

Ist Semester AD Mathematics			
Course Code	Course Title	Credit Hours	Category
MAT-3101	Calculus-I	3 (3-0)	Major
IDC-3102	Introduction to Programming	3 (2-1)	Interdisciplinary
GEN-3103	Quantitative Reasoning-I	3 (3-0)	General Education
GEN-3104	General Physics	3 (2-1)	General Education
GEN-3105	Functional English	3 (3-0)	General Education
GEN-3106	Applications of Information & Communication Technologies	3 (2-1)	General Education

1.1 MAT-3101: Calculus - I

Credit

Hours:

3(3-0)

Category: Major

Course Description

This foundational course introduces the core concepts of single-variable calculus. It rigorously covers the principles of limits, continuity, and differentiation, culminating in an introduction to the concept of integration. The course is designed to develop both the computational skills and the theoretical understanding necessary for all subsequent studies in mathematics and related scientific fields.

Course Learning Outcomes

Upon successful completion of this course, students will be able to:

- Understand the concepts of limits, continuity, differentiation and integration.
- Apply differentiation and integration techniques to solve real-world problems.
- Analyze the behavior of functions using graphical and analytical methods.

Comprehensive Course Contents

- **Week 1-2: Pre-Calculus Review.** Functions and their graphs, domain and range. Operations on functions. Trigonometric, exponential, and logarithmic functions.
- **Week 3-4: Limits and Continuity.** The concept of a limit, calculating limits using limit laws, the Squeeze Theorem. Continuity, types of discontinuities, the Intermediate Value Theorem.
- **Week 5-6: The Derivative.** The derivative as the slope of a tangent line and as a rate of change. The limit definition of the derivative. Differentiability and continuity.
- **Week 7-8: Differentiation Rules.** The power, product, and quotient rules. Derivatives of trigonometric functions. The chain rule.
- **Week 9-10: Advanced Differentiation.** Implicit differentiation. Derivatives of exponential and logarithmic functions. Derivatives of inverse trigonometric functions.
- **Week 11: Midterm Examination.**
- **Week 12-13: Applications of Differentiation.** Related rates. Finding absolute and local extrema. The Mean Value Theorem and Rolle's Theorem.
- **Week 14-15: Further Applications.** The first and second derivative tests for curve sketching (concavity, points of inflection). L'Hôpital's Rule. Optimization problems.
- **Week 16: Antiderivatives and Introduction to Integration.**
Antiderivatives, indefinite integrals. Introduction to the definite integral and the Fundamental Theorem of Calculus.

Recommended Books

- **Primary:** Stewart, J. (2021). *Calculus: Early Transcendentals* (9th ed.). Cengage Learning.
- **Supplementary:** Strang, G. (2017). *Calculus* (3rd ed.). Wellesley-Cambridge Press.
- **Supplementary:** Thomas, G. B., Weir, M. D., & Hass, J. R. (2018). *Thomas' Calculus* (14th ed.). Pearson.

1.2 IDC-3102: Introduction to Programming

Credit

Hours:3(2-1)

Category: Interdisciplinary

Course Description

This course is designed for students with no prior programming experience. It introduces the fundamental principles of computer programming and problem-solving using a high-level language, such as Python. Core topics include variables, data types, control structures (conditionals and loops), functions, and an introduction to basic data structures and object-oriented concepts. A significant lab component provides hands-on practice.

Course Learning Outcomes

Upon successful completion of this course, students will be able to:

- Understand the fundamental concepts of programming (variables, loops, and conditionals).
- Write basic programs to solve problems using structured programming techniques.

- Debug and test programs for accuracy and efficiency.

Comprehensive Course Contents

- **Week 1-2: Introduction to Computing.** Algorithms, flowcharts, pseudo-code. Introduction to the programming environment. Basic syntax, "Hello World" program.
- **Week 3-4: Variables and Data Types.** Primitive data types (integers, floats, strings, booleans). Variable declaration and assignment. Basic input/output operations.
- **Week 5-6: Operators and Expressions.** Arithmetic, relational, and logical operators. Operator precedence. Type casting.
- **Week 7 Midterm**
- **Week 8-9: Control Structures I.** Conditional statements: if, if-else, if-elif-else. Nested conditionals.
- **Week 10-11: Control Structures II.** Iteration and loops: for loops, while loops. Loop control statements (break, continue).
- **Week 12-13: Functions.** Defining and calling functions. Parameters and return values. Scope of variables (local and global).
- **Week 14: Data Structures.** Introduction to lists (arrays) and strings. Basic operations: indexing, slicing, iteration.
- **Week 15: File Handling and Exception Handling.** Reading from and writing to text files. Introduction to error handling with try-except blocks.
- **Week 16: Introduction to Object-Oriented Programming.** Concepts of classes and objects. Final project development and submission.

Recommended Books

- **Primary:** Matthes, E. (2019). *Python Crash Course* (2nd ed.). No Starch Press.
- **Supplementary:** Sweigart, A. (2019). *Automate the Boring Stuff with Python* (2nd ed.). No Starch Press.
- **Supplementary:** Downey, A. B. (2015). *Think Python: How to Think Like a Computer Scientist* (2nd ed.). O'Reilly Media.

1.3 GEN-3103: Quantitative Reasoning-I

Credit Hours: 3(3-0)

Category: General Education

Prerequisites: Strong foundation in Intermediate Mathematics

Course Description

This foundational course bridges secondary school mathematics with university-level mathematical thinking. It develops rigorous reasoning skills through the study of formal logic, set theory, proof techniques, and fundamental mathematical structures. The course emphasizes the transition from computational mathematics to abstract mathematical thinking, preparing students for advanced mathematics courses while complementing the concurrent Calculus I course.

Course Learning Outcomes

Upon successful completion of this course, students will be able to:

- Construct and analyze mathematical arguments using formal logic and proof techniques
- Apply set theory and function concepts to mathematical problem-solving
- Demonstrate understanding of number systems and their algebraic properties
- Solve problems using combinatorial reasoning and basic probability theory
- Communicate mathematical ideas with precision and clarity
- Translate between mathematical formalism and intuitive understanding

Comprehensive Course Contents

- **Week 1-3: Mathematical Logic and Set Theory**
 - Propositional logic: logical connectives, truth tables, logical equivalence
 - Predicate logic: quantifiers, nested quantifiers
 - Basic set operations: union, intersection, complement, Cartesian product
 - Set identities and proofs of set equality
 - Introduction to mathematical proofs: direct proof, proof by contraposition
- **Week 4-6: Proof Techniques and Number Systems**
 - Proof by contradiction and proof by cases
 - Mathematical induction and strong induction
 - Properties of integers: divisibility, prime factorization, Euclidean algorithm
 - Modular arithmetic and congruence relations
 - Construction and properties of rational numbers
- **Week 7: Midterm**
- **Week 8-9: Functions and Relations**
 - Functions: injective, surjective, bijective properties
 - Function composition and inversion
 - Relations: equivalence relations, partial orders
 - Cardinality: finite sets and introduction to infinite sets
- **Week 10-12: Combinatorics and Discrete Probability**
 - Basic counting principles: product rule, sum rule, inclusion-exclusion
 - Permutations, combinations, and binomial coefficients
 - Pigeonhole principle and applications
 - Sample spaces, events, and basic probability axioms
 - Conditional probability and independence
- **Week 13-15: Introduction to Mathematical Modeling**
 - Modeling with sequences and recurrence relations
 - Introduction to graph theory: basic definitions and examples
 - Elementary number theory applications
 - Problem-solving strategies and mathematical communication

- **Week 13-14: Conservation of Energy.** Conservation of mechanical energy. Relationship between conservative forces and potential energy. Conservation of total energy. Power.
- **Week 15-16: Linear Momentum and Collisions.** Linear momentum and its conservation. Impulse and momentum. Collisions in one and two dimensions (elastic and inelastic).

List of Experiments:

1. To learn the use of the vernier caliper, screw gauge, and to find the diameter, thickness, and radius of curvature of given objects.
2. To determine the acceleration due to gravity (g) by using a simple pendulum.
3. To study the relationship between force, mass, and acceleration using Atwood's machine (Verification of Newton's Second Law).
4. To find the moment of inertia of a flywheel.
5. To study simple harmonic motion (SHM) using a spring–mass system and determine the spring constant.
6. To study the motion of a body rolling down an inclined plane and compare experimental acceleration with theoretical values.
7. To determine the work done by a variable force using a force-displacement graph.
8. To determine the modulus of rigidity of a wire using a torsional pendulum.
9. To determine the Young's modulus of a wire using Searle's apparatus.
10. To verify Hooke's law and determine the force constant of a spring.

Recommended Books

- **Primary:** Young, H. D., & Freedman, R. A. (2019). *University Physics with Modern Physics* (15th ed.). Pearson.
- **Supplementary:** Halliday, D., Resnick, R., & Walker, J. (2020). *Fundamentals of Physics* (11th ed.). Wiley.
- **Supplementary:** Serway, R. A., & Jewett, J. W. (2018). *Physics for Scientists and Engineers* (10th ed.). Cengage Learning.

1.5 GEN-3105: Functional English

Credit Hours:3(3-0)

Category: General Education

Course Description

This course is designed to enhance students' English language skills for academic and professional communication. It focuses on developing proficiency in grammar, vocabulary, reading comprehension, and basic writing. The course aims to build confidence and competence in using English effectively in diverse real-world scenarios.

Course Learning Outcomes

Upon successful completion of this course, students will be able to:

- Apply enhanced English communication skills through effective use of word choices, grammar, and sentence structure.
- Comprehend a variety of literary/non-literary written and spoken texts in English.
- Communicate effectively in diverse contexts with cultural awareness.

Comprehensive Course Contents

Grammar:

- Basics of grammar
- Parts of speech and their use in communication
- Sentence structure
- Correct use of Tenses
- Active and passive voice
- Practice in unified sentences (unity and coherence)
- Analysis of Phrase, Clause and sentence structures
- Transitive and Intransitive Verbs
- Punctuation and Spellings

Reading skills:

- Comprehension skills
- Literal understanding of text, reading between lines (interpret text), reading beyond lines (to assimilate, integrate knowledge)
- Answers to the questions on a given text

Discussion:

- General topics and everyday conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of the students)
- Introducing ourselves, describing things, recounting past events, agreeing and disagreeing, compare and contrast

Listening:

- To be improved by showing documentaries/ films carefully selected by subject teacher
- Listening and note taking

Translation Skills:

- Urdu to English

Writing Skills:

- Paragraph Writing
Basic structure of paragraph and guidelines for writing an effective paragraph

Speaking Skills:

- Presentation Skills
- Introduction (types of presentation, structure of presentation)
- Prepared and unprepared talks

Note: Extensive reading is required for vocabulary building

Recommended Books:

1. **Functional English**

a) Grammar

1. Practical English Grammar by A. J. Thomson and A. V. Martinet.

Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492

2. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension

1. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

d) Speaking

- 1) Ellen, K. 2002. Maximize Your Presentation Skills: How to Speak, Look and Act on Your Way to the Top
- 2) Hargie, O. (ed.) Hand book of Communications Skills
- 3) Mandel, S. 2000. Effective Presentation Skills: A Practical Guide Better Speaking
- 4) Mark, P. 1996. Presenting in English. Language Teaching Publications

- **Primary:** Eastwood, J. (2002). *Oxford Practice Grammar*. Oxford University Press.
- **Supplementary:** Thomson, A. J., & Martinet, A. V. (1986). *A Practical English Grammar*. Oxford University Press.
- **Supplementary:** Raman, M., & Sharma, S. (2011). *Technical Communication: Principles and Practice*. Oxford University Press.

1.6 GEN-3106: Applications of Information & Communication Technologies

Credit Hours:3(2-1)

Category: General Education

Course Description

This course provides a practical, hands-on exploration of Information and Communication Technologies (ICT) and software tools. Students will gain proficiency in essential productivity applications (word processing, spreadsheets, presentations), online communication and collaboration tools, and cloud-based storage. The course also covers the principles of digital citizenship, including online ethics, security, and information literacy.

Course Learning Outcomes

Upon successful completion of this course, students will be able to:

- Explain the fundamental concepts, components, and scope of Information and Communication Technologies (ICT).
- Apply ICT platforms and tools to address basic needs in daily, academic, and professional life.
- Understand the ethical and legal considerations in the use of ICT platforms and tools.

Comprehensive Course Contents

Objective

1. Explain the fundamental concepts, components, and scope of Information and Communication Technologies (ICT).
2. Identify uses of various ICT platforms and tools for different purposes.

Course Contents:

1. Introduction to Information and Communication Technologies:

- Components of Information and Communication Technologies (basics of hardware, software, ICT platforms, networks, local and cloud data storage etc.).
- Scope of Information and Communication Technologies (use of ICT in education, business, governance, healthcare, digital media and entertainment, etc.).
- Emerging technologies and future trends.

2. Basic ICT Productivity Tools:

- Effective use of popular search engines (e.g., **Google**, Bing, etc.) to explore World Wide Web.
- Formal communication tools and etiquettes (Gmail, Microsoft Outlook, etc.).
- Microsoft Office Suites (Word, Excel, PowerPoint).
- Google Workspace (Google Docs, Sheets, Slides).
- Dropbox (Cloud storage and file sharing), Google Drive (Cloud storage with Google Docs integration) and Microsoft OneDrive (Cloud storage with Microsoft Office integration).
- Evernote (Note-taking and organization applications) and OneNote (Microsoft's digital notebook for capturing and organizing ideas).
Video conferencing (Google Meet, Microsoft Teams, Zoom, etc.).
- Social media applications (LinkedIn, Facebook, Instagram, etc.).

3. ICT in Education:

- Working with learning management systems (Moodle, Canvas, Google Classrooms, etc.).
- Sources of online education courses (Coursera, edX, Udemy, Khan Academy, etc.).
- Interactive multimedia and virtual classrooms.

4. ICT in Health and Well-being:

- Health and fitness tracking devices and applications (Google Fit, Samsung Health, Apple Health, Xiaomi Mi Band, Runkeeper, etc.).
- Telemedicine and online health consultations (OLADOC, Sehat Kahani, Marham, etc.).

5. ICT in Personal Finance and Shopping:

- Online banking and financial management tools (JazzCash, Easypaisa, Zong PayMax, I LINK and MNET, Keenu Wallet, etc.).
- E-commerce platforms (Daraz.pk, Telemart, Shophive, etc.).

6. Digital Citizenship and Online Etiquette:

- Digital identity and online reputation.
- Netiquette and respectful online communication.
- Cyberbullying and online harassment.

7. Ethical Considerations in Use of ICT Platforms and Tools:

- Intellectual property and copyright issues.
- Ensuring originality in content creation by avoiding plagiarism and unauthorized use of information sources.
- Content accuracy and integrity (ensuring that the content shared through ICT platforms is free from misinformation, fake news, and manipulation).

Practical Requirement

As part of the overall learning requirements, the course will include:

1. Guided tutorials and exercises to ensure that students are proficient in commonly used software applications such as word processing software (e.g., Microsoft Word), presentation software (e.g., Microsoft PowerPoint), spreadsheet software (e.g., Microsoft Excel) among such other tools. Students may be assigned practical tasks that require them to create documents, presentations, and spreadsheets etc.
2. Assigning of tasks that involve creating, managing, and organizing files and folders on both local and cloud storage systems. Students will practice file naming conventions, creating directories, and using cloud storage solutions (e.g., Google Drive, OneDrive).
3. The use of online learning management systems (LMS) where students can access course materials, submit assignments, participate in discussion forums, and take quizzes or tests. This will provide students with the practical experience with online platforms commonly used in education and the workplace.

Reading Materials

1. "Discovering Computers" by Vermaat, Shaffer, and Freund.
 2. "GO! with Microsoft Office" Series by Gaskin, Vargas, and McLellan.
 3. "Exploring Microsoft Office" Series by Grauer and Poatsy.
 4. "Computing Essentials" by Morley and Parker.
 5. "Technology in Action" by Evans, Martin, and Poatsy.
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