Bachelor of Engineering

Architectural Engineering

SPRINGFIELD RESEARCH UNIVERSITY

Bachelor of Engineering Architectural Engineering

MISSION STATEMENT

*The **SRU Bachelor of Engineering in Architectural Engineering** is dedicated to advancing the frontiers of science, engineering, and architecture. Our multidisciplinary program equips students to work at the intersection of architectural design and structural engineering. Through rigorous education, hands-on experiences, and ethical leadership, we empower graduates to apply engineering principles to the planning, design, and construction of the built environment. As future architects and engineers, our students contribute to sustainable, innovative, and resilient structures that enhance our society's well-being.*

The mission of the Bachelor of Engineering Architectural Engineering is to teach - integrating innovative technologies in structures to designing more resilient and environmentally friendly buildings, architectural engineers tackle challenges and technological innovations in the planning, designing, constructing and operation of buildings. At Springfield Research University, our Bachelor of Engineering in Architectural Engineering program prepares students for dynamic careers in the built environment. 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 architectural engineering.
    - Students gain a solid foundation in structural analysis, building materials, environmental systems, and sustainable design.
2. **Cutting-Edge Research**:
    - Our faculty and students actively contribute to advancing architectural 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 building performance analysis, 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 human well-being.
    - We empower them to make meaningful contributions to urban development, community resilience, and architectural aesthetics.

Integrating Knowledge Seamlessly

Our Bachelor of Engineering in Architectural Engineering program seamlessly integrates knowledge acquisition throughout the curriculum. Here's how we achieve this:

1. **Foundational Sciences**:
    - Students delve into core subjects such as structural mechanics, building physics, and construction materials.
    - These foundational sciences provide the essential groundwork for understanding building systems, load-bearing structures, and sustainable design principles.
2. **Applied Correlations**:

- Lectures and practical sessions correlate theoretical knowledge with real-world architectural scenarios.
- For instance, students learn about energy-efficient HVAC systems and immediately apply this knowledge in designing environmentally responsive buildings.

3. **Case-Based Learning**:
   - Real-world architectural cases serve as powerful teaching tools.
   - Students analyze building performance data, occupant comfort, and life safety considerations.
   - This approach bridges theory and practice, reinforcing architectural concepts.
4. **Simulated Design Experiences**:
   - Simulation labs replicate actual building design conditions.
   - Students practice architectural modeling, energy simulations, and structural analysis, honing their skills before working on real projects.
5. **Industry Collaborations and Internships**:
   - During industry placements and internships, students work directly with architectural professionals.
   - They apply theoretical knowledge in designing, evaluating, and retrofitting buildings.
6. **Cutting-Edge Research and Innovation**:
   - Students critically evaluate research articles, explore emerging technologies, and contribute to architectural advancements.
   - Evidence-based practices ensure that knowledge acquisition aligns with current best practices in architectural engineering.

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

Rationale for the Bachelor of Engineering in Architectural Engineering

At Springfield Research University, our Bachelor of Engineering in Architectural Engineering program is purposefully designed to prepare students for impactful careers in the built environment. 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 architectural design, construction, and sustainability.

National Needs (Eswatini):

1. **Quantitative Expertise**:
   - Eswatini requires skilled architectural professionals who can navigate complex scenarios in building design, structural analysis, and safety.
   - The program equips students with mathematical proficiency and critical thinking abilities to assess architectural conditions effectively.
2. **Cutting-Edge Practices**:
   - Graduates advocate for evidence-based decision-making, ensuring safety, efficiency, and equitable treatment in the construction industry.

- By enhancing their understanding of building materials, energy-efficient systems, and sustainable design, they contribute to better architectural 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 architectural challenges related to urbanization, infrastructure, and climate resilience.
    - The program aligns with SADC's goal of harmonizing architectural frameworks, promoting cooperation, and advancing sustainable building practices.
2. **Human Capital Development**:
    - Architectural professionals play a pivotal role in regional development and community well-being.
    - The program contributes to building a skilled workforce capable of addressing cross-border architectural complexities.
3. **Technological Advancements**:
    - SADC's prosperity relies on informed architectural practices that balance aesthetics, functionality, and environmental impact.
    - Our graduates contribute to maintaining architectural integrity, resolving design 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 architectural engineering.
    - Graduates not only assess technical data but also shape policies, regulations, and protocols that impact the built environment.
2. **Innovative Research**:
    - Students engage in specialized architectural research, addressing contemporary challenges such as sustainable design, urban planning, and resilient infrastructure.

Learning Outcomes for the Bachelor of Engineering in Architectural Engineering

The Bachelor of Engineering in Architectural Engineering program equips students with foundational, technical, and professional competencies essential for successful careers in the built environment. Upon degree completion, graduates will demonstrate the following abilities:

1. **Foundational Program Learning Outcomes**:
    - **Mathematical Proficiency**: Apply knowledge of mathematics, including differential equations, to solve complex architectural engineering problems.
    - **Physical Sciences Application**: Apply principles from physical sciences to address challenges in architectural engineering.
    - **Holistic Considerations**: Recognize and incorporate cultural, historical, and social behavior considerations, as well as contemporary issues, in developing, analyzing, and evaluating solutions to engineering and societal problems.
2. **Technical Program Learning Outcomes**:
    - **Engineering Problem Solving**:
        - Analyze and solve problems in engineering sciences, including mechanics of materials, thermodynamics, fluid dynamics, and electricity.
        - Conduct engineering laboratory and field experiments, analyze resulting data, and evaluate outcomes.
    - **System Design and Constraints**:
        - Design architectural systems or processes within realistic constraints, considering building codes, sustainability, health and safety, comfort, ethics, environmental impact, constructability, and economic factors.
        - Apply relevant knowledge, techniques, skills, and modern engineering tools to identify and formulate solutions for architectural engineering problems.
        - Apply basic principles to design, build, and operate mechanical, structural, and electrical systems in the context of architectural applications.
    - **Architectural Integration**:
        - Recognize and explain architectural design and history concepts, incorporating them into solving architectural engineering challenges.
        - Apply project management and construction management principles to the design, construction, and operation of architectural systems, adhering to regulations and standards.
        - Emphasize sustainability principles related to high-performance architectural buildings, energy efficiency, materials selection, and embedded systems.
3. **Technical Specialization**:
    - **Structural Building Systems Track**:
        - Analyze, design, and evaluate structural elements and systems using relevant building codes (e.g., IBC) and material standards (e.g., ACI, AISC).
    - **Mechanical Building Systems Track**:
        - Analyze and design HVAC, plumbing systems, and controls for buildings, considering energy performance, renewables, and ASHRAE standards.
        - Apply principles of engineering, fluid dynamics, thermodynamics, and building energy simulation.
4. **Professional Program Learning Outcomes**:
    - **Effective Communication**:
        - Organize and deliver effective verbal, written, quantitative, and graphical communications, including architectural drawings.
    - **Interdisciplinary Collaboration**:
        - Function effectively in interdisciplinary teams during the design and construction of architectural systems, applying leadership best practices.
    - **Lifelong Learning and Self-Direction**:

        - Understand the need for continuous learning and demonstrate self-directed study beyond formal instructions.
    - **Ethics and Global Perspective**:
        - Explain the role of professional licensure, globalization, business, and ethics in governing architectural engineering practice.

CAREER OPPORTUNITIES

Due to the diversity in study and adaptability in practice, architectural engineers are found in a wide variety of careers. In the private and government sector of the industry, their careers include architectural, structural building systems, mechanical building systems, HVAC systems, fire protection systems, electrical and lighting systems and building automation systems, as well as several managerial roles. With the increasing push for sustainability, the need for architectural engineers is more important than ever before.

The Faculty of Engineering and Electronics offers a Bachelor of Science in Architectural Engineering to prepare students to effectively design building systems (mechanical, electrical and lighting, fire protection, acoustics) and seamlessly integrate them with one another, providing creative solutions to modern and emerging challenges.

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 Architectural 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 Architectural 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 Architectural 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 Architectural 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 Architectural 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 Architectural. 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 Architectural engineering. Architectural Engineering courses simplifies the course numbering system.

I apologize for the oversight. Let's correct that! Here's the revised curriculum for Architectural Engineering:

1. **100-Level Courses:**
    - **ARC 101:** Introduction to Architectural Engineering
    - **ARC 110:** Linear Algebra for Architectural
    - **ARC 120:** Mechanics and Dynamics
2. **200-Level Courses:**
    - **ARC 201:** Architectural Structures
    - **ARC 210:** Building Systems and Technology
    - **ARC 220:** Materials Science for Architectural Engineering
3. **300-Level Courses:**
    - **ARC 301:** Environmental Systems in Architecture
    - **ARC 310:** Structural Analysis and Design
    - **ARC 320:** Architectural Acoustics and Lighting
4. **400-Level Courses:**

- **ARC 401:** Sustainable Design and Energy Efficiency
- **ARC 410**: Urban Planning and Design
- **ARC 420:** Advanced Topics in Architectural Engineering

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 Architectural 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
ARC000	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 architectural engineering.
    - **Quizzes and Short Tests**: Regular assessments on specific architectural engineering topics.
    - **Draft Assignments**: Receive feedback on early assignment drafts related to architectural 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 architectural engineering disciplines.
    - **End-of-Semester Projects**: Assess students' knowledge and problem-solving skills related to architectural engineering challenges.
    - **Oral Presentations**: Evaluate communication abilities within the context of architectural engineering solutions.
    - **Engineering Design Competitions**: Simulate real-world architectural engineering scenarios.
3. **Continuous Assessment (10%)**:
    - **Internships or Work Placements**: Engage in supervised architectural engineering placements, applying theoretical knowledge to practical projects.
    - **Assignments and Projects**: Regular tasks contribute to the overall grade, emphasizing practical skills in architectural engineering design and analysis.
    - **Research Papers**: Demonstrate research abilities related to architectural engineering innovations and advancements.
    - **Attendance and Active Participation**: Engage in lectures, workshops, and industry events specific to architectural 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

Architectural Engineering, ESQF Level 8 BE-ARC degree, typical course sequence

YEAR 1: SEMESTER 1

Code	Course	Lectures	Practicals	Credits
ARC100	General Chemistry I and Lab	**100**	**20**	**12**
ARC101	Calculus I	**120**	**0**	**12**
ARC102	Physics I – Mechanics	**100**	**20**	**12**
ARC103	Engineering Mathematics I	**100**	**20**	**12**
ARC104	Computing for Engineers and Scientists	**100**	**20**	**12**
ARC105	Design I	**100**	**20**	**12**
TOTAL				**72**

YEAR 1: SEMESTER 2

Code	Course	Lectures	Practicals	Credits
ARC106	Experimental Physics and Lab II – Mechanics	**100**	**20**	**12**
ARC107	Engineering Mathematics II	**120**	**0**	**12**
ARC108	Newtonian Mechanics for Engineering	**100**	**20**	**12**
ARC109	Fundamentals of Chemistry II	**100**	**20**	**12**
ARC110	Communication for Academic Purposes	**120**	**0**	**12**
ARC111	History of Building Technology and World Architecture	**120**	**0**	**12**
TOTAL				**72**

YEAR 2: SEMESTER 3

Code	Course	Lectures	Practicals	Credits
ARC212	Construction Graphics Communication	**100**	**20**	**12**
ARC213	Architectural Engineering Foundations	**100**	**20**	**12**
ARC214	Statics	**100**	**20**	**12**
ARC215	Electricity and Magnetism	**100**	**20**	**12**
ARC216	Engineering Mathematics III	**120**	**0**	**12**
ARC217	Communication for Professional Purposes	**120**	**0**	**12**
TOTAL				**72**

YEAR 2: SEMESTER 4

Code	Course	Lectures	Practicals	Credits
ARC218	Technical and Professional Writing	**100**	**20**	**12**
ARC219	Computer Applications in Construction	**100**	**20**	**12**
ARC220	Mechanics of Materials	**100**	**20**	**12**
ARC221	Materials Engineering for Civil Engineers	**100**	**20**	**12**
ARC222	Differential Equations	**120**	**0**	**12**
ARC223	History & Theory of Modern & Contemporary Architecture	**100**	**20**	**12**
TOTAL				**72**

YEAR 3: SEMESTER 5

Code	Course	Lectures	Practicals	Credits

ARC324	Architectural Engineering Systems	**100**	**20**	**12**
ARC325	Project Management for Facility Managers	**100**	**20**	**12**
ARC326	Materials of Construction	**100**	**20**	**12**
ARC327	Theory of Structures	**100**	**20**	**12**
ARC328	Principles of Thermodynamics	**100**	**20**	**12**
ARC329	Internship I	**0**	**120**	**12**
TOTAL				**72**

YEAR 3: SEMESTER 6

Code	Course	Lectures	Practicals	Credits
ARC330	Mechanical Systems for Buildings	**100**	**20**	**12**
ARC331	Social Issues in the History of the Construction Environment	**100**	**20**	**12**
ARC332	Fluid Dynamics	**100**	**20**	**12**
ARC333	Principles of Building Energy Analysis	**100**	**20**	**12**
ARC334	Principles of Electrical Engineering	**100**	**20**	**12**
ARC335	Internship II	**0**	**120**	**12**
TOTAL				**72**

YEAR 4: SEMESTER 7

Code	Course	Lectures	Practicals	Credits
ARC436	Lighting Engineering for Buildings	**100**	**20**	**12**
ARC437	Architectural Engineering Design I	**100**	**20**	**12**
ARC438	Structural Concrete Design	**100**	**20**	**12**
ARC439	Renewable Energy Systems	**100**	**20**	**12**
ARC440	Engineering and Enterprise	**120**	**0**	**12**
ARC441	Architectural Project I	**0**	**120**	**12**
TOTAL				**72**

YEAR 4: SEMESTER 8

Code	Course	Lectures	Practicals	Credits
ARC442	Architectural Engineering Design II	**100**	**20**	**12**
ARC443	Structural Steel Design	**100**	**20**	**12**
ARC444	Applied Heat and Mass Transfer	**100**	**20**	**12**
ARC445	Computational Fluid Dynamics	**100**	**20**	**12**
ARC446	Work based Learning	**0**	**120**	**12**
ARC447	Architectural Project II	**0**	**120**	**12**
TOTAL				**72**

COURSE DESCRIPTIONS

GENERAL CHEMISTRY FOR ENGINEERING STUDENTS

Introduction to important concepts and principles of chemistry; emphasis on areas considered most relevant in an engineering context; practical applications of chemical principles in engineering and technology.

GENERAL CHEMISTRY FOR ENGINEERING STUDENTS LABORATORY

Introduction to important concepts and principles of chemistry in the laboratory; emphasis on areas considered most relevant in an engineering context; practical applications of chemical principles in engineering and technology.

INTRODUCTION TO RHETORIC AND COMPOSITION

Intensive study of and practice in writing processes, from invention and researching to drafting, revising and editing, both individually and corroboratively; emphasis on effective rhetorical choices including audience, purpose, arrangement and style; focus on writing the academic essay as a vehicle for learning, communicating and critical analysis.

ENGINEERING LAB I - COMPUTATION

Introduction to the design and development of computer applications for engineers; computation to enhance problem solving abilities; basic concepts of software design through the implementation and debugging of student-written programs; introduction to engineering majors, career exploration, engineering practice within realistic constraints, e.g. economic, environmental, ethical, health and safety, and sustainability; pathways to success in engineering.

ENGINEERING MATHEMATICS I

Rectangular coordinates, vectors, analytic geometry, functions, limits, derivatives of functions, applications, integration, computer algebra.

EXPERIMENTAL PHYSICS AND ENGINEERING LAB II - MECHANICS

Description and application of laws of physical motion to the solution of science and engineering problems; using sensing, control and actuation for experimental verification of physics concepts while solving engineering problems.

ENGINEERING MATHEMATICS II

Differentiation and integration techniques and their applications (area, volumes, work), improper integrals, approximate integration, analytic geometry, vectors, infinite series, power series, Taylor series, computer algebra.

NEWTONIAN MECHANICS FOR ENGINEERING AND SCIENCE

Calculus-based introductory Newtonian mechanics; laws of physical motion for solution of science and engineering problems.

FUNDAMENTALS OF CHEMISTRY II

Theory and applications of oxidation-reductions systems; thermodynamics and kinetics; complex equilibria and solubility product; nuclear chemistry; descriptive inorganic and organic chemistry; introduction to analytical and synthetic methods and to quantitative techniques to both inorganic and organic compounds with emphasis on an investigative approach.

CONSTRUCTION GRAPHICS COMMUNICATION

Visualization, interpretation and communication of graphical geometry in construction design and engineering; graphical analysis of problems; sketching applications, computer aided design and fundamentals of information modeling software; introduction to common quantitative tools in construction.

ARCHITECTURAL ENGINEERING FOUNDATIONS

Introduction to the broad field and professional practice of architectural engineering, architectural engineering systems, and the role of the architectural engineer; emphasis on professional engineering design services, design and construction processes and documents, building envelope and materials, structural systems, mechanical systems, lighting systems, building systems integration, building codes and standards, fire safety, professional attributes of architectural engineers, and issues of human performance requirements and sustainability at relates to building system design.

ENGINEERING MECHANICS: STATICS

General principles of mechanics; concurrent force systems; statics of particles; equivalent force/moment systems; centroids and center of gravity; equilibrium of rigid bodies; trusses, frames, and machines; internal forces in structural members; friction; second moments of areas.

ARCHITECTURAL ENGINEERING FOUNDATIONS

Introduction to the broad field and professional practice of architectural engineering, architectural engineering systems, and the role of the architectural engineer; emphasis on professional engineering design services, design and construction processes and documents, building envelope and materials, structural systems, mechanical systems, lighting systems, building systems integration, building codes and standards, fire safety, professional attributes of architectural engineers, and issues of human performance requirements and sustainability at relates to building system design.

ENGINEERING MECHANICS: STATICS

General principles of mechanics; concurrent force systems; statics of particles; equivalent force/moment systems; centroids and center of gravity; equilibrium of rigid bodies; trusses, frames, and machines; internal forces in structural members; friction; second moments of areas.

EXPERIMENTAL PHYSICS AND ENGINEERING LAB III - ELECTRICITY AND MAGNETISM

Electromagnetism and electromechanical systems; use of sensing, control and actuation to demonstrate key physical relationships through the transducer relationships linking pressure, temperature and other physical stimuli to changes in electric and magnetic fields.

ENGINEERING MATHEMATICS III

Vector algebra, calculus of functions of several variables, partial derivatives, directional derivatives, gradient, multiple integration, line and surface integrals, Green's and Stokes' theorems

ELECTRICITY AND MAGNETISM FOR ENGINEERING AND SCIENCE

Calculus-based electricity and magnetism; electromagnetic phenomena; basic laws of electricity and magnetism; science and engineering problems involving charges, electromagnetic fields, and electrical circuits.

TECHNICAL AND PROFESSIONAL WRITING

Focus on writing for professional rhetorical situations; correspondence and researched reports fundamental to the workplace—memoranda, letters, electronic correspondence, research proposals and presentations; use of visual rhetoric and document design in print and electronic mediums; emphasis on audience awareness, clarity of communication and collaborative team-work.

COMPUTER APPLICATIONS IN ENGINEERING AND CONSTRUCTION

Application of computers to solution of civil engineering problems using various numerical methods; structured computer programming; mathematical modeling and error analysis; solution of algebraic and differential equations; numerical differentiation and integration; curve-fitting; root-finding.

MECHANICS OF MATERIALS

Applications of conservation principles and stress/deformation relationships for continuous media to structural members; axially loaded members; thin-walled pressure vessels; torsional and flexural members; shear; moment; deflection of members; combined loadings; stability of columns; nonsymmetrical bending, shear center; indeterminate members; elastic foundations.

MATERIALS ENGINEERING FOR CIVIL ENGINEERS

Scientific concepts of civil engineering materials; relationship between macroscopic material properties and response and microscopic properties; physical, mechanical, surface, fracture, and rheological properties of civil engineering materials including metals, composites, and polymers.

DIFFERENTIAL EQUATIONS

Ordinary differential equations, solutions in series, solutions using Laplace transforms, systems of differential equations.

SURVEY OF WORLD ARCHITECTURE HISTORY I

A survey of world architecture and the human-designed and built environment from prehistory to the 13th century.

SURVEY OF WORLD ARCHITECTURE HISTORY II

A survey of world architecture and the human-designed and built environment from the 13th to the 19th century.

HISTORY OF BUILDING TECHNOLOGY

Chronological development of civilization and building technology from prehistoric cultures to present; classic and modern materials, structural devices past and present, machine-produced products, prefabrication, construction methodology and servicing.

HISTORY AND THEORY OF MODERN AND CONTEMPORARY ARCHITECTURE

Development of modern and contemporary architecture in the 20th and 21st centuries; materials, structure, social and economic changes as well as architectural theory.

ARCHITECTURAL ENGINEERING SYSTEMS

Analysis and application of the engineering design process to solve problems associated with the design and operation of building systems, specifically related to HVAC, electrical power and lighting, and structural integrity; communication of solutions to technical problems of building systems, through writing, presentations, and team interactions, typical of architectural engineers in the building industry; emphasis on the engineering design process in architectural engineering, structural systems for buildings, mechanical systems for heating, ventilation, and air-conditioning, electrical lighting for buildings, building fire safety, building acoustics, building codes and standards, interface issues among different building systems, and sustainability aspects of building systems.

PROJECT MANAGEMENT FOR FACILITY MANAGERS

Overview of project management for facility managers covering concepts and components of project management and their interrelationships in construction practice.

MATERIALS OF CONSTRUCTION

Physical, mechanical and rheological properties and behavior of components and composite construction materials including aggregates, Portland cement concrete, bituminous materials, wood and masonry; production processes and proportioning of composite construction materials used in civil engineering.

THEORY OF STRUCTURES

Structural engineering--functions of structure, design loads, reactions and force systems; analysis of statically determinate structures including beams, trusses and arches; energy methods of determining deflections of structures; influence lines and criteria for moving loads; analysis of statically indeterminate structures including continuous beams and frames.

PRINCIPLES OF THERMODYNAMICS

Theory and application of energy methods in engineering; conservation of mass and energy; energy transfer by heat, work and mass; thermodynamic properties; analysis of open and closed systems; the second law of thermodynamics and entropy; gas, vapor and refrigeration cycles.

MECHANICAL SYSTEMS FOR BUILDINGS

Introduction to qualitative and quantitative engineering concepts of mechanical systems for buildings for architectural engineers, including HVAC systems, control of indoor air pollutants and fire suppression systems; emphasis on thermal behavior of buildings and building envelopes, human comfort requirements and psychometrics, thermal load calculations, HVAC systems/equipment, design of space air-conditioning and its relationship to architectural design, mechanical systems for indoor air quality and for fire suppression.

SOCIAL ISSUES IN THE HISTORY OF THE CONSTRUCTION ENVIRONMENT

Introduction to cultural and social issues in the built environment; exploration of how individual and collective ideas, values and beliefs are expressed in the construction environment; how the field of construction internalizes and thinks about these values across cultures and how authority, majorities and privilege affect the creativity of the built environment; emphasizes civil discourse to help recognize positionality and work collaboratively in a multicultural society.

FLUID DYNAMICS

Fluid properties; statics; kinematics; basic conservation principles of continuity, energy and momentum; similitude and hydraulic models; incompressible flow in pipes; fluid dynamic drag.

PRINCIPLES OF ELECTRICAL ENGINEERING

Fundamentals of electric circuit analysis and introduction to electronics for engineering majors other than electrical and computer engineering.

PRINCIPLES OF BUILDING ENERGY ANALYSIS

Analysis of building energy use by applying thermodynamics and heat transfer to building heating and cooling load calculations; heat balance and radiant time series calculation methods; psychometric analysis, indoor air quality, effect of solar radiation on heating and cooling of buildings; required design project.

LIGHTING ENGINEERING FOR BUILDINGS

Reinforces the fundamentals of illuminating engineering for building interiors; focuses on the design and analysis of electrical lighting systems, including the integration between the lighting design process and the technical foundations of building lighting; emphasis on the fundamentals of lighting engineering and basic engineering methods for building lighting systems, lighting design criteria, lighting calculations, and power budgets.

ARCHITECTURAL ENGINEERING DESIGN I

Instruction and practice in the design process applied to an architectural engineering design project; application of establishing customer need, determining requirements in terms of function and performance, developing alternative design concepts, performing trade-off studies among performance, cost and schedule, embodiment and detail design and the iteration of the above steps; major architectural engineering design project.

STRUCTURAL CONCRETE DESIGN

Behavior, design, and detailing of reinforced concrete structural members according to the ACI Building Code Requirements; design for ultimate limit states (flexible, shear, and axial loads) and serviceability requirements (cracking and deflection); applications include continuous beams and moment frames.

ARCHITECTURAL ENGINEERING DESIGN II

Application and extension of fundamentals of engineering design, product detail, and design development process, including case studies; emphasis on project management, marketing considerations, manufacturing detailed design specifications, failure modes, applications of codes and standards, selection of design margins, product (component) development guidelines, intellectual property, product liability and ethical responsibility; major architectural engineering design project.

STRUCTURAL STEEL DESIGN

Design of structural steel elements found in building structures, including tension members, compression members, beams, beam-columns and base plates; design of bolted and welded simple connections; design of bolted eccentric connections; design of bolted and welded partially and fully restrained connections.

COURSE OUTLINES

Course Title: General Chemistry for Engineering Students

Course Description:

The “General Chemistry for Engineering Students” course provides foundational knowledge in chemistry relevant to architectural engineering. Students will learn about chemical principles, atomic structure, chemical reactions, and materials science. The course emphasizes practical applications in engineering contexts.

Learning Objectives:

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

1. Understand fundamental concepts in chemistry.
2. Apply chemical principles to architectural materials and processes.
3. Analyze chemical reactions and their impact on construction materials.
4. Collaborate with architects, engineers, and scientists to address chemical challenges in architectural design.

Topics Covered:

1. **Atomic Structure and Periodic Trends**:
    - Elements, isotopes, and electronic configurations.
    - Periodic table and chemical properties.
2. **Chemical Bonding and Molecular Geometry**:
    - Covalent, ionic, and metallic bonds.
    - Lewis structures and molecular shapes.
3. **Chemical Reactions and Stoichiometry**:
    - Balancing equations and reaction types.
    - Limiting reactants and yield calculations.
4. **Materials Science and Architectural Applications**:
    - Properties of construction materials (e.g., concrete, steel, polymers).
    - Corrosion, durability, and sustainability.

Assessment:

Assessment methods may include:

- Examinations on chemical principles and reactions.
- Laboratory experiments related to architectural materials.
- Collaborative projects integrating chemistry into architectural design.

Recommended Reading:

1. “Chemistry: The Central Science” by Brown, LeMay, Bursten, and Murphy.
2. Relevant industry reports and guidelines.

Course Title: General Chemistry for Engineering Students Lab

Course Description:

The **General Chemistry for Engineering Students Lab** complements the theoretical aspects of chemistry covered in lectures. Students will engage in hands-on experiments, practical demonstrations, and laboratory work related to chemical concepts relevant to architectural

engineering. The course emphasizes safety protocols, data analysis, and practical applications.

Learning Objectives:

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

1. **Apply Chemical Concepts**: Conduct experiments that reinforce chemical principles discussed in lectures.
2. **Develop Laboratory Skills**: Learn techniques for handling chemicals, measuring quantities, and recording observations.
3. **Analyze Experimental Data**: Interpret experimental results, calculate yields, and assess the accuracy of measurements.
4. **Safety and Ethical Practices**: Follow safety guidelines, handle chemicals responsibly, and maintain ethical conduct in the laboratory.

Topics Covered:

1. **Laboratory Safety and Equipment**:
    - Safety protocols, protective gear, and emergency procedures.
    - Proper use of laboratory equipment (glassware, balances, pipettes).
2. **Chemical Reactions and Stoichiometry**:
    - Conduct experiments related to chemical reactions (e.g., acid-base titrations, redox reactions).
    - Calculate reaction yields and determine limiting reactants.
3. **Materials Science and Properties**:
    - Investigate material properties (e.g., density, solubility, conductivity).
    - Explore the behavior of architectural materials under different conditions.
4. **Data Analysis and Reporting**:
    - Record observations, collect data, and analyze experimental results.
    - Prepare laboratory reports following scientific conventions.

Assessment:

Assessment methods may include:

- Laboratory reports based on experimental work.
- Practical assessments evaluating laboratory skills.
- Safety quizzes and adherence to safety guidelines.

Recommended Reading:

1. “Chemistry: The Central Science” by Brown, LeMay, Bursten, and Murphy.
2. Laboratory manuals provided by the course instructor.

Course Title: Calculus

Course Description

This course introduces fundamental concepts of calculus and their applications in architectural engineering. Students will explore differentiation, integration, and multivariable calculus, with an emphasis on real-world problems relevant to architectural design and analysis.

Learning Objectives

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

1. Understand the principles of differential and integral calculus.
2. Apply calculus techniques to solve architectural engineering problems.
3. Analyze functions of several variables and their derivatives.
4. Interpret mathematical models in architectural contexts.

Topics Covered

1. **Differential Calculus**
    - Functions, limits, and continuity.
    - Derivatives and their applications (tangents, rates of change, optimization).
    - Partial derivatives and gradients.
    - L'Hôpital's rule for indeterminate forms.
2. **Integral Calculus**
    - Antiderivatives and definite integrals.
    - Techniques of integration (substitution, integration by parts).
    - Applications (area under curves, volumes, work problems).
    - Handling improper integrals.
3. **Multivariable Calculus**
    - Double and triple integrals.
    - Line and surface integrals.

Assessment

- Regular quizzes and homework assignments.
- Midterm and final exams.
- Practical applications in architectural modeling.

Recommended Reading

1. Stewart, J. (2019). *Calculus: Early Transcendentals*. Cengage Learning.
2. Adams, R. A., Essex, C., & Calter, M. (2019). *Calculus: A Complete Course*. Pearson.
3. Anton, H., Bivens, I., & Davis, S. (2016). *Calculus*. Wiley.

Course Title: Physics I (Mechanics)

Course Description

Physics I (Mechanics) introduces fundamental principles of classical mechanics. Students will explore the behavior of objects under the influence of forces, motion, and energy. The course emphasizes problem-solving techniques and real-world applications relevant to engineering.

Learning Objectives

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

1. Understand Newtonian mechanics and its applications.
2. Analyze forces, motion, and equilibrium.
3. Solve problems related to particle dynamics and rigid bodies.
4. Apply principles of energy and momentum.

Topics Covered

1. **Statics**
    - Forces and equilibrium.
    - Free-body diagrams.
    - Moments and couples.
    - Friction and applications.
2. **Kinematics**
    - Displacement, velocity, and acceleration.
    - Projectile motion.
    - Circular motion.
3. **Dynamics**
    - Newton's laws of motion.
    - Work, energy, and power.
    - Conservation of linear momentum.
    - Rotational dynamics.
4. **Applications**
    - Simple harmonic motion.
    - Oscillations.
    - Introduction to fluid mechanics.

Assessment

- Regular problem sets and quizzes.
- Midterm and final exams.
- Practical applications in engineering scenarios.

Recommended Reading

1. Halliday, D., Resnick, R., & Walker, J. (2018). *Fundamentals of Physics*. Wiley.
2. Thornton, S. T., & Marion, J. B. (2013). *Classical Dynamics of Particles and Systems*. Cengage Learning.

Course Title: Engineering Mathematics I

Course Description

Engineering Mathematics I provides foundational mathematical concepts essential for engineering practice. Students will develop analytical skills, problem-solving abilities, and mathematical reasoning. The course covers topics relevant to various engineering disciplines.

Learning Objectives

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

1. Understand fundamental mathematical principles.
2. Apply mathematical techniques to engineering problems.
3. Analyze functions, vectors, and matrices.
4. Interpret mathematical models in engineering contexts.

Topics Covered

1. **Calculus**
    - Limits, derivatives, and integrals.
    - Applications in engineering (e.g., rates of change, optimization).
2. **Linear Algebra**
    - Vectors and vector spaces.
    - Matrix operations and determinants.
    - Eigenvalues and eigenvectors.
3. **Differential Equations**
    - First-order and second-order differential equations.
    - Initial value problems.
    - Systems of linear differential equations.
4. **Numerical Methods**
    - Root-finding algorithms.
    - Interpolation and approximation.
    - Numerical integration.

Assessment

- Regular problem sets and quizzes.
- Midterm and final exams.
- Practical applications in engineering simulations.

Recommended Textbooks

1. Kreyszig, E. (2019). *Advanced Engineering Mathematics*. Wiley.
2. Stroud, K. A., & Booth, D. J. (2013). *Engineering Mathematics*. Palgrave Macmillan.

Course Title: Introduction to Computing for Engineers and Scientists

Course Description

This interdisciplinary course provides a practical introduction to computer science, focusing on science and engineering applications. Students will learn computational thinking, algorithmic problem-solving, and Python programming. The course covers case studies in physics, statistics, electrical engineering, biology, and other relevant topics.

Learning Objectives

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

1. Understand fundamental concepts in computer science.
2. Apply Python programming skills to solve engineering and scientific problems.
3. Analyze real-world scenarios using computational methods.

Topics Covered

1. **Computational Thinking and Problem Solving**
    - Introduction to algorithms and data structures.
    - Problem-solving strategies.
    - Case studies in physics and engineering.
2. **Python Programming Basics**
    - Syntax, variables, and control structures.
    - Functions and modular programming.
    - Scientific computing libraries (NumPy, SciPy).
3. **Applications in Science and Engineering**
    - Statistical analysis using Python.
    - Electrical circuit simulations.
    - Biological modeling.

Assessment

- Regular coding assignments and quizzes.
- Midterm and final exams.
- Practical projects related to scientific and engineering domains.

Recommended Resources

While there is no required textbook, consider using the following references:

- *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.

Course Title: Experimental Physics and Engineering Lab II - Mechanics

Course Description

This course focuses on the application of physical motion laws to solve science and engineering problems. Students will explore experimental verification of physics concepts using sensing, control, and actuation techniques. The course emphasizes hands-on laboratory work related to mechanics.

Learning Objectives

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

1. Apply laws of motion to practical scenarios.
2. Design and conduct experiments related to mechanics.
3. Use sensors and actuators for data collection and analysis.

Topics Covered

1. **Kinematics and Dynamics**
    - Particle motion, velocity, and acceleration.
    - Newton’s laws of motion.

    - Conservation of momentum and energy.
2. **Experimental Techniques**
    - Measurement devices (motion sensors, force transducers).
    - Data acquisition and analysis.
    - Error analysis and uncertainty.
3. **Laboratory Projects**
    - Projectile motion experiments.
    - Friction studies.
    - Simple harmonic motion investigations.

Assessment

- Regular lab reports and practical assignments.
- Final project demonstrating experimental skills.

Recommended Resources

1. Tipler, P. A., & Mosca, G. (2018). *Physics for Scientists and Engineers*. W. H. Freeman.
2. Halliday, D., Resnick, R., & Walker, J. (2018). *Fundamentals of Physics*. Wiley.

Course Title: Engineering Mathematics II

Course Description

Engineering Mathematics II builds upon foundational mathematical concepts introduced in the first year. The course focuses on advanced topics relevant to engineering analysis and problem-solving.

Learning Objectives

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

1. Solve linear differential equations of various types.
2. Apply Laplace transforms for frequency domain analysis in control systems.
3. Explore numerical methods for solving ordinary differential equations.
4. Understand probability theory and statistical methods for engineering applications.

Topics Covered

1. **Differential Equations**
    - Solution methods for linear differential equations.
    - Laplace transform and its theorems.
    - Numerical solutions for first-order ordinary differential equations.
    - Partial differential equations (heat, wave equations).
2. **Probability and Statistics**
    - Random variables and distributions.
    - Bayes' theorem.
    - Estimation techniques.
    - Quality control and reliability.

Assessment

- Coursework (Problem sets)
- Unseen examination

Course Title: Newtonian Mechanics for Engineering and Science

Course Description

Newtonian Mechanics explores the fundamental principles of motion and forces as formulated by Sir Isaac Newton. Students will learn how to analyze and predict the behavior of physical systems using classical mechanics.

Learning Objectives

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

1. Understand Newton's laws of motion.
2. Apply mathematical techniques to solve problems related to forces, motion, and equilibrium.
3. Analyze real-world scenarios using Newtonian mechanics.

Topics Covered

1. **Introduction to Mechanics**
    - Historical context and significance of Newtonian mechanics.
    - Vectors in mechanics (components, unit vectors, algebra).
2. **Translational Motion**
    - One-dimensional and two-dimensional linear motion.
    - Free body diagrams and forces.
    - Applications of Newton's laws.
3. **Oscillatory and Circular Motion**
    - Simple harmonic motion (e.g., pendulums, springs).
    - Circular orbits (e.g., planetary motion).
4. **Rotational Dynamics**
    - Angular momentum and torque.
    - Rotational equilibrium.
    - Moment of inertia.
5. **Particle Collisions**
    - Elastic and inelastic collisions.
    - Conservation of momentum and energy.

Assessment

- Regular problem-solving assignments.
- Midterm and final exams.
- Laboratory experiments demonstrating Newtonian principles.

Recommended Textbooks

1. A. P. French & M. G. Ebison. *Introduction to Classical Mechanics* (Chapman & Hall).
2. D. Morin. *Introduction to Classical Mechanics* (CUP) (good for Lagrangian dynamics and examples).
3. M. W. McCall. *Classical Mechanics: A Modern Introduction* (Wiley 2001).
4. C. Kittel et al. *Mechanics: Berkeley Physics Course Vol I* (McGraw Hill).
5. P. A. Tipler & G. Mosca. *Physics for Scientists & Engineers* (W. H. Freeman).

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 advanced topics relevant to engineering applications, emphasizing chemical principles and their practical implications.

Learning Objectives

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

1. Understand advanced chemical concepts.
2. Apply chemical principles to engineering problems.
3. Analyze real-world scenarios using chemistry.

Topics Covered

1. **Chemical Thermodynamics**
    - Laws of thermodynamics.
    - Heat transfer, work, and energy changes.
    - Enthalpy, entropy, and Gibbs free energy.
2. **Chemical Kinetics**
    - Reaction rates and rate laws.
    - Activation energy and reaction mechanisms.
    - Catalysis and enzyme kinetics.
3. **Quantum Chemistry**
    - Atomic structure and electronic configurations.
    - Molecular orbital theory.
    - Spectroscopy and molecular interactions.
4. **Materials Chemistry**
    - Properties of materials (metals, ceramics, polymers).
    - Corrosion and degradation.
    - Surface chemistry.

Assessment

- Regular problem-solving assignments.
- Midterm and final exams.
- Laboratory experiments demonstrating chemical principles.

Recommended Textbooks

1. Atkins, P., & de Paula, J. (2017). *Physical Chemistry*. Oxford University Press.

2. Silberberg, M. S. (2017). *Chemistry: The Molecular Nature of Matter and Change*. McGraw-Hill Education.

Course Title: History of Building Technology

Course Description

The course delves into the historical evolution of building technology, tracing its development from ancient times to the present. Students will explore how architectural techniques, materials, and construction methods have shaped the built environment across different cultures and eras.

Learning Objectives

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

1. Understand the cultural context in which building technology has evolved.
2. Analyze the impact of historical innovations on architectural design and construction.
3. Appreciate the interplay between technological advancements and societal needs.

Topics Covered

1. **Ancient Building Techniques**
    - Materials (stone, mud, timber).
    - Structural systems (post-and-beam, arches, vaults).
    - Case studies (Egyptian pyramids, Roman aqueducts).
2. **Medieval and Renaissance Innovations**
    - Gothic architecture (ribbed vaults, flying buttresses).
    - Renaissance engineering (dome construction, perspective).
3. **Industrial Revolution and Modernization**
    - Iron and steel structures.
    - Elevators, plumbing, and electrical systems.
    - Skyscrapers and mass production.
4. **Sustainable Building Practices**
    - Traditional wisdom (passive cooling, natural lighting).
    - Contemporary green technologies (solar panels, green roofs).

Assessment

- Research papers on specific historical periods or technological advancements.
- Presentations on influential architects, engineers, or construction methods.
- Site visits to historic buildings and landmarks.

Recommended Readings

1. Pevsner, N. (1968). *An Outline of European Architecture*. Penguin Books.
2. McCarter, R. (2013). *Modern Architecture*. Oxford University Press.

Course Title: Survey of World Architecture History

Course Description

This course provides a comprehensive survey of architectural history across different cultures and time periods. Students will explore major works of architecture, examining their context, significance, and impact on the built environment.

Learning Objectives

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

1. Analyze and interpret architectural styles, typologies, and innovations.
2. Understand the cultural, social, and historical contexts that shaped architectural development.
3. Appreciate the diversity and global influence of architectural achievements.

Topics Covered

1. **Ancient Architecture**
    - Egyptian, Greek, and Roman architectural forms.
    - Temples, amphitheaters, and civic structures.
2. **Medieval and Renaissance Architecture**
    - Gothic cathedrals, castles, and monasteries.
    - Renaissance palaces and urban planning.
3. **Baroque and Neoclassical Styles**
    - Baroque churches, palazzos, and gardens.
    - Neoclassical revival and its impact.
4. **Global Perspectives**
    - Architectural traditions in India, China, Japan, and the Islamic world.
    - Pre-Columbian architecture in the Americas.
5. **Modern and Contemporary Trends**
    - Industrial revolution and functionalist architecture.
    - Postmodernism, sustainability, and digital design.

Assessment

- Written analyses of architectural case studies.
- Presentations on influential architects and their works.
- Site visits to historical landmarks and buildings.

Recommended Readings

1. Ching, F. D. K., & Jarzombek, M. (2017). *A Global History of Architecture*. Wiley.
2. Watkin, D. (2005). *A History of Western Architecture*. Laurence King Publishing.

Course Title: Construction Graphics Communication

Course Description

The Construction Graphics Communication course focuses on visual communication techniques essential in the construction industry. Students will learn how to create and interpret construction drawings, blueprints, and other graphical representations used in architectural, engineering, and construction projects.

Learning Objectives

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

1. Understand the principles of graphic communication in construction.
2. Produce accurate construction drawings and schematics.
3. Interpret architectural plans and specifications.
4. Communicate effectively with project stakeholders using visual representations.

Topics Covered

1. **Introduction to Construction Graphics**
    - Overview of graphic communication tools (CAD software, drafting techniques).
    - Importance of standardized symbols and conventions.
2. **Blueprint Reading and Interpretation**
    - Understanding architectural, structural, and mechanical drawings.
    - Scale, dimensions, and annotations.
    - Identifying building components (walls, doors, windows, etc.).
3. **Construction Detailing**
    - Creating construction details (sections, elevations, details).
    - Representing materials, finishes, and construction methods.
4. **Building Information Modeling (BIM)**
    - Introduction to BIM software (Revit, ArchiCAD).
    - Collaborating on 3D models for construction projects.
5. **Graphic Presentations**
    - Developing presentation graphics for client meetings.
    - Visualizing site plans, floor plans, and elevations.

Assessment

- Regular assignments involving drawing exercises.
- Blueprint analysis and interpretation.
- Final project demonstrating proficiency in construction graphics.

Recommended Resources

1. Ching, F. D. K. (2014). *Architectural Graphics*. Wiley.
2. Dorf, R. C., & Bishop, R. H. (2012). *Modern Control Systems*. Pearson.

Course Title: Architectural Engineering Foundations

Course Description

The Architectural Engineering Foundations course provides essential knowledge and skills for students pursuing a career in architectural engineering. It lays the groundwork for understanding the interdisciplinary aspects of architectural design, construction, and sustainable building practices.

Learning Objectives

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

1. **Understand Architectural Principles:**
    - Explore architectural history, styles, and cultural influences.
    - Grasp the fundamentals of architectural design and aesthetics.
2. **Master Building Systems:**
    - Study structural systems, HVAC (heating, ventilation, and air conditioning), lighting, and acoustics.
    - Learn about sustainable building materials and energy-efficient design.
3. **Develop Technical Skills:**
    - Use architectural software tools (such as AutoCAD, Revit, or SketchUp).
    - Create basic architectural drawings and schematics.
4. **Collaborate Effectively:**
    - Understand the roles of architects, engineers, and other professionals in the construction industry.
    - Enhance communication and teamwork skills.

Topics Covered

1. **Architectural History and Styles**
    - Ancient architecture to modern trends.
    - Influential architects and iconic buildings.
2. **Architectural Design Principles**
    - Space planning, circulation, and functionality.
    - Aesthetics, proportion, and harmony.
3. **Building Systems Integration**
    - Structural components (foundations, beams, columns).
    - Mechanical, electrical, and plumbing (MEP) systems.
4. **Sustainable Design and Green Building**
    - Energy-efficient practices.
    - LEED (Leadership in Energy and Environmental Design) certification.
5. **Architectural Graphics and Representation**
    - Introduction to architectural drawings (plans, elevations, sections).

- Hands-on exercises using CAD software.

Assessment

- Regular assignments (design sketches, technical drawings).
- Quizzes on architectural history and principles.
- Final project demonstrating understanding of architectural concepts.

Recommended Resources

1. Ching, F. D. K. (2014). *Architectural Graphics*. Wiley.
2. Ballast, D. K. (2019). *Architect's Handbook of Professional Practice*. Wiley.

Course Title: Engineering Mechanics - Statics

Course Description

Engineering Mechanics - Statics focuses on the study of forces and their effects on rigid bodies at rest. Students will learn fundamental principles related to equilibrium, free body diagrams, and the analysis of structures. The course provides a solid foundation for understanding static systems in engineering.

Learning Objectives

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

1. **Apply Newton's Laws of Motion:**
   - Understand the concept of static equilibrium.
   - Analyze forces acting on particles and rigid bodies.
2. **Solve Equilibrium Problems:**
   - Calculate moments, couples, and resultant forces.
   - Determine reactions at supports.
3. **Analyze Truss Structures:**
   - Use the Method of Joints and Method of Sections.
   - Understand internal forces in truss members.
4. **Study Friction and Distributed Loading:**
   - Analyze frictional forces.
   - Consider distributed loads (such as hydrostatic pressure).
5. **Create Shear Force and Bending Moment Diagrams:**
   - Understand internal forces in beams.
   - Construct diagrams for structural analysis.

Topics Covered

1. **Introduction to Statics**
   - Definitions, units, and coordinate systems.
   - Scalars vs. vectors.
2. **Equilibrium of Particles and Rigid Bodies**
   - Free body diagrams.
   - Resultant forces and moments.
3. **Centre of Gravity and Centroids**

    - Determining centroids of common shapes.
    - Applications in engineering.
4. **Truss Analysis**
    - Method of Joints.
    - Method of Sections.
5. **Friction and Hydrostatics**
    - Laws of friction.
    - Hydrostatic pressure on suARCrged surfaces.
6. **Shear Force and Bending Moment Diagrams**
    - Internal forces in beams.
    - Constructing diagrams.

Assessment

- Regular problem-solving assignments.
- Quizzes and exams assessing understanding of statics concepts.
- Practical applications in structural analysis.

Recommended Resources

1. Hibbeler, R. C. (2016). *Engineering Mechanics: Statics*. Pearson.
2. Beer, F. P., Johnston, E. R., & Mazurek, D. F. (2017). *Vector Mechanics for Engineers: Statics*. McGraw-Hill Education.

Course Title: Experimental Physics and Engineering Lab III - Electricity and Magnetism

Course Description

This course explores electromagnetism and electromechanical systems. Students will use sensing, control, and actuation techniques to demonstrate key physical relationships. Topics include transducer relationships linking pressure, temperature, and other physical stimuli to changes in electric and magnetic fields.

Learning Objectives

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

1. Understand fundamental principles of electromagnetism.
2. Apply sensing and control methods to demonstrate physical phenomena.
3. Analyze transducer relationships in practical scenarios.

Topics Covered

1. **Electromagnetic Fields**
    - Electric and magnetic fields.
    - Maxwell's equations.
    - Electromagnetic waves.
2. **Sensors and Actuators**
    - Transducers for pressure, temperature, and other stimuli.
    - Sensing principles (piezoelectric, thermocouples, etc.).
    - Actuation techniques (electromagnetic, piezoelectric).

3. **Applications**
    - Electromechanical systems (motors, generators).
    - Magnetic levitation.
    - Sensors in engineering.

Assessment

- Laboratory experiments demonstrating electromagnetism concepts.
- Reports on transducer relationships and practical applications.
- Quizzes assessing understanding of course material.

Prerequisites

- Grade of C or better in MATH 152 or MATH 172 (or equivalent).
- Grade of C or better in PHYS 206 (or equivalent).
- Grade of C or better in PHYS 216 or ENGR 216.
- Concurrent enrollment in PHYS 207.

Course Title: Engineering Mathematics III

Course Description

Engineering Mathematics III builds upon the mathematical foundations established in previous courses. It covers advanced topics relevant to engineering applications, emphasizing mathematical modeling, differential equations, and numerical methods.

Learning Objectives

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

1. **Solve Differential Equations:**
    - Understand ordinary and partial differential equations.
    - Apply analytical techniques to solve specific types of equations.
2. **Explore Numerical Methods:**
    - Use numerical techniques for solving differential equations.
    - Understand error analysis and convergence.
3. **Study Complex Variables:**
    - Analyze functions of a complex variable.
    - Explore contour integration and residues.
4. **Apply Transform Methods:**
    - Understand Laplace and Fourier transforms.
    - Solve engineering problems using transform techniques.

Topics Covered

1. **Ordinary Differential Equations (ODEs)**
    - First-order ODEs.
    - Second-order linear ODEs.
    - Systems of ODEs.
2. **Partial Differential Equations (PDEs)**
    - Heat equation, wave equation, and Laplace equation.

- Separation of variables.

3. **Numerical Methods**
   - Finite difference methods.
   - Euler's method and Runge-Kutta methods.
4. **Complex Analysis**
   - Complex functions, Cauchy-Riemann equations.
   - Contour integration and residues.
5. **Transform Methods**
   - Laplace transforms.
   - Fourier transforms.

Assessment

- Regular problem-solving assignments.
- Quizzes and exams assessing understanding of mathematical concepts.
- Practical applications in engineering modeling.

Recommended Resources

1. Kreyszig, E. (2018). *Advanced Engineering Mathematics*. Wiley.
2. Zill, D. G., & Wright, W. S. (2017). *Advanced Engineering Mathematics*. Jones & Bartlett Learning.

Course Title: Electricity and Magnetism for Engineering and Science

Course Description

This course explores the fundamental principles of electricity and magnetism, providing a solid foundation for engineering and science students. Students will delve into the behavior of electric and magnetic fields, learn about electromagnetic waves, and understand how these phenomena impact various applications.

Learning Objectives

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

1. **Understand Electric Fields:**
   - Coulomb's law and electric charge.
   - Gauss's law and electric flux.
   - Capacitance and dielectrics.
2. **Explore Magnetic Fields:**
   - Biot-Savart law and magnetic induction.
   - Ampère's law and magnetic materials.
   - Inductance and mutual inductance.
3. **Study Electromagnetic Waves:**
   - Maxwell's equations and electromagnetic radiation.
   - Propagation of light and radio waves.
4. **Apply Concepts to Engineering and Science:**
   - Analyze circuits, transformers, and electromagnetic devices.
   - Understand the role of electromagnetism in technology.

Topics Covered

1. **Electric Fields**
    - Electric force and potential.
    - Conductors and insulators.
    - Electric field lines.
2. **Magnetic Fields**
    - Magnetic force on moving charges.
    - Magnetic field due to currents.
    - Magnetic materials and domains.
3. **Electromagnetic Waves**
    - Electromagnetic spectrum.
    - Polarization and reflection.
    - Applications in communication and imaging.

Assessment

- Regular problem-solving assignments.
- Quizzes and exams assessing understanding of electromagnetism concepts.
- Practical applications in engineering labs.

Recommended Resources

1. Griffiths, D. J. (2017). *Introduction to Electrodynamics*. Cambridge University Press.
2. Purcell, E. M. (2013). *Electricity and Magnetism*. Cambridge University Press.

Course Title: Technical and Professional Writing

Course Description

Technical and Professional Writing prepares students to communicate effectively in various professional contexts. The course emphasizes clear, concise, and reader-centered writing for diverse audiences. Students will learn to produce documents such as reports, proposals, manuals, and instructions.

Learning Objectives

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

1. **Analyze Contexts:**
    - Understand the purpose, audience, and constraints of different writing situations.
    - Adapt writing style and tone accordingly.
2. **Apply Writing Process Strategies:**
    - Plan, draft, revise, and edit documents systematically.
    - Use feedback to improve writing.
3. **Master Document Design and Layout:**
    - Create visually appealing and well-organized documents.
    - Use headings, lists, graphics, and tables effectively.
4. **Write for Specific Genres:**
    - Reports, feasibility studies, proposals, and specifications.

- User manuals, instructions, and technical documentation.

Topics Covered

1. **Understanding Professional Contexts**
   - Identifying stakeholders and their needs.
   - Analyzing communication channels (email, memos, reports).
2. **Writing Process and Strategies**
   - Brainstorming, outlining, and drafting.
   - Revising for clarity, coherence, and conciseness.
3. **Document Design and Visuals**
   - Layout principles (white space, fonts, headings).
   - Incorporating visuals (charts, diagrams, images).
4. **Specific Genres**
   - Reports: Structure, sections, and recommendations.
   - Proposals: Problem statements, solutions, and budgets.
   - User manuals: Clarity, step-by-step instructions.
5. **Ethical Considerations**
   - Plagiarism, citation, and professional integrity.

Assessment

- Writing assignments (reports, proposals, manuals).
- Peer reviews and revisions.
- Quizzes on writing principles and genres.

Recommended Resources

1. Markel, M. H. (2019). *Technical Communication*. Bedford/St. Martin's.
2. Alred, G. J., Brusaw, C. T., & Oliu, W. E. (2019). *Handbook of Technical Writing*. Bedford/St. Martin's.

Course Title: Computer Applications in Engineering and Construction

Course Description

The course "Computer Applications in Engineering and Construction" focuses on leveraging technology to enhance engineering and construction processes. Students will learn practical skills related to software tools commonly used in the industry. The course emphasizes hands-on experience and problem-solving.

Learning Objectives

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

1. **Master Software Tools:**
   - Gain proficiency in industry-standard software applications (e.g., AutoCAD, Primavera, Microsoft Project).
   - Understand their functionalities and applications in engineering and construction.
2. **Apply Computational Methods:**

    - Use software for cost estimating, scheduling, and project management.
    - Analyze construction data and make informed decisions.
3. **Create Effective Documentation:**
    - Develop clear and concise reports, proposals, and project documentation.
    - Utilize software for creating professional documents.
4. **Collaborate in a Digital Environment:**
    - Understand the importance of teamwork and communication in a technology-driven context.
    - Collaborate on shared platforms and manage digital files.

Topics Covered

1. **Introduction to Software Tools**
    - Overview of commonly used engineering and construction software.
    - Installation and basic functionalities.
2. **Cost Estimation and Scheduling**
    - Using software for project cost estimation.
    - Creating construction schedules and timelines.
3. **Document Creation and Management**
    - Word processing (e.g., Microsoft Word).
    - Spreadsheet applications (e.g., Microsoft Excel).
    - Presentation software (e.g., Microsoft PowerPoint).
4. **Project-Based Learning**
    - Hands-on exercises and real-world scenarios.
    - Applying software tools to solve construction problems.

Assessment

- Practical assignments using software applications.
- Project-based assessments (e.g., creating a construction schedule).
- Quizzes on software functionalities and best practices.

Recommended Resources

1. Autodesk (AutoCAD): Autodesk Official Website
2. Oracle (Primavera): Primavera P6
3. Microsoft (Project, Word, Excel, PowerPoint): Microsoft Office

Course Title: Mechanics of Materials

Course Description

Mechanics of Materials explores the behavior of materials under external loads. Students will learn about stress, strain, deformation, and the mechanical response of structures. The course emphasizes practical applications in engineering and construction.

Learning Objectives

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

1. **Analyze Stress and Strain:**

    - Understand the concepts of stress and strain.
    - Calculate stress and strain in various materials.
2. **Study Deformation and Deflection:**
    - Analyze axial loads, torsion, and bending.
    - Determine deflections in beams and structures.
3. **Explore Material Properties:**
    - Understand material behavior (elasticity, plasticity).
    - Investigate failure criteria and safety factors.
4. **Apply Concepts to Real-World Problems:**
    - Design and analyze structural components.
    - Evaluate the performance of materials under different conditions.

Topics Covered

1. **Introduction to Mechanics of Materials**
    - Stress, strain, and deformation.
    - Hooke's law and material properties.
2. **Axial Loading and Torsion**
    - Normal stress and strain.
    - Shear stress and strain.
    - Torsional deformation.
3. **Bending and Shear Forces**
    - Bending moment and shear force diagrams.
    - Flexural stress and strain.
    - Deflection of beams.
4. **Stress Transformation and Failure Theories**
    - Principal stresses and Mohr's circle.
    - Yield criteria (von Mises, Tresca).
    - Buckling and stability.

Assessment

- Problem-solving assignments and quizzes.
- Laboratory experiments on material behavior.
- Design projects related to structural analysis.

Recommended Resources

1. Beer, F. P., Johnston, E. R., & DeWolf, J. T. (2017). *Mechanics of Materials*. McGraw-Hill Education.
2. Hibbeler, R. C. (2017). *Mechanics of Materials*. Pearson.

Course Title: Materials Engineering for Civil Engineers

Course Description

Materials Engineering for Civil Engineers provides an in-depth understanding of the properties, behavior, and applications of materials commonly used in civil engineering projects. Students will explore various materials, their selection criteria, and their impact on structural design and construction.

Learning Objectives

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

1. **Analyze Material Properties:**
    - Understand the mechanical, thermal, and durability properties of materials.
    - Evaluate material behavior under different loads and environmental conditions.
2. **Select Appropriate Materials:**
    - Choose materials based on project requirements (strength, stiffness, corrosion resistance).
    - Consider sustainability and life cycle analysis.
3. **Study Structural Materials:**
    - Concrete, steel, timber, and masonry.
    - Geotechnical materials (soil, rock).
4. **Explore Emerging Materials:**
    - Polymers, composites, and sustainable alternatives.
    - Nanomaterials and smart materials.

Topics Covered

1. **Introduction to Materials Engineering**
    - Role of materials in civil engineering.
    - Material selection criteria.
2. **Mechanical Properties of Materials**
    - Stress, strain, and elasticity.
    - Failure modes (brittle, ductile, fatigue).
3. **Concrete and Cementitious Materials**
    - Composition, hydration, and curing.
    - Reinforced concrete design.
4. **Steel and Structural Alloys**
    - Steel properties and design.
    - Corrosion prevention.
5. **Timber and Masonry**
    - Timber behavior and design.
    - Masonry construction and properties.
6. **Geotechnical Materials**
    - Soil mechanics and rock properties.
    - Foundations and retaining walls.
7. **Emerging Materials and Sustainability**
    - Polymers, composites, and recycled materials.
    - Life cycle assessment.

Assessment

- Assignments on material selection and design.
- Laboratory experiments on material testing.
- Case studies analyzing real-world projects.

Recommended Resources

1. Callister, W. D., & Rethwisch, D. G. (2018). *Materials Science and Engineering: An Introduction*. Wiley.
2. Neville, A. M. (2011). *Properties of Concrete*. Pearson.

Course Title: Differential Equations

Course Description

Differential Equations explores mathematical models that describe change and dynamic behavior in various fields of science and engineering. Students will learn techniques for solving differential equations and their applications in real-world scenarios.

Learning Objectives

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

1. **Understand Differential Equations:**
    - Differentiate between ordinary and partial differential equations.
    - Interpret the physical meaning of solutions.
2. **Solve Differential Equations:**
    - Apply analytical methods to solve first-order and higher-order equations.
    - Use numerical techniques when analytical solutions are not feasible.
3. **Apply Differential Equations in Science and Engineering:**
    - Model physical phenomena (e.g., population growth, heat transfer, electrical circuits).
    - Analyze stability, resonance, and damping.
4. **Explore Advanced Topics:**
    - Systems of differential equations.
    - Fourier series and Laplace transforms.

Topics Covered

1. **First-Order Differential Equations**
    - Separable equations.
    - Linear equations.
    - Exact equations.
2. **Higher-Order Linear Differential Equations**
    - Homogeneous and nonhomogeneous equations.
    - Series solutions.
    - Applications in mechanics and vibrations.
3. **Systems of Differential Equations**
    - Matrix notation.
    - Eigenvalues and eigenvectors.
    - Stability analysis.
4. **Laplace Transforms**
    - Definition and properties.
    - Inverse transforms.
    - Applications in circuit analysis and control systems.

Assessment

- Problem-solving assignments.
- Quizzes and exams assessing understanding of differential equations concepts.
- Modeling projects applying differential equations to real-world problems.

Recommended Resources

1. Boyce, W. E., & DiPrima, R. C. (2017). *Elementary Differential Equations and Boundary Value Problems*. Wiley.
2. Zill, D. G., & Wright, W. S. (2017). *Differential Equations with Boundary-Value Problems*. Cengage Learning.

Course Title: History and Theory of Modern and Contemporary Architecture

Course Description

The course “History and Theory of Modern and Contemporary Architecture” delves into the evolution of architectural styles, theories, and practices from the late 19th century to the present day. Students will explore influential movements, architects, and critical debates that have shaped the built environment. The course emphasizes contextual understanding, critical analysis, and the impact of socio-cultural factors on architectural production.

Learning Objectives

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

1. **Analyze Architectural Movements:**
    - Understand the historical context and key principles of major architectural movements (e.g., Modernism, Postmodernism, Deconstructivism).
    - Explore how architectural ideologies respond to societal changes.
2. **Study Iconic Architects and Buildings:**
    - Investigate the work of influential architects (e.g., Le Corbusier, Frank Lloyd Wright, Zaha Hadid).
    - Analyze their design philosophies and innovations.
3. **Critically Evaluate Architectural Theories:**
    - Engage with theoretical texts and manifestos.
    - Discuss the role of architecture in culture, politics, and identity.
4. **Apply Insights to Contemporary Practice:**
    - Relate historical precedents to current architectural challenges.
    - Consider sustainability, urbanism, and digital technologies.

Topics Covered

1. **Modernism and the Avant-Garde**
    - Bauhaus, International Style, and functionalism.
    - Le Corbusier’s Five Points of Architecture.
2. **Postwar Reactions and Regionalism**
    - Brutalism, Metabolism, and contextualism.
    - Case studies of iconic buildings.
3. **Postmodernism and Deconstructivism**
    - Venturi, Scott Brown, and the “Less is a Bore” approach.
    - Gehry, Libeskind, and expressive forms.
4. **Contemporary Trends and Challenges**
    - Sustainability, parametric design, and adaptive reuse.
    - Urban regeneration and social equity.

Assessment

- Research papers on architectural movements or specific architects.
- Presentations analyzing architectural theories.
- Site visits to modern and contemporary buildings.

Recommended Resources

1. Frampton, K. (2007). *Modern Architecture: A Critical History*. Thames & Hudson.
2. Jencks, C. (2011). *The Language of Post-Modern Architecture*. Rizzoli.

Course Title: Architectural Engineering Systems

Course Description

Architectural Engineering Systems provides an interdisciplinary understanding of building systems and their integration within architectural design. Students will explore the technical aspects of building services, including mechanical, electrical, plumbing, and fire protection systems. The course emphasizes sustainable practices, energy efficiency, and human comfort.

Learning Objectives

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

1. **Understand Building Systems:**
    - Explore the role of building services in architectural design.
    - Recognize the impact of systems on occupant comfort and building performance.
2. **Analyze Mechanical Systems:**
    - Study HVAC (heating, ventilation, and air conditioning) design.
    - Evaluate energy-efficient solutions and thermal comfort.
3. **Explore Electrical and Lighting Systems:**
    - Understand electrical distribution, lighting design, and power requirements.
    - Consider safety, code compliance, and sustainability.
4. **Study Plumbing and Fire Protection Systems:**
    - Learn about water supply, drainage, and fire suppression.
    - Address water conservation and life safety.

Topics Covered

1. **Introduction to Building Systems**
    - Role of architectural engineering in building design.
    - Integration of systems within architectural spaces.
2. **Mechanical Systems**
    - HVAC design principles.
    - Energy modeling and load calculations.
    - Indoor air quality and thermal comfort.
3. **Electrical and Lighting Systems**

    - Electrical distribution and power requirements.
    - Lighting design and control.
    - Renewable energy integration.
4. **Plumbing and Fire Protection Systems**
    - Water supply and drainage.
    - Fire sprinklers and life safety.
    - Sustainable plumbing practices.

Assessment

- Design projects integrating building systems.
- Case studies analyzing real-world buildings.
- Quizzes assessing understanding of system components.

Recommended Resources

1. Chadderton, D. V. (2017). *Building Services Engineering*. Routledge.
2. Stein, B. (2018). *Mechanical and Electrical Equipment for Buildings*. Wiley.

Course Title: Project Management for Facility Managers

Course Description

Project Management for Facility Managers provides essential knowledge and skills for effectively managing projects within the context of facility management. Students will learn project planning, execution, monitoring, and control techniques specific to the built environment. The course emphasizes practical applications and real-world scenarios.

Learning Objectives

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

1. **Understand Project Management Fundamentals:**
    - Explore project life cycles, phases, and stakeholders.
    - Apply project management methodologies (e.g., PMBOK, Agile).
2. **Plan and Initiate Projects:**
    - Define project scope, objectives, and deliverables.
    - Develop project charters and work breakdown structures (WBS).
3. **Execute and Monitor Projects:**
    - Create project schedules and allocate resources.
    - Monitor progress, track milestones, and manage risks.
4. **Close Projects and Evaluate Success:**
    - Conduct project closure activities.
    - Perform post-project evaluations and lessons learned.

Topics Covered

1. **Introduction to Project Management**
    - Role of facility managers in project delivery.
    - Project constraints (time, cost, quality).
2. **Project Initiation and Planning**

    - Defining project scope and objectives.
    - Stakeholder identification and communication planning.
    - Risk assessment and mitigation.
3. **Project Execution and Control**
    - Scheduling techniques (Gantt charts, critical path method).
    - Resource allocation and team management.
    - Change management and scope control.
4. **Project Closure and Evaluation**
    - Handover procedures.
    - Post-project reviews and continuous improvement.

Assessment

- Project planning exercises.
- Case studies analyzing facility management projects.
- Quizzes assessing understanding of project management concepts.

Recommended Resources

1. Kerzner, H. (2017). *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. Wiley.
2. PMI (Project Management Institute). *A Guide to the Project Management Body of Knowledge (PMBOK Guide)*.

Course Title: Materials of Construction

Course Description

Materials of Construction provides an in-depth understanding of the various materials used in building and infrastructure projects. Students will explore the properties, behavior, and applications of construction materials. The course emphasizes sustainable practices, durability, and performance.

Learning Objectives

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

1. **Analyze Material Properties:**
    - Understand mechanical, thermal, and chemical properties.
    - Evaluate material behavior under different loads and environmental conditions.
2. **Study Common Construction Materials:**
    - Concrete, steel, timber, masonry, and composites.
    - Geotechnical materials (soil, rock).
3. **Explore Material Selection Criteria:**
    - Consider strength, durability, cost, and sustainability.
    - Address material compatibility and life cycle analysis.
4. **Apply Materials in Real-World Scenarios:**
    - Design considerations for specific applications.
    - Construction techniques and quality control.

Topics Covered

1. **Introduction to Construction Materials**
    - Role of materials in construction.
    - Material selection factors.
2. **Concrete and Cementitious Materials**
    - Composition, hydration, and curing.
    - Reinforced concrete design.
3. **Steel and Structural Alloys**
    - Properties, design, and corrosion prevention.
    - Steel framing and connections.
4. **Timber and Masonry**
    - Timber behavior, design, and preservation.
    - Masonry construction and properties.
5. **Geotechnical Materials**
    - Soil mechanics, compaction, and stabilization.
    - Rock properties and foundations.

Assessment

- Material testing experiments.
- Case studies analyzing real-world projects.
- Quizzes assessing understanding of material properties.

Recommended Resources

1. Ashby, M. F., & Jones, D. R. H. (2019). *Engineering Materials 1: An Introduction to Properties, Applications, and Design*. Butterworth-Heinemann.
2. Neville, A. M. (2011). *Properties of Concrete*. Pearson.

Course Title: Theory of Structures

Course Description

Theory of Structures introduces fundamental concepts related to the stability, determinacy, and behavior of structures. Students will explore various types of structures, analyze their response to loads, and understand the principles governing their design.

Learning Objectives

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

1. **Analyze Structural Stability:**
    - Understand the difference between stable and unstable structures.
    - Evaluate the stability of different types of frames and trusses.
2. **Study Statically Determinate Structures:**
    - Analyze statically determinate beams and frames.
    - Calculate reactions, internal forces, and deflections.
3. **Explore Indeterminate Structures:**
    - Understand the behavior of indeterminate structures.
    - Apply methods such as moment distribution and slope deflection.

4. **Apply Concepts to Real-World Problems:**
    - Design and analyze structural components.
    - Consider practical constraints and safety factors.

Topics Covered

1. **Structural Stability and Determinacy**
    - Stability criteria.
    - Degrees of indeterminacy.
2. **Statically Determinate Structures**
    - Analysis of beams and frames.
    - Reactions, shear forces, and bending moments.
3. **Indeterminate Structures**
    - Moment distribution method.
    - Slope deflection method.
    - Influence lines.
4. **Structural Design Principles**
    - Material selection.
    - Load combinations.
    - Safety factors.

Assessment

- Problem-solving assignments.
- Case studies analyzing real-world structures.
- Quizzes assessing understanding of structural concepts.

Recommended Resources

1. Hibbeler, R. C. (2017). *Structural Analysis*. Pearson.
2. McCormac, J. C., & Brown, R. H. (2018). *Design of Reinforced Concrete*. Wiley.

Course Title: Principles of Thermodynamics

Course Description

Principles of Thermodynamics introduces fundamental concepts related to energy, heat transfer, and the behavior of systems. Students will explore the laws governing energy conversion, analyze thermodynamic processes, and apply these principles to engineering systems.

Learning Objectives

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

1. **Understand Thermodynamic Concepts:**
    - Define temperature, pressure, and internal energy.
    - Apply the laws of thermodynamics to real-world scenarios.
2. **Study Energy Conversion:**

    - Analyze heat engines, refrigerators, and power cycles.
    - Evaluate energy efficiency and performance.
3. **Explore Phase Transitions and Equilibrium:**
    - Investigate phase diagrams and phase changes.
    - Understand equilibrium conditions.
4. **Apply Thermodynamics to Engineering Systems:**
    - Design and analyze energy conversion devices.
    - Consider practical constraints and sustainability.

Topics Covered

1. **Introduction to Thermodynamics**
    - System boundaries, properties, and states.
    - Zeroth, first, and second laws of thermodynamics.
2. **Energy Conversion Processes**
    - Heat engines, refrigerators, and heat pumps.
    - Carnot cycle and efficiency.
3. **Phase Transitions and Equilibrium**
    - Vapor-liquid equilibrium.
    - Triple point and critical point.
4. **Applications in Engineering Systems**
    - Power plants, HVAC systems, and refrigeration.
    - Energy storage and renewable technologies.

Assessment

- Problem-solving assignments.
- Case studies analyzing real-world thermodynamic systems.
- Quizzes assessing understanding of thermodynamic principles.

Recommended Resources

1. Cengel, Y. A., & Boles, M. A. (2018). *Thermodynamics: An Engineering Approach*. McGraw-Hill Education.
2. Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. B. (2019). *Fundamentals of Engineering Thermodynamics*. Wiley.

Course Title: Mechanical Systems for Buildings

Course Description

Mechanical Systems for Buildings provides an in-depth understanding of the design, operation, and maintenance of mechanical systems within the built environment. Students will explore heating, ventilation, air conditioning (HVAC), plumbing, and fire protection systems commonly found in residential, commercial, and industrial structures.

Learning Objectives

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

1. **Understand HVAC Systems:**

    - Explore principles of heating and cooling.
    - Analyze different HVAC system types (e.g., forced air, radiant, VRF).
2. **Study Plumbing Systems:**
    - Learn about water supply, drainage, and fixtures.
    - Understand plumbing codes and regulations.
3. **Explore Fire Protection Systems:**
    - Investigate fire sprinklers, alarms, and suppression.
    - Address life safety and building codes.
4. **Apply Energy Efficiency Strategies:**
    - Evaluate sustainable practices in mechanical design.
    - Consider energy conservation and renewable technologies.

Topics Covered

1. **Introduction to Mechanical Systems**
    - Role of mechanical systems in buildings.
    - Energy consumption and environmental impact.
2. **Heating and Cooling Systems**
    - Heat transfer mechanisms.
    - HVAC load calculations.
    - Equipment selection and distribution.
3. **Plumbing Systems**
    - Water supply and distribution.
    - Sanitary drainage and venting.
    - Fixtures and water conservation.
4. **Fire Protection Systems**
    - Fire sprinklers and alarms.
    - Smoke control and egress.
    - Fire safety regulations.

Assessment

- Design projects integrating mechanical systems.
- Case studies analyzing real-world buildings.
- Quizzes assessing understanding of system components.

Recommended Resources

1. ASHRAE Handbook: *Fundamentals*. American Society of Heating, Refrigerating and Air-Conditioning Engineers.
2. NFPA 13: *Standard for the Installation of Sprinkler Systems*. National Fire Protection Association.

Course Title: Social Issues in the History of the Construction Environment

Course Description:

This course explores the historical, cultural, and social aspects of construction within the architectural context. Students will examine how construction practices have evolved over time and consider the impact of societal factors on architectural design and infrastructure development.

Learning Objectives:

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

1. Understand the historical evolution of construction practices and their relevance to contemporary architectural engineering.
2. Analyze the intersection of social issues, cultural norms, and architectural design.
3. Evaluate ethical dilemmas faced by professionals in the construction industry.
4. Recognize the environmental impact of construction and explore sustainable practices.
5. Apply legal and regulatory knowledge to construction projects.

Topics Covered:

1. **Introduction to Social Issues in Construction**
    - Overview of the course objectives and relevance
    - Understanding the intersection of construction, society, and history
2. **Historical Perspectives on Construction**
    - Exploration of ancient construction practices and societal impact
    - Case studies of iconic historical structures and their significance
3. **Labor and Workforce Issues**
    - Labor conditions throughout history
    - Role of unions, worker rights, and safety regulations
4. **Environmental Impact and Sustainability**
    - Historical context of construction's impact on the environment
    - Sustainable practices and green building initiatives
5. **Ethical Considerations in Construction**
    - Examining ethical dilemmas faced by architects, engineers, and builders
    - Balancing economic interests with social responsibility
6. **Cultural and Social Influences on Design**
    - How cultural norms, aesthetics, and societal values shape architectural choices
    - Case studies of culturally significant buildings
7. **Urbanization and Infrastructure**
    - Urban development trends and challenges
    - Infrastructure planning and its impact on communities
8. **Legal and Regulatory Framework**
    - Historical evolution of construction laws and regulations
    - Current legal issues in the construction industry
9. **Case Studies and Guest Lectures**
    - Inviting industry professionals and historians to share insights
    - Analyzing real-world examples of social issues in construction
10. **Assessment:**
    - Participation in class discussions and case study analyses
    - Research paper or project related to a specific social issue in construction history

Recommended Reading List:

1. Kostof, S. (1995). *A History of Architecture: Settings and Rituals.* Oxford University Press.
2. Picon, A. (2010). *Digital Culture in Architecture: An Introduction for the Design Professions.* Birkhäuser.
3. Crawford, M. (2013). *Shop Class as Soulcraft: An Inquiry into the Value of Work.* Penguin Books.

Course Title: Fluid Dynamics

Course Description:

This course provides an introduction to the fundamental concepts and methods of fluid mechanics. Students will explore the behavior of fluids, including pressure, hydrostatics, buoyancy, and flow through pipes. The course emphasizes practical applications and problem-solving skills relevant to engineering practice.

Learning Objectives:

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

1. Understand the physical properties of fluids and their impact on flow behavior.
2. Apply equations of motion for incompressible ideal flow, including hydrostatics.
3. Analyze continuity, energy, and momentum principles in fluid systems.
4. Evaluate laminar and turbulent flows in various engineering applications.

Topics Covered:

1. **Fluid Properties and Behavior**
    - Pressure, density, and viscosity
    - Hydrostatics and buoyancy
2. **Equations of Motion and Conservation Laws**
    - Mass conservation equation
    - Momentum conservation for moving fluids
    - Energy conservation
3. **Control Volume Analysis**
    - Application of conservation laws to fixed and deforming control volumes
4. **Flow Types and Applications**
    - Laminar and turbulent flows
    - Flow through pipes and open channels
5. **Boundary-Layer Theory**
    - Introduction to boundary layers near surfaces

Assessment:

- Problem sets and assignments
- Exams

Recommended Reading List:

1. Kostof, S. (1995). *A History of Architecture: Settings and Rituals.* Oxford University Press.
2. Picon, A. (2010). *Digital Culture in Architecture: An Introduction for the Design Professions.* Birkhäuser.
3. Crawford, M. (2013). *Shop Class as Soulcraft: An Inquiry into the Value of Work.* Penguin Books.

Course Title: Principles of Building Energy Analysis

Course Description:

This course provides an introduction to building energy analysis, focusing on understanding and diagnosing energy use in buildings. Students will learn to analyze and reduce environmental, economic, and social impacts related to energy consumption. The course covers various building systems and components, emphasizing a multi-disciplinary approach.

Learning Objectives:

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

1. Apply basic energy calculations to components and systems impacting building energy use.
2. Use simple analysis techniques for building energy auditing and simulation.
3. Recognize interactive effects between different building components as related to energy use.

Topics Covered:

1. **Energy Fundamentals and Thermodynamics**
    - Energy sources, conversion, and efficiency
    - Thermodynamic principles relevant to buildings
2. **Building Envelope and Heat Transfer**
    - Insulation, windows, and thermal bridging
    - Heat transfer mechanisms (conduction, convection, radiation)
3. **Lighting Systems and Efficiency**
    - Types of lighting technologies
    - Daylighting strategies and energy-efficient lighting design
4. **HVAC Systems and Controls**
    - Heating, ventilation, and air conditioning
    - Energy-efficient HVAC design and operation
5. **Energy Auditing and Benchmarking**
    - Techniques for assessing building energy performance
    - Comparative analysis and benchmarking
6. **Building Simulation Tools**
    - Introduction to energy modeling software
    - Simulation for predicting energy consumption

Assessment:

- Quizzes assessing energy calculations and concepts
- Project work involving energy auditing and simulation

Recommended Reading List:

1. Mather, D. (2020)*Building Energy Analysis: Concepts and Applications*
2. ASHRAE Handbook: Fundamentals (latest edition)
3. DOE Building Energy Codes and Standards

Course Title: Principles of Electrical Engineering

Course Description:

This module delivers material on basic principles of electrical and electronic (EE) engineering. It introduces essential concepts and the scope of principles relevant to electronic engineering. The integration of theory and practice is emphasized, allowing students to gain confidence in analyzing and designing simple electrical and electronic circuits. The course culminates in a project covering topics taught throughout the module.

Learning Objectives:

1. Clearly describe and explain basic principles of electrical engineering.
2. Analyze and interpret, using various techniques, the characteristic behavior of simple electric, magnetic, and electronic circuits.

Outline Syllabus:

The following topics are typically covered in this course:

- Voltage and Current, AC, DC, Peak and RMS Values
- Resistance, Conductors, Semiconductors, Insulators
- Circuit laws and network theorems
- Resistors, Capacitors, and Inductors
- Principles of Magnetism and Electromagnetic Theory
- Basic Concepts of Electromagnetic Propagation and Antennas
- Basic Concepts of Communication Engineering and Networks
- Open-Loop and Closed-Loop Controllers and Systems
- Linear Systems Analysis in Time and Frequency Domains
- Electrical Machines and Supply Systems
- AC Fundamentals and Complex Numbers
- Polyphase Circuits
- Power System Engineering: AC and DC Transmission and Distribution
- Transformers, Electric Heating, Electrical Instruments, and Measurements

Course Title: Lighting Engineering for Buildings

Course Description:

This course focuses on the principles and applications of lighting design within architectural contexts. Students will explore various aspects of lighting, including natural and artificial lighting, energy efficiency, aesthetics, and human-centric design. The course emphasizes practical skills and theoretical knowledge relevant to creating well-lit, comfortable, and sustainable indoor spaces.

Learning Objectives:

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

1. Understand the fundamental concepts of lighting engineering.
2. Apply lighting design principles to enhance visual comfort, safety, and aesthetics.

3. Evaluate lighting technologies, fixtures, and control systems.
4. Consider environmental and energy-related aspects of lighting design.

Topics Covered:

1. **Introduction to Lighting Design**
    - Importance of lighting in architecture
    - Historical context and trends
2. **Lighting Fundamentals**
    - Properties of light (color temperature, intensity, direction)
    - Human perception of light
3. **Natural Lighting**
    - Daylighting strategies
    - Solar orientation and shading
4. **Artificial Lighting Systems**
    - Types of light sources (incandescent, fluorescent, LED)
    - Luminaire selection and placement
5. **Lighting Calculations and Design Metrics**
    - Illuminance levels (lux)
    - Uniformity, glare, and contrast
6. **Energy-Efficient Lighting**
    - Energy codes and regulations
    - Lighting controls (dimming, occupancy sensors)
7. **Aesthetics and Mood**
    - Lighting for different spaces (residential, commercial, outdoor)
    - Creating ambiance through lighting
8. **Human-Centric Lighting**
    - Circadian rhythms and health
    - Tunable white lighting
9. **Case Studies and Practical Exercises**
    - Analyzing existing buildings' lighting design
    - Designing lighting schemes for specific spaces

Assessment:

- Lighting design projects
- Quizzes and exams

Recommended Reading List:

1. Mardaljevic, J. (2015). *Daylighting: Natural Light in Architecture.* Routledge.
2. Rea, M. S. (2018). *The IESNA Lighting Handbook.* Illuminating Engineering Society of North America.

Course Title: Architectural Engineering Design I

Course Description:

This course introduces fundamental principles of architectural engineering design, emphasizing the integration of structural engineering, architectural aesthetics, and building services. Students will explore real-world scenarios, engage in hands-on projects, and develop practical skills relevant to designing functional and sustainable buildings.

Learning Objectives:

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

1. Understand the interdisciplinary nature of architectural engineering.
2. Apply design principles to create innovative and efficient building solutions.
3. Collaborate effectively with other engineering disciplines.
4. Develop critical thinking and problem-solving skills in architectural design.

Topics Covered:

1. **Introduction to Architectural Engineering**
    - Overview of architectural design process
    - Role of architectural engineers in construction projects
2. **Structural Integration**
    - Load-bearing systems and materials
    - Structural analysis and design considerations
3. **Architectural Aesthetics**
    - Principles of form, function, and aesthetics
    - Case studies of iconic architectural designs
4. **Building Services Integration**
    - HVAC, lighting, plumbing, and electrical systems
    - Energy-efficient and sustainable design practices
5. **Site Planning and Urban Context**
    - Site analysis and site-specific design
    - Urban design principles
6. **Design Studio Projects**
    - Hands-on design exercises
    - Collaborative work with other engineering students

Assessment:

- Design portfolios
- Studio presentations
- Written reflections on design process

Course Title: Structural Concrete Design

Course Description:

This course focuses on the principles and practices of designing reinforced concrete structures. Students will learn how to analyze and design concrete members, considering strength, serviceability, and safety. The course covers both theoretical concepts and practical applications.

Learning Objectives:

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

1. Understand the behavior of concrete under various states of stress.
2. Apply design codes and constraints to reinforced concrete members.

3. Design beams, slabs, columns, and footings.
4. Explore innovative solutions using high-performance concrete materials.

Topics Covered:

1. **Strength and Deformation of Concrete**
    - Stress-strain behavior
    - Failure criteria
2. **Reinforced Concrete Members**
    - Beams: Bending and shear design
    - Slabs: One-way and two-way systems
    - Columns: Axial and bending actions
3. **Footings**
    - Isolated rectangular spread footings
    - Concentric and eccentric loading
4. **Innovative Design Solutions**
    - High-performance concrete materials
    - Nonlinear analysis and complex systems (e.g., bridges, shells)

Assessment:

- Design projects and calculations
- Exams and quizzes

Course Title: Renewable Energy Systems

Course Description:

This course explores the principles, technologies, and applications of renewable energy sources. Students will gain an understanding of clean and sustainable energy systems, including their design, integration, and environmental impact.

Learning Objectives:

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

1. Describe the physical principles underlying various renewable energy technologies.
2. Evaluate the economic feasibility and environmental benefits of renewable energy systems.
3. Design and analyze renewable energy projects for electricity generation, heating, and transportation.
4. Explore emerging trends and innovations in the field.

Topics Covered:

1. **Introduction to Renewable Energy**
    - Overview of global energy challenges
    - Importance of transitioning to renewable sources
2. **Solar Energy**
    - Photovoltaic (PV) systems
    - Concentrated solar power (CSP)

3. **Wind Energy**
    - Wind turbine technology
    - Site selection and wind resource assessment
4. **Hydropower and Ocean Energy**
    - Run-of-river hydropower
    - Tidal and wave energy
5. **Biomass and Bioenergy**
    - Biomass conversion processes
    - Biogas, biofuels, and waste-to-energy
6. **Geothermal Energy**
    - Geothermal heat pumps
    - Enhanced geothermal systems
7. **Energy Storage and Grid Integration**
    - Battery technologies
    - Smart grids and demand-side management
8. **Environmental Impact and Policy**
    - Life cycle analysis
    - Renewable energy incentives and regulations

Assessment:

- Project-based assignments
- Quizzes and exams

Course Title: Engineering and Enterprise

Course Description:

The “Engineering and Enterprise” course aims to equip students with a comprehensive understanding of the intersection between engineering principles and business practices. Through a multidisciplinary approach, students will explore how engineering solutions can be effectively integrated into entrepreneurial ventures. The course emphasizes creativity, innovation, and practical skills necessary for successful engineering entrepreneurship.

Learning Objectives:

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

1. **Understand Business Fundamentals:**
    - Explore business models, market analysis, and financial planning.
    - Learn about intellectual property, patents, and licensing.
2. **Apply Engineering Principles to Entrepreneurship:**
    - Identify engineering opportunities for innovation and commercialization.
    - Evaluate technical feasibility and scalability of engineering solutions.
3. **Develop Entrepreneurial Skills:**
    - Create business plans and pitch proposals.
    - Collaborate in cross-functional teams to solve real-world problems.
4. **Explore Case Studies and Industry Trends:**
    - Analyze successful engineering startups and their strategies.
    - Stay informed about emerging technologies and market dynamics.

Topics Covered:

1. **Introduction to Engineering Entrepreneurship**
    - Role of engineers in startups and enterprises
    - Importance of interdisciplinary collaboration
2. **Business Basics for Engineers**
    - Market research and customer segmentation
    - Financial modeling and budgeting
3. **Innovation and Intellectual Property**
    - Patents, trademarks, and trade secrets
    - Licensing agreements and technology transfer
4. **Engineering Feasibility and Prototyping**
    - Technology readiness levels (TRLs)
    - Rapid prototyping and proof of concept
5. **Business Plan Development**
    - Value proposition and competitive analysis
    - Marketing and sales strategies
6. **Pitching and Investor Relations**
    - Crafting effective pitches
    - Understanding venture capital and angel investors
7. **Case Studies and Guest Speakers**
    - Inviting successful entrepreneurs and industry experts
    - Analyzing startup success stories

Assessment:

- Business plan presentation
- Group projects
- Written reflections on entrepreneurship challenges

Course Title: Architectural Engineering Design II

Course Description:

Architectural Engineering Design II builds upon the foundational concepts introduced in Architectural Engineering Design I. This advanced course delves deeper into the integration of structural engineering, architectural aesthetics, and building services. Students will engage in complex design projects, emphasizing creativity, innovation, and practical problem-solving skills.

Learning Objectives:

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

1. **Advanced Design Techniques:**
    - Apply advanced architectural design techniques to real-world scenarios.
    - Explore innovative solutions for complex building projects.
2. **Interdisciplinary Collaboration:**
    - Collaborate effectively with other engineering disciplines (civil, mechanical, electrical).
    - Understand the holistic impact of design decisions.
3. **Sustainable Design Practices:**
    - Integrate sustainability principles into architectural solutions.
    - Consider energy efficiency, materials, and environmental impact.

4. **Project Management and Communication:**
    - Develop project management skills for large-scale designs.
    - Communicate design intent clearly through presentations and documentation.

Topics Covered:

1. **Advanced Structural Integration**
    - High-rise buildings, bridges, and unconventional structures
    - Seismic design considerations
2. **Architectural Aesthetics and Cultural Context**
    - Cultural sensitivity in design
    - Case studies of iconic architectural landmarks
3. **Building Systems Integration**
    - HVAC, lighting, acoustics, and fire safety
    - BIM (Building Information Modeling) applications
4. **Sustainable Materials and Technologies**
    - Green building materials
    - Renewable energy integration
5. **Design Studio Projects**
    - Comprehensive design projects (e.g., mixed-use developments, institutional buildings)
    - Emphasis on interdisciplinary collaboration

Assessment:

- Design portfolios
- Group presentations
- Final design project with detailed documentation

Course Title: Structural Steel Design

Course Description:

This course provides an in-depth understanding of the design principles and practices related to steel structures. Students will learn how to analyze, model, and design steel members for various applications, including buildings, bridges, and industrial structures.

Learning Objectives:

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

1. **Steel Material Properties:**
    - Understand the mechanical properties of steel (yield strength, modulus of elasticity, etc.).
    - Explore different types of steel (structural, stainless, etc.).
2. **Load Analysis and Design Loads:**
    - Determine design loads (dead loads, live loads, wind loads, etc.).
    - Analyze load combinations for steel structures.
3. **Design of Steel Members:**
    - Beams and columns: Bending, shear, and axial forces.
    - Connections: Bolted and welded connections.

4. **Structural Stability and Buckling:**
    - Study lateral-torsional buckling and stability considerations.
    - Design for stability in steel frames.
5. **Steel Detailing and Fabrication:**
    - Understand shop drawings, fabrication processes, and tolerances.
    - Explore non-seismic detailing requirements.
6. **Case Studies and Practical Applications:**
    - Analyze real-world steel structures.
    - Apply design codes (e.g., AISC, Eurocode) to practical projects.

Assessment:

- Design projects (e.g., steel building design, bridge design)
- Quizzes and exams

Course Title: Applied Heat and Mass Transfer

Course Description:

This course focuses on the fundamental principles of heat and mass transfer and their practical applications in engineering. Students will explore the behavior of energy and mass in various systems, including solids, liquids, and gases. The course emphasizes both theoretical understanding and real-world problem-solving.

Learning Objectives:

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

1. **Understand Heat Transfer Mechanisms:**
    - Conduction, convection, and radiation.
    - Heat transfer coefficients and thermal resistance.
2. **Analyze Mass Transfer:**
    - Diffusion in solids and stagnant liquids.
    - Mass transfer coefficients.
3. **Apply Heat and Mass Transfer Equations:**
    - Steady-state and unsteady-state heat conduction.
    - Forced and natural convection.
4. **Explore Practical Applications:**
    - Heat exchangers, cooling systems, and insulation.
    - Mass transfer in chemical processes and environmental systems.

Topics Covered:

1. **Introduction to Heat and Mass Transfer**
    - Unified view of energy and mass transport.
    - Basic concepts and definitions.
2. **Heat Conduction**
    - Fourier’s law of heat conduction.
    - Steady and transient heat conduction in solids.
3. **Convection Heat Transfer**
    - Forced convection in fluids.

- Natural convection due to buoyancy.

4. **Radiation Heat Transfer**
   - Blackbody radiation.
   - Stefan-Boltzmann law.
5. **Mass Diffusion**
   - Fick's law of diffusion.
   - Mass transfer coefficients.
6. **Heat Exchangers and Applications**
   - Types of heat exchangers.
   - Design considerations.
7. **Environmental and Industrial Applications**
   - Air conditioning and refrigeration.
   - Combustion and energy systems.

Assessment:

- Problem-solving assignments.
- Quizzes and exams.

Course Title: Computational Fluid Dynamics (CFD)

Course Description:

This course focuses on the terminology, principles, and methods of Computational Fluid Dynamics (CFD). CFD plays a crucial role in various engineering disciplines, including aerodynamics, hydrodynamics, air-conditioning, and minerals processing. The course aims to achieve the following objectives:

1. **Contextualize CFD:**
   - Understand CFD as a valuable design tool for industry and a vital research tool for thermos-fluid studies.
   - Explore its applications across different fields.
2. **Basic Steps and Terminology:**
   - Conservation laws applied to fluid motion and heat transfer.
   - Computational methods (explicit, implicit), discretization schemes, and stability analysis.
3. **Practical Expertise:**
   - Solve CFD problems using commercial CFD codes.
   - Gain hands-on experience in modeling and analyzing fluid flow and heat transfer.
4. **Power and Limitations:**
   - Develop awareness of CFD's capabilities and constraints.

Topics Covered:

1. **Introduction to CFD**
   - Overview, historical context, and relevance.
   - Governing equations (Navier-Stokes, energy equation).
2. **Numerical Methods for CFD**
   - Finite difference, finite volume, and finite element methods.
   - Discretization and stability considerations.
3. **Turbulence Modeling**

- Reynolds-averaged Navier-Stokes (RANS) equations.
- k-ε, k-ω models.

4. **Mesh Generation and Preprocessing**
   - Structured and unstructured grids.
   - Boundary conditions and domain setup.
5. **Solver Techniques**
   - Pressure-based vs. density-based solvers.
   - Iterative methods (SIMPLE, SIMPLEC).
6. **Postprocessing and Visualization**
   - Extracting meaningful results.
   - Visualization tools.
7. **Applications and Case Studies**
   - External aerodynamics (airfoils, vehicles).
   - Internal flows (pipes, HVAC systems).

Assessment:

- Assignments and CFD simulations.
- Quizzes and a final project.

Course Title: Research Project in Architectural Engineering

Course Description:

The research project in architectural engineering provides students with an opportunity to delve into a specific area of interest within the field. Through independent research, critical analysis, and practical application, students will deepen their understanding of architectural engineering principles and contribute to the advancement of knowledge in the discipline.

Learning Objectives:

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

1. **Identify Research Topics:**
   - Select a relevant and focused research topic related to architectural engineering.
   - Formulate research questions or hypotheses.
2. **Conduct Literature Review:**
   - Review existing literature, identifying gaps and areas for investigation.
   - Understand the context and theoretical foundations of the chosen topic.
3. **Research Methodology:**
   - Choose appropriate research methods (quantitative, qualitative, or mixed).
   - Develop a research plan, including data collection and analysis.
4. **Data Collection and Analysis:**
   - Collect relevant data through experiments, surveys, simulations, or case studies.
   - Apply statistical or qualitative analysis techniques.
5. **Critical Thinking and Synthesis:**
   - Analyze research findings critically.
   - Synthesize results to draw meaningful conclusions.
6. **Effective Communication:**
   - Present research findings through written reports, presentations, or posters.

- Communicate complex ideas clearly to both technical and non-technical audiences.

Course Structure:

1. **Topic Selection and Proposal**
   - Introduction to research project guidelines.
   - Brainstorming and selecting research topics.
   - Developing a research proposal.
2. **Literature Review**
   - Conducting a comprehensive literature search.
   - Analyzing and synthesizing relevant studies.
   - Identifying gaps and research opportunities.
3. **Research Methodology**
   - Choosing appropriate research methods (experimental, survey, case study, etc.).
   - Developing a research plan, including ethical considerations.
   - Pilot testing data collection procedures.
4. **Data Collection and Analysis**
   - Collecting data based on the chosen methodology.
   - Applying statistical or qualitative analysis techniques.
   - Interpreting results and drawing conclusions.
5. **Report Writing and Presentation**
   - Structuring the research report (abstract, introduction, methodology, results, discussion, conclusion).
   - Creating effective visual aids for presentations.
   - Delivering a concise and engaging research presentation.
6. **Final Submission and Evaluation**
   - Submitting the final research report.
   - Peer review and feedback.
   - Reflecting on the research process and outcomes.

Assessment:

- Research proposal (10%)
- Literature review (20%)
- Research methodology and data collection (30%)
- Research report (30%)
- Presentation (10%)

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