M.E. AVIONICS
R-2019
CURRICULUM & SYLLABUS

VISION AND MISSION STATEMENTS OF THE AERONAUTICAL ENGINEERING DEPARTMENT

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 2019
CURRICULUM

SEMESTER I

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MH19101	Advanced Applied Mathematics	FC	4	3	1	0	4
2	AV19101	Aerospace Engineering (for Non-Aero graduates)	FC	3	3	0	0	3
	AV19102	Electronic Systems (for Aero graduates)						
3	AV19103	Digital Avionics	PC	3	3	0	0	3
4	AV19104	Image Processing for Aerospace Applications	PC	3	3	0	0	3
5		Professional Elective - I	PE	3	3	0	0	3
6	PG19101	Research Methodology and IPR	MC	3	3	0	0	3
7	AC19101	English for Research Paper Writing	MC	3	3	0	0	0
PRACTICAL								
1	AV19111	Avionics Integration Laboratory	PC	4	0	0	4	2
2	AV19112	Image Processing Laboratory	PC	4	0	0	4	2
TOTAL				**30**	**21**	**1**	**8**	**23**

SEMESTER II

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	AV19201	Communication and Navigation Systems	PC	3	3	0	0	3
2	AV19202	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	AC19201	Constitution of India	MC	3	3	0	0	0
PRACTICAL								
1	AV19211	Flight Control Systems Laboratory	PC	4	0	0	4	2
2	AV19212	Unmanned Aerial Vehicle Laboratory	PC	4	0	0	4	2
TOTAL				**26**	**18**	**0**	**8**	**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.		Professional Elective - V	PE	3	3	0	0	3
2.		Open Elective - I	OE	3	3	0	0	3
PRACTICAL								
3.	AV19311	Project Work (Phase I)	EEC	20	0	0	20	10
TOTAL				**26**	**6**	**0**	**20**	**16**

SEMESTER IV

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1.	AV19411	Project Work (Phase II)	EEC	32	0	0	32	16
TOTAL				**32**	**0**	**0**	**32**	**16**

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	AV19P11	Flight Instrumentation	3	0	0	3
2	AV19P12	Display Engineering	3	0	0	3
3	AV19P13	Aircraft Product and System Engineering, Standards and Certification.	3	0	0	3
4	AV19P14	Industrial Avionics	3	0	0	3
5	AV19P15	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	AV19P21	Avionics System Engineering	3	0	0	3
2	AV19P22	UAV System Design	3	0	0	3
3	AV19P23	System Modelling and Simulation	3	0	0	3
4	AV19P24	Digital Fly-By Wire Control	3	0	0	3
5	AV19P25	Instrumentation for Flight Testing	3	0	0	3
6	AV19P26	Soft computing for Avionics Engineers	3	0	0	3
7	AV19P27	Rocketry and Space Mechanics	3	0	0	3
8	AV19P28	Active Control Technology	3	0	0	3
9	AV19P29	Embedded Language with C	3	0	0	3

PROFESSIONAL ELECTIVE-V (SEMESTER III)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	AV19P31	Flight Data Management	3	0	0	3
2	AV19P32	Spacecraft Communication Systems	3	0	0	3
3	AV19P33	Real Time Embedded System	3	0	0	3
4	AV19P34	Fault Tolerant Computing	3	0	0	3
5	AV19P35	Artificial Intelligence	3	0	0	3
6	AV19P36	Payload and Sensors for UAV	3	0	0	3

LIST OF OPEN ELECTIVES

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	CP19O31	Business Analytics	3	0	0	3
2	ED19O31	Industrial Safety	3	0	0	3
3	ED19O32	Operations Research	3	0	0	3
4	PG19O31	Cost Management of Engineering Projects	3	0	0	3
5	ED19O33	Composite Materials	3	0	0	3
6	PG19O33	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	-	-	3	-	-	3	10	16
IV	-	-	-	-	-	-	16	16
Total	7	20	15	3	0	3	26	74

Subject Code	Subject Name	Category	L	T	P	C
MH19101	ADVANCED APPLIED MATHEMATICS	FC	3	1	0	4

Objectives:

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

UNIT-I LINEAR ALGEBRA 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 - Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

UNIT-III RANDOM PROCESSES 12

Classification – Auto correlation - Cross correlation - Stationary random process – Markov process –- Markov chain - Poisson process – Gaussian process.

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 Poison's equations.

Total Contact Hours : 60

Course Outcomes:

On completion of the course students will be able to

- Understand the concepts and develop the working knowledge in linear algebra
- Understand the concepts of probability and random variables.
- Understand the Markov chain and the usage of conditional probability in discrete –time markov chain.
- Construct the mathematical models for a linear programming
- Get introduce with the Fourier transforms and able to solve the partial differential equations.

Text Books:

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. Sankara Rao K., "Introduction to partial differential equations" Prentice Hall of India Pvt, Ltd, New Delhi, 1997

Reference Books / 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

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV19101.1	2	1	2	1	2	1	1	1
AV19101.2	1	1	1	1	1	1	1	1
AV19101.3	2	1	2	1	2	1	1	1
AV19101.4	1	1	1	1	1	1	1	1
AV19101.5	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
AV19101	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.

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
AV19101.1	1	1	1	1	1	2	1	1
AV19101.2	1	1	2	2	1	2	2	1
AV19101.3	3	2	3	3	2	3	3	2
AV19101.4	1	1	1	1	1	1	1	1
AV19101.5	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
AV19102	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.

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
AV19102.1	1	1	1	1	1	1	1	1
AV19102.2	2	1	1	1	2	1	1	1
AV19102.3	1	1	1	1	1	2	1	1
AV19102.4	2	1	1	1	1	1	1	1
AV19102.5	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
AV19103	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.

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
AV19103.1	2	1	3	1	1	1	1	1
AV19103.2	1	1	3	1	2	1	1	1
AV19103.3	1	1	3	1	1	1	1	1
AV19103.4	1	1	3	1	1	1	1	1
AV19103.5	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
AV19104	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.

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
AV19104.1	3	1	2	3	2	2	2	2
AV19104.2	2	1	2	3	2	2	1	3
AV19104.3	3	1	2	3	2	2	1	3
AV19104.4	3	1	2	3	2	2	2	3
AV19104.5	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
PG19101	RESEARCH METHODOLOGY AND IPR	MC	3	0	0	3

Objectives:

- To inculcate the importance of research methodology and Intellectual Property Rights.
- To make people know the approach and methodology for report writing.
- To get knowledge of patents, copy right, trademarks and designs.
- To make the students aware of their rights for the protection of their invention done in their project work.
- To get registration of patents in our country and foreign countries of invention, designs and thesis or theory written.

UNIT-I Research Methodology **9**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT-II Review of Literature and Technical Writing **9**

Effective literature studies approach, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT-III Intellectual Property Rights **9**

Nature of Intellectual Property, Patents, Designs, Trade and Copyright, copyright registration in India Process of Patenting and Development: technological research, innovation, patenting and development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under Patent Cooperation Treaty.

UNIT-IV Patent Rights and Recent Developments In IPR: Patent Rights **9**

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

UNIT-V Industrial Designs and Geographical Indications **9**

Industrial designs and IC Layout design, Registrations of designs, conditions and procedures of industrial designs-Cancellation of Registration, International convention of design- types and functions. Semiconductor Integrated circuits and layout design Act- Geographical indications-potential benefits of Geographical Indications.

Total Contact Hours : 45

Course Outcomes:

On completion of the course students will be able to

- Student can understand the research problem formulation and analyse research related information.
- Understanding that when IPR would take such important place in growth of individuals & nation.
- Understand the importance of copyright and industrial designs.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
- The students once they complete their academic projects, they get awareness of acquiring the patent and copyright for their innovative works.

Text Books:

1. Neeraj Pandey and Khushdeep Dharni, Intellectual Property Rights, First edition, PHI learning Pvt. Ltd., Delhi, 2014.
2. Uma Sekaran and Roger Bougie, Research methods for Business, 5th Edition, Wiley India, New Delhi, 2012.
3. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'" ,2nd edition, Juta Academic, 2001.
4. Ramakrishna B & Anilkumar H S, Fundamentals of Intellectual Property Rights, Ist edition,Notion Press, 2017.

Reference Books / Web links:

1. William G Zikmund, Barry J Babin, Jon C.Carr, Atanu Adhikari,Mitch Griffin, Business Research methods, A South Asian Perspective, 8th Edition, Cengage Learning, New Delhi, 2012.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
PG19101.1	1	1	1	1	1	2	1	1
PG19101.2	1	1	2	2	1	2	2	1
PG19101.3	3	2	3	3	2	3	3	2
PG19101.4	1	1	1	1	1	1	1	1
PG19101.5	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
AC19101	English for Research Writing	HS	3	0	0	0

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

Objectives:

- Express technical ideas in writing
- Plan and organize the research paper
- Understand the structure and familiarize the mechanics of organized writing
- Improvise academic English and acquire research writing skills
- To understand the ethics involved in publishing a paper.

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
- Learn the process of writing a research paper
- Know the process of publishing journal paper

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
AC19101.1	2	2	1	2	1	-	-	-
AC19101.2	2	2	1	2	1	-	-	-
AC19101.3	2	2	1	2	1	-	-	-
AC19101.4	2	2	1	2	1	-	-	-
AC19101.5	2	2	1	2	1	-	-	-
Avg.	2	2	1	2	1	-	-	-

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
AV19111	Avionics Integration Laboratory	PC	0	0	4	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
AV19111.1	2	2	3	2	2	1	2	2
AV19111.2	2	2	3	2	2	1	3	2
AV19111.3	2	2	3	3	2	1	3	2
AV19111.4	3	2	3	2	3	2	2	3
AV19111.5	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
AV19112	Image Processing Laboratory	PC	0	0	4	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
AV19112.1	2	2	2	1	1	2	1	3
AV19112.2	3	2	3	2	2	2	1	3
AV19112.3	3	2	3	2	2	2	1	3
AV19112.4	3	2	3	3	2	2	1	3
AV19112.5	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	Category	L	T	P	C
AV19201	COMMUNICATION AND NAVIGATION SYSTEMS	PC	3	0	0	3

Objectives:

- To introduce the fundamental concepts of communication and navigation.
- To introduce the principle and working of optical communication systems.
- To introduce the principle and working of satellite communication systems.
- To provide the knowledge on various radio navigation systems.
- To expose students to basic concepts of navigation, and satellite and hybrid navigation.

UNIT-I INTRODUCTION TO COMMUNICATION 5

Fundamental of communication systems, signals and information, system block diagram, performance metrics and data rate limits. Review of Fourier series and Transforms – Energy/Power Spectral Density. Amplitude modulation and frequency modulation.

UNIT-II OPTICAL COMMUNICATION 10

Optical fibres fundamentals - total internal reflection, single mode and multimode fibres, step index, graded index fibres, attenuation effects, cut-off wavelengths. Optical sources and detectors - LEDs, LED structures, injection laser diodes, PIN photo detectors, avalanche photo diodes, photo detector noise. Optical modulation and modulators, Optical amplifiers. Design of an optical communication link, OTDR. Optical networks- SONET/SDH optical CDMA.

UNIT-III SATELLITE COMMUNICATION 10

Modelling the space link - frequency allocation for satellite communication, satellite orbits and link availability, radio wave propagation for satellite communication - atmospheric losses, ionospheric effects, rain attenuation and antennae for satellite communication. Polarization effects. Equivalent isotropic radiated power, transmission losses, link power budget, system noise, carrier to noise ratio, effects of rain, inter-modulation noise, inter-satellite links. Interference in satellite systems. Multiple access methods for satellite communication - FDMA, TDMA, CDMA. Introduction to satellite networks.

UNIT-IV INTRODUCTION TO NAVIGATION SYSTEM 10

Radio navigation-ADF,DME,VOR,LORAN,DECCA,OMEGA,ILS,MLS-Inertial Navigation Systems(INS)-Inertial Sensors, INS block diagram-Satellite navigation system-GPS,IRNSS(NAVIC)

UNIT-V SATELLITE NAVIGATION & HYBRID NAVIGATION 10

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. Introduction to IRNSS(NAVIC)

Total Contact Hours : 45

Course Outcomes:

On completion of course students will be able to

- The students will understand the concepts of Communication and Navigation the necessary knowledge needed in modelling the communication and navigation process and methods.
- Understand the basic principles and working of optical communication systems.
- Understand the various aspects related to the satellite navigation systems.
- The students will have an exposure on various communication and navigation systems such as satellite systems, inertial measurement systems, radio navigation systems, satellite navigation – GPS ; Landing aid.
- Deploy these skills effectively in the analysis and understanding of communication and navigation systems in an aircraft.

Text Books:

1. Gerd Keiser - Optical fiber communication, McGraw Hill
2. Timothy Pratt, Charles W. Bostian - Satellite Communications, John Wiley and Sons
3. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons,2nd edition, 1997

Reference Books / Web links:

1 Simon Haykin, Communication Systems
2 John M. Senior - Optical fiber communication, Pearson
3 J. Gower - Optical communication systems, Prentice Hall
4 Dennis Roddy - Satellite Communications, 4th edition, McGraw Hill.
5 Bruce R. Elbert - Introduction to Satellite Communication, 3rd edition, Artech House
6 Nagaraja, N.S. "Elements of Electronic Navigation", Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 1975.
7 George M Siouris, 'Aerospace Avionics System; A Modern Synthesis', Academic Press Inc., 1993.
8 Albert Helfrick, 'Practical Aircraft Electronic Systems', Prentice Hall Education, Career & Technology, 1995.

COs	POs					PSOs		
	1	2	3	4	5	1	2	3
AV19201.1	1	1	1	1	1	2	1	1
AV19201.2	1	1	2	1	1	3	1	1
AV19201.3	1	1	2	1	1	3	1	1
AV19201.4	1	1	1	1	1	3	1	1
AV19201.5	1	1	2	1	1	3	1	1
Avg.	1	1	1.6	1	1	2.8	1	1

Subject Code	Subject Name	Category	L	T	P	C
AV19202	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.

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
AV19202.1	1	1	2	2	1	2	2	1
AV19202.2	3	1	2	3	2	3	2	1
AV19202.3	3	1	2	3	2	3	2	2
AV19202.4	3	1	2	3	2	3	2	2
AV19202.5	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
AC19201	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 know about Constitutional and Non- Constitutional bodies
- To understand the relationships exist between union and states
- To understand 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.
- Understand and abide the rules of the Indian constitution.
- Gain knowledge on functions of state Government and Local bodies.
- Gain Knowledge on constitution functions and role of constitutional bodies and amendments of constitution.

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
AV19211	FLIGHT CONTROL SYSTEMS LABORATORY	PC	0	0	4	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
AV19211.1	2	2	3	2	2	2	2	3
AV19211.2	3	2	3	2	3	3	3	3
AV19211.3	3	2	3	3	3	3	3	3
AV19211.4	3	2	3	3	3	3	3	3
AV19211.5	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
AV19212	UNMANNED AERIAL VEHICLE LABORATORY	PC	0	0	4	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
AV19212.1	2	2	3	1	1	1	2	1
AV19212.2	3	2	3	2	3	2	3	3
AV19212.3	3	2	3	2	3	2	3	1
AV19212.4	3	2	3	2	3	2	3	3
AV19212.5	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	Category	L	T	P	C
AV19311	PROJECT WORK (PHASE I)	EEC	0	0	20	10

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
AV19311.1	2	2	1	2	1	3	3	3
AV19311.2	2	2	1	2	1	3	3	3
AV19311.3	2	2	1	2	1	3	3	3
AV19311.4	2	2	1	2	1	3	3	3
AV19311.5	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
AV19411	PROJECT WORK (PHASE II)	EEC	0	0	32	16

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
AV19411.1	2	2	1	2	1	3	3	3
AV19411.2	2	2	1	2	1	3	3	3
AV19411.3	2	2	1	2	1	3	3	3
AV19411.4	2	2	1	2	1	3	3	3
AV19411.5	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
AV19P11	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.

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
AV19P101.1	1	1	1	1	1	1	1	1
AV19P101.2	2	1	2	1	1	2	1	1
AV19P101.3	2	1	2	1	1	2	1	1
AV19P101.4	1	1	2	1	1	1	1	1
AV19P101.5	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
AV19P12	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.

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
AV19P103.1	1	1	1	1	1	1	1	1
AV19P103.2	1	1	2	1	1	1	1	1
AV19P103.3	2	1	3	2	1	1	2	1
AV19P103.4	3	1	2	1	1	1	1	1
AV19P103.5	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
AV19P13	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.

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
AV19P104.1	1	1	1	1	1	1	1	1
AV19P104.2	1	1	1	1	1	1	1	1
AV19P104.3	1	1	3	1	1	1	1	1
AV19P104.4	2	1	1	1	1	1	2	1
AV19P104.5	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
AV19P14	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.

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
AV19P105.1	1	1	2	1	1	1	2	1
AV19P105.2	2	1	2	1	1	1	1	1
AV19P105.3	1	1	2	1	1	1	2	1
AV19P105.4	2	1	3	1	1	3	2	1
AV19P105.5	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
AV19P15	**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

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
AV19P107.1	1	1	2	2	3	1	1	2
AV19P107.2	2	1	2	3	3	1	1	2
AV19P107.3	2	1	3	3	3	1	1	3
AV19P107.4	1	1	3	3	3	1	1	2
AV19P107.5	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
AV19P21	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.

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
AV19P201.1	1	1	2	2	1	1	1	1
AV19P201.2	1	1	2	2	1	1	1	1
AV19P201.3	1	1	2	2	1	1	1	1
AV19P201.4	1	1	2	2	1	1	2	1
AV19P201.5	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
AV19P22	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.

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
AV19P202.1	1	1	1	1	1	1	1	1
AV19P202.2	2	1	2	2	2	1	2	1
AV19P202.3	1	1	2	2	2	2	2	1
AV19P202.4	2	1	2	1	2	2	1	1
AV19P202.5	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
AV19P23	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.

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
AV19P203.1	1	1	2	3	3	2	2	2
AV19P203.2	2	1	2	3	3	2	2	2
AV19P203.3	2	1	2	1	2	1	1	2
AV19P203.4	1	1	2	2	2	1	1	2
AV19P203.5	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
AV19P24	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.

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
AV19P204.1	1	1	2	1	1	1	1	1
AV19P204.2	1	1	3	1	1	2	2	1
AV19P204.3	1	1	3	1	1	2	2	1
AV19P204.4	1	1	3	2	1	2	2	1
AV19P204.5	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
AV19P25	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

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
AV19P205.1	1	1	2	1	1	2	2	1
AV19P205.2	2	1	2	2	1	2	3	3
AV19P205.3	2	1	2	2	2	2	3	1
AV19P205.4	2	1	2	2	1	3	3	1
AV19P205.5	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
AV19P26	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.

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
AV19P206.1	3	1	2	3	3	2	2	3
AV19P206.2	1	1	2	1	1	1	1	1
AV19P206.3	1	1	2	1	1	1	1	1
AV19P206.4	3	1	2	3	3	2	2	3
AV19P206.5	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
AV19P27	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.

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
AV19P207.1	2	1	3	1	2	3	1	1
AV19P207.2	2	1	3	1	2	3	1	1
AV19P207.3	2	1	3	1	2	3	1	1
AV19P207.4	2	1	3	1	1	1	1	1
AV19P207.5	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
AV19P28	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.

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
AV19P212.1	1	1	2	1	1	1	1	1
AV19P212.2	2	1	2	3	2	3	3	1
AV19P212.3	1	1	2	1	1	1	1	1
AV19P212.4	2	1	2	2	2	3	2	1
AV19P212.5	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
AV19P29	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.

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
AV19P214.1	2	1	2	2	2	1	1	2
AV19P214.2	1	1	2	2	2	1	1	2
AV19P214.3	2	1	2	2	3	2	2	3
AV19P214.4	2	1	2	2	3	2	2	3
AV19P214.5	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
AV19P31	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.

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
AV19P218.1	2	1	3	2	3	2	2	3
AV19P218.2	1	1	2	3	1	1	2	1
AV19P218.3	3	1	2	3	2	2	3	1
AV19P218.4	1	1	3	3	1	1	2	1
AV19P218.5	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
AV19P32	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.

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
AV19P304.1	1	1	2	2	1	1	2	1
AV19P304.2	2	1	2	2	1	3	1	1
AV19P304.3	2	1	3	2	1	1	2	1
AV19P304.4	2	1	3	2	1	1	2	1
AV19P304.5	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
AV19P33	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

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
AV19P305.1	2	1	3	2	2	2	2	1
AV19P305.2	2	1	2	3	3	2	3	1
AV19P305.3	3	1	2	3	3	2	3	1
AV19P305.4	3	1	2	3	3	3	3	1
AV19P305.5	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
AV19P34	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.

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
AV19P208.1	2	1	2	1	1	1	2	1
AV19P208.2	2	1	2	1	1	1	2	1
AV19P208.3	3	1	2	2	2	2	3	2
AV19P208.4	3	1	2	2	2	2	3	2
AV19P208.5	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
AV19P35	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.

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
AV19P309.1	3	1	3	2	3	3	2	3
AV19P309.2	3	1	3	2	3	3	2	3
AV19P309.3	2	1	2	3	3	3	3	3
AV19P309.4	2	1	3	2	2	2	2	3
AV19P309.5	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
AV19P36	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.

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
AV19P306.1	2	1	2	1	2	1	2	2
AV19P306.2	2	1	3	2	3	2	3	3
AV19P306.3	2	1	3	2	3	2	3	3
AV19P306.4	2	1	3	2	3	2	3	3
AV19P306.5	2	1	2	2	3	2	3	3
Avg.	2	1	2.6	1.8	2.8	1.8	2.8	2.8