**Self-Assessment Form**

**Instructions for Applicants**

**General:**

1. You must use your WES course-by-course (CxC) assessment to complete this form.
   1. When completing the self-assessment form, use the Bachelor’s degree courses.
   2. Only use your Master’s or Ph.D. in engineering **if they are necessary**. If you use too many graduate courses, the degree will **not be** eligible to use for waiving confirmatory exams.
2. Only complete column C2. Do not enter any information in column C3 or C4. If you do, it will be deleted.
   1. Enter the year, course name, credits and grade from the WES assessment Course-by-Course Analysis.
   2. Both the Basic Studies and Discipline Specific Syllabus Tables contain compulsory subjects and elective subjects. Include courses that cover any part of the syllabus even if you have more than the minimum number in the elective sections.
   3. Colour code the content in column C1 by highlighting it the same colour as the corresponding course you entered in column C2.

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| --- | --- | --- | --- | --- |
| **C1**  **APEGS Syllabus** | **C2**  **Self-Assessment (by applicant)** | | **C3**  **for Staff only** | **C4**  **for ARC only** |
| **COMPULSORY SUBJECTS**  **(all required)** | **WES assessment: year, course name, credits and grade.** | **Program Syllabus: page number, course name** | **Preliminary Review** | **Final Review** |
| **20-BS-A1 Mathematics:** Vector and Linear Algebra: Applications involving matrix algebra, determinants, eigenvalues and eigenvectors, vector functions and operations, orthogonal curvilinear coordinates. Calculus: first and second order linear ordinary differential equations, series solutions of ordinary differential equations, applications of partial derivatives, Lagrange multipliers, multiple integrals, line and surface integrals, integral theorems (Gauss, Green, Stokes). Power series. | 2004-2005: Applied Mathematics I, 2 credits. Grade: B  2004-2005: Applied Mathematics II, 2 credits. Grade: B  2005-2006: Applied Mathematics III,2 credits. Grade: B |  |  |  |

1. Once you have completed column C2, submit the **Word document** to [documents-academicreview@apegs.ca](mailto:documents-academicreview@apegs.ca).

**Program Syllabus (only required if requested by APEGS):**

1. Provide the program syllabus in a PDF document through the Contact Us page on the APEGS website.
2. If the course names in the program syllabus are different than those in your WES assessment you must provide an explanation of how they correlate in the program syllabus column of the form.
3. Use the page number of the PDF document of the program syllabus (not the original page number).

***By submitting this self-assessment, I declare that I have read and followed the instructions and that this self-assessment is accurate and complete, to the best of my knowledge and ability, and that I have provided all the relevant information that I have available to me. I understand that if information is incorrect or missing, that it may delay my application and may result in the assignment of academic deficiencies.***

**Self-Assessment Form – Aerospace/Aeronautical Engineering**

Use the information provided on the WES assessment to complete this information

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| --- | --- | --- | --- | --- |
| **Applicant Information:** | **Last Name, First Name** | | | |
|  | | | |
| **APEGS File #** |  | | | |
| **Institution Information** | | | | |
| **Credential** | **Awarded By** | **Major/Specialization** | **Year** | **Country** |
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**SELF-ASSESSMENT – FOR APPLICANT TO COMPLETE**

**BASIC STUDIES SYLLABUS TABLE**

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| **C1**  **APEGS Syllabus** | **C2**  **Self-Assessment (by applicant)** | | **C3**  **for Staff only** | **C4**  **for ARC only** |
| **COMPULSORY SUBJECTS**  **(all required)** | **WES assessment: year, course name, credits and grade.** | **Program Syllabus: page number, course name** | **Preliminary Review** | **Final Review** |
| **20-BS-A1 Mathematics:** Vector and Linear Algebra: Applications involving matrix algebra, determinants, eigenvalues and eigenvectors, vector functions and operations, orthogonal curvilinear coordinates. Calculus: first and second order linear ordinary differential equations, series solutions of ordinary differential equations, applications of partial derivatives, Lagrange multipliers, multiple integrals, line and surface integrals, integral theorems (Gauss, Green, Stokes). Power series. |  |  |  |  |
| **20-BS-A2 Probability and Statistics:** Concepts of probability, events and populations, probability theorems, concept of a random variable, continuous and discrete random variables, probability distributions, distributions of functions of a random variable, sampling and statistical estimation theory, hypothesis testing, simple regression analysis. |  |  |  |  |
| **20-BS-A3 Computation Methods:** Use of computers for numerical solution of engineering problems, including techniques involving high-level languages and other computational tools (e.g., spreadsheets). Data representation, approximations and errors. |  |  |  |  |
| **20-BS-A4 Engineering Design Process:** Design process and methods. Project management & teamwork. Requirements and function analysis in design. Conceptual design and testing. Concept evaluation design factors such as: cost, quality, manufacturability, safety, etc. Systems modelling & design detail. |  |  |  |  |
| **20-BS-B1 Statics and Dynamics:** Force vectors in two- and three-dimensions, equilibrium of a particle in two- and three-dimensions; moments and couples; equilibrium of rigid bodies in two- and three-dimensions; centroids, centres of gravity; second moment of area, moment of inertia; truss, frame and cable static analysis; friction. Planar kinematics of particles and rigid bodies; planar kinetics of particles and rigid bodies; work and energy, impulse, and momentum of particles and rigid bodies. |  |  |  |  |
| **20-BS-B3 Mechanics of Materials:** Definitions of normal stress, shearing stress, normal strain, shearing strain; shear force and bending moment diagrams; members subjected to axial loading; members subjected to torsional loading; compound stresses, Mohr's circle; deformation of flexural and torsional members; failure theories; elastic and inelastic strength criteria; columns. |  |  |  |  |
| **20-BS-B4 Mechanics of Fluids:** Fluid characteristics, dimensions and units, flow properties, and fluid properties; the fundamentals of fluid statics, engineering applications of fluid statics; the one-dimensional equations of continuity, momentum, and energy; laminar and turbulent flow, flow separation, drag and lift on immersed objects; wall friction and minor losses in closed conduit flow; flow of incompressible and compressible fluids in pipes; dimensional analysis and similitude; flow measurement methods. |  |  |  |  |
| **20-BS-B7 Thermodynamics:** Basic concepts and definitions, energy concepts and the first law of thermodynamics, properties of pure substances, closed systems, open systems, the second law of thermodynamics, enthalpy, entropy, exergy, gas power cycles, vapor and combined power cycles, refrigeration cycles. |  |  |  |  |
| **20-BS-B8 Properties of Materials:** Properties of materials for mechanical, thermal and electrical applications. Atomic bonding, solid solutions, crystallisation. Equilibrium phase diagrams, applications to steel and aluminium alloys, heat treatments. Structure and special properties of polymers and ceramic materials. General characteristics of metallic composites, polymeric composites and concrete. Introduction to materials in hostile environments: corrosion, creep at high temperature, refractory materials, subnormal temperature brittle fracture. |  |  |  |  |
| **20-BS-B12 Engineering Graphics:** Engineering drawing: Orthographic sketching. Standard orthographic projection. Principal views, selection and positioning of views. Visualization. Conventions and practices. First and second auxiliary views. Basic descriptive geometry. Section views, types, hatching conventions. Basic dimensioning requirements. Tolerance for fits and geometry control. Detail drawings and assembly drawings, other drawings and documents used in an engineering organization. Bill of materials. Fasteners and welds. |  |  |  |  |
| **C1**  **APEGS Syllabus** | **C2**  **Self-Assessment (by applicant)** | | **C3**  **for Staff only** | **C4**  **for ARC only** |
| **ELECTIVE SUBJECTS**  **(none required, but include them if you have them)** | **WES assessment: year, course name, credits and grade.** | **Program Syllabus: page number, course name** | **Preliminary Review** | **Final Review** |
| **20-BS-B2 Electric Circuits and Power:** Current, voltage, Ohm’s law, Kirchoff’s voltage and current laws, power; DC circuits, network theorems, network analysis; simple transients, AC circuits. Impedance concept, resonance; application of phasors and complex algebra in steady-state response; application of Laplace transforms; simple magnetic circuits; basic concepts and performance characteristics of transformers; an introduction to diodes and transistors; rectification and filtering; simple logic circuits. |  |  |  |  |
| **20-BS-B5 Digital Logic Circuits:** Boolean algebra, truth tables and minimization techniques. Logic devices, combinational logic, encoders, decoders and shift registers. Design of asynchronous circuits and synchronous circuits, arithmetic circuits and finite state machines together with clock and timing considerations. Introduction to programmable logic and computer-aided design and simulation tools for digital system design. |  |  |  |  |
| **20-BS-B6 Basic Electromagnetics:** Introduction to the fundamental electromagnetic fields and forces used in engineering, including fundamental laws, principles, and equations developed by Gauss, Faraday, Ampere, Kirchoff, Maxwell, leading to electromagnetic design and applications in engineering, such as for capacitors, dielectrics, and magnetic devices. |  |  |  |  |
| **20-BS-B9 Organic Chemistry:** Principles of organic chemistry developed around the concepts of structure and functional groups. The main classes of organic compounds. Properties of pure substances. Introduction to molecular structure, bond types, properties, synthesis and reactions, reaction mechanisms, as a means of systematizing organic reactions. |  |  |  |  |
| **20-BS-B13 Advanced Mathematics:** Solutions of differential equations, boundary value problems and orthogonal functions, Fourier series, complex variable analysis. |  |  |  |  |

**DISCIPINE SPECIFIC SYLLABUS TABLE**

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| **C1**  **APEGS Syllabus** | **C2**  **Self-Assessment (by applicant)** | | | **C3**  **for Staff only** | **C4**  **for ARC only** |
| **COMPULSORY SUBJECTS**  **(SEVEN REQUIRED)** | **WES assessment: year, course name, credits and grade.** | | **Program Syllabus: page number, course name** | **Preliminary Review** | **Final Review** |
| **20-Aero-A1 Aerodynamics [Aero I]:**  Aerodynamic forces and moments, centre of pressure and aerodynamic centre, flow similarity, conservation laws, flow concepts, Bernoulli’s equation and its applications, Laplace’s equation and elementary flows, non-lifting and lifting flows over a circular cylinder, the Kuta-Joukowsky theorem, source panel method, airfoil nomenclature and characteristics, the Kutta condition, Kelvin’s circulation theorem, classical thin airfoil theory for symmetric and cambered airfoils, vortex panel method, estimating skin friction drag for airfoils, downwash and induced drag, vortex filament concept, the Biot-Savart law, Helmholtz’s theorems, Prandtl’s lifting line theory for elliptical and general planform wings. Use of numeric modelling as a design and predictive tool. | |  |  |  |  |
| **20-Aero-A2 Flight Mechanics and Performance [Aero II]:** Fundamental concepts of aircraft aerodynamics (lift and drag, geometric and inertial properties), propulsion (power and thrust). Equations of motion for steady and accelerated flight. Methods of estimating aircraft performance for take-off, climb, cruise, turning and descent. Range and endurance trade-offs in aircraft design. Mathematical models for aircraft performance analysis. Methods for calculating load factors, V-n diagrams and flight envelopes. Modeling and assessing longitudinal, lateral and directional motion and maneuverability. Use of numeric modelling as a design and predictive tool. | |  |  |  |  |
| **20-Aero-A3 Aircraft Structures and Design:** The analysis and design of aircraft structure includes design criteria, structural-component design concepts, aircraft loads and load paths, aircraft materials including metallic and composite materials, design to static strength - buckling and crippling, mechanical joints, durability and damage tolerance, practical aircraft stress analysis and design considerations, certification of structure - aging and repair. Use of numeric modelling as a design and predictive tool. | |  |  |  |  |
| **20-Aero-A4 Propulsion:** Thermodynamics and fluid dynamics: mass, momentum and energy conservation, compressible fluid flow, isentropic flow, heat transfer. Propellers: momentum theory of propellers, blade element theory, velocity triangles, performance parameters. Internal combustion engines: spark-ignition, compression-ignition, supercharging. Jet engines: Cycle analysis of turbojets, design of intakes, compressor design, centrifugal compressors; axial-flow turbines, combustors, turbines, afterburners, exhaust nozzles, cycle analysis of turbofans, cycle analysis of turboprop engines, ramjets, scramjets. Rocket engines: thrust and specific impulse, nozzle theory and configuration, flight vehicles, chemical rockets, liquid propellants fundamentals, engine systems, solid rockets and propellants, hybrid rockets, rocket motor design, electric propulsion, rocket plumes. Aircraft fuel systems. Use of numeric modelling as a design and predictive tool. | |  |  |  |  |
| **20-Aero-A5 Aerospace Materials:** Properties, behaviour and manufacturing methods for aerospace materials used in aerospace structures, space structures, and propulsion components, including metals, polymers, composites, and ceramics.  Materials integrity, selection, and monitoring in harsh environment, re-entry from space. | |  |  |  |  |
| **20-Aero-A6 Stability and Control:** Review of forces and moments associated with aircraft aerodynamics (lift and drag, geometric and inertial properties), propulsion (power and thrust) airspeed and flight attitude. Equilibrium states; Physical effects of the wing, fuselage, and tail on aircraft motion Stability derivatives; Longitudinal static stability including pitch stiffness, neutral point and elevator trim. Lateral static stability including yaw and roll coupling, rudder power and adverse yaw. Certification requirements for lateral static stability. Analysis of the short-term response to perturbations from dynamic equilibrium (stability) including linearized equations for small disturbance analysis. Dynamic characteristics for free and forced response, lateral and longitudinal dynamics. Natural frequencies and damping, longitudinal Phugoid motion, lateral and rolling instabilities. Aircraft configurations and their relationship to stability derivatives and characteristic longitudinal and lateral-directional motions. Medium-term response to control inputs (control), equilibrium states, longitudinal, lateral and directional trim. Handling (flying) qualities across flight conditions. Control methods and systems with emphasis on flight vehicle stabilization by classical and modern control techniques; control techniques for aircraft stabilization including both autonomous and pilot-in-the-loop considerations. Sensors, actuators, stability augmentation and dynamic control systems. V/STOL stability, dynamics, and control during transition from hover to forward flight; parameter sensitivity; and handling quality analysis of aircraft through variable flight conditions. Use of numeric modelling as a design and predictive tool. | |  |  |  |  |
| **20-Aero-A7 Fluid Mechanics:** Fluid mechanics in the context of aerospace performance and control. Kinematics: Fluid motion, acceleration, Euler’s equations, irrotational and potential flows, plane potential flows. Bernoulli equation. Control volume approach and mass conservation, continuity equation. Momentum conservation and applications, Navier-Stokes equations. Energy conservation: energy, work and power; hydraulic and energy grade lines. Dimensional analysis and similitude: Buckingham π theorem, dimensional analysis, modeling. Viscous flows: boundary layer description, laminar and turbulent boundary layers, pressure gradient effects on boundary layers. Flow in conduits; laminar and turbulent flow in pipes; Moody diagram, losses in pipes. Use of numeric modelling as a design and predictive tool. Differential analysis of fluid flows, vorticity, stream function, stresses, and strains. Flow over immersed bodies, boundary layers, separation, and thickness. Drag, lift and applications. Introduction to compressible flows, speed of sound, Mach cone, and some characteristics of supersonic flows. | |  |  |  |  |
| **20-Aero-A8 Thermodynamics:** Thermodynamics in the context of aerospace systems. Thermodynamic systems, states, properties; specific volume, pressure and temperature, processes, and equilibrium. First law of thermodynamics; energy of a system; energy transfer by heat, energy balance for closed systems, energy analysis of cycles. Second law of thermodynamics; irreversible and reversible processes; application to thermodynamic cycles; Kelvin temperature scale; maximum performance measures for cycles operating between two reservoirs; Carnot cycle. Entropy: Clausius inequality, definition of entropy change, entropy balance for closed systems, isentropic processes; heat transfer and work in internally reversible, steady-state flow processes. Gas Power Systems: internal combustion engines; air-standard Otto cycle; air-standard Diesel cycle; gas turbine power plants; air-standard Brayton cycle.  Mixtures of gases, gases and vapours, air conditioning processes. Combustion and combustion equilibrium. Applications of thermo­dynamics to power production and utilization systems: study of basic and advanced cycles for gas compression, internal combustion engines, power from steam, gas turbine cycles, and refrigeration. Real gases.  Thermodynamics of upper atmosphere and re-entry vehicles; radiation in spacecraft thermal control; radiation of black, gray, and real bodies; emissivity and absorbency; geometric coefficients; emissive power and radiosity; radiation in a closed space; Stefan Boltzmann law, Planck distribution law and Wien displacement law for blackbody surface thermal radiation. Use of numeric modelling as a design and predictive tool. | |  |  |  |  |
| **C1**  **APEGS Syllabus** | **C2**  **Self-Assessment (by applicant)** | | | **C3**  **for Staff only** | **C4**  **for ARC only** |
| **ELECTIVE SUBJECTS**  **(minimum of three required)** | **WES assessment: year, course name, credits and grade.** | | **Program Syllabus: page number, course name** | **Preliminary Review** | **Final Review** |
| **20-Aero-B1 Aeroelasticity:**Collar’s triangle, notion of stability, free and forced vibration of the one-degree-of-freedom system, divergence and control reversal of rigid wings on elastic supports, steady-flow strip theory, divergence and control reversal of uniform elastic wings, roll effectiveness, airload distribution for uniform elastic wings, typical section model, steady, quasi-steady, and Theodorsen’s unsteady aerodynamic theories for a pitching-plunging typical section model, flutter analysis methods (p method, classical flutter analysis, k method, p-k method), flutter boundary characteristics. Use of numeric modelling as a design and predictive tool. | |  |  |  |  |
| **20-Aero-B2 Certification, Standards and Regulations:** Overview of Transport Canada and other international aviation regulations and standards (e.g. FAA, EASA). Aircraft systems design including requirements associated with Aircraft Type Design (Canada), Type Certification (FAA), regulations, criteria and demonstration of compliance. Risk-based regulatory development and hazard assessment approaches. Certification and test of safety-critical software. Aircraft categories and associated regulations. Ongoing airworthiness regulations including maintenance and repair. Delegation of authority; Approval of design, manufacturing, operation and maintenance organizations including delegation of authority. Licencing and training of individuals including flight crew and maintenance personnel. Operational safety and regulations concerning Air Traffic Control and the National Air Space (NAS). Environmental considerations, remotely piloted systems and the development process for new regulations. | |  |  |  |  |
| **20-Aero-B3 Numerical Methods:** Roots of algebraic and transcendental equations; function approximation; numerical differentiation; numerical integration; solution of systems of linear equations, curve fitting, polynomial interpolation and splines. Computational techniques and state-of-the-art algorithms for solving ordinary/partial differential equations, nonlinear systems, and unconstrained/constrained optimization problems; error analysis and efficient implementation of these algorithms for aerospace applications such as aerostructures, aerodynamics, dynamics and control, and aerospace systems. | |  |  |  |  |
| **20-Aero-B4 Advanced Aerodynamics:** Compressible Fluid Flow: Wave propagation in compressible media, isentropic flow of a perfect gas, flow in convergent-divergent ducts, de Laval nozzles, diffusers. Shockwaves: normal shockwaves, oblique shockwaves, reflected shockwaves, expansion waves, supersonic inlets, Prandtl-Meyer flow. Linearized flow: transonic flow, compressibility correction, critical Mach number. Aerodynamics: area rule, supercritical airfoils, lifting surfaces, slender bodies. Hypersonic flow: chemically reaction flow, thin shock layers, Newtonian laws. Use of numeric modelling as a design and predictive tool. | |  |  |  |  |
| **20-Aero-B5 Human/Machine Interface Design:** Introduction to human/machine design engineering in an aerospace context. Human sensory perceptions and information processing models. Psychology of information processing and perception. Implementation of aircraft control: control surfaces and their operations, development of thrust and its control; basic and advanced concepts avionics and aircraft systems, including avionics systems framework and design; autopilot systems, their algorithms, dynamics and interaction problems; flight instruments, principles of operation and dynamics; crew-plane interface, displays and human-machine interaction; cockpit layouts—basic configuration, ergonomic design, control field forces; HUD; flight management systems, and communication equipment; introduction to flight simulation: overview of visual, audio and motion simulator systems; advanced concepts in flight simulators; Matlab/Simulink; characteristics and performance of linear feedback control systems; adaptive control systems. Software integration with crew and transparency of automated control systems. | |  |  |  |  |
| **20-Aero-B6 Instrumentation and Measurement:** Design knowledge of the multiple signal processing chains required in aerospace applications, from transducer, transmission, processing and conditioning and use in avionics systems and displays. Characterisation of each stage in the process in terms of performance, error production and necessary signal conditioning, e.g. measurement of physical quantities; static and dynamic characteristics of instruments — calibration, linearity, precision, accuracy, and bias and sensitivity drift; sources of errors; experiment planning; data analysis techniques; signal generation, acquisition and processing; principles and designs of systems for measurement of position, velocity, acceleration, pressure, force, stress, temperature, flow-rate, proximity detection.  Discrete-time processing of continuous-time signals. Linear Time Invariant (LTI) systems. Unit impulse response and convolution. The Fourier transform representation of signals and systems.  Basic structures for Finite-Impulse-Response and Infinite-Impulse-Response filters. Computer-based MATLAB simulation. | |  |  |  |  |
| **20-Aero-B7 Orbital Mechanics/Attitude Dynamics:** Keplerian two-body problem: Kepler's laws, orbital elements, orbit determination. Orbital perturbations: oblateness of the Earth, atmospheric drag. Orbital maneuvers and interplanetary flights, Spacecraft Formation Flying. Applications of Newtonian and Lagrange methods in orbital motion and attitude motion; orbital elements, orbital perturbations, interplanetary trajectory design procedure, orbital maneuvers; coordination transformation; design of spacecraft attitude dynamics (spacecraft dynamics and attitude stability) and controllers. Use of numeric modelling as a design and predictive tool. | |  |  |  |  |
| **20-Aero-B8 Spacecraft/Space System Design:** Space mission analysis; implications for systems and missions; exploration missions; space environment and its effect on spacecraft design; spacecraft structures and mechanisms; spacecraft propulsion and launch; Spacecraft payloads (remote sensing, imaging systems, astronomy instrumentation etc.); spacecraft thermal control; spacecraft electrical power systems; communications. | |  |  |  |  |
| **20-Aero-B9 Space Environment:** Upper atmosphere and Ionosphere, Atmospheric oxygen and UV, Solar system, Solar wind, Gravitational fields, Atmospheric drag, Electric and Magnetic fields, Earth’s environment and impacts on spacecraft design, Effect of radiation, Thermal effects, Plasma interactions, Surface contamination and charging, Space debris. | |  |  |  |  |
| **20-Aero-B10 Aerospace Communications Systems:** Analogue and digital aerospace communications systems includes crew radios, maintenance data systems, satellite data links. Radio communications; link analysis and performance, terrestrial and satellite communications.  Fundamentals; decibel, intermodulation, idB compression, dynamic range, SNR, noise figure, noise temperature, antenna gain, EIRP, G/T. Line-of-sight links; receiver, diversity, fade margin. Satellite links; link calculations, multiple accessing, earth stations. Fiber links, fiber types, sources, detectors, systems.  Review of signals, linear systems and Fourier theory; signal bandwidth and spectra; digital waveform coding; introduction to analog and digital modulation systems; synchronization; characterization and effects of noise; link budgets; communications media and circuits; applications to current communications systems.  Analog communications and frequency multiplexing; pulse-code-modulation and time multiplexing; additive white Gaussian noise; matched filter and correlator receiver; maximum likelihood receiver and error probability; intersymbol interference, pulse shaping filter; Signal Space Analysis; Union Bound on the probability of error; Pass-band communication Systems; coherent and non-coherent communication systems. Introduction to synchronization. | |  |  |  |  |
| **20-Aero-B11 Electromagnetics and Electromagnetic Compatibility:** Controlling radiated and conducted emissions and susceptibilities. Electric and magnetic field screening mechanisms. Digital/Analogue circuits as noise sources. Shielding and enclosures, electric and magnetic field screening mechanisms, shielding effectiveness, grounding considerations, bonding and safety of fuel systems. EMC test facilities, screened rooms, TEM cells, signals and spectra, intermodulation, cross-modulation, the spectrum analyzer. Noise and pseudo-random noise, noise performance of measurement/receiving systems, noise equivalent bandwidth, noise figure, antenna noise temperature and S/N ratio.  Hazards of EM radiation to ordnance (HERO) and aircraft. Coupled transmission lines. Modes of coupling. EMI impact on flight control systems and flight management systems.  Systems integration from an EMC perspective. EMC control plans and specifications. EMC certification testing (461/462, CISPR, EU, FCC, FAR/CAR). Grounding, bonding, shielding. Lightning/ESD resistance. EMC and the space environment. EMC and flight-safety critical systems. Models and simulation of EMC threats.  Control of threats from lightning, HIRF, atmospheric phenomena, control of charge distribution on aerospace vehicles. Hardening of aerospace systems.  Threats of the space and near-space environment. Interference from passenger-operated electronics. Techniques in Electromagnetic Compatibility. | |  |  |  |  |
| **20-Aero-B12 Navigation Systems:** Theory and analysis of modern electronic navigation instrumentation, communication and radar systems, approach aids, airborne systems, transmitters and antenna coverage; noise and losses, target detection, digital processing, display systems and technology; demonstration of avionic systems using flight simulator. Earth coordinate and mapping systems.  Integration of avionics systems; review of Earth’s geometry and Newton’s laws; inertial/laser ring navigation sensors and systems (INS); errors and uncertainty in navigation; Global Positioning System (GPS); differential and carrier tracking GPS applications; terrestrial radio navigation systems; Kalman filtering; integration of navigation systems using Kalman filtering; integration of GPS and INS using Kalman filtering.  Integration of navigation systems to aircraft systems. Navigation systems for use beyond land. Fault-tolerant navigation and control systems. Airborne mapping, doppler and multimode radar. Integrated communication/navigation systems. | |  |  |  |  |