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UNIVERSITY DEPARTMENTS

REGULATIONS - 2019

CHOICE BASED CREDIT SYSTEM

M.E. AVIONICS

THE VISION OF THE DEPARTMENT OF AEROSPACE ENGINEERING

The Department of Aerospace Engineering shall strive to be a globally known department, committed for its academic excellence, professionalism and societal expectations. The Department aims to impart state of the art technical knowledge, practical skills, leadership qualities, team spirit, ethical values and entrepreneurial skill to make all the students capable of taking up any task relevant to the area of Aerospace Engineering.

THE MISSION OF THE DEPARTMENT OF AEROSPACE ENGINEERING

The Mission of the Department of Aerospace Engineering is to

- Prepare the students to have a very good fundamental knowledge to meet the present and future needs of industries.
- Improve the technical knowledge of the students in tune with the current requirements through collaboration with industries and research organization.
- Make the students gain enough knowledge in various aspects of system integration.
- Motivate the students to take up jobs in national laboratories and aerospace industries of our country.
- Take up inter and multidisciplinary research, sponsored and consultancy projects with industries and research establishments.
- Encourage the faculty members and students to do research and to update with the latest developments in the area of Aerospace Engineering.

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1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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

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

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

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

V. **PEO 5:** Motivation to pursue research in Avionics field: Graduates will have interest and strong desire to undertake research oriented jobs and responsibilities in Universities and Industries.

2. PROGRAMME OUTCOMES (POs)

On successful completion of the programme,

PO #	Graduate Attribute	Programme outcome
1.	Engineering knowledge	Postgraduate will be able to use the Engineering knowledge acquired from the basic courses offered in the programme to pursue either doctoral studies or a career as an academician / scientist or engineer.
2.	Problem analysis	Post Graduate will acquire the ability to design, analyze as well as to conduct experiments to interpret data in the field of Avionics.
3.	Design / Development of solutions	Postgraduate will have the ability to design a system or a component to meet the design requirements with constraints exclusively meant for Avionics.
4.	Conduct investigations of complex problems	Post Graduate will have a firm scientific, technological and communication base that helps him/her to conduct investigations of complex problems in the Aircraft industry and R & D organizations related to Avionics and other professional fields.
5.	Modern tool usage	Post Graduate will become familiar with modern engineering tools and analyze the problems within the domains of Avionics as a member of multidisciplinary teams

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6.	The Engineer and society	Postgraduate will be capable of doing research in inter and multidisciplinary areas which will result in more efficient and cheaper products that are beneficial to society.
7.	Environment and sustainability	Postgraduate will exhibit awareness of contemporary issues on environment focussing on the necessity to develop new system design and testing methods for the solution of problems related to avionics industry.
8.	Ethics	Post Graduate will acquire an understanding of professional and ethical responsibility with reference to their career in the field of Avionics and other professional fields.
9.	Individual and team work	Postgraduate will be trained towards developing and understanding the importance of design and development of avionics subsystems from system integration point of view which requires team work.
10.	Communications	Postgraduate will be able to communicate effectively both in verbal and nonverbal forms.
11.	Project management and finance	Postgraduate will show his ability for managerial skills in design or research teams and will be able to deliver cost effective solutions for products and services.
12.	Life-long learning	Postgraduate will be capable of understanding the value of life-long learning.

3. PROGRAMME SPECIFIC OUTCOMES

PSO1: The postgraduate will become familiar with approach to analysis for avionics engineering problems and conversant with methods of solutions.

PSO2: The post graduate will become well versed with usage of modern techniques and software tools to design and develop avionics subsystems and products.

PSO3: The postgraduate will excel as an individual as well as team member in design and research teams in universities and avionics industries.

PSO4: The postgraduate will become an enthusiast to learn new technologies and methods life long in the area of avionics engineering.

4. Mapping of PEOs with POs

Programme Educational Objectives	Programme Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO12
I	✓	✓	✓		✓	✓	✓	✓		✓		✓
II	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
III	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
IV	✓	✓	✓		✓		✓			✓	✓	✓
V	✓	✓	✓	✓	✓	✓	✓	✓				✓

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MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME

	COURSE TITLE	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PROGRAM CORE COURSES (PCC)	Advanced applied Mathematics		✓	✓	✓	✓	✓						
	Digital Avionics	✓	✓	✓		✓	✓	✓		✓		✓	
	Flight Instrumentation	✓	✓	✓	✓	✓		✓					
	Bridge Core course Aerospace Engineering (For Non-Aero Students) (OR) Electronic Systems (For Aero Students)	✓	✓	✓	✓	✓							
	Avionics Integration Laboratory	✓	✓	✓	✓	✓		✓		✓			✓
	ADA Programming Laboratory	✓	✓	✓	✓	✓	✓			✓			✓
	Navigation Systems	✓	✓	✓	✓	✓	✓	✓					✓
	Aerospace Guidance and Control	✓	✓	✓	✓	✓				✓	✓		✓
	Rocketry and Space Mechanics	✓	✓	✓		✓	✓						✓
	Automatic Flight Control Systems Laboratory	✓	✓	✓	✓	✓	✓	✓		✓			✓
	Navigation and Guidance Laboratory	✓	✓	✓	✓	✓	✓	✓		✓			✓
		✓	✓	✓	✓	✓	✓	✓					
PROFESSIONAL ELECTIVE COURSES (PEC)	**Program Elective –I**												
	Modern Control Theory and Applied Mathematics	✓	✓	✓	✓	✓	✓						✓
	Electro Optic Systems for Avionics Engineers	✓	✓	✓		✓	✓						✓
	System modeling and Simulation for Avionics Engineers	✓	✓	✓	✓	✓	✓					✓	✓
	Avionics System Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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	Program Elective – II												✓
	Image Processing for Aerospace Applications	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
	Fault Tolerant Computing	✓	✓	✓	✓	✓							✓
	Real Time Embedded Systems and Applications	✓	✓	✓	✓	✓	✓	✓					✓
	Program Elective – III												
	Elements of Satellite Technology	✓	✓		✓	✓	✓	✓					✓
	Electronic Warfare	✓	✓	✓	✓	✓	✓		✓				✓
	Microwaves and Radar	✓	✓	✓	✓	✓	✓	✓					
	UAV System Design	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓
	Program Elective - IV	✓	✓	✓	✓	✓	✓						
	Digital Fly By Wire	✓	✓	✓	✓	✓	✓	✓					✓
	Missile Technology	✓	✓	✓			✓						
	Industrial Avionics	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
	Program Elective – V	✓		✓									
	Spacecraft Communication Systems	✓		✓		✓	✓	✓					✓
	Theory of Detection and Estimation of Digital signals.	✓	✓	✓	✓	✓	✓						✓
	Soft Computing for Avionics Engineers	✓	✓	✓	✓	✓	✓			✓			✓

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I – IV SEMESTER CURRICULUM AND SYLLABUS
M.E. AVIONICS

SEMESTER I

S. No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5159	Advanced Applied Mathematics	FC	3	1	0	4	4
2.	AV5101	Digital Avionics	PCC	4	0	0	4	4
3.	AV5151	Flight Instrumentation	PCC	3	0	0	3	3
4.	AV5102 AV5103	**Bridge Core course** Aerospace Engineering (For Non-Aero Students) (OR) Electronic Systems (For Aero Students)	PCC	3	1	0	4	4
5.	RM5151	Research Methodology & IPR	RMC	2	0	0	2	2
6.		Audit Course-I *	AC	2	0	0	2	0
7.		Program Elective-I	PEC	3	0	0	3	3
PRACTICALS								
8.	AV5111	Avionics Integration Laboratory	PCC	0	0	4	4	2
9.	AV5112	ADA Programming Laboratory	PCC	0	0	4	4	2
			TOTAL	**20**	**2**	**8**	**30**	**24**

*Audit course is optional

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SEMESTER II

S. No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AV5201	Navigation Systems	PCC	3	0	0	3	3
2.	AV5251	Aerospace Guidance and Control	PCC	3	1	0	4	4
3.	AL5076	Rocketry and Space Mechanics	PCC	3	0	0	3	3
4.		Program Elective-II	PEC	3	0	0	3	3
5.		Program Elective-III	PEC	3	0	0	3	3
6.		Audit Course-II*	AC	2	0	0	2	0
PRACTICALS								
7.	AV5211	Automatic Flight Control Systems Laboratory	PCC	0	0	4	4	2
8.	AV5212	Navigation and Guidance Laboratory	PCC	0	0	4	4	2
9.	AV5213	Mini Project with Seminar	EEC	0	0	4	4	2
			TOTAL	**17**	**1**	**12**	**30**	**22**

*Audit course is optional

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Program Elective-IV	PEC	3	0	0	3	3
2.		Program Elective-V	PEC	3	0	0	3	3
3.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
4.	AV5311	Dissertation-I	EEC	0	0	12	12	6
			TOTAL	**9**	**0**	**12**	**21**	**15**

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SEMESTER IV

S. No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	AV5411	Dissertation - II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 73

FOUNDATION COURSE (FC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5159	Advanced Applied Mathematics	FC	3	1	0	4	4

PROGRAM CORE COURSES (PCC)

S. NO.	CODE NO.	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	AV5101	Digital Avionics	4	0	0	4	1
2.	AV5151	Flight Instrumentation	3	0	0	3	1
3.	AV5102 AV5103	**Bridge Core course** Aerospace Engineering (For Non-Aero Students) (OR) Electronic Systems (For Aero Students)	3	1	0	4	1
4.	AV5111	Avionics Integration Laboratory	0	0	4	2	1
5.	AV5112	ADA Programming Laboratory	0	0	4	2	1
6.	AV5201	Navigation Systems	3	0	0	3	2
7.	AV5251	Aerospace Guidance and Control	3	1	0	4	2
8.	AL5076	Rocketry and Space Mechanics	3	0	0	3	2
9.	AV5211	Automatic Flight Control Systems Laboratory	0	0	4	2	2
10.	AV5212	Navigation and Guidance Laboratory	0	0	4	2	2
					TOTAL CREDITS:	**33**	

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PROGRAM ELECTIVE COURSES (PEC)

SEMESTER I
ELECTIVE - I

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	AV5001	Modern Control Theory and Applied Mathematics	PEC	3	0	0	3	3
2.	AV5002	Electro Optic Systems for Avionics Engineers	PEC	3	0	0	3	3
3.	AV5003	System Modeling and Simulation for Avionics Engineers	PEC	3	0	0	3	3
4.	AV5004	Avionics System Engineering	PEC	3	0	0	3	3

SEMESTER II
ELECTIVE - II

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	AV5005	Image Processing for Aerospace Applications	PEC	3	0	0	3	3
2.	AV5006	Fault Tolerant Computing	PEC	3	0	0	3	3
3.	AV5007	Real Time Embedded Systems and Applications	PEC	3	0	0	3	3

SEMESTER II
ELECTIVE - III

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	AS5072	Elements of Satellite Technology	PEC	3	0	0	3	3
2.	AV5008	Electronic Warfare	PEC	3	0	0	3	3
3.	NE5077	Microwaves and Radar	PEC	3	0	0	3	3
4.	AV5009	UAV System Design	PEC	3	0	0	3	3

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SEMESTER III
ELECTIVE - IV

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	AV5010	Digital Fly-By Wire Control	PEC	3	0	0	3	3
2.	AV5011	Missile Technology	PEC	3	0	0	3	3
3.	AV5012	Industrial Avionics	PEC	3	0	0	3	3

SEMESTER III
ELECTIVE - V

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	AV5013	Spacecraft Communication Systems	PEC	3	0	0	3	3
2.	AV5014	Theory of Detection and Estimation of Digital Signals.	PEC	3	0	0	3	3
3.	AV5015	Soft Computing for Avionics Engineers	PEC	3	0	0	3	3

RESEARCH METHODOLOGY AND IPR COURSE (RMC)

S. NO.	CODE NO.	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	RM5151	Research Methodology & IPR	2	0	0	2
					TOTAL CREDITS:	**2**

OPEN ELECTIVE COURSES (OEC)

*(out of 6 courses one course must be selected)

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	OE5091	Business Data Analytics	OEC	3	0	0	3	3
2.	OE5092	Industrial Safety	OEC	3	0	0	3	3
3.	OE5093	Operations Research	OEC	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	OEC	3	0	0	3	3
5.	OE5095	Composite Materials	OEC	3	0	0	3	3
6.	OE5096	Waste to Energy	OEC	3	0	0	3	3

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AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			Lecture	Tutorial	Practical	
1.	AX5091	English for Research Paper Writing	2	0	0	0
2.	AX5092	Disaster Management	2	0	0	0
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0
4.	AX5094	Value Education	2	0	0	0
5.	AX5095	Constitution of India	2	0	0	0
6.	AX5096	Pedagogy Studies	2	0	0	0
7.	AX5097	Stress Management by Yoga	2	0	0	0
8.	AX5098	Personality Development Through Life Enlightenment Skills	2	0	0	0
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0
			Total Credits			**0**

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	CODE NO.	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEM
			L	T	P		
1.	AV5213	Mini Project with Seminar	0	0	4	2	2
2.	AV5311	Dissertation-I	0	0	12	6	3
3.	AV5411	Dissertation-II	0	0	24	12	4
					TOTAL CREDITS:	**20**	

SUMMARY

	NAME OF THE PROGRAMME					
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	PCC	19	14	00	00	33
2.	PEC	03	06	06	00	15
3.	RMC	02	00	00	00	02
4.	OEC	00	00	03	00	03
5.	EEC	00	02	06	12	20
6.	Non Credit/Audit Course	✓	✓	00	00	
	TOTAL CREDIT	**24**	**22**	**15**	**12**	**73**

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MA5159 **ADVANCED APPLIED MATHEMATICS** **L T P C**
3 1 0 4

OBJECTIVES:

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

UNIT I LINEAR ALGEBRA 12

Vector spaces – norms – Inner Products – Eigenvalues using QR transformations – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications - pseudo inverse – least square approximations --Toeplitz matrices and some applications.

UNIT II ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

UNIT III RANDOM PROCESSES 12

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

UNIT IV LINEAR PROGRAMMING 12

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT V FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Fourier transforms: Definitions, properties-Transform of elementary functions, Dirac Delta functions – Convolution theorem – Parseval‘s identity – Solutions to partial differential equations: Heat equations, Wave equations, Laplace and Poisson‘s equations.

TOTAL: 45+15=60 PERIODS

OUTCOMES:

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

- Apply the concepts of linear algebra to solve practical problems.
- Use the ideas of probability and random variables in solving engineering problems.
- Classify various random processes and solve problems involving stochastic processes.
- Formulate and construct mathematical models for linear programming problems and solve the transportation and assignment problems.
- Apply the Fourier transform methods of solving standard partial differential equations.

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1. Andrews, L.C. and Philips.R.L., "Mathematical Techniques for engineering and scientists", Printice Hall of India, New Delhi, 2006.
2. Bronson, R., "Matrix Operation", Schaum's outline series, Tata McGrawHill, New York, 2011.
3. O'Neil P.V., "Advanced Engineering Mathematics", Cengage Learning, 8th Edition, India, 2017.
4. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes", Academic Press, Boston, 2014.
5. Sankara Rao, K., "Introduction to partial differential equations", Prentice Hall of India, pvt, Ltd, 3rd Edition, New Delhi, 2010.
6. Taha H.A., "Operations Research: An introduction", Ninth Edition, Pearson Education, Asia, 10th Edition, New Delhi, 2017.

AV5101 **DIGITAL AVIONICS** **L T P C**
4 0 0 4

OBJECTIVES:

- To introduce role of avionics system and its architecture
- To understand the avionics system design development and integration using simulation tools
- To introduce different types of cockpit displays.
- To know modular avionics packaging and EMI/EMC requirements in avionics
- To study system assessment, validation, certification and maintenance of avionics system

UNIT I INTRODUCTION TO AVIONICS **12**

Role for Avionics in Civil and Military Aircraft systems, Avionics sub-systems -design- Introduction to control surface actuation system, Fly-by-wire Actuators, defining avionics System/subsystem-Requirements & importance of 'ilities'- Avionics system architectures – Integrated Modular Avionics - Guidance and Certification Considerations

UNIT II AVIONICS SYSTEM DATA BUSES, DESIGN AND INTEGRATION **12**

MIL-STD-1553B, ARINC-429, ARINC-629, CSDB, AFDX and its Elements, CAN Bus, ARINC 825, ARINC 826, Avionics system design, Development and integration-Use of simulation tools, stand alone and integrated Verification and Validation.

UNIT III AVIONICS SYSTEM ESSENTIALS: DISPLAYS, I/O DEVICES AND POWER **12**

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

UNIT IV MAINTENANCE AND PACKAGING **12**

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.

UNIT V SYSTEM ASSESSMENT, VALIDATIONAND CERTIFICATION 12

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

TOTAL: 60 PERIODS

OUTCOMES:

Students will be able to:

CO1: Enumerate the basic concepts of Avionics Systems to the engineers.
CO2: Explain the working of avionics systems in an aircraft.
CO3: Explain the topics such as Avionics system architecture, Avionics bus systems, integration, display systems and packaging.
CO4: Deploy these skills effectively in the understanding and analysis of avionics systems.
CO5: Perform documentation on hardware and software development for certification process.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓							✓			✓
CO2		✓	✓						✓			✓
CO3	✓		✓		✓	✓	✓		✓			✓
CO4	✓	✓	✓		✓	✓					✓	✓
CO5			✓						✓		✓	✓

REFERENCES:

1. Albert Helfrick, Principles of Avionics, Avionics Communication Inc, USA, 2012.
2. Cary R. Spitzer, The Avionics Handbook, CRC Press, 2000.
3. Collinson R.P.G. Introduction to Avionics, Chapman and Hall, 1996.
4. Jim Curren, Trend in Advanced Avionics, IOWA State University, 1992.
5. Middleton, D.H. Avionics Systems, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
6. Spitzer, C.R. Digital Avionics Systems, Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.

AV5151 FLIGHT INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I MEASUREMENT SCIENCE AND DISPLAYS 9

Instrumentation brief review-Concept of measurement - Functional elements of an instrument system –Transducers - classification - classification of aircraft instruments-Instrument displays panels and cockpit layout, Electronic Flight Instrument System.

UNIT II AIR DATA INSTRUMENTS AND SYNCHRO TRANSMISSION SYSTEMS 9

Air data instruments-airspeed, altitude, Vertical speed indicators, Altitude alerting systems, Machmeter, Mach Warning system, Static Air temperature, Angle of attack measurement, Stall Warning system, Synchronous data transmission system

UNIT III GYROSCOPIC AND ADVANCED FLIGHT INSTRUMENTS 9

Gyroscope and its properties, gyro system, Gyro horizon, Erection systems for Gyro Horizons-Direction gyro-direction indicator, Rate gyro-rate of turn and slip indicator, Turn coordinator, acceleration and turning errors, Standby Attitude Director Indicator, Gyro stabilized Direction Indicating Systems, Advanced Direction Indicators, Horizontal Situation Indicator.

UNIT IV AIRCRAFT COMPASS SYSTEMS & FLIGHT MANAGEMENT SYSTEM 9

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

UNIT V POWER PLANT INSTRUMENTS & FLIGHT DATA RECORDING 9

Pressure measurement, temperature measurement, fuel quantity measurement, engine power and control instruments-measurement of RPM, manifold pressure, torque, exhaust gas temperature, EPR, Engine Fuel Indicators, engine vibration monitoring, Cockpit Voice Recorder and Flight Data Recorder.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Design the error model and estimate the error in the aircraft instruments
CO2: Explain about the various air data systems and synchronous data transmissions systems
CO3: Apply the principle of gyroscope, DGU, RMI, FMS in 4D flight management in the Avionics domain requirements.
CO4: Classify the different sensors and select the appropriate one for the given requirements.
CO5: Explain the operation and importance of engine instruments and flight data recorder.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓								
CO2	✓						✓					
CO3					✓							✓
CO4		✓	✓				4.					✓
CO5	✓	✓		✓								✓

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AV5102 **AEROSPACE ENGINEERING** **L T P C**
3 1 0 4

OBJECTIVES:

- To provide knowledge in the basic concepts of aerospace engineering including Aerodynamics, Aircraft performance, stability &control, Aircraft Structures and Propulsion.
- To provide exposure on the factors that influence aircraft design and limit aircraft performance
- To provide knowledge on analysis of longitudinal/lateral/directional motions.
- To provide knowledge to perform preliminary design computations to meet static stability and time requirements
- To provide exposure on dynamic flight conditions using the non-linear equations of motion

UNIT I FUNDAMANTALS OF AERODYNAMICS 12

Different types of flight vehicles, classifications-Components of an airplane and their functions-Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation. International standard atmosphere - Evolution of lift, drag and moment. Airfoils, Airfoil nomenclature Mach number, Speed of sound- Pitot static tube – I.A.S, E.A.S and T.A.S, Types of drag. Drag reduction in airplanes.

UNIT II AIRPLANE PERFORMANCE 12

General equation of motion of an airplane. Steady level flight, Thrust required and Power required, Thrust available and Power available for propeller driven and jet powered aircraft, Effect of altitude, maximum level flight speed, conditions for minimum drag and minimum power required, Shallow and steep angles of climb, Rate of climb, Maximum Climb angle and Maximum Rate of climb- Absolute and service ceiling, Gliding flight, Glide hodograph, Range and Endurance of Propeller and Jet aircrafts. Effect of wind on range and endurance. Estimation of take-off and landing distances, level turn, minimum turn radius, maximum turn rate, bank angle and load factor. V-n diagram

UNIT III STATIC STABILITY AND CONTROL 12

General concepts-Degrees of freedom of a rigid body, Static and dynamic stability, Criteria for longitudinal static stability, contribution to stability by wing, tail, fuselage, wing fuselage combination, Neutral point-Stick fixed and Stick free conditions, Free elevator factor, , elevator control power, elevator angle to trim, Directional stability-yaw and sideslip, Criterion of directional stability, contribution to static directional stability by wing, fuselage, tail, rudder requirements, Lateral stability-Dihedral effect, criterion for lateral stability, contribution of fuselage, wing, wing fuselage, tail.

UNIT IV DYNAMIC STABILITY 12

Equations of motion, small disturbance theory, Different types of axes. Derivation of equations of motion for Estimation of longitudinal stability derivatives, Routh's discriminant, solving the stability quartic, Phugoid motion, Factors affecting the period and damping. Characteristic modes of oscillation in stick fixed and stick free conditions, Response, Lateral dynamics. Dutch roll and spiral instability, Auto rotation and spin

UNIT V AIRCRAFT STRUCTURES AND POWERPLANT SYSTEMS 12

Introduction to Aircraft structures -Loads-Types of construction- Design feature of Aircraft materials. Different types of load carrying members on Wing and Fuselage. Aircraft propulsion, Rocket propulsion, Construction and working of Turbo jet, Turbo prop, Turbo fan and Ram jet engines Types of propellants.

TOTAL: 60 PERIODS

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OUTCOMES:

Students will be able to:

CO1: Gain knowledge of the different performance parameters such as level flight take-off, climb, cruise, turn, descent and landing performance.

CO2: Explain the factors influencing aircraft design that limit aircraft performance and different structural load carrying members of the airplane.

CO3: Apply the basic concepts of Aerospace, their power plants, the Mechanics of its flight, the dihedral effect, rolling power and control effectiveness of aileron in the appropriate domain.

CO4: Analyze the dynamic stability from various components of the airplane

CO5: Perform preliminary design computations to meet static stability and analyze dynamic flight conditions using the non-linear equations of motion

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓	✓	✓							
CO3	✓			✓	✓							✓
CO4	✓	✓		✓	✓							✓
CO5	✓	✓	✓	✓								✓

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1. Kermode, A.C, Mechanics of Flight, English Book Store, New Delhi, 1982.
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AV5103 ELECTRONIC SYSTEMS L T P C

3 1 0 4

OBJECTIVES

- To provide knowledge in the basic concepts and applications of electronics systems including Transistors, Operational Amplifiers, Digital Electronics, Microprocessors and Micro-Controllers.
- To introduce to analysis and design of feedback amplifiers, oscillatory circuits.
- To provide knowledge on design of DC power supplies.
- To provide knowledge on design of digital logic circuits using logic gates and flip-flops.
- To introduce to interfacing and control of peripherals with microcontrollers using assembly language programming.

UNIT I TRANSISTORS AND LINEAR IC’s 12

Introduction to electronic devices, BJT, modes of operation - classification of transistors-OP-AMP specifications, applications, voltage comparator, A/D and D/A converter, sample and hold circuit, timer, VCO, PLL, interfacing circuits, Introduction to analog computer.

UNIT II SIGNAL GENERATORS AND DC POWER SUPPLIES 12

Mutivibrators using IC555, Schmitt Trigger. RC phase shift oscillator, Wien bridge oscillator, Crystal oscillator. LC oscillators. Relaxation oscillators, Rectifiers, DC-DC converters, Voltage Regulators.

UNIT III DIGITAL SYSTEMS **12**

Number system, Review of TTL, ECL, CMOS- Logic gates, Flip Flops, Shift Register, Counter, Multiplexer, Demultiplexer / Decoder, Encoder, Adder, Arithmetic functions, analysis and design of clocked sequential circuits, Asynchronous sequential circuits, Finite State Machines.

UNIT IV MICROPROCESSOR BASED SYSTEMS **12**

Introduction to Microprocessor design using Digital Circuits – 8085 microprocessor, Architecture – External Memory interfacing – Peripheral IC Interfacing-interfacing with Alpha numeric displays – Recent trends in advanced processors: SOC, DSP, FPGA, CPLD.

UNIT V MICROCONTROLLER BASED SYSTEMS **12**

AVR Micro controllers – Architecture – Assembly language Programming–Timer and Counter Programming – D/A and A/D interfacing – Multiple Interrupts – Analog interfacing and industrial control, Interfacing of LVDTs, Resolvers, Encoders, hall effect sensors, LCD panels, Stepper motor controller.

TOTAL: 60 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the operation and applications of basic electronic devices and Linear IC's
CO2: Design a signal generator and analog circuits using BJT and OP-AMP.
CO3: Design a digital circuit using Logic Gates and understand their implementation in microprocessor/microcontroller
CO4: Select and interface suitable peripherals to microprocessors/microcontroller.
CO5: Program and control the microprocessor/microcontroller using assembly language programming

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓							✓
CO4	✓		✓	✓								✓
CO5	✓		✓		✓							

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2. Gayakwad, Ramakant A., Op-Amps and Linear Integrated Circuits, Prentice Hall/ Pearson Higher Education, New Delhi, 1999.
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RM5151 **RESEARCH METHODOLOGY AND IPR** **LT P C**
2 0 0 2

OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION 6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

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

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

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

TOTAL: 30 PERIODS

OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3	✓							✓				
CO4	✓				✓							
CO5	✓					✓						✓

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AV5111 AVIONICS INTEGRATION LABORATORY L T P C
0 0 4 2

OBJECTIVES:

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

LIST OF EXPERIMENTS

1. Testing of installation of MIL –STD-1553, ARINC-429 and ARINC -629 card (Self test)
2. Configuring MIL –STD-1553 cards in transmitting and receiving mode.
3. Configuring ARINC-429 and ARINC -629 cards in transmitting and receiving mode.
4. Testing of installation and configuring of AFDX card in transmitting and receiving mode.
5. Using the interactive driver to transmit or receive the data
   - On a single PC by loop back connection.
   - PC to PC by connecting a shielded pair of wires.
6. Transmit and receive the messages
   - Using loop back connection with single card.
   - Using connector (shielded pair of wires).
7. Calibration of Inertial Measurement Unit (IMU)
8. Sensor data fusion using complementary filter
9. Development of Inertial Measurement Unit (IMU) based angle estimation based on Euler‘s and Quaternion approach.

TOTAL: 60 PERIODS

OUTCOMES:

Students will be able to:

CO1: Integrate and operate avionic bus systems.
CO2: Install and Configure MIL-STD-1553B, ARIINC 429 and AFDX cards in transmitting and receiving mode.
CO3: Configure MIL-STD-1553B, ARIINC 429 and AFDX cards in transmitting and receiving mode.
CO4: Extract data from IMU and to represent attitude in Euler and Quaternion form using data fusion.
CO5: Implement in Real time the sensor data over data buses to various terminals.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							
CO2	✓			✓	✓							
CO3	✓		✓	✓	✓		✓		✓			✓
CO4	✓	✓	✓		✓							
CO5	✓		✓	✓	✓							

AV5112 **ADA PROGRAMMING LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- Be familiar with the basics of ADA programming language
- Be exposed to the concepts of ABSTRACT DATA TYPES
- To write, test, and debug simple ADA programs.
- To implement ADA programs with conditionals and loops.
- Learn to use Arrays, strings, functions, structures and unions for structuring ADA programs.
- Read and write data from/to files in ADA.

LIST OF PROGRAMS:

1. Search and Print passenger and flight details (Control statements, string operations).
2. 3x3 matrix multiplication in ADA (Arrays & looping statements).
3. Parameter passing to subprogram.
4. Swapping of 3 variables without temporary variable (functions).
5. Class definition and handling.
6. Exception handling.
7. Packages in ADA.
8. File handling 'statistics of character types in given file'.
9. A program to detect Bayes criterion to detect intended signal from a source.
10. A program to integrate INS and GPS flight data.

PLATFORM NEEDED gnat-community-interpreter for Windows.

TOTAL: 60 PERIODS

OUTCOMES:

Students will be able to:

CO1: Conversant with the basics of ADA programming language
CO2: Capable of writing, testing, and debugging simple ADA programs
CO3: Use methods and classes using packages
CO4: Design file and exception handling
CO5: Implement engineering algorithms using ADA

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓						✓			
CO4	✓	✓	✓	✓	✓				✓			✓
CO5	✓	✓	✓		✓	✓			✓			✓

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AV5201 **NAVIGATION SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES:

To impart knowledge on the concept of

- Different axis systems and co-ordinate transformation techniques
- Different radio navigation systems
- Inertial sensors and inertial navigation
- Various approach and landing aids of aircraft
- Satellite navigation & Hybrid navigation

UNIT I NAVIGATION SYSTEMS & INERTIAL SENSORS 9

Introduction to navigation – Categories of navigation- Evolution of Air navigation – Introduction to Inertial Sensors – Accelerometers –Gyroscopes- Mechanical Gyro - Ring Laser gyro- Fiber optic gyro – MEMS system

UNIT II INERTIAL NAVIGATION SYSTEMS 9

Navigation Equations - Different co-ordinate frames – Transformation Techniques - Earth in inertial space - – INS Mechanization- Stable Platform and Strap down –INS components: transfer function and error analysis -Coriolis effect- Rate corrections - Schuler Tuning - INS system block diagram – Initial calibration and Alignment Algorithms

UNIT III RADIO NAVIGATION 9

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

UNIT IV LANDING SYSTEMS AND AIR TRAFFIC MANAGEMENT 9

Instrument Landing System- Microwave Landing System- GPS based Landing system - Ground controlled approach system- Transponder Landing System - surveillance systems-Airborne Collision Avoidance Systems

UNIT V SATELLITE NAVIGATION & HYBRID NAVIGATION 9

Introduction to GPS -system description -basic principles -position and velocity determination-signal structure-DGP: LAAS, WAAS - Estimation and mixed mode navigation- Multisensor Integrated Navigation -Integration of GPS and INS-utilization of navigation systems in aircraft.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the need for different axis systems and select the suitable system for the given condition.

CO2: Derive the necessary mathematical knowledge that are needed in modelling the navigation process and methods.

CO3: Analyse various Navigation systems such as Inertial Measurement systems, Radio Navigation Systems, Satellite Navigation – GPS; Landing aids.

CO4: Perform data fusion and sensor integration.

CO5: Deploy these skills effectively in the analysis and understanding of hybrid navigation systems in an aircraft.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓	✓	✓	✓								
CO3	✓		✓	✓	✓							✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓	✓		✓	✓	✓					

REFERENCES:

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AV5251 AEROSPACE GUIDANCE AND CONTROL L T P C
3 1 0 4

OBJECTIVES:

- To learn about the aircraft equations of motion and method of linearization.
- To learn about the operating principle of guidance law
- To study about the augmentation systems
- To study longitudinal stability and to design the longitudinal autopilot
- To study lateral stability and to design the lateral autopilot

UNIT I INTRODUCTION 12

Introduction to Guidance and control - Definition, Historical background – Coordinate Frame - Equations of motion – Lineraization.

UNIT II AUGMENTATION SYSTEMS 12

Need for automatic flight control systems, Stability augmentation systems, control augmentation systems, Design of Limited authority and Full Authority 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 12

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

TOTAL: 60 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the equations governing the aircraft dynamics and the process of linearizing them.
CO2: Define the various guidance schemes and requirements for aircrafts and missiles.
CO3: Apply the principle of stability and control augmentation systems.
CO4: Analyse the oscillatory modes and methods of suppressing them
CO5: Design the controller for lateral, longitudinal and directional control of aircrafts.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓							✓		✓
CO2	✓	✓							✓	✓		
CO3	✓	✓		✓								
CO4	✓	✓	✓		✓							
CO5	✓	✓	✓	✓	✓							✓

REFERENCES:

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AL5076 ROCKETRY AND SPACE MECHANICS L T P C

3 0 0 3

COURSE OBJECTIVES:

1. This course presents the fundamental aspects of rocket motion along with detailed estimation of rocket trajectories.
2. This course also imparts knowledge on optimization of multistage rockets.
3. This course provides the basics of space mechanics required for an aeronautical student
4. This course helps students to provide with the basics of orbit transfer of satellites.
5. This course will help students to gain knowledge on various control methods of rockets.

UNIT I ORBITAL MECHANICS 9

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

UNIT II SATELLITE DYNAMICS 9

Geosynchronous and geostationary satellites- factors determining life time of satellites – satellite perturbations – orbit transfer and examples –Hohmann orbits – calculation of orbit parameters– Determination of satellite rectangular coordinates from orbital elements.

UNIT III ROCKET MOTION 10

Principle of operation of rocket motor – thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories – determinations of range and altitude – simple approximations to burnout velocity.

UNIT IV ROCKET AERODYNAMICS 9

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

UNIT V STAGING AND CONTROL OF ROCKET VEHICLES 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, students will be able

CO1: To knowledge on the fundamental laws of orbital mechanics with particular emphasis on interplanetary trajectories.

CO2: To calculate orbital parameters and perform conceptual trajectory designs for geocentric or interplanetary missions.

CO3: To familiarize themselves with trajectory calculations for planar motion of rockets.

CO4: To determine forces and moments acting on airframe of a missile.

CO5: To acquire knowledge on the need for staging and stage separation dynamics of rocket vehicles.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓				✓				✓	
CO2	✓	✓	✓	✓	✓		✓	✓			✓	
CO3	✓	✓	✓	✓	✓	✓	✓					✓
CO4	✓	✓	✓		✓	✓	✓					✓
CO5	✓	✓	✓	✓			✓	✓				✓

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AV5211 AUTOMATIC FLIGHT CONTROL SYSTEMS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To introduce the advanced concepts of flight control and required mathematical knowledge.
- To provide exposure on Root locus, analysis of stability through Root locus plots, Bode plot, Lead Lag compensator.
- To provide exposure on PID controller tuning, controller and autopilot design.
- To provide exposure on data fusion and estimation using kalman filter.
- To provide exposure on hardware in loop simulation.

LIST OF EXPERIMENTS

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

NOTE: Implementation using X-plane, Flight-Gear & Aerosim (Experiments from 5 to 9)

TOTAL: 60 PERIODS

OUTCOMES:
Students will be able to:

CO1: Perform stability analysis of a given aircraft transfer function using different analysis techniques.
CO2: Design a controller using PID and LQR methods
CO3: Design the controller for lateral, longitudinal and directional control of aircrafts.
CO4: Test the designed controller using flight simulator for fixed wing and rotory wing aircrafts.
CO5: Perform Hardware-In-Loop Simulation and modify design parameters to achieve desired results.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓	✓						✓
CO3	✓	✓	✓	✓	✓				✓			✓
CO4	✓		✓	✓	✓		✓		✓			
CO5	✓			✓	✓	✓						✓

AV5212 NAVIGATION AND GUIDANCE LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To provide exposure on inertial sensors Calibration procedures and navigation algorithms
- To provide exposure to hybrid navigation systems
- To provide exposure on Camera Calibration, Optical Flow Estimation, Object detection and tracking methods
- To provide exposure on target coordinate estimation and control for aerial image
- To provide exposure on Kalman Filter design and UAV landing guidance

LIST OF EXPERIMENTS

1. Calibration of MEMS accelerometers
2. Calibration of MEMS gyroscopes
3. Sensor Data Fusion using Kalman filter
4. INS/GPS Integration
5. Simulation of Way Point Navigation using X-Plane
6. Camera calibration
7. Optical Flow Estimation
8. Object detection and tracking
9. Target coordinate estimation using UAV aerial image
10. Integration of Gimbal camera and control for aerial imaging and relative navigation
11. Integration of GPS, Range sensors and Altimeter for landing guidance
12. Simulation of UAV landing guidance using GPS, Range sensors and Altimeter data
13. Design of Kalman filter

TOTAL: 60 PERIODS

OUTCOMES:

Students will be able to:

CO1: Calibrate MEMS IMU and fuse the sensor data using Kalman Filter
CO2: Simulate the waypoint navigation system and integrate the INS/GPS navigation systems
CO3: Calibrate the camera and estimate the state using optical flow
CO4: Perform object detection, tracking, target coordinate estimation and integration of Gimbal camera for UAV aerial image
CO5: Integrate the GPS, Range sensor and Altimeter data for UAV landing guidance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓	✓	✓							
CO2	✓		✓		✓	✓						✓
CO3	✓			✓		✓						
CO4	✓	✓	✓	✓	✓		✓		✓			✓
CO5	✓	✓	✓	✓	✓				✓			

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AV5001 MODERN CONTROL THEORY AND APPLIED MATHEMATICS L T P C
3 0 0 3

OBJECTIVES:

- To understand classical control systems and to analyze the stability of them
- To understand the state space analysis and the design concepts
- To understand the nature of non-linear systems and to analyze the stability of such system
- To understand the non-linear systems and its stability analysis
- To understand the application of selected tools and design and development of optical control system.

UNIT I INTRODUCTION 9

Basic Concepts - Review of Classical Control -Representation of Linear Systems -First and Second Order Linear Differential Equations – Linear differential equations, Laplace transforms, Fourier transforms, Mathematical modeling of dynamic systems –deterministic, linear time invariant systems, transfer functions. Initial value and final value theorem, Inverse Laplace transforms- Time Response of Linear Dynamical Systems - Transfer Functions- Stability of Linear Time Invariant Systems

UNIT II STATE SPACE ANALYSIS 9

Concept of state, state variables and state model, state modeling of linear systems- State space representation using physical variables, phase variables & canonical variables - Controllability and Observability - State Feedback- Pole Placement

UNIT III NON-LINEAR SYSTEMS 9

Types of Non-Linearity – Typical Examples – Properties of nonlinear systems – Nonlinear differential equations – Numerical solutions to nonlinear differential equations – common physical non-linearity-saturation, friction, backlash, dead zone, relay- Stability analysis of nonlinear systems- Mathematical modeling of non-linear systems- Stability Steady-State Accuracy. Satisfactory Transient Response Satisfactory Frequency Response Classical Methods for Improving Performance Classical Performance Measures and Frequency domain analysis Bode plot Root locus, Analytical Methods Continuous-Time Control System Design

UNIT IV NONLINEAR SYSTEM ANALYSIS 9

BIBO and Asymptotic stability – Phase plane analysis (analytical and graphical methods) —Stability Analysis by Describing function method -Lyapunov Theory – Constructions of Lyapunov Functions - Nonlinear Observer - Back-Stepping - Linear Quadratic (LQ) Observer - An Overview of Kalman Filter Theory-Kalman Filter Design- Discretization of continuous system, Sampling theory, Bilinear transformation, Tustin transformation, Discrete transfer functions solution to discrete equations, Analysis of continuous and Discrete-Time Control Systems. Discrete-Time Control System Design Example

UNIT V OPTIMAL CONTROL 9

Introduction: Classical control optimization, formulation of optimal control problem- Optimal state regulator design: Lyapunov equation-Matrix Riccati equation- Stability Analysis of Dynamic Systems-Linear Quadratic Regulator- LQR steady state optimal control- Applications- State Variable Feedback and Controllability- Pole Placement or Eigenvalue Assignment- State Variable Observers

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Apply mathematical knowledge and basics of science and engineering to develop model for non-linear system.
CO2: Analyze non-linear system based on the first principle model.
CO3: Analyze the solution for complex non-linear system.
CO4: Develop various control schemes for non-linear systems.
CO5: Linearize non-linear system for developing linear control

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓				✓						✓
CO2	✓	✓	✓		✓							✓
CO3	✓	✓		✓	✓							✓
CO4	✓		✓	✓	✓	✓						✓
CO5	✓	✓	✓									✓

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AV5002 ELECTRO OPTIC SYSTEMS FOR AVIONICS ENGINEERS L T P C
3 0 0 3

OBJECTIVES:

- To understand the basic concepts of Laws of Black body radiation
- To understand the advanced concepts of Laser systems
- To understand the advanced concepts of Laser systems
- To introduce the concepts of imaging devices and tracking systems
- To give exposure on basic of various Fiber optic systems and their application in avionics domain

UNIT I INTRODUCTION 9

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

UNIT II LASER SYSTEMS 9

Theory of Laser operation, Optical resonators, Temporal and spatial coherence, Introduction to gas, solid and semiconductor lasers Modulators: Electro Optic, Magneto optic and Acousto- Optic-modulators, Q switching, Mode locking, Cavity dumping, Introduction to Holography, Ring Laser gyro, Laser hazards and Safety measures.

UNIT III INFRARED SYSTEMS 9

Infrared and thermal detectors, Description and design features of typical passive search and detection, Infrared imaging, Forward looking Infra Red (FLIR) Tracking and Homing systems. Satellite Radiometers.

UNIT IV IMAGING DEVICES AND TRACKING SYSTEMS 9

Imaging tubes: Vidicon, Pyroelectric vidicon, Image intensifier tubes, CCD, Focal plane arrays (FPA), Optical tracking, Sensor steering and stabilization, Servo Control. Opto mechanical design of camera and systems. Description and design features of laser ranging and guidance system, LIDAR.

UNIT V FIBER OPTIC SYSTEMS 9

Types of Fiber optic cables and their characteristics, fiber optic sources and detectors, Avionics fiber optic data busses: IEEE std 1393, MIL STD 1773 etc. Multiplexing schemes for onboard avionics, Fiber optic gyro.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Apply the concepts of Black body radiation, Black body sources.

CO2: Explain the working and applications of LASERs

CO3: Explain the working and applications of Infrared imaging devices

CO4: Explain the working and applications of imaging and tracking devices.

CO5: Analyze the fiber-optic systems, allowing the avionics engineers to deploy these skills effectively in the design and development of optical systems in avionics engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓	✓	✓									✓
CO3	✓	✓				✓						
CO4	✓	✓				✓						
CO5	✓	✓	✓		✓	✓						✓

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AV5003 SYSTEM MODELING AND SIMULATION FOR AVIONICS ENGINEERS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the concepts of aircraft mathematical model and Aircraft Equations of Motion
- To introduce the probability concepts in simulation
- To impart practical knowledge on the simulation of aircraft systems.
- To introduce the knowledge about various types of flight simulators
- To introduce interfacing of Flight simulators with AeroSim and Aerospace Blockset

UNIT I SYSTEM MODELS AND SIMULATION 9

Continuous and discrete systems, System modeling, Static models, Dynamic models, Principles used in modeling the techniques of simulation, Dynamic modeling of the Quadrotor - Aircraft mathematical model, Aircraft axis systems - Aircraft Equations of Motion – Aircraft force equations – Moment Equations – Longitudinal and Lateral Directional EOM- Kinematic Equations – Linearizing the EOM- Equations of longitudinal and lateral directional motion- Analytical modeling of aircraft wing loads, Bending moment model

UNIT II PROBABILITY, CONCEPTS IN SIMULATION 9

Stochastic Variables, Discrete probability functions, continuous probability function, Measure of Probability functions, Continuous uniformly distributed random number, Congestion in systems, Arrival patterns, various types of distribution, Simulation of Queuing systems

UNIT III SYSTEM SIMULATION 9

Discrete events, Representation of time, Generation of arrival patterns, Simulation Programming tasks, Gathering statistics, Counters and summary statistics, Simulation language. Continuous System models, Differential equation, Analog methods, digital analog simulators, Continuous system simulation language (CSSLs), Hybrid simulation, UAV and MAV simulation, Simulation of an autopilot, INS, autonomous landing systems, Interactive systems, AeroSim and Aerospace Blockset libraries for flight simulation

UNIT IV SYSTEM DYNAMICS AND MATHEMATICAL MODELS FOR FLIGHT SIMULATION 9

Historical background growth and decay models, System dynamics diagrams, Multi – segment models, Representation of time delays, The Dynamo Language Elements of Mathematical models, Equation of motion, Representation of aerodynamics data, Aircraft systems, Structure and cockpit systems, Motion system, Visual system, Instructor‘s facilities.

UNIT V FLIGHT SIMULATOR AS A TRAINING DEVICE AND RESEARCH TOOL 9

Introduction, advantage of simulator, the effectiveness of Simulator, The user‘s role, Simulator Certification, Data sources, Validation, in- flight simulators - Interfacing Flight Gear Flight Simulator using AeroSim and Aerospace Blockset

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the equations governing the aircraft dynamics and the process of linearizing them.
CO2: Derive the equations of aircraft wing loads, bending moment model.
CO3: Explain the probability concepts in simulation and flight simulators.
CO4: Perform and compare the simulation on different flight simulators
CO5: Demonstrate the concepts and working of a flight simulator.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2	✓	✓		✓	✓							
CO3	✓	✓			✓							✓
CO4	✓	✓	✓	✓	✓	✓					✓	
CO5	✓		✓			✓						✓

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AV5004 AVIONICS SYSTEM ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To provide exposure to basic concepts of Aircraft product system engineering and design
- To provide exposure to different fault and failure analysis methods in avionic systems.
- To provide exposure on systems engineering process, System Architecture and integration
- To provide exposure on the importance of Maintainability, reliability and availability of the product.
- To provide exposure importance of formal planning and documentation in systems engineering.

UNIT I INTRODUCTION TO SYSTEMS ENGINEERING 9

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

UNIT II THE AIRCRAFT SYSTEMS AND DESIGN 9

Introduction-Everyday Examples of Systems-Aircraft Systems-Generic Systems-Product Life Cycle-Different Phases-Whole Life Cycle Tasks-Systems Analysis- Design Drivers in the Project, Product, Operating Environment-Interfaces with the Subsystems- Mission analysis

UNIT III SYSTEM ARCHITECTURES AND INTEGRATION 9

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

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UNIT IV PRACTICAL CONSIDERATIONS AND CONFIGURATION CONTROL 9

Stake holders-Communications-Criticism- Configuration Control Process-Portrayal of a System- Varying Systems Configurations- Compatibility-Factors Affecting Compatibility – Systems Evolution. Considerations and Integration of Aircraft Systems-Risk Management.

UNIT V SYSTEMS RELIABILITY AND MAINTAINABILITY 9

Systems and Components-Analysis-Influence, Economics, Reliability - Design for Reliability – Redundancy Management - Fault and Failure Analysis - System Life Cycle cost-Case Study-Maintenance Types-Program-Planning and Design.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Describe the importance of systems engineering process in product development

CO2: Categorize different aircraft systems and will be able to differentiate the avionics architectures

CO3: Analyze the different stages of product development and factors influencing in each stage

CO4: Design the different alternatives during design process

CO5: Plan, organize and document the task related to product design, development and testing.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2		✓	✓						✓			
CO3				✓	✓						✓	✓
CO4	✓	✓	✓			✓	✓	✓			✓	
CO5			✓		✓	✓		✓	✓	✓	✓	✓

REFERENCES:

1. Andrew P. Sage and James E. Armstrong. Introduction to Systems Engineering, Wiley-Interscience; 1st edition, 2000.
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AV5005 IMAGE PROCESSING FOR AEROSPACE APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- To introduce basics of image processing, imaging sensors and Geometric spatial transformations
- To introduce the concepts in image enhancement and camera calibration techniques
- To understand the image segmentation and feature extraction methods
- To introduce the detailed concepts on multi resolution analysis
- To expose students to the state of the art image processing algorithms for aerospace applications

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Introduction – Elements of visual perception, Steps in Image Processing Systems – Image Acquisition – Sampling and Quantization – Pixel Relationships – Colour Fundamentals and Models, Image File Formats, Brightness adaptation and discrimination, weber ratio, Lightness constancy, Simultaneous contrast, Geometric Spatial Transformations, Introduction to the Mathematical tools - Image Acquisition-Imaging Sensors-CCD and CMOS.

UNIT II IMAGE ENHANCEMENT AND CAMERA CALIBRATION 9

Spatial Domain Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – DFT, FFT, Properties of 2D-FT, DCT, Smoothing and Sharpening filters – Homomorphic Filtering –Basic model of imaging geometry-Ideal Camera–Camera with intrinsic parameters-Approximate camera models–Camera Calibration–Methods and Procedure

UNIT III IMAGE SEGMENTATION AND FEATURE ANALYSIS 9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Color Image Segmentation, Motion Segmentation, Feature Analysis and Extraction, Template Matching methods

UNIT IV MULTI RESOLUTION ANALYSIS 9

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

UNIT V AEROSPACE APPLICATIONS 9

Image Recognition - Image Classification – Content-based image retrieval- Image Fusion – Image Analysis–Colour Image Processing - Vision based navigation algorithms–Computer Vision Algorithms for Unmanned Aerial Vehicles- Object detection – Tracking, Visual motion analysis – Optical Flow.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the mathematics behind image processing, point operations and colour image enhancement and restoration.
CO2: Perform image processing using Feature Analysis, Feature Extraction and Template Matching methods.
CO3: Perform Object detection, Tracking, Visual motion analysis and Optical Flow methods.
CO4: Perform Image enhancement, Wavelet transforms, multi-resolution analysis
CO5: Deploy these skills effectively in vision based navigation and control.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓	✓						✓
CO4	✓	✓			✓							✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓				✓

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1. Alexander Hornberg, Handbook of Machine Vision, First Edition, 2006
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8. Ron Graham, Alexander Koh, Digital Aerial Survey: Theory and Practice, Whittles Publishing; First edition, 2002.

AV5006 **FAULT TOLERANT COMPUTING** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I FAULT TOLERANCE **9**

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

UNIT II ERROR DETECTION **9**

Measure for error detection – Mechanisms for error detection – Measures for damage confinement and damage assessment – Protection mechanisms – Protection in multi-level systems.

UNIT III ERROR RECOVERY **9**

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

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UNIT IV SOFTWARE FAULT TOLERANCE **9**

The recovery block scheme – Implementation of recovery block – Acceptance – tests – run-time Overheads.

UNIT V SYSTEMS STRUCTURE AND RELIABILITY **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the advanced concepts of Fault Tolerance

CO2: Derive the necessary mathematical knowledge that are needed in understanding the necessary procedures involved.

CO3: Design Redundancy system, Fault Tolerant system architecture, error handling and recovery

CO4: Deploy these skills effectively in the solution of problems in avionics engineering.

CO5: Design the software fault tolerant documents based on the pertaining tests and standards

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓	✓								
CO2		✓	✓									
CO3	✓	✓	✓	✓	✓							✓
CO4		✓										✓
CO5	✓	✓		✓								

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AV5007 REAL TIME EMBEDDED SYSTEMS AND APPLICATIONS **L T P C**
3 0 0 3

OBJECTIVES:

To understand the basics of embedded system, architecture of PIC microcontroller and ARM processor.

- To understand the RTOS concepts like scheduling and memory management related to the embedded system.
- To learn the protocols of embedded wired and wireless application.
- To understand the concepts of software abstraction and peripheral interfacing.
- To understand concepts involved in the design of hardware and software components for an embedded system.

UNIT I EMBEDDED SYSTEM ARCHITECTURE 9

Real Time System – Embedded Systems –Embedded System Architecture - Simple Programming for Embedded System – 'Q' format of decimal number representation – Process of Embedded System Development - Pervasive Computing – Information Access Devices, Smart Cards – PIC Microcontrollers – ARM Processor – introduction to SoC - Real time Microcontrollers – Low power embedded systems.

UNIT II CONNECTIVITY 9

I2C, SPI, CAN, Wireless Connectivity - Bluetooth – Other short Range -Protocols – Wireless Application Environment – Service Discovery – Middleware.

UNIT III EMBEDDED/REAL TIME OPERATING SYSTEM 9

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

UNIT IV SOFTWARE DEVELOPMENT FOR EMBEDDED APPLIATIONS 9

Software abstraction using Mealy-Moore FSM controller, Basic concepts of developing device driver, Concurrency – Exceptions – Tools – Debugging Techniques – Optimization- Introduction to real time UML – DSP using ARM processor.

UNIT V CASE STUDIES WITH EMBEDDED CONTROLLER 9

Programmable interface with A/D & D/A interface, IMU Interfacing, Basic multirotor Stabilization, PWM motor speed controller using timer interrupts, Data Fusion of Range Sensors, Digital servo design using angle encoder.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the concepts of typical embedded systems.
CO2: Analyse a suitable choice of embedded processor for a given application.
CO3: Design the hardware and software for the embedded system.
CO4: Develop the real time kernel/operating system functions, task control block structure and analyze different task states.
CO5: Implement different types of inter task communication and synchronization techniques.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓		✓						✓
CO4	✓		✓	✓								✓
CO5	✓			✓	✓		✓					

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2. Buhr, R.J.A, Bailey, D.L. An Introduction to Real-Time Systems, Prentice-Hall International, 1999.
3. David E-Simon, An Embedded Software Primer, Pearson Education, 2007.
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9. Wayne Wolf, Computers as Components. Principles of Embedded Computer System Design, Mergen Kaufmann Publisher, 2006.

AS5072 ELEMENTS OF SATELLITE TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

This course will make students

1. To learn the satellite mission and configurations,
2. To have an basic idea on power system of satellites
3. To learn the attitude and orbit control systems of satellites.
4. To gain knowledge on basic of propulsion systems, structures, and thermal controls involved in satellites.
5. To learn the basic aspects of telemetry systems.

UNIT I SATELLITE MISSION AND CONFIGURATION 9

Mission Overview – Requirements for different missions – Space Environment, Spacecraft configuration-Spacecraft Bus–Payload–Requirements and constraints– Initial configuration decisions and Trade-offs–Spacecraft configuration process– Broad design of Spacecraft Bus– Subsystem layout–Types of Satellites–Constellations– Applications.

UNIT II POWER SYSTEM 8

Power sources–Energy storage–Solar panels–Deployable solar panels–Spacecraft Power management –Power distribution–Deep Space Probes.

UNIT III ATTITUDE AND ORBIT CONTROL SYSTEM (AOCS) 9

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

UNIT IV PROPULSION SYSTEMS, STRUCTURES AND THERMAL CONTROL 10

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

UNIT V TELEMETRY SYSTEMS 9

Base Band Telemetry system– Modulation– TT & CRF system–Telecommand system–Ground Control Systems

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

Upon completion of this course, Students will

CO1: Be able to describe the main components of a satellite and its importance.

CO2: Compare the merits and demerits of various power systems used.

CO3: Be able to learn the dynamics of the satellite.

CO4: Be able to study the design of propulsion systems, structures needed for satellites.

CO5: Acquire knowledge on satellite orbit control and telemetry systems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓	✓	✓		✓			✓
CO2	✓	✓	✓			✓					✓	
CO3	✓	✓			✓		✓					✓
CO4	✓	✓	✓	✓	✓	✓		✓				
CO5	✓	✓					✓					✓

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1. James R.Wertz, "Spacecraft Attitude Determination and Control", Kluwer Academic Publisher, 1988.
2. James R Wertz & Wiley J. Larsen, "Space Mission Analysis and Design", (Space Technology Library, Vol. 8, Microcosm Publisher, 1999.
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AV5008 **ELECTRONIC WARFARE** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I ELECTRONIC WARFARE (EW) PRINCIPLES AND RADAR **9**

Electronic Warfare taxonomy-EW Mission and scenarios – Basic principles of Radar – Radar Equations - Types

UNIT II ELECTRONIC SUPPORT MEASURE (ESM) RECEIVERS - ELECTRONIC COUNTER MEASURES (ECM) **9**

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

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UNIT III RADAR AND ECM PERFORMANCE ANALYSIS 9

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

UNIT IV EW SIGNAL PROCESSING 9

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

UNIT V ELECTRONIC COUNTER - COUNTER MEASURES (ECCM) 9

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.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the importance and advantages of electronic warfare
CO2: Explain the electronic support measure and electronic counter measures
CO3: Do the performance analysis of Radar detection
CO4: Demonstrate the receiver subsystem, the pre-processor and the data servo loop - Mile parameter tracking
CO5: Explain system assessment, counter measures (ECCM)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓	✓										
CO3		✓		✓	✓	✓						✓
CO4	✓		✓	✓	✓							✓
CO5	✓	✓			✓	✓		✓				

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

NE5077 MICROWAVES AND RADAR L T P C
3 0 0 3

OBJECTIVES:

- To provide knowledge on the electronic devices and their implementation in generating RADAR signal
- To study the principles of operation and types of RADAR.
- To understand the theoretical principles underlying microwave sources for RADAR.
- To provide knowledge on signal processing involved in RADAR
- To learn about RADAR tracking.

UNIT I MICROWAVESOURCES 9

Passive waveguide components, Microstrip line structure and components, Simple theory and operating characteristics of Reflex klystrons, Two cavity Klystrons, Magnetrons, and TWTS - solid state source - TEDS, IMPATTS, TRAPATT, GaAs FETs and Tunnel diode.

UNIT II RADAR PRINCIPLES 9

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

UNIT III TYPES OF RADARS 9

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

UNIT IV RADAR SIGNAL PROCESSING 9

Radar requirements –Matched filters- Radar ambiguity function – Optimum waveforms for detection in clutter – Classes of waveforms – Digital representation of signals -Pulse compression

UNIT V TRACKING RADAR 9

Tracking with radar – Monopulse Tracking – conical scan and sequential lobing –limitations to tracking Accuracy- Kalman Tracker -Fundamentals of Airborne radar

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: To understand the concepts of radar
CO2: To derive a radar equations
CO3: To design a radar system.
CO4: To design and implement radar tracking algorithms.
CO5: To review the types of microwave sources

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓	✓		✓	✓							
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓	✓						✓
CO5	✓	✓		✓	✓	✓						

REFERENCES:

1. Blackman S.S., —Multiple target tracking with radar applications‖, Artech House 1986.
2. Filipo Neri, "Introduction to Electronic Defense Systems", 2nd Edition, Scitech, 2006.
3. Fred E. Nathanson— Radar design Principles — Signal processing and the environment, Prentice Hall, 2007
4. Guy V. Morris, Linda L. Harkness, Airborne Pulsed Doppler radar, Second Edition, Artech House Publishers, 1996.
5. Liao, Y. Microwave Devices and Circuits, Prentice Hall, 1980.
6. Michael. O. Kolawole, "Radar Systems, Peak Detection and Tracking", Elsevier, Burlington, 2002.
7. Skolnik, M.I. Introduction to Radar System (Second Edition) McGraw Hill, 2017.
8. Toomay J.C. and Paul. J. Hannen, "Principles of Radar‖, 3rd Edition, PHI, 2010.

AV5009	UAV SYSTEM DESIGN	L T P C
		3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TO UAV 9

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

UNIT II BASICS OF AIRFRAME 9

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

UNIT III AVIONICS HARDWARE 9

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

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS 9

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

UNIT V PATH PLANNING AND MAV 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Categorize UAV based on its physical dimension and weight.
CO2: Design a suitable airframe according to the application requirements.
CO3: Select the proper hardware, payload and communication method for the UAV.
CO4: Design an UAV using the skills learned to satisfy the requirements.
CO5: Explain the UAV terminologies and different certification standards.

REFERENCES:

1. Armand J. Chaput, ―Design of Unmanned Air Vehicle Systems‖, Lockheed Martin Aeronautics Company, 2001
2. Jane‘s- Unmanned Aerial Vehicles and Targets, Jane‘s Information Group; ASIN: 0710612575, 1999.
3. Kimon P. Valavanis, Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy‖, Springer, 2007.
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5. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2		✓	✓	✓		✓						
CO3		✓	✓		✓							
CO4		✓	✓	✓			✓		✓			✓
CO5	✓						✓		✓		✓	✓

AV5010 **DIGITAL FLY-BY WIRE CONTROL** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TO FLY-BY-WIRE CONTROL 9

Need for FBW systems, Historical perspectives in design Programs-Douglas Long Beach Programs, WPAFB B 47 In House Program, LTV IAP, Sperry Phoenix Programs, CAS and SAS, CCV and ACT concepts.

UNIT II ELEMENTS OF DFBW CONTROL 9

Description of various elements of DFBW systems - Concept of redundancy and reliability, Fault coverage and redrecentundant 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 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, Built-in-test features, Software development, Redundancy management, Issues of digital control laws

UNIT V RECENT TRENDS IN DFBW 9

Thrust Vectoring - Fly-By-Light – Control Configured Vehicle (CCV) and Active Control Technology (ACT) concepts – MIL-F 9490-D Guidelines - Testing and Case Studies.

TOTAL: 45 PERIODS

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OUTCOMES:

Students will be able to:

CO1: Explain the basic concepts of Fly-by-wire and provide the necessary mathematical knowledge that are needed in understanding modern aircraft control strategies.

CO2: Explain the advanced concepts of Fly-by-wire

CO3: Explain on various topics such as evolution of FBW, Elements, architecture, design and design issues of DFBW.

CO4: Deploy these skills effectively in the analysis and understanding of modern control methods.

CO5: Design the control law for lateral and longitudinal axis with the necessary mathematical knowledge that are needed in creating modern aircraft control strategies.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓								
CO2	✓	✓		✓								✓
CO3	✓	✓	✓	✓								
CO4	✓	✓		✓	✓	✓						✓
CO5	✓	✓	✓	✓	✓		✓					✓

REFERENCES:

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2. Collinson R.P.G. Introduction to Avionicsǁ, Chapman and Hall, 1996.
3. Gibson, J.G. Handling qualities and the fly-by-wire airplane. Proceedings of the AGARD flight mechanics symposium o stability and control AGARD CP-260, 1978.
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AV5011 **MISSILE TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I MISSILE SYSTEM 9

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

UNIT II AERODYNAMICS 9

Missile aerodynamics- design methodology, aerodynamic prediction method, aerodynamic loads & performance analysis, wind tunnel and flight testing of missile models and missile prototypes.

UNIT III PROPULSION 9

Principles of jet propulsion and rocketry, nozzle theory and performance parameters of solid rockets and ramjet and compound jet engines – evaluation of flight performance - forces acting on vehicle - basic relations of motion - multi stage vehicles

UNIT IV NAVIGATION, GUIDANCE & CONTROL 9

Navigation - types - inertial - GPS - radar based terrain mapping, guidance - explicit - PN –APN - beam riding – CLOS, control – autopilot, and actuation - hydraulic - pneumatic – electromechanical- RCS

UNIT V MISSILE TRAJECTORY CALCULATIONS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Demonstrate the working of a Missile system and launchers in co-ordinate frames.

CO2: Discuss about design methodology of missiles and detailed view about aerodynamic loads and experimental methods.

CO3: Explain about propulsion principles and staging of vehicles in space.

CO4: Differentiate the types of navigation systems and their pros and cons.

CO5: Perform calculation of ballistic missile trajectories.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2		✓	✓									✓
CO3	✓											
CO4	✓	✓										
CO5		✓	✓			✓						✓

REFERENCES:

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2. Frederick White, J. Flight Performance Handbook for Powered Flight Operations, John Wiley & Sons, Inc., 1963.
3. Garnel, Guided Weapon Control Systems, 2nd Edition, Pergamon Press, 1980.
4. Merrill, G. Dictionary of Guided Missiles and Space Craft, D. Van Nostrand and Company, Inc,1959.

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AV5012	INDUSTRIAL AVIONICS	L T P C 3 0 0 3

OBJECTIVES:

- To introduce the basic knowledge on avionics system engineering, avionic subsystems and aircraft electrical systems
- To introduce to the avionic software standards & requirements and safety issues.
- To have a clear view about safety of complex systems
- To introduce to on board Navigation and Communication systems
- To get knowledge about FMS and HMI.

UNIT I SYSTEM ENGINEERING AND AIRCRAFT ELECTRICAL SYSTEMS 9

System engineering overview, system engineering contract process, Technical process, H/w & S/w life cycle, Avionics systems includes FMS, BITE, Air traffic management systems, cockpit display system, Navigation, Mission management system, TCAS- Electric power generation, regulation and distribution systems, Industrial Power electronics, power supply, Battery charging systems, Engine electronics , Air-conditioning and lighting systems, wiring and cabling, Power supply Standards, and wiring and cabling standards

UNIT II ON BOARD SOFTWARE 9

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

UNIT III SAFETY OF COMPLEX SYSTEMS 9

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

UNIT IV ON BOARD NAVIGATION AND COMMUNICATION SYSTEMS 9

Over view of navigational aids, Flight planning, Area navigation, required time of arrival, RNAV architecture, Performance aspects, approach and landing challenges, regulatory and safety aspects, GPS and GNSS characteristics, Receiver autonomous integrity monitoring (RAIM)-Cockpit Instruments instrument errors and calibration, Data acquisition systems, ATEs, Display systems, Actuation a systems, Redundancy management. Reliability engineering System Maintenance

UNIT V FMS & HUMAN MACHINE INTERFACE 9

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

TOTAL : 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Be able to interpret avionic software standards & requirements and safety issues.

CO2: Be able to explain the need for onboard Navigation systems, FMS and HMI.

CO3: Be able to explain the advanced concepts of Industrial avionics to the engineers and provide the necessary knowledge that are needed in understanding relevant processes.

CO4: Have an exposure on various topics such as System Engineering, on- board software, safety of complex systems, FMS, ARINC 424 and Human interface

CO5: Be able to deploy these skills effectively in the solution of problems in Avionics Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓								✓	
CO2	✓	✓										
CO3				✓	✓	✓	✓					
CO4	✓		✓					✓				✓
CO5		✓	✓			✓		✓				

REFERENCES:

1. Andrew P. Sage, James C. Armstrong Jr. Introduction to Systems Engineering, Wiley-Interscience; 1 edition, 2000.
2. Collinson, R.P.G. Introduction to Avionics Systems, Third Edition, Springer Publishers, 2003.
3. Ian Moir, Allan Seabridge, Malcolm Jukes, Civil Avionics systems, Wiley; 2nd edition, 2013.
4. Spitzer, C.R. Digital Avionics Systems‖, Prentice Hall, U.S.A, 1987.

AV5013 SPACECRAFT COMMUNICATION SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I ELEMENTS OF SATELLITE COMMUNICATIONS 9

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 9

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 9

VSAT-VSAT Technologies, Networks MSS-AMSS, MMSS

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the advanced concepts of Spacecraft communication systems to the engineers

CO2: Derive the necessary mathematical equations that are needed in understanding the physical processes.

CO3: Explain Orbital mechanics, elements of satellite communication system, links and multiplexing, multiple access, telemetry, tracking and telecommand

CO4: Review the communication codes schemes

CO5: Deploy these skills effectively in the solution of problems in avionics engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2			✓									
CO3							✓					✓
CO4	✓				✓		✓					
CO5			✓			✓	✓					✓

REFERENCES:

1. Elbert, Bruce R, Satellite communication applications handbook, Artech house Boston, 2004.
2. Kadish, Jules E, Satellite Communications Fundamentals, Artech House, Boston, 2000
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6. Tri T Ha, Digital Satellite Communication, Macmillan Publishing Company, 1986.
7. Wilbur L. Pritchard and Joseph A. Sciulli, Satellite Communication Systems Engineering, Prentice Hall, New Jersey, 1986.

AV5014	THEORY OF DETECTION AND ESTIMATION OF DIGITAL SIGNALS	L T P C 3 0 0 3

OBJECTIVES

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

UNIT I REVEIW OF PROBABILITY AND STOCHASTIC PROCESS 9

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

UNIT II SINGLE AND MULTIPLE SAMPLE DETECTION 9

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

UNIT III FUNDAMENTALS OF ESTIMATION THEORY 9

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

UNIT IV WIENER AND KALMAN FILTERS 9

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

UNIT V APPLICATIONS 9

Detector Structures in Non-Gaussian Noise, Examples of Noise Models, Receiver Structures, and Error-Rate Performance, Estimation of Non-Gaussian Noise Parameters Fading Multipath Channel Models, Receiver Structures with Known Channel Parameters, Receiver Structures without Knowledge of Phase, Receiver Structures without Knowledge of Amplitude or Phase, Receiver Structures and Performance with No Channel Knowledge.

TOTAL:45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the concepts of detection, estimation and multi-user detection theory
CO2: Apply the theory behind various estimation techniques.
CO3: Analyze detection and estimation theory to solve communication problems.
CO4: Apply probability and stochastic process concepts in detection and estimation.
CO5: Design Wiener and Kalman filters to solve linear estimation problems.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓								
CO2	✓	✓	✓									
CO3		✓		✓	✓	✓						✓
CO4	✓	✓	✓	✓								✓
CO5	✓		✓		✓							

REFERENCES:

1. Harry L. Van Trees, "Detection, Estimation and Modulation Theory", Part I John Wiley and Sons, New York, 2001.
2. Steven M. Kay, "Fundamentals of Statistical Processing, Volume I: Estimation Theoryǁ, Prentice Hall Signal Processing Series, Prentice Hall, PTR, New Jersy, 1993.
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AV5015 SOFT COMPUTING FOR AVIONICS ENGINEERS L T P C
3 0 0 3

OBJECTIVES:

- To familiarize with soft computing concepts.
- To introduce the ideas of Neural Networks and use of heuristics based on human experience.
- To introduce Fuzzy set theory and different fuzzy models for controller design
- To introduce the concepts of Genetic algorithm and its applications to soft computing using some applications.
- To introduce to neuro-fuzzy modelling

UNIT I NEURAL NETWORKS 9

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

UNIT II FUZZY SET THEORY 9

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

UNIT III OPTIMIZATION METHODS 9

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

UNIT IV NEURAL AND FUZZY CONTROL SCHEMES 9

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

UNIT V NEURO FUZZY MODELLING **9**

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

TOTAL:45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the advanced concepts of Soft-computing

CO2: Provide the necessary mathematical knowledge that are needed in modeling the related processes.

CO3: Select a suitable soft-computing technique to solve the given problem effectively

CO4: Design a controller based on Neural Networks, Fuzzy logic and Neuro-fuzzy modeling.

CO5: Deploy the skills effectively in the solution to problems in avionics engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓			✓								
CO2	✓	✓	✓	✓								
CO3	✓	✓		✓	✓							✓
CO4	✓		✓	✓	✓	✓						✓
CO5	✓		✓		✓	✓			✓			✓

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1. Anderson J. A. An Introduction to Neural Networks, PHI, 2001.
2. Davis E. Goldberg, Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley, N.Y., 2000.
3. Freeman J.A. & Skapura, D.M. Neural Networks: Algorithms, Applications and Programming Techniques, Addison Wesley, 2000.
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6. Timothy J. Ross., Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997.

OE5091 **BUSINESS DATA ANALYTICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn odelling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student will be able to:

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for odelling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	3	1
CO2	2	1	1	2	1	1
CO3	1	1	2	3	3	1
CO4	2	2	1	2	1	1
CO5	1	1	2	2	1	1
CO6	1	1	1	3	2	1

OE5092 **INDUSTRIAL SAFETY** **LT P C**
3 0 0 3

OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION **9**

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING **9**

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION **9**

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING **9**

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn, Foundation Engineering Handbook, Chapman & Hall London, 2013.
4. Higgins & Morrow, Maintenance Engineering Handbook, Eighth Edition,2008

OE5093 OPERATIONS RESEARCH L T P C
3 0 0 3

OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I 9

Transportation problems -Northwest corner rule, least cost method, Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9

Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: To formulate linear programming problem and solve using graphical method.

CO2: To solve LPP using simplex method

CO3: To formulate and solve transportation, assignment problems

CO4: To solve project management problems

CO5: To solve scheduling problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member,Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1 – Understand the costing concepts and their role in decision making

CO2–Understand the project management concepts and their various aspects in selection

CO3–Interpret costing concepts with project execution

CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques

CO5 - Become familiar with quantitative techniques in cost management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓			✓	✓		✓	✓
CO2	✓	✓	✓		✓				✓		✓	✓
CO3	✓	✓	✓		✓	✓					✓	✓
CO4	✓	✓	✓		✓		✓				✓	✓
CO5	✓	✓	✓		✓	✓	✓				✓	✓

Attested

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REFERENCES:

1.Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095	COMPOSITE MATERIALS	L T P C
		3 0 0 3

OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

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OUTCOMES:

Students will be able to:

CO1: Know the characteristics of composite materials and effect of reinforcement in composite materials.

CO2: Know the various reinforcements used in composite materials.

CO3: Understand the manufacturing processes of metal matrix composites.

CO4: Understand the manufacturing processes of polymer matrix composites.

CO5: Analyze the strength of composite materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓								
CO2		✓	✓	✓	✓						✓	
CO3			✓	✓	✓		✓				✓	
CO4			✓	✓	✓		✓				✓	
CO5			✓	✓	✓		✓					

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

OE5096 **WASTE TO ENERGY** **L T P C**
3 0 0 3

OBJECTIVES:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION **9**

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV BIOMASS COMBUSTION **9**

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY **9**

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2	✓		✓									✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓		✓					✓
CO5	✓	✓	✓		✓							✓

REFERENCES:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

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1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

Attested

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AX5092 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION **6**

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS **6**

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA **6**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT **6**

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT **6**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL: 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

Attested

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REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C
2 0 0 0

OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS **6**

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES **6**

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS **6**

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE **6**

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING **6**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

AX5094	VALUE EDUCATION	L T P C
		2 0 0 0

OBJECTIVES

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING

1. Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

AX5095 **CONSTITUTION OF INDIA** **L T P C**
2 0 0 0

OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE:

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION:

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Attested

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SUGGESTED READING

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX5096 PEDAGOGY STUDIES L T P C
2 0 0 0

OBJECTIVES

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

AX5097 STRESS MANAGEMENT BY YOGA L T P C
2 0 0 0

OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

1. 'Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L T P C 2 0 0 0

OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 - Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.