxi, Take off and landing, Circuit patterns.Use of Aeronautical Charts and Navigation.
9. Aviation Safety: Avoidance of accidents, Training and adherence to rules, SOPs.
10. General topics: observation and reporting, patterns of weather behavior, bad weather flying.

Reference Books:
Manuals prepared by Jeet Aerospace