M.E. AVIONICS
R-2023
CURRICULUM & SYLLABUS

VISION AND MISSION STATEMENTS OF THE DEPARTMENT OF AERONAUTICAL ENGINEERING

VISION

To provide excellent graduate education in Aeronautical Engineering and continuously support the community of aerospace professionals that will spearhead and strengthen the design and development of Aerospace related industries and institutions in India.

MISSION

- To impart quality exposure in theory and practical with proficiency, skill and humane values with the best of teaching and industrial expertise.
- To continuously strengthen the laboratory learning of students in tune with the best industry processes and practices.
- To ensure the updated knowledge and skill sets of students in emerging technologies.
- To provide the students the right ambience and opportunities to develop into creative, talented and globally competent aero professionals.
- To promote research and development activities in the sphere of aeronautics for the benefit of the society.

Program Educational Objectives (PEOs)

PEO I

Our post graduates have the ability to apply knowledge across the disciplines and in emerging research areas of Aerospace Engineering for doctoral research, employability and product development.

PEO II

Work independently as well as collaboratively with others, while demonstrating the professional and ethical responsibilities of the engineering profession.

PEO III

Participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.

Programme Outcomes (POs)

PO1: An ability to independently carry out research /investigation and development work to solve practical problems related to avionic systems.

PO2: An ability to write and present a substantial technical report related to the research carried in the field of avionics.

PO3: An ability to demonstrate mastery over avionic system design. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Programme Specific Outcomes (PSOs)

A post graduate of the Avionics program will

1. Develop deep working knowledge to solve complex problems in navigation guidance and control.

2. Demonstrate the problem-solving ability and hands-on skills to enter careers in the design, development, testing and maintenance of avionics systems.

3. Be equipped to use various simulation tools and programming languages to solve practical, design and analysis problems.

CURRICULUM AND SYLLABUS
M.E. AVIONICS
REGULATIONS 2023
CURRICULUM

SEMESTER I

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MH23111	Advanced Applied Mathematics	FC	4	3	1	0	4
2	AV23111	Aerospace Engineering (for Non-Aero graduates)	FC	3	3	0	0	3
	AV23112	Electronic Systems (for Aero graduates)						
3	AV23113	Digital Avionics	PC	3	3	0	0	3
4	AV23114	Image Processing for Aerospace Applications	PC	3	3	0	0	3
5		Professional Elective - I	PE	3	3	0	0	3
6	PG23111	Research Methodology and IPR	MC	3	3	0	0	3
7	AC23111	English for Research Paper Writing	MC	3	3	0	0	0
PRACTICAL								
1	AV23121	Avionics Integration Laboratory	PC	3	0	0	3	2
2	AV23122	Image Processing Laboratory	PC	3	0	0	3	2
TOTAL				**31**	**24**	**1**	**6**	**23**

SEMESTER II

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	AV23211	Communication Systems	PC	3	3	0	0	3
2	AV23212	Aerospace Guidance and Control	PC	3	3	0	0	3
3		Professional Elective - II	PE	3	3	0	0	3
4		Professional Elective - III	PE	3	3	0	0	3
5		Professional Elective - IV	PE	3	3	0	0	3
6	AC23211	Constitution of India	MC	3	3	0	0	0
PRACTICAL								
1	AV23221	Flight Control Systems Laboratory	PC	3	0	0	3	2
2	AV23222	Unmanned Aerial Vehicle Laboratory	PC	3	0	0	3	2
TOTAL				**24**	**18**	**0**	**6**	**19**

Note 1: Students will be encouraged to undergo Industrial training during semester break (1-2 months duration).

SEMESTER III

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AV23311	Navigation Systems	PC	3	3	0	0	3
2.	AV23312	Introduction to Robotics and sensors	PC	3	3	0	0	3
3.		Professional Elective – V	PE	3	3	0	0	3
4.		Open Elective – I	OE	3	3	0	0	3
PRACTICAL								
5.	AV23321	Project Work (Phase I)	EEC	20	0	0	20	8
TOTAL				**26**	**6**	**0**	**20**	**20**

SEMESTER IV

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1.	AV23421	Project Work (Phase II)	EEC	32	0	0	32	12
TOTAL				**32**	**0**	**0**	**32**	**12**

Note 2:
In case of students opting to go for I year industrial project work, relevant MOOC courses will be awarded with credits in lieu of III semester PE - V and OE – I.

LIST OF AUDIT COURSES

Sl. No.	COURSE TITLE
1	English for Research Paper Writing
2	Disaster Management
3	Sanskrit for Technical Knowledge
4	Value Education
5	Constitution of India
6	Pedagogy Studies
7	Stress Management by Yoga
8	Personality Development through Life Enlightenment Skills.

LIST OF ELECTIVES

PROFESSIONAL ELECTIVES – I (SEMESTER I)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	AV23A11	Flight Instrumentation	3	0	0	3
2	AV23A12	Display Engineering	3	0	0	3
3	AV23A13	Aircraft Product and System Engineering, Standards and Certification.	3	0	0	3
4	AV23A14	Industrial Avionics	3	0	0	3
5	AV23A15	Detection and Estimation theory	3	0	0	3

PROFESSIONAL ELECTIVES – II, III & IV (SEMESTER II)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	AV23B11	Avionics System Engineering	3	0	0	3
2	AV23B12	UAV System Design	3	0	0	3
3	AV23B13	System Modelling and Simulation	3	0	0	3
4	AV23B14	Digital Fly-By Wire Control	3	0	0	3
5	AV23B15	Instrumentation for Flight Testing	3	0	0	3
6	AV23B16	Soft computing for Avionics Engineers	3	0	0	3
7	AV23B17	Rocketry and Space Mechanics	3	0	0	3
8	AV23B18	Active Control Technology	3	0	0	3
9	AV23B19	Embedded Language with C	3	0	0	3

PROFESSIONAL ELECTIVE-V (SEMESTER III)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	AV23C11	Flight Data Management	3	0	0	3
2	AV23C12	Spacecraft Communication Systems	3	0	0	3
3	AV23C13	Real Time Embedded System	3	0	0	3
4	AV23C14	Fault Tolerant Computing	3	0	0	3
5	AV23C15	Artificial Intelligence	3	0	0	3
6	AV23C16	UAV Payload and Sensors	3	0	0	3

LIST OF OPEN ELECTIVES

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	CP23O11	Business Analytics	3	0	0	3
2	ED23O11	Industrial Safety	3	0	0	3
3	ED23O12	Operations Research	3	0	0	3
4	PG23O11	Cost Management of Engineering Projects	3	0	0	3
5	ED23O13	Composite Materials	3	0	0	3
6	PG23O12	Waste to Energy	3	0	0	3

STRUCTURE OF POSTGRADUATE ENGINEERING PROGRAM

Sl. No	Category	No. of Credits (AICTE)	No. of Credits (R2017)	No. of Credits (R2019)	% of distribution (R2019)
1	Foundation Courses (FC)	0	10	7	9.5
2	Professional core courses (PC)	16	26	20	27
3	Professional Elective courses (PE)	19	18	15	20
4	Mandatory Courses (MC)	4	0	3	4
5	Open Elective Course (OE)	3	0	3	4
6	Project work, seminar and internship in industry or elsewhere (EEC)	26	19	26	35.5

SEMESTER WISE CREDIT DISTRIBUTION

Semester	Credits							
Category	**FC**	**PC**	**PE**	**MC**	**HS**	**OE**	**EEC**	**Total**
I	7	10	3	3	0	-	-	23
II	-	10	9	0	-	-	-	19
III	-	6	3	-	-	3	8	20
IV	-	-	-	-	-	-	12	12
Total	7	26	15	3	0	3	20	74

Subject Code	Subject Name	Category	L	T	P	C
MH23111	ADVANCED APPLIED MATHEMATICS	FC	3	1	0	4
Common to I sem. - M.E. AVIONICS						

Objectives:
• To become computational proficiency involving procedures in Linear Algebra and to provide an axiomatic description of an abstract vector space
• To provide necessary concepts in probability and random processes for applications such as random signals, linear systems in Aeronautical engineering.
• To get familiarized with the numerical methods which are necessary to solve numerically the ordinary differential equations that arise in engineering.
• To formulate and obtain the optimal solution for Linear Programming problems.
• To apply Fourier transforms to initial–boundary value problems in Partial Differential Equations.

UNIT-I	LINEAR ALGEBRA	12
Vector spaces – norms – Inner Products – Eigen values using QR transformations – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications - pseudo inverse – least square approximations - Toeplitz matrices and some applications		
UNIT-II	**ONE DIMENSIONAL RANDOM VARIABLES**	12
Random variables - Probability function – moments - moment generating functions and their properties - Normal distributions –Classification – Auto correlation - Cross correlation - Stationary random process- Poisson process – Gaussian process.		
UNIT-III	**ORDINARY DIFFERENTIAL EQUATIONS**	12
Runge-Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.		
UNIT-IV	**LINEAR PROGRAMMING**	12
Formulation - Graphical solution – Simplex method - Two phase method - Transportation and Assignment Models		
UNIT-V	**FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS**	12
Fourier transforms: Definitions, properties-Transform of elementary functions, Dirac Delta functions – Convolution theorem – Parseval's identity– Solutions to partial differential equations: Heat equations, Wave equations, Laplace and Poisson's equations.		
Total Contact Hours:60		

Course Outcomes:
On completion of the course, students will be able to
• Demonstrate Linear algebra techniques in the solutions of relevant problems in engineering.
• Apply the concepts in probability and random processes in the problems such as random signals, linear systems related to Aeronautical engineering.
• Develop solutions for differential equations using various numerical techniques.
• Construct and solve complex linear programming problems in engineering and technology.
• Apply Fourier transforms to initial–boundary value problems of Partial Differential Equations arising in Engineering and Technology.

SUGGESTED ACTIVITIES
• Problem solving sessions
• Activity Based Learning

SUGGESTED EVALUATION METHODS (if Any) (UNIT/ Module Wise) – could suggest topic
• Tutorial problems
• Assignment problems
• Quizzes
• Class Presentation/Discussion

Reference Book(s):	
1.	Bronson R.,"Matrix Operation, Schaum's outline series", Mc-Graw Hill, New York , 1989.
2.	Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes", Academic Press, (An imprint of Elsevier), 2010.
3.	Taha H.A., "Operations Research: An introduction", Pearson Education, Asia, New Delhi, Ninth Edition, 2012.
4.	Veerarajan T, "Probability, statistics and random process with queueing theory and queueing networks", 4th Edition, McGraw - Hill Publishing Company Limited.

Reference Books(s) / Web links:	
1.	Andrews L.C., and Philips R.L., "Mathematical Techniques for engineering and Scientists", Prentice Hall, 2006.
2.	O'Neil P.V.,"Advanced Engineering Mathematics", (Thomson Asia Pvt Ltd, ingapore), Cengage learning India private limited, 2007.
3.	SankaraRao K., "Introduction to partial differential equations" Prentice Hall of India Pvt, Ltd, New Delhi, 1997.
4.	Jay L. Devore," Probability and Statistics for Engineering and Sciences", 8th Edition, Cengage Learning Pvt. Ltd., New Delhi, 2014.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
MH23111.1	2	1	2	1	2	1	1	1
ME23111.2	1	1	1	1	1	1	1	1
ME23111.3	2	1	2	1	2	1	1	1
MH23111.4	1	1	1	1	1	1	1	1
MH23111.5	2	1	2	1	2	1	1	1
Avg.	1.6	1	1.6	1	1.6	1	1	1

Subject Code	Subject Name	Category	L	T	P	C
AV23111	AEROSPACE ENGINEERING (For Non – Aero Graduates)	FC	3	0	0	3

Objectives:

- To introduce the students about basics airplane and concepts of aerodynamics.
- To familiarize the concepts of aircraft performance.
- To introduce the various stability and control aspects of an airplane.
- To give knowledge about the basics of aircraft structures and materials.
- To make the students understand the principle and operation of propulsive unit of an airplane.

UNIT-I CONFIGURATION OF AIRPLANE AND BASIC AERODYNAMICS 9

How an Airplane flies - components of an airplane and their functions - Airfoils and streamlines - forces acting on an airplane - lift and drag – types of Drag– speed and power – International Standard Atmosphere.

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

Concepts of static and dynamic stability and control– yaw and sideslip – dihedral effect – rudder requirements – directional and spiral divergence – Dutch roll– autorotation and spin – Phugoid Oscillations – Short period oscillations

UNIT-IV AIRCRAFT STRUCTURES 9

Introduction to Aircraft structures - Loads - Types of construction – Types of structural elements and its failure modes - Design feature of Aircraft materials.

UNIT-V PROPULSION 9

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

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Understand the basic components and their functions.
- Understand the various performance measures of an airplane.
- Get exposed about the stability and control aspects of an airplane.
- Understand the various constructions of aircraft structure and the materials used for it.
- Familiarize with the principle and operations of aircraft and rocket propulsion systems.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Problem solving technique
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests
- Mini projects

Text Books:

1 Kermode, A.C, ‘Mechanics of Flight’ English Book Store, New Delhi, 1982.
2 Van Sickle Neil, D ‘Modern Airmanship’ VanNostr and Reinhol, New York, 1985.

Reference Books / Web links:

1 Megson T.H. ‘Aircraft Structures for Engineering Student’s II Edition, Edward Arnold, Kent, U.S.A. 1990
2 J. D. Anderson Jr., “Introduction to Flight”, Mc-Graw Hill Higher Education, 1978.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23111.1	1	1	1	1	1	2	1	1
AV23111.2	1	1	2	2	1	2	2	1
AV23111.3	3	2	3	3	2	3	3	2
AV23111.4	1	1	1	1	1	1	1	1
AV23111.5	1	1	2	1	1	1	1	1
Avg.	1.4	1.2	1.8	1.6	1.2	1.8	1.6	1.2

Subject Code	Subject Name	Category	L	T	P	C
AV23112	ELECTRONIC SYSTEMS (For Aero Graduates)	FC	3	0	0	3

Objectives:

- To introduce the basic concepts of comparator, converter and interfacing circuits.
- To give exposure on the construction and working of digital circuits.
- To get introduce about the basics of signal generators.
- To make familiarize with the microprocessor and its applications.
- To make familiarize with the microprocessor and its applications.

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 GENERATORS **9**

Monostable, Astable and Bistable muti-vibrators. 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.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- The Students will understand the available basic concepts of Electronic Systems to the engineers and the necessary basic understanding of electronic systems
- Get exposure in the construction and working of digital circuits.
- Understand the various signal generators that are used in the avionics.
- Get introduce with the microprocessors and able to analyze them.
- Get familiarize with the microcontrollers and able to deploy these skills effectively in avionics engineering.

SUGGESTED ACTIVITIES

- Reinforced learning
- Poster presentations
- Presentations
- Group Discussions

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

1 Jacob Millman, Christos C Halkias, SatyabrataJit, Millman's, "Electronic Devices and Circuits", Second Edition, Tata McGraw Hill,New Delhi, 2007.

2 Donald P Leach, Albert Paul Malvino, GoutamSaha, "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.

Reference Books / Web links:

1 John Crisp, "Inroduction to Microprocessor and Microcontroller", Newnes Publication, London. 2004.

2 William Kleitz, "Microprocessor and Microcontroller Fundamentals: The 8085 and 8051 Hardware and Software", Prentice Hall Inc, New York, 1997.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23112.1	1	1	1	1	1	1	1	1
AV23112.2	2	1	1	1	2	1	1	1
AV23112.3	1	1	1	1	1	2	1	1
AV23112.4	2	1	1	1	1	1	1	1
AV23112.5	3	1	2	2	2	1	2	1
Avg.	1.8	1	1.2	1.2	1.4	1.2	1.2	1

Subject Code	Subject Name	Category	L	T	P	C
AV23113	DIGITAL AVIONICS	PC	3	0	0	3

Objectives:

- To introduce the basic concepts of avionics systems.
- To introduce the basic concept of Avionics system data buses and Avionics system essentials.
- To get introduce the packaging techniques and standards of avionics systems.
- To give knowledge about the Avionic system assessment, validation, certification.
- To understand the maintenance and cost aspects of avionics systems.

UNIT-I INTRODUCTION TO AVIONICS AND AVIONICS SYSTEM DATA BUSES, DESIGN AND INTEGRATION 15

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

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

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-III PACKAGING 4

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

UNIT-IV 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 Assessment and Validation -Civil and Military standards - Certification of Civil Avionics.

UNIT-V 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.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Understand the basic concepts of Avionics Systems to the engineers.
- Get the necessary knowledge on working of avionics systems in an aircraft.
- Get exposure on various topics such as Avionics system architecture, Avionics bus systems, integration, display systems and packaging.
- Deploy these skills effectively in the understanding and analysis of avionics systems.
- Understand the maintenance and cost aspects of avionics systems.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

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.
4 Collinson R.P.G. “Introduction to Avionics”, Chapman and Hall, 1996.

Reference Books / Web links:

1 Middleton, D.H. “Avionics Systems”, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
2 Jim Curren, “Trend in Advanced Avionics”, IOWA State University, 1992.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23113.1	2	1	3	1	1	1	1	1
AV23113.2	1	1	3	1	2	1	1	1
AV23113.3	1	1	3	1	1	1	1	1
AV23113.4	1	1	3	1	1	1	1	1
AV23113.5	1	1	3	1	1	1	3	1
Avg.	1.2	1	3	1	1.2	1	1.4	1

Subject Code	Subject Name	Category	L	T	P	C
AV23114	IMAGE PROCESSING FOR AEROSPACE APPLICATIONS	PC	3	0	0	3

Objectives:

- To introduce the basic concepts, methodologies and algorithms of digital image processing.
- To introduce the students to the concept of image enhancement and restoration.
- To introduce the concepts of image analysis and object recognition.
- To expose students to current technologies and issues that is specific to image processing systems.
- To introduce the basic theory used in digital image processing for aerospace applications

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 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

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 9

Multi Resolution Analysis: Image Pyramids – Multi resolution expansion – Wavelet Transforms, Fast Wavelet transforms, Wavelet Packets.

UNIT-V AEROSPACE APPLICATIONS 9

Principles of digital aerial photography- Sensors for aerial photography - Aerial Image Exploration Photo-interpretation, objective analysis and image quality - Image Recognition - Image Classification – Image Fusion – Colour Image Processing - Video Motion Analysis – Case studies- vision based navigation and control.

Total Contact Hours : 45

Course Outcomes:

On completion of course students will be able to

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

SUGGESTED ACTIVITIES

- Online Quizzes
- Mini projects
- Presentations
- Group Discussions
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Reference Books / Web links:

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.
6. Ron Graham, Alexander Koh,”Digital Aerial Survey: Theory and Practice”, Whittles Publishing; First edition,2002.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23114.1	3	1	2	3	2	2	2	2
AV23114.2	2	1	2	3	2	2	1	3
AV23114.3	3	1	2	3	2	2	1	3
AV23114.4	3	1	2	3	2	2	2	3
AV23114.5	2	1	2	3	2	2	2	3
Avg.	2.6	1	2	3	2	2	1.6	2.8

Subject Code	Subject Name	Category	L	T	P	C
PG23111	RESEARCH METHODOLOGY AND IPR	MC	3	0	0	3

Objectives:

- To understand the research problem formulation and analyse the research related information by following research ethics
- To inculcate the understanding of today's computer, information technology and also understand tomorrows world of ideas and creativity.
- To Emphasize the role of IPR in individual and nations growth.

UNIT-I Introduction to Research Methodology 9

Objectives and Motivation of Research - Types of Research - Defining and Formulating the Research Problem - Errors in selecting a research problem - Features of research design, Different Research Designs- Criteria of good research - Problems encountered by researchers in India - Benefits to the society in general.

UNIT-II DATA ANALYSIS AND HYPOTHESIS TESTING 9

Data collection: Primary data - Secondary data - Data organization - Sample design - Estimation of population - Parametric vs. non parametric methods - Measures of central tendency and dispersion.ANOVA; Principles of least squares-Regression and correlation; Normal DistributionProperties of Normal Distribution; Testing of Hypothesis – Hypothesis Testing Procedure, Types of errors, t-Distribution - Chi-Square Test as a Test of Goodness of Fit - Use of statistical softwares.

UNIT-III LITERATURE REVIEW AND RESEARCH REPORT WRITING 9

Effective literature studies approaches- Importance of literature survey - Sources of information– analysis – Plagiarism - Research ethics.Interpretation and Report Writing - Techniques and Precautions; Report Writing – Significance - Different Steps – Layout - Types of reports, Mechanics of Writing a Research Report - Precautions in Writing Reports; Format of the research report

UNIT-IV INTRODUCTION TO INTELLECTUAL PROPERTY , TRADE MARKS ,GRAPHICAL INDICATION AND INDUSTRIAL DESIGN 9

Importance of intellectual property rights; types of intellectual property-international organizations; Purpose and function of trademarks - acquisition of trade mark rights - protectable matter - selecting and evaluating trade mark - trade mark registration processes. Industrial designs and IC Layout design - Registrations of designs-Semiconductor Integrated circuits and layout design Act - Geographical indications-potential benefits of Geographical Indications.

UNIT-V LAW OF COPYRIGHTS & PATENTS 9

Fundamental of copy right law - originality of material - rights of reproduction - rights to perform the work publicly - copy right ownership issues - copy right registration -notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process - ownership rights and transfer New Developments in IPR: Administration of Patent System..

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Understand the research problem and research process
- To formulate the hypothesis, data collection and processing, analyzing the data using statistical methods
- Interpret the observations and communicating the novel findings through a research report.
- Apply the conceptual knowledge of intellectual property rights for filing patents and trade mark registration process.
- Understand the adequate knowledge on copyright and patent law and rights.

Reference Books:

1 C.R. Kothari, Research Methodology: Methods and Techniques, 2nd revised edition, New Age International Publishers, New Delhi, 2004.

2 Deborah, E. Bouchoux, Intellectual property right, 5th edition, Cengage learning, 2017.

3 R. Panneerselvam, Research Methodology, PHI learning Pvt. Ltd., 2009.

4 Prabuddha Ganguli, Intellectual property right - Unleashing the knowledge economy, Tata McGraw Hill Publishing Company Ltd, 2001.

5 Donald R. Cooper and Ramela S. Schindler, Business Research Methods, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2000

6 Uma Sekaran, Research Methods for Business, John Wiley and Sons Inc., New York, 2000.

7 Ranjit Kumar, Research Methodology, Sage Publications, London, New Delhi, 1999.

8.T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
PG23111.1	1	1	1	1	1	2	1	1
PG23111.2	1	1	2	2	1	2	2	1
PG23111.3	3	2	3	3	2	3	3	2
PG23111.4	1	1	1	1	1	1	1	1
PG23111.5	1	1	2	1	1	1	1	1
Avg.	1.4	1.2	1.8	1.6	1.2	1.8	1.6	1.2

Subject Code	Subject Name	Category	L	T	P	C
AC23111	English for Research Writing	HS	3	0	0	0

Common to all branches of M.E. /M.Tech / MBA – I Semester

Objectives:

- To facilitate the students to express technical ideas in writing
- To train the students in using language structures appropriately
- To enable students to plan and organize the research paper
- To assist the students in understanding the structure and familiarise the mechanics of organised writing
- To equip the students to improvise academic English and acquire research writing skills

UNIT-I INTRODUCTION TO RESEARCH WRITING 9

Research – Types of Research - Selecting the Primary resources - Categorizing secondary sources - Discovering a researchable area and topic – Need Analysis - Research Question- Focussing on the Research Problem- Developing Research Design – Framing the Hypothesis – Identifying the Scope of the Research - Writing – General and Academic Writing

UNIT-II LANGUAGE OF WRITING 9

Active reading – text mining – use of academic words – jargons – ambiguities – use of expression – use of tense - proper voices – third person narration – phraseology – use of foreign words – use of quotes – interpreting quotes.

UNIT-III THE FORMAT OF WRITING 9

Types of Journals - different formats and styles - IEEE format - Structure – Margins - Text Formatting - Heading and Title - Running Head with Page Numbers - Tables and illustrations - Paper and Printing - Paragraphs - Highlighting – Quotation – Footnotes

UNIT-IV ORGANISING A RESEARCH PAPER 9

Title- Abstract – Introduction – Literature review - Methodology - Results –Discussion –Conclusion - Appendices - Summarising - Citation and Bibliography

UNIT-V PUBLISHING PAPER 9

Finding the Prospective publication or Journal - analysing the credits - Reviewing - Revising – Plagiarism Check - Proof reading - Preparing the Manuscript- Submitting - Resubmitting - Follow up - Publishing

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Understand the basic structure of research work
- Apply proper use of language in writing paper
- Comprehend different formats of journal paper
- Follow the process of writing a research paper and write one

  Emulate the process of publishing journal paper and publish papers

SUGGESTED ACTIVITIES

- Group Discussions
- Writing review of literature
- Presentations
- Case study
- Writing a paper

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

1. Adrian Wallwork: "English for Writing Research Papers", Springer Science Business Media, Second Edition, LLC 2011
2. Stephen Howe and Kristina Henrikssion: "Phrasebook for Writing Papers and Research in English", The Whole World Company Press, Cambridge, Fourth edition 2007
3. The Modern Language Association of America: "MLA Handbook for Writers of Research Papers" 8th Edition, The Modern Language Association of America, 2016
4. Rowena Murray: The Handbook of Academic Writing: A Fresh Approach, Sarah Moore Open University Press, 2006

Reference Books / Web links:

1. Stephen Bailey: Academic Writing: A Practical Guide for Students Routledge Falmer: 2003
2. Joseph M. Moxley: Publish, Don't Perish: The Scholar's Guide to Academic Writing and Publishing, Praeger Publishers, 1992

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AC23111.1	2	2	1	2	1	-	-	-
AC23111.2	2	2	1	2	1	-	-	-
AC23111.3	2	2	1	2	1	-	-	-
AC23111.4	2	2	1	2	1	-	-	-
AC23111.5	2	2	1	2	1	-	-	-
Avg.	2	2	1	2	1	-	-	-

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
AV23121	Avionics Integration Laboratory	PC	0	0	3	2

Objectives:

- To provide practical knowledge in the basic concepts of avionic system integration.
- To provide practical knowledge in the operation of basic civil and military avionic data bus.
- To know how to develop handle the various avionics systems.

List of Experiments

1 Testing of installation and Configuring of MIL –STD-1553 cards in transmitting and receiving mode.

2 Testing of installation and Configuring of ARINC-429/ARINC -629 cards in transmitting and receiving mode.

3 Interfacing the arduino MPU 6050 with basic sensors.

4 Develop an arduino CAN bus transmitter and receiver module.

5 Study of Avionics Full Duplex switched Ethernet (AFDX) Protocol.

6 Development of Inertial Measurement Unit (IMU) based angle estimation based on Euler‘s and Quaternion approach.

7 Development of Voice Control Device.

8 Development of touch screen LCD on Raspberry pi.

9 Development of Basic Flight stabilization for both rotary wing and fixed wing aircraft.

10 Development of Electronic flight instrument system using MATLAB interface.

Total Contact Hours : 60

Course Outcomes:

- 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.
- The students will be in a position to design and develop the avionics systems.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23121.1	2	2	3	2	2	1	2	2
AV23121.2	2	2	3	2	2	1	3	2
AV23121.3	2	2	3	3	2	1	3	2
AV23121.4	3	2	3	2	3	2	2	3
AV23121.5	3	2	3	3	3	3	2	3
Avg.	2.4	2	3	2.4	2.4	1.6	2.4	2.4

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
AV23122	Image Processing Laboratory	PC	0	0	3	2

Objectives:

- To introduce the concepts of image processing and to provide necessary knowledge that is needed in modeling the image process.
- To expose students to basic concepts such as distance and connectivity, image transformation, point operation, analysis of colour image processing.

List of Experiments

1 Design of Distance and Connectivity in digital image.
2 Development of Image Arithmetic operation/Affine Transformation technique.
3 Implementation of Point Operations.
4 Development of Neighbourhood Operations.
5 Image Histogram.
6 Linear filtering using convolution/Highly Selective filtering
7 Edge Detection
8 Two-dimensional Fourier transforms I and II
9 Color Image Processing/Morphological Operations.
10 Image Segmentation/Image Processing Test Bench.

Total Contact Hours : 60

Course Outcomes:

- The students will understand the concepts of image processing technique to the engineers and to provide the necessary knowledge that are needed in modelling the image processes.
- The students will have an exposure on various topics such as distance and connectivity, image arithmetic, transformation, point operation, analysis of colour image processing and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23122.1	2	2	2	1	1	2	1	3
AV23122.2	3	2	3	2	2	2	1	3
AV23122.3	3	2	3	2	2	2	1	3
AV23122.4	3	2	3	3	2	2	1	3
AV23122.5	3	2	3	3	2	2	1	3
Avg.	2.8	2	2.8	2.2	1.8	2	1	3

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
AV23211	Communication systems		3	0	0	3

Objectives:

- To study the various modulation technique in analog communication systems
- To study the various modulation technique in digital communication systems
- To gain knowledge on wireless communication systems
- To learn the concept of sources and detectors in optical communication
- To gain knowledge on satellite communication systems

UNIT-I	ANALOG COMMUNICATION	9

Basic blocks of Communication System, Amplitude Modulation, Frequency and Phase modulation, Pulse Modulation techniques – Sampling Process, PAM, PWM and PPM concepts, Super Heterodyne Receivers.

UNIT-II	DIGITAL COMMUNICATION	9

Pulse code modulation (PCM), BASK, BFSK, and BPSK- Transmitter, Receiver, FSK, QAM, Linear block codes-Encoding and decoding. Cyclic codes, Frequency-hop Spread Spectrum modulation

UNIT-III	WIRELESS COMMUNICAITON	9

Introduction to Wireless Communication, Cellular concept, Mobile Radio Propagation; Reflection, Diffraction, Fading. Multipath propagation, FDMA, TDMA and CDMA, 5G technology.

UNIT-IV	OPTICAL COMMUNICATION	9

Optical fibers-wave propagation, dispersion and loss, Optical sources- LEDs and Laser Diodes, Optical Amplifiers, Optical detectors-PIN and Avalanche photodiodes, WDM Concepts.

UNIT-V	SATELLITE COMMUNICATION	9

Elements of orbital mechanics, Equations of motion, Tracking and orbit determination, Orbital correction/control, Elements of communication satellite design, Spacecraft subsystems. Spacecraft integration, Satellite launch systems.

Total Contact Hours:45

Course Outcomes:
• Classify the various modulation technique in analog communication system.
• Describe the various modulation of digital communication systems
• Discuss the various multiple user techniques like FDMA, TDMA, CDMA
• Describe the various optical sources and detectors
• Describe the satellite orbits and launching procedures

SUGGESTED ACTIVITIES

- Problem solving sessions
- Activity Based Learning
- Reinforced learning

SUGGESTED EVALUATION METHODS

- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):
1.Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006
2.Rappaport,T.S., "Wireless communications", Pearson Education, 2003.
3.Gerd Keiser, "Optical Fiber Communications" McGraw -Hill International, 4thedition, 2010
4.Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2006.
5.Simon Haykin, "Communication Systems", 3rd Edition John Wiley & sons, 2001.
6.J.G.Proakis, M.Salehi, "Fundamentals of Communication Systems", 2nd Edition, Pearson Education, 2006.

Reference Books(s) / Web links:
1. John.M.Senior, "Optical Fiber Communications, Principles and Practice", Prentice Hall of India, 3rd Edition, 2008.
2. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007
3. H P Hsu, Schaum Outline Series - "Analog and Digital Communications" Tata McGraw Hill, 2006

CO \ PO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
AE23211.1	3	2	2	1	1	3	2	1
AE23211.2	3	2	2	1	2	3	2	1
AE23211.3	3	2	2	1	2	3	2	1
AE23211.4	3	2	2	1	2	3	2	1
AE23211.5	3	2	2	-	2	3	2	1
Avg	3	2	2	1	1.8	3	2	1

Subject Code	Subject Name	Category	L	T	P	C
AV23212	AEROSPACE GUIDANCE AND CONTROL	PC	3	0	0	3

Objectives:

- To introduce students to the concept of guidance and control in aircraft.
- To expose students to the basic concept of augmentation and autopilot control in aircraft.
- To study longitudinal stability and to design the longitudinal autopilot
- To study lateral stability and to design the lateral autopilot
- To expose students to the basic concept of missile and launch vehicle.

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. 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.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Upon completion of this course, students will understand the advanced concepts of Guidance and Control of an aircraft to the engineers and to provide the necessary mathematical knowledge that are needed in modelling the guidance and control methods.
- To 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
- To know about the Displacement, Pitch Orientation Control system Glide Slope Coupler and Automatic Flare Control systems
- Know the Damping of dutch roll, methods of Obtaining Coordination, Yaw Orientation Control system, turn compensation and Automatic lateral Beam Guidance.
- The students will have an exposure on various topics such as 6-DOF equations of motion, autopilots and augmentation systems and missile guidance systems and will be able to deploy these skills effectively in the design of control for aerospace systems.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

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.

Reference Books / Web links:

1 Collinson R.P.G, 'Introduction to Avionics', Chapman and Hall, India, 1996.
2 Garnel.P. &East.D.J, 'Guided Weapon control systems', Pergamon Press, Oxford, 1977.
3 Nelson R.C 'Flight stability & Automatic Control', McGraw Hill, 1989.
4 BernadEtikin,'Dynamic of flight stability and control', John Wiley, 1972.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23212.1	1	1	2	2	1	2	2	1
AV23212.2	3	1	2	3	2	3	2	1
AV23212.3	3	1	2	3	2	3	2	2
AV23212.4	3	1	2	3	2	3	2	2
AV23212.5	2	1	2	3	2	2	2	1
Avg.	2.4	1	2	2.8	1.8	2.6	2	1.4

Subject Code	Subject Name	Category	L	T	P	C
AC23211	CONSTITUTION OF INDIA	MC	3	0	0	0

Objectives:

- To inculcate the values enshrined in the Indian constitution.
- To create a sense of responsible and active citizenship
- To make the students aware of the Constitutional and the Non- Constitutional bodies
- To help the students understand the relationships exist between union and states
- To make the students understand the sacrifices made by the freedom fighters.

UNIT-I INTRODUCTION 9

Historical Background - Constituent Assembly of India - Philosophical foundations of the Indian Constitution - Features - Basic Structure – Preamble.

UNIT-II UNION GOVERNMENT - EXECUTIVE, LEGISLATURE AND JUDICIARY 9

Union and its territory - Citizenship - Fundamental Rights - Directive Principles of State Policy (DPSP) - Fundamental Duties. President - Vice President - Prime Minister - Central Council of Ministers - Cabinet Committees - Parliament: Committees, Forums and Groups - Supreme Court.

UNIT-III STATE GOVERNMENT & UNION TERRITORIES: STATE GOVERNMENT: EXECUTIVE, LEGISLATURE AND JUDICIARY 9

Governor - Chief Minister - State Council of Ministers - State Legislature - High Court - Subordinate Courts - Panchayati Raj – Municipalities-Union Territories - Scheduled and Tribal Areas.

UNIT-IV RELATIONS BETWEEN UNION AND STATES **9**

Relations between Union and States - Services under Union and States. Cooperative Societies - Scheduled and Tribal Areas - Finance, Property, Contracts and Suits - Trade and Commerce within Indian Territory – Tribunals.

UNIT-V CONSTITUTIONAL BODIES AND AMENDMENTS **9**

Introduction to Constitutional & Non-Constitutional Bodies-Elections - Special Provisions relating to certain classes - Languages - Emergency Provisions - Miscellaneous - Amendment of the Constitution - Temporary, Transitional and Special Provisions - Short title, date of commencement, Authoritative text in Hindi and Repeals. Schedules of the Constitution of India - Appendices in the Constitution of India.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Appreciate the philosophical foundations of the Indian Constitution.
- Understand the functions of the Indian government.
- Apprehend and abide by the rules of the Indian constitution.
- Comprehend the functions of state Government and Local bodies.
- Gain Knowledge on constitution functions and role of constitutional bodies andamendments of constitution.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

1. M Lakshmikanth "Indian Polity", McGraw Hill Education, 5th edition 2017.
2. Durga Das Basu, "Introduction to the Constitution of India ", Lexis Nexis, New Delhi., 21st edition, 2013.

Reference Books / Web links:

1. Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi, 7th edition, 2015.
2. Subhash Kashyap, "Our Constitution: An Introduction to India's Constitution and Constitutional Law", National Book Trust India, 1994.
3. Mahendra Prasad Singh and Himanshu Roy, "Indian Political System", Pearson India, 4th edition, 2017.

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
AV23221	FLIGHT CONTROL SYSTEMS LABORATORY	PC	0	0	3	2

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.

List of Experiments

1 Stability analysis using Root Locus plot.
2 Stability analysis using Bode Plot technique and Nyquist plot.
3 Design of PID controller.
4 Development of Equations of Motion
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 Kalman filter.
10 Implementation of Hardware-In-Loop Simulation (HILS) for fixed wing aircraft.

Total Contact Hours : 60

Course Outcomes:

- 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 modelling 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

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23221.1	2	2	3	2	2	2	2	3
AV23221.2	3	2	3	2	3	3	3	3
AV23221.3	3	2	3	3	3	3	3	3
AV23221.4	3	2	3	3	3	3	3	3
AV23221.5	2	2	3	1	2	1	1	3
Avg.	2.6	2	3	2.2	2.6	2.4	2.4	3

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
AV23222	UNMANNED AERIAL VEHICLE LABORATORY	PC	0	0	3	2

Objectives:

- To introduce the working of various unmanned aerial vehicles.
- To provide the exposure in integration and testing of the remote controlled and autonomous unmanned aerial vehicles.
- To provide the exposure in working of fixed wing and rotary wing unmanned aerial vehicles.
- To develop the ability of students in order to utilize the UAVs in various applications.

List of Experiments

1 Study on development and integration of Drones.
2 Study on development and integration of Unmanned Aerial Systems.
3 Integration and testing Remote Controlled Fixed Wing UAV
4 Integration and testing Remote Controlled Vertical Take-off and Landing UAV
5 Integration and testing Autonomous Fixed Wing UAV
6 Integration and testing Autonomous Vertical Take-off and Landing UAV
7 Integration and testing of Hybrid UAV
8 Application of UAV in Remote sensing
9 Application of UAV in Disaster management
10 Image processing using Raspberry Pi for agricultural applications

Total Contact Hours : 60

Course Outcomes: Upon completion of this course,

- Students will understand the working of different unmanned aerial vehicles
- Students will get the ability to develop and test the remote controlled, autonomous aerial vehicles
- Students will get the ability to develop and test the rotary wing, fixed wing aerial vehicles.
- Students will get the ability to utilize the UAVs in various applications.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23222.1	2	2	3	1	1	1	2	1
AV23222.2	3	2	3	2	3	2	3	3
AV23222.3	3	2	3	2	3	2	3	1
AV23222.4	3	2	3	2	3	2	3	3
AV23222.5	2	2	3	3	1	3	3	1
Avg.	2.6	2	3	2	2.2	2	2.8	1.8

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
AV23311	**Navigation systems**	PC	3	0	0	3

Objectives: To impart knowledge on the concept of
• Different axis systems and co-ordinate transformation techniques
• Different radio navigation systems
• Inertial sensors and inertial navigation
• Various approach and landing aids of aircraft
• Satellite navigation & Hybrid navigation

UNIT-I	**NAVIGATION SYSTEMS & INERTIAL SENSORS**	8
Introduction to navigation – Types – Introduction to Inertial Sensors - Mechanical - Ring Laser gyro- Fiber optic gyro – MEMS system		
UNIT-II	**INERTIAL NAVIGATION SYSTEMS**	10
INS components: transfer function and errors- Earth in inertial space - coriolis effect – INS Mechanization. Stable Platform and Strap down – Navigation algorithms - INS system block diagram, Different co-ordinate systems – Transformation Techniques - Schuler Tuning -compensation errors - Gimbal lock – Initial calibration and Alignment Algorithms		
UNIT-III	**RADIO NAVIGATION**	9
Different types of radio navigation- ADF, VOR, DME - Doppler – Hyperbolic Navigations -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.		
Total Contact Hours:45		

Course Outcomes:
• To explain the advanced concepts of Aircraft Navigation to the engineers
• 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
• To deploy the basics of navigation skills effectively in the analysis and understanding of navigation systems in an aircraft.
• Describe the satellite navigation and hybrid navigation such as GPS ,INS and Integration of GPS and INS.

SUGGESTED ACTIVITIES

- Problem solving sessions
- Activity Based Learning
- Reinforced learning

SUGGESTED EVALUATION METHODS

- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):
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.

Reference Books(s) / Web links:
1. Sen, A.K. & Bhattacharya, A.B. ―Radar System and Radar Aids to Navigation‖, Khanna Publishers, 1988
2. Slater, J.M. Donnel, C.F.O and others, ―Inertial Navigation Analysis and Design‖, McGrawHill Book Company, New York, 1964

CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**
AV23311.1	3	2	2	1	2	3	2	1
AV23311.2	3	2	2	1	2	3	2	1
AV23311.3	3	2	2	1	2	3	2	1
AV23311.4	3	2	2	1	2	3	2	1
AV23311.5	3	2	2	1	2	3	2	1
Avg	3	2	2	1	2	3	2	1

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
AV23312	Introduction to Robotics and sensors	PC	3	0	0	3

Objectives:

- List and explain the basic elements of industrial robots
- Analyse about robot kinematics and various types of sensors used in robotics.
- Explore about the different types of drives and its control methods
- Provide essential programming knowledge in AML, Python, ROS.
- Summarize various industrial and non-industrial applications of robots

UNIT-I	**Introduction to robotics**	9

Brief History-Definition -Three laws -Robot anatomy-DOF- Misunderstood devices. Classification of Robotic systems- work volume- type of drive. Associated parameters- resolution, accuracy, repeatability, dexterity, compliance, RCC device. Introduction to Principles & Strategies of Automation-Types & Levels of Automations-

Need of automation- Industrial applications of robot.

UNIT-II	**Grippers and Sensors for Robotics**	9

Grippers for Robotics - Types of Grippers- Guidelines for design for robotic gripper- Force analysis for various basic gripper system,HC SR 04 Ultrasonic sensor,Electronic pitot static sensor,Altimeter sensor Sensors for Robots - Types of Sensors used in Robotics- Classification and applications of sensors- Characteristics of sensing devices- Selections of sensors. Need for sensors and vision system in the working and control of a robot.

UNIT-III	**Drives and Control for Robotics**	9

Drive - Types of Drives- Types of transmission systems- Actuators and its selection while designing a robot system.

Control Systems: Types of Controllers- Introduction to closed loop control.

UNIT-IV	**Programming and Languages for Robotics**	9

Robot Programming: Methods of robot programming- WAIT, SIGNAL and DELAY commands, subroutines. Programming Languages: Generations of Robotic Languages- Introduction to various types such as VAL, RAIL,AML, Python, ROS. Development of languages since WAVE till ROS.

UNIT-V	**Related Topics in Robotics**	9

Socio-Economic aspect of robotisation. Economical aspects for robot design- Safety for robot and standards- Introduction to Artificial Intelligence- AI techniques- Need and application of AI- New trends & recent updates in robotics and drone.

Total Contact Hours:45

Course Outcomes:
• To express his views as per terminologies related to Robotics technology.
• To apply logic for selection of robotic sub systems and systems.
• To analyse basics of principals of robot system integration.
• To understand ways to update knowledge in the required area of robotic technology.
• To understand classification of robot actuators in industrial applications.

SUGGESTED ACTIVITIES

- Problem solving sessions
- Activity Based Learning
- Implementation of small module

SUGGESTED EVALUATION METHODS

- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):
1. S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014)
2. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006)
3. Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, (2019)

Reference Books(s) / Web links:
1. S. B. Niku, Introduction to Robotics – Analysis, Contro, Applications, 3rd edition, John Wiley & Sons Ltd., (2020)
2. Mikell Groover, Mitchell Weiss, Roger N. Nagel, Nicholas Odrey, Ashish Dutta, Industrial Robotics 2nd edition, SIE, McGraw Hill Education (India) Pvt Ltd (2012)
3. R. D. Klafter, Thomas A. Chmielewski, and Mechael Negin, Robotic Engineering – An Integrated Approach, EEE, Prentice Hall India, Pearson Education Inc. (2009)

CO \ PO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
AV23312.1	3	1	2	1	3	3	2	1
AV23312..2	3	2	2	2	3	3	2	1
AV23312..3	3	2	2	2	2	3	2	1
AV23312..4	3	2	2	2	3	3	2	1
AV23312..5	3	1	2	1	2	3	2	1
Avg	3	2	2	2	3	3	2	1

Subject Code	Subject Name	Category	L	T	P	C
AV23321	PROJECT WORK (PHASE I)	EEC	0	0	20	8

Objectives:

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination

Guidance for Review and Evaluation

The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of construction engineering and management. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

Total Contact Hours : 180

Course Outcomes: Upon completion of this course, Students can able to

- Have a clear idea of his/her area of work.
- Carry out the remaining phase II work in a systematic way.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23321.1	2	2	1	2	1	3	3	3
AV23321.2	2	2	1	2	1	3	3	3
AV23321.3	2	2	1	2	1	3	3	3
AV23321.4	2	2	1	2	1	3	3	3
AV23321.5	2	2	1	2	1	3	3	3
Avg.	2	2	1	2	1	3	3	3

Subject Code	Subject Name	Category	L	T	P	C
AV23421	PROJECT WORK (PHASE II)	EEC	0	0	32	12

Objectives:

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions

Guidance for Review and Evaluation

The student should continue the phase I work on the selected topic as per the formulated methodology under the same supervisor. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

Total Contact Hours : 360

Course Outcomes: Upon completion of this course, Students can able to

- Take up any challenging practical problems in their field of engineering and find better solutions to it.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23421.1	2	2	1	2	1	3	3	3
AV23421.2	2	2	1	2	1	3	3	3
AV23421.3	2	2	1	2	1	3	3	3
AV23421.4	2	2	1	2	1	3	3	3
AV23421.5	2	2	1	2	1	3	3	3
Avg.	2	2	1	2	1	3	3	3

Subject Code	Subject Name	Category	L	T	P	C
AV23A11	FLIGHT INSTRUMENTATION	PE	3	0	0	3

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 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 SYSTEM 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 9

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

UNIT-V POWER PLANT ISTRUMENTS 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 Contact Hours : 45

Course Outcomes:

On completion of course students will be able to

- The students will understand the available basic concepts of Flight instruments to the engineers and the necessary knowledge that are needed in understanding their significance and operation.
- Measure the error and can find the error estimation in the aircraft instruments
- Know about the various air data systems and synchronous data transmissions systems
- 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.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Reference Books / Web links:

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.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23A11.1	1	1	1	1	1	1	1	1
AV23A11.2	2	1	2	1	1	2	1	1
AV23A11.3	2	1	2	1	1	2	1	1
AV23A11.4	1	1	2	1	1	1	1	1
AV23A11.5	1	1	1	1	1	1	1	1
Avg.	1.4	1	1.6	1	1	1.4	1	1

Subject Code	Subject Name	Category	L	T	P	C
AV23A12	DISPLAY ENGINEERING	PE	3	0	0	3

Objectives:

- To provide basic knowledge on the types of displays, their operation and characteristics.
- To impart knowledge on the different cockpit displays
- To provide knowledge in the cockpit display characteristics, display processor, its requirements & architecture.
- To give exposure in the field of display control
- To expose students about the architecture and graphics pertaining to aircraft display systems.

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, 3DGraphics: 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.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Students will understand the advanced concepts of Display systems to the engineers and to provide the necessary domain knowledge that are needed in understanding display systems.
- Know the structure of cockpit display system and various displays available in the cockpit.
- Will understand the characteristics, display processor, its requirements & architecture
- Understand the concept of display optimization.
- 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.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

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.

Reference Books / Web links:

1. Davis, Computer Displays, Prentice – Hall, 1982.
2. R.B.G. Collinson – Introduction to Avionics, Chapman & Hall, 1996.
3. Spitzer, Digital Avionics System, Prentice Hall, New Jersey, 1987.
4. Cary R. Spitzer, The Avionics Handbook, CRC Press, 2000.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23A12.1	1	1	1	1	1	1	1	1
AV23A12.2	1	1	2	1	1	1	1	1
AV23A12.3	2	1	3	2	1	1	2	1
AV23A12.4	3	1	2	1	1	1	1	1
AV23A12.5	3	1	3	1	1	1	1	1
Avg.	2	1	2.2	1.2	1	1	1.2	1

Subject Code	Subject Name	Category	L	T	P	C
AV23A13	AIRCRAFT PRODUCT AND SYSTEM ENGINEERING, STANDARDS AND CERTIFICATION	PE	3	0	0	3

Objectives:

- To introduce the basic concepts of system engineering development cycle.
- To introduce the basic concepts of system engineering management
- To introduce the students to the concept of Aircraft Product and System Engineering, Standards and Certification.
- To provide the necessary knowledge needed in design and development of new aircraft systems.
- To expose students to concept such as avionics system engineering design life cycle, design standards and certification standards.

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 AND CERTIFICATION OF AVIONICS SYSTEMS 12

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 Certification, Civil Aviation Authorities, Regulatory and Advisory Agencies, Type Certification, Certification Process, Delegation, Product Certification Process Roadmap

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

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-IV 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-V CERTIFICATION CONSIDERATIONS FOR HIGHLY-INTEGRATED ORCOMPLEX 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.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Understand the basic concepts of system engineering development cycle
- Understand the basic concepts of system engineering management
- Students will understand the advanced concepts of Aircraft product and system engineering, standards and certification to the engineers.
- Get the necessary knowledge that is 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.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

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.

Reference Books / Web links:

1. SAEARP4761, Guidelines and Methods for Conducting the Safety Assessment Process on Civil Aircraft Airborne Systems and Equipment, Warrendale, PA, 1996
2. DO-254/EUROCAE ED-80, Design Assurance Guidance For Airborne Electronic Hardware, RTCA Inc., Washington, D.C, April 19, 2000
3. SAE ARP4754, Certification Considerations for Highly-Integrated or Complex Aircraft Systems, SAE, Warrendale, PA, 1996.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23A13.1	1	1	1	1	1	1	1	1
AV23A13.2	1	1	1	1	1	1	1	1
AV23A13.3	1	1	3	1	1	1	1	1
AV23A13.4	2	1	1	1	1	1	2	1
AV23A13.5	1	2	1	1	1	1	1	1
Avg.	1.2	1.2	1.4	1	1	1	1.2	1

Subject Code	Subject Name	Category	L	T	P	C
AV23A14	INDUSTRIAL AVIONICS	PE	3	0	0	3

Objectives:

- To introduce the basic knowledge on avionics system engineering and avionic subsystems.
- To introduce to the avionic software standards & requirements.
- To introduce the safety measures and tools of avionics software.
- To introduce to on board Navigation systems and their advances.
- To introduce the man machine interface of the aircraft and flight management system.

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 Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Understand the advanced concepts of Industrial avionics to the engineers and to provide the necessary knowledge that are needed in understanding relevant processes.
- Have an exposure on various topics such as System Engineering, on-board software, safety of complex systems and will be able to deploy these skills effectively in the solution of problems in avionics engineering.
- Understand the various regulations and certification requirements for avionics software.
- Understand the various navigation sources available in the aircraft.
- Get introduce with the cockpit and flight management system.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

1 Spitzer, C.R. "Digital Avionics Systems", Prentice Hall, U.S.A
2 Introduction to Systems Engineering by Andrew P.Sage and James E.Armstrong

Reference Books / Web links:

1 Civil Avionics systems by lanmoir and Allan seabridge , Professional Engineering Publishing Limited, London and Bury St Edmunds, UK
2 Introduction to Avionics Systems by R.P.G. Collinson Third Edition, Springer Publishers.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23A14.1	1	1	2	1	1	1	2	1
AV23A14.2	2	1	2	1	1	1	1	1
AV23A14.3	1	1	2	1	1	1	2	1
AV23A14.4	2	1	3	1	1	3	2	1
AV23A14.5	1	1	3	1	1	2	2	1
Avg.	1.4	1	2.4	1	1	1.6	1.8	1

Subject Code	Subject Name	Category	L	T	P	C
AV23A15	**DETECTION AND ESTIMATION THEORY**	PE	**3**	**0**	**0**	**3**

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.
- To make familiarize about the applications of detection and estimation theory.

UNIT-I REVEIW 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, Spatial 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, Kalman Algorithm - Computational Considerations, 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.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- 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.
- Understand the theory behind various estimation techniques.
- Learn about the basics of multi-user detection theory

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

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, NewJersy, 1993.

Reference Books / Web links:

1. Harry L. Van Trees, "Detection, Estimation and Modulation Theory", Part I John Wiley and Sons, New York, 2001.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23A15.1	1	1	2	2	3	1	1	2
AV23A15.2	2	1	2	3	3	1	1	2
AV23A15.3	2	1	3	3	3	1	1	3
AV23A15.4	1	1	3	3	3	1	1	2
AV23A15.5	2	1	3	3	3	1	1	2
Avg.	1.6	1	2.6	2.8	3	1	1	2.2

Subject Code	Subject Name	Category	L	T	P	C
AV23B21	AVIONICS SYSTEM ENGINEERING	PE	3	0	0	3

Objectives:

- To introduce the basic concept of system engineering to optimize the design and analysis of Avionic systems
- 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,
- To introduce the knowledge about the configuration control of avionics system design.
- To provide the basic exposure on maintainability and reliability.

UNIT-I INTRODUCTION TO SYSTEMS ENGINEERING 9

Overview of Systems Engineering- Systems Engineering Concept Map-Systems Definition - The seven steps Systems Engineering-Conceptual System Design- System Engineering Process-Requirements And Management- Trade Studies-;Integrated Product And Process Development

UNIT-II THE AIRCRAFT SYSTEMS AND DESIGN 9

Introduction-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- Mission analysis

UNIT-III SYSTEM ARCHITECTURES AND INTEGRATION 9

Introduction-Systems Architectures-Modelling 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

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Understand the introduction to the concepts of System Engineering to the engineers and the necessary knowledge that can be significantly introduced to optimize the design and analysis of avionic systems.
- Have an exposure on various topics such as the System Engineering as a process, System Architecture and integration, Maintainability and reliability.
- Understand the basic aspects of system reliability and maintainability
- Understand the system configuration control process.
- Deploy these skills effectively in the design process of systems in an aircraft.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

1. Systems Approach to Engineering Design by Peter. Sydenham, Artech house, Inc, London, 2003
2. Systems Engineering by Erik Aslaksen and Rod Belcher.
3. Design and Development of an Aircraft Systems by Ian Moir and Allan Seabridge

Reference Books / Web links:

1. Aircraft Systems Mechanical, electrical, and avionics subsystems integration by Ian Moir and Allan Seabridge John Wiley & Sons Ltd (2009)
2. Introduction to Systems Engineering by Andrew P.Sage and James E.Armstrong.

Cos	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23B21.1	1	1	2	2	1	1	1	1
AV23B21.2	1	1	2	2	1	1	1	1
AV23B21.3	1	1	2	2	1	1	1	1
AV23B21.4	1	1	2	2	1	1	2	1
AV23B21.5	1	1	2	3	2	1	2	1
Avg.	1	1	2	2.2	1.2	1	1.4	1

Subject Code	Subject Name	Category	L	T	P	C
AV23B22	UAV SYSTEM DESIGN	PE	3	0	0	3

Objectives:

- To expose students to concepts needed in modelling and analysing an unmanned system.
- To expose students to the design and development of UAV.
- To expose students to the type of payloads used in UAV.
- To study path planning
- To understand the avionics hardware used in the UAV

UNIT-I INTRODUCTION TO UAV 9

History of UAV –classification –basic terminology –applications-Airframe configurations.

UNIT-II BASICS OF AIRFRAME AND AERODYNAMIC DESIGN 9

Scale effects – Packaging Density – Airframe Structures and Mechanisms – Aerodynamics – Power plant Selection - equipment maintenance and management-control surfaces-specifications – Modular construction.

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

Dispensable and Non Dispensable payloads – Control of HTOL, VTOL, Hybrid UAVs – Control of Payloads and Sensors - Communication media, Radio communication, Mid-Air Collision Avoidance.

UNIT-V CONTROL STATIONS LAUNCH AND RECOVERY 9

Mini UAV Laptop GCS, Close Range UAV System GCS, Medium and Long Range UAV GCS, Launch and Recovery -Recent trends in UAV-Case Studies

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Understand the advanced concepts of UAV System Design to the engineers.
- Have the necessary mathematical knowledge that are needed in modelling and analyzing an unmanned system.
- Have knowledge about payloads and design standards, concluding with case studies of different such unmanned systems.
- Have an exposure on various topics such as Design and development of UAVs and will be able to deploy these skills effectively in the solution of problems in avionics engineering.
- Understand the basic and difficulties in path planning.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

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

Reference Books / Web links:

1. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007
2. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998,
3. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001
4. P.J.Swatton , "Ground studies for pilots' flight planning", Sixth edition, 2002.

Cos	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23B22.1	1	1	1	1	1	1	1	1
AV23B22.2	2	1	2	2	2	1	2	1
AV23B22.3	1	1	2	2	2	2	2	1
AV23B22.4	2	1	2	1	2	2	1	1
AV23B22.5	3	1	3	3	1	2	3	2
Avg.	1.8	1	2.2	1.8	1.6	1.6	1.8	1.2

Subject Code	Subject Name	Category	L	T	P	C
AV23B23	SYSTEM MODELLING AND SIMULATION	PE	3	0	0	3

Objectives:

- To introduce to students the concept of mathematical modelling and simulation.
- To introduce the concept of probability in simulation.
- To expose students to the concept and working of a flight simulator.
- To make the students comfortable in developing mathematical models for system simulation.
- To provide the knowledge of system dynamics in flight 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 Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Understand the advanced concepts of Mathematical Modelling and Simulation to the engineers and to provide the necessary mathematical knowledge that are needed in modelling physical processes.
- Have an exposure on various topics such as System Models, probability concepts in simulation and flight simulators
- Have an experience on flight simulators.
- Deploy these skills effectively in the understanding the concepts and working of a flight simulator.
- Understand the importance of system dynamics in flight simulation.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

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

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23B23.1	1	1	2	3	3	2	2	2
AV23B23.2	2	1	2	3	3	2	2	2
AV23B23.3	2	1	2	1	2	1	1	2
AV23B23.4	1	1	2	2	2	1	1	2
AV23B23.5	1	1	2	1	2	1	1	2
Avg.	1.6	1	2	2	2.4	1.4	1.4	2

Subject Code	Subject Name	Category	L	T	P	C
AV23B24	DIGITAL FLY-BY-WIRE CONTROL	PE	3	0	0	3

Objectives:

- To expose students to the basic concept of Digital Fly By Wire Control.
- To understand the importance of digital fly-by-wire controls in modern aircraft control strategies.
- To introduce different DFBW architectures, redundancy and reliability
- To understand the system requirements of digital fly-by-wire control system.
- To provide knowledge on active control technology, design issues and generic failures.

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

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 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

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Students will understand the advanced concepts of Fly-by-wire to the engineers and to provide the necessary mathematical knowledge that are needed in understanding modern aircraft control strategies.
- Understand the importance of digital fly-by-wire controls in modern aircraft control strategies.
- Understand the architecture and elements of DFBW systems.
- Understand the requirements for DFBW system design
- The students will have an exposure on various topics such as evolution of FBW, design and design issues of DFBW and will be able to deploy these skills effectively in the analyzing and understanding modern control methods.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

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)

Reference Books / Web links:

1. 'Modern Air Combat', Salamander Books Ltd , 2001.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23B24.1	1	1	2	1	1	1	1	1
AV23B24.2	1	1	3	1	1	2	2	1
AV23B24.3	1	1	3	1	1	2	2	1
AV23B24.4	1	1	3	2	1	2	2	1
AV23B24.5	3	1	3	3	3	3	2	2
Avg.	1.4	1	2.8	1.6	1.4	2	1.8	1.2

Subject Code	Subject Name	Category	L	T	P	C
AV23B25	INSTRUMENTATION FOR FLIGHT TESTING	PE	3	0	0	3

Objectives:

- To expose students to the concept of flight testing.
- To introduce students to the concept of data acquisition systems.
- To expose students to the principles of telemetry system.
- To understand the advanced concepts of ground telemetry station.
- To understand the advanced concepts of range instrumentation.

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 de-multiplexing - FM, PAM and PCM De-multiplexing systems - IRIG Standards - Recorders - Quick look displays - Data compression

UNIT-V RANGE INSTRUMENTATION 4

Introduction - Typical range activities - TSPI Systems.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Gets exposure in the concept of flight testing.
- Understand the concept data acquisition systems.
- Get exposure to the concepts of telemetry systems
- Understand the concepts of ground telemetry station
- Understand the concepts of range instrumentation

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Reinforced learning

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

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

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23B25.1	1	1	2	1	1	2	2	1
AV23B25.2	2	1	2	2	1	2	3	3
AV23B25.3	2	1	2	2	2	2	3	1
AV23B25.4	2	1	2	2	1	3	3	1
AV23B25.5	1	1	2	2	1	3	3	1
Avg.	1.6	1	2	1.8	1.2	2.4	2.8	1.6

Subject Code	Subject Name	Category	L	T	P	C
AV23B26	SOFT COMPUTING FOR AVIONICS ENGINEERS	PE	3	0	0	3

Objectives:

- To expose students to the basic concept of fuzzy and neural networks.
- To familiarize with soft computing concepts.
- To introduce the use of heuristics based on human experience.
- To understand the concepts of soft computing control schemes and modelling
- To introduce the concepts of Genetic algorithm and its applications to soft computing using some applications.

UNIT-I NEURAL NETWORKS 9

Supervised Learning Neural Networks – Perceptrons – Adaline – Back propagation Multilayer Perceptron – Radial Basis Function Networks – Unsupervised Learning Neutral Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Counter Propagation Networks- Advances in Neural Network

UNIT-II FUZZY SET THEORY 9

Fuzzy Sets – Basic Definition and Terminology – Set Theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Reasoning – Extension Principle and Fuzzy Relations – Fuzzy IF-THEN Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Model – Sugeno Fuzzy Model – Tsukamoto Fuzzy Model – Input Space Partitioning and Fuzzy Modeling.

UNIT-III OPTIMIZATION METHODS 9

Derivative Based Optimization – Derivative free Optimization - Genetic Algorithm – Design Issues In Genetic Algorithm, Genetic Modeling – Optimization of Membership Function and Rule Base using GA – Fuzzy Logic Controlled GA.

UNIT-IV NEURAL AND FUZZY CONTROL SCHEMES 9

Direct and Indirect Neuro Control Schemes – Fuzzy Logic Controller – Familiarization of Neural Network and Fuzzy Logic Toolbox - Case Studies.

UNIT-V NEURO FUZZY MODELLING 9

Fuzzification and Rule Base using ANN – Fuzzy Neuron – Adaptive Neuro-fuzzy Inference SystemArchitecture – Hybrid Learning Algorithm – Learning Methods that Cross fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Students will understand the advanced concepts of Soft-computing to the engineers and to provide the necessary mathematical knowledge that are needed in modelling the related processes.
- Get exposure to the fuzzy and neural network concepts.
- Understand the use of heuristics based on human experience.
- Get introduce with the concepts of Genetic algorithm and its applications to soft computing using some applications.
- The students will have an exposure on Neuro-fuzzy modeling and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

1. "Neural Networks: Algorithms, Applications and Programming Techniques", Freeman J.A. &D.M. Skapura, Addison Wesley, 2000.
2. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.
3. Anderson J.A "An Introduction to Neural Networks",PHI, 2001.
4. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.

Reference Books / Web links:

1. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 2000.
2. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23B26.1	3	1	2	3	3	2	2	3
AV23B26.2	1	1	2	1	1	1	1	1
AV23B26.3	1	1	2	1	1	1	1	1
AV23B26.4	3	1	2	3	3	2	2	3
AV23B26.5	2	1	2	3	3	2	2	3
Avg.	2	1	2	2.2	2.2	1.6	1.6	2.2

Subject Code	Subject Name	Category	L	T	P	C
AV23B27	ROCKETRY AND SPACE MECHANICS	PE	3	0	0	3

Objectives:

- To introduce students to the concept of rocketry and space mechanics.
- 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 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- factors determining life time of satellites – satellite perturbations – methods to calculate 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.

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 multi-staging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles - SITVC.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Upon completion of this course, students will understand the advanced concepts in Rocketry and Space Mechanics to the engineers and to provide the necessary mathematical knowledge that are needed in understanding the physical processes.
- The students will have an exposure on Orbital Mechanics as well as space mechanics and will be able to deploy these skills effectively in the understanding of Rockets and like spacecraft systems.
- Understand the concepts of rocketry and satellite dynamics
- Understand the concepts of rocket aerodynamics, rocket propulsion and multi staging of rockets
- Understand the concept of satellite injection and its perturbations.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Reinforced learning

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

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

Reference Books / Web links:

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

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23B27.1	2	1	3	1	2	3	1	1
AV23B27.2	2	1	3	1	2	3	1	1
AV23B27.3	2	1	3	1	2	3	1	1
AV23B27.4	2	1	3	1	1	1	1	1
AV23B27.5	2	1	3	1	2	2	1	1
Avg.	2	1	3	1	1.8	2.4	1	1

Subject Code	Subject Name	Category	L	T	P	C
AV23B28	ACTIVE CONTROL TECHNOLOGY	PE	3	0	0	3

Objectives:

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

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 manoeuvring - spin-stall prevention and similar limiting concepts - Combat manoeuvres'.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Students will understand the advanced concepts in Active Control Technology to the engineers and to provide the necessary mathematical knowledge that are needed in modelling physical processes.
- Understand the concepts of active control functions and design considerations
- Understand the concepts of fly-by-wire, active control technology and its functions.
- Get knowledge in flying qualities and principles control modes of combat aircraft.
- Have exposure on various topics such as Automatic configuration management and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions
- Active based learning

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

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.

Reference Books / Web links:

1 AGARD-CP-228, 'Structural aspects of active Controls', 1977.
2 AGARD-IS-89, 'Task oriented flight control Systems', 1977.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23B28.1	1	1	2	1	1	1	1	1
AV23B28.2	2	1	2	3	2	3	3	1
AV23B28.3	1	1	2	1	1	1	1	1
AV23B28.4	2	1	2	2	2	3	2	1
AV23B28.5	2	1	2	3	2	3	3	1
Avg.	1.6	1	2	2	1.6	2.2	2	1

Subject Code	Subject Name	Category	L	T	P	C
AV23B29	EMBEDDED LANGUAGE WITH C	PE	3	0	0	3

Objectives:

- To expose the students to the fundamentals of embedded Programming.
- To Introduce the GNU C Programming Tool Chain in Linux.
- To study the basic concepts of embedded C and Embedded OS
- To introduce time driven architecture, Serial Interface with a case study.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT-I EMBEDDED PROGRAMMING 9

C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization – In-line Assembly.

UNIT-II C PROGRAMMING TOOLCHAIN IN LINUX 9

C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using *gprof* - Memory Leak Detection with *valgrind* - Introduction to GNU C Library

UNIT-III EMBEDDED C 9

Adding Structure to 'C' Code: Object oriented programming with C, Header files for Project and Port,
Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

UNIT-IV EMBEDDED OS 9

Creating embedded operating system: Basis of a simple embedded OS, Introduction to sEOS, Using Timer 0 and Timer 1, Portability issue, Alternative system architecture, Important design considerations when using sEOS- Memory requirements - embedding serial communication & scheduling data transmission - Case study: Intruder alarm system

UNIT-V PYTHON PROGRAMMING 9

Basics of PYTHON Programming Syntax and Style – Python Objects– Dictionaries – comparison with C programming on Conditionals and Loops – Files – Input and Output – Errors and Exceptions – Functions – Modules – Classes and OOP – Execution Environment

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- The learning process delivers insight into Embedded programming languages/software compatible to embedded process development with improved design & programming skills.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.
- Develop the knowledge in Embedded C and Embedded OS
- Get introduced with GNU C Programming Tool Chain in Linux.
- Basic concepts of python programming.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Reinforced learning

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

1 Mark Lutz,"LearningPython,Powerful OOPs,O'reilly,2011
2 Stephen Kochan, "Programming in C", 3rd Edition, Sams Publishing, 2009.
3 Michael J Pont, "Embedded C", Pearson Education, 2007.

Reference Books / Web links:

1 Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc, 2006.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23B29.1	2	1	2	2	2	1	1	2
AV23B29.2	1	1	2	2	2	1	1	2
AV23B29.3	2	1	2	2	3	2	2	3
AV23B29.4	2	1	2	2	3	2	2	3
AV23B29.5	2	1	2	2	3	2	2	3
Avg.	1.8	1	2	2	2.6	1.6	1.6	2.6

Subject Code	Subject Name	Category	L	T	P	C
AV23C31	FLIGHT DATA MANAGEMENT	PE	3	0	0	3

Objectives:

- To introduce students to the concept of flight data management.
- To introduce the flight data monitoring procedure and activities.
- To understand the various flight data management systems present in the air vehicles.
- To introduce with the flight data recorder and activities.
- To understand the flight data analysis through case studies.

UNIT-I INTRODUCTION **5**

Definitions-Fundamental concepts and definitions-FDM and SMS, Objectives of an operator's FDM system, Description of a typical FDB system-system outline-information flow, Aircraft operations, Data Acquisitions, Ground based data replay and Analysis programs, Information and Information data base, continued monitoring.

UNIT-II FLIGHT DATA MONITORING **10**

FDM within Safety Management System-Safety culture, risk identification, How sms can benefit from FDM and vice-versa, FDM Technology-Data Recording Technology, Interpretation and use of FDM information

UNIT-III AIRCRAFT FDM SYSTEMS **10**

Introduction, Equipment Specification, Maintaining equipment performance, QAR serviceability and MEL'S., Safety Reports and Mandatory occurrence reporting, FDM in small fleets and Business Aviation, Helicopter Flight Data Monitoring.

UNIT-IV FLIGHT DATA RECORDER **10**

Applicable Recorded Flight Data, FDR Data: Disclosure and Access , FDR Recovery: From On Scene to the FDR Laboratory , FDR Data: Non-Safety Board FDR Download, FDR Arrival at the Safety Board Recorder Laboratory, Initial FDR Readout , FDR Preliminary Data: Release to the Parties , FDR Preliminary Data: Safety Board Staff and Official Use, Planning the FDR Group Meeting, The FDR Group Meeting ,FDR Animations ,The FDR Factual Report , Release of the Recorder and Original Data Media, Military Investigations or Other Federal Agencies , NTSB Investigation with Foreign Representatives, Foreign Investigations with NTSB Participation or Assistance.

UNIT-V FLIGHT DATA ANALYSIS CASE STUDIES **10**

Go-around procedure, Low-speed after take-off, Fuel conservation of short- haul operators, Air-craft deicing, FDM for the business jet user

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Students will understand the concept of Flight Data management, the necessary knowledge needed in modelling the Data Management process and methods.
- The students will have an exposure on various Flight Data Management process such as flight data recording, flight data analysis and airline safety management.
- The students will be able to use these skills effectively in providing solution to problems in aircraft safety and management.
- Understand the flight data recording systems.
- Familiarize with the flight data monitoring systems.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Reinforced learning

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

1. Flight Data Recorder Handbook for Aviation Accident Investigations Office of Research and Engineering Office of Aviation Safety Washington, DC 20594
2. CAP 739-Flight Data Monitoring

Reference Books / Web links:

1. Flight data monitoring on ATR aircraft 2016

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23C31.1	2	1	3	2	3	2	2	3
AV23C31.2	1	1	2	3	1	1	2	1
AV23C31.3	3	1	2	3	2	2	3	1
AV23C31.4	1	1	3	3	1	1	2	1
AV23C31.5	1	1	3	3	1	1	2	1
Avg.	1.6	1	2.6	2.8	1.6	1.4	2.2	1.4

Subject Code	Subject Name	Category	L	T	P	C
AV23C32	SPACECRAFT COMMUNICATION SYSTEMS	PE	3	0	0	3

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 8

Satellite Systems, Orbital description and Orbital mechanics of LEO, MEO and GSO, Placement of a Satellite in a GSO, Satellite – description of different Communication subsystems, Bandwidth allocation.

UNIT-II TRANSMISSION, MULTIPLEXING, MULTIPLE ACCESS AND CODING 12

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

UNIT-III SATELLITE LINK DESIGN 9

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 9

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 7

VSAT-VSAT Technologies, Networks MSS-AMSS, MMSS

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Understand the advanced concepts of Spacecraft communication systems to the engineers and to provide the necessary mathematical knowledge that are needed in understanding the physical processes.
- Understand the basics of orbital mechanics and performance parameters.
- Get introduce with the spacecraft subsystems and payload operations.
- Introduce with the concepts of telemetry tracking and telecommand.
- The students will have an exposure on various topics such as elements of satellite communication system, links and multiplexing, multiple access and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

1. Wilbur L. Pritchard and Joseph A.Sciulli, Satellite Communication Systems Engineering, Prentice Hall, New Jersey, 1986.
2. Timothy Pratt and Charles W.Bostain, Satellite Communications, John Wiley and Sons, 1986.
3. Tri T Ha, Digital Satellite Communication, Macmillan Publishing Company, 1986.
4. Kadish, Jules E, Satellite Communications Fundamentals, Artech House, Boston 2000

Reference Books / Web links:

1. Lida,Takashied.,Satellite communications:System and its design technology, Ohmsha Tokyo 2000
2. Maral, Gerard,Satellite communications systems: Systems, techniques and technology, John Wiley, Newyork 2002.
3. Elbert, Bruce R, Satellite communication applications handbook, Artech house Boston 2004.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23C32.1	1	1	2	2	1	1	2	1
AV23C32.2	2	1	2	2	1	3	1	1
AV23C32.3	2	1	3	2	1	1	2	1
AV23C32.4	2	1	3	2	1	1	2	1
AV23C32.5	3	1	2	2	1	2	2	1
Avg.	2	1	2.6	2	1	1.6	1.8	1

Subject Code	Subject Name	Category	L	T	P	C
AV23C33	REAL TIME EMBEDDED SYSTEMS	PE	3	0	0	3

Objectives:

- To understand the basics of embedded system, architecture of PIC microcontroller and ARM processor
- To understand the basics of embedded system, architecture of PIC microcontroller and ARM processor
- To learn the protocols of embedded wireless application
- To understand concepts involved in the design of hardware and software components for an embedded system.
- To expose students to the basic concept of Real Time UML.

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.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Students will understand the advanced concepts of Real-time embedded systems to the engineers and to provide the necessary knowledge for their design and development.
- Make a choice a suitable embedded processor for a given application.
- Design the hardware and software for the embedded system.
- Design and develop the real time kernel/operating system functions, task control block structure and analyze different task states.
- Implement different types of inter task communication and synchronization techniques

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

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.
3. C.M.Krishna, Kang G.Shin, "Real Time Systems", Mc-Graw Hill, 1997.
4. B.P.Douglass, "Real Time UML 2nd Edition", Addison-Wesley 2000.
5. J.Schiller, "Mobile Communication", Addison-Wesley, 1999.
6. Dr.K.V.K.K.Prasad, "Embedded/Real Time Systems: Concepts, Design and Programming",

Reference Books / Web links:

1. DreamTech press, Black Book, 2005. (UNIT – I)
2. R.Barnett, L.O.Cull, S.Cox, "Embedded C Programming and the Microchip PIC", Thomason Learning 2004.
3. Wayne Wolf, "Computers as Components - Principles of Embedded Computer System Design", Mergen Kaufman Publisher, 2006.
4. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc-Graw Hill, 2004.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23C33.1	2	1	3	2	2	2	2	1
AV23C33.2	2	1	2	3	3	2	3	1
AV23C33.3	3	1	2	3	3	2	3	1
AV23C33.4	3	1	2	3	3	3	3	1
AV23C33.5	2	1	3	2	2	2	2	1
Avg.	2.6	1	2.4	2.6	2.6	2.2	2.6	1

Subject Code	Subject Name	Category	L	T	P	C
AV23C34	FAULT TOLERANT COMPUTING	PE	3	0	0	3

Objectives:

- To expose students to the basic concepts of fault tolerance in systems.
- To introduce students to the concept of structure and reliability of systems.
- To expose students to the concept of software fault tolerance.
- To study about the system architectures, integration, practical considerations and configuration.
- To learn about the error detection and correction techniques.

UNIT-I ERROR DETECTION 12

Measure for error detection – Mechanisms solution of problems in avionics engineering.

UNIT-II 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 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.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Students will understand the advanced concepts of Fault Tolerance to the engineers and to 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 design and will be able to deploy these skills effectively in the analyzing and understanding fault tolerant methods.
- Understand the concepts of reliability in fault tolerant systems.
- Understand the fault tolerant system architectures, integration, practical considerations and configuration
- Understand the concepts of error detection and error correction.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

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.

Reference Books / Web links:

1 John D. Musa, Anthony Jannino, Kzuhira, Okunito, Software reliability measurement, prediction and application, McGraw – Hill, 1989.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23C34.1	2	1	2	1	1	1	2	1
AV23C34.2	2	1	2	1	1	1	2	1
AV23C34.3	3	1	2	2	2	2	3	2
AV23C34.4	3	1	2	2	2	2	3	2
AV23C34.5	3	1	2	2	2	2	3	2
Avg.	2.6	1	2	1.6	1.6	1.6	2.6	1.6

Subject Code	Subject Name	Category	L	T	P	C
AV23C35	ARTIFICIAL INTELLIGENCE	PE	3	0	0	3

Objectives:

- To introduce students to the basic concepts of artificial intelligence.
- To introduce the students about the concept of knowledge representation.
- To introduce the students about the concept knowledge inference.
- To make understand the students about planning and machine learning.
- To introduce about the working and architecture of expert systems.

UNIT-I INTRODUCTION TO Al AND PRODUCTION SYSTEMS 9

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics -Specialized production system- Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction - Related algorithms, Measure of performance and analysis of search algorithms.

UNIT-II REPRESENTATION OF KNOWLEDGE 9

Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

UNIT-III KNOWLEDGE INFERENCE 9

Knowledge representation -Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory-Bayesian Network-Dempster – Shafer.

UNIT-IV PLANNING AND MACHINE LEARNING 9

Basic plan generation systems - Strips -Advanced plan generation systems – K strips -Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.

UNIT-V EXPERT SYSTEMS 9

Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Identify the problems that are responsive to provide solution by AI methods and identify appropriate AI methods to solve a given problem.
- Give a definite structure to a given problem in the language or framework of different AI methods and implement basic AI algorithms.
- Design and evaluate different algorithms based on observation and experience.
- Understand about planning and machine learning
- Get exposure about expert system working and architecture.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Mini Projects

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Continuous Assessment Tests

Text Books:

1 Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill- 2008. (Units-I,II,VI & V)
2 Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007. (Unit-III).

Reference Books / Web links:

1 Peter Jackson, "Introduction to Expert Systems", 3 rd Edition, Pearson Education, 2007.
2 Stuart Russel and Peter Norvig "AI – A Modern Approach", 2 nd Edition, Pearson Education 2007.
3 Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23C35.1	3	1	3	2	3	3	2	3
AV23C35.2	3	1	3	2	3	3	2	3
AV23C35.3	2	1	2	3	3	3	3	3
AV23C35.4	2	1	3	2	2	2	2	3
AV23C35.5	2	1	3	2	2	2	2	3
Avg.	2.4	1	2.8	2.2	2.6	2.6	2.2	3

Subject Code	Subject Name	Category	L	T	P	C
AV23C36	PAYLOAD AND SENSORS FOR UAV	PE	3	0	0	3

Objectives:

- To introduce students to the basic concepts of different types of sensors used in UAV.
- To understand the various payloads of an UAV
- To introduce with the concepts of data fusion algorithms and architectures.
- To introduce the concepts of fuzzy logic and fuzzy neural networks
- To expose students to the concept of artificial neural networks.

UNIT-I PAYLOAD FOR UAV **9**

Introduction – Types – Non-dispensable Payloads - Electro-optic Payload Systems - Electro-optic Systems Integration - Radar Imaging Payloads - Other Non-dispensable Payloads - Dispensable Payloads - Payload Development.

UNIT-II SENSOR **9**

Data fusion applications to multiple sensor systems - Selection of sensors - Benefits of multiple sensor systems - Influence of wavelength on atmospheric attenuation - Fog characterization - Effects of operating frequency on MMW sensor performance - Absorption of MMW energy in rain and fog - Backscatter of MMW energy from rain - Effects of operating wavelength on IR sensor performance - Visibility metrics - Visibility - Meteorological range - Attenuation of IR energy by rain - Extinction coefficient values - Summary of attributes of electromagnetic sensors - Atmospheric and sensor system computer simulation models

UNIT-III DATA FUSION ALGORITHMS AND ARCHITECTURES 9

Definition of data fusion - Level 1 processing - Detection, classification, and identification algorithms for data fusion - State estimation and tracking algorithms for data fusion - Level 2, 3, and 4 processing - Data fusion processor functions - Definition of an architecture - Data fusion architectures - Sensor-level fusion - Central-level fusion - Hybrid fusion - Pixel-level fusion - level fusion-Decision-level fusion - Sensor footprint registration and size considerations - Dempster-Shafer Evidential Theory- Summary

UNIT-IV ARTIFICIAL NEURAL NETWORKS **9**

Applications of artificial neural networks - Adaptive linear combiner - Linear classifiers - Capacity of linear classifiers - Nonlinear classifiers - Madaline - Feedforward network - Capacity of nonlinear classifiers - Supervised and unsupervised learning - Supervised learning rules - Voting Logic Fusion

UNIT-V FUZZY LOGIC AND FUZZY NEURAL NETWORKS **9**

Conditions under which fuzzy logic provides an appropriate solution - Illustration of fuzzy logic in an automobile antilock braking system - Basic elements of a fuzzy system - Fuzzy logic processing - Fuzzy centroid calculation

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Students will understand the advanced concepts of payloads and sensors used in UAV and provide the necessary knowledge for their design and development.
- Understand the concepts data fusion algorithms and architectures
- Understand the concepts of fuzzy logic and fuzzy neural networks.
- Get exposure on artificial neural networks.
- The students will have an exposure on various topics such as data fusion algorithms and architecture, artificial and fuzzy neural network and fuzzy logic and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Mini Projects

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

1. 'Unmanned aircraft systems UAVs design, development and deployment' Reg Austin Aeronautical Consultant, A John Wiley and Sons, Ltd., Publication
2. Mathematical Techniques in Multi-sensor Data Fusion (Artech House Information Warfare Library) [Hardcover] David L. Hall, Sonya A. H. McMullen
3. Handbook of Multisensor Data Fusion: Theory and Practice, Second Edition (Electrical Engineering & Applied Signal Processing Series) Martin Liggins II David Hall, James

Reference Books / Web links:

1. Sensor and Data Fusion: A Tool for Information Assessment and Decision Making, Second Edition (SPIE Press Monograph PM222) Lawrence A. Klein
2. Multi-Sensor Data Fusion with MATLAB by Jitendra R. Raol

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV23C36.1	2	1	2	1	2	1	2	2
AV23C36.2	2	1	3	2	3	2	3	3
AV23C36.3	2	1	3	2	3	2	3	3
AV23C36.4	2	1	3	2	3	2	3	3
AV23C36.5	2	1	2	2	3	2	3	3
Avg.	2	1	2.6	1.8	2.8	1.8	2.8	2.8