PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. **PEO 1:** Successful Moulding of Graduate into Avionics Professional: Graduates of the programme will acquire adequate knowledge both in practical and theoretical domains in the field of Avionics Engineering through rigorous post graduate education.

II. **PEO 2:** Successful Career Development: Graduates of the programme will have successful technical and managerial career in Avionics industries and aviation engineering management.

III. **PEO 3:** Contribution to Avionics Field: Graduates of the programme will have innovative ideas and potential to contribute for the development and current needs of the Aviation industries.

IV. **PEO 4:** Sustainable interest for Lifelong learning: Graduates of the programme will have sustained interest to learn and adapt new technology developments to meet the changing industrial scenarios.

PROGRAMME OUTCOMES (POs):

1. Post Graduate will acquire the ability to design, analyze as well as to conduct experiments to interpret data in the field of avionics engineering.

2. Post Graduate will demonstrate the ability to design a system or a component to meet the design requirements with constraints exclusively meant for Avionics Engineering.

3. Post Graduate will become familiar with modern engineering tools and analyze the problems within the domains of Avionics Engineering as a member of multidisciplinary teams.

4. Post Graduate will acquire an understanding of professional and ethical responsibility with reference to their career in the field of Avionics Engineering and other professional fields.

5. Post Graduate will be trained towards understanding the importance of design and development of Flight Control System, Navigation System and System Simulation from system integration point of view.

6. Post Graduate will be able to communicate effectively both in verbal and non verbal forms.

7. Post Graduate will be capable of understanding the value for life-long learning.

8. Post Graduate will have a firm scientific, technological and communication base that helps him to find a placement in the Aircraft industry and R & D organizations related to Avionics Engineering and other professional fields.

9. Post Graduate will be capable of doing doctoral studies and research in inter and multidisciplinary areas.
## MAPPING OF PEOS AND POS

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# M.E. Avionics Regulations-2015

## Choice Based Credit System Curricula and Syllabi

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ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.E.AVIONICS
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM
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# FOUNDATION COURSES (FC)

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## EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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OBJECTIVES:

- To encourage students to develop a working knowledge of the central ideas of linear algebra.
- To study and understand the concepts of probability and random variable of the various functions.
- Understand the notion of a Markov chain, and how simple ideas of conditional probability and matrices can be used to give a thorough and effective account of discrete-time Markov chains.
- To formulate and construct a mathematical model for a linear programming problem in real life situation.
- Introduce the Fourier Transform as an extension of Fourier techniques on periodic functions and to solve partial differential equations.

UNIT I LINEAR ALGEBRA 9+3

UNIT II ONE DIMENSIONAL RANDOM VARIABLES 9+3

UNIT III RANDOM PROCESSES 9+3
Classification – Auto correlation - Cross correlation - Stationary random process – Markov process — Markov chain - Poisson process – Gaussian process.

UNIT IV LINEAR PROGRAMMING 9+3
Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT V FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS 9+3

TOTAL: 45+15:60 PERIODS

OUTCOMES:
On successful completion of this course, all students will have developed knowledge and understanding in the fields of linear algebra, probability, stochastic process, linear programming problem and Fourier transform.

TEXT BOOKS:
REFERENCES:

AV7101 AVIONICS SYSTEM ENGINEERING  L T P C  3 0 0 3

OBJECTIVES:
- To provide exposure to basic concepts of Aircraft product system engineering, design and analysis of avionic systems.
- To provide exposure on systems engineering process, System Architecture and integration, Maintainability and reliability.

UNIT I INTRODUCTION TO SYSTEMS ENGINEERING  9

UNIT II THE AIRCRAFT SYSTEMS AND DESIGN  9

UNIT III SYSTEM ARCHITECTURES AND INTEGRATION  9

UNIT IV PRACTICAL CONSIDERATIONS AND CONFIGURATION CONTROL  9

UNIT V SYSTEMS RELIABILITY AND MAINTAINABILITY  9
Systems and Components-Analysis-Influence, Economics, Design for Reliability-Fault and Failure Analysis-Case Study-Maintenance Types-Program-Planning and Design.

TOTAL: 45 PERIODS

OUTCOME:
Upon completion of the course:
- The students will analyze the basic concepts of System Engineering and will acquire necessary knowledge that can be used to optimize the design and analysis of avionic systems.

REFERENCES:
2. Systems Engineering by Erik Aslaksen and Rod Belcher.
3. Design and Development of an Aircraft Systems by Ian Moir and Allan Seabridge.
5. Introduction to Systems Engineering by Andrew P. Sage and James E. Armstrong.
OBJECTIVES:
- To provide knowledge in the basic concepts of aerospace engineering including Aerodynamics, Aircraft performance, stability & control, Aircraft Structures and Propulsion.
- To provide knowledge on analysis of longitudinal/lateral/directional motions.

UNIT I CONFIGURATION OF AIRPLANE AND BASIC AERODYNAMICS 9

UNIT II AIRCRAFT PERFORMANCE 9
Straight and level flight – conditions for minimum Drag and minimum power – climbing and gliding – Range and Endurance – Take off and Landing – V-n diagram.

UNIT III STABILITY AND CONTROL 9

UNIT IV AIRCRAFT STRUCTURES 9
Introduction to Aircraft structures - Loads - Types of construction - Design feature of Aircraft materials.

UNIT V PROPULSION 9
Aircraft propulsion, Rocket propulsion, power plant classification, principles of operation, Areas of their application.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course,
- The students will explain the available basic concepts of aeronautical engineering to the engineers and the necessary mathematical knowledge that are needed in modeling physical phenomena involved.
- The students will also have an exposure on various topics such as Lift, Drag, aircraft performance, structure and propulsion and will be able to deploy these skills effectively in the understanding of concepts relating to an aircraft.

REFERENCES

AV 7105 ELECTRONIC SYSTEMS

OBJECTIVES:
- To provide knowledge in the basic concepts and applications of electronics systems including Operational Amplifiers, Digital Electronics, Microprocessors and Micro-Controllers.
- To introduce to analysis and design of feedback amplifiers and oscillatory circuits.
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

TOTAL: 45 PERIODS

OUTCOME:
- The Students will analyze the basic concepts of Electronic Systems, their design and operation.
- The students will also have an exposure on various topics such as Operational Amplifiers, Signal Generators, Digital Systems, Microprocessor and Microcontroller based systems
- Students will be able to deploy these skills effectively in understanding the systems and analyzing the electronic systems employed in avionics engineering.

REFERENCES:

AV 7103  DIGITAL AVIONICS
L T P C
3 0 0 3

OBJECTIVES:
- To introduce role of avionics system and its architecture
- To understand the avionics system design development and integration using simulation tools
- To know modular avionics packaging and EMI/EMC requirements in avionics
- To study system assessment, validation, certification and maintenance of avionics system
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  MAINTENANCE AND PACKAGING

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.

TOTAL: 45 PERIODS

OUTCOMES:
- To impart the basic concepts of Avionics Systems to the engineers.
- To provide the necessary knowledge on working of avionics systems in an aircraft.
- To give an exposure on various topics such as Avionics system architecture, Avionics bus systems, integration, display systems and packaging.
- To deploy these skills effectively in the understanding and analysis of avionics systems.

REFERENCES:
OBJECTIVES:
- To understand the advanced concepts of Opto-electronics and also the necessary domain knowledge that are needed for avionics applications
- To give exposure on basic of various optical phenomena and their application in avionics domain

UNIT I  INTRODUCTION  6

UNIT II  LASER SYSTEMS  9

UNIT III  INFRARED SYSTEMS  9
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.

UNIT IV  IMAGING DEVICES AND TRACKING SYSTEMS  12
Imaging tubes: Vidicon, Pyroelectricvidicon, 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  9
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.

TOTAL: 45 PERIODS

OUTCOMES:
- The students will also have an, working and applications of LASERs and Infrared imaging and tracking devices.
- To discuss the advanced topics relating to fiber-optic systems, allowing the avionics engineers to deploy these skills effectively in the design and development of optical systems in avionics engineering.

REFERENCES:
OBJECTIVES:
- To learn the concept of measurement, error estimation and classification of aircraft instrumentation and displays
- To study air data instruments and synchronous data transmissions systems
- To study gyroscope and its purposes, aircraft compass system and flight management system
- To study Data acquisition and handling systems
- To impart knowledge about the basic and advanced flight instruments, their construction, characteristics and their operation.

UNIT I MEASUREMENT SCIENCE AND DISPLAYS 9
Instrumentation brief review-Concept of measurement-Errors and error estimation- Functional elements of an instrument system –Transducers - classification - Static and dynamic characteristics- calibration- classification of aircraft instruments-Instrument displays panels and cockpit layout.

UNIT II AIR DATA INSTRUMENTS AND SYNCHRO TRANSMISSION SYSTEMS 9
Air data instruments-airspeed, altitude, Vertical speed indicators. Static Air temperature, Angle of attack measurement, Synchronous data transmission system

UNIT III GYROSCOPIC INSTRUMENTS 9
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 & FLIGHT MANAGEMENT SYSTEM 9
Direct reading compass, magnetic heading reference system-detector element, monitored gyroscope system, DGU, RMI, deviation compensator. FMS- Flight planning-flight path optimization-operational modes-4D flight management

UNIT V POWER PLANT INSTRUMENTS 9
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.

TOTAL: 45 PERIODS

OUTCOMES:
- The learners will be able to measure the error and can find the error estimation in the aircraft instruments
- The learners will be able know about the various air data systems and synchronous data transmissions systems
- The learners will be able to know the principle of gyroscope and its property, principle of DGU, RMI, FMS and its operation mode in 4D flight management.
- The students will also have an exposure to various topics such as measurement concepts, air data sensors and measurements, Flight Management Systems, and other instruments pertaining to Gyroscopic measurements and Engine data measurements and will be able to deploy these skills effectively in understanding and analyzing the instrumentation methods in avionics engineering.

REFERENCES:
OBJECTIVES:

- To provide practical knowledge in the basic concepts of avionic system integration and operation of basic civil and military avionic data bus.
- To install and Configure MIL-STD-1553B, ARINC 429 and AFDX data cards to transfer and receive data.

1. Testing of installation of MIL –STD-1553, ARINC-429 and ARINC -629 card (Self test)
3. Testing of installation and configuring of AFDX card in transmitting and receiving mode.
4. 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.
5. Transmit and receive the messages
   a) Using loop back connection with single card.
   b) Using connector (shielded pair of wires).
6. Development of Inertial Measurement Unit (IMU) based angle estimation based on Euler’s and Quaternion approach.
7. Development of Basic Flight stabilization for both rotary wing and fixed wing aircraft
8. Implementation of Aircraft primary data on both HUD and HMD Displays
9. Implementation of ADSP-BF 561 processor based real-time image processing application

TOTAL: 60 PERIODS

OUTCOME:

Upon completion of the course,

- The students will obtain practical knowledge on the avionic system integration and operation of avionic bus systems.
- The students will also have an experience of installation, working and testing of various avionic bus systems and will be able to deploy these skills effectively in understanding of systems in avionics engineering.
- Students will be able to install and Configure MIL-STD-1553B, ARINC 429 and AFDX cards in transmitting and receiving mode.
UNIT II INERTIAL NAVIGATION SYSTEMS

UNIT III RADIO NAVIGATION
Different types of radio navigation- ADF, VOR, DME - Doppler – Hyperbolic Navigations - 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.

TOTAL: 45 PERIODS

OUTCOMES:
• Upon completion of the course, students will explain the advanced concepts of Aircraft Navigation to the engineers and to provide the necessary mathematical knowledge that are needed in modeling the navigation process and methods.
• The students will have an exposure on various Navigation systems such as Inertial Measurement systems, Radio Navigation Systems, Satellite Navigation – GPS ; Landing aids and will be able to deploy these skills effectively in the analysis and understanding of navigation systems in an aircraft.

REFERENCES:

AV 7203 SYSTEM MODELLING AND SIMULATION FOR AVIONICS ENGINEERS

OBJECTIVES:
• To introduce the concepts of aircraft mathematical model and simulation of aircraft systems.
• To introduce the knowledge about various types of flight simulators and Probability concepts in simulation.
UNIT I  SYSTEM MODELS AND SIMULATION  7
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  8
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  10
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  12
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  8
Introduction, advantage of simulator, the effectiveness of Simulator, The user’s role, Simulator Certification, Data sources, Validation, in-flight simulators

TOTAL: 45 PERIODS

OUTCOME:
- Students will explain the advanced concepts of Mathematical Modeling and Simulation to the engineers and to provide the necessary mathematical knowledge that are needed in modeling physical processes.
- The students will have an exposure on various topics such as System Models, probability concepts in simulation and flight simulators.
- Students will be able to deploy the skills effectively in demonstrating the concepts and working of a flight simulator.

REFERENCES:

AL 7154  ROCKETRY AND SPACE MECHANICS  L T P C
3 0 0 3

OBJECTIVES:
- To impart knowledge on orbital mechanics and satellite dynamics.
- To provide knowledge on motion of rockets and its aerodynamics.
- To provide knowledge on rocket propulsion and multi staging of rockets.
- To give knowledge on satellite injection and its perturbations.
UNIT I ORBITAL MECHANICS

UNIT II SATELLITE DYNAMICS

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.

UNIT IV ROCKET AERODYNAMICS

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

TOTAL: 45 PERIODS

OUTCOME:
• Upon completion of this course, students will explain the advanced concepts in Rocketry and Space Mechanics to the engineers and provide the necessary mathematical knowledge that are needed in understanding the physical processes.
• The students will have an exposure on various topics such as Orbital Mechanics, Rocket Propulsion and Aerodynamics, Rocket Staging and will be able to deploy these skills effectively in the understanding of Rockets and like spacecraft systems.

REFERENCES:

AV 7201 AEROSPACE GUIDANCE AND CONTROL L T P C
3 0 0 3

OBJECTIVES:
• To learn about the operating principle of guidance law
• To study about the augmentation systems
• To study longitudinal stability and to design the longitudinal autopilot
• To study lateral stability and to design the lateral autopilot
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.

TOTAL: 45 PERIODS

OUTCOME:
• The learners will be able know about the various guidance schemes and missile type requirements
• The learners will be able to know the principle of stability and control augmentation systems
• The learners will be able to know about the Displacement, Pitch Orientation Control system Glide Slope Coupler and Automatic Flare Control systems.
• The learners will be able to know the damping of Dutchroll methods of Obtaining Coordination, Yaw Orientation Control system, turn compensation and Automatic lateral Beam Guidance.

REFERENCES:

AV 7211  AUTOMATIC FLIGHT CONTROL SYSTEMS LABORATORY

OBJECTIVES:
• To introduce the advanced concepts of flight control and required mathematical knowledge.
• To provide exposure on Root locus, analysis of stability through Root locus plots, Bode plot, Lead Lag compensator.
• To provide exposure on PID controller tuning, controller and autopilot design.

1. Stability analysis using Root locus, Bode plot, Nyquist plot and Polar plot techniques
2. Development of Longitudinal and Lateral Equations of Motion
3. Performance Improvement of Aircraft Dynamics by pole placement technique
4. Design of PID and LQR algorithm for aircraft dynamics
5. Design of Displacement longitudinal autopilot
6. Design of Automatic Glide Slope Control System and Flare Control System
7. Design of Automatic Lateral beam guidance system
8. Design of Van-Guard Missile system
9. Design of complementary filter and Kalman filter
10. Implementation of Hardware-In-Loop Simulation (HILS) for fixed wing aircraft
11. Implementation of open loop and closed loop control of Linear Electric Actuator.

TOTAL: 60 PERIODS

OUTCOME:
• Upon completion of this course, students will explain the advanced concepts of Flight Control to the engineers and provide the necessary mathematical knowledge that are needed in modeling the control processes.
• The students will have an exposure on various topics such as Root locus, analysis of stability through Root locus plots, Bode plot, Lead Lag compensator, PID controller and tuning, controller and autopilot design and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

NOTE: Implementation using X-plane, Flight-Gear & Aerosim (experiments from 5 to 11)

AV 7301 DIGITAL FLY-BY WIRE CONTROL L T P C
3 0 0 3

OBJECTIVES:
• To impart the knowledge on the concepts of digital fly-by-wire controls and their importance in understanding modern aircraft control strategies.
• To introduce different DFBW architectures, redundancy and reliability.
• To provide knowledge on active control technology, design issues and generic failures.

UNIT I INTRODUCTION TO FLY-BY-WIRE CONTROL
Need for FBW 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

TOTAL: 45 PERIODS
OUTCOMES:
- Upon completion of this course, students will explain the advanced concepts of Fly-by-wire to the engineers and provide the necessary mathematical knowledge that are needed in understanding modern aircraft control strategies.
- The students will have an exposure on various topics such as evolution of FBW, Elements, architecture, design and design issues of DFBW.
- The students will be able to deploy these skills effectively in the analyzing and understanding modern control methods.

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)

AV 7302 UAV SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES:
- To introduce basic concepts of UAV
- To understand the basics of airframe
- To understand the avionics hardware
- To know communication payloads and controls and design considerations.
- To study path planning, Micro Aerial Vehicles and UAV certification standards.

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

UNIT II BASICS OF AIRFRAME

UNIT III AVIONICS HARDWARE
Autopilot –AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply processor, integration, installation, configuration, and testing

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS
Payloads–Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –SAS-flight director-commands and videos-elements of control loops-flight computer sensor-displays-parameter settings-modems-memory system-simulation-ground test-analysis troubleshooting

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

TOTAL: 45 PERIODS

OUTCOMES:
- Upon completion of this course, students will explain the advanced concepts of UAV System Design to the engineers and provide the necessary mathematical knowledge that are needed in modeling and analyzing an unmanned system.
- The students will have an exposure on various topics such as Design and development of UAVs, payloads and design standards, concluding with case studies of different such unmanned systems and will be able to deploy these skills effectively in the solution of problems in avionics engineering.
REFERENCES:
1. Jane’s Unmanned Aerial Vehicles and Targets, Jane’s Information Group; ASIN: 0710612575, 1999

AV 7001  ACTIVE CONTROL TECHNOLOGY  L T P C  3 0 0 3

OBJECTIVES:
- To introduce to the concepts of fly-by-wire, active control technology and its functions.
- To provide knowledge on automatic configuration management, active control design considerations.
- To impart knowledge on flying qualities and principles control modes of combat aircraft.

UNIT I  ACTIVE CONTROL FUNCTIONS  12
Introduction-active control technology concepts-control configured vehicle-Design Philosophy, Aerodynamics: Relaxed static stability, Automatic Configuration management, side force control, Structures, Maneuuvre 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  5
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  8
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  13
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  7
Pitch rate Command - Attitude hold system - Carefree maneuvering - spin-stall prevention and similar limiting concepts - Combat maneuvers.

TOTAL: 45 PERIODS
OUTCOMES:
- Upon completion of this course, students will explain the advanced concepts in Active Control Technology to the engineers and provide the necessary mathematical knowledge that are needed in modeling physical processes.
- The students will have an exposure on various topics such as Automatic configuration management, design considerations, fly-by-wire concepts, flying qualities and control modes of combat aircraft and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:

AV 7002 AIRBORNE ACTUATORS AND SENSORS L T P C 3 0 0 3

OBJECTIVES:
- To learn the concept of actuation systems and its type
- To learn the concept of servo components
- To study modeling, design and testing of aircraft actuation systems
- To understand the principles of gyroscope, gyro equation and test methodologies
- To learn the concept of sensor testing
- To introduce various types of aircraft actuation systems, inertial sensors, modelling and testing of 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 Gyroscopes - 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.

TOTAL: 45 PERIODS

OUTCOMES:
- The learners will be able to explain the principle of actuation system and types of actuation system
- The learners will be able to apply the principle of servo valves and servo amplifiers pick-offs
- The learners will be able to perform design and testing on actuation systems
- The learners will be able to discuss the principle, theory and application of inertial sensors.
• The learners will able to perform testing on sensor.
• The students will have an exposure on various topics such as aircraft actuation systems, servo-components, inertial sensors, modeling, design and testing of sensors and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:

AV 7003 AIRBORNE FIRE CONTROL L T P C
3 0 0 3

OBJECTIVES:
To impart knowledge on
i. Weapon fire control and its problem for projectiles
ii. Features of fire control systems
iii. Computing systems for weapon firing

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.

TOTAL: 45 PERIODS

OUTCOME:
• Upon completion of this course, students will explain the advanced concepts in Airborne Fire control to the engineers and provide the necessary practical knowledge that are needed in handling airborne safety related issues.
• The students will have an exposure on various topics such as Fire control, problems and it features systems to control fire and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:
OBJECTIVES:

- To provide exposure to advanced concepts of Aircraft product and system engineering, standards and certification.
- To provide the necessary knowledge to design and development of new aircraft systems.
- To provide exposure on Avionic system engineering design life cycle, design standards and certification, DO-178B and DO 254 standards

UNIT I  
AVIONICS SYSTEM ENGINEERING DEVELOPMENT CYCLE  
8

UNIT II  
SYSTEMS ENGINEERING MANAGEMENT AND CERTIFICATION OF AVIONICS SYSTEMS  
12

UNIT III  
SOFTWARE CONSIDERATIONS IN AIRBORNE SYSTEMS AND EQUIPMENT CERTIFICATION (DO-178B)  
9

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

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

TOTAL: 45 PERIODS
OUTCOMES:

- Upon completion of this course, students will explain the advanced concepts of Aircraft product and system engineering, standards and certification to the engineers and provide the necessary knowledge that are needed in design and development of new aircraft systems.
- The students will have an exposure on various topics such Avionic system engineering design life cycle, design standards and certification, DO-178B and DO 254 standards and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:

7. SAE ARP4754, Certification Considerations for Highly-Integrated or Complex Aircraft Systems, SAE, Warrendale, PA, 1996.

AV 7005 

AVIONICS NETWORK TECHNOLOGY 

L T P C 3 0 0 3

OBJECTIVES:

- To impart knowledge about the most important avionics network architectures
- To introduce various network topology in an aircraft.

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.

TOTAL: 45 PERIODS

OUTCOMES:
- Students will explain the advanced concepts of Avionics Networking Technology to the engineers and provide the necessary knowledge that are needed in understanding the related processes.
- The students will have an exposure on various networks in an aircraft ranging from optical, telecommunication, wireless sensor network and military avionics network and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:

AV 7006 DISPLAY ENGINEERING L T P C 3 0 0 3

OBJECTIVES:
- To provide basic knowledge on the types pf displays, their operation and characteristics.
- To impart knowledge on the different cockpit displays, their characteristics, display processor, and its requirements & architecture.
- To provide knowledge on different technologies involved in computer graphics.

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  10

UNIT III  DISPLAY PROCESSOR REQUIREMENTS & ARCHITECTURE  8

UNIT IV  COCKPIT EVALUATOR  8
Generation of display symbologies with facilities for quick modification and evaluation Cockpit Information and Display Controls organization and Optimization.

UNIT V  COMPUTER GRAPHICS  10

TOTAL: 45 PERIODS

OUTCOME:
- Upon completion of this course, students will explain the advanced concepts of Display systems to the engineers and provide the necessary domain knowledge that are needed in understanding display systems.
- The students will have an exposure on various display systems, cockpit display, display architecture and graphics pertaining to aircraft display systems and will be able to deploy these skills effectively in the design and development of display systems for aircrafts.

REFERENCES:
OBJECTIVES:

- To introduce basics of image processing and transformation features
- To have a clear view about image reconstruction using projections
- To see the image pattern recognition and estimation and clustering procedures.
- To introduce the basic theory used in digital image processing for aerospace applications
- To expose students to current technologies and issues that are specific to image processing systems.

UNIT I  FUNDAMENTALS OF IMAGE PROCESSING


UNIT II  IMAGE ENHANCEMENT AND CAMERA CALIBRATION


UNIT III  IMAGE SEGMENTATION AND FEATURE ANALYSIS


UNIT IV  MULTI RESOLUTION ANALYSIS


UNIT V  AEROSPACE APPLICATIONS


TOTAL: 45 PERIODS

OUTCOME:

- To discuss the working of image processing, point operations and colour image enhancement and restoration.
- Students will explain the advanced concepts of Image processing for aerospace applications to the engineers and provide the necessary mathematical knowledge that are needed in modeling physical processes.
- The students will have an exposure on various topics such as Image enhancement, Wavelet transforms, multi-resolution analysis and vision based navigation and control and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:

OBJECTIVES:
• To introduce the advanced concepts of flight testing instruments, telemetry systems, and data acquisition systems
• Students will understand the advanced concepts of ground telemetry station and range instrumentation.

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

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

UNIT III TELEMETRY SYSTEM
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

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

OUTCOMES:
• Students will explain the advanced concepts of Flight testing instruments to the engineers and provide the necessary mathematical knowledge that are needed in understanding the process involved.
• The students will have an exposure on various topics such as Principles and concepts of measurement and instrumentation, Data acquisition, Telemetry and Range instrumentation and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:
OBJECTIVES:

- To introduce basics of orbital mechanics and various performance parameters
- To know about spacecraft subsystems and payload operations
- To get knowledge about multiple access systems and Network aspects in existing & planned sub systems
- To know about various mobile and fixed services feasible in satellite and classification of various satellites based on platforms
- To introduce to the concepts of telemetry tracking and telecommand.

UNIT I ELEMENTS OF SATELLITE COMMUNICATION


UNIT II TRANSMISSION, MULTIPLEXING, MULTIPLE ACCESS AND CODING

Different modulation and Multiplexing Schemes, Multiple Access Techniques FDMA, TDMA, CDMA, and DAMA, Coding Schemes, Satellite Packet Communications.

UNIT III SATELLITE LINK DESIGN

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

UNIT IV SATELLITE TELEMETRY, TRACKING AND TELECOMMAND

Introduction to telemetry systems - Aerospace transducer - signal conditioning – multiplexing methods - Analog and digital telemetry - Command line and remote control system - Application of telemetry in spacecraft systems - Base Band Telemetry system - Computer command & Data handling, Satellite command system-Issues.

UNIT V APPLICATIONS

VSAT-VSAT Technologies, Networks MSS-AMSS, MMSS

OUTCOMES:

- Upon completion of this course, students will explain the advanced concepts of Spacecraft communication systems to the engineers and provide the necessary mathematical knowledge that are needed in understanding the physical processes.
- The students will have an exposure on various topics such as Orbital mechanics, elements of satellite communication system, links and multiplexing, multiple access, telemetry, tracking and telecommand and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:

OBJECTIVES:
- To provide basic knowledge on the concept of fault tolerance and redundancy.
- To learn about the error detection and correction techniques.
- To study about the system architectures, integration, practical considerations and configuration.
- To study system reliability and maintainability.

UNIT I  FAULT TOLERANCE  10

UNIT II  ERROR DETECTION  8

UNIT III  ERROR RECOVERY  12

UNIT IV  SOFTWARE FAULT TOLERANCE  8
The recovery block scheme – Implementation of recovery block – Acceptance – tests – run-time Overheads.

UNIT V  SYSTEMS STRUCTURE AND RELIABILITY  7

TOTAL: 45 PERIODS

OUTCOMES:
- Upon completion of this course, students will explain the advanced concepts of Fault Tolerance to the engineers and provide the necessary mathematical knowledge that are needed in understanding the necessary procedures involved.
- The students will have an exposure on various topics such as Redundancy, Fault Tolerant system architecture and design, error handling and recovery and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:
OBJECTIVES:
- To familiarize with soft computing concepts.
- To introduce the ideas of Neural Networks, fuzzy logic and use of heuristics based on human experience.
- To introduce the concepts of Genetic algorithm and its applications to soft computing using some applications.

UNIT I NEURAL NETWORKS

UNIT II FUZZY SET THEORY

UNIT III OPTIMIZATION METHODS

UNIT IV NEURAL AND FUZZY CONTROL SCHEMES
Direct and Indirect Neuro Control Schemes – Fuzzy Logic Controller – Familiarization of Neural Network and Fuzzy Logic Toolbox - Case Studies.

UNIT V NEURO FUZZY MODELLING

TOTAL:45 PERIODS

OUTCOME:
- Students will explain the advanced concepts of Soft-computing to the engineers and provide the necessary mathematical knowledge that are needed in modeling the related processes.
- The students will have an exposure on various topics such as Neural Networks, Fuzzy logic and Neuro-fuzzy modeling
- Students will be able to deploy the skills effectively in the solution of problems in avionics engineering.

REFERENCES:
OBJECTIVES:
- To understand the basics of embedded system, architecture of PIC microcontroller and ARM processor.
- To understand the RTOS concepts like scheduling and memory management related to the embedded system.
- To learn the protocols of embedded wireless application.
- To understand concepts involved in the design of hardware and software components for an embedded system.

UNIT I INTRODUCTION

UNIT II EMBEDDED/REAL TIME OPERATING SYSTEM

UNIT III CONNECTIVITY

UNIT IV REAL TIME UML

UNIT V SOFTWARE DEVELOPMENT AND CASE STUDY

OUTCOMES:
- To be able to make a choice a suitable embedded processor for a given application.
- To be able to design the hardware and software for the embedded system.
- To be able to design and develop the real time kernel/operating system functions, task control block structure and analyze different task states.
- To be able to implement different types of inter task communication and synchronization techniques.

REFERENCES:
OBJECTIVES:

- To introduce satellite systems and their different configurations.
- To introduce satellite sub systems like power system, telemetry system, attitude and orbit control system, their design and problems involved with it.
- To provide knowledge on propulsion systems, structures and thermal control.

UNIT I  SATELLITE MISSION AND CONFIGURATION  9

UNIT II  POWER SYSTEM  8

UNIT III  ATTITUDE AND ORBIT CONTROL SYSTEM  9
Coordinate system – AOCS requirements – Environment effects – Attitude stabilization – Attitude sensors – Actuators – Design of control algorithms.

UNIT IV  PROPULSION SYSTEMS, STRUCTURES AND THERMAL CONTROL  11

UNIT V  TELEMETRY SYSTEMS  8
Base Band Telemetry system – Modulation – TT & C RF system – Telecommand system – Ground Control Systems

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of this course, students will explain the advanced concepts of satellite architecture and technology to the engineers and provide the necessary mathematical knowledge that are needed in modeling physical processes.
- The students will have an exposure on various satellite sub-systems ranging from telemetry, attitude and orbital control, propulsion, structure and satellite mission related concepts and will be able to deploy these skills effectively in the solution of problems in avionics engineering

REFERENCES:
OBJECTIVES:
- To understand the concepts related to Electromagnetic interference in PCBs
- To provide solutions for minimizing EMI in PCBs
- To learn EMI standards in the design of PCBs
- To learn various EMI coupling principles, EMI standards and measurements
- To provide knowledge on EMI control techniques and design procedures to make EMI compatible PCBs

UNIT I  EMI/EMC CONCEPTS  9
EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards.

UNIT II  EMI COUPLING PRINCIPLES  9
Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling; Near field cable to cable coupling, cross talk; Field to cable coupling; Power mains and Power supply coupling.

UNIT III  EMI CONTROL TECHNIQUES  9
Shielding, Filtering, Grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control.

UNIT IV  EMC DESIGN OF PCBs  9
Component selection and mounting; PCB trace impedance; Routing; Cross talk control; Power distribution decoupling; Zoning; Grounding; VIAs connection; Terminations.

UNIT V  EMI MEASUREMENTS AND STANDARDS  9
Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx/Rx Antennas, Sensors, Injectors/Couplers, and coupling factors; EMI Rx and spectrum analyzer; Civilian standards - CISPR, FCC, IEC, EN; Military standards-MIL461E/462.

TOTAL: 45 PERIODS

OUTCOMES:
- Analyze Electromagnetic interference effects in PCBs
- Propose solutions for minimizing EMI in PCBs
- Analyze Electromagnetic environment, EMI coupling, standards, measurement and control techniques

REFERENCES
OBJECTIVES:

- To introduce history and classifications of Missile systems and basics of trajectories.
- To have a clear view about Aerodynamic characteristics of missiles and performance of missiles under testing.
- To know about principles of Rocket and jet propulsion and nozzle characteristic parameter.
- To study the types of navigation used in missiles and their characteristics.
- To compute trajectory calculations for ballistic missiles.

UNIT I  MISSILE SYSTEMS  8
Introduction - history - classification - missile system elements, missile ground systems - radars – launchers, coordinate frames, basics of trajectory dynamics.

UNIT II  AERODYNAMICS  9
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  8
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  12

UNIT V  MISSILE TRAJECTORY CALCULATIONS  8
Vertical, inclined and gravity turn trajectories – determination of range and altitude- numerical computation of ballistic trajectories.

OUTCOME:
The student should able to:

- To demonstrate the working of a Missile system and launchers in co-ordinate frames.
- To discuss about design methodology of missiles and detailed view about aerodynamic loads and experimental methods.
- To explain about propulsion principles and staging of vehicles in space.
- To differentiate the types of navigation systems and their pros and cons.
- To have thorough knowledge in calculation of ballistic missile trajectories.

REFERENCES:
OBJECTIVES:

- To introduce different co-ordinate transformation techniques and basic missile equations of motion.
- To introduce types of missile airframes and autopilots.
- To introduce different missile guidance and control techniques.
- To introduce to weapon delivery system and the problems involved in it.

UNIT I MISSILE SYSTEMS INTRODUCTION 8
History of guided missile for defence applications- Classification of missiles— The Generalized Missile Equations of Motion- Coordinate Systems- Lagrange’s Equations for Rotating Coordinate Systems- Rigid-Body Equations of Motion-missile system elements, missile ground systems.

UNIT II MISSILE AIRFRAMES, AUTOPILOTS AND CONTROL 9

UNIT III MISSILE GUIDANCE LAWS 10

UNIT IV STRATEGIC MISSILES 10

UNIT V WEAPON DELIVERY SYSTEMS 8

TOTAL : 45 PERIODS

OUTCOME:

- Upon completion of this course, students will explain the advanced concepts of Missile Guidance and control to the engineers and provide the necessary mathematical knowledge that are needed in modeling physical processes.
- The students will have an exposure on various topics such as Types of missiles, missile airframe, control and autopilot, guidance laws and weapon delivery system and will be able to deploy these skills effectively in the solution of problems in missile control technology.

REFERENCES:

OBJECTIVES:

- To understand the concepts of detection and estimation.
- To learn the basics of multi-user detection theory.
- To understand the theory behind various estimation techniques.
- To understand Wiener filter and Kalman filter in detail.

UNIT I REVIEW OF PROBABILITY AND STOCHASTIC PROCESS 9+3


UNIT II SINGLE AND MULTIPLE SAMPLE DETECTION 9+3

Hypothesis Testing and the MAP Criterion, Bayes Criterion, Minimax Criterion, Neyman-Pearson Criterion, Sequential Detection, The Optimum Digital Detector in Additive Gaussian Noise, Performance of Binary Receivers in AWGN.

UNIT III FUNDAMENTALS OF ESTIMATION THEORY 9+3


UNIT IV WIENER AND KALMAN FILTERS 9+3


UNIT V APPLICATIONS 9+3

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.

TOTAL:60 PERIODS

OUTCOMES:

- To be able to apply detection and estimation theory to solve communication problems.
- To apply probability and stochastic process concepts in detection and estimation.
- To design Wiener and Kalman filters to solve linear estimation problems.

REFERENCES:

OBJECTIVES:
- To introduce principles of electronic warfare, electronic support measure and electronic counter measures
- To understand the Radar Warning Receivers trends in display technology
- To understand the Radar detection performance low RCS aircraft
- To know EM sensor subsystem, Mile parameter tracking
- To study electronic counter - counter measures (ECCM)

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.

OUTCOMES:
The student should able to:
- To discuss the electronic warfare
- To explain the electronic support measure and electronic counter measures
- To development and integration using Radar detection performance low RCS aircraft
- To demonstrate the receiver subsystem, the pre-processor and the data servo loop - Mile parameter tracking
- To explain system assessment, counter measures (ECCM)

REFERENCES:
OBJECTIVES:
- To provide knowledge on the Fault-tolerant systems, fault diagnosis, adaptive control, robust control, and redundancy control and study future issues.
- To learn design of parametric faults and decoupling from disturbance.
- To understand the principles of fault diagnosis

UNIT I INTRODUCTION
Scope of Approaches to fault detection and diagnosis: Model free methods and Model based methods - Introduction to Random variables-Distribution-Bivariate distribution- Multivariate distribution-Normal distribution-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

OUTCOMES:
- Upon completion of this course, students will explain the advanced concepts of Fault Tolerant Control to the engineers and provide the necessary mathematical knowledge that are needed in modeling physical processes.
- The students will have an exposure on various topics such as Multivariate distribution, likelihood distribution, analytical redundancy concept, parity equation and directional residual and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:
AV 7010 FLIGHT DYNAMICS L T P C 3 0 0 3

OBJECTIVES:
- To provide knowledge on theory and methods for describing and predicting the motions of aircraft.
- The course introduces students to the performance, stability, and control of airborne vehicles.
- Topics include equations of motion, configuration aerodynamics, analysis of linear systems, and longitudinal/lateral/directional motions.

UNIT I FLIGHT DYNAMICS 8
General equation of motion for rigid airplane – concept of equilibrium - Aerodynamic and thrust forces and forward motion – steady state – Perturbed state.

UNIT II STEADY STATE STABILITY AND CONTROL 9
Static – Straight-line flight – Maneuvering, flight design for dynamic stability and response requirements – importance of stability derivatives.

UNIT III STABILITY AND CONTROL OF THE ELASTIC AIRPLANE 8
Frequency response of airplane – atmospheric disturbances and their effects on flight – effect of atmospheric turbulence on flight stability.

UNIT IV DESIGN AND ORIENTATION 10
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.

UNIT V SYSTEM AND MISSION ORIENTATION 10

TOTAL: 45 PERIODS

OUTCOMES:
- Upon completion of this course, students will explain the advanced concepts of Flight Mechanics and exhibit the necessary mathematical knowledge that are needed in modeling physical processes.
- The students will have an exposure on various topics such as Equations of motion, stability and control, design and orientation and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:
AV 7011 FLIGHT SIMULATION FOR COMBAT AIRCRAFT SYSTEM

OBJECTIVES:
- To introduce to the basics of flight simulation and avionics systems simulation.
- To provide detailed idea on cockpit signal, simulation system and interfaces.
- To provide knowledge on Simulator certification standards.

UNIT I INTRODUCTION TO FLIGHT SIMULATION
Introduction to Simulation, basics of modeling and simulation, Combat simulation techniques, System Architecture, simulation Roles, Introduction to real time operating system, Simulation standards, Hardware and software requirements

UNIT II COCKPIT SIGNAL AND SIMULATION SYSTEM AND INTERFACES
Cockpit, Displays, Ergonomics, Reachability & Controls, Operating Procedure, Cockpit Lighting, Workload assessment, Data Acquisition, B1553, Rs422, Fiber optics, AFDX, STANAG, Real time networks, Analog and discrete I/Os, LVDTs and RVDTs,

UNIT III AVIONICS SYSTEM SIMULATION

UNIT IV ENVIRONMENTAL SYSTEM SIMULATION AND INSTRUCTOR STATION
Terrain map generation, Fly through simulation, Pilot views, Special effects, Seamless image generation, culling and Rendering, Control station, Brief and debrief station, Test station, Data Management system, Mission scenario generation and Target models

UNIT V INTEGRATION & CERTIFICATION
Transport Delay and Latency Testing Methods, simulator verification and validation, Integration methods, Configuration management, Types of evaluations Conduct of evaluations, simulator qualification, Certification process-Case studies: F-16A Full Mission Simulator, LCA combat simulator, Air Combat Simulators for various air forces

OUTCOMES:
- Upon completion of this course, students will explain the advanced concepts of Flight simulation for combat aircraft system to the engineers and provide the necessary mathematical knowledge that are needed in modeling physical processes.
- The students will have an exposure on various topics such as Flight simulation, cockpit signals and simulation, environment simulation and avionic system simulation and integration and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:
2. David Allerton, “PRINCIPLES OF FLIGHT SIMULATION”, Department of Automatic Control and Systems Engineering, The University of Sheffield, 2009
OBJECTIVES:
- To study the principles, types of radar and its signal processing.
- To understand the theoretical principles underlying microwave sources for RADAR.
- To learn about RADAR tracking.

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

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

TOTAL: 45 PERIODS

OUTCOME:
- To be able to design a radar system.
- To be able to design and implement radar tracking algorithms.
- To be able to describe the types of microwave sources

REFERENCES:
OBJECTIVES:

- To introduce the advanced concepts of human engineering and Man Machine Systems.
- To introduce design criteria for information displays, Anthropometry and aviation related human stress management.

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 cockpits, 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.

TOTAL: 45 PERIODS

OUTCOMES:

- Students will understand the advanced concepts of Human Engineering to the engineers and to provide the necessary mathematical knowledge that are needed in modeling physical processes.
- The students will have an exposure on various topics such as Man-machine systems, Anthropometry, Human stress management, human system interface and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:


OBJECTIVES:

- To introduce the basic knowledge on avionics system engineering and avionic subsystems.
- To introduce the avionic software standards & requirements and safety issues.
- To introduce to on board Navigation systems, FMS and HMI.
UNIT I   SYSTEM ENGINEERING  9
System engineering overview, system engineering contract process, Technical process, H/w & S/w life cycle, Avionics systems includes FMS, BITE, Air traffic management systems, cockpit display system, Navigation, Mission management system, TCAS

UNIT II  ON BOARD SOFTWARE  8
Introduction to FAR, JAR.25-1309 regulations & DO-178 standards. System aspects and software levels. Software development requirements, verification requirements, software configuration management requirements, software quality assurance requirements according to levels- case study.

UNIT III SAFETY OF COMPLEX SYSTEMS  9
Introduction & objectives-Definition of basic concepts, certification regulations, analysis methods, Dependability techniques and tools- FMEA, FTA, combined failures, Reliability of systems, standards, methods of reliability analysis, certificate of Airworthiness, Risk management concepts – case study.

UNIT IV  ON BOARD NAVIGATION SYSTEMS  9
Over view of navigational aids, Flight planning, Area navigation, required time of arrival, RNAV architecture, performance aspects, approach and landing challenges, regulatory and safety aspects, GPS and GNSS characteristics, Receiver autonomous integrity monitoring(RAIM).

UNIT V   FMS & HUMAN MACHINE INTERFACE  10
Introduction, ARINC 424, Aircraft Performance, Aircraft Guidance, Flight plan, Trajectory and prediction, Position determination, VNAV, Flight Management Computer, control display unit, control display page function, flight management function, Navigation display system, Tactical display, FMS Graphical Flight Planning display, cockpit display system, aircraft display control panel.

TOTAL: 45 PERIODS

OUTCOMES:
• Upon completion of this course, students will explain the advanced concepts of Industrial avionics to the engineers and provide the necessary knowledge that are needed in understanding relevant processes.
• The students will have an exposure on various topics such as System Engineering, on-board software, safety of complex systems, FMS, ARINC 424 and Human interface and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

REFERENCES:
2. Introduction to Systems Engineering by Andrew P.Sage and James E.Armstrong
3. Civil Avionics systems by Ianmoir and Allan seabridge , Professional Engineering Publishing Limited, London and Bury St Edmunds, UK

AV 7017   PROGRAMMING IN ADA  L T P C 3 0 0 3

OBJECTIVES:
• To learn the concept of object oriented programming
• To learn about the ADA data types
• To study about the ADA packages
• To study about the parallel programming
• To study the interface with other languages
UNIT I  OBJECT ORIENTED PROGRAMMING  
Overview- History of Ada, Inheritance, dynamic dispatching (polymorphism)- Encapsulation.

UNIT II  ADA DATA TYPES  
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  
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  
Access types-declaration -unbounded types, unchecked deal location-task and protected types multitasking.

UNIT V  INTERFACING WITH OTHER LANGUAGES  
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

TOTAL: 45 PERIODS

OUTCOMES:
- The learners will be able to apply the principles of Ada and encapsulation
- The learners will be able to analyze structure, types, Boolean loop and iteration
- The learners will be able to demonstrate the I/O capabilities, generics, packages and definition
- The learners will be able to discuss Access types, declaration, unbounded types, unchecked deal location-task and protected types- multitasking, Interfacing with C, Java vs Ada, Ada applets, Java interfaces and aliased components

REFERENCES: