# M.E. AVIONICS

## CURRICULUM I TO IV SEMESTERS (FULL TIME)

### SEMESTER I

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UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY CHENNAI : CHENNAI 600 025

REGULATIONS - 2009

CURRICULUM I TO VI SEMESTERS (PART TIME)

M.E. AVIONICS

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AIM:
To make available the advanced concepts of Engineering Mathematics to the engineers and to provide the necessary mathematical skills that are needed in modeling physical processes.

OBJECTIVES:
The students will have an exposure on various topics such as Nonlinear Ordinary Differential Equation, Calculus of Variations, Matrix Theory, Graphs, Paths and Cycles and Random Processes and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

UNIT I NONLINEAR ORDINARY DIFFERENTIAL EQUATION 12
Introduction – Equations reducible to linear form – Bernoulli’s equation – Riccati’s equation – Special forms of Riccati’s equation – The Lane-Emden equation – The nonlinear Pendulum – Duffing equation.

UNIT II CALCULAS OF VARIATIONS 12
Introduction – Euler’s equation – Lagrange’s equations of Dynamics – Integrals involving higher order derivatives – Problems with constraints – Direct methods and Eigen value problems.

UNIT III MATRIX THEORY 12
Special vectors and matrices – Matrix inversion lemma – The Cholesky decomposition – Singular value decomposition

UNIT IV GRAPS, PATHS AND CYCLES 12

UNIT V RANDOM PROCESSES 12
Classification – Stationary random processes – Markov process – Auto correlation and Cross correlation functions.

TEXT BOOKS:

REFERENCES:
UNIT I INTRODUCTION TO AVIONICS
Role for Avionics in Civil and Military Aircraft systems, Avionics sub-systems and design, defining avionics System/subsystem requirements-importance of ‘ilities’, Avionics system architectures.

UNIT II AVIONICS SYSTEM DATA BUSES, DESIGN AND INTEGRATION

UNIT III AVIONICS SYSTEM ESSENTIALS: DISPLAYS, I/O DEVICES AND POWER
Trends in display technology, Alphanumeric displays, character displays etc., Civil and Military aircraft cockpits, MFDs, MFK, HUD, HDD, HMD, DVI, HOTAS, Synthetic and enhanced vision, situation awareness, Panoramic/big picture display, virtual cockpit-Civil and Military Electrical Power requirement standards, comparing the Military and Civil Requirements and Tips for Power System Design.

UNIT IV PACKAGING
Modular Avionics Packaging - Trade-off studies - ARINC and DOD types - system cooling - EMI/EMC requirements & standards.

UNIT V SYSTEM ASSESSMENT, VALIDATION AND CERTIFICATION
Fault tolerant systems - Hardware and Software, Evaluating system design and Future architecture - Hardware assessment-FARs guide certification requirements-Fault Tree analysis –Failure mode and effects analysis – Criticality, damaging modes and effects analysis - Software development process models - Software Assessment and Validation -Civil and Military standards - Certification of Civil Avionics.

UNIT VI MAINTENANCE and COSTS OF AVIONICS

REFERENCES:
UNIT I  INTRODUCTION

UNIT II  LASER SYSTEMS
Theory of Laser operation, Optical resonators, Temporal and spatial coherence, Introduction to gas, solid and semiconductor lasers Modulators: Electro Optic, Magneto optic and Acousto Optic modulators, Q switching, Mode locking, Cavity dumping, Introduction to Holography, Laser gyro. Laser hazards and Safety measures

UNIT III  INFRARED SYSTEMS
Infrared and thermal detectors, Description and design features of typical passive search and detection, Infrared imaging, Forward looking Infra Red (FLIR) Tracking and Homing systems. Satellite Radiometers.

UNIT IV  IMAGING DEVICES AND TRACKING SYSTEMS
Imaging tubes: Vidicon, pyroelectric vidicon etc, Image intensifier tubes, CCD, Focal plane arrays (FPA), Optical tracking, Sensor steering and stabilization, Servo Control. Opto mechanical design of camera and systems. Description and design features of laser ranging and guidance system, LIDAR

UNIT V  FIBER OPTIC SYSTEMS
Types of Fiber optic cables and their characteristics, fiber optic sources and detectors, Avionics fiber optic data busses: IEEE std 1393, MIL STD 1773 etc. Multiplexing schemes for onboard avionics, Fiber optic gyro

REFERENCES:
AV9113 FLIGHT INSTRUMENTATION

UNIT I MEASUREMENT SCIENCE
Instrumentation brief review-Concept of measurement- Errors and error estimation- Functional elements of an instrument system- System representation- Static and dynamic characteristics- calibration- Estimate of system performance-classification of aircraft instruments-Instrument displays panels and cockpit layout.

UNIT II AIR DATA INSTRUMENTS AND SYNCHRO TRANSMISSION SYSTEMS
Air data instruments-airspeed, altitude, Vertical speed indicators. Static Air temperature, Angle of attack measurement, Synchronous data transmission system

UNIT III GYROSCOPIC INSTRUMENTS
Gyroscope and its properties, gyro system, Gyro horizon, Direction gyro-direction indicator, Rate gyro-rate of turn and slip indicator, Turn coordinator, acceleration and turning errors.

UNIT IV AIRCRAFT COMPASS SYSTEMS
Direct reading compass, magnetic heading reference system-detector element, monitored gyroscope system, DGU, RMI, deviation compensator

UNIT V POWER PLANT INSTRUMENTS
Pressure measurement, temperature measurement, fuel quantity measurement, engine power and control instruments-measurement of RPM, manifold pressure, torque, exhaust gas temperature, EPR, fuel flow, engine vibration, monitoring.

UNIT VI FLIGHT MANAGEMENT SYSTEM AND HANDLING SYSTEMS
FMS- Flight planning-flight path optimization-operational modes-4D flight management Introduction to telemetry flight data testing. Application of telemetry in UAVs and Satellites

L: 45

REFERENCES:

AV9115 AIRCRAFT ENGINEERING

UNIT I CONFIGURATION OF AIRPLANE AND ITS COMPONENTS

UNIT II AERODYNAMICS
Airfoils and streamlines - forces acting on an airplane - lift and drag - speed and power – physical properties and structure of atmosphere - theory of flight.

UNIT III STABILITY AND CONTROL
Introduction to stability and control, Concepts of static and dynamic stability and control, Dynamic instability and control, V-n diagram, Range and endurance

UNIT IV AIRCRAFT STRUCTURES
Introduction to Aircraft structures - Loads - Types of construction - Design feature Aircraft materials.

UNIT V PROPULSION
Aircraft propulsion, Rocket propulsion, power plant classification, principles of operation, Areas of their application

REFERENCES:

UNIT I LINEAR IC’s
OP-AMP specifications, applications, voltage comparator, A/D and D/A converter, sample and hold circuit, timer, VCO, PLL, interfacing circuits.

UNIT II DIGITAL SYSTEMS
Review of TTL, ECL, CMOS- Logic gates, Flip Flops, Shift Register, Counter, Multiplexer, Demultiplexer / Decoder, Encoder, Adder, Arithmetic functions, analysis and design of clocked sequential circuits, Asynchronous sequential circuits.

UNIT III SIGNAL GENERATORS

UNIT IV MICROPROCESSOR BASED SYSTEMS
The 8085 microprocessor, interfacing with Alpha numeric displays, LCD panels, Stepper motor controller, Analog interfacing and industrial control.

UNIT V MICROCONTROLLER BASED SYSTEMS

REFERENCES:
AV9118     AVIONICS INTEGRATION LABORATORY

1. Testing of installation of MIL –STD-1553, ARINC-429 and ARINC -629 card
   (Self test)

2. Configuring MIL –STD-1553, ARINC-429 and ARINC -629 cards in transmitting
   And receiving mode

3. Testing of installation and configuring of AFDX card in transmitting and receiving
   mode. Using the interactive driver to transmit or receive the data
   a) On a single PC by loop back connection.
   b) PC to PC by connecting a shielded pair of wires.

4. Transmit and receive the messages
   a) Using loop back connection with single card.
   b) Using connector (shielded pair of wires).

5. Implementation of Wireless RC transceiver using AM, FM.

6. Microcontroller based Data Acquisition System

7. Simulation of PPI

P: 60
UNIT I INERTIAL SENSORS
Gyroscopes-Mechanical-electromechanical-Ring Laser gyro- Fiber optic gyro, Accelerometers

UNIT II INERTIAL NAVIGATION SYSTEMS
INS components: transfer function and errors-The earth in inertial space, the coriolis effect-Mechanisation. Platform and Strap down, INS system block diagram, Different co-ordinate systems, Schuler loop, compensation errors, Gimbal lock, Alignment.

UNIT III RADIO NAVIGATION
Different types of radio navigation- ADF, VOR/DME- Doppler –LORAN, DECCA and Omega - TACAN

UNIT IV APPROACH AND LANDING AIDS
ILS, MLS, GLS - Ground controlled approach system - surveillance systems-radio altimeter

UNIT V SATELLITE NAVIGATION & HYBRID NAVIGATION
Introduction to GPS -system description -basic principles -position and velocity determination-signal structure-DGPS, Introduction to Kalman filtering-Estimation and mixed mode navigation-Integration of GPS and INS-utilization of navigation systems in aircraft

REFERENCES:

AV9122 AEROSPACE GUIDANCE AND CONTROL

UNIT I INTRODUCTION
Introduction to Guidance and control - definition, Historical background

UNIT II AUGMENTATION SYSTEMS
Need for automatic flight control systems, Stability augmentation systems, control augmentation systems, Gain scheduling concepts.

UNIT III LONGITUDINAL AUTOPILOT
Displacement Autopilot-Pitch Orientation Control system, Acceleration Control System, Glide Slope Coupler and Automatic Flare Control and Flight path stabilization, Longitudinal control law design using back stepping algorithm.

UNIT IV LATERAL AUTOPILOT

UNIT V MISSILE AND LAUNCH VEHICLE GUIDANCE
Operating principles and design of guidance laws, homing guidance laws- short range, Medium range and BVR missiles, Launch Vehicle- Introduction, Mission requirements, Implicit guidance schemes, Explicit guidance, Q guidance schemes

REFERENCES:

UNIT I  SYSTEM MODELS AND SIMULATION  
Continuous and discrete systems, System modeling, Static models, Dynamic models, Principles used in modeling the techniques of simulation, Numerical computation techniques for models, Distributed lag models, Cobweb models.

UNIT II  PROBABILITY, CONCEPTS IN SIMULATION  
Stochastic Variables, Discrete probability functions, continuous probability function, Measure of probability functions, Continuous uniformly distributed random number, Congestion in systems, Arrival patterns, Various types of distribution.

UNIT III  SYSTEM SIMULATION  
Discrete events, Representation of time, Generation of arrival patterns, Simulation programming tasks, Gathering statistics, Counters and summary statistics, Simulation language. Continuous System models, Differential equation, Analog methods, digital analog simulators, Continuous system simulation language (CSSLs), Hybrid simulation, Simulation of an autopilot, Interactive systems.

UNIT IV  SYSTEM DYNAMICS AND MATHEMATICAL MODELS FOR FLIGHT SIMULATION  
Historical background growth and decay models, System dynamics diagrams, Multi – segment models, Representation of time delays, The Dynamo Language Elements of Mathematical models, Equation of motion, Representation of aerodynamics data, Aircraft systems, Structure and cockpit systems, Motion system, Visual system, Instructor’s facilities.

UNIT V  FLIGHT SIMULATOR AS A TRAINING DEVICE AND RESEARCH TOOL  
Introduction, advantage of simulator, the effectiveness of Simulator, The user’s role, Simulator Certification, Data sources, Validation, in- flight simulators

REFERENCES:

UNIT I  ORBITAL MECHANICS

UNIT II  SATELLITE DYNAMICS
Geosynchronous and geostationary satellites life time – satellite perturbations – Hohmann orbits – calculation of orbit parameters – Determination of satellite rectangular coordinates from orbital elements

UNIT III  ROCKET MOTION
Principle of operation of rocket motor - thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories determinations of range and altitude – simple approximations to burnout velocity – staging of rockets.

UNIT IV  ROCKET AERODYNAMICS

UNIT V  STAGING AND CONTROL OF ROCKET VEHICLES
Need for multistaging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles - SITVC.

TEXT BOOKS:

REFERENCES:
1. Stability analysis using Root locus, Bode plot, Nyquist plot and Polar plot techniques
2. Design of lead, lag and lead-lag compensator for aircraft dynamics
3. Performance Improvement Of Aircraft Dynamics By pole placement technique
4. Development Of Longitudinal Equations Of Motion
5. Design of displacement longitudinal autopilot
6. Design Of Automatic Glide Slope Control System And Flare Control System
7. Development Of Lateral Equations Of Motion
8. Design of Lateral Autopilot
9. Design of Turn Co-ordination system
10. Design of Automatic Lateral beam guidance system
11. Design of Van-Guard Missile system
12. Design of observers
13. Design of Kalman filters

NOTE: Implementation using MATLAB, X-plane, Flight-Gear & Aerosim or any equivalent software
UNIT I INTRODUCTION TO DIGITAL FLY-BY-WIRE CONTROL
Need for DFBW systems, Historical perspectives in design Programs-Douglas Long Beach Programs, WPAFB B 47 In House Program, LTV IAP, Sperry Phoenix Programs, CAS and SAS, CCV and ACT concepts.

UNIT II ELEMENTS OF DFBW CONTROL
Description of various elements of DFBW systems - Concept of redundancy and reliability, Fault coverage and redundant architecture

UNIT III DFBW ARCHITECTURES
Need for redundant architecture, discussion on triplex vs. quadruplex architecture for DFBW system, Concept of cross-strapping, Actuator command voting and servo force voting etc.

UNIT IV SOME REQUIREMENTS FOR DFBW SYSTEM DESIGN
Survivable Flight control System programs, ADP Phases-Simplex package Evaluation -FBW without Mechanical Backup-Survivable Stabilator Actuator package, Reliability requirements and their relevance to DFBW system design, redundant power supply requirements, Environmental and weight, volume constraints.

UNIT V DESIGN ISSUES IN DFBW SYSTEM DESIGN
Thermal consideration, Built-in-test features, reliable software development, Redundancy management (voting, monitoring), Failure and maintenance philosophies, Implementation, Issues of digital control laws, Generic failures in Hardware and software. Advanced concepts in DFBW System Design

REFERENCES:

2. AGARD-CP-137, “Advances in Control systems”, (Chap.10, 17,21, 22, 23, 24)
4. AGARD-CP-260, “Stability and Control” (Chap.15)
UNIT I  INTRODUCTION TO SYSTEMS ENGINEERING

UNIT II  AIRCRAFT SYSTEMS AND DESIGN
Everyday Examples of Systems-Aircraft Systems-Generic Systems-Product Life Cycle-Different Phases-Whole Life Cycle Tasks-Systems Analysis- Design Drivers in the Project, Product, Operating Environment-Interfaces with the Subsystems

UNIT III  SYSTEM ARCHITECTURES AND INTEGRATION

UNIT IV  PRACTICAL CONSIDERATIONS AND CONFIGURATION CONTROL
Stake holders-Communications-Criticism- Configuration Control Process-Portrayal of a System-Varying Systems Configurations- Compatibility-Factors Affecting Compatibility – Systems Evolution Considerations and Integration of Aircraft Systems

UNIT V  SYSTEMS RELIABILITY AND MAINTAINABILITY
Systems and Components-Analysis-Influence, Economics, Design for Reliability-Fault and Failure Analysis-Case Study-Maintenance Types-Program-Planning and Design

REFERENCES:

UNIT I  DISPLAY DEVICES
Trends in display technology – Alphanumeric displays, character display etc. Basic components of display systems. CRT displays, Plasma display, LCDs, Solid state displays, etc and their characteristics

UNIT II  COCKPIT DISPLAYS

UNIT III  DISPLAY PROCESSOR REQUIREMENTS & ARCHITECTURE

UNIT IV  COCKPIT EVALUATOR
Generation of display symbologies with facilities for quick modification and evaluation Cockpit Information and Display Controls Organization and Optimization

UNIT V  COMPUTER GRAPHICS

REFERENCES:
UNIT I  FAULT TOLERANCE  10

UNIT II  ERROR DETECTION  12
Measure for error detection – Mechanisms for error detection – Measures for damage confinement and damage assessment – Protection mechanisms – Protection in multi-level systems

UNIT III  ERROR RECOVERY  12

UNIT IV  SOFTWARE FAULT TOLERANCE  4
The recovery block scheme – Implementation of recovery block – Acceptance – tests – run-time overheads

UNIT V  SYSTEMS STRUCTURE AND RELIABILITY  7

REFERENCES:

AV9155 PROGRAMMING IN ADA  

UNIT I  OBJECT ORIENTED PROGRAMMING  9
Overview- History of Ada -Inheritance, dynamic dispatching (polymorphism)- Encapsulation.

UNIT II  ADA DATA TYPES  9
Basic Ada structures, program units, Ada structures, lexical elements, identifiers, numeric literals, character literals, Basic types- integer , float, Boolean, user defined types & rule types- Enumeration. Array, records, limited and private limited types, control structure- if, case, loop, loop iteration schemes, subprograms-declaration, parameter passing- local and global variables.

UNIT III  ADA PACKAGES  9
Declaration and bodies-packages-compilation units, I/O capabilities, Text file I/o, various text file, package command line options, child packages, exceptions - declarations, handling, generics-definitions, formal parameters, visibility rules.

UNIT IV  PARALLEL PROGRAMMING  9
Access types-declaration -unbounded types, unchecked deal location-task and protected types- multitasking.

UNIT V  INTERFACING WITH OTHER LANGUAGES  9
Interfacing with C, Java vs. Ada, Ada applets, Java interfaces and aliased components- flight safety and Ada, recursion and efficiency, software inspection, debugging, Ada bindings, other Ada capabilities

REFERENCES:

UNIT I  MICROWAVE SOURCES  10
Passive waveguide components, Microstrip line structure and components, Simple theory and operating characteristics of Reflex klystrons, Two cavity Klystrons, Magnetrons, and TWTS - solid state source - TEDS, IMPATTs, TRAPATT, GaAs FETs and Tunnel diode.

UNIT II  RADAR PRINCIPLES  8

UNIT III  TYPES OF RADARS  10

UNIT IV  RADAR SIGNAL PROCESSING  9
Radar requirements - Matched filters- Radar ambiguity function – Optimum waveforms for detection in clutter – Classes of waveforms – Digital representation of signals - Pulse compression

UNIT V  TRACKING RADAR  8
Tracking with radar – Monopulse Tracking – conical scan and sequential lobing – limitations to tracking Accuracy- Kalman Tracker - Fundamentals of Airborne radar

REFERENCES:

UNIT I  ELECTRONIC WARFARE (EW) PRINCIPLES AND OVERVIEW  3
Electronic Warfare taxonomy - EW Mission and scenarios

UNIT II  ELECTRONIC SUPPORT MEASURE (ESM) RECEIVERS - ELECTRONIC COUNTER MEASURES (ECM)  12
Radar Warning Receivers (RWR) - Passive direction finding and emitter - location - noise jamming - Deception Electronic Counter Measures (DECM) - Modern ECM systems.

UNIT III  RADAR AND ECM PERFORMANCE ANALYSIS  9
Radar detection performance low RCS aircraft - ECM - Jamming equations - EW receiver sensitivity

UNIT IV  EW SIGNAL PROCESSING  9
Signal environment - EM sensor subsystem - The receiver subsystem - The pre-processor the data servo loop - Mile parameter tracking - Advanced pulley power - Managed Jamming.

UNIT V  ELECTRONIC COUNTER - COUNTER MEASURES (ECCM)  12
Radar applications in weapon systems - Radar types and characteristics, EW Technology and Future Trends - Antenna Technology - ECM transmitter power source technology - EW receiver technology - EW at millimeter Wavelength - Low Observability EW technology.

REFERENCES:

UNIT I INTRODUCTION TO FLIGHT TESTING 5
Introduction - Methodology - Planning - Techniques - Instrumentation & Telemetry - Data analysis.

UNIT II DATA ACQUISITION SYSTEMS 12
Basic concepts of measurement - Units - Generalized performance characteristics – Errors, Sensors & Transducers, Types selection - Sampling – System design - System error analysis.

UNIT III TELEMETRY SYSTEM 14
System block diagram, Frequency and Time Division Multiplexing, Frequency Modulation - Pulse amplitude modulation - Pulse code modulation, Radio Link - Airborne and ground antennas, Link parameters - Design and analysis.

UNIT IV GROUND TELEMETRY STATION 10
Introduction - Principles of demultiplexing - FM, PAM and PCM Demultiplexing systems - IRIG Standards - Recorders - Quick look displays - Data compression

UNIT V RANGE INSTRUMENTATION 4
Introduction - Typical range activities - TSPI Systems.

REFERENCES:

UNIT I  INTRODUCTION TO HUMAN ENGINEERING AND MAN MACHINE SYSTEMS  
Definitions, scope and applications Purpose of man machine system, Types of systems, Operational functions and components, Sensory and motor processes, Human information processes, Human motor activity.

UNIT II  INFORMATION DISPLAYS  
Types of information presented by displays, Design criteria for displays, Selection of sensory modalities for displays, Checklist for good display/indicator selection and arrangements for displays, speech communication.

UNIT III  HUMAN CONTROL OF SYSTEMS  
Principles of control design and related devices, Design of controls in aircraft cockpit, coding of controls.

UNIT IV  ANTHROPOMETRY  
Definition, Importance, Static and dynamic anthropometry, Anthropometry and cockpit Design. Basic principles of seat design, crew seat design - Transport aircraft and helicopters, Passenger - seats. Work space lay out for Fighter, Helicopters and Transport aircraft.

UNIT V  HUMAN FACTORS STUDY IN RELATION TO AVIATION-STRESSES  
Hypoxia, Acceleration, Thermal stress, Noise vibration and fatigue. Life support system in Aircraft- Scope, types of life-support system, human factor considerations.

REFERENCES:

UNIT I INTRODUCTION TO UAV
History of UAV – classification – basic terminology – models and prototypes – applications

UNIT II BASICS OF AIRFRAME

UNIT III AVIONICS HARDWARE

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS

UNIT V PATH PLANNING AND MAV
Waypoints navigation – ground control software – Recent trends in UAV – Case Studies

REFERENCES:

1. Jane's Unmanned Aerial Vehicles and Targets, Jane's Information Group; ASIN: 0710612575, 1999
UNIT I  AVIONICS SYSTEM ENGINEERING DEVELOPMENT CYCLE  8

UNIT II  SYSTEMS ENGINEERING MANAGEMENT  8

UNIT III  CERTIFICATION OF AVIONICS SYSTEMS  5
Certification, Civil Aviation Authorities, Regulatory and Advisory Agencies, Regulation, Advisory Circular, Order, MOPS, TSO, Type Certification, Supplementary Type Certification, Certification Process, Delegation, Product Certification Process Roadmap

UNIT IV  SOFTWARE CONSIDERATIONS IN AIRBORNE SYSTEMS AND EQUIPMENT CERTIFICATION (DO-178B)  8

UNIT V  DESIGN ASSURANCE GUIDANCE FOR AIRBORNE ELECTRONIC HARDWARE (DO- 254)  8

UNIT VI  CERTIFICATION CONSIDERATIONS FOR HIGHLY-INTEGRATED OR COMPLEX AIRCRAFT SYSTEMS (SAE ARP4754)  8
REFERENCES:

7. SAE ARP4754, Certification Considerations for Highly-Integrated or Complex Aircraft Systems, SAE, Warrendale, PA, 1996.
UNIT I  ACTIVE CONTROL FUNCTIONS
Introduction-active control technology concepts-control configured vehicle-Design Philosophy, Aerodynamics: Relaxed static stability, Automatic Configuration management, side force control. Structures, Manoeuvre load control, Gust load alleviation, Ride smoothing, fatigue alleviation, Flutter-mode control, Propulsion and Flight Control Integration Technology (PROFIT)

UNIT II  ACTIVE CONTROL DESIGN CONSIDERATIONS
Stability augmentation, Command augmentation, Control of aircraft center of gravity, Elastic mode stabilization, and Gust load control, Reliability, redundancy

UNIT III  FLY-BY-WIRE TECHNOLOGY
Fly-By-Wire concepts. Primary and secondary electrical flight control system, Redundancy and architecture trade studies - analog and digital FBW Systems - Typical fly-by-wire flight control system elements - Application of fly-by-wire technology to civil and military aircraft.

UNIT IV  FLYING QUALITIES
Definition, Cooper - Harper rating scale - flying qualities requirements - Relaxed static stability flying qualities requirements - Lower order equivalent systems criteria Neal - Smith criteria.

UNIT V  CONTROL MODES OF COMBAT AIRCRAFT
Pitch rate Command - Attitude hold system - Carefree maneuvering - spin-stall prevention and similar limiting concepts - Combat maneuvers.

REFERENCES:

UNIT I  FIRE CONTROL
Introduction -Fire Control problems, Geometrical approach, Coordinate and computing frames, Vectors in fire control.

UNIT II  FIRE CONTROL PROBLEM FOR PROJECTILES
Statement of the fire control problem, Miss-producing effects, prediction, Time of Flight of the projectile.

UNIT III  FEATURES OF FIRE CONTROL SYSTEMS
Line of sight and the tracking line, Weapon line, computed weapon line and correct weapon line, Geometrical Interference, Space Integration, Classification of fire control systems, prediction, Pursuit and proportional navigation courses, Hit probability.

UNIT IV  ORIENTATION MEASUREMENTS WITH GYROS
Gyroscopes, Measurements of direction, Controlled line, Single axis tracking loops

UNIT V  FIRE CONTROL COMPUTING SYSTEMS
Computing methods and system classification, Prediction computation, Lead computing, Curvature correction, Velocity jump correction and the error corrections, Attack Courses, Bombing computations, Bombsights, Bombing modes.

REFERENCES:

<table>
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<td>FLIGHT DYNAMICS</td>
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<td>General equation of motion for rigid airplane – concept of equilibrium - Aerodynamic and thrust forces and forward motion – steady state – Perturbed state.</td>
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<td>II</td>
<td>STEADY STATE STABILITY AND CONTROL</td>
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<td>Static – Straight-line flight – Maneuvering, flight design for dynamic stability and response requirements – importance of stability derivatives.</td>
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<td>III</td>
<td>STABILITY AND CONTROL OF THE ELASTIC AIRPLANE</td>
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<td>Frequency response of airplane – atmospheric disturbances and their effects on flight – effect of atmospheric turbulence on flight stability.</td>
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<td>DESIGN AND ORIENTATION</td>
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<td>Mission requirements leading to total configuration selection – role of aerodynamic design in the selection of total configuration- structural constraints on configuration selection- Flight mechanics analysis to support aircraft configuration. - Identification of aircraft parameters.</td>
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<td>SYSTEM AND MISSION ORIENTATION</td>
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REFERENCES:

UNIT I  MISSILE SYSTEMS
Introduction - history - classification - missile system elements, missile ground systems -
radars – launchers, coordinate frames, basics of trajectory dynamics.

UNIT II  AERODYNAMICS
Missile aerodynamics - design methodology, aerodynamic prediction method, aerodynamic
loads & performance analysis, wind tunnel and flight testing of missile models and missile
prototypes.

UNIT III  PROPULSION
Principles of jet propulsion and rocketry, nozzle theory and performance parameters of solid
rockets and ramjet and compound jet engines – evaluation of flight performance - forces
acting on vehicle - basic relations of motion - multi stage vehicles

UNIT IV  NAVIGATION, GUIDANCE & CONTROL
Navigation - types - inertial - GPS - radar based terrain mapping, guidance - explicit - PN –
APN - beam riding – CLOS, control – autopilot, and actuation - hydraulic - pneumatic -
electromechanical - RCS

UNIT V  MISSILE TRAJECTORY CALCULATIONS
Vertical, inclined and gravity turn trajectories – determination of range and altitude- numerical
computation of ballistic trajectories.

REFERENCES:

1. G. Merrill, “Dictionary of Guided Missiles and Space Craft”, D. Van Nostrand and
UNIT I  INTRODUCTION
Scope of - Approaches to fault detection and diagnosis: Model free methods and Model based methods - Introduction to Random variables - Distribution - Bivariatedistribution - Multivariatedistribution - Normaldistribution - Maximum likelihood distribution - Hypothesis testing

UNIT II  ANALYTICAL REDUNDANCY CONCEPT
Additive faults and disturbance - Multiplicative faults and disturbance - Residual generation - Detection property - Isolation property - Computational property - Design of Residual generation - Specification and implementation

UNIT III  PARITY EQUATION IMPLEMENTATION OF RESIDUAL GENERATOR - PARITY EQUATION FORMULATION
Implementation of single residual - Implementation with input output relation - Fault system matrix Design for structure residual - Structural definition - Canonical structures - Handling disturbance - Residual structure for multiple faults

UNIT IV  DESIGN FOR DIRECTIONAL RESIDUAL
Directional specifications - Parity equation - Linearly dependent columns - Residual generation for parametric faults - Representation of parametric fault - Design for parametric fault and model errors - Robustness in residual generation - Perfect decoupling from disturbance

UNIT V  ADVANCE TOPICS
Fault diagnosis using Kalman filtering - Fault diagnosis using principle component analysis - Fault diagnosis using ANN and Fuzzy clustering

Case study: Aircraft fault detection

REFERENCES:

UNIT I SATELLITE MISSION AND ORBITS

UNIT II SPACERCRAFT CONFIGURATION AND SPACECRAFT POWER SYSTEM

UNIT III SPACERCRAFT ATTITUDE AND ORBIT CONTROL SYSTEM (AOCS)
Coordinate system – AOCS requirements – Environment effects – Attitude stabilization – Attitude sensors – Actuators – Design of control algorithms.

UNIT IV PROPULSION SYSTEMS, STRUCTURES AND THERMAL CONTROL

UNIT V SATELLITE TELEMETRY, TRACKING AND TELECOMMANDE
Base Band Telemetry system – Modulation – TT & C RF system – Telecomm and system

REFERENCES:

4. Lecture notes on " Satellite Architecture", ISRO Satellite Centre Bangalore – 560 017
UNIT I  FUNDAMENTALS OF IMAGE PROCESSING  

UNIT II  IMAGE ENHANCEMENT AND RESTORATION  

UNIT III  IMAGE SEGMENTATION AND FEATURE ANALYSIS  

UNIT IV  MULTI RESOLUTION ANALYSIS AND COMPRESSIONS  

UNIT V  APPLICATIONS OF IMAGE PROCESSING  
Representation and Description, Image Recognition- Image Understanding – Image Classification – Video Motion Analysis – Image Fusion – Steganography – Colour Image Processing

REFERENCES:

AV9177  AIRBORNE ACTUATORS AND SENSORS

UNIT I   AIRCRAFT ACTUATION SYSTEMS
Introduction - Principles of actuation systems, Types of actuation systems.

UNIT II  SERVO COMPONENTS
Actuators, Valves, Servo amplifiers pick-offs.

UNIT III MODELING, DESIGN, AND TESTING
Linear and non-linear actuation system, modeling of actuation systems, Servo-loop analysis
actuator design - testing methodologies, Performance testing test equipments for actuation
systems.

UNIT IV  INERTIAL SENSORS
Gyroscope- Principles , Gyro equations, Rate Gyros - Rate integration and free Gyro, Vertical
and Directional Gyros, Laser Gyroscope - Inertial navigation - Basic principles, theory and
applications. Accelerometers-- Principles & Theory, Spring mass, force balance and piezo-
electric accelerometers, MEMS sensors

UNIT V  SENSOR TESTING
Test philosophies and methodologies, Test equipment, Performance testing of sensors.

REFERENCES:

1. James Ephraim Johnson, Electrohydraulic Servo Systems, Published by Editors of
   Hydraulics & pneumatics magazine, 1977.
   1978.
NE9156 REAL TIME EMBEDDED SYSTEMS

UNIT I INTRODUCTION

UNIT II EMBEDDED/REAL TIME OPERATING SYSTEM

UNIT III CONNECTIVITY

UNIT IV REAL TIME UML
Requirements Analysis – Object Identification Strategies – Object Behavior – Real Time Design Patterns

UNIT V SOFTWARE DEVELOPMENT AND CASE STUDY

REFERENCES:
UNIT I  EM ENVIRONMENT
Concepts of EMI and EMC, Noise, Definitions, Practical concerns, Sources of EMI: Natural, Apparatus and Circuits, conducted and radiated EMI, Transient EMI, Effects of EMI on Airborne systems.

UNIT II  EMI COUPLING PRINCIPLES
Conducted, Radiated and Transient Coupling, Common Impedance, Ground Coupling, Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, Near Field Cable to Cable Coupling, Power Mains and Power Supply Coupling.

UNIT III  EMI STANDARDS AND MEASUREMENTS

UNIT IV  EMI CONTROL TECHNIQUES
Shielding, Grounding, Bonding, Isolation Transformer, Transient Suppressors, EMC connectors, Gaskets, optoisolators, EMI Filters, Power line filter design, Signal Control, Component Selection and Mounting issues.

UNIT V  EMC DESIGN OF PCBS
Digital Circuit radiation, Cross Talk in PCB traces, Impedance Control, Power Distribution Decoupling, Zoning, Propagation Delay Models, PCB Designs guidelines for reduced EMI.

REFERENCES:


UNIT I REVIEW OF PROBABILITY AND STOCHASTIC PROCESS

UNIT II SINGLE AND MULTIPLE SAMPLE DETECTION

UNIT III FUNDAMENTALS OF ESTIMATION THEORY

UNIT IV WIENER AND KALMAN FILTERS

UNIT V APPLICATIONS
Detector Structures in Non-Gaussian Noise, Examples of Noise Models, Receiver Structures, and Error-Rate Performance, Estimation of Non-Gaussian Noise Parameters Fading Multipath Channel Models, Receiver Structures with Known Channel Parameters, Receiver Structures without Knowledge of Phase, Receiver Structures without Knowledge of Amplitude or Phase, Receiver Structures and Performance with No Channel Knowledge.

REFERENCES:

UNIT I INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS
Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Machine Learning Basics

UNIT II GENETIC ALGORITHMS
Introduction to Genetic Algorithms (GA) – Applications of GA in Machine Learning - Machine Learning Approach to Knowledge Acquisition

UNIT III NEURAL NETWORKS

UNIT IV FUZZY LOGIC

UNIT V NEURO-FUZZY MODELING

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TEXT BOOKS:

REFERENCES:
UNIT I  OPTICAL NETWORKS
Fiber channel- WDM LAN- Fiber channel-RF over fiber- Highly integrated photonics (HIP)- Routing in optics- Amplification in optics.

UNIT II  ATN (AERONAUTICAL TELECOMMUNICATION NETWORK)

UNIT III  WIRELESS SENSOR NETWORK

UNIT IV  WIDEBAND WIRELESS COMMUNICATION AND NETWORKS FOR MILITARY AVIONICS
Communication data link (CDL) - IP based routing in FBW-Smart antenna networking.

UNIT V  REAL TIME INTEGRATED AVIONICS NETWORK
Inter networking- Multimedia- Pilot vehicles-other defense and aerospace application-Scalable Coherent interface-SCI/RI-Integrated modulator avionics.

REFERENCES: