Bachelor of Engineering

Aerospace Engineering

SPRINGFIELD RESEARCH UNIVERSITY

Bachelor of Engineering Aerospace Engineering

MISSION STATEMENT

*The **SRU Bachelor of Engineering in Aerospace Engineering** stands at the intersection of scientific discovery, engineering innovation, and aviation exploration. Our program blends theoretical foundations with hands-on experience, equipping students to design and optimize aircraft, spacecraft, and propulsion systems. Through cutting-edge research projects and collaboration with leading experts, our graduates emerge as adaptable problem solvers, ready to shape the future of flight.*

At Springfield Research University, our Bachelor of Engineering in Aerospace Engineering program prepares students for dynamic careers in the aerospace industry. Our mission is built upon three fundamental pillars:

1. **Academic Excellence**:

   - We maintain rigorous standards, fostering critical thinking and intellectual growth.
   - Through engaging coursework, practical training, and evidence-based practice, we empower students to excel in the complex world of aerospace engineering.
   - Students gain a solid foundation in aircraft structures, materials, aerodynamics, and propulsion systems.

2. **Cutting-Edge Research**:

   - Our faculty and students actively contribute to advancing aerospace technology.
   - By addressing real-world challenges, exploring innovative design concepts, and shaping industry practices, we drive positive change within the field.
   - Students engage in research projects, simulations, and wind tunnel experiments, enhancing their ability to provide innovative solutions.

3. **Societal Impact**:

   - We recognize our responsibility to society and the environment.
   - Our graduates are not only skilled engineers but also ethical leaders who advocate for safety, sustainability, and global connectivity.
   - We empower them to make meaningful contributions to aviation, space exploration, and the well-being of humanity.

The mission of the Bachelor of Engineering Aerospace Engineering is to provide a comprehensive education to prepare graduates for productive careers and responsible citizenship with special emphasis on the needs of aviation, aerospace engineering, and related fields. The program's focus is primarily on the engineering of mission-oriented vehicles for atmospheric and space flight. At Springfield Research University, our Bachelor of Engineering in Aerospace Engineering program is committed to seamlessly integrating aerospace knowledge acquisition throughout the curriculum. Here's how we achieve this:

1. **Foundational Sciences**:

   - Students delve into core subjects such as aerodynamics, flight mechanics, and materials science. These foundational sciences provide the essential groundwork for understanding aircraft structures, propulsion systems, and aerospace functions.

2. **Applied Correlations**:
   - Lectures and practical sessions correlate theoretical knowledge with real-world aerospace scenarios. For example, students learn about aircraft stability and control theory and immediately apply it during hands-on exercises using flight simulators.

3. **Case-Based Learning**:
   - Real-world aerospace cases serve as powerful teaching tools. Students analyze mission profiles, flight data, and design specifications. This approach bridges theory and practice, reinforcing aerospace concepts.

4. **Simulated Flight Experiences**:
   - Simulation labs replicate actual flight conditions. Students practice flight maneuvers, system troubleshooting, and emergency procedures, honing their skills before working with actual aircraft.

5. **Industry Collaborations and Internships**:
   - During industry placements and internships, students work directly with aerospace professionals.
   - They apply theoretical knowledge in designing, testing, and maintaining aircraft components.

6. **Cutting-Edge Research and Innovation**:
   - Students critically evaluate research articles, explore emerging technologies, and contribute to aerospace advancements.
   - This integration of evidence-based practices ensures that knowledge acquisition aligns with current best practices in the aerospace industry.

By seamlessly weaving theory, practical experiences, and evidence-based approaches, our program prepares graduates to contribute effectively to the dynamic field of aerospace engineering.

RATIONALE FOR THE BACHELOR OF ENGINEERING IN AEROSPACE ENGINEERING

Our Bachelor of Engineering in Aerospace Engineering program at Springfield Research University is purposefully designed to prepare students for impactful careers in the aerospace industry. Rooted in academic excellence, this program equips students with essential knowledge, practical skills, and hands-on experience. By emphasizing evidence-based practices and innovation, our graduates emerge as competent professionals poised to make a positive impact on the future of aviation, space exploration, and technological advancements.

National Needs (Eswatini):

1. **Quantitative Expertise**:

   - Eswatini requires skilled aerospace professionals who can navigate complex scenarios in aircraft design, performance analysis, and safety.
   - The program equips students with mathematical proficiency and critical thinking abilities to assess aerospace conditions effectively.

2. **Cutting-Edge Practices**:

   - Graduates advocate for evidence-based decision-making, ensuring safety, efficiency, and equitable treatment in aviation and space industries.

   - By enhancing their understanding of aerodynamics, propulsion, and materials, they contribute to better aerospace outcomes.

3. **Policy and Innovation**:

   - The program fosters critical thinking, enabling graduates to engage in research, policy formulation, and informed decision-making at the national level.

Regional Needs (SADC):

1. **Harmonization of Practices**:

   - SADC member states share aerospace challenges.

   - The program aligns with SADC's goal of harmonizing aerospace frameworks, promoting cooperation, and advancing aviation and space practices.

2. **Human Capital Development**:

   - Aerospace professionals play a pivotal role in regional transportation and communication systems.

   - The program contributes to building a skilled workforce capable of addressing cross-border aerospace complexities.

3. **Technological Advancements**:

   - SADC's prosperity relies on informed aerospace practices.

   - Our graduates contribute to maintaining aerospace system order, resolving challenges, and fostering regional well-being.

Purpose of the Program:

1. **Technical Leadership**:

- The program educates ethical leaders who champion evidence-based practices, fairness, and safety in aerospace engineering.

- Graduates not only assess technical data but also shape policies, regulations, and protocols.

2. **Innovative Research**:

   - Students engage in specialized aerospace research, addressing contemporary challenges and contributing to technological advancements.

LEARNING OBJECTIVES

1. **Problem Solving and Application**:
   - Students will identify, formulate, and solve complex engineering problems by applying fundamental principles of aerospace engineering, scientific methods, and mathematical analysis.
   - They will develop critical thinking skills to address challenges related to aircraft design, propulsion systems, and aerodynamics.
2. **Effective Teamwork and Leadership**:
   - Students will function effectively within interdisciplinary teams.
   - They will provide leadership, foster collaboration, and create an inclusive environment.
   - Teamwork will be essential for achieving shared goals, planning tasks, and meeting project objectives.
3. **Experimental Skills and Data Analysis**:
   - Students will design and conduct appropriate experiments related to aerospace engineering.
   - They will analyze and interpret data, drawing meaningful conclusions.
   - Engineering judgment will guide their decision-making in various contexts, from flight testing to materials selection.

These learning objectives empower graduates to excel in the dynamic field of aerospace engineering.

LEARNING OUTCOMES

The Bachelor of Engineering in Aerospace Engineering program equips graduates with essential competencies to thrive in the dynamic field of aerospace engineering. By the end of the program, students will be able to:

1. **Problem-Solving Proficiency**:
   - Identify, formulate, and solve complex engineering problems by applying principles of aerospace engineering, scientific inquiry, and mathematical analysis.
   - Develop critical thinking skills to address challenges related to aircraft design, propulsion systems, and aerodynamics.
2. **Engineering Design Acumen**:

    - Apply engineering design principles to create innovative solutions that meet specified needs.
    - Consider public health, safety, welfare, as well as global, cultural, social, environmental, and economic factors in their designs.
3. **Effective Communication**:
    - Communicate effectively with diverse audiences, including technical experts, stakeholders, and the public.
    - Present complex aerospace concepts clearly and persuasively.
4. **Ethical and Professional Responsibility**:
    - Recognize ethical dilemmas in engineering situations.
    - Make informed judgments that consider the broader impact of aerospace solutions on a global, economic, environmental, and societal scale.
5. **Collaborative Leadership**:
    - Function effectively within interdisciplinary teams.
    - Provide leadership, foster collaboration, and create an inclusive environment.
    - Establish goals, plan tasks, and meet project objectives collectively.
6. **Experimental Aptitude**:
    - Develop and conduct appropriate experiments related to aerospace engineering.
    - Analyze and interpret data, drawing meaningful conclusions.
    - Apply engineering judgment to make informed decisions based on empirical evidence.
7. **Lifelong Learning and Adaptability**:
    - Acquire and apply new knowledge as needed, using appropriate learning strategies.
    - Stay abreast of technological advancements and industry trends.

These outcomes prepare graduates to contribute significantly to the advancement of aerospace technology and its positive impact on society.

CAREER OPPORTUNITIES

With an aerospace engineer degree, you can qualify for a variety of careers in technology, engineering, data science and safety. Here are some jobs in aerospace engineering and related fields for those with aerospace engineering degrees:

1. College professor

Primary duties: College professors give lectures, teach classes, mentor students and conduct research on behalf of their institution. Additionally, college professors often get to work on independent and theoretical research projects. They conduct studies, publish their research and frequently travel to present their findings at professional conferences. A college professor with a history or an educational background in aerospace engineering may teach classes like physics, mechanical design and astrophysics. This can be a rewarding career option for those with a passion for training aspiring aerospace engineers but also enjoy conducting their own research for publication.

2. Drafter

Primary duties: A drafter is an engineering professional who prepares technical drawings and plans using specialized software. They create schematics that outline design plans so that engineers and architects can build prototypes and perfect their designs. Since many industries rely on drafters to create highly detailed technical schematics, these professionals often specialize in producing drawings within a particular industry. Having a degree in aerospace engineering can benefit drafters looking to work in aircraft and spaceship design. This can be an excellent career option for those who enjoy working with technical software, collaborating with engineers and creating detailed technical drawings.

3. Aerospace technician

Primary duties: An aerospace technician is a critical member of an aerospace engineering team. They work in laboratories, manufacturing plants and engineering offices to run and maintain the equipment used to test and prepare spacecraft. Most often, aerospace technicians work alongside engineers during the prototype testing process. They run many of the tests that help engineers understand how functional their design prototypes are for implementation. These professionals apply their high-level technical knowledge to assess prototypes, install and maintain testing equipment, troubleshoot design problems and help engineers construct functional aerospace equipment. They may also provide maintenance for previously manufactured devices.

4. Data analyst

Primary duties: Data analysts collect, analyze and report data to help scientists, business executives and other professionals make evidence-based decisions that benefit their work. These professionals have extensive knowledge of data modeling software and computer programming techniques. These skills allow them to customize programs to suit specific data processing purposes. Since data analysis is an important aspect of many industries, these professionals often specialize in a particular field. For data analysts who wish to work in the aerospace industry, having a degree in aerospace engineering can help them work well as part of an engineering team.

5. Aircraft mechanic

Primary duties: Aircraft mechanics are essential to ensuring that aircraft operate safely. They supervise, manage and perform maintenance on aircraft to ensure it meets the highest possible standards for safety and functionality. They also perform inspections and complete repairs before and after flights. Having a degree in aerospace engineering can help aircraft mechanics gain a deep level of technical understanding of how air and spacecraft operate. For example, an aerospace engineering degree can provide mechanics with detailed knowledge of how physics affects the functioning of aircraft. This detailed understanding allows mechanics to assess and repair aircraft components.

6. Inspection manager

Primary duties: An inspection manager, also known as an inspector and compliance officer, is a safety specialist who oversees the work of designers, engineers, constructors and spacecraft operators to ensure compliance with safety standards. Working on or with spacecraft requires extensive knowledge of specialized equipment and technology, so these professionals need a high level of training to perform in their roles. Inspector and compliance officers apply their knowledge of safety guidelines to ensure that spacecraft function as intended and meet a high standard of safety. These professionals enforce regulations and make sure that spacecraft and aerospace equipment function effectively.

7. Technical sales engineer

Primary duties: Technical sales engineers are sales specialists who use their knowledge of engineering equipment to offer clients sales advice and support. These professionals have detailed knowledge of manufacturing processes and different types of equipment that engineers use in their work. They may sell computer software, equipment, machinery or tools that help engineers design and build devices. Often, technical sales engineers have experience in the engineering industry that provides them with the knowledge needed to make recommendations. Having a degree in aerospace engineering can make technical sales engineers more effective in their role by providing them with industry knowledge.

8. Mechanical engineer

Primary duties: Mechanical engineers specialize in designing mechanical equipment for use in various industries. Although mechanical engineers often work in a separate field from aerospace engineers, there are opportunities for these two engineering sectors to overlap. In particular, mechanical engineers may design the equipment that aerospace engineers use to build spacecraft. Having a degree in either mechanical engineering or aerospace engineering can provide professionals with the skills needed to become a mechanical engineer. For example, mechanical and aerospace engineers may use similar processes and techniques when designing mechanical components. They draft, design and test prototypes for mechanical devices.

9. Aerospace engineer

Primary duties: Many students pursuing a degree in aerospace engineering plan to use it to become aerospace engineers. Aerospace engineers design, build and test spacecraft, aircraft and other types of equipment used in aerospace exploration and research. They apply engineering principles specifically to creating devices that can perform specific functions in astronautical research. Professionals in this position often work for either government-run or private aerospace research companies. They have specialized knowledge that allows them to plan and develop equipment suitable for working in extreme environments. Their work requires them to apply their technical knowledge to overcome mechanical design challenges.

10. Data engineer

Primary duties: Data engineers design and create systems that allow them to collect, store and process data for specific purposes. Many industries rely on data engineers to create systems that allow them to manage massive amounts of data, so professionals in this position need to have a high level of expertise in software development and data analysis. Many data engineers work in the engineering and technology sectors where they work as part of a team that designs and develops new equipment and technologies that advance their field. Having a degree in aerospace engineering can benefit data engineers in the industry.

ENTRY REQUIREMENTS

The student must have 6 credits and/or passes in SGCSE/GCE/IGCSE O' level including a pass with Grade C or better in English Language and at least four other subjects. Special: Mathematics and any other two from Chemistry, Combined Science, Physics, Physical Science. Faculty may set mature entry requirements subject to approval by Senate.

The Bachelor's Degree shall:

The Bachelor's degree program in Aerospace Engineering at Springfield Research University is designed to equip students with the skills and knowledge necessary for a successful career in this dynamic field. Here are the key features of our program:

1. **Duration**:
    - The program spans **four years** for full-time students or **six years** for part-time students, including an industrial attachment or internship period.
2. **Semester Structure**:
    - Each academic year consists of **two semesters**.
    - **Semester Duration**: Each semester runs for **20 weeks**.
        - **Orientation Week**: One week dedicated to orientation.
        - **Teaching Weeks**: A minimum of **14 weeks** for instruction.
        - **Mid-Semester Break**: A one-week break for students.
        - **Examination Period**: Two weeks for final exams.
        - **Results Processing**: Two weeks allocated for marking and result processing.

Our program ensures a rigorous academic experience while allowing flexibility for part-time students. Students engage in hands-on learning, theoretical coursework, and practical projects, preparing them for the exciting challenges of the Aerospace industry.

Special Departmental Regulations

1. **Course Completion Requirements**:
    - All **Core**, **Prerequisite**, **Required**, **General**, and **Elective** courses within the degree program are compulsory. Students must pass these courses with a minimum grade of **50%** to graduate.
    - However, during the third and fourth years, all courses must be passed with a minimum grade of **60%** (equivalent to a CGPA of **3.00**) to qualify for graduation.
2. **Optional Courses**:
    - Optional courses do not contribute to the final grade. Their marks are excluded from the computation of the overall grade.
3. **Externalization of Courses**:
    - All courses within the degree programs must be completed internally. Externalization is not permitted.
4. **Quality Control and Evaluation**:
    - Regular academic audits and reviews occur every four years, overseen by external moderators. Internal program evaluation is ongoing.
5. **Competence and Preparation**:

- The courses offered in the Bachelor of Engineering in Aerospace Engineering program provide adequate competences, preparing students for professional practice at the required academic level.

6. **Core and Prerequisite Courses**:
   - Students must pass all Core and Prerequisite courses with a minimum grade of **50%** before progressing to the next level or enrolling in additional courses.

Degree Award and Classification

- Upon successful completion of all **Core**, **Required**, and **Education** courses, as well as meeting the program requirements, a student will be awarded the degree of **Bachelor of Engineering in Aerospace Engineering** at the end of the final year.
- The **normal classification** of a Bachelor's Degree is determined based on the academic performance during the third and fourth years of study.

Rationale to Course Numbering

At Springfield Research University, we meticulously design our Aerospace Engineering curriculum to empower students with the knowledge and skills needed to thrive in this dynamic field. Our course numbering system serves as a roadmap, guiding students through their academic journey - ****100-level courses**** introduce foundational concepts. - ****200-level courses**** build on those foundations. - ****300-level courses**** explore more specialized topics. - ****400-level courses**** are advanced and often include research or project components. Let's delve into the reasons behind our thoughtful approach:

1. **Logical Progression**: Our course numbers reflect a logical progression. Foundational concepts begin with the "100" series, followed by deeper explorations in the "200" and "300" levels. Advanced topics and research opportunities reside in the "400" series.
2. **Prerequisites and Coherence**: Clear numbering helps students understand prerequisites and co-requisites. For instance, a 200-level course assumes knowledge from related 100-level courses, ensuring a coherent learning experience.
3. **Specialization and Depth**: As students advance, higher-level courses delve into specialized areas such as control systems, machine learning, and autonomous Aerospace. The numbering system communicates this depth of study.
4. **Alignment with Program Goals**: Each course number aligns with our program's learning outcomes. Whether it's mastering kinematics or diving into image processing, students can track their progress.
5. **Transferability**: Consistent numbering facilitates credit transfer between institutions, supporting seamless academic mobility.

In summary, our course numbering isn't just a sequence—it's a deliberate framework that enhances learning, fosters curiosity, and prepares our students for impactful careers in Aerospace engineering. Aerospace Engineering courses simplifies the course numbering system.

1. **100-Level Courses:**

- **AER 101**: Introduction to Aerospace Engineering
- **AER 110:** Linear Algebra for Aerospace
- **AER 120:** Mechanics and Dynamics

2. **200-Level Courses:**
   - **AER 201**: Robot Kinematics and Dynamics
   - **AER 210:** Digital Electronics
   - **AER 220:** Materials Science for Aerospace
3. **300-Level Courses:**
   - **AER 301:** Control Systems for Robots
   - **AER 310:** Programming Embedded Systems
   - **AER 320:** Sensors and Perception
4. **400-Level Courses:**
   - **AER 401:** Machine Learning in Aerospace
   - **AER 410:** Robotic Vision and Image Processing
   - **AER 420:** Autonomous Aerospace

The Bachelor of Engineering is a four (4) program. The student is expected to accumulate 576 credit points to be considered to have met the requirements of the Bachelor of Engineering in Aerospace Engineering and must pass each module by at least 50%.

- Level 1 = minimum of credits 144 (1440 notional hours of study)
- Level 2 = minimum of credits 144 (1440 notional hours of study)
- Level 3 = minimum of credits 144 (1440 notional hours of study)
- Level 4 = minimum of credits 144 (1440 notional hours of study)

TOTAL credit points 576 (5760 notional hours of study)

Credit Transfer and Accumulation

1. Credits are derived from engagement of students in learning activities during lectures, seminars, tutorials, micro or macro field trips, directed and self-directed learning and writing examination tests and assignments.
2. Modules from the engineering faculty are worth 12 credit. Lecture attendance is compulsory. Students who attend less than 80% of lessons will not be allowed to sit for their sessional examinations.

Weighting

The degree class shall be based on weighting the results from part 1, 2, 3, and 4, the Degree weighting shall be as follows:

Level 1	20%
Level 2	20%

Level 3 30%

Level 4 30%

Distribution of Notional Hours

Module	Lecture Hrs	Tutorials/ Seminars	Self-Directed Study	Assignment Tests/Exams	Notional Hrs	Credits
AER000	36	24	30	30	120	12
PROJECT	0	0	60	60	120	12

ASSESSMENT METHODS

1. **Formative Assessment (30%)**:
    - **Class Participation**: Actively engage in discussions, seminars, and practical activities related to aerospace engineering.
    - **Quizzes and Short Tests**: Regular assessments on aerospace engineering topics.
    - **Draft Assignments**: Receive feedback on early assignment drafts related to aerospace engineering principles.
    - **Peer Review**: Collaborate with peers to review and improve each other's engineering project work.
2. **Summative Assessment (60%)**:
    - **Final Examinations**: Comprehensive exams covering course content specific to aerospace engineering.
    - **End-of-Semester Projects**: Assess students' knowledge and problem-solving skills related to aerospace engineering challenges.
    - **Oral Presentations**: Evaluate communication abilities within the context of aerospace engineering solutions.
    - **Engineering Design Competitions**: Simulate real-world aerospace engineering scenarios.
3. **Continuous Assessment (10%)**:
    - **Internships or Work Placements**: Engage in supervised aerospace engineering placement, applying theoretical knowledge to practical projects.
    - **Assignments and Projects**: Regular tasks contribute to the overall grade, emphasizing practical skills in engineering design and analysis.
    - **Research Papers**: Demonstrate research abilities related to aerospace engineering innovations and advancements.

- **Attendance and Active Participation**: Engage in lectures, workshops, and industry events specific to aerospace engineering practices.

These adapted assessment methods align with Springfield Research University's commitment to academic excellence and the development of competent engineers.

Teaching Methods

At Springfield Research University (SRU), we are committed to employing a diverse array of teaching methods to ensure a comprehensive and engaging learning experience for our students. Our teaching methods are carefully selected to align with the programme's objectives and to meet the needs of our diverse student body. The following are the key teaching methods utilized across all SRU programmes:

1. Lectures:

- Lectures are used to introduce and explain key concepts, theories, and principles. They provide a structured and systematic approach to delivering content, allowing students to gain a solid foundation in their respective fields. Lectures are often supplemented with visual aids, multimedia presentations, and interactive elements to enhance understanding and engagement.

2. Seminars:

- Seminars are interactive sessions that promote critical thinking and in-depth discussion on specific topics. Students are encouraged to actively participate, share their perspectives, and engage in debates. Seminars provide an opportunity for students to develop their analytical and communication skills.

3. Workshops:

- Workshops are hands-on sessions that focus on practical skills and applications. These sessions allow students to engage in experiential learning, apply theoretical knowledge to real-world scenarios, and collaborate with peers on projects and activities. Workshops are designed to foster creativity, problem-solving, and teamwork.

4. Problem-Based Learning (PBL):

- Problem-Based Learning is a student-centered approach that involves presenting students with complex, real-world problems to solve. Students work in small groups to research, discuss, and propose solutions, developing critical thinking and collaborative skills in the process. PBL encourages independent learning and active engagement.

5. Case Studies:

- Case studies are used to analyze real-life situations and decision-making processes. Students examine and discuss case studies to understand the context, identify key issues, and evaluate possible solutions. This method helps students develop their analytical and problem-solving abilities while relating theoretical concepts to practical situations.

6. Clinical Practice:

- For programmes that include a clinical component, such as Health and Medical Sciences, clinical practice is an integral part of the curriculum. Students gain hands-on experience in clinical settings, working under the supervision of qualified professionals. This method provides valuable opportunities for students to apply their knowledge, develop clinical skills, and gain insights into professional practice.

7. Research Projects:

- Research projects are designed to cultivate a culture of inquiry and innovation. Students engage in independent or group research projects, exploring topics of interest and contributing to the body of knowledge in their field. Research projects develop students' research skills, critical thinking, and ability to communicate findings effectively.

8. Online Learning:

- Online learning is incorporated to provide flexible and accessible education. SRU utilizes online platforms to deliver lectures, conduct discussions, and facilitate collaborative projects. Online learning allows students to access course materials, participate in virtual classrooms, and engage with peers and instructors remotely.

9. Continuous Assessment:

- Continuous assessment methods, such as quizzes, assignments, and presentations, are used to monitor students' progress and provide ongoing feedback. These assessments help identify areas for improvement and ensure that students are meeting learning objectives throughout the course.

10. Peer Learning:

- Peer learning encourages students to collaborate and learn from each other. Group projects, study groups, and peer review sessions provide opportunities for students to share knowledge, offer feedback, and support each other's learning journey.

At SRU, our commitment to employing diverse and effective teaching methods ensures that our students receive a well-rounded education that prepares them for success in their chosen fields. We continuously review and enhance our teaching practices to provide the best possible learning experience for our students.

Delivery Methods

At Springfield Research University (SRU), we utilize a variety of delivery methods to ensure that our educational programmes are accessible, engaging, and effective. Our delivery methods are designed to cater to the diverse needs of our students and to provide flexible learning opportunities. The following are the key delivery methods employed across all SRU programmes:

1. In-Person Delivery:

- **Classroom Lectures:** Traditional classroom lectures provide a structured and interactive environment where students can engage with instructors and peers. These sessions often include discussions, presentations, and multimedia resources to enhance learning.

- **Laboratory Sessions:** For programmes that require practical and experimental learning, laboratory sessions are conducted in specialized labs equipped with the necessary tools and equipment. These hands-on sessions allow students to apply theoretical knowledge in a controlled environment.

- **Clinical Placements:** Health and Medical Sciences programmes include clinical placements in hospitals, clinics, and healthcare facilities. These placements provide students with real-world experience under the supervision of qualified professionals.

2. Online Delivery:

- **Virtual Classrooms:** Online platforms are used to deliver lectures, conduct discussions, and facilitate collaborative projects. Virtual classrooms enable students to access course materials, participate in live sessions, and engage with peers and instructors from remote locations.
- **Recorded Lectures:** Recorded lectures are made available for students to access at their convenience. This flexible approach allows students to review and revisit course content as needed.
- **Online Assessments:** Online assessments, including quizzes, assignments, and exams, are conducted through secure online platforms. These assessments provide timely feedback and help monitor students' progress.

3. Blended Learning:

- **Hybrid Courses:** Blended learning combines in-person and online delivery methods to provide a flexible and comprehensive learning experience. Hybrid courses may involve alternating between classroom sessions and online activities.
- **Flipped Classroom:** In the flipped classroom model, students access instructional content online before class and use in-person sessions for interactive, application-based activities. This approach encourages active learning and deeper engagement with the material.

4. Independent Study:

- **Self-Paced Learning:** Self-paced learning allows students to progress through course materials at their own speed. This method is ideal for students who prefer to learn independently and manage their own schedules.
- **Research Projects:** Independent research projects provide students with the opportunity to explore topics of interest, develop research skills, and contribute to the body of knowledge in their field. Faculty advisors provide guidance and support throughout the research process.

5. Collaborative Learning:

- **Group Projects:** Group projects foster teamwork and collaboration among students. These projects often involve problem-solving, research, and presentations, allowing students to learn from each other and develop interpersonal skills.
- **Peer Review:** Peer review sessions encourage students to provide and receive constructive feedback on each other's work. This method promotes critical thinking, reflection, and improvement.

6. Experiential Learning:

- **Internships and Work Placements:** Internships and work placements provide students with practical experience in their chosen field. These opportunities allow students to apply their knowledge in real-world settings, develop professional skills, and build industry connections.

- **Field Trips and Excursions:** Field trips and excursions offer experiential learning opportunities outside the classroom. These activities provide students with firsthand exposure to relevant sites, industries, and practices.

7. Continuous Assessment:

- **Formative Assessments:** Formative assessments, such as quizzes, assignments, and in-class activities, provide ongoing feedback to students and help track their progress. These assessments are designed to support learning and identify areas for improvement.
- **Summative Assessments:** Summative assessments, including final exams, projects, and presentations, evaluate students' overall performance and mastery of course content.

At SRU, our diverse delivery methods ensure that students receive a well-rounded and flexible education that caters to their individual learning preferences. We are committed to continuously enhancing our delivery methods to provide the best possible learning experience for our students.

Curriculum

Aerospace Engineering, ESQF Level 8 BE-AER degree, typical course sequence

YEAR 1: SEMESTER 1

Code	Course	Lectures	Practicals	Credits
AER100	Engineering Mathematics I	120	0	12
AER101	Fundamentals of Chemistry and Lab	100	20	12
AER102	Physics (Mechanics/Newtonian)	100	20	12
AER103	Electrical and Electronic Engineering	100	20	12
AER104	Computing for Engineers and Scientists	100	20	12
AER105	Design I	100	20	12
TOTAL				72

YEAR 1: SEMESTER 2

Code	Course	Lectures	Practicals	Credits
AER106	Engineering Mathematics II	120	0	12
AER107	Engineering Physics I	100	20	12
AER108	Fundamentals of Chemistry II	100	20	12
AER109	Communication for Academic Purposes	120	0	12
AER110	Engineering Science	100	20	12
AER111	Introduction to Engineering	100	20	12
TOTAL				72

YEAR 2: SEMESTER 3

Code	Course	Lectures	Practicals	Credits
AER212	Linear Differential Equations	120	0	12
AER213	Calculus III	120	0	12
AER214	Engineering Physics II	100	20	12
AER215	Statics	100	20	12
AER216	Aerospace Fundamentals	100	20	12

AER217	Communication for Professional Purposes	120	0	12
TOTAL				72

YEAR 2: SEMESTER 4

Code	Course	Lectures	Practicals	Credits
AER218	Linear Algebra	120	0	12
AER219	Thermodynamics I	120	0	12
AER220	Dynamics	100	20	12
AER221	Mechanics of Materials	100	20	12
AER222	Space Mission Analysis and Design	100	20	12
AER223	Management and Business Fundamentals	120	0	12
TOTAL				72

YEAR 3: SEMESTER 5

Code	Course	Lectures	Practicals	Credits
AER324	Introduction to Numerical Analysis	120	0	12
AER325	Fundamentals of Electrical Engineering	120	0	12
AER326	Thermodynamics II	100	20	12
AER327	Aerodynamics I Laboratory	100	20	12
AER328	Aerospace systems	100	20	12
AER329	Internship I	120	0	12
TOTAL				72

YEAR 3: SEMESTER 6

Code	Course	Lectures	Practicals	Credits
AER330	Aerodynamics II	100	20	12
AER331	Flight Dynamics	100	20	12
AER332	Orbital Mechanics	100	20	12
AER333	Aerospace Structures I	100	20	12
AER334	Engineering Physiology and Lab	100	20	12
AER335	Internship II	0	120	12
TOTAL				72

YEAR 4: SEMESTER 7

Code	Course	Lectures	Practicals	Credits
AER436	Aerospace Dynamics III	100	20	12
AER437	Aerospace Propulsion	100	20	12
AER438	Aerospace Structures II	100	20	12
AER439	Aerospace Design I	100	20	12
AER440	Aerospace Capstone Project A	20	100	12
AER441	Work based Learning I	0	120	12
TOTAL				72

YEAR 4: SEMESTER 8

Code	Course	Lectures	Practicals	Credits
AER442	Engineering Enterprise	100	20	12
AER443	Aerospace Structural Dynamics	100	20	12
AER444	Aerospace Design II	100	20	12
AER445	Robotics and Automation	60	60	12
AER446	Aerospace Capstone Project B	20	100	12

AER447	Work based Learning II	**0**	**120**	**12**
TOTAL				**72**

COURSE DESCRIPTIONS

INTRODUCTION TO FLIGHT

Standard atmosphere, basic aerodynamic theory, airfoil and wing descriptions, wing structures, introduction to orbital mechanics, elementary aerospace vehicle performance, aircraft stability and control and experiential introduction to aerospace engineering.

INTRODUCTION TO FLIGHT MECHANICS

Introductory material in aerospace engineering; development of standard atmosphere; aerodynamic theory; airfoil and wing descriptions; aircraft performance.

INTRODUCTION TO AEROSPACE MECHANICS

Planar kinematics; fundamentals of Newtonian mechanics; system of particles and rigid bodies; the effect of friction forces on motion and static equilibrium; rectilinear and curvilinear motion of particles; translational momentum; moments of inertia; angular momentum; planar motion of rigid bodies; impact dynamics; situations involving variable mass; introduction to orbital mechanics.

AEROSPACE ENGINEERING MECHANICS

Fundamentals of Newtonian mechanics; static equilibrium of particles, system of particles and rigid bodies; free body diagrams; rectilinear and curvilinear motion of particles; linear momentum; angular momentum; friction; plane motion of rigid bodies; beams and trusses.

INTRODUCTION TO AEROTHERMODYNAMICS

Study of thermodynamic properties and processes, heat and work, first and second laws of thermodynamics, power and refrigeration ideal cycles, psychrometrics.

INTRODUCTION TO AEROSPACE MECHANICS OF MATERIALS

Fundamental concepts for deformable bodies (conservation of linear and angular momentum, kinematics and thermoelasticity); notions of stress and strain and illustrative examples for engineering applications; introduction to experimental methods and reporting, instrumentation and uncertainty analysis; measurement of elastic and thermal material properties.

INTRODUCTION TO AEROSPACE COMPUTATION

Review of basic skills required for developing computer programs and introduction to more advanced concepts in scientific computing to solve aerospace engineering problems; numerical and analytical methods of solving engineering problems involving interpolation and extrapolation; function approximation; numerical differentiation; integration; solutions to linear and non-linear equations and systems of equations; eigenvalues and eigenvectors, numerical integration of differential equations with aerospace engineering applications.

PROFESSIONAL DEVELOPMENT

Participation in an approved high-impact learning practice; reflection on professional outcomes from engineering body of knowledge; documentation and self-assessment of learning experience at mid-curriculum point.

THEORETICAL AERODYNAMICS

Fundamentals of incompressible flow, conservation principles, continuity, momentum, rotationality, circulation, lift, drag, potential flow, thin airfoil theory, panel methods, airfoil design, high lift devices, finite wing theory, vortex lattice methods, and wing design.

HIGH SPEED AERODYNAMICS

Fundamentals of compressible flow, acoustic waves, shock and expansion waves, shock-expansion theory, supersonic airfoil design, small perturbation theory, conical flow theory, supersonic wing panel methods, supersonic wing design, similarity theory, cone flow, unsteady waves, and theory of characteristics.

AEROSPACE STRUCTURAL ANALYSIS I

Structural design considerations; mechanics of structures; introduction to elasticity; constitution of materials; analysis of typical aerospace structures in bending, extension, torsion and shear.

AEROSPACE STRUCTURAL ANALYSIS II

Work and energy principles; analysis of indeterminate structures by classical virtual work and finite elements; introduction to elastic stability of columns; application of energy methods to determine stresses, strains and displacements in typical aerospace structures; design considerations in aerospace structures.

AEROSPACE ENGINEERING LABORATORY

Intermediate and advanced topics in instrumentation, signal conditioning, data acquisition analysis for aerospace-related measurements; emphasis on technical reporting and data presentation; measurements of materials strain, deformation, pressure, velocity and aerodynamic forces; experimental investigations of static and dynamic response of structures; use of nonintrusive optical techniques; uncertainty analysis; linear regression, Fourier transform and power spectra; tests for statistical significance.

AEROSPACE DYNAMICS

Spatial kinematics; general motion of particles; Euler angles; Newton-Euler methods for translation and rotation of rigid bodies; work-energy and impulse momentum principles applied to aerospace systems; Linear theory of free and forced vibrations and dynamic response of single and multi-degree of freedom systems; frequency response of first and second order systems with instrumentation applications.

DYNAMICS OF AEROSPACE VEHICLES

Derivation of the nonlinear flight dynamics equations; linearization; aircraft static stability and control; longitudinal and lateral dynamic stability; development of state-space models; stability derivatives; longitudinal and lateral modes and transfer functions; flying qualities; elements of configuration design; response to control inputs.

AEROTHERMODYNAMICS AND PROPULSION

Aerothermodynamics of gases; laws of thermodynamics; equilibrium conditions; mixtures of gases; combustion and thermochemistry; compressible internal flows with friction, heat transfer and shock; turbojet cycle analysis and performance; chemical rockets.

AEROSPACE VEHICLE DESIGN I

Aerodynamic design, specification, arrangement, performance analysis, weight and balance, stability.

AEROSPACE VEHICLE DESIGN II

System optimization by examination and analysis of necessary trade-offs.

MECHANICS OF ADVANCED AEROSPACE STRUCTURES

Advanced analysis techniques for aerospace structures; material anisotropy, plasticity, fatigue and fracture; laminated materials; solution of plane elasticity, plate and multi-component structural configurations; buckling of beams and plates; application of finite element analysis.

AEROSPACE STRUCTURAL DESIGN

Overall structural integrity of complete aerospace systems; structures subjected to critical loads; design considerations in aerospace structures.

APPLICATIONS OF FRACTURE MECHANICS TO AEROSPACE STRUCTURES

Foundations of linear elastic fracture mechanics of aerospace structure; calculation of stress intensity factors and energy release rates; crack growth under fatigue loading; ASTM standards for fracture testing; the role of fracture mechanics in the analysis and design of aerospace structures.

AEROSPACE MATERIALS SCIENCE

Relationship between aerospace engineering material properties and microstructure; mechanical and thermal properties; environmental degradation; mechanical failure.

HUMAN PERFORMANCE IN AEROSPACE ENVIRONMENTS

Current physiological and psychological aspects affecting human performance during space missions using a quantitative approach and engineering methods.

COMPUTATIONAL FLUID DYNAMICS FOR AEROSPACE APPLICATIONS

Present methods for solving internal and external flow problems for inviscid and viscous compressible flow; Euler, Navier-Stokes and Large Eddy Simulation solvers, boundary conditions formulation, and basics of parallel processing.

AEROSPACE PROPULSION

Air breathing propulsion; design and analysis of inlets, compressors, combustors, turbines and nozzles; application to aeronautical and ground transportation.

CHEMICAL ROCKET PROPULSION

Nozzles and heat transfer in rockets, liquid and solid propellant systems; combustion and combustion stability; flight performance including trajectories, multistaging and exchange rate curves; rocket testing.

AEROELASTICITY

Classical analysis of fundamental aeroelastic phenomena with application to aerospace vehicles; flutter, divergence, control effectiveness.

ACTIVE CONTROLS FOR AEROSPACE VEHICLES

Introduction to the Theory of Automatic Control specifically applied to aerospace vehicles; techniques for analysis and synthesis of linear control systems, stability criteria, systems response and performance criteria; design studies of active controls to improve aerospace vehicle performance.

ORBITAL MECHANICS

Two-body problem, restricted three-body problem, orbital perturbations, orbital maneuvers, interplanetary trajectories, orbit determination and other selected topics.

SPACECRAFT ATTITUDE DYNAMICS AND CONTROL

Introduces fundamental concepts of satellite attitude dynamics and control; includes derivations of environmental disturbances due to gravity gradient, aerodynamic, and solar radiation pressure; includes treatments of attitude control subsystems, such as thrusters, reaction wheels, CMGs, and magnetic torquers, and their designs.

FLIGHT TEST ENGINEERING

Application of performance and stability and control theory to flight test measurements; standard atmosphere and airspeed equations for pilot-static system calibrations; flight test methods for evaluating performance, stability and control, and stall-spin characteristics;

laboratory practice in planning and conducting small flight test project.

SPACE SYSTEM DESIGN

Introduces prevailing practices and processes used in modern space system design; applies knowledge in component engineering disciplines to a design challenge of interest to NASA or DoD; utilizes instruction in systematic methods of design and on dynamics of teamwork; when possible concludes with detailed design using an engineering design facility.

ELECTROMAGNETIC SENSING FOR SPACE-BORNE IMAGING

Study IR and Visible range imaging systems to obtain high resolution imaging of objects from space; this area has numerous applications and areas of advanced development; following instruction in needed background on optics, telescopes, and interferometry, perform preliminary design of imaging system with a different imaging design offered each year.

NUMERICAL SIMULATION

Numerical and analytical simulation of physical problems in sciences and engineering using applied methods; developing and using numerical techniques for physical problems described by nonlinear algebraic equations, ordinary and partial differential equations.

AEROTHERMOCHEMISTRY

Composition of chemically reacting gases (air and propellant); thermodynamic functions based on classical and quantum mechanical theories; calculation of gas temperatures; equilibrium, frozen and non-equilibrium flows through nozzles and shock waves.

COCKPIT SYSTEMS AND DISPLAYS

Design, development, and implementation of cockpit systems and multi-function displays; cockpit system requirements and specifications; human-machine interfaces, Flight Management Systems, navigation and guidance systems; 3-D real-time displays of weather, traffic, and terrain; characteristics and missions of air vehicles; project design and cost analysis.

VEHICLE MANAGEMENT SYSTEMS

Introduction to vehicle management systems for manned and unmanned air and space vehicles; system centric concepts, requirements definition, specifications, and architectures; reliability analysis, health monitoring, and mission management; SISO digital design of integrated flight control, propulsion control and structural control; introduction to vehicle autonomy; design and analysis methods, industrial examples.

HUMAN SPACEFLIGHT OPERATIONS

Essential aspects of human spaceflight operations as performed by NASA; in-depth understanding of the state-of-the-art in spacecraft operations, including spacecraft systems, ground and launch operations, mission management and on-orbit activities such as science, robotics, spacewalking and human health maintenance; applications to future space systems.

HEAT TRANSFER AND VISCOUS FLOWS

Navier-Stokes and boundary layer equations; exact and approximate solutions; laminar boundary layers; origin of turbulence; transition; turbulent boundary layers; viscous airfoil design; one and two dimensional heat transfer; methods for steady and transient heat conduction; thermal boundary layers; convection; and radiation.

HELICOPTER AERODYNAMICS

Hovering theory, hovering and vertical flight performance, factors affecting hovering and vertical flight performance, auto-rotation in vertical descent, concepts of blade motion and control, aerodynamics of forward flight, forward flight performance, operational envelope and introduction to conceptual design of helicopters.

AIRFOIL AND WING DESIGN

Subsonic airfoil design and analysis, subsonic wing design and analysis, swept and delta wings, vortex lift, transonic flow methods, viscous transonic phenomena, transonic airfoil and wing design, optimization and advanced topics such as supersonic panel methods.

MANAGEMENT AND BUSINESS IN AEROSPACE ENGINEERING

This course bridges technical expertise with managerial acumen in the aerospace industry. Students explore project management, financial principles, supply chain dynamics, entrepreneurship, legal aspects, and ethical considerations specific to aerospace ventures. By course end, students are equipped to contribute as skilled engineers and informed decision-makers shaping the future of aerospace enterprises.

SPACE MISSION ANALYSIS AND DESIGN

This course bridges technical expertise with managerial acumen in the aerospace industry. Students explore mission analysis, design, and systems engineering based on the concepts of autonomous systems. From planning space missions to managing them within legal and safety constraints, graduates emerge equipped to shape the future of space exploration.

SPACE SYSTEMS

This course provides a comprehensive overview of space systems engineering. Students delve into the design, integration, and functioning of various subsystems within a complete space system. Topics include spacecraft propulsion, communication, power, thermal control, and mission planning. Practical projects and access to cutting-edge facilities enhance students' expertise in spacecraft engineering, preparing them for roles in the aerospace industry.

WORK-BASED LEARNING I AND II

These work-based courses provide a flexible and cost-effective way for engineers to gain academic qualifications while remaining employed. Through individually tailored programs, students integrate workplace learning with supervised professional development. The focus is on meeting requirements for professional registration as an Incorporated Engineer (Bachelors). Learners engage in structured learning, ensuring competence development without leaving their jobs. Successful completion leads to an academic degree and eligibility for a Professional Review Interview with a participating professional engineering institution. These programs offer a planned pathway toward registration, emphasizing practical skills and real-world application.

INTERNSHIP I & II

These work-based internships provide students with practical experience within the aerospace industry. During both Internship I and II, students engage in 10-week summer placements, gaining insights into areas such as innovation, digital technologies, design, and manufacturing. Participants work across product lifecycles, exploring sustainable flight, ethical considerations, and artificial intelligence applications. Successful completion enhances employability and may lead to graduate program opportunities with industry leaders.

COURSE OUTLINES

Course Title: Engineering Mathematics 1

Course Description:

Engineering Mathematics 1 provides fundamental mathematical concepts and techniques relevant to aerospace engineering. Students will learn how to apply mathematical principles to solve real-world problems encountered in aerospace design, analysis, and research.

Learning Objectives:

- Understand essential mathematical concepts such as calculus, linear algebra, and differential equations.
- Apply mathematical techniques to model and analyze aerospace systems.
- Develop problem-solving skills specific to aerospace engineering.

Topics Covered:

- Calculus (differentiation, integration, and applications)
- Linear algebra (vectors, matrices, and systems of linear equations)
- Differential equations (ordinary and partial)
- Complex numbers

- Numerical methods
- Fourier series and transforms
- Laplace transforms
- Probability and statistics (basic concepts)

Assessment and Grading:

- Regular homework assignments and problem-solving exercises
- Midterm exams covering specific topics
- Final exam assessing overall understanding
- Class participation and engagement

Recommended Books:

- “Advanced Engineering Mathematics” by Erwin Kreyszig
- “Mathematical Methods for Physics and Engineering” by K.F. Riley, M.P. Hobson, and S.J. Bence

Course Title: Fundamentals of Chemistry and Lab 1

Course Description:

Fundamentals of Chemistry and Lab 1 introduces essential chemical concepts relevant to aerospace engineering. Students will explore the behavior of matter, chemical reactions, and laboratory techniques.

Learning Objectives:

- Understand the periodic table, atomic structure, and chemical bonding.
- Apply stoichiometry to analyze chemical reactions.
- Perform basic laboratory experiments related to aerospace materials.

Topics Covered:

- Atomic theory and periodicity
- Chemical bonding and molecular structure
- Stoichiometry and reaction equations
- Gases, liquids, and solids
- Thermochemistry
- Laboratory safety and techniques

Assessment and Grading:

- Lab reports and practical assessments
- Quizzes on theoretical concepts
- Participation in lab sessions
- Final lab exam

Recommended Books:

- “Chemistry: The Central Science” by Brown, LeMay, Bursten, and Murphy
- “Laboratory Techniques in Organic Chemistry” by Mohrig, Alberg, and Schatz

Course Title: Physics (Mechanics/Newtonian)

Course Description:

This comprehensive course delves into the principles of classical mechanics, emphasizing their applications in aerospace engineering. Students will explore both theoretical concepts and practical problem-solving techniques.

Learning Objectives:

- Develop a deep understanding of motion, forces, and energy within the context of aerospace systems.
- Apply Newton's laws to analyze mechanical behavior in various scenarios.
- Cultivate critical thinking skills for solving complex aerospace engineering problems.

Topics Covered:

- **Kinematics**:
  - Position, velocity, acceleration, and motion equations.
  - Projectile motion and circular motion.
- **Dynamics**:
  - Newton's laws of motion.
  - Work, energy, and conservation laws.
  - Impulse and momentum.
- **Applications in Aerospace Engineering**:
  - Orbital mechanics: Kepler's laws, satellite motion, and interplanetary trajectories.
  - Flight dynamics: Aircraft performance, stability, and control.
  - Attitude control: Gyroscopic motion and spacecraft orientation.

Assessment and Grading:

- Regular problem sets and conceptual exercises.
- Midterm exams covering both theory and practical applications.
- Comprehensive final exam assessing overall understanding.
- Active participation in class discussions and group projects.

Recommended Books:

- "Classical Mechanics" by John R. Taylor: A rigorous yet accessible text covering fundamental principles.
- "Introduction to Flight" by John D. Anderson Jr.: Provides context on aerospace applications.

Course Title: Introduction to Electrical and Electronic Engineering

Course Description:

This module provides a basic introduction to electrical and electronic devices, power transmission, and the distribution and utilization of electrical energy in an aerospace engineering context.

Learning Objectives:

- Understand fundamental electrical concepts, including voltage, current, and resistance.
- Explore electronic components such as diodes, transistors, and integrated circuits.
- Apply electrical principles to aerospace systems and avionics.

Topics Covered:

- Basics of electrical circuits
- Semiconductor devices
- Digital electronics
- Power systems and distribution
- Avionics and flight control electronics

Assessment and Grading:

- Regular assignments and practical exercises
- Quizzes on theoretical concepts
- Lab sessions demonstrating electronic circuits
- Final exam assessing overall understanding

Recommended Books:

- "Electric Circuits" by James W. Nilsson and Susan A. Riedel
- "Microelectronic Circuits" by Adel S. Sedra and Kenneth C. Smith

Course Title: Introduction to Computing for Engineers and Scientists

Course Description:

ENGI 1006 is an interdisciplinary course in computing intended for first-year engineering students, but open to students from all schools. It provides a practical introduction to computer science, covering computational thinking, algorithmic problem-solving, and Python programming. The focus is on science and engineering applications, including case studies in physics, statistics, electrical engineering, biology, and other relevant topics.

Learning Objectives:

- Understand fundamental computational concepts.
- Apply Python programming skills to solve engineering problems.
- Explore real-world applications in science and aerospace engineering.

Topics Covered:

- Computational thinking and problem-solving strategies.
- Introduction to Python programming.
- Case studies in physics, statistics, and electrical engineering.
- Scientific data analysis and visualization.

Assessment and Grading:

- Regular assignments and coding exercises.
- Quizzes assessing theoretical knowledge.
- Practical projects related to aerospace applications.
- Final exam evaluating overall understanding.

Recommended Resources:

- No required textbook, but consider reference books like:
  - "Introduction to Computation and Programming Using Python" by John Guttag.
  - "The Practice of Computing using Python" by William Punch and Richard Enbody.
  - "Python for Everyone" by Cay Horstmann and Rance Necaise.

Software:

- Use Anaconda distribution for Python and libraries.
- Explore GitHub for code version control.
- Supplementary materials available on the Ed platform.

Course Title: Design 1

Course Description:

"Design 1" introduces students to fundamental principles of engineering design, emphasizing creativity, problem-solving, and interdisciplinary collaboration.

Learning Objectives:

- Develop design thinking skills.
- Apply engineering concepts to practical projects.
- Understand the design process from ideation to implementation.

Topics Covered:

- Introduction to design methodologies
- Creativity and innovation
- Project scoping and requirements
- Conceptual design and feasibility analysis
- Prototyping and testing

Assessment and Grading:

- Design projects (individual or team-based)

- Design reports and presentations
- Participation in design workshops
- Final design portfolio

Recommended Resources:

- No specific textbook required, but consider design literature and case studies.

Course Title: Engineering Mathematics II

Course Description:

Engineering Mathematics 2 builds upon foundational mathematical concepts, emphasizing their applications in solving engineering problems.

Learning Objectives:

- Master numerical methods for solving partial differential equations (PDEs).
- Develop proficiency in numerical software (e.g., Python) for engineering computations.
- Understand analytical methods for solving PDEs and linear systems.

Topics Covered:

- **Numerical Methods for PDEs**:
  - Finite differences: Formulas for first and second order derivatives.
  - Schemes for one and two-dimensional elliptic boundary value problems (e.g., Poisson's equation).
  - Solving linear equations using LU factorization, Jacobi, and Gauss-Seidel methods.
- **Numerical Software**:
  - Basic syntax and commands in Python.
  - Reading documentation for relevant functions.
  - Computation of Fourier coefficients, function values, and series solutions of ODEs and PDEs.
- **Analytical Methods for PDEs**:
  - Fourier series: Representation of periodic functions.
  - Convergence of Fourier series.
  - Solution techniques for Laplace's equation.
- **Linear Systems**:
  - Spectral solution of linear differential equations via eigenvalues and eigenvectors.
  - Stability analysis using eigenvalues.
  - State-feedback control and pole-placement.
  - Transfer functions and output response.

Assessment and Grading:

- Regular assignments, quizzes, and practical exercises.
- Comprehensive final exam.

Recommended Resources:

- No specific textbook required, but consider reference materials on numerical methods and mathematical software.

Course Title: Engineering Physics 1

Course Description:

Engineering Physics 1 introduces fundamental principles of physics relevant to aerospace engineering. Students will explore topics essential for understanding aircraft and spacecraft behavior.

Learning Objectives:

- Develop a solid foundation in classical mechanics, electromagnetism, and thermodynamics.
- Apply physics concepts to aerospace systems and design.
- Enhance problem-solving skills through practical applications.

Topics Covered:

- **Classical Mechanics**:
  - Newtonian mechanics: Kinematics, dynamics, and conservation laws.
  - Oscillations and waves.
- **Electromagnetism**:
  - Electric fields, magnetic fields, and electromagnetic waves.
  - Maxwell’s equations.
- **Thermodynamics**:
  - Laws of thermodynamics.
  - Heat transfer and energy conversion.
- **Applications in Aerospace**:
  - Flight dynamics, orbital mechanics, and propulsion.

Assessment and Grading:

- Regular problem sets and quizzes.
- Midterm exams covering theoretical concepts.
- Final exam assessing overall understanding.

Recommended Resources:

- “University Physics” by Young and Freedman.
- Lecture notes and supplementary materials.

Course Title: Fundamentals of Chemistry II

Course Description:

Fundamentals of Chemistry II builds upon the foundational concepts introduced in Fundamentals of Chemistry I. This course focuses on more advanced topics relevant to aerospace engineering, including materials science, chemical reactions, and their applications.

Learning Objectives:

- Explore advanced chemical principles related to aerospace materials.
- Understand reaction kinetics, equilibrium, and thermodynamics.
- Apply chemistry knowledge to aerospace systems and design.

Topics Covered:

- **Materials Science**:
  - Properties of materials used in aerospace engineering (metals, polymers, ceramics, composites).
  - Material selection criteria for specific applications (strength, weight, thermal properties).
- **Chemical Reactions**:
  - Reaction kinetics: Rate laws, reaction mechanisms.
  - Chemical equilibrium: Le Chatelier's principle, equilibrium constants.
  - Thermodynamics: Entropy, enthalpy, Gibbs free energy.
- **Applications in Aerospace**:
  - Corrosion prevention and materials degradation.
  - Composite materials for lightweight structures.
  - Aerospace coatings and surface treatments.

Assessment and Grading:

- Regular problem-solving assignments.
- Quizzes assessing theoretical knowledge.
- Lab experiments related to materials characterization.
- Final exam evaluating overall understanding.

Recommended Resources:

- "Materials Science and Engineering: An Introduction" by William D. Callister Jr.
- Lecture notes and supplementary materials.

Course Title: Academic Communication Skills

Course Description:

This course focuses on enhancing communication skills essential for success in academic and professional contexts within the aerospace field.

Learning Objectives:

- Develop effective written and oral communication skills.
- Understand technical writing conventions and scientific reporting.
- Collaborate in interdisciplinary teams and present findings.

Topics Covered:

- **Technical Writing**:
  - Clarity, conciseness, and coherence in reports and research papers.
  - Citations, referencing, and avoiding plagiarism.
- **Oral Presentations**:
  - Structuring presentations for clarity and impact.
  - Visual aids and effective delivery.
- **Collaboration and Teamwork**:
  - Communicating within interdisciplinary teams.
  - Resolving conflicts and fostering productive collaboration.

Assessment and Grading:

- Written assignments (research papers, summaries).
- Oral presentations on aerospace topics.
- Participation in group discussions and peer reviews.

Recommended Resources:

- "The Elements of Style" by William Strunk Jr. and E.B. White.
- Practice materials from scientific journals and conferences.

Course Title: Engineering Science

Course Description:

Engineering Science provides a solid foundation in fundamental scientific principles applicable to aerospace engineering. Students will explore interdisciplinary topics essential for designing and analyzing aerospace systems.

Learning Objectives:

- Understand core scientific concepts (physics, chemistry, materials science).
- Apply scientific principles to solve engineering problems.
- Develop critical thinking skills for complex aerospace challenges.

Topics Covered:

- **Physics**:
  - Classical mechanics: Kinematics, dynamics, and conservation laws.
  - Electromagnetism: Electric fields, magnetic fields, and electromagnetic waves.
  - Thermodynamics: Laws, heat transfer, and energy conversion.
- **Chemistry**:
  - Materials science: Properties of aerospace materials (metals, polymers, composites).

        - Chemical reactions: Kinetics, equilibrium, and thermodynamics.
    - **Interdisciplinary Applications**:
        - Aerospace materials selection.
        - System modeling and analysis.
        - Environmental considerations.

Assessment and Grading:

- Regular problem-solving assignments.
- Quizzes assessing theoretical knowledge.
- Lab experiments related to materials characterization.
- Final exam evaluating overall understanding.

Recommended Resources:

- Textbooks covering physics, chemistry, and materials science.
- Lecture notes and supplementary materials.

Course Title: Introduction to Engineering

Course Description:

This foundational course introduces students to the diverse field of engineering. It provides an overview of engineering disciplines, problem-solving techniques, and the engineering design process.

Learning Objectives:

- Understand the role of engineers in society.
- Explore various engineering fields (e.g., civil, mechanical, electrical, aerospace).
- Develop critical thinking skills for solving engineering challenges.

Topics Covered:

- **Introduction to Engineering**:
    - Historical context and evolution of engineering.
    - Ethical considerations and professional responsibilities.
- **Engineering Disciplines**:
    - Overview of civil, mechanical, electrical, chemical, and aerospace engineering.
    - Interdisciplinary connections.
- **Problem-Solving Techniques**:
    - Analytical methods and mathematical modeling.
    - Creative thinking and innovation.
- **Engineering Design Process**:
    - Problem identification and requirements analysis.
    - Conceptualization, prototyping, and testing.
    - Iterative design and optimization.

Assessment and Grading:

- Regular assignments and quizzes.
- Design projects related to real-world problems.
- Class participation and engagement.

Recommended Resources:

- No specific textbook required, but consider introductory engineering literature.

Course Title: Linear Differential Equations

Course Description:

This course introduces students to linear differential equations and their applications in aerospace engineering. Topics covered include first and higher-order differential equations, power series methods, Laplace transformations, differentiation and integral theorems, systems of linear differential equations, and partial differential equations. Students will gain a solid foundation in solving and analyzing linear differential equations relevant to aerospace systems.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Solve first and higher-order linear differential equations using various techniques.**
2. **Apply Laplace transformations to analyze dynamic systems.**
3. **Understand the behavior of linear systems through differentiation and integral theorems.**
4. **Model and solve partial differential equations relevant to aerospace phenomena.**

Course Structure:

1. **Introduction to Differential Equations (10 credits):**
    - First-order differential equations.
    - Higher-order linear differential equations.
    - Power series solutions.
2. **Laplace Transformations (15 credits):**
    - Laplace domain representation.
    - Inverse Laplace transforms.
    - Transfer functions and system response.
3. **Systems of Linear Differential Equations (12 credits):**
    - Matrix methods for solving systems.
    - Eigenvalues and eigenvectors.
    - Stability analysis.
4. **Partial Differential Equations (8 credits):**
    - Introduction to partial differential equations.
    - Classification (elliptic, parabolic, hyperbolic).
    - Boundary value problems.

Prerequisites:

- Basic knowledge of calculus and ordinary differential equations.

Assessment:

Assessment methods include exams, problem-solving assignments, and projects.

Course Title: Calculus III for Engineers

Course Description:

Calculus III builds upon the foundational concepts from Calculus I and II, emphasizing multivariable calculus and vector analysis. Students delve into three-dimensional space, partial derivatives, multiple integrals, and vector calculus. The course prepares engineers to apply advanced mathematical techniques in various engineering disciplines.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Analyze functions of several variables using partial derivatives.**
2. **Evaluate multiple integrals over regions in space.**
3. **Understand vector fields, line integrals, and surface integrals.**
4. **Apply calculus techniques to solve engineering problems.**

Course Structure:

1. **Multivariable Calculus**
    - Partial derivatives and gradients.
    - Tangent planes and directional derivatives.
    - Optimization in multivariable functions.
2. **Multiple Integrals**
    - Double integrals over rectangular and non-rectangular regions.
    - Triple integrals in Cartesian, cylindrical, and spherical coordinates.
    - Applications in volume, mass, and center of mass calculations.
3. **Vector Calculus**
    - Vector fields and divergence.
    - Line integrals and Green's theorem.
    - Surface integrals and Stokes' theorem.

Prerequisites:

- Successful completion of Calculus I and II.

Assessment:

Assessment methods include exams, problem-solving assignments, and applications to engineering problems.

Course Title: Engineering Physics II

Course Description:

Engineering Physics II builds upon the foundational concepts from Engineering Physics I, emphasizing advanced topics in physics relevant to aerospace engineering. Students will explore electromagnetism, quantum mechanics, and thermodynamics. The course provides essential knowledge for understanding physical phenomena encountered in aerospace systems.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Apply principles of electromagnetism to analyze electrical circuits and electromagnetic waves.**
2. **Understand quantum mechanics concepts related to atomic and subatomic particles.**
3. **Analyze thermodynamic processes and their applications in engineering systems.**

Course Structure:

1. **Electromagnetism**
   - Maxwell's equations and electromagnetic waves.
   - Electric circuits, capacitors, and inductors.
   - Antennas and radiation.
2. **Quantum Mechanics**
   - Wave-particle duality.
   - Schrödinger equation and quantum states.
   - Quantum mechanics applications in materials science.
3. **Thermodynamics**
   - Laws of thermodynamics.
   - Heat engines, refrigeration cycles, and entropy.
   - Applications in propulsion systems and energy conversion.

Prerequisites:

- Successful completion of Engineering Physics I or equivalent.

Assessment:

Assessment methods include exams, problem-solving assignments, and laboratory experiments.

Course Title: Statics

Course Description:

Statics is a fundamental engineering course that focuses on the equilibrium of rigid bodies and the analysis of forces acting on them. Students learn how to apply Newton's laws of motion to solve problems related to structures, machines, and aerospace systems.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Analyze forces and moments in static equilibrium.**
2. **Apply free body diagrams to solve engineering problems.**
3. **Understand the principles of truss analysis and structural stability.**
4. **Evaluate frictional forces and their impact on mechanical systems.**

Course Structure:

1. **Introduction to Statics :**
    - Basic concepts: forces, moments, and equilibrium.
    - Vector representation of forces.
    - Resultant forces and couples.
2. **Two-Dimensional Statics:**
    - Equilibrium equations for particles and rigid bodies.
    - Free body diagrams and force analysis.
    - Applications to beams, frames, and trusses.
3. **Friction and Applications:**
    - Types of friction (static and kinetic).
    - Frictional forces in mechanical systems.
    - Belt and pulley systems.
4. **Structural Analysis:**
    - Truss analysis using method of joints and method of sections.
    - Stability of structures.
    - Center of gravity and centroids.

Prerequisites:

- Basic knowledge of physics and mathematics.

Assessment:

Assessment methods include exams, problem-solving assignments, and laboratory exercises.

Course Title: Aerospace Fundamentals

Course Description:

Aerospace Fundamentals provides an introductory overview of key concepts in aeronautical and astronautical engineering. Students gain foundational knowledge necessary for more advanced aerospace courses. The course covers fundamental principles related to flight, aerodynamics, materials, propulsion, and space exploration.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Understand the basic principles of flight and aerodynamics.**
2. **Analyze forces acting on aircraft and spacecraft.**
3. **Explore materials used in aerospace engineering.**
4. **Examine propulsion systems and their applications.**
5. **Discuss space exploration and its challenges.**

Course Structure:

1. **Introduction to Aerospace Engineering:**
    - Historical overview of aviation and space exploration.
    - Role of aerospace engineers in industry and research.
2. **Aerodynamics:**
    - Lift, drag, and thrust.
    - Bernoulli's principle and airfoil design.
    - Introduction to computational fluid dynamics (CFD).
3. **Materials for Aerospace Applications:**
    - Properties of metals, composites, and ceramics.
    - Material selection criteria for structural components.
    - High-temperature materials for reentry and propulsion.
4. **Propulsion Systems:**
    - Jet engines, rockets, and electric propulsion.
    - Thrust-to-weight ratio and specific impulse.
    - Environmental impact of propulsion technologies.
5. **Space Exploration:**
    - Orbital mechanics and celestial navigation.
    - Challenges of human spaceflight and robotic missions.
    - Future trends in space exploration.

Prerequisites:

- Basic knowledge of physics and mathematics.

Assessment:

Assessment methods include exams, problem-solving assignments, and group projects.

Course Title: Topics in Linear Algebra

Course Description:

"Topics in Linear Algebra" delves into advanced concepts beyond the basics of linear algebra. Students explore specialized areas and applications related to matrices, vector spaces, and linear transformations. The course aims to deepen understanding and provide practical insights for various disciplines.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Apply advanced matrix operations and transformations.**
2. **Analyze specialized vector spaces and their properties.**
3. **Explore applications in fields such as data science, optimization, and quantum mechanics.**

Course Structure:

1. **Matrix Decompositions (10 credits):**
   - Eigenvalue decomposition.
   - Singular value decomposition (SVD).
   - Jordan canonical form.
2. **Vector Spaces Beyond R^n (15 credits):**
   - Complex vector spaces.
   - Function spaces (e.g., functionals, polynomials).
   - Inner product spaces.
3. **Applications and Extensions (12 credits):**
   - Principal component analysis (PCA) and dimensionality reduction.
   - Linear programming and optimization.
   - Quantum mechanics and linear operators.

Prerequisites:

- Solid understanding of basic linear algebra concepts.

Assessment:

Assessment methods include exams, problem-solving assignments, and projects related to specific applications.

Course Title: Thermodynamics I

Course Description:

Thermodynamics I introduces fundamental concepts related to energy, heat transfer, and thermodynamic systems. Students explore the behavior of gases, liquids, and solids, as well as the laws governing energy transformations. The course provides a solid foundation for understanding engineering processes and systems.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Apply the first and second laws of thermodynamics to analyze energy interactions.**
2. **Understand properties of pure substances and ideal gases.**
3. **Evaluate heat transfer mechanisms (conduction, convection, radiation).**
4. **Solve problems related to work, efficiency, and energy cycles.**

Course Structure:

1. **Introduction to Thermodynamics:**
    - Basic definitions (system, surroundings, boundary).
    - State variables (pressure, temperature, volume).
    - Thermodynamic processes (isothermal, adiabatic, etc.).
2. **Energy and Heat Transfer:**
    - First law of thermodynamics (energy conservation).
    - Heat transfer mechanisms (conduction, convection, radiation).
    - Energy balance in closed and open systems.
3. **Properties of Substances:**
    - Ideal gas law and real gas behavior.
    - Specific heats and enthalpy.
    - Phase transitions and phase diagrams.
4. **Work and Efficiency:**
    - Work done by gases and other systems.
    - Efficiency of heat engines and refrigerators.
    - Carnot cycle and its limitations.

Prerequisites:

- Basic knowledge of physics and calculus.

Assessment:

Assessment methods include exams, problem-solving assignments, and laboratory experiments.

Course Title: Dynamics

Course Description:

“Dynamics” explores the motion of particles and rigid bodies, emphasizing kinematics, kinetics, and the principles of energy and momentum. Students delve into the behavior of aerospace systems, understanding forces, accelerations, and motion in three dimensions.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Analyze the motion of particles and rigid bodies using kinematics and kinetics.**
2. **Apply principles of work, energy, and momentum to engineering problems.**
3. **Understand rotational dynamics and gyroscopic effects.**
4. **Solve complex aerospace dynamics scenarios.**

Course Structure:

1. **Kinematics of Particles:**
    - Rectilinear and curvilinear motion.
    - Normal and tangential coordinates.
    - Relative motion and constrained motion.

2. **Kinetics of Particles and Rigid Bodies:**
    - Newton’s second law and equations of motion.
    - Rotational motion and angular momentum.
    - Gyroscopic effects in aerospace systems.
3. **Energy and Momentum Principles:**
    - Work-energy theorem and conservation of energy.
    - Impulse and momentum.
    - Applications to spacecraft maneuvers and aircraft dynamics.
4. **Three-Dimensional Dynamics:**
    - Motion in three dimensions.
    - Euler angles and quaternion representations.
    - Orbital dynamics and celestial mechanics.

Prerequisites:

- Solid understanding of physics and calculus.

Assessment:

Assessment methods include exams, problem-solving assignments, and practical simulations.

Course Title: Technical and Professional Writing

Course Description:

Technical and Professional Writing prepares students to produce effective documents for various contexts, including business, engineering, and technology. The course emphasizes clarity, precision, and reader-centered communication. Students learn to create well-organized, informative, and persuasive documents tailored to specific audiences.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Demonstrate rhetorical knowledge to create effective technical writing documents for end-users.**
2. **Apply flexible writing process strategies to produce clear, high-quality deliverables in various genres.**
3. **Use professional conventions for clean and clear design, style, and layout of written materials.**
4. **Gather and apply researched information appropriate to their field, citing sources correctly.**

Course Structure:

1. **Introduction to Technical Writing (10 credits):**
    - Understanding the purpose and audience of technical documents.
    - Analyzing writing contexts and genres (reports, feasibility studies, proposals).
2. **The Writing Process (15 credits):**
    - Strategies for planning, drafting, revising, and editing.
    - Adapting writing techniques to different genres and purposes.

3. **Ensuring Clarity and Readability (12 credits):**
    - Simplifying complex information.
    - Using plain language and avoiding jargon.
    - Proofreading and error correction.
4. **The Mechanics of Writing (8 credits):**
    - Grammar, punctuation, and sentence structure.
    - Consistent formatting and citation styles (APA, MLA, etc.).
5. **Structuring Information for Better Understanding (10 credits):**
    - Organizing content logically (headings, subheadings, lists).
    - Visual aids (tables, graphs, diagrams) for clarity.
6. **Designing Your Document (10 credits):**
    - Layout, fonts, and visual hierarchy.
    - Creating user-friendly documents (user manuals, instructions, technical reports).

Prerequisites:

- None; open to all students interested in improving their technical writing skills.

Assessment:

Assessment methods include writing assignments, peer reviews, and a final project.

Course Title: Mechanics of Materials

Course Description:

"Mechanics of Materials" explores the behavior of solid materials under various loads and stresses. Students learn how to analyze and design structures, considering factors such as strength, deformation, and failure. The course provides essential knowledge for engineering applications in aerospace, civil, and mechanical fields.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Analyze stress and strain in materials subjected to different loading conditions.**
2. **Understand material properties, including elasticity, plasticity, and fracture mechanics.**
3. **Design and assess structural components for safety and efficiency.**
4. **Apply principles of mechanics to real-world engineering problems.**

Course Structure:

1. **Introduction to Mechanics of Materials:**
    - Stress and strain definitions.
    - Hooke's law and material behavior.
    - Axial loading and deformation.
2. **Mechanical Properties of Materials:**
    - Elastic and plastic deformation.
    - Yield strength, ultimate strength, and toughness.

- Fatigue and creep behavior.
3. **Stress Analysis:**
   - Analysis of beams and columns.
   - Torsion and shear stress.
   - Combined loading and Mohr's circle.
4. **Deflection and Stability:**
   - Deflection of beams and shafts.
   - Buckling and stability analysis.
   - Design considerations for safety.

Prerequisites:

- Basic knowledge of statics and calculus.

Assessment:

Assessment methods include exams, problem-solving assignments, and laboratory experiments.

Course Title: Introduction to Numerical Analysis

Course Description:

"Introduction to Numerical Analysis" analyzes the basic techniques for efficiently solving problems in science and engineering using numerical methods. The course covers a range of topics, including root finding, interpolation, approximation of functions, integration, differential equations, and direct and iterative methods in linear algebra.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Apply numerical techniques for root finding and interpolation.**
2. **Approximate functions using appropriate methods.**
3. **Solve ordinary differential equations using numerical approaches.**
4. **Understand direct and iterative methods for solving linear algebraic systems.**

Course Structure:

1. **Root Finding and Interpolation (10 credits):**
   - Bisection method, Newton-Raphson method.
   - Polynomial interpolation (Lagrange, Newton).
   - Error analysis and convergence.
2. **Approximation of Functions (15 credits):**
   - Least squares approximation.
   - Chebyshev approximation.
   - Spline interpolation.
3. **Numerical Integration (12 credits):**
   - Trapezoidal rule, Simpson's rule.
   - Gaussian quadrature.
   - Adaptive methods.

4. **Ordinary Differential Equations (8 credits):**
    - Euler's method, Runge-Kutta methods.
    - Stability and stiffness.
    - Boundary value problems.
5. **Linear Algebraic Systems (10 credits):**
    - Gaussian elimination.
    - Iterative methods (Jacobi, Gauss-Seidel).
    - Eigenvalue problems.

Prerequisites:

- Basic knowledge of calculus and linear algebra.

Assessment:

Assessment methods include exams, problem-solving assignments, and practical implementations using software tools (e.g., MATLAB).

Course Title: Fundamentals of Electrical Engineering

Course Description:

"Fundamentals of Electrical Engineering" provides an introduction to essential concepts in electrical engineering. Students explore fundamental principles related to circuits, electromagnetism, and electronic devices. The course lays the groundwork for more advanced topics in electrical and electronic engineering.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Analyze basic DC and AC circuits using Kirchhoff's laws and network theorems.**
2. **Understand the behavior of passive components (resistors, capacitors, inductors).**
3. **Apply principles of electromagnetism to analyze magnetic fields and inductance.**
4. **Explore semiconductor devices and their applications.**

Course Structure:

1. **Introduction to Electrical Engineering:**
    - Historical overview and relevance of electrical engineering.
    - Units, measurements, and safety considerations.
2. **DC Circuits:**
    - Ohm's law and voltage-current relationships.
    - Circuit analysis techniques (nodal analysis, mesh analysis).
    - Thevenin and Norton equivalents.
3. **AC Circuits:**
    - Sinusoidal waveforms and phasors.
    - Impedance and complex power.
    - AC circuit analysis (RLC circuits).

4. **Electromagnetism:**
    - Magnetic fields, flux, and Faraday's law.
    - Self-inductance and mutual inductance.
    - Applications in transformers and motors.
5. **Semiconductor Devices (10 credits):**
    - Diodes, transistors, and operational amplifiers.
    - Digital logic gates and basic digital circuits.
    - Introduction to integrated circuits.

Prerequisites:

- Basic knowledge of physics and algebra.

Assessment:

Assessment methods include exams, laboratory experiments, and design projects.

Course Title: Thermodynamics II

Course Description:

"Thermodynamics II" builds upon the foundational concepts from Thermodynamics I, delving deeper into advanced topics related to energy transfer, phase equilibrium, and thermodynamic cycles. Students explore real-world applications and gain a more comprehensive understanding of thermodynamic processes.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Analyze complex thermodynamic systems using the second law of thermodynamics.**
2. **Understand phase transitions, vapor-liquid equilibrium, and chemical reactions.**
3. **Apply thermodynamic principles to power cycles (Rankine, Brayton) and refrigeration cycles.**
4. **Evaluate the efficiency and performance of energy conversion processes.**

Course Structure:

1. **Entropy and the Second Law:**
    - Entropy change in reversible and irreversible processes.
    - Carnot cycle and its efficiency.
    - Entropy generation and availability.
2. **Phase Equilibrium and Chemical Reactions:**
    - Vapor-liquid equilibrium (Raoult's law, Henry's law).
    - Chemical potential and fugacity.
    - Reaction equilibrium and equilibrium constants.
3. **Power Cycles:**
    - Rankine cycle (steam power plants).
    - Brayton cycle (gas turbines).
    - Combined cycles and cogeneration.

4. **Refrigeration and Heat Pump Cycles:**
    - Vapor compression refrigeration.
    - Absorption refrigeration.
    - Coefficient of performance (COP).

Prerequisites:

- Successful completion of Thermodynamics I or equivalent.

Assessment:

Assessment methods include exams, problem-solving assignments, and design projects related to energy systems.

Course Title: Aerodynamics I and Lab

Course Description:

"Aerodynamics I and Lab" provides an in-depth understanding of fluid dynamics as applied to aerospace engineering. Students explore the principles governing airfoil behavior, lift, drag, and stability. The accompanying lab sessions allow practical application of theoretical concepts through experiments and simulations.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Analyze airfoil behavior and aerodynamic forces using fundamental principles.**
2. **Understand boundary layers, flow separation, and stall phenomena.**
3. **Apply computational tools and wind tunnel experiments to study aerodynamic performance.**
4. **Design and optimize airfoil shapes for specific applications.**

Course Structure:

1. **Introduction to Aerodynamics:**
    - Basic concepts: lift, drag, and circulation.
    - Airfoil terminology and nomenclature.
    - Aerodynamic coefficients.
2. **Airfoil Theory:**
    - Thin airfoil theory (Kutta-Joukowski theorem).
    - Lift distribution and circulation.
    - Prandtl lifting-line theory.
3. **Boundary Layers and Flow Separation:**
    - Laminar and turbulent boundary layers.
    - Transition and separation points.
    - Stall characteristics.
4. **Wind Tunnel Experiments:**
    - Wind tunnel design and instrumentation.
    - Lift and drag measurements.
    - Airfoil performance analysis.

5. **Computational Aerodynamics:**
    - Panel methods and vortex lattice methods.
    - Computational fluid dynamics (CFD) simulations.
    - Airfoil design optimization.

Prerequisites:

- Successful completion of Fluid Mechanics and Thermodynamics courses.

Assessment:

Assessment methods include exams, lab reports, and design projects related to airfoil performance.

Course Title: Aerospace Systems

Course Description:

"Aerospace Systems" provides an in-depth exploration of integrated aerospace systems, covering both theoretical concepts and practical applications. Students gain insights into the design, analysis, and operation of complex aerospace systems, including aircraft, spacecraft, and unmanned vehicles.

Learning Outcomes:

By the end of this course, students will be able to:

1. Understand the interdisciplinary nature of aerospace systems, including mechanical, electrical, and software components.
2. Analyze system requirements, interfaces, and interactions.
3. Apply systems engineering principles to real-world aerospace projects.
4. Evaluate system performance, reliability, and safety.

Course Structure:

1. **Introduction to Aerospace Systems:**
    - Overview of aerospace domains (aviation, space exploration, drones).
    - Historical context and technological advancements.
2. **Systems Engineering Fundamentals:**
    - Requirements analysis and system architecture.
    - Trade-offs, constraints, and optimization.
    - Verification and validation.
3. **Aircraft Systems:**
    - Avionics, flight control, and navigation.
    - Propulsion systems (jet engines, turboprops).
    - Environmental control and life support.
4. **Spacecraft Systems:**
    - Orbital mechanics and mission design.
    - Payload integration and communication.
    - Thermal management and radiation shielding.
5. **Unmanned Aerial Systems:**

- Drone technology and applications.
- Autonomy, sensors, and data processing.
- Regulatory considerations.

Prerequisites:

- Basic knowledge of aerospace engineering and relevant disciplines.

Assessment:

Assessment methods include exams, group projects, and case studies related to aerospace systems.

Course Title: Aerodynamics II

Course Description:

"Aerodynamics II" builds upon the foundational concepts from "Aerodynamics I," delving deeper into advanced topics related to fluid dynamics and aerodynamic performance. Students explore real-world applications, including airfoil design, compressible flow, and high-speed aerodynamics.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Analyze compressible flow behavior using fundamental principles.**
2. **Understand shock waves, expansion waves, and supersonic flow.**
3. **Apply computational tools and wind tunnel experiments to study high-speed aerodynamics.**
4. **Design and optimize airfoils and wings for specific applications.**

Course Structure:

1. **Compressible Flow:**
    - Isentropic flow and Mach number.
    - Normal and oblique shock waves.
    - Supersonic and hypersonic aerodynamics.
2. **Airfoil Design and Performance:**
    - Transonic flow and critical Mach number.
    - Airfoil thickness and camber considerations.
    - Lift, drag, and wave drag.
3. **Wind Tunnel Experiments:**
    - High-speed wind tunnel testing.
    - Shock wave visualization.
    - Boundary layer control.
4. **Computational Aerodynamics:**
    - Euler equations and Navier-Stokes equations.
    - Computational fluid dynamics (CFD) simulations.

    - Aerodynamic optimization.

Prerequisites:

- Successful completion of “Aerodynamics I” or equivalent.

Assessment:

Assessment methods include exams, lab reports, and design projects related to high-speed aerodynamics.

Course Title: Flight Dynamics

Course Description:

“Flight Dynamics” explores the behavior of aircraft in flight, focusing on the principles governing their motion, stability, and control. Students delve into aerodynamic forces, aircraft performance, and flight control systems. The course provides essential knowledge for aerospace engineers and pilots.

Learning Outcomes:

By the end of this course, students will be able to:

1. Analyze the motion of aircraft in various flight conditions.
2. Understand aerodynamic forces (lift, drag, thrust, weight) and their effects.
3. Evaluate aircraft performance parameters (range, endurance, climb rate).
4. Apply principles of stability and control to flight maneuvers.

Course Structure:

1. **Introduction to Flight Dynamics:**
    - Overview of flight regimes (takeoff, climb, cruise, descent, landing).
    - Aircraft coordinate systems and reference frames.
    - Equations of motion for aircraft.
2. **Aerodynamic Forces and Moments:**
    - Lift and drag forces.
    - Pitch, roll, and yaw moments.
    - Stability derivatives.
3. **Aircraft Performance:**
    - Power and thrust requirements.
    - Range and endurance calculations.
    - Climb performance and service ceiling.
4. **Longitudinal and Lateral Stability:**
    - Static stability and dynamic stability.
    - Control surfaces (ailerons, elevators, rudder).
    - Dutch roll, phugoid, and spiral modes.

Prerequisites:

- Successful completion of Aerodynamics I and Aircraft Design courses.

Assessment:

Assessment methods include exams, flight simulations, and design projects related to flight dynamics.

Course Title: Orbital Mechanics

Course Description:

"Orbital Mechanics" explores the fundamental principles governing the motion of objects in space. Students delve into the dynamics of celestial bodies, spacecraft trajectories, and mission design. The course covers topics related to two-body motion, perturbations, and interplanetary transfers.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Analyze the motion of satellites and planets using Kepler's laws and Newtonian mechanics.**
2. **Design and characterize planet-centered orbits considering perturbations and transfer maneuvers.**
3. **Model orbital perturbations, Earth-bound and interplanetary trajectories, and gravity-assist maneuvers.**
4. **Apply analytical and numerical methods for orbit propagation and determination.**

Course Structure:

1. **Two-Body Motion:**
    - Kepler's laws and orbital elements.
    - Trajectory equations and energy.
    - Circular, elliptical, and hyperbolic orbits.
2. **Orbital Perturbations:**
    - Atmospheric drag and solar radiation pressure.
    - Earth-bound and interplanetary trajectory design.
    - Gravity-assist maneuvers.
3. **Orbit Propagation and Determination):**
    - Analytical methods for orbit prediction.
    - Numerical techniques (e.g., Runge-Kutta) for orbit propagation.
    - Orbit determination from observations.
4. **Satellite Attitude Dynamics:**
    - Modeling and applications of spacecraft attitude control.
    - Introduction to libration points and dynamical system theory.

Course Title: Aerospace Structures I

Course Description:

"Aerospace Structures I" introduces fundamental principles related to the analysis and design of aircraft and spacecraft structures. Students explore the behavior of thin-walled members, stress and strain relationships, and structural components. The course covers topics such as shear force, bending moment, and experimental strain measurement.

Learning Outcomes:

By the end of this course, students will be able to:

1. Estimate forces and moments applied over an aircraft's flight envelope.
2. Create free-body diagrams of aircraft internal and external structures using vector algebra.
3. Solve for forces and moments applied to typical internal aircraft members.
4. Construct shear force and bending moment diagrams for cantilevered wings under various loads.
5. Understand the principles of strain gage technology and its application.
6. Compute area properties (centroid and moments of inertia) for two-dimensional wing and fuselage cross sections.
7. Calculate shear stress and angle of twist in shaft-type structures subjected to torsion.
8. Apply Mohr's Circle to determine maximum principal stresses.
9. Collaborate effectively in teams to design, execute, and analyze results from lab problems.

Course Topics:

1. Introduction to Flight Vehicle Structures
2. Forces Acting on an Aircraft
3. Statically Determinate and Indeterminate Structures
4. Landing Gear
5. Energy Methods of Structural Analysis
6. Introduction to Theory of Elasticity – Stress
7. Introduction to Theory of Elasticity – Strain

Required Texts/Readings:

- Beer and Johnston, "Statics and Mechanics of Materials," 3rd edition, Elsevier
- Peery and Azar, "Aircraft Structures," Mc Graw Hill
- Bruhn, "Analysis and Design of Flight Vehicle Structures"
- Donaldson, "Analysis of Aircraft Structures"
- Rivello, "Theory and Analysis of Flight Structures"
- Niu, "Airframe Stress Analysis and Sizing"
- Lomax, "Structural Loads Analysis for Commercial Transport Aircraft: Theory and Practice"
- Cutler, "Understanding Aircraft Structures"
- Bisplinghoff, Ashley, and Halfman, "Aeroelasticity"
- Sarafin, "Spacecraft Structures and Mechanisms: From Concept to Launch"

Course Title: Engineering Physiology and Lab

Course Description:

"Engineering Physiology and Lab" provides a comprehensive understanding of physiological principles relevant to engineering applications. Students explore the interactions between biological systems and external factors, emphasizing quantitative analysis and experimental techniques. The accompanying lab sessions allow practical application of theoretical concepts through experiments and simulations.

Learning Outcomes:

By the end of this course, students will be able to:

1. **Apply knowledge of mathematics, physics, and engineering to cellular and systems physiology.**
2. **Understand physiological function, dysfunction, and the mechanisms underlying treatment.**
3. **Analyze physiological responses to environmental stressors (e.g., temperature, altitude, radiation).**
4. **Evaluate the impact of physiological factors on engineering design and safety.**

Course Structure:

1. **Introduction to Physiology**
    - Overview of human physiology and homeostasis.
    - Cellular structure and function.
    - Membrane transport mechanisms.
2. **Cardiovascular and Respiratory Systems**
    - Blood circulation, cardiac output, and blood pressure.
    - Gas exchange, lung mechanics, and respiratory control.
    - Physiological responses to exercise and altitude.
3. **Biomechanics and Musculoskeletal System**
    - Skeletal structure, joints, and muscle function.
    - Biomechanical analysis of movement.
    - Ergonomics and workplace design.
4. **Environmental Physiology**
    - Heat stress, cold stress, and thermoregulation.
    - Radiation exposure and biological effects.
    - Space physiology and microgravity.

Laboratory Sessions:

1. **Experimental Techniques**
    - Measurement of physiological parameters (heart rate, blood pressure, oxygen consumption).
    - Data acquisition and analysis using sensors and instrumentation.
    - Simulation of physiological responses in controlled environments.
2. **Human Performance Assessment**
    - Exercise testing and fitness evaluation.
    - Ergonomic assessments and workplace design.
    - Safety considerations in extreme environments.

Prerequisites:

- Basic knowledge of biology, physics, and engineering.

Assessment:

Assessment methods include exams, lab reports, and design projects related to engineering physiology.

Course Title: Aerospace Dynamics III

Course Description

Aerospace Dynamics III builds upon foundational knowledge from earlier courses. It delves deeper into the dynamics of aerospace systems, emphasizing advanced topics and practical applications.

Topics Covered

Aerodynamics

- Unsteady aerodynamics
- Vortex dynamics
- Aeroelasticity
- High-speed flows

Structures and Materials

- Advanced materials for aerospace structures
- Structural dynamics
- Fatigue and fracture mechanics

Dynamics and Control

- Flight dynamics
- Stability and control
- Aircraft handling qualities
- Control system design

Systems and Design

- Multidisciplinary design optimization
- Integration of subsystems (propulsion, avionics, etc.)
- Reliability and safety considerations

Assessment

- Regular assignments, quizzes, and exams
- Group projects and presentations
- Individual research or design projects

Recommended Reading List

- T. A. Ward, *Introduction to Flight Dynamics*, AIAA Education Series.
- E. H. Dowell, *Aeroelasticity of Plates and Shells*, Dover Publications.
- J. Roskam, *Airplane Flight Dynamics and Automatic Flight Controls*, DARcorporation.

Course Title: Aerospace Propulsion

Course Description

This course focuses on the principles, design, and performance of propulsion systems used in aerospace applications. Students will explore both air-breathing (jet engines) and rocket engines, considering functional requirements, environmental limitations, and engineering constraints.

Topics Covered

Air-Breathing Engines

- Gas turbine engines (turbojets, turbofans, turboprops)
- Thermodynamics of compressors, combustion chambers, and turbines
- Propulsion cycle analysis
- Performance parameters (thrust, specific fuel consumption)

Rocket Propulsion

- Chemical rockets (liquid and solid propellants)
- Rocket propulsion cycles (open and closed cycles)
- Nozzles and exhaust velocity
- Hybrid propulsion systems

Advanced Concepts

- Electric propulsion (ion thrusters, Hall-effect thrusters)
- Microthrusters for small satellites
- Environmental impact and emissions reduction

4. Assessment

- Regular assignments, quizzes, and exams
- Design projects related to propulsion system components
- Computational simulations and analysis

5. Recommended Reading List

- J. D. Mattingly, W. H. Heiser, and D. T. Pratt, *Aircraft Engine Design*, AIAA Education Series.
- G. C. Oates, *Aerothermodynamics of Gas Turbine and Rocket Propulsion*, AIAA Education Series.
- R. P. Hesketh, *Rocket Propulsion Elements*, Wiley.

Course Title: Aerospace Structures II

Course Description

In Aerospace Structures II, students delve deeper into the analysis and design of aerospace structures. The course covers advanced topics related to materials, structural assemblies, and dynamic behavior.

Topics Covered

Basic Concepts

- Design and failure criteria for aerospace structures
- Advanced strength of materials analysis for elastic structures
- Materials selection for aerospace applications

Structural Analysis

- Vibration and bending of plates and beams
- Analysis of aircraft skin structures
- Buckling and stability considerations

4. Assessment

- Regular assignments and problem-solving exercises
- Design projects related to structural components
- Computational simulations and analysis

5. Recommended Reading List

- J. N. Reddy, *Introduction to the Finite Element Method*, McGraw-Hill.
- D. J. Peery, *Aircraft Structures*, McGraw-Hill.
- N. E. Dowling, *Mechanical Behavior of Materials*, Pearson.

Course Title: Aerospace Design I

Course Description

Aerospace Design I introduces students to fundamental design methods and certification requirements in aerospace engineering. The course covers the design of essential aerospace structural components, including struts, bolts, lugs, rivets, undercarriages, engine moments, and external structures. Students will explore different loading conditions, such as design and off-design, gyroscopic effects, cyclic loads, vibrations, and landing scenarios.

Topics Covered

- Introduction to aerospace design principles
- Certification standards and regulations
- Design of structural components:
    - Struts
    - Bolts

    - Lugs
    - Rivets
    - Undercarriages
    - Engine moments
    - External structures
- Consideration of various loading conditions:
    - Design and off-design scenarios
    - Gyroscopic effects
    - Cyclic loads
    - Vibrations
    - Landing conditions

4. Assessment

- Regular assignments and design projects
- Practical application of design principles
- Evaluation of structural components under different loads

5. Recommended Reading List

- T. H. Megson, *Introduction to Aircraft Structural Analysis*, Butterworth-Heinemann.
- D. P. Raymer, *Aircraft Design: A Conceptual Approach*, AIAA Education Series.

Course Title: Aerospace Capstone Project A

Course Description

Aerospace Capstone Project A provides senior undergraduate students with a high-quality, hands-on experience in the practice of aerospace engineering. Students work on a requirements-based design project in self-directed teams, producing a prototype to satisfy a specific need or serve a particular purpose.

Topics

- Industry-sponsored or faculty-driven projects
- Conceiving, designing, implementing, operating, and documenting experimental projects
- Applying engineering skills to real-world challenges

Assessment

- Collaborative team projects
- Practical application of design principles
- Documentation and presentation of project outcomes

Recommended Reading List

- No specific reading list provided, as the focus is on practical application and project work.

Course Title: Engineering and Enterprise

Course Description

The **Engineering and Enterprise** course integrates engineering principles with business and entrepreneurial skills. Students explore the intersection of technical innovation, project management, and commercial viability within the aerospace industry.

Topics

- **Engineering Fundamentals:**
  - Core engineering concepts
  - Problem-solving techniques
  - Technical communication
- **Business and Entrepreneurship:**
  - Market analysis
  - Business models
  - Intellectual property
  - Project funding
- **Project Management:**
  - Planning and execution
  - Risk assessment
  - Team dynamics
- **Case Studies and Industry Insights:**
  - Real-world examples from aerospace companies
  - Guest lectures by industry professionals

Assessment

- Group projects (designing and pitching innovative solutions)
- Individual assignments (business plans, feasibility studies)
- Presentations and teamwork evaluations

Recommended Reading List

- No specific reading list provided, as the focus is on practical application and interdisciplinary learning.

Course Title: Aerospace Structural Dynamics

Course Description

Aerospace Structural Dynamics focuses on the dynamic behavior of aerospace structures. Students will study vibration, rigid body dynamics, and their applications to aerostructures. The course covers both theoretical concepts and practical analysis techniques.

Topics

- **Vibration Analysis:**
  - Single degree of freedom model
  - Free and forced vibration

    - Steady-state, impulse, and arbitrary loading
- **Rigid Body Dynamics:**
    - Structural response to external forces
    - Gyroscopic effects
    - Cyclic loads and vibrations

Assessment

- Regular assignments and problem-solving exercises
- Application of dynamic principles to real-world aerospace structures

Course Title: Aerospace Design II

Course Description

Aerospace Design II builds upon foundational knowledge from earlier courses. It focuses on advanced design principles and methodologies specific to aerospace engineering. Students will learn how to apply theoretical concepts to practical design challenges.

Topics

- **Advanced Design Methods:**
    - Multidisciplinary optimization
    - Conceptual design
    - Parametric modeling
- **Aerostructural Design:**
    - Wing design
    - Fuselage design
    - Landing gear systems
- **Design for Manufacturing and Assembly:**
    - Materials selection
    - Manufacturing processes
    - Assembly considerations

Assessment

- Individual and group design projects
- Evaluation of design solutions based on performance, safety, and manufacturability

Recommended Reading List

- J. D. Anderson, *Introduction to Flight*, McGraw-Hill.
- D. P. Raymer, *Aircraft Design: A Conceptual Approach*, AIAA Education Series.

Course Title: Robotics and Automation

Course Description

The **Robotics and Automation** course explores the principles, design, and implementation of robotic systems and automated processes. Students will learn about sensors, actuators, control algorithms, and programming techniques relevant to aerospace applications.

Topics

- **Introduction to Robotics:**
  - Robot kinematics and dynamics
  - Sensors (vision, lidar, IMU)
  - Robot programming (ROS, Python)
- **Automation Systems:**
  - PLCs (Programmable Logic Controllers)
  - Industrial automation
  - Process control
- **Applications in Aerospace:**
  - UAVs (Unmanned Aerial Vehicles)
  - Robotic assembly in manufacturing
  - Space exploration robots

Assessment

- Assignments, labs, and practical projects
- Design and implementation of robotic systems
- Collaborative teamwork

Recommended Reading List

- J. Craig, *Introduction to Robotics: Mechanics and Control*, Pearson.
- R. S. Dorf, *Introduction to Electric Circuits and Machines*, Wiley.

Course Title: Aerospace Capstone Project B

Course Description

Aerospace Capstone Project B is the culmination of the aerospace engineering program. It allows students to apply their knowledge and skills to a substantial project. Students work in teams or individually on industry-sponsored or faculty-driven projects related to aerospace systems, design, or research.

Topics

- **Project Selection and Proposal:**
  - Identifying project scope and objectives
  - Proposal development and approval
- **Project Execution:**
  - Detailed design and analysis
  - Prototyping and testing

    - Iterative refinement
- **Documentation and Presentation:**
    - Technical reports
    - Oral presentations
    - Demonstrating project outcomes

Assessment

- Evaluation based on project deliverables, teamwork, and technical proficiency

Recommended Reading List

- No specific reading list provided, as the focus is on practical application and project work.

Management and Business in Aerospace Engineering

Course Description

This course bridges technical expertise with managerial acumen in the aerospace industry. Students explore project management, financial principles, supply chain dynamics, entrepreneurship, legal aspects, and ethical considerations specific to aerospace ventures.

Learning Objectives:

1. Understand project lifecycles, risk assessment, and resource allocation.
2. Grasp financial principles for aerospace projects.
3. Explore supply chain dynamics and procurement strategies.
4. Cultivate an entrepreneurial mindset and evaluate market opportunities.
5. Navigate legal aspects and consider ethical dilemmas.

Topics Covered:

1. Project Management
2. Financial Management
3. Supply Chain and Logistics
4. Entrepreneurship
5. Legal and Regulatory Framework
6. Ethics and Sustainability

Assessment:

- Assignments and case studies
- Group projects
- Examinations

Recommended Reading:

1. "Project Management: A Systems Approach to Planning, Scheduling, and Controlling" by Harold Kerzner
2. "Financial Management for Engineers" by Frank Crundwell
3. "Supply Chain Management: Strategy, Planning, and Operation" by Sunil Chopra and Peter Meindl

Course Title: Space Mission Analysis and Design

Course Description: Covering space missions, law, safety, and systems engineering, this course is designed to further the careers of those in space organizations and graduates seeking careers in the space industry. Students will gain a detailed understanding of autonomous systems, underpinning the systems approach to mission analysis, design, and subsequent systems engineering of space vehicles and ground support. The course explores how the space sector is utilized by commercial and government organizations, enabling students to plan a space mission from inception to completion. Additionally, students learn how to manage a space mission within the constraints of legal and safety regulations.

Learning Objectives:

1. Conceptual mission design.
2. Defining top-level mission requirements.
3. Mission operational concepts.
4. Mission operations analysis and design.
5. Estimating space system costs.
6. Spacecraft design development, verification, and validation.

Topics Covered:

- Principles of mission design.
- Spacecraft systems and subsystems.
- Launch operations.
- Space law and regulations.
- Safety considerations.
- Autonomous systems in space missions.

Assessment:

- Assignments and projects.
- Examinations.
- Practical simulations.

Recommended Reading:

1. “Space Mission Engineering: The New SMAD” by James R. Wertz and Wiley J. Larson.
2. “Introduction to Space Systems: Design and Synthesis” by Miguel R. Aguirre.

Course Title: Space Systems

Course Description

Covering space missions, law, safety, and systems engineering, this course is designed to further the careers of those in space organizations and graduates seeking careers in the space industry. Students will gain a detailed understanding of autonomous systems, underpinning the systems approach to mission analysis, design, and subsequent systems engineering of space vehicles and ground support. The course explores how the space sector is utilized by commercial and government organizations, enabling students to plan a space mission from inception to completion. Additionally, students learn how to manage a space mission within the constraints of legal and safety regulations.

Learning Objectives:

1. Conceptual mission design.
2. Defining top-level mission requirements.
3. Mission operational concepts.
4. Mission operations analysis and design.
5. Estimating space system costs.
6. Spacecraft design development, verification, and validation.

Topics Covered:

- Principles of mission design.
- Spacecraft systems and subsystems.
- Launch operations.
- Space law and regulations.
- Safety considerations.
- Autonomous systems in space missions.

Assessment:

- Assignments and projects.
- Examinations.
- Practical simulations.

Recommended Reading:

1. "Space Mission Engineering: The New SMAD" by James R. Wertz and Wiley J. Larson.
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Course Title: Internship I & II

Course Description

These work-based internships provide students with practical experience within the aerospace industry. During both Internship I and II, students engage in 10-week summer placements, gaining insights into areas such as innovation, digital technologies, design, and manufacturing. Participants work across product lifecycles, exploring sustainable flight, ethical considerations, and artificial intelligence applications. Successful completion enhances employability and may lead to graduate program opportunities with industry leaders.

Learning Objectives:

1. Conceptualize and apply theoretical knowledge in real-world aerospace contexts.
2. Develop problem-solving skills through hands-on experience.
3. Collaborate with industry professionals and adapt to workplace dynamics.
4. Gain insights into industry practices, safety regulations, and ethical considerations.

Topics Covered:

- Industry-specific projects (e.g., aircraft design, propulsion systems, avionics).
- Safety protocols and risk management.
- Project management and teamwork.
- Legal and ethical aspects of aerospace engineering.

Assessment:

- Regular progress reports during the internship.
- Final presentation or report summarizing the experience.
- Evaluation by industry mentors.

Recommended Reading:

1. "Introduction to Aerospace Engineering" by Sean Clarke.
2. "Aerospace Engineering: From the Ground Up" by Ben Senson.

Course Title: Work-Based Learning I & II

Course Description

Work-Based Learning provides a flexible and cost-effective way for engineers to gain academic qualifications while remaining employed. These individually tailored programs integrate learning in the workplace with supervised professional development. Work-Based Learning I and II allow students to contribute to real-world projects within the aerospace industry. Participants gain practical insights into innovation, digital technologies, design, and manufacturing. The structured learning program is designed to meet company and employee aspirations without disrupting the workforce.

Learning Objectives:

1. Apply theoretical knowledge in real-world aerospace contexts.
2. Develop problem-solving skills through hands-on experience.
3. Collaborate with industry professionals and adapt to workplace dynamics.
4. Gain insights into industry practices, safety regulations, and ethical considerations.

Topics Covered:

- Industry-specific projects (e.g., aircraft design, propulsion systems, avionics).
- Safety protocols and risk management.
- Project management and teamwork.
- Legal and ethical aspects of aerospace engineering.

Assessment:

- Regular progress reports during the internship.
- Final presentation or report summarizing the experience.
- Evaluation by industry mentors.

Recommended Reading:

1. "Introduction to Aerospace Engineering" by Sean Clarke.
2. "Aerospace Engineering: From the Ground Up" by Ben Senson.

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