DEPARTMENT OF AERONAUTICAL & AUTOMOBILE ENGINEERING, MIT Manipal.

M Tech Avionics Program Structure (Applicable to 2023 admission onwards)

YEAR	FIRST SEMESTER						SECOND SEMESTER					
	SUB CODE	**SUBJECT NAME**	**L**	**T**	**P**	**C**	**SUB CODE**	**SUBJECT NAME**	**L**	**T**	**P**	**C**
I	MAT 5121	Computational Methods	3	1	0	4	AAE 5215 AAE 5216	Airborne Platform -System Design Approach – Unmanned Aircraft System Space borne Platform -System Design Approach – Small Satellite Design	3	1	0	4
	AAE 5117	Avionics System Engineering	3	1	0	4	AAE 5217	Navigation Guidance and Control	3	1	0	4
	AAE 5118	Digital Avionics and EMI/EMC	3	1	0	4	AAE ****	Program Elective- I	3	1	0	4
	AAE 5119	Flight Instrumentation And Data Acquisition	3	1	0	4	AAE ****	Program Elective- II	3	1	0	4
	AAE 5120 AAE 5121	Mechanics of Flights (Non-Aero) Spacecraft and Dynamics (Aero)	3	1	0	4	AAE ****	Program Elective- III	3	1	0	4
	HUM 5051	Research Methodology and Technical Communication*	1	0	3	-	*** ****	Open Elective	3	0	0	3
	AAE 5143	Automatic Flight Control Systems Lab	0	0	3	1	HUM 5051	Research Methodology and Technical Communication*	1	0	3	2
	AAE 5144	Avionics System Engineering Lab	0	0	3	1	AAE 5243	Embedded System-Software Safety and Security Lab	0	0	3	1
	AAE 5145	Sensors and Data Handling Lab	0	0	3	1	AAE 5244	Antenna Design and Wireless Communication Lab	0	0	3	1
	Total		**16**	**5**	**12**	**23**			**17**	**5**	**9**	**27**
	THIRD AND FOURTH SEMESTER											
II	AAE 6091	PROJECT WORK & INDUSTRIAL TRAINING							**0**	**0**	**0**	**25**

*TAUGHT IN BOTH SEMESTERS AND EVALUATED AND CREDITED IN THE SECOND SEMESTER

PROGRAM ELECTIVES	
COURSE CODE	**COURSE TITLE**
AAE 5424	3D Mapping/Photogrammetry Software Analysis
AAE 5425	Adaptive Control
AAE 5426	Advance Missile Guidance
AAE 5427	Aircraft Computer Systems And Networks
AAE 5428	Aircraft Electrical System
AAE 5429	Analog and Digital Communication
AAE 5430	Antenna Designing, Simulation and Placement for Aerospace
AAE 5431	Artificial Intelligence And Machine Learning
AAE 5432	Aviation Laws, Rule, And Regulation
AAE 5433	Digital Control System
AAE 5434	Digital Signal Processing
AAE 5435	Electro Optic Systems
AAE 5436	Embedded Systems: Software Safety and Security of Embedded System
AAE 5437	Humanoid Robots
AAE 5438	Kalman Filter and Applications
AAE 5439	MEMS & MMIC In Aerospace Application
AAE 5440	Practical Cryptography in C/C++
AAE 5441	Programming Languages For Image Processing and Computer Vision Algorithm
AAE 5442	Radar

PROGRAM ELECTIVES	
COURSE CODE	**COURSE TITLE**
AAE 5443	Radar Energy Warfare and the Challenges of Stealth Technology
AAE 5444	RF System Design For Radar and Wireless Communications
AAE 5445	Satellite Communication System
AAE 5446	Smart Sensor Development and Application
AAE 5447	System Modelling and Simulation
AAE 5448	Virtual Reality and 3d Imaging for Military Simulation
OPEN ELECTIVES	
COURSE CODE	COURSE TITLE
AAE 5306	Antenna Designing, Simulation And Placement For Aerospace
AAE 5307	Embedded Systems: Software Safety and Security of Embedded System
AAE 5308	Unmanned Aircraft System

FIRST SEMESTER

MAT 5121: COMPUTATIONAL METHODS [3 1 0 4]

Mathematical Modeling with ordinary/partial/higher order differential equations: Models in arms race, compartment models, heat flow problems and vibration of strings. Modeling through graphs. Solution of linear and nonlinear system of equations: Direct methods, Newton Raphson method (system of non-linear equations), Birgevieta method, Bairstow's methods. Numerical Solution of Ordinary Differential Equations. Multi step methods: Boundary Value Problems: Integral Transforms: The Fourier transform pair. Laplace transforms of elementary functions – inverse Laplace transforms.

References:

1. Atkinson K.E., An Introduction to Numerical Analysis (2e), John Wiley and Sons 1989.
2. Smith G.D., Numerical Solution of Partial Differential Equations, (3e) Oxford University Press, 2004.
3. Jain, Iyengar and Jain, Numerical methods for Scientific and Engineering Computations, New Age Publishers.
4. Kapoor J.N., Mathematical Modeling, Wiley Eastern, 1988.
5. Aris R., Mathematical Modeling Techniques, Pitmanm 1978.
6. Kreyszig, E., Advanced Engineering Mathematics, (10e), John Wiley 2011.

AAE 5117 AVIONICS SYSTEM ENGINEERING [3 1 0 4]

Introduction of Systems Engineering, avionics system engineering, system project management and software system engineering. Avionics life cycle cost, schedule and risk management, system engineering principle to avionics system, Existing avionics systems and their functions, new avionics subsystem and their base, project management of avionics engineering, software design, development and integration to system., Avionics Systems Essentials, Design areas of concern to system engineers, CARs, FARs, and certification requirements, identify design evaluation criteria and assign weighting values to the evaluation criteria, System requirements System engineering concepts, functional design, trade studies for the best system design. Case Study on Avionics Systems-Fly by Wire, Communication and Navigation systems, Autopilot, A380/B-787, Fail passive, Fail safe and fail operation etc.

References:

1. Cary R. Spitzer, Digital Avionics Handbook: -Avionics Development and Implementation, 2nd Edition, CRC Press, Taylor & Francis Group, 2007.
2. Blanchard, Benjamin S., and Fabrycky, Wolter J., Englewood Cliffs, N.J, System Engineering and Analysis, Prentice-Hall, 1990.
3. Defense Systems Management College, Systems Engineering Management Guide, U.S. Government Printing Office, December 1989.
4. United Airlines Staff. Avionics Fundamentals, IAP, Incorporated, 1987.
5. Kendal B. Manual of Avionics Blackwell Scientific Publications, Melbourne, 1993.
6. Pallett E.H.J. Aircraft Instruments, 3rd Edition Longman, London, 2011.

AAE 5118 DIGITAL AVIONICS AND EMI/EMC [3 1 0 4]

Evolution of Avionics: digital avionics overview-airframe manufacture's point of view and ATA Safety and Certification-Communication, Navigation, Global positioning system, Fault Tolerant Avionics, Electromagnetic Environment, Vehicle health management, system safety and development, RTCA DO-160, DO-178B/C, DO-254, Avionics functions: Human factors engineering and flight deck design, Display devices, Electrical systems, Air traffic control demonstration aspects, Flight critical digital control systems, Fault tolerant systems, Avionics Tools, Technique and Methods: Electronic Hardware reliability, Integrated Modular Avionics Design and certification, Avionics application software standard interface, Packaging.

EMI/EMC: EMI/EMC requirements BIT and CFDS, Cash flow analysis, Software costs, establishing spares level, EMC Testing on Airborne Equipment, Aircraft Generated Electromagnetic Interference on Future Electronic Systems, Electromagnetic Interference to Flight Navigation and Communication Systems

Case study on Airbus 380 and Boeing 777/787 aircraft.

References:

1. Cary R. Spitzer, Uma Ferrell and Thomas Ferrell and Associates Consulting, Inc. Thomas Ferrell, Digital Avionics Handbook, Third Edition, CRC Press Taylor & Francis Group, LLC, 2015.
2. Dr. Reinaldo J. Perez, Handbook of Aerospace Electromagnetic Compatibility, IEEE Press, Wiley, 2018.
3. Cary R. Spitzer, Digital Avionics Handbook: -Avionics Development and Implementation, 2nd Edition, CRC Press, Taylor & Francis Group, 2007.
4. Spitzer, C.R., Digital Avionics Systems, Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987
5. Chris Kendall et al, Aircraft Generated Electromagnetic Interference on Future Electronic Systems, DOT/FAA/CT-83/49, Federal Aviation Administration, 1983.
6. Authors of Conference et al, Digital Avionics System Conference, Boston, MA, U.S.A. https://doi.org/10.2514/MDAS75, 02 April 1975 - 04 April 1975.

AAE 5119 FLIGHT INSTRUMENTATION AND DATA ACQUISITION [3 1 0 4]

Basics of Aircraft, Aircraft instrument Types and Cockpit Layout, Air data Instruments, flight instruments, Sensors, Laser Gyroscope and its application, Standby and emergency instruments, Flight control systems-AFCS, Electrical systems -Aircraft power generation and power distribution, Flight Management Systems FMS, FAN, Black Boxes Cockpit Voice Recorder and Flight Data Recorder, etc. Environmental condition systems, Aircraft Safety and warning Systems, Emergency systems - Aircraft Communication Navigation Systems, ELT, Technology-data buses and avionics protocols, microelectronics devices, Introduction to Data Acquisition and Signal Conditioning, Signals, Sensors, and Signal, Military Data Acquisition Systems, and Instruments Datasheets.

References:

1. Ian Moir, Allan Seabridge, Aircraft Systems: Mechanical, Electrical, and Avionics Subsystems Integration, 3rd Edition, Aerospace Series, Wiley, 2011.
2. Measurement and Computing, Data Acquisition Handbook, Measurement and Computing Corporation, 2012.
3. Thomas K. Eismin, Aircraft Electricity and Electronics, 6th Edition, McGraw Hill Education (India) Private Limited.
4. S. Nagabhushana and L.K. Sudha, Aircraft Instrumentation and Systems, Publisher: I K International Publishing House, 2010.
5. Henderson Max F. Aircraft Instruments and Avionics for A & P Technicians, Casper Wyo 1993.
6. S. Nagabhushana and N. Prabhu, Principles of Modern Avionics, I K International Publishing House, 2018.

AAE 5120 MECHANICS OF FLIGHT [3 1 0 4]

Introduction to Air Vehicle Stability & Controls – including brief history of aircraft development with emphasis on stability and flight controls. Review of basic Aerodynamics, Propulsion and Flight Vehicle Performance. Aircraft Equations of Motion – Axis systems, Co-ordinate Transformations, Force & Moment Equations. Aircraft Static Stability – Control Power, Longitudinal Static Stability, Static Margin. Lateral – Directional Static Stability. Linearising the Equations of Motion – Small Perturbation Approximations Decoupled set of Longitudinal and Lateral – Directional Equations. Aircraft Dynamic Stability – Spring Mass Damper analogy and Laplace Transformation. Roots in Complex Plane, Aircraft Dynamic Stability. Longitudinal, Lateral and Directional modes. Atmospheric Disturbances and Aircraft Gust Response. Wake Vortex, Nose Vortex, Wing Rock, Departure and Spin. Structural Modelling and Aircraft Flexibility.

Aircraft Dynamic Stability – Flying Qualities. Flight simulations. Cooper Harper Rating Scale. Classical Feed Back Control, Stability Augmentation and Autopilots

References:

1. Thomas R. Yechout, Introduction to Aircraft Flight Mechanics, AIAA Education Series, Copyright 2003.
2. Bernard Etkin, Dynamics of Atmospheric Flight, John Wiley & Sons, Inc, 2005.
3. Robert C. Nelson, Flight Stability and Automatic Control, 2nd edition, The McGraw-Hill Companies, Inc, 1997.
4. John H. Blakelock, Automatic Control of Aircraft and Missiles, 3rd edition, John Wiley & Sons, Inc, 1991.
5. Kermondes, A. C., Mechanics of Flight, Prentice Hall, latest edition, 2012.
6. Anderson Jr., J. D., Introduction to Flight, McGraw-Hill, latest edition, 2015.

AAE 5121 SPACECRAFT AND DYNAMICS [3 1 0 4]

Introduction to space environment: Understand the Space environment-LEO, Deep space, Spacecraft's Systems overview, Engineering behind Spacecraft, orbital motion of spacecraft, Rigid body kinematics in 3D, Rigid body dynamics, Nonlinear spacecraft stability and control. Science and Engineering behind Rockets and launch vehicles, launch vehicles and control.

References:

1. A. H. J. de Ruiter, C. J. Damaren, J. R. Forbes; Spacecraft Dynamics and Control: An Introduction, Wiley, 2013.
2. Howard D. Curtis, Orbital Mechanics for Engineering Students, Butterworth-Heinemann; 3rd edition, 2013, ISBN-13 : 978-0080977478.
3. P. C. Hughes, Spacecraft Attitude Dynamics, Wiley, 1986.
4. Peter C. Hughes, Spacecraft Attitude Dynamics, Dover Publications Inc. 2004.
5. Alan C. Tribble, The Space Environment: Implications for Spacecraft Design - Revised and Expanded Edition, Princeton University Press, 2004, ISBN: 9780691213071.

HUM 5051 RESEARCH METHODOLOGY & TECHNICAL COMMUNICATION [1 0 3 -]

Research Methodology: Basic concepts: Types of research, Significance of research, Research framework. Sources of data, Methods of data collection. Research formulation: Components, selection and formulation of a research problem, Objectives of formulation, and Criteria of a good research problem. Research hypothesis: Criterion for hypothesis construction, Nature of hypothesis, Characteristics and Types of hypothesis, Elements of research design, Introduction to various sampling methods Sources of data, Collection of data, Research reports, references styles, Effective Presentation techniques, Research Ethics.

References:

1. Sekaran, U., & Bougie, R. (2016). Research methods for business: A skill building approach. John Wiley & Sons.
2. Zikmund, W. G., Babin, B. J., Carr, J. C., & Griffin, M. (2013). Business research methods. Cengage Learning.
3. Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed methods approaches. Sage Publications.
4. Donald R Cooper & Pamela S Schindler, Business Research Methods, McGraw Hill International, 2018.

AAE 5143 AUTOMATIC FLIGHT CONTROL SYSTEMS LAB [0 0 3 1]

Dynamics simulation of Aircraft, Rotorcraft, Missile, Spacecraft and Robots. Mathematical modelling and simulation, Algorithm development and testing of classical, modern control. Linear and Nonlinear Control design. Optimization-Linear, Nonlinear, and biologically inspired techniques. Linearization of systems dynamics. Trajectory optimization, navigation, guidance and control, Design of AFCS (Automatic Flight Control System), Fly-by-Wire flight control, Adaptive control- Case study: AiStar, F-16, TEJAS etc., Practical issues in design and implementation, Active Noise control for pilot helmet.

Autopilot System design and development, Actuation system, Autonomous Unmanned Systems-UAV, UWV, Space Mission and Robots and, instrumentation and flight testing, swarm and cooperative Control and Networking.

Fault tolerant flight control, Formation flight control, Human/Machine interface, Thrust vectoring control, Engine control.

References:

1. Ching-Fang Lin, Modern Navigation, Guidance, And Control Processing, 1st Edition, Volume II, Prentice Hall; 1997.
2. Eugene Lavretsky, Robust and Adaptive Control: With Aerospace Applications, 2013th Edition, Springer, 2013.
3. Darrol Stinton, Flying Qualities and Flight Testing of the Airplane, AIAA Education, American Institute of Aeronautics and Astronautics, 1998.
4. Miomir Vukobratovic and Dragan Stokic, Applied Control of Manipulation Robots: Analysis, Synthesis and Exercises, 1st Edition, Springer, 1989.
5. Brian L. Stevens, Frank L. Lewis & Eric N. Johnson, Aircraft Control and Simulation: Dynamics, Controls Design, and Autonomous Systems, 3rd Edition, Wiley-Blackwell, 2015.

AAE 5144 AVIONICS SYSTEM ENGINEERING LAB [0 0 3 1]

System Engineering life cycle in product design-UAS, UWV, Small Satellite, Avionics Systems, UAS Design, development and system integration, Software simulation-Flight simulator, software in loop simulation (SILS), Hardware in loop simulation (HILS), Processor in Loop simulation, Formation flying.

Design and development of PCB Circuits-Power module, Transceiver, Autopilot systems, Antenna Systems, Remote Video Terminals, Sensors development, Navigation and Communication Equipments.

Avionics Test Bench, Electrical Ground support Equipments, Electrical Test Bench. Software Define Radio [SDR], Aircraft Display, Design and Development of microelectronics system from requirement to validation/documentation, Embedded system development, Software Learning: DO178B/C certification for software and hardware development, GCS Design and integration, C/C++/ADA programming.

Experiments based on DAQ, Power Meter, Digital Multimeter, Ammeter, EMI/EMC Probes, RF Analyzer, Signal Generator, Spectrum Analyzer etc.

References:

1. David Allerton, Principles of Flight Simulation, Aerospace Series, John Wiley & Sons,2009.
2. Cary R. Spitzer, Digital Avionics Handbook: Avionics Development and Implementation, 2nd Edition, CRC Press, Taylor & Francis Group, 2007.
3. Jonathan W Valvano, Embedded Systems: Introduction to ARM Cortex-M Microcontrollers, 2nd ed, Createspace Independent Publishing Platform; 2012.
4. S. Nagabhushana and N. Prabhu, Principles of Modern Avionics Paperback, I K International Publishing House, 2018.
5. Len Buckwalter, Avionics Training: Systems, Installation, and Troubleshooting, Avionics Communications Inc., 2005
6. System Handbook & Instruction Documents provided with hardware.

AAE 5145 SENSORS AND DATA HANDLING LAB [0 0 3 1]

Camera -RGB/Thermal/IR/CCTV Laboratory Signal capturing, analysis, and application algorithm development. GPS data capturing and analysis for trajectory generation or surveying or agriculture purpose. Air Data systems, AHRS Sensor capturing for human gestures, modelling and simulation.

Object Tracking-Ergonomics and Robot, motion capture, Vision based aerial manipulation, control and navigation, Constrained motion planning, Vision based navigation, motion gesture, Robot manipulator etc. 3D Mapping of 4K Data, Virtual Reality, RADAR Simulation, Military simulation.

Sensor fusion and integration with embedded and SoC development board for health monitoring, environment monitoring, agricultural crops monitoring, Collision avoidance systems, Identification and Tracking, Machine learning. Audio and Video Signal Analysis.

IMU Research-Raw data analysis of various motions indoor or outdoor of laboratory, Capturing of Flight test data and analysis of drones/aircraft, Flying and Handling qualities, Application of Wind Vane sensors, sonar, Proximity sensors, LiDAR, motion sensors, etc, Remote Sensing data analysis.

Understanding Onboard Computers and Datahandling equipments, Command and Control and Communications, LabVIEW, MATLAB, Integration of Sensor with DAQ.

References:

1. Kiyoharu Aizawa, Katsuhiko Sakaue, Yasuhito Suenaga, Image Processing Technologies: Algorithms, Sensors, and Applications, Series: Signal Processing and Communications, 1st Edition, CRC Press, 2004.
2. Jens Eickhoff, Onboard Computers, Onboard Software and Satellite Operations: An Introduction, Springer Series in Aerospace Technology ISSN 1869-1730 e-ISSN 1869-1749,2012.
3. Darrol Stinton, Flying Qualities and Flight Testing of the Airplane, AIAA Education, American Institute of Aeronautics and Astronautics, 1998.
4. Martin Liggins II, David Hall, James Llinas, Handbook of Multisensor Data Fusion: Theory and Practice, Second Edition, CRC Press, 2008.
5. David C. Swanson, Signal Processing for Intelligent Sensor Systems with MATLAB, 2nd Edition, CRC Press, 2011.
6. Joseph Howse, Prateek Joshi, Michael Beyeler, OpenCV: Computer Vision Projects with Python, Packt Publishing Limited, 2016.

7. Doru Talaba & Angelos Amditis, Product Engineering: Tools and Methods Based on Virtual Reality, Intelligent Systems, Control and Automation: Science and Engg. Series, Springer, 2008.

SECOND SEMESTER

AAE 5215 AIRBORNE PLATFORM-SYSTEM DESIGN APPROACH [3 1 0 4]-

UNMANNED AIRCRAFT SYSTEM

Introduction to Unmanned Aircraft Systems (UAS) and Applications of UAS, Introduction to Design and Selection of the System, Aerodynamics and Airframe Configurations, Characteristics of Aircraft Types, Design Standards and Regulatory Aspects, Aspects of Airframe Design, Design for Stealth - different signature, Payload Types, Communications, Control and Stability- HTOL, Helicopters, Convertible Rotor Aircraft, Payload Control, Sensors and Autonomy, Navigation, Launch and Recovery, Control Stations- Control Station Composition, System Architecture, Mini- UAV 'Laptop' Ground Control Station, GCS for UAVs, types. Support Equipment, Transportation, Design for Reliability, EMC/EMI of UAS. Introduction to System Development and Certification, System Development, Certification, Establishing Reliability, UAV System testing, system -in flight testing, sites study, Operational Trials and Full Certification, UAV System Deployment, Defence Application- Navy Role, Army Role, Airforce Role, Civilian, Paramilitary and Commercial Roles, Prospects and Challenges and Evolution.

References:

1. Reg Austin, Unmanned Aircraft Systems UAVs Design, Development and Deployment, First Edition, A John Wiley and Sons, Ltd., 2010.
2. Jay Gundlach, Designing Unmanned Aircraft Systems: A Comprehensive Approach, Second Edition, AIAA Education Series, 2014.
3. Jay Gundlach, Civil and Commercial Unmanned Aircraft Systems, AIAA Education Series, 2016.
4. Dr David C. Ison, Small Unmanned Aircraft Systems Guide: Exploring Designs, Operations, Regulations, and Economics, Aviation Supplies & Academics Inc, 2017.
5. Douglas M. Marshall et al., Introduction to Unmanned Aircraft Systems, Second edition Taylor & Francis, 2016.
6. F.B. da Silva S.D. Scott M.L. Cummings, Design Methodology for Unmanned Aerial Vehicle (UAV) Team Coordination, MIT Department of Aeronautics and Astronautics, Cambridge, MA 0213, 2007.

AAE 5216 AIRBORNE PLATFORM-SYSTEM DESIGN APPROACH [3 1 0 4]-

SMALL SATELLITE DESIGN

Introduction to spacecraft, spacecraft elements, spacecraft sub systems, Orbital mechanics, Spacecraft system engineering, History of Small Satellites, First Small Satellites, System engineering aspects of small satellites, Small Satellite Design requirements and derivation, Software tools and Hardware required, small satellite projects classifications, systems and subsystem of small satellite, Resources required in design and development, Subsystem realization, Spacecraft Testing, Verification and Validation, Launch Vehicle and deployment, Space debris. Testing facilities and spacecraft test.

Case study of Small Satellite Design and manufacturing, Testing, launch arrangements, ground systems, and economic and regulatory arrangements surrounding small satellites. The Future of Small Satellites, Formation flights etc.

References:

1. A. Shajin Nargunam, Fundamentals of Small Satellite: - Design and Developmental Stages, LAP LAMBERT Academic Publishing,2020, ISBN-13:978-6202557054.
2. Alan C. Tribble, The Space Environment: Implications for Spacecraft Design - Revised and Expanded Edition, Princeton University Press, 2004, ISBN: 9780691213071.
3. Helvajian and Janson, Small Satellites Past, Present and Future, 2009, ISBN 978-1884989223.
4. Zheng You, Space Microsystems and Micro/Nano Satellites, 1st Edition, ELSEVIER, Micro and Nano Technologies, 2017, ISBN: 9780128126721.
5. Joseph N. Pelton, Scott Madry, Handbook of Small Satellites: Technology, Design, Manufacture, Applications, Economics and Regulation, Springer International Publishing, 2020.
6. Scott Madry, Peter Martinez and Rene Laufer, Innovative Design, Manufacturing and Testing of Small Satellites, Springer, 2018, ISBN 9783319750941.
7. ISRO Materials.

AAE 5217 NAVIGATION, GUIDANCE AND CONTROL [3 1 0 4]

Fundamentals of navigation, guidance and control, Geometric concepts of navigation, Reference frames, coordinate transformation, comparison of transformation methods. Inertial sensors, Inertial navigation systems- Integrated navigation, Fundamentals of radar, satellite navigation system, Classification of Missiles, Guided Missile, Fundamentals of Guidance, Interception and Avoidance, Guidance Laws, Command and Homing Guidance, Classical Guidance Laws, Modern Guidance Laws-Guidance Laws Derived from Optimal Control Theory - PPN with Non-Manoeuvring and Manoeuvring Targets. Applied optimal control and optimal guidance laws; Differential games and pursuit evasion problems; Recent advances in guidance theory; Missile Autopilots, Adaptive Control – Guidance. Functional Block Diagram, Missile Control Methods. Collision detection and avoidance strategies.

Applications to guided missiles, unmanned aerial vehicles and Mobile robots, APOLLO guidance and navigation - Spacecraft.

References: -

1. Ching-Fang Lin, Modern Navigation, Guidance, and Control Processing, Prentice Hall, 1991.
2. Anthony Lawrence, Modern Inertial Technology: Navigation, Guidance, and Control, 2nd Edition, Mechanical Engineering Series, Springer, 2001.
3. Zarchan P., Tactical and Strategic Missile Guidance, 5th Edition, AIAA Series, 2007.
4. Myron Kayton & Walter R. Fried, Avionics Navigation Systems, 2nd Edition, Wiley-interscience, 1997.
5. Roger W. Pratt, FLIGHT CONTROL SYSTEMS practical issues in design and implementation, Control Engineering Series-57, The Institution of Electrical Engineers and The American Institute of Aeronautics and Astronautics, 2000.
6. Brian L. Stevens, Frank L. Lewis & Eric N. Johnson, Aircraft Control and Simulation: Dynamics, Controls Design, and Autonomous Systems, 3rd Edition, Wiley-Blackwell, 2015.

AAE 5243 EMBEDDED SYSTEM-SOFTWARE SAFETY AND SECURITY LAB [0 0 3 1]

Group A: Embedded System, Software Development based on ARM Processor etc: Keil Embedded development tools/ µVision, ARM, M-Cortex, Beagle Bone, Arduino, Raspberry Pi, Evaluation board for ARM Cortex-M, PCB Design for embedded system - Eagle/Proteus, FPGA & ASIC, RF Front End Architecture, RTOS, DSP, LabVIEW and MyRIO with sensors interface and DAQ, Vivado and Xilinx Hardware-MPSoC, SoC, Pynq, Python based problems. Data Science and Handling.

Group B: Software Safety and Security, standards/certification/testing/LDRA Tools: LDRA Rules, LDRA Cover, LDRA Unit, Session 1: Write a source code in C language, Session 2 Structural Code Coverage Session 3 Unit Testing, Target based Testing, Cyber Security, Cryptology and Cryptography, Secure Communications etc. Coding standards and Software protocols.

References:

1. E. A. Lee and S. A. Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach, Second Edition, MIT Press, 2017.
2. Kai Qian, David den Haring and Li Cao, Embedded Software Development with C, Springer Science and Business Media, LLC, 2009.
3. Michael Barr, Anthony Massa, Programming Embedded Systems, Second Edition with C and GNU Development Tools, 2nd Edition, O'Reilly Media, 2009.
4. Renu Rajani, Pradeep Oak, Software Testing Effective Methods Tools & Techniques, Tata Mcgraw Hill Publishing Co Ltd, 2017.
5. MISRA C:2012 Standard.
6. SEI CERT C Secure Coding Standard URL: https://www.cert.org/secure-coding/products-services/secure-coding-download.cfm

AAE 5244 ANTENNA DESIGN AND WIRELESS COMMUNICATION LAB [0 0 3 1]

Antenna Simulation package: Creating the required geometry & its changes in relevant Software Solutions package, do necessary mesh size, solving the problem with given specification & analyze all required results.

Group A *(Antenna Design):* Dipole antenna, Dipole Antenna into Yagi-Uda. Rectangular Waveguide for the X- band Satellite Applications.–Design microstrip antennas; rectangular, circular, square patch antenna. Analysis their radiation patterns, return loss, gain antenna efficiency, i/p impedance etc.-

Group B *(Wired antennas with placement on electrically large platform):* Place the Monopole Antenna analyze the distortion due to the reflections from the UAV body. Understand and analyze the effect of different position of monopole antenna Coupling and Interference between the two monopole antennas, monostatic RCS.

Group C : Analog Communication, Digital Communication, Wireless Communication, 4G/5G VoLTE, Optical Fibre Communication., Antenna Design and fabrication. PCB Machine.

Group D: RF equipment testing and analysis, EMI/EMC, Electrical Systems, VNA. Spectrum Analyzer and RF Signal generator, Antenna Testing and measurements, Signal generation and analysis, CRO, DSO, MSO, 2 TO 4 Channel data analysis.

References:

1. Mathew N O Sadiku, Elements of Electromagnetics, 3rd edition, Oxford University Press, 2001.
2. C.A. Balanis, Antenna Theory - Analysis and Design, 4th Edition, John Wiley, 2016.
3. B. P. Lathi, Z. Ding, Modern Digital and Analog Communication Systems, Oxford University Press, 2010.
4. Proakis, John G.; Salehi, Masoud, Communication systems engineering, 2nd. Upper Saddle River, New Jersey: Prentice Hall, 2002. ISBN 0130617938.
5. Thereza Macnamara, Introduction to Antenna Placement and Installation, 1st Edition, Wiley, 2010.
6. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rd Edition, The McGraw Hill Companies 2008.
7. Pekka Eskelinen, Introduction to RF Equipment and System Design, Artech House Publishers, ISBN-13:978-1580536653, 2003.

SECOND YEAR

AAE 6091 PROJECT WORK [0 0 0 25]

Students are required to undertake innovative and research-oriented projects, which not only reflect their knowledge gained in the previous two semesters but also reflect additional knowledge gained from their own effort. The project work can be carried out in the institution/ industry/ research laboratory or any other competent institutions. The duration of project work should be a minimum of 36 weeks. There will be a mid-term evaluation of the project work done after about 18 weeks. An interim project report is to be submitted to the department during the mid-term evaluation. Each student must submit to the department a project report in prescribed format after completing the work. The final evaluation and viva-voice will be after submission of the report. Each student must make a presentation on the work carried out before the departmental committee for project evaluation. The mid-term & end semester evaluation will be done by the departmental committee including the guides.

PROGRAM ELECTIVE

AAE 5424 3D MAPPING/PHOTOGRAMMETRY MAPPING SOFTWARE ANALYSIS [3 1 0 4]

Introduction of 3D mapping/Photogrammetry mapping, GIS, Difference Between GIS And Geospatial, Types of Photogrammetry-Aerial Photogrammetry & Close-Range photogrammetry, Output From 3D Maps, Models And GIS, Principles of Photography and Imaging, Cameras and Other Imaging Devices, Image Measurements and Refinements, Object Space Coordinate Systems, Elementary Methods of Planimetric Mapping for GIS, Fundamental Principles of Digital Image Processing, Control for Aerial Photogrammetry, Aero triangulation, Project Planning, Photogrammetry Software: top 10 photogrammetry software for building 3D maps and models using drones on the market, Application: Processing UAV Imagery and its Applications, Remote sensing satellite, surveying, 3D shape analysis techniques and their applications.

References:

1. Paul Wolf, Bon DeWitt, Elements of Photogrammetry with Applications in GIS, 3rd Edition, McGraw-Hill Science/Engineering/Math, 2000.
2. Hamid Laga, Yulan Guo, Hedi Tabia, Robert B. Fisher, Mohammed Bennamoun, 3D Shape Analysis: Fundamentals, Theory, and Applications, WILEY, 2018, ISBN: 978-1-119- 40519-1.
3. Tickoo Sham, Exploring AutoCAD Map 3D 2018, BPB Publications. 2018, ISBN: 9789386551665, 9386551667.
4. Tripp Corbin GISP, Learning ArcGIS Pro, Packt Publishing Limited, 2015.
5. Jai Galliott, Military Robots: Mapping the Moral Landscape, Military and Defence Ethics, 1st Edition, Routledge, 2017.
6. Mahmoud Hassani and James Carswell, Transition from analogue to Digital Photogrammetry, Advances in remote sensing Vol I. No. 3 – VII, 1992.

AAE 5425 ADAPTIVE CONTROL [3 1 0 4]

Introduction, Optimal Control and the Linear Quadratic Regulator, Command Tracking and the Robust Servomechanism, State Feedback H∞ Optimal Control, Adaptive Control: Motivation and Introduction, Lyapunov Stability of Motion, State Feedback Direct Model Reference Adaptive Control, Model Reference Adaptive Control. Discrete-time MPC with Constraints, Discrete-time MPC Using Laguerre Functions, Discrete-time MPC with Prescribed Degree of Stability, Continuous-time Orthonormal Basis Functions, Continuous-time MPC, Continuous-time MPC with Constraints, Continuous-time MPC with Prescribed Degree of Stability, Classical MPC Systems in State-space Formulation, Implementation of Predictive Control Systems

References:

1. Lavretsky, Eugene, Wise, Kevin, Robust and Adaptive Control with Aerospace Applications, Advanced Textbooks in Control and Signal Processing, Springer-Verlag London, 2013.
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3. Eugene Lavretsky, Robust and Adaptive Control: with Aerospace Applications, Advanced Textbooks in Control and Signal Processing, Springer, 2013.
4. Sastry, S.; Bodson, M., Adaptive Control: Stability, Convergence, and Robustness, Dover Publications, Inc.: Mineola, NY, USA, 2011.
5. Whitaker, H.; Yamron, J.; Kezer, A., Design of Model Reference Adaptive Control Systems for Aircraft (Report R-164), MIT Press Instrumentation Laboratory, Cambridge, MA, USA, 1958.
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AAE 5426 ADVANCE MISSILE GUIDANCE [3 1 0 4]

Numerical technique: Solution of differential equation, laplace transform, numerical integration, Z transform, Difference equation. Tactical missile guidance: Proportional navigation, simulation in 2D, Engagement solution, linearization, closed form solution, zero miss distance. Methods of adjoint and Homing loop, Noise analysis, Proportional Navigation and other Guidance, Ballistic target properties, Extended Kalman filtering and ballistic coefficients estimation, ballistic target challenges, multiple targets, Weaving targets , problem formulation, closed form solution, Missile airframe and mathematical model, force and moment derivation, linearization, Flight control design and interaction with guidance system, Other methods for guidance laws development, Differential game guidance laws development.

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1. Paul Zarchan, Tactical and Strategic Missile Guidance, Sixth Edition, American Institute of Aeronautics and Astronautics, Inc, 2012, ISBN: 978-1-60086-894-8.
2. N.A. Shneydor, Missile Guidance and Pursuit: Kinematics, Dynamics and Control, Horwood Series in Engineering, Horwood Publishing Ltd, 1998.
3. Warren J. Boord, John B. Hoffman, "Air and Missile Defense Systems Engineering", 1 edition, CRC Press, 2016.
4. Joseph Carleone, Tactical Missile Warheads, American Institute of Aeronautics and Astronautics, Inc, 1993, ISBN: 978-1-56347-067-7.
5. Ashton B. Carter, David N. Schwartz, Ballistic Missile Defense, Brookings Institution, 1984.
6. Peter H. Zipfel, Modeling and Simulation of Aerospace Vehicle Dynamics, 3rd Revised edition, AIAA Education Series, American Institute of Aeronautics & Astronautics, 2014.

AAE 5427 AIRCARFT COMPUTER SYSTEMS AND NETWORKS [3 1 0 4]

Basic functions and facilities of a computer, Computer Systems Hardware, Introduction: Building computers from logic: the ALU, Building computers from logic: the memory, The Intel Pentium CPU, Subroutines, Simple input and output, Serial and Parallel Connections, The memory hierarchy, Storage Devices and Communication, Networking Essentials., Networking Computers, Communications, Data Communications and Transmission Media, The Internet, Aspects of Data Communications and Network Security, Local area networks (LANs), Wide area networks (WANs), Network segments, Intranets, Data Communication Systems, other Network, Operating Systems, Windows XP, Filing systems, Visual output, RISC processors: ARM and SPARC, VLIW processors: the EPIC Itanium, Parallel processing, Case study : Aircraft computers, Aircraft Networking, Aircraft Data Network (ADN),

References:

1. Rob Williams, Computer Systems Architecture - A Networking Approach, 2nd Edition, PEARSON Prentice Hall, 2006.
2. Barry G. Blundell, Nawaz Khan, Aboubaker Lasebaeet al., Computer Systems and Networks, 1st Edition, Cengage Learning EMEA, 2007.
3. Irv Englander, The Architecture of Computer Hardware, System Software, And Networking: An Information Technology Approach, John Wiley & Sons, Inc., 2019.
4. Olivier Bonaventure, Computer Networking: Principles, Protocols and Practice Release 0.25, Creative Commons license, 2011.
5. Dale Stacey, Aeronautical Radio Communication Systems and Networks, John Wiley & Sons, Ltd, 2008.
6. Philipp Goedeking, Networks in Aviation: Strategies and Structures, 2010th Edition, Springer, 2010.

AAE 5428 AIRCRAFT ELECTRICAL SYSTEM [3 1 0 4]

Overview of Aircraft Electrical System: Electrical fundamentals, Basic, Electronic fundamentals, digital fundamentals, Electric Measuring Instruments. Aircraft Batteries and other source – Types of Batteries, Battery and Charger Characteristics, Power Supply, Regulator, Inverter, TRU, APU, Emergency power. D. C. Generators, Generator Controls, Generator Controls, D. C. Alternators and Controls, Wiring Installation, Circuit protection, shielding/screening, power distribution, Aircraft Electrical Systems, engine starting, ignition and indicating, fuel management, bus system, charging, standby and essential powers, Control and Transduces-switches, relays, contactors, transducers. Aircraft Lighting Systems, Electrical System Components, Electrical and magnetic field - EM/EMC/lightning, airworthiness.

References:

1. Mike Tooley and David Wyatt, Aircraft Electrical and Electronic Systems: Principles, Operation and Maintenance, 1st Edition, Butterworth-Heinemann: Elsevier, 2009.
2. Ian Moir, Allan Seabridge, Aircraft Systems: Mechanical, Electrical, and Avionics Subsystems Integration, 3rd Edition, Aerospace Series, Wiley, 2011.
3. Thomas K. Eismin, Aircraft Electricity and Electronics, 6th Edition, McGraw Hill Education(India) Private Limited.
4. EHJ Pallett, Aircraft Electrical Systems, 3rd Edition, PEARSON India Education Services Pvt. Ltd, 1997.
5. Cary R. Spitzer, Digital Avionics Handbook: -Avionics Development and Implementation, 2nd Edition, CRC Press, Taylor & Francis Group, 2007.
6. Len Buckwalter, Avionics Training: Systems, Installation, and Troubleshooting, Avionics Communications Inc., 2005

AAE 5429 ANALOG AND DIGITAL COMMUNICATION [3 1 0 4]

Introduction, communication process, source, channel, modulation process, ADC, DAC, Signals and Signal Space, signal classification, functions, Analysis and Transmission of Signals, Fourier series, Fourier transform, energy signal, power signal, correlation and auto correlation, Application, Amplitude Modulations and Demodulations, SSB, DSB-SC, VSB, Angle Modulation and Demodulation, PM, FM, Wideband FM, demodulators or detectors, Fundamentals of Probability Theory, Random Processes and Spectral Analysis, Noises, Performance of communication systems, AM and FM Receiver, sampling theory, Introduction to Information Theory, Error Correcting Codes, Spread Spectrum Communications, Cellular and mobile communication, Security in Next Generation Air Traffic Communication Network, Aircraft communication, satellite communication etc.

References:

1. B. P. Lathi, Z. Ding, Modern Digital and Analog Communication Systems, Oxford University Press, 2010.
2. S. Haykin, Communication Systems, Wiley India Edition, 2009.
3. Proakis, John G.; Salehi, Masoud, Communication systems engineering, 2nd. Upper Saddle River, New Jersey: Prentice Hall, 2002. ISBN 0130617938.
4. Sklar, Bernard, Digital communications: fundamentals and applications, 2nd. Upper Saddle River: Prentice Hall, 2001. ISBN 0130847887.
5. Sanjay Sharma, Communication system (Analog and Digital), Reprint 2013 edition, S.K. Kataria & Sons, 2013.
6. Carlson, A. Bruce; Rutledge, Janet C.; Crilly, Paul B., “Communication systems: an introduction to signals and noise in electrical communication”, 4th. McGraw-Hill, New York [etc.], 2002. ISBN 0070111278.

AAE 5430 ANTENNA DESIGNING, SIMULATION AND PLACEMENT FOR AEROSPACE [3 1 0 4]

Fundamentals of Antenna, Basic Antenna and Propagation Theory: Introduction, Characteristics of Electromagnetic Waves, Interaction between Two Wave Polarizations, Vertical & Horizontal Polarization. Characteristics of an Antenna. Propagation. Antennas and Applications: Structural details, dimensions, radiation pattern, specifications, features and applications of antennas. Antennas Placement/Used on Aircraft: Introduction, Near and Far Fields of an Antenna, Antennas on Aerospace/UAV structures, Polar Radiation Patterns., Basics of Computer simulation tools, Antenna Designing simulation using CST, Simulation of 1D/2D/Far-field results, analysis of radiation pattern, analysis of input impedance in terms of real and complex results, analysis of gain and antenna efficiency. Aircraft antenna design and analysis using software.

References

1. C.A. Balanis, Antenna Theory - Analysis and Design, 4th Edition, John Wiley, 2016.
2. Mathew N O Sadiku, Elements of Electromagnetics, 3rd edition, Oxford University Press, 2001.
3. Thereza Macnamara, Introduction to Antenna Placement and Installation, 1st Edition, Wiley, 2010.
4. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rd Edition, The McGraw Hill Companies, 2008.
5. J. E. Rhodes, Antenna Handbook, Department of The Navy, 2016.
6. Lo, Y.T., Lee, S. W., Antenna Handbook Theory, Applications, and Design, Springer US, 1988.

AAE 5431 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING [3 1 0 4]

Artificial Neural Network: Introduction, basic models, Hebb's learning, Adaline, Perceptron, Multilayer feed forward network, Back propagation, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Types of learning, Self-Organizing Feature Maps Evolutionary and Stochastic techniques: Genetic Algorithm (GA), different operators of GA, analysis of selection operations, Hybrid Systems: Neural-Network-Based Fuzzy Systems, Genetic Algorithm for Neural Network Design and Learning, Machine Learning and data science: Machine learning, pattern recognition, image processing, text processing, natural language processing, graphics, cognition and computation, data mining, Introduction to Computer Vision: Edge detection, Point Correspondence and Stereopsis, Surface directions, Expert Systems: fundamental blocks, case studies in various domains, Intelligent System Applications: Intelligent Systems for Search and modelling, Automated Training Using an Intelligent System, Intelligent Systems for Control.

References:

1. Neural Networks, Fuzzy logic and Genetic Algorithms, Synthesis and applications by S. Rajsekharan, Vijayalaxmi Pai Russell S. and Norvig P. (1995).
2. Intelligent Hybrid Systems, D. Ruan, Kluwer Academic Publisher, 1997.
3. Holland, J. H. Adaption in Natural and Artificial Systems, University of Michigan Press. (1975).
4. Neural Fuzzy Systems, Chin-Teng Lin & C. S. George Lee, Prentice Hall PTR.
5. Genetic Algorithms in Search and Optimization, and Machine Learning, D. E. Goldberg, Addison Wesley, 1989.
6. Schalkoff, R. J. Artificial Intelligence: An Engineering Approach, McGraw Hill, New York (1990).

AAE 5432 AVIATION LAWS, RULE, AND REGULATION [3 1 0 4]

Aviation laws, Regulation and Deregulation, Airline Markets, Open Skies, New legal and regulatory challenges, national and international flights. Air Transport Policy, An introduction to Aircraft Act 1934, Aircraft Rules 1937 and amendments, Aviation Regulatory authorities DGCA, FAA, EASA and other country specific authorities, Civil Aviation Requirements, and its amendments. CARs related to Aircraft manufacturing (CAR 21), Type certification, Aircraft maintenance and certification. Licensing of Aircraft Engineers, Continuing Airworthiness, Airworthiness Directives and mandatory modifications, Air Operator Certificate, Scheduled and non-scheduled air transport services, MROs, ICAO, Introduction to various ICAO Annextures. ATA,

References:

1. Lucy Budd, Stephen Ison, Aviation Law and Regulation, 1st Edition, Routledge, 2020. ISBN 9781472451576.
2. De Florio, Airworthiness: An Introduction to Aircraft Certification A Guide to Understanding JAA, EASA and FAA Standards, 1st Edition, Butterworth-Heinemann, 2006.
3. V. Krishnan & S.R. Iyer, A.K. Chopra, A Handbook on Air Regulations for Pilots (in 2 Parts), The English Book Store (The Aviation People), 2014.
4. Michael Kroes, William Watkins, Frank Delp, Ronald Sterkenburg, Aircraft Maintenance and Repair, Seventh Edition, McGraw-Hill Education, 2013.
5. Study Materials: https://www.civilaviation.gov.in/en/archive-document/2312, https://www.faa.gov/regulations_policies, https://www.dgca.gov.in/digigov-portal/

AAE 5433 DIGITAL CONTROL SYSTEM [3 1 0 4]

Introduction to Digital Control, Modeling of Digital Control Systems, Digital Control System Design, State Space Representation, Optimal Control: Optimization, Unconstrained, optimization, Constrained optimization, linear quadratic regulator, Hamiltonian system Eigenstructure of the Hamiltonian matrix, Elements of Nonlinear Digital Control Systems, Practical Issues Design of the hardware and software architecture, Software requirements, filters, Controller structure, Sampling period switching, MATLAB commands, Computer Control Systems, Introduction to Computer Control, Robust Digital Controller Design Methods, Digital PID Controller, System Model Simulation of a digital aircraft flight control system, A new method, Digital Adaptive Flight Control System for Aerospace Vehicles, FLY BY WIRE, REDUNDANT FLIGHT CONTROL SYSTEM.

References:

1. Sami Fadali, Antonio Visioli, Digital Control Engineering Analysis and Design, Second Edition, Elsevier Inc, 2013.
2. Ioan Doré Landau, Gianluca Zito, Digital Control Systems: Design, Identification and Implementation Communications and Control Engineering, Springer Science & Business Media, 2007.
3. Charles L. Philips, H. Troy Nagle, Digital Control System Analysis and Design, 3rd Edition, Prentice-Hall, Inc, 1995.
4. M Gopal, Digital Control and State Variable Methods, Conventional and Neural-Fuzzy Control Systems, 6th Edition, Tata McGraw-Hill, Delhi, 2003.
5. Karl Johan Aström, Richard M. Murray, Feedback Systems, An Introduction for Scientists and Engineers, 3rd edition, Princeton University Press, 2010.

AAE 5434 DIGITAL SIGNAL PROCESSING [3 1 0 4]

Introduction of DSP, The Breadth and Depth of DSP, The Roots of DSP, Telecommunications, Audio Processing, Echo Location, Image Processing, Aerospace signal processing - Radar, sonar, electronic warfare, Laplace transform, Fourier series, Fourier transform, energy signal, power signal, correlation and auto correlation Signal intelligence (SIGINT), Sensor processing to enable situational awareness. Statistics, Discrete Fourier Transform, Introduction to Digital Filters, Signal processing- Audio Processing, Image Formation & Display, Digital Signal Processors, Complex Techniques, Design projects, digital signal processing for improving SIGINT and cyber security, radar signal, DSP systems by Coreel technology, Abaco, Orolia, Aitech, Rohde & Swarz, Pentek, Annapolis & TE, X-ES, Kontron etc.

References:

1. Steven W. Smith, The Scientist and Engineer's Guide to Digital Signal Processing, Second Edition, California Technical Publishing, 1999.
2. C. Ramesh Babu, Digital Signal Processing, Fourth Edition, Scitech Publications Private Limited, 2007.
3. Proakis, John G.; Manolakis, Dimitris G, Introduction to digital signal processing, New York: London: MacMillan; Collier MacMillan, 1988. ISBN 0023968109.
4. Oppenheim, Alan V.; Schafer, Ronald W, Discrete-time signal processing, 3rd. Upper Saddle River (N.J.): Prentice-Hall, 2010. ISBN 9780131988422.
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6. Sklar, Bernard, Digital communications: fundamentals and applications, 2nd. Upper Saddle River: Prentice Hall, 2001. ISBN 0130847887.

AAE 5435 ELECTRO OPTIC SYSTEMS [3 1 0 4]

Introduction to Electro-optic and Infrared (EO/IR) Systems Engineering, Electro-Optics (EO) - generation, modulation, detection, measurement, and display, Radiation in the Visible and Infrared, Electromagnetic Spectrum, EMFT in EO, Radiation Sources, Genesis of electro-optic systems, Electro-Optic and Infrared Systems, Components, Electro-Optical Systems Design, Analysis, and Testing, Laser Imaging Systems Spectral Imaging, Detection, Resolution, and Recognition, Lasers, Detector Characteristics, Image and Camera Tubes, Signal modulation schemes in optical, Forward error correction coding, Photographing E-O Displays, LIDAR and LADAR, Optical Communications Systems, Modern communications designs for FOC/FSOC applications, General LIDAR ranging, Medical Imaging, Optical Systems in Space, An Integrated Electro-Optical Payload System for Forest Fires Monitoring from Airborne Platform

References:

1. Joseph S. Accetta, David L. Shumaker, The Infrared and Electro-Optical Systems Handbook, (S. R Robinson, Emerging Systems and Technologies, Volume 8), Infrared Information Analysis Center & SPIE, 1993.
2. Sherman Karp, Larry B. Stotts, Fundamentals of Electro-Optic Systems Design: Communications, Lidar, and Imaging, 1st Edition, Cambridge University Press, 2013.
3. William Wolfgang Arrasmith, Systems Engineering and Analysis of Electro-Optical and Infrared Systems, Taylor & Francis Inc, 2015, ISBN: 9781466579927.
4. Mark A. Mentzer, Applied Optics Fundamentals and Device Applications: Nano, MOEMS, and Biotechnology, 1 edition CRC Press, 2017.
5. Davis Christopher, C. Davis, Lasers and Electro-optics: Fundamentals and Engineering, 2nd Edition, Cambridge University Press, 1996.
6. Barbara G. Grant, Getting Started with UAV Imaging Systems: A Radiometric Guide, Volume: PM270, ISBN: 9781510601833, SPIE Digital Library, 2016.

AAE 5436 EMBEDDED SYSTEMS: SOFTWARE SAFETY AND SECURITY OF EMBEDDED SYSTEM [3 1 0 4]

Introduction of Embedded System, Embedded processor, Memory system, peripherals, Interfacing, Software Development based on ARM Processor etc, Development of autopilot, Effective software development for aerospace safety and critical application, software development and testing, requirement analysis, SDLC & Fundamentals of Software Testing /Embedded System, Introduction to Coding, Introduction to Process Standard DO-178C for Avionics, Lab Session 1 (Static Analysis, SW Quality & Secure Coding Standards Compliance), Lab Session 2 (Structural Code Coverage), Lab Session 3 (Unit Testing, Target based Testing). CERT C, CERT C++. MISRA.

References:

1. E. A. Lee and S. A. Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach, Second Edition, MIT Press, 2017.
2. Kai Qian, David den Haring and Li Cao, Embedded Software Development with C, Springer Science and Business Media, LLC, 2009.
3. Michael Barr, Anthony Massa, Programming Embedded Systems, Second Edition with C and GNU Development Tools, 2nd Edition, O'Reilly Media, 2009.
4. Renu Rajani, Pradeep Oak, Software Testing Effective Methods Tools & Techniques, Tata Mcgraw Hill Publishing Co Ltd, 2017.
5. MISRA C:2012 Standard
6. SEI CERT C Secure Coding Standard URL: https://www.cert.org/secure-coding/products-services/secure-coding-download.cfm

AAE 5437 HUMANOID ROBOTS [3 1 0 4]

History of Humanoid, Humanoid Mechanism and Design (HMD), Humanoid Kinematics and Dynamics (HKD), Humanoid Control (HC), Humanoid Balance (HB), Humanoid Motion Planning, Optimization and Gait Generation, Humanoid Simulation and software (HSS), Human-Humanoid Interaction (HHI), Applications of Humanoids (HApp), Development Story of 15 Famous Humanoid Robots (H15), Humanoid Sensing, Actuation and Intelligence, Cognitive Intelligence and Robots, Robotic frameworks and middleware, Robotic architectures: AuRA, BERRA, DCA, Saphira, GenoM.

References:

1. Ambarish Goswami, Prahlad Vadakkepat, Jong-Hwan Kim, Humanoid Robotics: A Reference, Springer-Verlag/Sci-Tech/Trade, 2018. ISBN - 10:9400760450, ISBN - 13:9789400760455.
2. Ben Choi, Humanoid Robots, IntechOpen, 2009, ISBN: 978-953-7619-44-2.
3. Dragomir Nenchev Atsushi Konno Teppei Tsujita, Humanoid Robots: Modeling and Control, 1st Edition, Butterworth-Heinemann, 2018, eBook ISBN: 9780128045824, Paperback ISBN: 9780128045602.
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5. Konar, Amit, Pedrycz, Witold, Cognitive Intelligence and Robotics, Springer, ISSN: 2520-1956.
6. Brad Miller, Ken Streeter, Beth Finn, Jerry Morrison, C/C++ Programming Guide for the FIRST Robotics Competition, Rev 0.5, FIRST, 2008.

AAE 5438 KALMAN FILTER AND APPLICATION [3 1 0 4]

Linear dynamics systems, their solutions, controllability and observability, Stochastic differential equations, shaping filter, state augmentation, covariance propagation equation, orthogonality principle, linear optimal filters and predictors, Kalman Filter, Kalman-Bucy filter, optimal linear predictors, noise sources and correlation, Riccati equation, relationship, nonlinear applications estimation problems, linearization method, Method of Least Squares, Recursive Least-Squares Filtering, Polynomial Kalman Filters, Continuous Polynomial Kalman Filter, Extended Kalman Filtering, Assorted Techniques for Improving Kalman-Filter Performance, Chain-Rule and Least-Squares Filtering, State-Dependent Riccati Equation Filter, Unscented Kalman Filter, Application of Kalman filter.

References:

1. Grewal, Mohinder, S. Andrews, Angus P., Kalman Filtering Theory and Practice Using MATLAB, 4th Edition, John Wiley & Sons, Inc, 2014.
2. Zarchan, Paul, Musoff, Howard, Frank K. Lu, Fundamentals of Kalman Filtering: A Practical Approach, 4th Edition, Astronautics and Aeronautics, AIAA, 2013.
3. Grewal, Mohinder, S., Andrews, Angus P. Bartone, Chris G. Global Navigation Satellite Systems, Inertial Navigation, and Integration, 3rd Edition, John Wiley & Sons, Inc, 2013.
4. Haykin, Simon, S., Kalman Filtering and Neural Networks, John Wiley & Sons, Inc, 2001.
5. S. F. Schmidt, The Kalman filter: Its recognition and development for aerospace applications, AIAA J. Guid. Contr., vol. 4, pp. 4–7, 1981.
6. Bar-Shalom, Yaakov, Li, Xiao-Rong, Estimation and Tracking: Principles, Techniques, and Software, YBS Publishing (1993 by Artec House, Inc.), 1998.

AAE 5439 MEMS & MMIC IN AEROSPACE APPLICATION [3 1 0 4]

MEMS Theory, Design and Fabrication: Overview of Microelectromechanical Systems and Microstructures in Aerospace Applications, mechanical properties of MEMS materials, modeling and simulation of MEMS, MMIC Theory, Design, Simulation and Fabrication: Introduction, advantages and disadvantages, application, device technology, Device and fabrication Technology: substrate, transistor, passive components, CAD Techniques, MEMS & MMIC Applications: overview of current, emerging, and possible future MEMS/MMIC applications in aerospace. Microelectromechanical Systems for aerospace and Spacecraft Communications and many others applications

References:

1. Mohamed Gad-el-Hak, The MEMS Handbook - 3 Volume Set, Mechanical and Aerospace Engineering Series, 2nd Edition, CRC Press, 2005.
2. Steve Marsh, Practical MMIC Design, Artech House Publishers, 2006.
3. Robert Osiander, M. Ann Garrison Darrin, John L. Champion, MEMS and Microstructures in Aerospace Applications, CRC Press Taylor & Francis Group, 2006.
4. I.D. Robertson, S. Lucyszyn, RFIC and MMIC Design and Technology, Materials, Circuits and Devices Series, 2nd Edition, The Institution of Engineering and Technology, 2001.
5. Mohamed Gad-el-HakThe, MEMS Handbook: MEMS Design and Fabrication, Second Edition, Taylor & Francis Group, LLC, 2014.
6. Reza GhodssiPinyen Lin, MEMS Materials and Processes Handbook, MEMS Reference Shelf book series, Springer Nature, 2018.

AAE 5440 PRACTICAL CRYPTOGRAPHY IN C/C++ (ENCRYPTION AND DECRYPTION ALGORITHMS) [3 1 0 4]

Basics of Security and Cryptography, what is encryption and Decryption, Types of algorithms, Encryption vulnerabilities, Classical Cryptographic Algorithms, Rotor Machine, Block Cipher, Data Encryption Standard, Advanced Encryption Standard, Asymmetric Key Algorithms, The RSA Algorithm, Elliptic Curve Cryptography, Message Digest Algorithm, Secure Hash Algorithm, Fundamentals of Identity-Based Cryptography, Symmetric Key Encryption Acceleration on Heterogeneous Many-Core Architectures, Methods and Algorithms for Fast Hashing in Data Streaming, Arithmetic and Number Theory in C, Introduction, Number Formats, Modular Arithmetic, Where All Roads Meet, A Successor, Large Random Numbers, Strategies for Testing LINT, The LINT Public Interface: Members and Friends, An Application Example: The RSA Cryptosystem.

References:

1. Saiful Azad, Al-Sakib Khan Pathan, PracticalCryptography: Algorithms and Implementations Using C++, 1st Edition, Auerbach Publications, 2014.
2. Bruce Schneier, Applied Cryptography: Protocols, Algorithms, and Source Code in C, 2nd Ed., 1996.
3. A.J. Menezes, P. van Oorschot and S.A. Vanstone. The Handbook of Applied Cryptography. CRC Press, 1997.
4. Robert C. Seacord, Secure Coding in C and C++, Addison-Wesley Professional, 2005.
5. John Viega and Matt Messier, Secure Programming Cookbook for C and C++, O'Reilly, 2003.
6. George Loukas, Cyber-Physical Attacks: A Growing Invisible Threat, Butterworth-Heinemann, 2015.
7. Welschenbach, Michael, Cryptography in C and C++, Apress, 2005.

AAE 5441 PROGRAMMING LANGUAGES FOR IMAGE PROCESSING AND COMPUTER VISION ALGORITHM [3 1 0 4]

Introduction to Digital Image Processing and Analysis, Digital Image Analysis and Computer Vision, Digital Image Processing And Human Vision: Image Algebra, Image Enhancement Techniques, Edge Detection and Boundary Finding Techniques, Thresholding Techniques,
Thinning And Skeletonizing, Connected Component Algorithms, Fundamental Tools for Image Processing and Analysis: Application Development with the MATLAB CVIP Toolbox and CVIPTOOLS- MATLAB CVIP Toolbox and CVIPlab, C/C++, Introduction to OpenCV and OpenCV3's Python API. Develop a computer vision application using above software for making an object disappear from an image, identifying different shapes, reconstructing a 3D map from images, and building an augmented reality, hand gesture recognition, tracking visually salient objects, as well as recognizing traffic signs and emotions on faces, Medical Imaging Systems, [80% should be algorithm discussion than theory.]

References:

1. Scott E Umbaugh, Digital Image Processing and Analysis: Applications with MATLAB and CVIPtools, 3rd Edition, CRC Press, 2017.
2. Artyom M. Grigoryan, Merughan M. Grigoryan, Image Processing: Tensor Transform and Discrete Tomography with MATLAB, 1st Edition, CRC Press, 2018.
3. Joseph Howse, Prateek Joshi, Michael Beyeler, OpenCV: Computer Vision Projects with Python, Packt Publishing Limited, 2016.
4. Omer Demirkaya, Musa H. Asyali, Prasanna K. Sahoo, Image Processing with MATLAB: Applications in Medicine and Biology, 1st Edition, CRC Press, 2008.
5. Joseph N. Wilson, Gerhard X. Ritter, Handbook of Computer Vision Algorithms in Image Algebra, 2nd edition, CRC Press, 2000.
6. Abhinav Dadhich, Practical Computer Vision: Extract insightful information from images using TensorFlow, Keras, and OpenCV, Packt Publishing Limited, 2018.

AAE 5442 RADAR [3 1 0 4]

An Introduction and Overview of Radar, Airborne Radar, Fundamentals of Radar, MTI Radar, Airborne MTI, Pulse Doppler Radar, Sea Clutter, Ground Echo, Multifunctional Radar Systems for Fighter Aircraft, Radar Receivers, Automatic Detection, Tracking, and Sensor Integration, Pulse Compression Radar, Tracking Radar, The Radar Transmitter, Solid-State Transmitters, Reflector Antennas, Phased Array Radar Antennas, Radar Cross Section, Synthetic Aperture Radar, Air-to- Air operation, Imaging Radar, Space-Based Remote Sensing Radars, Meteorological Radar, HF Over-the-Horizon Radar, Ground Penetrating Radar, Civil Marine Radar, Bistatic Radar, Radar and Electronic Warfare: Electronic Counter-Countermeasures, Radar Digital Signal Processing, The Propagation Factor, F p, in the Radar Equation, Representing Radar systems, Aviation weather surveillance systems, advanced radar and surface sensors for flight safety and air traffic management.

References:

1. Merrill I. Skolnik, Radar Handbook, 3rd Edition, McGraw-Hill, New York, New York, USA, 2008.
2. Stimson, George W.; Griffiths, Hugh D.; Baker, Chris J.; Adamy, Dave, Introduction to Airborne Radar, 3rd Edition, Aerospace & Radar Technology, Institution of Engineering and Technology, Institution of Engineering and Technology, 2014.
3. Martin Schetzen, Airborne Doppler Radar, The American Institute of Aeronautics and Astronautics, Inc, 2006.
4. George W. Stimson, Introduction to Airborne Radar, Aerospace & Radar Systems, 2nd Edition, SciTech Publishing, 1998.
5. William L. Melvin, James A. Scheer, Principles of Modern Radar: Advanced techniques, Electromagnetics and Radar, SciTech Publishing, 2012.
6. Busyairah Syd Ali, Aircraft Surveillance Systems Radar Limitations and the Advent of the Automatic Dependent Surveillance Broadcast, Taylor and Francis Books Limited U.K., 2018.

AAE 5443 RADAR ENERGY WARFARE AND THE CHALLENGES OF STEALTH TECHNOLOGY [3 1 0 4]

Introduction of radar energy warfare and stealth technology, fundamentals of radar, electronic counter and electronic counter-counter measures, radar absorbing materials, radar cross section, science of stealth technology. Introduction to Luneberg lens reflectors, understand state-of-the-art radar energy warfare and stealth technology research and applications.

Reference

1. Bahman Zohuri, Radar Energy Warfare and the Challenges of Stealth Technology, Springer Cham, First Edition, ISBN 978-3-030-40618-9, 2020.
2. Mark A. Richards, Fundamentals of Radar Signal Processing", The McGraw-Hill Companies, Inc. 2005.
3. J. A. Boyd et al., Electronic Countermeasures, Peninsula Publishing, Los Altos, Calif., 1978.
4. Hema Singh and Rakesh Mohan Jha, "Active Radar Cross Section Reduction, Theory and Applications", Cambridge University Press, published in 2015.
5. Allen E. Fuhs, and David C. Jenn, "Fundamentals of Stealth with Counter Stealth Radar Fundamentals: Applied to Radar, Laser, Infrared, Visible, Ultraviolet, & Acoustics," Naval Air Warfare Center Weapons Division China Lake, CA, Lecture Notes, 1999.

AAE 5444 RF SYSTEM DESIGN FOR RADAR AND WIRELESS COMMUNICATIONS [3 1 0 4]

RF system design in radar and wireless communications' components-antennas, filters, amplifiers, modulators, and demodulators, mitigation of noise and intermodulation distortion effects, RF system design workflows for radar, long-term evolution (LTE), 5G, and wireless local area network (WLAN) applications, RF systems and RFIC design, RF System Design of Transceivers.

1. David Tse, Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press 2005, ISBN-10 0-521-84527-0.
2. Qizheng Gu, RF System Design of Transceivers for Wireless Communications, Springer-Verlag New York Inc.; 1st ed. 2005. Corr. 2nd printing 2006 edition, 2006.
3. Pekka Eskelinen, Introduction to RF Equipment and System Design, Artech House Publishers, ISBN-13:978-1580536653, 2003.
4. Nickolas Kingsley, Joseph R. Guerci, Radar RF Circuit Design, Second Edition, ISBN: 9781630818982, 2022.

AAE 5445 SATELLITE COMMUNICATION SYSTEM [3 1 0 4]

Introduction, satellite communication, overview. Orbital mechanics and launchers. Satellites: satellite subsystems, AOCS, TTC&M, power system, antennas, communication subsystem, equipment reliability and space qualification. Satellite Link Design: Transmission theory, system noise temperature, Uplink and Downlink design, Design for specified C/N, System design examples, Modulation and Multiplexing technique for satellite link: Frequency modulation, Analog FM transmission, Digital transmission, Digital modulation and demodulation, Multiple access, VSAT Systems, LEO, MEO and Non-Geostationary/ Geostationary satellites-design, GAGAN/IRNSS, Application of satellite

References:

1. Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communication, 2nd Edition, John Wiley and Sons, 2003.
2. Louis J. Ippolito Jr., Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance, 2nd Edition, Wiley, 2017.
3. Dennis Roddy, Satellite Communications, 4th Edition, McGraw-Hill International, 2006.
4. Ilcev, Stojce Dimov, Global Mobile Satellite Communications Applications: For Maritime, Land and Aeronautical Applications, Volume 2, Springer International Publishing, 2018.
5. Andrew Barron, Amsats and Hamsats: Amateur Radio and other Small Satellites, Amazon Digital Services LLC, 2018.
6. Gerard Maral, Michel Bousquet, Zhili Sun, Satellite Communications Systems: Systems, Techniques and Technology, 5th Edition, Wiley, 2010.

AAE 5446 SMART SENSORS DEVELOPMENT AND APPLICATION [3 1 0 4]

Introduction, Sensing and Sensor Fundamentals, Sensor Characteristics, Physical Principles of Sensing, Data Acquisition, Key Sensor Technology Components: Hardware and Software Overview, Optical Components of Sensors, Sensor Materials and Technologies, Interface Electronic Circuits, Occupancy and Motion Detectors, Position, Displacement, and Level, Velocity and Acceleration, Force, Strain, and Tactile Sensors, Sensor Deployments: Smart Sensor Systems for Aerospace Applications: , Full-Field Range Imaging System for Mobile Robotic Applications, Nano-Biosensor Development for Biomedical and Environmental Measurements, Sensor Deployments for Home and Community Settings, Body-Worn, Ambient, and Consumer Sensing for Health Applications, Wellness, Fitness, and Lifestyle Sensing Applications, Environmental Monitoring for Health and Wellness, Summary and Future Trends.

References:

1. Jacob Fraden, Handbook of Modern Sensors Physics, Designs, and Applications, Fourth Edition, Springer New York, 2010.
2. Michael J. McGrathCliodhna Ní Scanaill, Sensor Technologies:Healthcare, Wellness, and Environmental Applications, Open Access, Springer Link, Apress, Berkeley, CA, 2013.
3. Subhas Chandra Mukhopadhyay, Aimé Lay-Ekuakille, and Anton Fuchs (Eds.), New Developments and Applications in Sensing Technology, Springer-Verlag Berlin Heidelberg, 2011.
4. Sergey Y. YurishMaria Teresa S. R. Gomes, Smart Sensors and MEMS, NATO Science Series book series (NAII, volume 181), Springer, Dordrecht, 2004.
5. Martin Liggins II, David Hall, James Llinas, Handbook of Multisensor Data Fusion: Theory and Practice, Second Edition, CRC Press, 2008.
6. David C. Swanson, Signal Processing for Intelligent Sensor Systems with MATLAB, 2nd Edition, CRC Press, 2011.

AAE 5447 SYSTEM MODELING AND SIMULATION [3 1 0 4]

What are systems, Requirements writing for a System, Modelling of Flight Dynamics, Mathematical Concepts in Modeling, Frames and Coordinate, Kinematics of Translation and Rotation, simple ballistic trajectories to controlled and guided flight. Simulation of Aerospace Vehicles, Degrees-of-Freedom Simulation, Real-Time Applications, Familiarization with the CADAC FORTRAN and C++ simulations, Aerospace Simulations in C++, Aerospace Simulations in FORTRAN, Foundation of Tensor Flight Dynamics, CADAC++ Architecture, What is SysML, how and why to deploy MBSE, systems and model-based systems engineering, Systems Modeling Language, practical examples of MBSE methodologies to understand their application to specifying and designing a system, Architecting Spacecraft with SysML.

References:

1. Peter H. Zipfel, Modeling and Simulation of Aerospace Vehicle Dynamics, AIAA Education Series, 3rd Revised edition, American Institute of Aeronautics & Astronautics, 2014.
2. Dr. Peter H Zipfel, Fundamentals of Six Degrees of Freedom Aerospace Simulation and Analysis in FORTRAN and C++, Library of Flight, Cdr edition, American Institute of Aeronautics & Astronautics, 2004.
3. Brian L. Stevens, Frank L. Lewis, Eric N. Johnson, Aircraft Control and Simulation: Dynamics, Controls Design, and Autonomous Systems, 3rd edition, John Wiley & Sons, 2016.
4. Dr. Peter H Zipfel, Modeling INS/GPS/Star-Tracker in 6 DoF: Simulating N&G&C of a Three-Stage Rocket Booster in CADAC++, 1 edition, CreateSpace Independent Publishing Platform, 2015.
5. Giuseppe Petrone, Giuliano Cammarata, Modelling and Simulation, IntechOpen, 2008.
6. George Koelsch, Requirements Writing for System Engineering, 1st Edition, APress, 2016.

AAE 5448 VIRTUAL REALITY (VR) AND 3D IMAGING FOR MILITARY SIMULATION [3 1 0 4]

Introduction and Background, Virtual Reality, History, An Overview of Various Realities, Immerson, Presence, and Reality Trade-Offs, The Basics: Design Guidelines, Objective and Subjective Reality, Perceptual Models and Processes, Perceptual Modalities, Perception of Space and Time, Perceptual Stability, Attention, and Action, Perception, Adverse Health Effects: Transitioning to VR Content Creation, Content Creation: Design Guidelines, Interaction, Human- Centered Interaction, VR Interaction Concepts, Input Devices, Interaction Patterns and Techniques, Interaction: Design Guidelines, Iterative Design, Philosophy of Iterative Design, Iterative Design: Design Guidelines, The Future Starts Now, The Present and Future State of VR, Military application: Introduction, The Real and The Virtual, The Military Applications, Human Computer Interaction, Human Performance Metrics, The Capability of Virtual Reality to Meet Military Requirements, virtual Reality and Technologies for Combat Simulation, Virtual reality and its military utility, Military Simulation Systems.

References:

1. Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, Association for Computing Machinery and Morgan & Claypool New York, NY, USA, 2016.
2. Steven M. LaValle, Virtual Reality, Cambridge University Press, 2007.
3. Celine Tricart, Virtual Reality Filmmaking: Techniques & Best Practices for VR Filmmakers, 1st Edition, Routledge, 2017.
4. Steve Aukstakalnis, Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability), 1st Edition, Addison-Wesley Professional, 2016.
5. Roger Dean Smith, Military Simulation & Serious Games: Where We Came from and Where We Are Going, Modelbenders LLC, 2009.
6. Neyland D, Virtual Combat: A Guide to Distributed Interactive Simulation, Satckpole Books, 1997.

OPEN ELECTIVES

AAE 5306 ANTENNA DESIGNING, SIMULATION AND PLACEMENT FOR AEROSPACE [3 0 0 3]

Fundamentals of Antenna, Basic Antenna and Propagation Theory: Introduction, Characteristics of Electromagnetic Waves, Interaction between Two Wave Polarizations, Vertical & Horizontal Polarization. Characteristics of an Antenna. Propagation. Antennas and Applications: Structural details, dimensions, radiation pattern, specifications, features and applications of antennas. Antennas Placement/Used on Aircraft: Introduction, Near and Far Fields of an Antenna, Antennas on Aerospace/UAV structures, Polar Radiation Patterns., Basics of Computer simulation tools, Antenna Designing simulation using CST, Simulation of 1D/2D/Far-field results, analysis of radiation pattern, analysis of input impedance in terms of real and complex results, analysis of gain and antenna efficiency. Aircraft antenna design and analysis using software.

References

1. C.A. Balanis, Antenna Theory - Analysis and Design, 4th Edition, John Wiley, 2016.
2. Mathew N O Sadiku, Elements of Electromagnetics, 3rd edition, Oxford University Press, 2001.
3. Thereza Macnamara, Introduction to Antenna Placement and Installation, 1st Edition, Wiley, 2010.
4. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rd Edition, The McGraw Hill Companies, 2008.
5. J. E. Rhodes, Antenna Handbook, Department of The Navy, 2016.
6. Lo, Y.T., Lee, S. W., Antenna Handbook Theory, Applications, and Design, Springer US, 1988.

AAE 5307 EMBEDDED SYSTEMS: SOFTWARE SAFETY AND SECURITY OF EMBEDDED SYSTEM [3 0 0 3]

Introduction of Embedded System, Embedded processor, Memory system, peripherals, Interfacing, Software Development based on ARM Processor etc: Keil Embedded development tools/ µVision, ARM, M-Cortex, Effective software development for aerospace safety and critical application, software development and testing, requirement analysis, SDLC & Fundamentals of Software Testing /Embedded System, Introduction to Coding Standards i.e. CERT C and MISRA C:2012, Top 10 Secure Coding Best Practices, Introduction to Functional Safety ISO 26262:2011 for Automotive, Introduction to Process Standard DO-178C for Avionics, Lab Session 1 (Static Analysis, SW Quality & Secure Coding Standards Compliance), Lab Session 2 (Structural Code Coverage), Lab Session 3 (Unit Testing, Target based Testing).

References:

1. E. A. Lee and S. A. Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach, Second Edition, MIT Press, 2017.
2. Kai Qian, David den Haring and Li Cao, Embedded Software Development with C, Springer Science and Business Media, LLC, 2009.
3. Michael Barr, Anthony Massa, Programming Embedded Systems, Second Edition with C and GNU Development Tools 2nd Edition, O'Reilly Media, 2009.
4. Renu Rajani, Pradeep Oak, Software Testing Effective Methods Tools & Techniques, Tata Mcgraw Hill Publishing Co Ltd, 2017.
5. MISRA C:2012 Standard
6. SEI CERT C Secure Coding Standard URL: https://www.cert.org/secure-coding/products-services/secure-coding-download.cfm

AAE 5308 UNMANNED AIRCRAFT SYSTEM [UAS] [3 0 0 3]

Introduction to Unmanned Aircraft Systems (UAS) and Applications of UAS, Introduction to Design and Selection of the System, Aerodynamics and Airframe Configurations, Characteristics of Aircraft Types, Design Standards and Regulatory Aspects, Payload Types Control and Stability, Sensors and Autonomy, Navigation, Launch and Recovery, Control Stations- Control Station Composition, System Architecture, Support Equipment, Transportation, EMC/EMI of UAS. Introduction to System Development and Certification, UAV System Deployment, Defence Application-Navy Role, Army Role, Air force Role, Civilian, Paramilitary and Commercial Roles, Prospects and Challenges and Evolution. Economic and Business, Education and Research, Miscellaneous Missions, Special Topics

References:

6. Reg Austin, Unmanned Aircraft Systems UAVs Design, Development and Deployment, First Edition, A John Wiley and Sons, Ltd., 2010.
7. Jay Gundlach, Designing Unmanned Aircraft Systems: A Comprehensive Approach, Second Edition, AIAA Education Series, 2014.
8. Jay Gundlach, Civil and Commercial Unmanned Aircraft Systems, AIAA Education Series, 2016.
9. Dr David C. Ison, Small Unmanned Aircraft Systems Guide: Exploring Designs, Operations, Regulations, and Economics, Aviation Supplies & Academics Inc, 2017.
10. Douglas M. Marshall et al., Introduction to Unmanned Aircraft Systems, Second edition Taylor & Francis, 2016.
11. F.B. da Silva S.D. Scott M.L. Cummings, Design Methodology for Unmanned Aerial Vehicle (UAV) Team Coordination, MIT Department of Aeronautics and Astronautics, Cambridge, MA 0213, 2007.