HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

SCHOOL OF AERONAUTICAL SCIENCES

M.Tech. Avionics

&

M.Tech. Avionics (Specialization in UAV)

2018

CURRICULUM & SYLLABUS

M.Tech. Avionics

SEMESTER – I

S.No.	Code No.	Course Title	L	T	P	C	TCH
THEORY							
1	AEC3701	Digital Avionics & Electro Magnetic Interference / Electro Magnetic compatibility	3	0	0	3	3
2	AEC3702	Flight Instruments and Data Acquisition	3	0	0	3	3
3	MAA3704	Applied Mathematics for Avionics	3	0	0	3	3
4	DE	Department Elective - I	3	0	0	3	3
5	DE	Department Elective - II	3	0	0	3	3
6	ZZZ3715	Research Methodology & IPR#	2	1	0	2	3
PRACTICAL							
7	AEC3791	Integrated Avionics lab	0	0	4	2	4
8	AEC3796	Seminar	0	0	3	2	3
	TOTAL					**21**	**25**

#Compulsory course for all PG Program

SEMESTER – II

S.No.	Code No.	Course Title	L	T	P	C	TCH
THEORY							
1	AEC3704	Aerospace Guidance and control	3	0	0	3	3
2	AEC3705	Aircraft Navigation system	3	0	0	3	3
3	AEC3706	Aerospace Structures Health Monitoring: Smart Sensor Technologies and Signal Processing	3	0	0	3	3
4	DE	Department Elective - III	3	0	0	3	3
5	OE	Open elective	3	0	0	3	3
PRACTICAL							
6	AEC3792	Automatic Flight Control Laboratory	0	0	4	2	4
7	AEC3781	Mini Project	0	0	6	2	6
TOTAL						**19**	**25**

* For specialization in UAV

SEMESTER – III

S.No.	Code No.	Course Title	L	T	P	C	TCH
THEORY							
1	DE	Department Elective – IV[$]	3	0	0	3	3
PRACTICAL							
2	AEC3797	Internship[#]	0	0	3	2	3
3	AEC3798	Project Work – Phase I	0	0	24	8	24
	TOTAL					**13**	**30**

* For specialization in UAV

Internship to be undergone during vacation between 2nd or 3rd semesters

$ Incorporation of MOOC to be offered for this course.

SEMESTER – IV

S.No.	Code No.	Course Title	L	T	P	C	TCH
1	AEC799	Project Work – Phase II	0	0	24	12	24
TOTAL						**12**	**24**

TOTAL CREDIT - 65

Department Elective –I

Sl. No.	Course Code	Course Title	L	T	P	Credit	TCH
1	AEC3721	Airborne actuator and sensors	3	0	0	3	3
2	AED3721	UAV System design*	3	0	0	3	3
3	AEC3722	Image processing for Aerospace application	3	0	0	3	3
4	AED3722	Payload and sensors for UAVs*	3	0	0	3	3

*** For specialization in UAV**

Department Elective –II

Sl. No.	Course Code	Course Title	L	T	P	Credit	TCH
1	AEC3723	Avionics system Engineering	3	0	0	3	3
2	AED3723	UAV Path Planning and Control*	3	0	0	3	3
3	AEC3724	Industrial Avionics	3	0	0	3	3
4	AED3724	Modeling and simulation of dynamic systems*	3	0	0	3	3
5	AEC3725	Electronic warfare	3	0	0	3	3
6	AED3725	Robotics and Dynamics*	3	0	0	3	3

*** For specialization in UAV**

Department Elective –III

Sl. No.	Course Code	Course Title	L	T	P	Credit	TCH
1	AEC3726	Digital fly-by-wire	3	0	0	3	3
2	AEC3727	Real Time Embedded Systems	3	0	0	3	3
3	AEC3728	Spacecraft communication systems	3	0	0	3	3
4	AED3728	Aerodynamics for UAV*	3	0	0	3	3
5	AEC3729	Programming in ADA	3	0	0	3	3
6	AED3729	Nonlinear and Robust Control*	3	0	0	3	3

*** For specialization in UAV**

Department Elective –IV

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
1	AEC3729	Flight Mechanics	3	0	0	3	3
2	AED3729	UAV – Operational and industrial aspects *	3	0	0	3	3
3	AEC3730	Electromagnetic interference and compatibility	3	0	0	3	3
4	AED3730	UAV Material and Fabrication Methodologies*	3	0	0	3	3

*** For specialization in UAV**

SEMESTER – I

COURSE TITLE	DIGITAL AVIONICS & EMI/EMC				
AEC3701	AEB	Credits	3	L-T-P-S	3-0-0-3
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	
Prerequisites : NA					

AIM OF THE COURSE

Learn the fundamentals of avionics system used in civil and military aircraft. Can develop the skill on using simulation tools, can compare the military and civil power requirement and tips for developing the package and power system. And also discussed about software development process ,Software Assessment and Validation for Civil and Military standards .

MODULE 1: INTRODUCTION TO AVIONICS6 (4L + 2T)

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.

MODULE 2: AVIONICS SYSTEM ESSENTIALS: DISPLAYS, I/O DEVICES AND POWER 10 (8L + 2T)

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

MODULE 3: AVIONICS SYSTEM DATA BUSES, DESIGN AND INTEGRATION 10(8L + 2T)

Trends in display technology, Alphanumeric displays, character displays etc., Civil and Military aircraft cockpits, MFDs, MFK, HUD, HDD, HMD, DVI, HOTAS, Synthetic and enhanced vision, situation awareness, Panoramic/big picture display, virtual cockpit-Civil and Military Electrical Power requirement standards, comparing the Military and Civil Requirements and Tips for Power System Design.

MODULE 4: PACKAGING AND EMI/EMC 8 (6L + 2T)

BIT and CFDS, Automatic Test Equipment - Speeds maintenance - ATLAS, Remote diagnostics and maintenance support-Life Cycle Costs for Military and Civil Avionics -Modular Avionics Packaging - Trade-off studies - ARINC and DOD types - system cooling - EMI/EMC requirements & standards.

MODULE 5: SYSTEM ASSESSMENT, VALIDATION AND CERTIFICATION 11(9L + 2T)

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

TEXT BOOKS

1. Spitzer, C.R. ―Digital Avionics Systems‖, The Blackburn Press; 0002- edition (October 1, 2000)

REFERENCES

1. Cary R .Spitzer, ―The Avionics Handbook‖, CRC Press, 2000.
2. Collinson R.P.G. ―Introduction to Avionics‖, Chapman and Hall, 1996.
3. Middleton, D.H. ―Avionics Systems‖, Longman Scientific and Technical, Longman Group
4. UK Ltd., England, 1989
5. Jim Curren, ―Trend in Advanced Avionics‖, IOWA State University, 1992.

e-book

https://books.google.co.in/books?id=pdmeAAAAIAAJ
https://books.google.co.in/books?isbn=084938348X
MOOC
https://study.com/articles/Online_Avionics_Course_Information.html
http://www1.rmit.edu.au/courses/C37011aero53971105
https://www.coursera.org/courses?query=aviation
COURSEWARE LINK
TUTORIAL LINK
OBJECTIVES OF THE COURSE
The course should enable the students to understand and design 1. To introduce role of avionics system and its architecture 2. To understand the avionics system design development and integration using simulation tools 3. To know modular avionics packaging and EMI/EMC requirements in avionics 4. To study system assessment, validation, certification and maintenance of avionics system
LEARNING OUTCOME OF THE COURSE
After learning the course, the students should be able to: • To impart the basic concepts of Avionics Systems to the engineers. • To provide the necessary knowledge on working of avionics systems in an aircraft. • To give an exposure on various topics such as Avionics system architecture, Avionics bus systems, integration, display systems and packaging. • To deploy these skills effectively in the understanding and analysis of avionics systems

COURSE TITLE	FLIGHT INSTRUMENTS AND DATA ACQUISITION				
AEC3702	AEB	Credits	3	L-T-P-S	3-0-0-3
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	

Prerequisites : NA

AIM OF THE COURSE

Data acquisition involves measuring signals (from a real-world physical system) from different sensors, and digitizing the signals for storage, analysis and presentation.

MODULE 1: MEASUREMENT SCIENCE AND DISPLAYS 9 (7L + 2T)

Instrumentation brief review-Concept of measurement-Errors and error estimation-Functional elements of an instrument system –Transducers - classification - Static and dynamic characteristics- calibration- classification of aircraft instruments-Instrument displays panels and cockpit layout

MODULE 2: AIR DATA INSTRUMENTS AND SYNCHRO TRANSMISSION SYSTEMS 9 (7L + 2T)

Air data instruments-airspeed, altitude, Vertical speed indicators. Static Air temperature, Angle of attack measurement, Synchronous data transmission system

MODULE 3: GYROSCOPIC INSTRUMENTS 9(7L + 2T)

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.

MODULE 4: AIRCRAFT COMPASS SYSTEMS &FLIGHT MANAGEMENT SYSTEM 9(7L + 2T)

Direct reading compass, magnetic heading reference system-detector element, monitored gyroscope system, DGU, RMI, deviation compensator. FMS- Flight planning-flight path optimization-operational modes-4D flight management

MODULE 5: POWER PLANT INSTRUMENTS 9 (7L + 2T)

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.

TEXT BOOKS

Spitzer, C.R. ―Digital Avionics Systems‖, The Blackburn Press; 0002- edition (October 1, 2000)

REFERENCES

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

E-Book

https://books.google.co.in/books?id=zwmJI0I3qCMC&printsec=frontcover&dq=Aircraft+Instruments+%26+Integrated+systems+mooc+courses&hl=en&sa=X&ved=0ahUKEwjD7NPUm8TdAhWILI8KHXAiAjwQ6AEIJjAA

https://books.google.co.in/books?id=0AjKjw-yviMC&printsec=frontcover&dq=Aircraft+Instruments+%26+Integrated+systems+mooc+courses&hl=en&sa=X&ved=0ahUKEwjD7NPUm8TdAhWILI8KHXAiAjwQ6AEIMDAC

MOOC

https://www1.rmit.edu.au/courses/C37011aero53971105

https://www.coursehero.com/file/20267917/Aircraft-Instruments-and-/

https://www.canvas.net/browse/erau/courses/aviation-maintenance

COURSEWARE LINK

TUTORIAL LINK

OBJECTIVES OF THE COURSE

The course should enable the students to understand and design

- 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.

LEARNING OUTCOME OF THE COURSE

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

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 20%)
Applying the knowledge acquired from the course	(Weightage: 20%)
Designing and analysing various engineering problems	(Weightage: 40%)
Evaluate and create the design	(Weightage: 20%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	**40%**	**20%**

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

COURSE TITLE	APPLIED MATHEMATICS FOR AVIONICS (AVIONICS)				
COURSE CODE	MAA3702	Credits	3	L-T-P-S	3-1-0-0
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	

Prerequisites : Basic knowledge on matrices , interpolation, set theory concepts and functions

AIM OF THE COURSE

Aim of this course is to enrich the students community with fundamental knowledge on advanced and applied mathematics topics like (i) Factorization of matrices (ii) Solutions of Nonlinear differential equations like Bernoullis and Riccatti's equations (iii) Cubic Spline and Hermite's Interpolation, (iv) Eulerien and Hamiltonian Graphs and (v) Fuzzy sets and Fuzzy function. These topics are very often used for research and development of Aeronautics and Avionics Fields.

MODULE 1: MATRIX THEORY **9(7L + 2T)**

Special vectors and matrices, Matrix inversion lemma, least square normal equation, Cholesky decomposition, Singular value decomposition (SVD)

MODULE 2: NON-LINEAR ORDINARY DIFFERENTIAL EQUATION **9(7L + 2T)**

Equation, with separable variables, Equations reducible to linear form, Bernoullis equation, Riccati's equation, Special Forms of Riccati's equation, The Lane Emden equation, The nonlinear Pendulum, Duffing equation.

MODULE 3:INTERPOLATION AND NUMERICAL INTEGRATION **9(7L + 2T)**

Interpolation: Newton Interpolation formulae- Lagrange's Interpolation-Cubic Spline interpolation, Hermite's Interpolation, Numerical integration: Gaussian Quadra line, Cubature.

MODULE 4: GRAPHS **9(7L + 2T)**

Graphs: Definition and examples - Sub graphs, Types of Graphs,- Graph Isomorphism- Eulerian trails and circuits-Euler's Theorem -Planar Graphs- Hamiltonian Graphs - Dirac's theorem.

MODULE 5: FUZZY SETS and FUZZY FUNCTIONS **9(7L + 2T)**

Fuzzy sets: Basic set theoretic operations for Fuzzy sets-Types of fuzzy sets-Fuzzy Relation and Fuzzy Graphs. Fuzzy Analysis: Fuzzy functions on fuzzy sets- Integration of Fuzzy functions –Fuzzy differentiations.

TEXT BOOKS

- Bronson, R., "Matrix operations, Schaum's outline series", McGraw Hill, New York., 1989.
- Jain. M.K. Iyengar S.R.K., and Jain R.K. "Numerical Methods for Scientific & engineering Computation", Wiley Eastern Ltd., 1987.

REFERENCES

- Froberg, C.E, "Numerical Mathematics", The Benjamin/Cummings Publishing Co., Inc., 1985.
- Stephenson, G. Radmore. P.M. "Advanced mathematical Methods for Engineering and science students", Cambridge university Press 1999.
- Bondy.J.A. and Murthy, U.S.R., "Graph Theory with applications", Macmillan, 1977.
- Zimmermann.H.J, "Fuzzy set theory and its applications" 4th Edition, Springer Science +Business Media 2001.

E-BOOKS

https://cours.etsmtl.ca/sys843/REFS/Books/ZimmermannFuzzySetTheory2001.pdf

http://web.xidian.edu.cn/zhangxin/files/20130329_182950.pdf

MOOC

https://nptel.ac.in/syllabus/111106049/

https://onlinecourses.nptel.ac.in/noc18_cs53/preview

https://nptel.ac.in/courses/111105035/

COURSEWARE LINK

TUTORIAL LINK

OBJECTIVES OF THE COURSE
The course should enable the students to understand • Special Matrices and Factorization of a Matrix • Solution of Non-Linear differential equations • Hermite's and Cubic spline Interpolation • Euler and Hamiltonian Graphs • Fuzzy sets, Fuzzy Graphs , integration of Fuzzy functions.

LEARNING OUTCOME OF THE COURSE
After learning the course the students should be able to: • Factorize the matrix using Cholesky and SVD • Solve Riccatti and Duffing equations. • Interpolate functions using Hemites and Cubic Spline interpolation. And solve integrals using numerical method. • Understand basic concepts on Eulerien and Hamiltonian Graphs • Understand different Fuzzy sets and Fuzzy functions

ASSESSMENT	
Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:	
Remembering and understanding the course contents	(Weightage: 20%)
Applying the knowledge acquired from the course	(Weightage: 20%)
Designing and analysing various engineering problems	(Weightage: 40%)
Evaluate and create the design	(Weightage: 20%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)		
THEORY COMPONENT		
INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	**40%**	**20%**

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)
Written examination for three hours

COURSE TITLE	Research Methodology & IPR				
COURSE CODE	ZZZ3715	Credits	3	L-T-P-S	3-0-0-3
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	
Prerequisites : NA					

AIM OF THE COURSE: To understand research problem and IPR role in research aspects.

OUTCOME OF THE COURSE:

At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology,buttomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals &nation, it is needless to emphasis the need of information about Intellectual Property Rightto be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further researchworkand investment in R & D, which leads to creation of new and better products, and in turnbrings about, economic growth and social benefits.

MODULE 1: Research Problem 9

Meaning of research problem, Sources of research problem, Criteria Characteristics of a goodresearch 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

MODULE 2: Assessment and Methodology 9

Effective literature studies approaches, 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

MODULE 3: Data Analysis and interpretation 9

Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerationsin research Data analysis, Statistical techniques and choosing an appropriate statistical technique,Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference,Interpretation of results.

MODULE 4: Patent Rights 9

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process ofPatenting and Development: technological research, innovation, patenting, development.International Scenario: International cooperation on Intellectual Property. Procedure for grantsof patents, Patenting under PCT.

MODULE 5: Patent Information 9

Patent Rights: Scope of Patent Rights. Licensing and transfer of Technology. Patent information and databases.Geographical Indications.

MODULE 6: IPR Development 9

New Developments in IPR: Administration of Patent System. New developments inIPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge Case Studies,IPR and IITs.

REFERENCES

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in NewTechnological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008
10. C. R. Kothari, GauravGarg, Research Methodology Methods and Techniques , New Age
11. International publishers, Third Edition. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition,SAGE, 2005
12. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition Creswell, John W. Research design: Qualitative, quantitative, and mixed methods, approaches. Sage publications, 2013.

E-BOOKS

COURSEWARE LINK

TUTORIAL LINK

COURSE TITLE	AVIONICS INTEGRATION LABORATORY				
AEC3791	AEB	Credits	1	L-T-P-S	3-1-0-4
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	
Prerequisites : NA					

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

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

3. Testing of installation and configuring of AFDX card in transmitting and receiving mode.

4. Using the interactive driver to transmit or receive the data

a) On a single PC by loop back connection.

b) PC to PC by connecting a shielded pair of wires.

5. Transmit and receive the messages

a) Using loop back connection with single card.

b) Using connector (shielded pair of wires).

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

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

8. Implementation of Aircraft primary data on both HUD and HMD Displays

9. Implementation of ADSP-BF 561 processor based real-time image processing application

OBJECTIVES OF THE COURSE

The course should enable the students to understand and design

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

LEARNING OUTCOME OF THE COURSE

After learning the course the students should be able to:

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

SEMESTER – II

COURSE TITLE	AEROSPACE GUIDANCE AND CONTROL				
COURSE CODE	AEC3704	Credits	3	L-T-P-S	3-0-0-3

Prerequisites : Control Engineering

AIM OF THE COURSE

To provide the understanding on the guidance mechanism for aircraft and missile while providing controls to them.

UNIT I: INTRODUCTION **4**

Introduction to Guidance and control - Definition, Historical background.

UNIT II: AUGMENTATION SYSTEMS **7**

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

UNIT III: LONGITUDINAL AUTOPILOT **12**

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

UNIT IV: LATERAL AUTOPILOT **10**

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

UNIT V MISSILE AND LAUNCH VEHICLE GUIDANCE **12**

Operating principles and design of guidance laws, homing guidance laws- short range, Medium range and BVR missiles, Launch Vehicle- Introduction, Mission requirements, Implicit guidance schemes, Explicit guidance, Q guidance schemes.

TEXT BOOKS

1. Blake Lock, J.H "Automatic control of Aircraft and missiles", John Wiley Sons, New York, 1990.
2. Collinson R.P.G, "Introduction to Avionics Systems", Springer Netherlands, 3rd edition, 2011.

REFERENCES

1.Garnel.P. & East.D.J, "Guided Weapon control systems", Pergamon Press, Oxford, 1977.
2. Nelson R.C "Flight stability & Automatic Control", McGraw Hill, 2nd edition, 1998.
3.Bernad Etikin, " Dynamics of Atmospheric Flight", Courier Corporation, 2012
4. Performance, Stability, Dynamics, and Control of Airplanes By Bandu N. Pamadi, American Institute of Aeronautics and Astronautics, Incorporated, 3rd edition 2015
5. Brian L. Stevens, Frank L. Lewis, Eric N. Johnson "Aircraft Control and Simulation: Dynamics, Controls Design and Autonomous Systems" Third Edition, John Wiley & Sons, 2015
6. Paul Zarchan "Tactical and Strategic Missile Guidance" American Institute of Aeronautics and Astronautics, 5th edition, 2007.

E-BOOKS

MOOC

tps://ocw.mit.edu/courses/aeronautics-and-astronautics/16-885j-aircraft-systems-engineering-fall-005/video-lectures/lecture-16/

https://nptel.ac.in/courses/101108047/

https://nptel.ac.in/courses/101108057/#

https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-30-estimation-and-control-of-aerospace-

systems-spring-2004/

COURSEWARE LINK

TUTORIAL LINK

OBJECTIVES OF THE COURSE

1. To learn about the operating principle of guidance law
2. To study about the augmentation systems
3. To study longitudinal stability and to design the longitudinal autopilot
4. To study lateral stability and to design the lateral autopilot

LEARNING OUTCOME OF THE COURSE

After learning the course the students should be able to:

1. The learners will be able know about the various guidance schemes and missile type requirements
2. The learners will be able to know the principle of stability and control augmentation systems
3. The learners will be able to know about the Displacement, Pitch Orientation Control system Glide Slope Coupler and Automatic Flare Control systems.
4. The learners will be able to know the Damping of Dutch roll methods of Obtaining Coordination, Yaw Orientation Control system, turn compensation and Automatic lateral Beam Guidance.

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 20%)
Applying the knowledge acquired from the course	(Weightage: 30%)
Designing and analysing various engineering problems	(Weightage: 40%)
Evaluate and create the design	(Weightage: 10%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

COURSE TITLE	AIRCRAFT NAVIGATION SYSTEM				
COURSE CODE	AEC3705	Credits	3	L-T-P-S	3-0-0-3

Prerequisites : NA

AIM OF THE COURSE

Discusses the types and the important aspects of sensors and the navigation aids related to Aircraft.

UNIT I NAVIGATION SYSTEMS & INERTIAL SENSORS **6**

Introduction to navigation – Types – Introduction to Inertial Sensors - Mechanical - Ring Laser gyro- Fiber optic gyro – MEMS system

UNIT II INERTIAL NAVIGATION SYSTEMS **9**

INS components: transfer function and errors- Earth in inertial space - coriolis effect – INS Mechanization. Stable Platform and Strap down – Navigation algorithms - INS system block diagram, Different co-ordinate systems – Transformation Techniques - Schuler Tuning - compensation errors - Gimbal lock – Initial calibration and Alignment Algorithms

UNIT III RADIO NAVIGATION **12**

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

UNIT IV APPROACH AND LANDING AIDS **6**

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

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

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

TEXT BOOKS

REFERENCES:

1. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems ', John Wiley & Sons,2nd edition, 1997
2. Nagaraja, N.S. 'Elements of Electronic Navigation‖, Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 1975.

REFERENCES

1. Bekir Esmat, 'Introduction To Modern Navigation Systems' World Scientific, 2007
2. LaurieTetleyDavidCalcutt , Electronic Navigation Systems (Third Edition), 2001
3. G. S. Rao 'Global Navigation Satellite Systems' Tata McGraw-Hill Education, 2010
4. Alexander V. Nebylov, Joseph Watson 'Aerospace Navigation Systems' John Wiley & Sons, Ltd. 2016.
5. George M Siouris, 'Aerospace Avionics System ; A Modern Synthesis', Academic Press Inc., 1993.
6. Albert Helfrick, 'Practical Aircraft Electronic Systems', Prentice Hall Education, Career & Technology, 1995.
7. Albert D. Helfrick, 'Modern Aviation Electronics', Second Edition, Prentice Hall Career & Technology, 1994.
8. Sen, A.K. & Bhattacharya, A.B. 'Radar System and Radar Aids to Navigation‖, Khanna Publishers, 1988.
9. Slater, J.M. Donnel, C.F.O and others, 'Inertial Navigation Analysis and Design‖, McGraw-Hill Book Company, New York, 1964.

E-BOOKS

https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20080040876.pdf

www.davi.ws/avionics/TheAvionicsHandbook_Cap_13.pdf

https://ttu-ir.tdl.org/ttu-ir/bitstream/handle/2346/17403/Ufford_Adam_Thesis.pdf;sequence=1

MOOC
https://nptel.ac.in/courses/101108056/
https://nescacademy.nasa.gov/category/3/sub/1
http://courses.ce.metu.edu.tr/ce5802/2015/02/11/hello-world/
COURSEWARE LINK
TUTORIAL LINK
OBJECTIVES OF THE COURSE
To impart knowledge on the concept of 1. Different axis systems and co-ordinate transformation techniques 2. Different radio navigation systems 3. Inertial sensors and inertial navigation 4. Various approach and landing aids of aircraft 5. Satellite navigation & Hybrid navigation
LEARNING OUTCOME OF THE COURSE
1. Upon completion of the course, students will explain the advanced concepts of Aircraft Navigation to the engineers and to provide the necessary mathematical knowledge that are needed in modeling the navigation process and methods. 2. The students will have an exposure on various Navigation systems such as Inertial Measurement systems, Radio Navigation Systems, Satellite Navigation – GPS ; Landing aids and will be able to deploy these skills effectively in the analysis and understanding of navigation systems in an aircraft.
ASSESSMENT
Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 30%)
Applying the knowledge acquired from the course	(Weightage: 30%)
Designing and analysing various engineering problems	(Weightage: 30%)
Evaluate and create the design	(Weightage: 10%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)		
THEORY COMPONENT		
INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%
ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)		
Written examination for three hours		

COURSE TITLE	AEROSPACE STRUCTURES HEALTH MONITORING: SMART SENSOR TECHNOLOGIES AND SIGNAL PROCESSING				
COURSE CODE	AEC3706	Credits	3	L-T-P-S	3-1-0-4
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	

Prerequisites : NA

AIM OF THE COURSE

- Discusses the most important aspects related to smart technologies for damage detection; this includes not only monitoring techniques but also aspects related to specifications, design parameters, assessment and qualification routes.
- Presents real case studies and applications; this includes in–flight tests; the work presented goes far beyond academic research applications.
- Displays a balance between theoretical developments and engineering applications

MODULE 1: Aircraft Structural Health and Usage Monitoring 10 (8L + 2T)

Introduction - Aircraft Structural Damage - Ageing Aircraft Problem - Lifecycle Cost of Aerospace Structures - Aircraft Structural Design - Damage Monitoring Systems in Aircraft - Non-destructive Testing - Structural Health Monitoring - Emerging Monitoring Techniques and Sensor Technologies

MODULE 2: Operational Load Monitoring Using Optical Fibre Sensors 8 (6L + 2T)

Introduction - Fibre Optics - Sensor Target Specifications - Reliability of Fibre Bragg Grating Sensors - Fibre Coating Technology - Example of Surface Mounted Operational Load Monitoring Sensor System - Optical Fibre Strain Rosette - Example of Embedded Optical Impact Detection System

MODULE 3: Damage Detection Using Stress and Ultrasonic Waves 9 (7L + 2T)

Acoustic Emission – Ultrasonics - Acousto-ultrasonics - Guided Wave Ultrasonics - Piezoelectric Transducers - Passive Damage Detection Examples - Active Damage Detection Examples

MODULE 4: Signal Processing for Damage Detection 9 (7L + 2T)

Introduction - Data Pre-processing - Signal Features for Damage Identification - Time–Domain Analysis - Spectral Analysis - Instantaneous Phase and Frequency - Time–Frequency Analysis - Wavelet Analysis - Dimensionality Reduction Using Linear and Nonlinear Transformation - Data Compression Using Wavelets Wavelet-based Denoising - Pattern Recognition for Damage Identification - Artificial Neural Networks

MODULE 5: Structural Health Monitoring Evaluation Tests 9 (7L + 2T)

Introduction - Large-scale Metallic Evaluator - Large-scale Composite Evaluator- Flight Tests - Summary

TEXT BOOKS

Staszewski, W., Boller, C., & Tomlinson, G. R. (Eds.). (2004). Health monitoring of aerospace structures: smart sensor technologies and signal processing. John Wiley & Sons.

REFERENCES

Title	Structural Health Monitoring for Space Systems (Aerospace Series)
Editors	Andrei Zagrai (Editor), Brandon Arritt (Editor), Derek Doyle (Editor)
Publisher	Wiley-Blackwell **ISBN-10:** 1118729641

E-BOOKS

https://play.google.com/store/books/details?id=nzSPVBZ_Yg0C&rdid=book-nzSPVBZ_Yg0C&rdot=1&source=gbs_vpt_read&pcampaignid=books_booksearch_viewport

https://play.google.com/store/books/details/Victor_Giurgiutiu_Structural_Health_Monitoring_wit?id=AG5h8Hu-MdUC

MOOC

https://onlinecourses.nptel.ac.in/noc18_oe05/preview

http://www.cism.it/courses/A1102/

http://courses.ce.metu.edu.tr/ce5802/2015/02/11/hello-world/

COURSEWARE LINK

TUTORIAL LINK

OBJECTIVES OF THE COURSE

The course should enable the students to understand and design

- recent developments in smart sensor technology for health monitoring in aerospace structures,
- providing a valuable introduction to damage detection techniques
- Focussing on engineering applications, by smart structures and materials experts from aerospace manufacturers
- includes not only monitoring techniques but also aspects related to specifications, design parameters, assessment and qualification routes
- Displays a balance between theoretical developments and engineering applications

LEARNING OUTCOME OF THE COURSE

- After learning the course the students should be able to:
- Develop the new type of smart sensor for health monitoring system
- Design the damage detection using different technique.
- Understand the development of sensor using smart materials for aerospace application.
- Analysis, assessment of manufactured sensor
- Understand the difference between theoretical developments and engineering applications

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 20%)
Applying the knowledge acquired from the course	(Weightage: 20%)
Designing and analysing various engineering problems	(Weightage: 40%)
Evaluate and create the design	(Weightage: 20%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

COURSE TITLE	AUTOMATIC FLIGHT CONTROL LABORATORY				
COURSE CODE	AEC3792	Credits	2	L-T-P-S	0-0-4-2

Prerequisites : NA

AIM OF THE COURSE

Provide the students with the ability to mathematically model, design and analyze a problem using math tools.

1. Analysis of stability for the aircraft model.
2. Development of Longitudinal and Lateral Equations of Motion.
3. Improvement of Aircraft stability using compensators.
4. Controllers design using PID and LQR algorithm to improve aircraft stability.
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 in aircraft.
10. Design and Simulation of Hardware interface for controller.
11. Design and Simulation of servo controller.
12. Data acquisition and interface with actuators for controlling the attitude.
13. Design and Implementation of flight controller between two PC using simulator packages.

OBJECTIVES OF THE COURSE

The subject should enable the students
1. To design and analyze the aircraft control system.
2. To know about the influence of various parameters in modelling of the aircraft.
3. To understand the functioning of various control algorithm in the design.
4. To understand the response of control system and the ways to improve it.
5. To understand the data acquisition and hardware interface and simulation.

LEARNING OUTCOME OF THE COURSE

The students must be able to
1. Understand the functions control systems for aircraft.
2. Carry out data acquisition from various sensors and interfacing with hardware.
3. Understand the modelling of aircraft parameters for controlling.
4. Understand the control laws and implementation.
5. Understand how data acquisition simulation of control system.

LIST OF EQUIPMENT

S.No.	Details of Equipments	Quantity	Experiment Nos.
1.	Computers	20	All the experiments
2	Matlab / Scilab / Octave / any open source math tool	20	All the experiments
3	Actuator / hardware interface	10	10, 11
4	Data acquisition board	10	12
5	Flight simulator x-plane/ FlightGear/ any open source tool	10	13

Department Elective –I

COURSE TITLE	Airborne actuator and sensors				
COURSE CODE	AEC3721	Credits	3	L-T-P-S	3-0-0-3
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	
Prerequisites : NA					

AIM OF THE COURSE

- understanding basic laws and phenomena on which operation of sensors and actuators-transformation of energy is based.
- To describe development and application of sensors and actuator and basic laws and phenomena that define behavior of sensors and actuators

MODULE 1: AIRCRAFT ACTUATION SYSTEMS **6**

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

MODULE 2: SERVO COMPONENTS **8**

Actuators, Valves, Servo amplifiers pick-offs.

MODULE 3: MODELING, DESIGN, AND TESTING **10**

Linear and non-linear actuation system, modeling of actuation systems, Servo-loop analysis actuator design - testing methodologies, Performance testing test equipments for actuation systems.

MODULE 4: INERTIAL SENSORS **12**

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

MODULE 5: SENSOR TESTING **9**

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

TEXT BOOKS

1.James Ephraim Johnson, Electrohydraulic Servo Systems, Published by Editors of Hydraulics& pneumatics magazine, 1977.

REFERENCES

1. Neal E.Wood et al, 'Electro-mechanical actuation development AFFDL-TR-150' DEC 1978.
2. Pallett, E.H.J. 'Aircraft instruments, principles and applications', Pitman publishing Ltd., London, 1991

E-BOOKS

https://www.elsevier.com/books/smart-actuator-and-sensor-technologies/leang/978-0-12-809455-6

https://www.sciencedirect.com/journal/sensors-and-actuators-b-chemical/vol/189

MOOC

https://www.coursera.org/learn/internet-of-things-sensing-actuation

https://www.mooc-list.com/course/iot-sensors-and-devices-edx

COURSEWARE LINK

nil

TUTORIAL LINK

nil

OBJECTIVES OF THE COURSE

The course should enable the students to understand and design

1. Upon completion of this course, students will understand the advanced concepts of Airborne actuators and sensors to the engineers and to provide the necessary mathematical knowledge that are needed in modeling physical processes
2. The students will have an exposure on various topics such as aircraft actuation systems, servo-components, inertial sensors, modeling, design and testing of sensors and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

LEARNING OUTCOME OF THE COURSE

After learning the course the students should be able to:

1. understanding basic laws and phenomena on which operation of sensors and actuators-transformation of energy is based
2. development and application of sensors and actuator and basic laws and phenomena that define behavior of sensors and actuators

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 20%)
Applying the knowledge acquired from the course	(Weightage: 20%)
Designing and analysing various engineering problems	(Weightage: 40%)
Evaluate and create the design	(Weightage: 20%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

COURSE TITLE	IMAGE PROCESSING FOR AEROSPACE APPLICATIONS				
COURSE CODE	AEC3722	Credits	3	L-T-P-S	3-0-0-3
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	
Prerequisites : NA					

AIM OF THE COURSE

1. 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
2. The students will have an exposure on various topics such as Image enhancement, Wavelet transforms, multi-resolution analysis and vision based navigation and control and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

MODULE 1: 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

MODULE 2: 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.

MODULE 3: 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

MODULE 4: MULTI RESOLUTION ANALYSIS **9**

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

MODULE 5: 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 bas ed navigation and control.

TEXT BOOKS

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.

REFERENCES

1. Anil K.Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall India, 2007.
2. Madhuri A. Joshi, ‘Digital Image Processing: An Algorithmic Approach”, Prentice-Hall India, 2006.
3. Rafael C.Gonzalez , Richard E.Woods and Steven L. Eddins, “Digital Image Processing Using MATLAB”, First Edition, Pearson Education, 2004.
4. Ron Graham, Alexander Koh,”Digital Aerial Survey: Theory and Practice”, Whittles Publishing; First edition,2002.

E-BOOKS

https://onlinelibrary.wiley.com/doi/book/10.1002/9781118787922

https://www.springer.com/in/book/9781447143956

MOOC

https://www.coursera.org/learn/digital

https://www.mooc-list.com/course/image-analysis-methods-biologists-futurelearn

COURSEWARE LINK

nil

TUTORIAL LINK

nil

OBJECTIVES OF THE COURSE

The course should enable the students to understand and design

1. 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
2. The students will have an exposure on various topics such as Image enhancement, Wavelet transforms, multi-resolution analysis and vision based navigation and control and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

LEARNING OUTCOME OF THE COURSE

After learning the course the students should be able to:

1. 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
2. The students will have an exposure on various topics such as Image enhancement, Wavelet transforms, multi-resolution analysis and vision based navigation and control and will be able to deploy these skills effectively in the solution of problems in avionics engineering

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 20%)
Applying the knowledge acquired from the course	(Weightage: 20%)
Designing and analysing various engineering problems	(Weightage: 40%)
Evaluate and create the design	(Weightage: 20%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

COURSE TITLE	UAV System design				
COURSE CODE	AED3721	Credits	3	L-T-P-S	3-0-0-3
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	
Prerequisites : NA					

AIM OF THE COURSE

To study elements of UAS design, including architectural options, and design drivers across diverse systems classes.

MODULE 1: Overview of Unmanned Aircraft Systems 10

Introduction, Defining an Unmanned Aircraft, Introduction to System Elements and Architectures, Unmanned Aircraft Classification, Initial Unmanned-Aircraft Sizing, Introduction, Simple Weight Relationships, Flight Performance, Simple Aerodynamics Methods, Initial UA Sizing Process, Examples, Unmanned-Aircraft Geometry and Configurations. Aircraft Geometry Relationships, Configuration Drivers, Wing System Configurations, Tail Configurations, Fuselage System Configurations, Rotorcraft Configurations, Problems

MODULE 2: Avionics, Flight Software, and Subsystems8

Introduction, Avionics - Avionics Design, Physical Environment, Electromagnetic Compatibility and Interference. Avionics Components Navigation Sensors, Landing Aids, Air Data Systems, Autopilots and Flight Control Algorithms, UA Management Systems, Mission Management Systems, Engine Controllers, Computers and Processors Remote Interface Units, Data Bus, Wiring Harnesses, Airspace Integration Systems, Flight-Test Equipment, Avionics Architectures, Flight Software Subsystems - Electrical Power System, Environmental Control System, Fuel System, Flight Control System, Pneumatic and Hydraulic System, Anti-Ice System, Landing-Gear System, Launch and Recovery, Problems.

MODULE 3:Communication Systems, Physics of Remote Sensing and in situ Measurement 10

Introduction, Radio-Frequency Physics, Elements of Communication Systems, Link Budget Analysis, Antennas, Antenna Integration, Communication System Types, Modulation Techniques, Interception, Detection, and Jamming, RF Performance Simulation, Line-of-Sight Communications, Beyond Line-of-Sight Communications, Frequency Management, Problems. Electromagnetic Spectrum Characteristics, Aerial Remote Sensing, Optical Systems, Radar, Synthetic Aperture Radar, Light Detection and Ranging (LiDAR), In situ Measurements, Problems

MODULE 4: Missions and Payloads, Mission Systems Integration9

Introduction, Military Missions, Science and Research Missions, Commercial and Civil Missions. Optical Payload Assembly Layout, Actuation, and Stabilization, Sizing for Performance, Field-of-Regard Requirements, Payload Placement and UA Configuration for Field of Regard, RF Payload Integration, Airframe Mechanical Integration, Imagery Products, Software Integration, Avionics and Power Interfaces, Payload Data Management, Ground Element Integration, Payload Interface Control, Payload Modularity, Problems.

MODULE 5: Command, Control, Tasking, Processing, Exploitation, and Dissemination8

Introduction, Control Element Functions and Personnel Roles. Mission Planning and Execution - Mission Planning, Geospatial Information Systems, Human System Interface (HSI), Communications, Contingency Management, Payload Control, Security. Overview of Introduction, Control Element Functions and Personnel Roles. Mission Planning and Execution - Mission Planning, Geospatial Information Systems, Human System Interface (HSI), Communications, Contingency Management, Payload Control, Security. Overview of Remote Viewing Terminals, Launch and Recovery Elements, Mission Control Elements, Tasking, Processing, Exploitation, and Dissemination (TPED), Hardware, Computers and User Interface Hardware, Shelter Design and Facility Integration, Training, Interoperability, Problems.

TEXT BOOKS

1. Gundlach, Jay., "Designing Unmanned Aircraft Systems " - A Comprehensive Approach., 2012 American Institute of Aeronautics and Astronautics.
2. Reg Austin, "Unmanned Air Systems: UAV Design, Development and Deployment"., Wiley; 1 edition (June 15, 2010)

REFERENCES

- Reg Austin "Unmanned Aircraft Systems UAV Design, Development And Deployment", Wiley, 2010.
- Robert C. Nelson, Flight Stability And Automatic Control, McGraw-Hill, Inc, 1998.
- Kimon P. Valavanis, "Advances In Unmanned Aerial Vehicles: State Of The Art And The Road To Autonomy", Springer, 2007
- Paul G Fahlstrom, Thomas J Gleason, "Introduction To UAV Systems", UAV Systems, Inc, 1998
- Dr. Armand J. Chaput, "Design Of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001
- Paul Fahlstrom, Thomas Gleason.,"Introduction to UAV Systems"., Wiley; 4 edition (September 17, 2012)

E-BOOKS

- Haiyang Chao and YangQuan Chen. **Remote Sensing and Actuation Using Unmanned Vehicles.** Wiley-IEEE Press. Publication Date: August 28, 2012. Number of Pages: 232 http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118122763.html
- DingyuXue, YangQuan Chen. **System Simulation Techniques with MATLAB and Simulink.** 2013, Hardcover. CRC Press. http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118647920.html
- DingyüXue and YangQuan Chen. **Modeling, Analysis and Design of Control Systems in MATLAB and Simulink.** World Scientific Publishing Co. 580pp, Nov 2014, ISBN: 978-981-4618-45-8 (hardcover) http://mechatronics.ucmerced.edu/MADbook

MOOC

https://onlinecourses.nptel.ac.in/noc18_ae07/preview
http://www.simscale-academy.com/p/drone-design-workshop
https://www.coursera.org/learn/robotics-flight

COURSEWARE LINK

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OBJECTIVES OF THE COURSE

The course should enable the students to understand and design

1. To develop an overall understanding of materials for UAV fabrication.
2. To develop a firm understanding of various operational safety and rule-compliance requirements.
3. To understand basic UAVmaterials
4. To obtain basic knowledge of UAVstructures and command control
5. To obtain basic knowledge of UAVMissions and Payloads, Mission Systems Integration

LEARNING OUTCOME OF THE COURSE

After learning the course the students should be able to:

1. To be able to understand typical Unmanned Aircraft Systems
2. To be able to operate typical civilian low cost UAS systems
3. To be able to understand and comply Avionics, Flight Software, and Subsystems
4. To be able to integrate typical mission sensors in Missions and Payloads, Mission Systems Integration

5. To be able to get ready Command, Control, Tasking, Processing, Exploitation, and Dissemination		
ASSESSMENT		
Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:		
Remembering and understanding the course contents		(Weightage: 20%)
Applying the knowledge acquired from the course		(Weightage: 20%)
Designing and analysing various engineering problems		(Weightage: 40%)
Evaluate and create the design		(Weightage: 20%)
ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)		
THEORY COMPONENT		
INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%
ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)		
Written examination for three hours		

Department Elective –II

COURSE TITLE	AVIONICS SYSTEM ENGINEERING				
COURSE CODE	AEC3723	Credits	3	L-T-P-S	3-0-0-3
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	

Prerequisites : NA

AIM OF THE COURSE

1. The students will 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
2. The students will also have an exposure on various topics such as the System Engineering as a process, System Architecture and integration, Maintainability and reliability and will be able to deploy these skills effectively in the design process of systems in an aircraft.

MODULE 1: INTRODUCTION TO SYSTEMS ENGINEERING 7

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

MODULE 2: SYSTEMS ENGINEERING MANAGEMENT 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, Modelling and Simulation, Metrics, Risk Management Planning, Organizing and Managing - Systems Engineering Planning, Product Improvement Strategies, Organizing and Integrating, System Development, Contractual Considerations, Management Considerations.

MODULE 3: CERTIFICATION OF AVIONICS SYSTEMS 8

Certification, Civil Aviation Authorities, Regulatory and Advisory Agencies, Regulation, Advisory Circular, Order, MOPS, TSO, Type Certification, Supplementary Type Certification, Certification Process, Delegation, Product Certification, Process Roadmap

MODULE 4: SOFTWARE CONSIDERATIONS IN AIRBORNE SYSTEMS AND EQUIPMENT CERTIFICATION 10

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

MODULE 5: SYSTEMS RELIABILITY AND MAINTAINABILITY 8

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

TEXT BOOKS

1. The Avionics Hand Book by Cary R. Spitzer (CRC Press)

REFERENCES

1. Systems Approach to Engineering Design by Peter. Sydenham, Artech house, Inc, London, 2003
2. Aircraft Systems Mechanical, electrical, and avionics subsystems integration by Ian Moir and Allan Seabridge John Wiley & Sons Ltd (2009)
3. Design and Development of an Aircraft Systems by Ian Moir and Allan Seabridge.

E-BOOKS

https://books.google.co.in/books/about/Avionics_Systems_Engineering_Section_341.html

https://books.google.co.in/books/about/Aircraft_Systems.html?id=Hcgh8SturJQC&redir_esc=y

MOOC

https://www.coursera.org/learn/robotics-flight

https://alison.com/course/introduction-to-drones

COURSEWARE LINK

nil

TUTORIAL LINK

nil

OBJECTIVES OF THE COURSE

The course should enable the students to understand and design

3. The students will 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
4. The students will also have an exposure on various topics such as the System Engineering as a process, System Architecture and integration, Maintainability and reliability and will be able to deploy these skills effectively in the design process of systems in an aircraft

LEARNING OUTCOME OF THE COURSE

After learning the course the students should be able to:

3. The students will 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
4. The students will also have an exposure on various topics such as the System Engineering as a process, System Architecture and integration, Maintainability and reliability and will be able to deploy these skills effectively in the design process of systems in an aircraft

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 20%)
Applying the knowledge acquired from the course	(Weightage: 20%)
Designing and analysing various engineering problems	(Weightage: 40%)
Evaluate and create the design	(Weightage: 20%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

COURSE TITLE	ELECTRONIC WARFARE				
COURSE CODE	AEC3725	Credits	3	L-T-P-S	3-0-0-3
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	
Prerequisites : NA					

AIM OF THE COURSE

To introduce basic concepts of electronic warfare, electronic support measure and electronic counter measures ,electronic signal processing in relation to mile parameter tracking and managed jamming

MODULE 1: ELECTRONIC WARFARE (EW) PRINCIPLES AND OVERVIEW 5

Introduction- Electronic Warfare taxonomy-EW Mission

MODULE 2: ELECTRONIC SUPPORT MEASURE (ESM) - ELECTRONIC COUNTER MEASURES (ECM) 10

Radar Warning Receivers (RWR) - Passive direction finding and emitter - location - noise jamming - Deception Electronic Counter Measures (DECM) - Modern ECM systems.

MODULE 3: RADAR AND ECM PERFORMANCE ANALYSIS 9

Radar detection performance low RCS aircraft - ECM - Jamming equations - EW receiver sensitivity

MODULE 4: EW SIGNAL PROCESSING 9

Signal environment - EM sensor subsystem - The receiver subsystem - The pre-processor - The data servo loop - Mile parameter tracking - Advanced pulley power - Managed Jamming.

MODULE 5: ELECTRONIC COUNTER - COUNTER MEASURES (ECCM) 12

Radar applications in weapon systems - Radar types and characteristics, EW Technology and Future Trends - Antenna Technology - ECM transmitter power source technology - EW receiver technology - EW at millimeter Wavelength - Low observability EW technology.

TEXT BOOKS

1. Curtis Schleher. D. “Introduction to Electronic Warfare’, Artech House Inc., U.S.A., 1986

REFERENCES

1. Mario De Archnaelis, “Electronic War from Battle of Osushima to the Falklands and Lebanon Conflicts”, Ritana Books, New Delhi, 1990.
2. Sen, A.K. Bhattacharya, A.B. “Radar Systems & Radar Aids to Navigation”, Khanna Publishers, 1988.

E-BOOKS

https://books.google.com/books/about/Introduction_to_Electronic_Warfare_Model.html

https://books.google.com/books/about/Electronic_Warfare_Pocket_Guide.html?id=A3ZYYZyPG_MC

MOOC

https://www.cranfield.ac.uk/courses/short/defence-and-security/military-electronic-warfare

https://pe.gatech.edu/certificates/electronic-warfare-technology-certificate

COURSEWARE LINK

nil

TUTORIAL LINK

nil

OBJECTIVES OF THE COURSE

The course should enable the students to understand and design

- To introduce principles of electronic warfare, electronic support measure and electronic counter measures

- To understand the Radar Warning Receivers trends in display technology
- To understand the Radar detection performance low RCS aircraft
- To know EM sensor subsystem , Mile parameter tracking
- To study electronic counter - counter measures (ECCM)

LEARNING OUTCOME OF THE COURSE

After learning the course the students should be able to:

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

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 20%)
Applying the knowledge acquired from the course	(Weightage: 20%)
Designing and analysing various engineering problems	(Weightage: 40%)
Evaluate and create the design	(Weightage: 20%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

COURSE TITLE	UAV Path Planning and Control				
COURSE CODE	AED3723	Credits	3	L-T-P-S	3-0-0-3
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	
Prerequisites : NA					

AIM OF THE COURSE

- To impart through knowledge in system path modelling, system identification and simulation of avionics system
- The student will learn locomotion, perception measurement techniques, localization, path planning and navigation

MODULE 1: BASICS OF UAV **7**

History of unmanned air vehicle (UAV) development. Unmanned aircraft systems: coordinate frames, kinematics and dynamics, forces and moments, lateral and longitudinal autopilots.

MODULE 2: COMMUNICATION PAYLOADS AND CONTROLS **9**

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range – SAS-flight director-commands and videos-elements of control loops-flight computer sensor-displays-parameter settings-modems-memory system-simulation-ground test-analysis trouble shooting

MODULE 3: SIMULATION AND BASIC CONTROL SYSTEM **10**

Simulation-basics – types – hardware in loop simulations – time response parameters - time response of 1st and 2ndorder systems - simulation of systems in software environment. Basic Elements of Control System – Open loop and Closed loop systems – Characteristics of on off, P, PI, PD and PID Controllers – Implementation issues of PID Controller – Modified PID Controller – Tuning of controllers

MODULE 4: TRAJECTORY PLANNING AND PATH PLANNING ALGORITHMS **10**

Path planning – trajectory planning – Joint space trajectory planning – Cartesian space trajectory planning – Blending – Continuous trajectory recording (Trajectory following), Dubin's curves, way-points, Voronoi partitions. Path following and guidance: Straight line and curve following, vision based guidance. Future directions and the road ahead

MODULE 5: WAY POINT NAVIGATION **9**

Waypoints navigation-ground control software-Recent trends in UAV-Case Studies

TEXT BOOKS

1. Farid Golnaraghi, Benjamin C. Kuo, Automatic Control systems (2014), 9th edition, Wiley India Pvt Ltd

REFERENCES

1. W. Bolton, Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering (2010), Pearson Education
2. Kimon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007
3. P.J.Swatton , “Ground studies for pilots’ flight planning”, Sixth edition, 2002.

E-BOOKS

Farbod Fahimi, Autonomous Robots Modeling, Path Planning and control, (2009), Springer. ISBN: 9780387095370.

Randal W. Beard and Timothy W. McLain, Small Unmanned Aircraft Theory & Practice, Princeton University Press, 2012

MOOC

https://www.coursera.org/learn/robotics-flight

https://www.edx.org/course/autonomous-navigation-flying-robots-tumx-autonavx-0		
COURSEWARE LINK		
nil		
TUTORIAL LINK		
nil		
OBJECTIVES OF THE COURSE		
The course should enable the students to understand and design 1.A thorough understanding of aircraft flight dynamics 2. A rigorous training in MATLAB based high fidelity modelling and simulation 3. An understanding of the synergy between various aircraft subsystems		
LEARNING OUTCOME OF THE COURSE		
After learning the course the students should be able to: 1.A thorough understanding of aircraft flight dynamics 2. A rigorous training in MATLAB based high fidelity modelling and simulation 3. An understanding of the synergy between various aircraft subsystems		
ASSESSMENT		
Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:		
Remembering and understanding the course contents	(Weightage: 20%)	
Applying the knowledge acquired from the course	(Weightage: 20%)	
Designing and analysing various engineering problems	(Weightage: 40%)	
Evaluate and create the design	(Weightage: 20%)	
ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)		
THEORY COMPONENT		
INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%
ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)		
Written examination for three hours		

Department Elective –III

COURSE TITLE	AERODYNAMICS FOR UAV				
COURSE CODE	AEC3728	Credits	3	L-T-P-S	3-0-0-3

Prerequisites : NA

AIM OF THE COURSE

Provides an idea about the various aerodynamic concepts in the design of UAV.

UNIT I: FUNDAMENTALS OF AERODYNAMICS

Forces and moments; Centre of pressure; Aerodynamic centre; Inviscid/viscous flow; Incompressible / compressible flow; Bernoulli's Equation; d'Alembert's Paradox; Kutta-Joukowski Theorem; Circulation; Laminar and turbulent boundary layers.

UNIT II: AIRFOILS FOR UAVs

Symmetric and cambered airfoils; Airfoil nomenclature; Airfoil numbering system; Modern low-speed airfoils; Natural laminar flow (NLF) airfoils; Reflexed airfoils; Concave pressure recovery; High-lift design philosophy; Selected research papers; Examples and practical applications.

UNIT III: GEOMETRIC AND AERODYNAMIC TWIST

Washout; Washin; Induced drag; Elliptical wing planform; Stall control; Tapered planform & wingtip Reynolds number; Retained aileron function; Linear spanwise twist distribution; Optimized twist distribution; Optimized total twist; Twisterons.

UNIT IV: ADAPTIVE WING TECHNOLOGY

Transition delaying mechanisms; Geometric & pneumatic devices; Self-activated movable flaps; Effective wing geometry; Variable sweep; Variable leading/trailing edge camber; Contour bumps; Flaps; Slats; Air jet; Sub-boundary layer vortex generators; Flexible wing; Wing flutter; Morphing

UNIT V: ROTORCRAFT AERODYNAMICS

Helicopter UAVs; Rotor thrust; Rotor drag, Coning angle; Disc loading; Helicopter flight principles; Ground effect; Translational lift; Autorotation; Vortex ring state; Blade & blade tip design; Rotational airflow; Blade tip speed; Retreating blade stall; Blade flapping; Blade sailing; High-inertia blades; Tip sweepback; Anti-torque rotor design

TEXT BOOKS

1. Pascual Marqués, Andrea Da Ronch. 'Advanced UAV Aerodynamics, Flight Stability and Control: Novel Concepts, Theory and Applications' 2017 John Wiley & Sons Ltd.

REFERENCES

1.J.D. Anderson, "Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York, 5th edition
2010.
2.Rathakrishnan.E., Gas Dynamics, Prentice Hall of India, 5th edition, 2013.
3.Shapiro, A.H., Dynamics & Thermodynamics of Compressible Fluid Flow, Ronald Press, 1982.
4.E.L. Houghton and N.B. Caruthers, Aerodynamics for Engineering Students, Butterworth-Heineman series, 5th edition 2003.
5.Zucrow, M.J., and Anderson, J.D., Elements of gas dynamics McGraw-Hill Book Co., New York,
1989.
6.W.H. Rae and A. Pope, "Low speed Wind Tunnel Testing", John Wiley Publications, 3rd Edition 1999

E-BOOKS

MOOC

https://www.edx.org/course/flight-vehicle-aerodynamics-mitx-16-110x-0		
https://onlinecourses.nptel.ac.in/noc18_ae07/preview		
COURSEWARE LINK		
TUTORIAL LINK		
OBJECTIVES OF THE COURSE		
To introduce the students the fundamental concepts and topic related to aerodynamics of flight vehicles like fundamental forms of flow, aerodynamic coefficient, incompressible and compressible flow theories, viscous flow measurements and various configuration of UAV and wings.		
LEARNING OUTCOME OF THE COURSE		
Upon completion of the course, students will understand the behaviour of airflow over bodies with particular emphasis on airfoil sections.		
ASSESSMENT		
Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:		
Remembering and understanding the course contents	(Weightage: 30%)	
Applying the knowledge acquired from the course	(Weightage: 30%)	
Designing and analysing various engineering problems	(Weightage: 30%)	
Evaluate and create the design	(Weightage: 10%)	
ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)		
THEORY COMPONENT		
INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%
ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)		
Written examination for three hours		

COURSE TITLE	Digital fly-by-wire				
COURSE CODE	AEC3726	Credits	3	L-T-P-S	3-0-0-3

Prerequisites : NA

AIM OF THE COURSE

Discusses the important aspects of sensors and the control aids related to Aircraft.

UNIT I INTRODUCTION TO FLY-BY-WIRE **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 **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.

TEXT BOOKS

1. Vernon R Schmitt, James W Morris and Gavin D Jenny, ‘Fly By Wire-A Historical Perspectivell, SAE International, 1998.

REFERENCES

1. AGARD-CP-137, ‘Advances in Control systemsll, (Chap.10, 17,21, 22, 23, 24)
2. AGARD-CP-384, ‘Active Control Systems Reviewll, Evaluations and Projections.
3. AGARD-CP-260, ‘Stability and Controlll (Chap.15)
4. Bill Gunston, Mike Spick , ‘Modern Air Combat: The Aircraft, Tactics and Weapons Employed in Aerial Warfare Today, Salamander Books Ltd , 1983.
5. Ward Larsen, ‘Fly By Wire’ Oceanview Publishing, 2010.

E-BOOKS

http://www.dtic.mil/dtic/tr/fulltext/u2/679158.pdf

https://www.nasa.gov/vision/earth/improvingflight/fly_by_wire.html

ieeecss.org/sites/ieeecss.org/files/documents/IoCT-Part2-09FlyByWire-HR.pdf

MOOC

COURSEWARE LINK

TUTORIAL LINK

OBJECTIVES OF THE COURSE

1. To impart the knowledge on the concepts of digital fly-by-wire controls and their importance in understanding modern aircraft control strategies.

2. To introduce different DFBW architectures, redundancy and reliability.
3. To provide knowledge on active control technology, design issues and generic failures.

LEARNING OUTCOME OF THE COURSE

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

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 30%)
Applying the knowledge acquired from the course	(Weightage: 30%)
Designing and analysing various engineering problems	(Weightage: 30%)
Evaluate and create the design	(Weightage: 10%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

COURSE TITLE	Programming in ADA				
COURSE CODE	AEC3729	Credits	3	L-T-P-S	3-0-0-3

Prerequisites : NA

AIM OF THE COURSE

Provide a detailed view on the programming language to meet the requirements of industries.

UNIT I OBJECT ORIENTED PROGRAMMING 9

Overview- History of Ada -Inheritance, dynamic dispatching (polymorphism)- Encapsulation

UNIT II ADA DATA TYPES 9

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

UNIT III ADA PACKAGES 9

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

UNIT IV PARALLEL PROGRAMMING 9

Access types-declaration -unbounded types, unchecked deal location-task and protected types multitasking.

UNIT V INTERFACING WITH OTHER LANGUAGES 9

Interfacing with C, Java vs. Ada, Ada applets, Java interfaces and aliased components- flight safety and Ada, recursion and efficiency, software inspection, debugging, Ada bindings, other Ada capabilities

TEXT BOOKS

1. Programming in Ada 2012, John Barnes, Cambridge University Press, 2014.
2. Introduction to Ada Programming, Andrew Shvets, CreateSpace Independent Publishing Platform, 2nd Edition, 2018
3. Analysable Real-time Systems: Programmed in Ada, Alan Burns, Andy Wellings, Createspace Independent Publishing Platform, 2016

REFERENCES

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

E-BOOKS

www.xplora.org/downloads/Knoppix/books/Ada_Programming.pdf

https://en.wikibooks.org/wiki/Ada_Programming

https://people.cs.kuleuven.be/~dirk.craeynest/ada-belgium/events/09/090207-fosdem/01-intro-ada.pdf

MOOC

http://university.adacore.com/courses/

http://learnadanow.com/

COURSEWARE LINK

TUTORIAL LINK

OBJECTIVES OF THE COURSE

1. To learn the concept of object oriented programming
2. To learn about the ADA data types
3. To study about the ADA packages
4. To study about the parallel programming
5. To study the interface with other languages

LEARNING OUTCOME OF THE COURSE

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

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 30%)
Applying the knowledge acquired from the course	(Weightage: 30%)
Designing and analysing various engineering problems	(Weightage: 30%)
Evaluate and create the design	(Weightage: 10%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

COURSE TITLE	Real Time Embedded Systems				
COURSE CODE	AEC3727	Credits	3	L-T-P-S	3-0-0-3

Prerequisites : NA

AIM OF THE COURSE

Discusses the important aspects of sensors and the processor for applicato

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 – Microcontrollers – ARM Processor - Real time Microcontrollers – Low power embedded systems, microcontrollers & RF.

UNIT II EMBEDDED/REAL TIME OPERATING SYSTEM **9**

Events - Real Time Scheduling 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 Behaviour – 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**.**

TEXT BOOKS

1. R.J.A.Buhr, D.L.Bailey, 'An Introduction to Real-Time Systems', Prentice-Hall International, 1999.

REFERENCES

1. Xiaocong Fan, 'Real-Time Embedded Systems: Design Principles and Engineering Practices' Newnes, 2015.
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. Dr.K.V.K.K.Prasad, 'Embedded/Real Time Systems: Concepts, Design and Programming‖, DreamTech Press, Black Book, 2005.
6. R.Barnett, L.O.Cull, S.Cox, 'Embedded C Programming and the Microchip PIC‖, Thomason Learning, 2004.
7. Wayne Wolf, 'Computers as Components - Principles of Embedded Computer System Design‖, Mergen Kaufmann Publisher, 2006.
8. Sriram V Iyer, Pankaj Gupta, 'Embedded Real Time Systems Programming‖, Tata Mc-Graw Hill, 2004.

E-BOOKS

https://people.cs.vt.edu/~cameron/cs4504/quan.pdf

https://pdfs.semanticscholar.org/a24e/C37903e740a61af9310efda3b7af8cdd00401.pdf

MOOC

https://www.coursera.org/learn/real-time-systems

https://nptel.ac.in/courses/108105063/

https://in.udacity.com/course/embedded-systems--ud169

https://ce.uci.edu/courses/sectiondetail.aspx?year=2013&term=FALL&sid=00108

COURSEWARE LINK

TUTORIAL LINK

OBJECTIVES OF THE COURSE

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

LEARNING OUTCOME OF THE COURSE

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

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 30%)
Applying the knowledge acquired from the course	(Weightage: 30%)
Designing and analysing various engineering problems	(Weightage: 30%)
Evaluate and create the design	(Weightage: 10%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

COURSE TITLE	Spacecraft communication systems				
COURSE CODE	AEC3728	Credits	3	L-T-P-S	3-0-0-3

Prerequisites : NA

AIM OF THE COURSE

Understand about the satellite and the ways of communication and onboard sensors to achieve it.

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

TEXT BOOKS

1. Wilbur L. Pritchard and Joseph A.Sciulli, Satellite Communication Systems Engineering, Prentice Hall, New Jersey, 1986.

REFERENCES

1. Gerard Maral, Michel Bousquet, ‘Satellite Communications Systems: Systems, Techniques and Technology’, John Wiley & Sons, 2011.
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
5. Lida,Takashied.,Satellite communications:System and its design technology, Ohmsha Tokyo 2000
6. Maral, Gerard,Satellite communications systems: Systems, techniques and technology, John Wiley, Newyork 2002.
7. Elbert, Bruce R, Satellite communication applications handbook, Artech house Boston 2004.

E-BOOKS

https://www.tutorialspoint.com/satellite_communication/satellite_communication_tutorial.pdf

http://archive.mu.ac.in/myweb_test/Satelight%20Comm..pdf

MOOC

https://www.coursera.org/learn/satellite-communications

https://nptel.ac.in/courses/117105131/#

https://nptel.ac.in/courses/106105082/33

COURSEWARE LINK
TUTORIAL LINK

OBJECTIVES OF THE COURSE

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

LEARNING OUTCOME OF THE COURSE

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

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 30%)
Applying the knowledge acquired from the course	(Weightage: 30%)
Designing and analysing various engineering problems	(Weightage: 30%)
Evaluate and create the design	(Weightage: 10%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

Department Elective –IV

COURSE TITLE	Flight Mechanics				
COURSE CODE	AEC3729	Credits	3	L-T-P-S	3-0-0-3
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	

Prerequisites : NA

AIM OF THE COURSE

To understand the performance of an aircraft in various operating conditions, and static, dynamic response for different disturbances.

MODULE 1: Basic Aerodynamics **10**

Fundamental Physical Quantities of a Flowing Gas, The source of all Aerodynamic Forces, Anatomy of an Airplane, **Equation of Continuity**, Flow with no Friction - Incompressible and Compressible Flow, Momentum Equation, Some Applications – Speed of Sound, Flow with Friction - Boundary Layer concept, **Laminar** boundary layer, **Turbulent** boundary layer, Transition from laminar to turbulent flow. Flow separation.

Airfoils and Wings : Airfoil Nomenclature, Aerodynamic Coefficients, Airfoil Data, Infinite versus Finite Wings, Drag – Divergence Mach Number, Wave Drag, Summary of Airfoil Drag, Finite Wings, Calculation of Induced Drag, Swept wings, Flaps – A Mechanism for high lift, How Lift is Produced, Problems.

MODULE 2: Airplane Performance **8**

Equations of Motion, ***Static Performance*** – Thrust required for level and unaccelerated flight, Thrust available and Maximum Velocity, Power required for level and unaccelerated flight, Power available and Maximum Velocity, Rate of Climb, Gliding Flight, Absolute and Service Ceilings, Time to Climb, Range and Endurance – Jet Airplane.

Dynamic Performance – Take off and Landing Performance, Turning flight and V- n diagram, Problems

MODULE 3: Principles of Stability and Control **10**

Definition of Airplane's axes – 6 Degree of Freedom (DOF), Concept of Stability and Control, Moments on the Airplane, Absolute Angle of Attack, Criteria for ***Static Longitudinal Stability*** – Quantitative Discussions, ***Static Longitudinal Control*** - Calculation of Elevator angle to trim, Stick-Fixed versus Stick-Free Static stability, Elevator Hinge Moment, Stick-Free Longitudinal Static Stability, Directional Static Stability, Lateral Static Stability, Problems.

MODULE 4: Lateral and Directional Stability **9**

Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock.

MODULE 5: DYNAMIC STABILITY **8**

Dynamic longitudinal stability: Equations of motion - Stability derivatives - Characteristic equation of stick fixed case - Modes and stability criterion - Effect of freeing-the stick - Brief description of lateral and directional. Dynamic stability - Spiral, divergence, Dutch roll, auto rotation and spin.

TEXT BOOKS

1. John David Anderson Jr., "Introduction to Flight"., McGraw-Hill Science/ Engineering/ Math; 7th edition (March 7, 2011)
2. Robert C Nelson., "Flight Stability and Automatic Control"., TBS; 2nd Edition (1997)

REFERENCES

- Jan Roskam., "Airplane Flight Dynamics and Automatic Flight Controls"., Darcorporation (January 2003)
- A. C. Kermode., "Mechanics of Flight"., Pearson Education Limited; III edition (December 4,

2012).Donald McLean., "Automatic Flight Control Systems"., Prentice Hall International Series in Systems and Control Engineering.

E-BOOKS

1. http://www.springer.com/in/book/978146146767
2. http://royalmechanicalbuzz.blogspot.in/2015/04/strength-of-materials-book-by-r-k-bansal.html
3. http://www.engineering108.com/pages/Mechanical_Engineering/SM/Strength_of_Materials_ebooks_free_download.html

MOOC

1. https://ecourses.ou.edu/cgi-bin/ebook.cgi?topic=me
2. http://nptel.ac.in/courses/101106042/1

COURSEWARE LINK

https://sites.google.com/a/hindustanuniv.ac.in/sas-aerodynamics-flight

OBJECTIVES OF THE COURSE

The course should enable the students to understand and design

1. Know about the forces and moments that are acting on an aircraft, the different types of drag, drag polar, ISA, variation of thrust, power, SFC with velocity and altitude.
2. Have understanding about performance in level flight, minimum drag and power required, climbing, gliding and turning flight, v-n diagram and load factor.
3. Knowledge about degrees of stability, stick fixed and stick free stability, stability criteria, effect of fuselage and CG location, stick forces, aerodynamic balancing.
4. Understanding about lateral control, rolling and yawing moments, static directional stability, rudder and aileron control requirements and rudder lock.
5. Understanding about dynamic longitudinal stability, stability derivatives, modes and stability criterion, lateral and directional dynamic stability.

LEARNING OUTCOME OF THE COURSE

After learning the course the students should be able to:

1. Understand drag force acting on an airplane, and variations due to velocity and altitude
2. Understand elements of airplane performance
3. Understand static longitudinal stability of an aircraft
4. Understand lateral and directional stability
5. Understand dynamic stability of an aircraft

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 20%)
Applying the knowledge acquired from the course	(Weightage: 20%)
Designing and analysing various engineering problems	(Weightage: 40%)
Evaluate and create the design	(Weightage: 20%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

COURSE TITLE	UAV - OPERATIONAL AND INDUSTRIAL ASPECTS				
COURSE CODE	AED3729	Credits	3	L-T-P-S	3-0-0-3
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	

Prerequisites : NA

AIM OF THE COURSE

To study advanced terminology, models and prototypes of operational aspects of UAV.

And also to learn the UAV system in term of Robotics, Devices Simulation and Operational Regimes

MODULE 1: INTRODUCTION **10**

Introduction, Terminologies in Unmanned Aircraft, Distinction Between Manned and Unmanned Aircraft, History of Unmanned Aircraft, System Elements and Architectures

MODULE 2: UAV-TYPES AND ROLES **8**

Micro Air Vehicles, Small UAV, Tactical UAV, MALE, HALE, Ultra Long Endurance, UCAV, Types based on Launching and recovery, Planetary Aircraft, Lighter Than Air, Recent trends and developments.

MODULE 3: UAV DESIGN CONSIDERATIONS **10**

Aerodynamics concepts, Weight based design, Structural Design, Flight Performance Analysis - Constraint Analysis, Systems Integration, Control Element, Hardware, Architecture Selection

MODULE 4: UAV SYSTEM AND SENSOR OPERATIONS **9**

Propulsion Systems – Types of engine - special types, Avionics system, Flight control Software, Subsystems, Launch and Recovery, Communication, Remote Sensing, Radar, Optical, Ground Control Stations, Payloads

MODULE 5: UAV- INDUSTRIAL ASPECTS **8**

Training, Interoperability, Cost Analysis, Reliability, Maintainability, Systems Engineering, Optimization, Design Environments Market Survey, Competitive Analysis, Customer Requirement, Government Acquisition

TEXT BOOKS

- Designing Unmanned Aircraft Systems: A Comprehensive Approach by jay Gundlach, - American Institute of Aeronautics and Astronautics 2012
- Douglas M. Marshall, Richard K. Barnhart, Stephen B. Hottman, Eric Shappee, Michael Thomas Most. **Introduction to Unmanned Aircraft Systems**. CRC Press. October 25, 2011 by CRC Press; Textbook - 233 Pages - 56 B/W Illustrations; ISBN 9781439835203 - CAT# K11588.

REFERENCES

- Reg Austin "Unmanned Aircraft Systems UAV Design, Development And Deployment", Wiley, 2010.
- Robert C. Nelson, Flight Stability And Automatic Control, McGraw-Hill, Inc, 1998.
- Kimon P. Valavanis, "Advances In Unmanned Aerial Vehicles: State Of The Art And The Road To Autonomy", Springer, 2007
- Paul G Fahlstrom, Thomas J Gleason, "Introduction To UAV Systems", UAV Systems, Inc, 1998
- Dr. Armand J. Chaput, "Design Of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001

E-BOOKS

- Haiyang Chao and YangQuan Chen. **Remote Sensing and Actuation Using Unmanned Vehicles.** Wiley-IEEE Press. Publication Date: August 28, 2012. Number of Pages: 232 http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118122763.html
- DingyuXue, YangQuan Chen. **System Simulation Techniques with MATLAB and Simulink.** 2013,

Hardcover. CRC Press. http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118647920.html

- DingyüXue and YangQuan Chen. **Modeling, Analysis and Design of Control Systems in MATLAB and Simulink.** World Scientific Publishing Co. 580pp, Nov 2014, ISBN: 978-981-4618-45-8 (hardcover) http://mechatronics.ucmerced.edu/MADbook

MOOC

https://www.coursera.org/lecture/robotics-flight/unmanned-aerial-vehicles-V136S
https://onlinecourses.nptel.ac.in/noc18_ae07/preview

COURSEWARE LINK

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OBJECTIVES OF THE COURSE

The course should enable the students to understand and design

- To develop an overall understanding of UAS history, UAS types, and civilian small UAS applications;
- To develop a firm understanding of UAS operational safety and rule-compliance requirements.
- To understand basic UAS elements;
- To obtain basic knowledge of UAS aerodynamics and flight dynamics;
- To obtain basic knowledge of UAS guidance, navigation and control;
- To obtain basic knowledge of UAS payloads and the enabled ConOps (concept of operations);
- To obtain basic knowledge of UAS mission planning, GCS operations;

LEARNING OUTCOME OF THE COURSE

After learning the course the students should be able to:

- To be able to understand typical civilian low cost UAS systems;
- To be able to operate typical civilian low cost UAS systems;
- To be able to understand and comply FAA regulations on small UAS operations;
- To be able to integrate typical mission sensors in typical civilian low cost UAS systems;
- To be able to get ready for applying for an FAA's Remote Pilot Certificate with a Small UAS rating
- To be able to get ready to create UAS related engineering practice/service or to join UAS work force.

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 20%)
Applying the knowledge acquired from the course	(Weightage: 20%)
Designing and analysing various engineering problems	(Weightage: 40%)
Evaluate and create the design	(Weightage: 20%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours

COURSE TITLE	UAV MATERIAL AND FABRICATION METHODOLOGIES				
COURSE CODE	AED3730	Credits	3	L-T-P-S	3-0-0-3
CIE	100 Marks (50% weightage)		ESE	100 Marks (50% weightage)	
Prerequisites : NA					

AIM OF THE COURSE

- Defining the design environment in which future UAVs will operate, including loads definition, reliability requirements, and aeroelasticity
- Reducing manufacturing costs for airframe structural components, including advanced composite materials and multifunctional materials

MODULE 1: UAV STRUCTURES

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

MODULE 2: UAV Vehicles Structures and Materials

Physics of Solid materials – Stress and Strain. Elements of Aircraft structure – Main Structural Elements, Wing box and carry-through structure, Fuselage bulkhead, Wing structure. Materials – High temperature alloys and Composite materials. Fatigue

MODULE 3: VARIOUS MATERIALS

metal, wood, and composite , Ceramics materials and Rapid Prototyping Materials – material properties

MODULE 4: SHELL STRUCTURE ANALYSIS

Unmanned Aircraft Loads- Skin-Panel Method - Boom-and-Web Method- Finite Element Modeling- Aeroelasticity- Fuselage Analysis and Sizing- Wing Sizing

MODULE 5: STRUCTURES MANUFACTURING

Composites Manufacturing- Student Projects and Simple Prototype Methods (case study)

TEXT BOOKS

1. Designing Unmanned Aircraft Systems: A Comprehensive Approach by jay Gundlach, - American Institute of Aeronautics and Astronautics 2012

REFERENCES

4. John.D.Anderson, Jr., „Introduction to flight" TATA McGraw-Hill, 2006
5. Megson T.H. „Aircraft Structures for Engineering Student"s II Edition, Edward Arnold, Kent, U.S.A. 1990

E-BOOKS

https://www.nap.edu/read/9878/chapter/7#53

MOOC

https://www.roboversity.com/new-course-on-unmanned-air-vehicles-at-vel-tech-university

COURSEWARE LINK

Nil

TUTORIAL LINK

Nil

OBJECTIVES OF THE COURSE

The course should enable the students to understand and design

1. Defining the design environment in which future UAVs will operate, including loads definition, reliability requirements, and aeroelasticity
2. Reducing manufacturing costs for airframe structural components, including

advanced composite materials and multifunctional materials

LEARNING OUTCOME OF THE COURSE

After learning the course the students should be able to:

1. Defining the design environment in which future UAVs will operate, including loads definition, reliability requirements, and aeroelasticity
2. Reducing manufacturing costs for airframe structural components, including advanced composite materials and multifunctional materials

ASSESSMENT

Questions for CIE (50%) and ESE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

Remembering and understanding the course contents	(Weightage: 20%)
Applying the knowledge acquired from the course	(Weightage: 20%)
Designing and analysing various engineering problems	(Weightage: 40%)
Evaluate and create the design	(Weightage: 20%)

ASSESSMENT PATTERN FOR CIE 100 MARKS (50 % weightage)

THEORY COMPONENT

INTERNAL EXAM (Average of two)	**MODEL EXAM**	**ASSIGNMENT & SELF STUDY**
40%	40%	20%

ASSESSMENT PATTERN FOR ESE 100 MARKS (50 % weightage)

Written examination for three hours