UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY CHENNAI : : CHENNAI 600 025

REGULATIONS - 2009

CURRICULUM I TO IV SEMESTERS (FULL TIME)

M.E. AVIONICS

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MA9116	Applied Mathematics for Avionics Engineers	3	1	0	4
2	AV9111	Digital Avionics	3	0	0	3
3	AV9112	Electro-optic systems	3	0	0	3
4	AV9113	Flight Instrumentation	3	0	0	3
5	AV9115 **AV9116**	**Bridge Course** Aircraft Engineering (For Non-Aero students) (OR) Electronic Systems (For Aero students)	3	0	0	3
6	E1	Elective I	3	0	0	3
PRACTICAL						
7	AV9118	Avionics Integration Lab	0	0	4	2
		TOTAL	**18**	**1**	**4**	**21**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	AV9121	Navigation Systems	3	0	0	3
2	AV9122	Aerospace Guidance and Control	3	0	0	3
3	AV9123	Mathematical Modeling & Simulation	3	0	0	3
4	AV9124	Rocketry & Space Mechanics	3	0	0	3
5	E2	Elective II	3	0	0	3
6	E3	Elective III	3	0	0	3
PRACTICAL						
7	AV9127	Flight Control Lab	0	0	4	2
		TOTAL	**18**	**0**	**4**	**20**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	E4	Elective IV	3	0	0	3
2	E5	Elective V	3	0	0	3
3	E6	Elective VI	3	0	0	3
PRACTICAL						
4	AV9134	Project Work (Phase I)	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	AV9141	Project Work (Phase II)	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

Total no.of credits to be earned for the award of Degree = 68

UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY CHENNAI : : CHENNAI 600 025

REGULATIONS - 2009

CURRICULUM I TO VI SEMESTERS (PART TIME)

M.E. AVIONICS

SEMESTER – I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MA9116	Applied Mathematics for Avionics Engineers	3	1	0	4
2	AV9111	Digital Avionics	3	0	0	3
3	AV9115	Aircraft Engineering	3	0	0	3
PRACTICAL						
4	AV9118	Avionics Integration Lab	0	0	4	2
		TOTAL	9	1	4	12

SEMESTER – II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	AV9122	Aerospace Guidance and Control	3	0	0	3
2	AV9124	Rocketry & Space Mechanics	3	0	0	3
3	E1	Elective - I	3	0	0	3
PRACTICAL						
4	AV9127	Flight Control Lab	0	0	4	2
		TOTAL	9	0	4	11

SEMESTER – III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	AV9112	Electro-Optic Systems	3	0	0	3
2	AV9113	Flight Instrumentation	3	0	0	3
3	E2	Elective - II	3	0	0	3
		TOTAL	9	0	0	9

SEMESTER – IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	AV9121	Navigation Systems	3	0	0	3
2	AV9123	Mathematical Modeling & Simulation	3	0	0	3
3	E3	Elective - III	3	0	0	3
		TOTAL	9	0	0	9

SEMESTER V

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	E4	Elective IV	3	0	0	3
2	E5	Elective V	3	0	0	3
3	E6	Elective VI	3	0	0	3
PRACTICAL						
4	AV9134	Project Work (Phase I)	0	0	12	6
		TOTAL	9	0	12	15

SEMESTER – VI

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1	AV9141	Project Work (Phase II)	0	0	24	12
		TOTAL	0	0	24	12

Total no. of credits to be earned for the award of Degree = 68

LIST OF ELECTIVES

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1	AV9151	Digital Fly-By-Wire Control	3	0	0	3
2	AV9152	Avionics System Engineering	3	0	0	3
3	AV9153	Display Engineering	3	0	0	3
4	AV9154	Fault Tolerant Computing	3	0	0	3
5	AV9155	Programming in Ada	3	0	0	3
6	NE9164	Microwaves and Radar	3	0	0	3
7	AV9166	Electronic Warfare	3	0	0	3
8	AV9164	Instrumentation for Flight testing	3	0	0	3
9	AV9168	Human Engineering	3	0	0	3
10	AV9169	UAV System Design	3	0	0	3
11	AV9170	Aircraft Product &System Engineering, Standards & Certification	3	0	0	3
12	AV9171	Active Control Technology	3	0	0	3
13	AV9172	Airborne Fire Control	3	0	0	3
14	AV9173	Flight Mechanics	3	0	0	3
15	AV9174	Missile Technology	3	0	0	3
16	AV9175	Fault Tolerant Control	3	0	0	3
17	AV9176	Satellite Architecture and communication	3	0	0	3
18	CP9167	Digital Image Processing	3	0	0	3
19	AV9177	Airborne Actuators & Sensors	3	0	0	3
20	NE9156	Real Time Embedded System	3	0	0	3
21	AV9178	Electromagnetic Interference and Compatibility	3	0	0	3
22	NE9167	Detection and Estimation theory	3	0	0	3
23	CP9159	Soft computing	3	0	0	3
24	AV9179	Avionics Network Technology	3	0	0	3

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MA9116 APPLIED MATHEMATICS FOR AVIONICS ENGINEERS

L T P C
3 1 0 4

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

Graphs – Sub graphs – Complements – Graph isomorphism – Vertex degree – Eulerian graphs – Planar graphs – Hamiltonian graphs.

UNIT V RANDOM PROCESSES 12

Classification – Stationary random processes – Markov process – Auto correlation and Cross correlation functions.

L: 60

TEXT BOOKS:

1. Stephenson.G, Radmore.P.M. "Advanced Mathematical Methods for Engineering and Science students", Cambridge University Press 1999.
2. Kreyszig.E, "Advaned Engineering Mathematics", John Wiley, 9th Edition, 2006.
3. Boyce & DiPrima, with ODE Architect CD, 8th Edition, 2005.

REFERENCES:

1. Jain.M.K. Iyengar.S.R.K. And Jain.R.K. "Numerical Methods for Scientific & Engineering Computation", Wiley Eastern Ltd., 1987.
2. Bronson.R. Matrix Operations, "Schaum's outline series", Mc Graw Hill, New York, 1989.

AV9111 DIGITAL AVIONICS

L T P C
3 0 0 3

UNIT I INTRODUCTION TO AVIONICS 4

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 11

MIL-STD-1553B, ARINC-429, ARINC-629, CSDB, AFDX and its Elements, Avionics system design, Development and integration-Use of simulation tools, stand alone and integrated Verification and Validation.

UNIT III AVIONICS SYSTEM ESSENTIALS: DISPLAYS, I/O DEVICES AND POWER 11

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 4

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

UNIT V SYSTEM ASSESSMENT, VALIDATION AND CERTIFICATION 11

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 4

BIT and CFDS, Automatic Test Equipment - Speeds maintenance - ATLAS, Remote diagnostics and maintenance support-Life Cycle Costs for Military and Civil Avionics - Cash flow analysis - Software costs - Establishing spares level.

L: 45.

REFERENCES:

1. Spitzer, C.R. "Digital Avionics Systems", Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.
2. Cary R .Spitzer, "The Avionics Handbook", CRC Press, 2000.
3. Collinson R.P.G. "Introduction to Avionics", Chapman and Hall, 1996.
4. Middleton, D.H. "Avionics Systems", Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
5. Jim Curren, "Trend in Advanced Avionics", IOWA State University, 1992.

AV9112 ELECTRO OPTIC SYSTEMS

L T P C
3 0 0 3

UNIT I INTRODUCTION 6

Electro Magnetic spectrum, Thermal radiation, Laws of Black body radiation, Emissivity and Kickoff's law, Black body sources, Atmospheric propagation characteristics: Scattering effect, Transmission through rain, Scintillations.

UNIT II LASER SYSTEMS 9

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 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. Satellite Radiometers.

UNIT IV IMAGING DEVICES AND TRACKING SYSTEMS 12

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 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

L: 45

REFERENCES:

1. S.C.Gupta, "Optoelectronic devices and Systems", Prentice Hall of India, New Delhi, 2005.
2. Richard.D.Hudson.Jr, "Infrared System Engineering", John Wiley and Sons, Newyork, 2006.
3. Keith Atkins, "Jane's Electro-optic Systems, 2005-06", 11th ed, Janes Information Group Ltd, Surrey, 2005.
4. J.Wilson and J.F.B.Hawkes, "Optoelectronics an Introduction", Prentice Hall of India, New Delhi, 1992.

AV9113 FLIGHT INSTRUMENTATION

L T P C
3 0 0 3

UNIT I MEASUREMENT SCIENCE 9

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 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 6

Direct reading compass, magnetic heading reference system-detector element, monitored gyroscope system, DGU, RMI, deviation compensator

UNIT V POWER PLANT INSTRUMENTS 6

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 6

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:

1. Pallet, E.H.J. “Aircraft Instruments & Integrated systems”, Longman Scientific and Technical, McGraw-Hill, 1992.
2. Murthy, D.V.S., “Transducers and Measurements”, McGraw-Hill, 1995
3. Doeblin.E.O, “Measurement Systems Application and Design”, McGraw-Hill, New York, 1999.
4. HarryL.Stilz, “Aerospace Telemetry”, Vol I to IV, Prentice-Hall Space Technology Series.

AV9115 AIRCRAFT ENGINEERING

L T P C
3 0 0 3

UNIT I CONFIGURATION OF AIRPLANE AND ITS COMPONENTS 9

How an Airplane flies - components of an airplane and their functions - motions of a plane - Pitching, Rolling and Yawing-Banking, skidding and slipping - starting, taxiing - Take-off's - landing - stalling, spinning, spirals - cross wind take-offs and landings. Different types of flight vehicles.

UNIT II AERODYNAMICS 9

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 9

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 9

Introduction to Aircraft structures - Loads - Types of construction - Design feature Aircraft materials.

UNIT V PROPULSION 9

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

L: 45

REFERENCES:

1. Kermode, A.C., "Mechanics of Flight", (Revised by RH Bernard & DR Philpott), LPE, Pearson Education, 2005.
2. Van Sickle Neil D, "Modern Airmanship" Vann strand Reinhold, New York, 1985.
3. Megson T.H. "Aircraft Structures for Engineering Student's II Edition", Edward Arnold, Kent, U.S.A. 1990

AV9116 ELECTRONIC SYSTEMS

L T P C
3 0 0 3

UNIT I LINEAR IC's **9**

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 **9**

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 GNERATORS **9**

Monostable, Astable and Bistable mutivibrators.Schmitt Trigger. Conditions for oscillation, RC phase shift oscillator, Wien bridge oscillator, Crystal oscillator. LC oscillators. Relaxation oscillators

UNIT IV MICROPROCESSOR BASED SYSTEMS **9**

The 8085 microprocessor, interfacing with Alpha numeric displays, LCD panels, Stepper motor controller, Analog interfacing and industrial control.

UNIT V MICROCONTROLLER BASED SYSTEMS **9**

8031 / 8051 Micro controllers:– Architecture- Assembly language Programming-Timer and Counter Programming- External Memory interfacing –- D/A and A/D conversions – Multiple Interrupts . Introduction to 16 bit Microcontrollers.

L: 45

REFERENCES:

1. Jacob Millman, Christos C Halkias, Satyabrata Jit, Millman's, "Electronic Devices and Circuits", Second Edition, Tata McGraw Hill,New Delhi, 2007.
2. Donald P Leach, Albert Paul Malvino, Goutam Saha, "Digital Principles and Applications", 6th Edition Tata McGraw Hill, New Delhi,2006..
3. Gayakwad, Ramakant A., "Op-Amps And Linear Integrated Circuits", Prentice Hall/ Pearson Higher Education, New Delhi, 1999.
4. John Crisp, "Inroduction to Microprocessor and Microcontroller", Newnes Publication, London. 2004.
5. William Kleitz, "Microprocessor and Microcontroller Fundamentals: The 8085 and 8051 Hardware and Software", Prentice Hall Inc, New York, 1997

AV9118 AVIONICS INTEGRATION LABORATORY

L T P C
0 0 4 2

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

AV9121 NAVIGATION SYSTEMS

L T P C
3 0 0 3

UNIT I INERTIAL SENSORS 6

Gyroscopes-Mechanical-electromechanical-Ring Laser gyro- Fiber optic gyro, Accelerometers

UNIT II INERTIAL NAVIGATION SYSTEMS 9

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 12

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

UNIT IV APPROACH AND LANDING AIDS 6

ILS, MLS, GLS - Ground controlled approach system - surveillance systems-radio altimeter

UNIT V SATELLITE NAVIGATION & **HYBRID NAVIGATION 12**

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

L: 45

REFERENCES:

1. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons,2nd edition, 1997
2. Nagaraja, N.S. "Elements of Electronic Navigation", Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 1975.
3. George M Siouris, 'Aerospace Avionics System; A Modern Synthesis', Academic Press Inc., 1993**.**
4. Albert Helfrick, 'Practical Aircraft Electronic Systems', Prentice Hall Education, Career & Technology, 1995.
5. Albert D. Helfrick, 'Modern Aviation Electronics', Second Edition, Prentice Hall Career & Technology, 1994.
6. Sen, A.K. & Bhattacharya, A.B. "Radar System and Radar Aids to Navigation", Khanna Publishers, 1988.
7. Slater, J.M. Donnel, C.F.O and others, "Inertial Navigation Analysis and Design", McGraw-Hill Book Company, New York, 1964.

AV9122 AEROSPACE GUIDANCE AND CONTROL

L T P C
3 0 0 3

UNIT I INTRODUCTION 4

Introduction to Guidance and control - definition, Historical background

UNIT II AUGMENTATION SYSTEMS 7

Need for automatic flight control systems, Stability augmentation systems, control augmentation systems, Gain scheduling concepts.

UNIT III LONGITUDINAL AUTOPILOT 12

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 10

Damping of the Dutch Roll, Methods of Obtaining Coordination, Yaw Orientation Control system, turn compensation, Automatic lateral Beam Guidance. Introduction to Fly-by-wire flight control systems, Lateral control law design using back stepping algorithm.

UNIT V MISSILE AND LAUNCH VEHICLE GUIDANCE 12

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

L: 45

REFERENCES:

1. Blake Lock, J.H 'Automatic control of Aircraft and missiles ', John Wiley Sons, New York, 1990.
2. Stevens B.L & Lewis F.L, 'Aircraft control & simulation', John Wiley Sons, New York, 1992.
3. Collinson R.P.G, 'Introduction to Avionics', Chapman and Hall, India, 1996.
4. Garnel.P. & East.D.J, 'Guided Weapon control systems', Pergamon Press, Oxford, 1977.
5. Nelson R.C 'Flight stability & Automatic Control', McGraw Hill, 1989.
6. Bernad Etikin,'Dynamic of flight stability and control', John Wiley, 1972.

AV9123 MATHEMATICAL MODELLING AND SIMULATION

L T P C
3 0 0 3

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

L: 45

REFERENCES:

1. Gordon. G., "System Simulation" , Prentice – Hall Inc., 1992.
2. Stables, K.J. and Rolfe, J.M. "Flight Simulation", Cambridge University Press, 1986.

AV9124 ROCKETRY AND SPACE MECHANICS

L T P C
3 0 0 3

UNIT I ORBITAL MECHANICS 9

Description of solar system – Kepler's Laws of planetary motion – Newton's Law of Universal gravitation – Two body and Three-body problems – Jacobi's Integral, Librations points - Estimation of orbital and escape velocities

UNIT II SATELLITE DYNAMICS 9

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 10

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 9

Description of various loads experienced by a rocket passing through atmosphere – drag estimation – wave drag, skin friction drag, form drag and base pressure drag – Boat-tailing in missiles – performance at various altitudes – conical and bell shaped nozzles – adapted nozzles – rocket dispersion – launching problems.

UNIT V STAGING AND CONTROL OF ROCKET VEHICLES 8

Need for multistaging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles - SITVC.

L : 45

TEXT BOOKS:

1. G.P. Sutton, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1986.
2. J.W. Cornelisse, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd., London, 1982

REFERENCES:

1. Van de Kamp, "Elements of astromechanics", Pitman Publishing Co., Ltd., London, 1980.
2. E.R. Parker, "Materials for Missiles and Spacecraft", McGraw-Hill Book Co., Inc., 1982.

AV9127 FLIGHT CONTROL LAB

L T P C
0 0 4 2

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

P: 60

NOTE: Implementation using MATLAB, X-plane, Flight-Gear & Aerosim or any equivalent software

AV9151 DIGITAL FLY-BY-WIRE CONTROL

L T P C
3 0 0 3

UNIT I INTRODUCTION TO DIGITAL FLY-BY-WIRE CONTROL 7

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 9

Description of various elements of DFBW systems - Concept of redundancy and reliability, Fault coverage and redundant architecture

UNIT III DFBW ARCHITECTURES 9

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 9

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 11

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

L: 45

REFERENCES:

1. Vernon R Schmitt, James W Morris and Gavin D Jenny, “Fly By Wire-A Historical Perspective”, SAE International, 1998.
2. AGARD-CP-137, “Advances in Control systems”, (Chap.10, 17,21, 22, 23, 24)
3. AGARD-CP-384, “Active Control Systems Review”, Evaluations and Projections.
4. AGARD-CP-260, “Stability and Control” (Chap.15)
5. ‘Modern Air Combat’, Salamander Books Ltd , 2001.

AV9152 AVIONICS SYSTEM ENGINEERING

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION TO SYSTEMS ENGINEERING 9

Overview-Systems Definition And Concepts-Conceptual System Design- System Engineering Process- Requirements And Management- Trade Studies-Integrated Product And Process Development- Verification of Systems Requirements.

UNIT II AIRCRAFT SYSTEMS AND DESIGN 9

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 9

Systems Architectures-Modeling and Trade-Offs- Evolution of Avionics Architectures-Systems Integration Definition- Examples of Systems Integration-Integration Skills-Management of Systems Integration

UNIT IV PRACTICAL CONSIDERATIONS AND CONFIGURATION CONTROL 9

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 9

Systems and Components-Analysis-Influence, Economics, Design for Reliability-Fault and Failure Analysis-Case Study-Maintenance Types-Program-Planning and Design

L: 45

REFERENCES:

1. Peter.Sydenham , “Systems Approach to Engineering”, Artech house, Inc, London, 2004.
2. Aslaksen, Erik and Rod Belcher, “Systems Engineering”, Prentice Hall, 1992.
3. Allan G. Seabridge and Ian Moir, “Design and Development of Aircraft Systems: An Introduction “, (Aiaa Education Series), 2004.
4. Andrew P. Sage, James E., Jr. Armstrong, "Introduction to Systems Engineering (Wiley Series in Systems Engineering and Management)”, 2000.

AV9153 DISPLAY ENGINEERING

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UNIT I DISPLAY DEVICES 9

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

Head up displays – Basic principles – Holographic HUDs - HUD electronics – HUD design and display generation. Helmet mounted displays – Helmet design factor – Helmet mounted sights – Head tracking system. Head down displays – Raster overlay display generation – Digitally generated color map displays. Multifunction displays – control and data entry – Multifunction keyboards- voice interactive systems.

UNIT III DISPLAY PROCESSOR REQUIREMENTS & ARCHITECTURE 8

Concepts – Role of display processor – Design steps – Hardware architecture and Building blocks – Software Architecture – Symbol Generator –Display drive circuits – Display management Processor

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

2D Graphics: Line, Curve and elipse Algorithms – Attributes – 2D" transformation – viewing, 3D Graphics: 3 D Concepts – Object Representation – Transformation – Viewing – Color models – Animation – Multimedia technologies – Compression and decompression – Data and file format standards – Full motion video – Storage and retrieval technologies.

L: 45

REFERENCES:

1. Donald Hearn & Pauline Baker, "Computer Graphics", Second edition, 1996
2. Prabath K. Andleigh & Kiran Thakrar, "Multimedia Systems & Design". First Deition, Prentice Hall O India, 1995.
3. Judith Jeffcoate, "Multimedia In Practice Technology And Applications", First Edition, Prentice Hall of India, 1995.
4. Foley, Vandam, Feiner, Huges, "Computer Graphics: Principles and Practice", Second Edition, Pearson Education, 2003.
5. Cooly,"Essence of Computer Graphics", First Edition. Pearson Education, 2004.
6. Goloi W.K. "Interactive Computer Graphics, Data structures, Algorithms, Languages" Prentice –Hall, 1988.
7. Davis, Computer Displays, Prentice – Hall, 1982.
8. R.B.G. Collinson – Introduction to Avionics, Chapman & Hall, 1996.
9. Spitzer, Digital Avionics System, Prentice Hall, New Jersey, 1987.
10. Cary R. Spitzer, The Avionics Handbook, CRC Press, 2000.

AV9154 FAULT TOLERANT COMPUTING

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UNIT I FAULT TOLERANCE 10

Principles of fault tolerance – redundancy – quantitative reliability – evaluation – exception handling. Application of fault tolerant systems in aircraft – reliability strategies – Fault Tolerant Processor – Hardware and software

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

Measures for error recovery – mechanisms for error recovery – check points and audit trials – the recovery cache – Concurrent processes – recovery for competing process – recovery for cooperating process – distributed systems – fault treatment – location and repair.

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

System structure – systems model – Software / Hardware interaction and multi-level systems – atomic actions – systems reliability – systems specification - Erroneous transitions and states – component / design failure – errors and faults.

L: 45

REFERENCES:

1. Anderson and Lee, Fault tolerant principles and practice, Prentice – Hall, 1981
2. Siewiorek, C.P. and Swartz, R.S Theory and practice of reliable system design, McGraw – Hill, 1983.
3. John D. Musa, Anthony Jannino, Kzuhira, Okunito, Software reliability measurement, prediction and application, McGraw – Hill, 1989.

AV9155 PROGRAMMING IN ADA

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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:

1. Ada for experienced programmers-Habermann AN, Peary DE-Addison Wiley, 1983.
2. Ada in industry- Heibrunner s- Cambridge UniversityPress-1988.
3. Ada: Introduction & Ada reference manual- HegardH-Springer Verlag
4. Ada: Reference manual, Programming language-Spamger verlag
5. Ada as a second language, Norman H.Cohen, McGraw Hill II edition, 1995.
6. Ada 95: Problem solving and program design, Michael B. Feildman, Elliot B. Koffman, Addison – Wesley, 1999.
7. Ada 95: The Craft of object oriented programming, John English I edition, Prentice Hall, 1996.
8. Herbert schildt, " Java 2 The Complete Reference", McGraw Hill, 2007.

NE9164 MICROWAVES AND RADAR

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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

Introduction to Radar – Radar range equation – Receiver noise and signal to noise ratio- Radar cross section (RCS) – Radar system – Radar Antennas

UNIT III TYPES OF RADARS 10

CW and FMCW radars-Tracking radars-MTI radar -Principles of coherent MTI radars - Digital MTI, Synthetic Aperture radar, Principles of Pulsed Doppler Radar, Low-, High-, and medium-PRF Mode.

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

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REFERENCES:

1. Fred E.Nathanson " Radar design Principles " Signal processing and the environment, Prentice Hall, 2004
2. Y. Liao, Microwave Devices and Circuits, Prentice Hall, 1980.
3. M.I. Skolnik, Introduction to Radar System (Second Edition) McGraw Hill, 1980.
4. M.I. Skolnik, Radar Handbook (Second Edition) McGraw Hill, 1990.
5. Guy V. Morris, Linda L. Harkness, Airborne Pulsed Doppler radar, Second Edition, Artech House Publishers, 1996.
6. Blackman S.S., "Multiple target tracking with radar applications" Artech House 1986.

AV9166 ELECTRONIC WARFARE

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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.

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REFERENCES:

1. Curtis Schleher. D. “Introduction to Electronic Warfare’, Artech House Inc., U.S.A., 1986
2. Mario De Archnaelis, “Electronic War from Battle of Osushima to the Falklands and Lebanon Conflicts”, Ritana Books, New Delhi, 1990.
3. Sen, A.K. Bhattacharya, A.B. “Radar Systems & Radar Aids to Navigation”, Khanna Publishers, 1988.

AV9164 INSTRUMENTATION FOR FLIGHT TESTING

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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.

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REFERENCES:

1. Doebelin. O, ‘Measurement Systems - Application and Design’, McGraw-Hill, 1986.
2. Rangan, C.S. Sharma, G.R. Mani, V.S.V., ‘Instrumentation Devices and Systems’, McGraw-Hill, 1986.
3. HarryL.Stilz, “Aerospace Telemetry”, Vol I to IV, Prentice-Hall Space Technology Series.

AV9168 HUMAN ENGINEERING

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UNIT I INTRODUCTION TO HUMAN ENGINEERING AND MAN MACHINE SYSTEMS 9

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 10

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 10

Principles of control design and related devices, Design of controls in aircraft cockpit, coding of controls.

UNIT IV ANTHROPOMETRY 11

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 11

Hypoxia, Acceleration, Thermal stress, Noise vibration and fatigue. Life support system in Aircraft- Scope, types of life-support system, human factor considerations.

L: 45

REFERENCES:

1. William L. Wolfe and George J. Zissis, Infrared Handbook , Office of Naval Research Dept. of the navy Washington DC,1978.
2. Wasten, J. “Optoelectronics”, Van Nostrand Reinheld (UK) co. ltd.. UK. 1988.
3. Robert G. Seippel, “Opto – electronics for technology and engineering” Prentice Hall, New Jersey, 1989.

AV9169 UAV SYSTEM DESIGN

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UNIT I INTRODUCTION TO UAV 9

History of UAV –classification –basic terminology-models and prototypes –applications

UNIT II BASICS OF AIRFRAME 9

Airframe –dynamics –modeling- structures –wing design- engines types-equipment maintenance and management-control surfaces-specifications.

UNIT III AVIONICS HARDWARE 9

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

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS 9

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-trouble shooting

UNIT V PATH PLANNING AND MAV 9

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
2. R. Said and H. Chayeb, "Power supply system for UAV", KTH, 2002.
3. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
4. Skafidas, "Microcontroller Systems for a UAV", KTH, TRITA-FYS 2002:51 ISSN 0280-316 X. 34, 2002
5. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007
6. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998,
7. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001
8. P.J.Swatton , "Ground studies for pilots' flight planning", Sixth edition, 2002.

AV9170 AIRCRAFT PRODUCT &SYSTEM ENGINEERING, STANDARDS & CERTIFICATION

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UNIT I AVIONICS SYSTEM ENGINEERING DEVELOPMENT CYCLE 8

Establishing the Avionics System Requirements by Mission Scenario Analysis, Functional Analysis, Physical Partitioning, Avionics Architectural Design, Specification of HW/ SW of Subsystems, Development / Procurement of HW/ SW of Subsystems, SW Integration, HW/SW Integration, Standalone testing of subsystems, Avionics System Integration in Ground based Integration Lab, Integration of Avionics System in Aircraft, Flight Testing, Operational Test and Evaluation by user, Deployment, SW updates, Avionics Upgrades.

UNIT II SYSTEMS ENGINEERING MANAGEMENT 8

The Systems Engineering Process - Overview, Requirements Analysis, Functional Analysis and Allocation, Design Synthesis, Verification, Systems Engineering Process Outputs System Analysis and Control - Work Breakdown Structure, Configuration Management, Technical Reviews and Audits, Trade Studies, Modeling and Simulation, Metrics, Risk Management Planning, Organizing, And Managing - Systems Engineering Planning, Product Improvement Strategies, Organizing and Integrating, System Development, Contractual Considerations, Management Considerations

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

System Aspects Relating To Software Development, Software Life Cycle, Software Planning Process, Software Development Processes, Software Verification Process, Software Configuration Management Process, Software Quality Assurance Process, Certification Liaison Process, Overview Of Aircraft And Engine Certification, Software Life Cycle Data, Additional Considerations -Use of Previously Developed Software, Tool Qualification, SW Reliability Models, Formal Methods

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

System Aspects of Hardware Design Assurance, Hardware Design Life Cycle, Planning Process, Hardware Design Processes, Validation and Verification Process, Configuration Management Process, Process Assurance, Certification Liaison Process, Hardware Design Life Cycle Data

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

System Development Process Guidelines and Methods, Development Assurance and Safety Directed Development Concept, Certification Process and Coordination, Requirement Determination and Assignment of Development Assurance Level, Safety Assessment Process, Validation of Requirements, Implementation Verification, Configuration Management, Process Assurance.

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REFERENCES:

1. IEEE Std 1220-1998, IEEE Standard for Application and Management of the Systems Engineering Process, 2005.
2. Systems Engineering Fundamentals, Supplementary Text Prepared By The Defense Acquisition University Press Fort Belvoir, Virginia 22060-5565, 2001
3. NASA Systems Engineering Handbook, SP-610S, June 1995
4. INCOSE, Systems Engineering Handbook, A "What To" Guide For All SE Practitioners, INCOSE-TP-2003-016-02, Version 2a, 1 June 2004
5. RTCA DO-178B/EUROCAE ED-12B, Software Considerations in Airborne Systems and Equipment Certification, RTCA Inc.,Washington, D.C, 1992.
6. DO-254/EUROCAE ED-80, Design Assurance Guidance For Airborne Electronic Hardware, RTCA Inc.,Washington, D.C, April 19, 2000
7. SAE ARP4754, Certification Considerations for Highly-Integrated or Complex Aircraft Systems, SAE, Warrendale, PA, 1996.
8. SAE ARP4761, Guidelines and Methods for Conducting the Safety Assessment Process on Civil Aircraft Airborne Systems and Equipment, Warrendale, PA, 1996

AV9171 ACTIVE CONTROL TECHNOLOGY

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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, 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 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.

L: 45

REFERENCES:

1. AGARD-AG-234, ‘Active controls aircraft Design’, 1978.
2. AGARD-CP-157, ‘Impact of active control technology in aircraft design’, 1975.
3. AGARD-CP-260, ‘Stability and control’, 1978.
4. AGARD-CP-137, ‘Advance in Control systems’, 1974.
5. AGARD-CP-228, ‘Structural aspects of active Controls’, 1977.
6. AGARD-IS-89, ‘Task oriented flight control Systems’, 1977.

AV9172 AIRBORNE FIRE CONTROL

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UNIT I FIRE CONTROL 6

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

UNIT II FIRE CONTROL PROBLEM FOR PROJECTILES 7

Statement of the fire control problem, Miss-producing effects, prediction, Time of Flight of the projectile.

UNIT III FEATURES OF FIRE CONTROL SYSTEMS 8

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 8

Gyroscopes, Measurements of direction, Controlled line, Single axis tracking loops

UNIT V FIRE CONTROL COMPUTING SYSTEMS 16

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.

L: 45

REFERENCES:

1. Walter Wrigley and John Hovorka, 'Fire Control Principles', McGraw-Hill Book Co., 1959.
2. George W.Masters, 'Integrated Weapon system Test and Evaluation', Airborne systems Course, United States Naval Test Pilot School, 1981, AD A130541.

AV9173 FLIGHT MECHANICS

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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

Automatic flight controls – Formulation of Guidance Laws – Concepts of advanced control technology – Mission requirements – selection of flight modes – Conceptual design of system, Laying down of relevant specifications – Flight planning and flight test data analysis.

L: 45

REFERENCES:

1. Roskam.J, ‘Airplane flight dynamics and automatic flight controls’, Part I and II,Roskam Aviation and Engg corporation,1975.
2. Bernad Etikin,’Dynamic of flight stability and control’, John Wiley, 1972.
3. Babister, A.W. ‘Aircraft Stability and Response’ I Edition, Pergamon Press, 1980.
4. Nelson R.C ‘Flight stability & Automatic Control’, McGraw Hill, 1989.

AV9174 MISSILE TECHNOLOGY

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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

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 8

Vertical, inclined and gravity turn trajectories – determination of range and altitude- numerical computation of ballistic trajectories.

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REFERENCES:

1. G. Merrill, “Dictionary of Guided Missiles and Space Craft”, D. Van Nostrand and Company, Inc, 1959.
2. S. S. Chin, “Missile Configuration Design”, McGraw Hill, 1961.
3. P. Garnel, “Guided Weapon Control Systems”, 2nd Edition, Pergamon Press, 1980.
4. J. Frederick White, “Flight Performance Handbook for Powered Flight Operations”, John Wiley & Sons, Inc., 1963.

AV9175 FAULT TOLERANT CONTROL

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UNIT I INTRODUCTION 9

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 9

Additive faults and disturbance-Multiplicative faults and disturbanceResidualgeneration-Detectionproperty-Isolationproperty-Computationalproperty-Design of Residual generation-Specification and implementation

UNIT III PARITY EQUATION IMPLEMENTATION OF RESIDUAL GENERATOR-PARITY EQUATION FORMULATION 9

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 9

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 9

Fault diagnosis using Kalman filtering-Fault diagnosis using principle component analysis – Fault diagnosis using ANN and Fuzzy clustering

Case study: Aircraft fault detection

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REFERENCES:

1. Janos.J.Gertler, “Fault detection and diagnosis in engineering systems”, second edition, Marcel Dekker, 1998.
2. Rami S.Mangoubi, “Robust Estimation and Failure detection”, Springer-Verlag London, 1998.

AV9176 SATELLITE ARCHITECTURE & COMMUNICATION

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UNIT I SATELLITE MISSION AND ORBITS 9

Mission Overview – Planning – Analysis _ Operations - Orbital Mechanics – Orbit Perturbations – Special orbits – Space Environment, Spacecraft configuration.

UNIT II SPACECRAFT CONFIGURATION AND SPACECRAFT POWER SYSTEM 9

Spacecraft Bus – Payload – Requirements and constraints – Initial configuration decisions and Trade-offs – Spacecraft configuration process – Broad design of Spacecraft Bus – Subsystem layout-Power sources – Energy storage – Spacecraft Power management – Power distribution.

UNIT III SPACECRAFT ATTITUDE AND ORBIT CONTROL SYSTEM (AOCS) 9

Coordinate system – AOCS requirements – Environment effects – Attitude stabilization – Attitude sensors – Actuators – Design of control algorithms.

UNIT IV PROPULSION SYSTEMS, STRUCTURES AND THERMAL CONTROL 10

Systems Trade-off – Mono-propellant systems – Thermal consideration – System integration design factors – Pre-flight test requirements – System reliability Configuration design of Spacecraft structure – Structural elements – Material selection – Environmental Loads – Structural fabrication –Orbital environments - Average temperature in Space – Transient temperature evaluation – Thermal control techniques – Temperature calculation for a spacecraft – Thermal design and analysis program structure – Thermal design verification – Active thermal control techniques.

UNIT V SATELLITE TELEMETRY, TRACKING AND TELECOMMAND 8

Base Band Telemetry system – Modulation – TT & C RF system – Telecomm and system

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REFERENCES:

1. Space Mission Analysis and Design (Third Edition) by James R.Wertz and Wiley J.Larson – 1999.
2. James R.Wertz “Spacecraft Attitude Determination and Control”, Kluwer Academic Publisher, 1988.
3. Marcel J.Sidi “Spacecraft Dynamics and Control”, Cambridge University press, 1997.
4. Lecture notes on “ Satellite Architecture”, ISRO Satellite Centre Bangalore – 560 017

CP9167 DIGITAL IMAGE PROCESSING

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UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Introduction – Elements of visual perception, Steps in Image Processing Systems – Image Acquisition – Sampling and Quantization – Pixel Relationships – Colour Fundamentals and Models, File Formats Introduction to the Mathematical tools

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Spatial Domain Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – DFT, FFT, DCT, Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.

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UNIT III IMAGE SEGMENTATION AND FEATURE ANALYSIS 9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Feature Analysis and Extraction.

UNIT IV MULTI RESOLUTION ANALYSIS AND COMPRESSIONS 9

Multi Resolution Analysis: Image Pyramids – Multi resolution expansion – Wavelet Transforms, Fast Wavelet transforms, Wavelet Packets. Image Compression: Fundamentals – Models – Elements of Information Theory – Error Free Compression – Lossy Compression – Compression Standards – JPEG/MPEG.

UNIT V APPLICATIONS OF IMAGE PROCESSING 9

Representation and Description, Image Recognition- Image Understanding – Image Classification – Video Motion Analysis – Image Fusion – Steganography – Colour Image Processing

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REFERENCES:

1. Rafael C.Gonzalez and Richard E.Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2008.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis and Machine Vision”, Third Edition, Third Edition, Brooks Cole, 2008.
3. Anil K.Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall India, 2007.
4. Madhuri A. Joshi, ‘Digital Image Processing: An Algorithmic Approach”, Prentice-Hall India, 2006.
5. Rafael C.Gonzalez , Richard E.Woods and Steven L. Eddins, “Digital Image Processing Using MATLAB”, First Edition, Pearson Education, 2004.

AV9177 AIRBORNE ACTUATORS AND SENSORS

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UNIT I AIRCRAFT ACTUATION SYSTEMS 9

Introduction -Principles of actuation systems, Types of actuation systems.

UNIT II SERVO COMPONENTS 9

Actuators, Valves, Servo amplifiers pick-offs.

UNIT III MODELING, DESIGN, AND TESTING 9

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 9

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 9

Test philosophies and methodologies, Test equipment, Performance testing of sensors.

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REFERENCES:

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2. Neal E.Wood et al, 'Electro-mechanical actuation development AFFDL-TR-150' DEC 1978.
3. Pallett, E.H.J. 'Aircraft instruments, principles and applications', Pitman publishing Ltd., London, 1981.

NE9156 REAL TIME EMBEDDED SYSTEMS

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UNIT I INTRODUCTION 12

Real Time System – Embedded Systems – Architecture of Embedded System - Simple Programming for Embedded System – Process of Embedded System Development - Pervasive Computing – Information Access Devices – Smart Cards – PIC Microcontroller – ARM Processor.

UNIT II EMBEDDED/REAL TIME OPERATING SYSTEM 9

Operating System Concepts: Processes, Threads, Interrupts, Events - Real Time Scheduling Algorithms - Memory Management – Overview of Operating Systems for Embedded, Real Time, Handheld Devices – Target Image Creation – Programming in Linux, RTLinux, VxWorks, uC/Os-overview.

UNIT III CONNECTIVITY 9

Wireless Connectivity - Bluetooth – Other short Range Protocols – Wireless Application Environment – Service Discovery – Middleware

UNIT IV REAL TIME UML 6

Requirements Analysis – Object Identification Strategies – Object Behavior – Real Time Design Patterns

UNIT V SOFTWARE DEVELOPMENT AND CASE STUDY 9

Concurrency – Exceptions – Tools – Debugging Techniques – Optimization – Case Studies - Interfacing Digital Camera with USB port and Data Compressor.

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REFERENCES:

1. R.J.A.Buhr, D.L.Bailey, “An Introduction to Real-Time Systems”, Prentice-Hall International, 1999.
2. David E-Simon, “An Embedded Software Primer”, Pearson Education, 2007. (UNIT– II)
3. C.M.Krishna, Kang G.Shin, “Real Time Systems”, Mc-Graw Hill, 1997. (UNIT- II)
4. B.P.Douglass, “Real Time UML 2nd Edition”, Addison-Wesley 2000. ((UNIT – IV)
5. J.Schiller, “Mobile Communication”, Addison-Wesley, 1999. (UNIT – III)
6. Dr.K.V.K.K.Prasad, “Embedded/Real Time Systems: Concepts, Design and Programming”, DreamTech press, Black Book, 2005. (UNIT – I)
7. R.Barnett, L.O.Cull, S.Cox, “Embedded C Programming and the Microchip PIC”, Thomason Learning 2004. (UNIT – I)
8. Wayne Wolf, “Computers as Components - Principles of Embedded Computer System Design”, Mergen Kaufman Publisher, 2006.
9. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata Mc-Graw Hill, 2004.

AV9178 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

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UNIT I EM ENVIRONMENT 9

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 9

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 9

Units of specifications, Civilian standards, MIL461, 462, 704E,F standards, IEEE, ANSI, IEC standards. CE mark. EMI Test, Open Area Test Site, Precautions, Site imperfections and Errors, Measurement Antennas. Radiated interference measurements: EMI Shielded Chamber, Anechoic chamber, Reverberating chamber, TEM Cell. Conducted Interference measurements Common mode, Differential mode interferences Pulsed EMI Immunity, ESD, EFT tests, Surge testing.

UNIT IV EMI CONTROL TECHNIQUES 9

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 9

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

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REFERENCES:

1. W. Prasad Kodali, “Engineering Electromagnetic Compatibility: Principles, Measurements, Technologies, and Computer Models”, IEEE Press, Newyork, 2001.
2. Henry W.Ott, “Noise Reduction Techniques in Electronic Systems ", 2nd Edition, John Wiley and Sons, Newyork, 1988.
3. Mark I. Montrose, Edward M. Nakauchi, “Testing for EMC compliance”, IEEE / Wiley Interscience, Newyork 2004.

NE9167 - DETECTION AND ESTIMATION THEORY

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UNIT I REVIEW OF PROBABILITY AND STOCHASTIC PROCESS 9

Conditional Probability, Bayes' Theorem , Random Variables, Conditional Distributions and Densities, moments and distribution of random variables., Stationary Processes Cyclostationary Processes Averages and Ergodicity Autocorrelation Function Power Spectral Density Discrete-Time Stochastic Processes patial Stochastic Processes Random Signals, Relationship of Power Spectral Density and Autocorrelation Function.

UNIT II SINGLE AND MULTIPLE SAMPLE DETECTION 9

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

Formulation of the General Parameter Estimation Problem, Relationship between Detection and Estimation Theory, Types of Estimation Problems, Properties of Estimators, Bayes Estimation, Minimax Estimation, Maximum-Likelihood Estimation, Comparison of Estimators of Parameters

UNIT IV WIENER AND KALMAN FILTERS 9

Orthogonality Principle, Autoregressive Techniques, Discrete Wiener Filter, Continuous Wiener Filter, Generalization of Discrete and Continuous Filter Representations , Linear Least-Squares Methods, Minimum-Variance Weighted Least-Squares Methods, Minimum-Variance Least-Squares or Kalman Algorithm, Kalman Algorithm Computational Considerations, Kalman Algorithm for Signal Estimation, Continuous Kalman Filter, Extended Kalman Filter

UNIT V APPLICATIONS 9

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.

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REFERENCES:

1. Thomas Schonhoff," Detection and Estimation Theory", Prentice Hall, NewJersy, 2007
2. Steven M. Kay," Fundamentals of Statistical Processing, Volume I: Estimation Theory", Prentice Hall Signal Processing Series, Prentice Hall, PTR,New Jersy,1993.
3. Harry L. Van Trees, Detection, Estimation, and Modulation Theory, Part I John Wiley and Sons, New York, 2001.

CP9159 SOFT COMPUTING

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UNIT I INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS 9

Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Machine Learning Basics

UNIT II GENETIC ALGORITHMS 9

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

UNIT III NEURAL NETWORKS 9

Machine Learning Using Neural Network, Adaptive Networks – Feed forward Networks – Supervised Learning Neural Networks – Radial Basis Function Networks - Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance architectures – Advances in Neural networks.

UNIT IV FUZZY LOGIC 9

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions- Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making

UNIT V NEURO-FUZZY MODELING 9

Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rulebase Structure Identification – Neuro-Fuzzy Control – Case studies.

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TEXT BOOKS:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2003.
2. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”,
3. Prentice Hall, 1995**.**
4. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Edn., 2003.

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1. Mitchell Melanie, “An Introduction to Genetic Algorithm”, Prentice Hall, 1998.
2. David E. Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Addison Wesley, 1997.
3. S. N. Sivanandam, S. Sumathi and S. N. Deepa, “Introduction to Fuzzy Logic using MATLAB”, Springer, 2007.
4. S.N.Sivanandam · S.N.Deepa, “Introduction to Genetic Algorithms”, Springer, 2007.
5. Jacek M. Zurada, “Introduction to Artificial Neural Systems”, PWS Publishers, 1992.

AV 9179 AVIONICS NETWORKING TECHNOLOGY

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UNIT I OPTICAL NETWORKS 9

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) 9

ATN Concepts – ATN functionality – ATN Components – End Systems – ATN physical and administrative structures – ATN planning and implementation process – ATN Router.

Military Gigabit type – Ethernet Architecture – Modems - Wideband mobile routers – Smart router – IP Address in cockpit

UNIT III WIRELESS SENSOR NETWORK 9

Introduction-Challenges for wireless sensor networks-Comparison of sensor network with ad hoc network-single node architecture-Hardware components-energy consumption of sensor nodes-Network architecture-sensor network scenarios-types of sources and sinks-single hop versus multi-hop-networks-multiple sinks and sources-Design principles-Development of wireless sensor networks-Application-military-Target detection tracking-Habitat monitoring-Environmental disaster monitoring.

UNIT IV WIDEBAND WIRELESS COMMUNICATION AND NETWORKS FOR MILITARY AVIONICS 9

Communication data link (CDL) - IP based routing in FBW-Smart antenna networking.

UNIT V REAL TIME INTEGRATED AVIONICS NETWORK 9

Inter networking- Multimedia- Pilot vehicles-other defense and aerospace application-Scalable Coherent interface-SCI/RI-Integrated modulator avionics.

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1. Jian-Guozhang, A.Pervez, A.B.Sharma, “Avionics Data Buses: Overview”, IEEE AESS Magazine, Feb 2003.
2. Carry A spitzer, “Avionics Data Buses”, Fifty edition 2005.
3. Frank Gross, “Smart Antennas for Wireless Communication” Wisely Publications, second edition 2004.
4. Hamed Al-Raweshidy, Shozo Komaki. “Radio Over Fiber Technology, for Mobile Communication Network”, 2002.
5. Clifford Headuey, Govind P Agarwal, “Raman Amplification in Fiber Opical Communication Systems”, Tara-McGrall publications, 2002.
6. Feng zhao, Leonidas guibas, “Wiresess Sensor Networks: An Information Processing Approach”, Elsevier publication, 2004.
7. C.S.Raghavendra Krishna, M.sivalingam and Tarip znati, “Wireless Sensor Networks”, Springer publication, 2004.
8. H.Callaway, “Wireless Sensor Networks: Architecture And Protocol-Edgar”, CRS press.2004.
9. Holger Karl, Andrea’s willig, “Protocal and Architecture for Wireless Sensor Networks”, John willey publication, Jan 2006.

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