



Department of Mathematics



Government College University, Faisalabad

Curriculum and Syllabus

Associate Degree in Mathematics



Department of Mathematics
Government College University, Faisalabad.



Scheme of Studies

Associate Degree in Mathematics

Total Semesters: 4 Semesters

Duration of Each Semester: 18 Weeks

Semester-I

Sr. No.	Course Code	Course Title	Domain	Cr. Hours
1	MTH-301	Calculus-I	Major Course	3(3-0)
2	PHY-322	Fundamentals of Electricity and Magnetism	Interdisciplinary	3(2-1)
3	ENG-321	Functional English	General Education (Compulsory English)	3(3-0)
4	ICT-321	Applications of Information and Communication Technologies	General Education (Compulsory)	3(2-1)
5	QTR-421	Quantitative Reasoning-I	General Education (Quantitative Reasoning)	3(3-0)
6	GSC-321	The Science of Global Challenges	General Education (Natural Sciences)	3(2-1)
7	UHQ-301	Understanding of Holy Quran-I	HEC and Punjab Govt Requirement	1(0-1)



Department of Mathematics



Government College University, Faisalabad

Total	19
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Semester-II

Sr. No.	Course Code	Course Title	Domain	Cr. Hours
1	MTH-302	Calculus-II	Major Course	3(3-0)
2	ENG-322	Expository Writing	General Education (Compulsory English)	3(3-0)
3	STA-642	Probability Theory	Interdisciplinary	3(3-0)
4	ICP-321	Ideology and Constitution of Pakistan	General Education (Compulsory)	2(2-0)
5	QTR-422	Quantitative Reasoning-II	General Education (Quantitative Reasoning)	3(3-0)
6	PES-301	Physical Education and Sports	General Education (Arts and Humanities)	2(2-0)
7	ISL-321 / ETH-321	Islamic Studies/ Ethics	General Education (Compulsory Islamic Studies)	2(2-0)
Total				18

Semester-III

Sr. No.	Course Code	Course Title	Domain	Cr. Hours
1	MTH-401	Linear Algebra	Major Course	3(3-0)



Department of Mathematics



Government College University, Faisalabad

2	MTH-403	Ordinary Differential Equations	Major Course	3(3-0)
3	MTH-405	Number Theory	Major Course	3(3-0)
4	MTH-407	Vector and Tensor Analysis	Major Course	3(3-0)
5	MTH-409	Mechanics	Major Course	3(3-0)
6	STA-509	Introduction to Data Science	Interdisciplinary	3(3-0)
7	UHQ-401	Understanding of Holy Quran-II	HEC and Punjab Govt Requirement	1(0-1)
Total				19

Semester-IV

Sr. No.	Course Code	Course Title	Domain	Cr. Hours
1	MTH-402	Differential Geometry	Major Course	3(3-0)
2	MTH-406	Cryptography	Major Course	3(3-0)
3	MTH-408	Partial Differential Equations	Major Course	3(3-0)
4	CCC-405	Artificial Intelligence	Interdisciplinary	3(2-1)
5	PST-321	Pakistan Studies	General Education (Compulsory Social Science)	2(2-0)
6	CCE-321	Civics and Community Engagement	General Education (Compulsory)	2(2-0)
7	BAM-422	Entrepreneurship	General Education (Compulsory)	2(2-0)



Department of Mathematics



Government College University, Faisalabad

Total	18
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Semester-I

Course Code	Course Title	Credit Hours
MTH-301	Calculus-I	3(3-0)

Prerequisites: Knowledge of sets, relations and functions

Limits and Continuity. The fundamental concepts of limits, continuity, types of discontinuities.

Derivatives. Derivatives of functions, Techniques of differentiation, Proofs of Rolle's Theorem, Mean Value Theorem. Applications of derivatives.

Integration. Introduction to integration. Fundamental Theorem of Calculus. Definite integrals, techniques of integration, indeterminate forms, improper integrals.

Sequence and Series. Sequence. Results related to infinite series

Recommended Books:

1. Anton, H., Bivens, I. C., & Davis. S. (2021). *Calculus*, (12th Edition), Wiley.
2. Finney, R. L., & Weir, M. D. (2001). *Thomas calculus: early transcendentals*. Addison-Wesley.
3. Stewart, J., Clegg, D. K., & Watson. S. (2020). *Calculus: Early Transcendental*. Brooks/Cole Publishing Company, Pacific Grove, CA.
4. Thomas, G. B., & Finney, R. L. (1998). *Calculus and Analytical Geometry*. Addison Wesley.

Course Code	Course Title	Credit Hours
PHY-322	Fundamentals of Electricity and Magnetism	3(2-1)



Department of Mathematics



Government College University, Faisalabad

Electric charges, Conductor, Insulators, Coulomb’s law, Electric field, Electric field intensity, Flux of electric field, Gauss’s law and applications, Potential energy, Electric potential energy, Electric potential, Capacitor, Capacitance, Capacitors in series and parallel, Energy storage in an electric field, Electric current, Electromotive force, Motion of charge particles in electrical and magnetic fields, Analysis of circuits, Resistors in series and parallel, Energy transferred in an electric circuit, Magnetic force on a moving charge, Magnetic force on a current carrying wire, Ampere’s law, Faraday law of induction, Lenz’s law, Motional emf, Generator and motors, Induced electric fields, Visible light, Speed of light, Reflection and refraction of light waves, Double refraction, Polarization by scattering, Total internal reflection, Diffraction, Single slit diffraction, Diffraction grating, X-ray diffraction, Polarization, Types of polarization, Photon, Photoelectric effect, Compton effect

1. To study the behavior of RLC series circuit and determination of its resonance frequency.
2. To study the behavior of RLC Parallel circuit and determination of its resonance frequency.
3. Calibration of a voltmeter by a potentiometer.
4. Calibration of an ammeter by a potentiometer.
5. To determine the high resistance by Neon flash lamp and a capacitor.

Recommended Books:

1. Halliday, Resnick and Walker, 2011, *Fundamental Physics*, 9th Ed., John Wiley and Sons Inc. New York.
2. *Young and Freedman*, 2010 *University Physics* 12th edition.
3. Halliday, Resnick and Krane, 2002. *Physics Vol. I & II*, 5th Ed, John Wiley and Sons Inc. New York.
4. Sears, Zemansky and Young, 2000, *University Physics*, 8th Ed, Addison-Wesley. Reading (MA) USA.

Course Code	Course Title	Credit Hours
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Department of Mathematics



Government College University, Faisalabad

ENG-321	Functional English	3(3-0)
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1. Foundations of Functional English:

- Vocabulary building (contextual usage, synonyms, antonyms and idiomatic expressions)
- Communicative grammar (subject-verb-agreement, verb tenses, fragments, run-ons, modifiers, articles, word classes, etc.)
- Word formation (affixation, compounding, clipping, back formation, etc.)
- Sentence structure (simple, compound, complex and compound-complex)
- Sound production and pronunciation

2. Comprehension and Analysis

- Understanding purpose, audience and context
- Contextual interpretation (tones, biases, stereotypes, assumptions, inferences, etc.)
- Reading strategies (skimming, scanning, SQ4R, critical reading, etc.)
- Active listening (overcoming listening barriers, focused listening, etc.)

3. Effective Communication:

- Principles of communication (clarity, coherence, conciseness, courteousness, correctness, etc.)
- Structuring documents (introduction, body, conclusion and formatting)
- Inclusivity in communication (gender-neutral language, stereotypes, cross-cultural communication, etc.)
- Public speaking (overcoming stage fright, voice modulation and body language)
- Presentation skills (organization content, visual aids and engaging the audience)
- Informal communication (small talk, networking and conversational skills)
- Professional writing (business e-mails, memos, reports, formal letters, etc.)



Department of Mathematics



Government College University, Faisalabad

Recommended Books:

1. "Understanding and Using English Grammar" by Betty Schramper Azar.
2. "English Grammar in Use" by Raymond Murphy.
3. "The Blue Book of Grammar and Punctuation" by Jane Straus.
4. "English for Specific Purposes: A Learning-Centered Approach" by Tom Hutchinson and Alan Waters.
5. "Cambridge English for Job-hunting" by Colm Downes.
6. "Practical English Usage" by Michael Swan.
7. "Reading Literature and Writing Argument" by Missy James and Alan P. Merickel.
8. "Improving Reading: Strategies, Resources, and Common Core Connections" by Jerry Johns and Susan Lenski.
9. "Comprehension: A Paradigm for Cognition" by Walter Kintsch.
10. "Communication Skills for Business Professionals" by J.P. Verma and Meenakshi Raman

Course Code	Course Title	Credit Hours
ICT-321	Applications of Information and Communication Technologies	3(2-1)

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.

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)



Department of Mathematics



Government College University, Faisalabad

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.).

ICT in Education:

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

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.)

ICT in Personal Finance and Shopping:

Online banking and financial management tools (JazzCash, Easypaisa, Zong PayMax, ILINK and MNET, Keenu Wallet, etc.). E-commerce platforms (Daraz.pk, Telemart, Shophive, etc.) 6. Digital Citizenship and Online Etiquette:

Digital Citizenship and Online Etiquette:

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

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)

Recommended Books

1. "Discovering Computers" by Vermaat, Shaffer, and Freund.
2. "GO! with Microsoft Office" Series by Gaskin, Vargas, and MeLellan.
3. "Exploring Microsoft Office" Series by Grauer and Poatsy.



Department of Mathematics



Government College University, Faisalabad

4. "Computing Essentials" by Morley and Parker.
5. "Technology in Action" by Evans, Martin, and Poatsy

Course Code	Course Title	Credit Hours
QTR-421	Quantitative Reasoning-I	3(3-0)

Numerical Literacy: Introduction to quantitative reasoning, number system and basic arithmetic operations, unit and their conversions, dimensions, area, perimeter and volume, proportions, rates, ratio and percentages, odds and odds ratio, scale of measurements, tabular and graphical presentation of data, data handling (small and large), data errors, absolute and relative and their applications, quantitative reasoning exercises using number knowledge.

Fundamental Mathematical Concepts: Basics of geometry (lines, angles, circles, polygons etc.), Sets and their operations, Relations, functions and their graphs, Exponents, factoring and simplifying algebraic expression, Algebraic and graphical solutions of linear and quadratic equations and inequalities, Quantitative reasoning exercises using fundamental mathematical concepts.

Fundamental Statistical and Mathematical Concepts: Population and sample, descriptive statistics, measures of variability, sets and their operations, rules of counting: multiplication rule, permutation and combination, probability and its application in real life, introduction to random variables and their probability distributions, quantitative reasoning exercises using fundamental statistical concepts.

Recommended Books:

1. Zaslou, E. (2020). *Quantitative Reasoning: Thinking in Numbers*. Cambridge University Press.
2. Rehman, A., Mubeen, S., Imran, M., Imran M. (2024). *Exploring Quantitative Skills*, Allied Book Center
3. Sevilla, A., and Somers, K. (2013). *Quantitative Reasoning: Tools for Today's Informed Citizens*. 2nd Ed., Wiley Global Education.
4. Rosen, K. H. (2007). *Discrete Mathematics and its Application* (7th ed.), McGraw-Hill.
5. Aufmann, R. N., Lockwood, J. S., Nation, R. D., and Clegg, D. K. (2008). *Mathematical*



Department of Mathematics



Government College University, Faisalabad

Thinking and Quantitative Reasoning. Houghton Mifflin Company.

Course Code	Course Title	Credit Hours
GSC-321	The Science of Global Challenges	3(2-1)

Introduction to the global scientific challenges, Impact of climate change, energy crisis, and emerging diseases on life

Climate Change Science: Introduction, Green House Effect, An overview of important greenhouse gases and their sources. Role of anthropogenic activities in climate change since industrial revolution, Carbon capture technologies, Role of the El-Nino and La-Nina in regulating the global climate, Climate change modeling and mitigation strategies

Energy: Science of Energy, Forms of Energy, Energy Conversion, Renewable and non-renewable energy sources, Solar and wind energy, Coal, natural gas, shale gas, as source of energy, challenges, issues, potential

Human survival and infectious disease: Introduction, classification and historical perspective of infectious disease, Viruses and Zoonotic Diseases, Antibiotic Resistance, Immunization Strategies, Global Impact of Infectious Diseases, Emerging Diseases and Changing Interactions
Science, Technology, and Society: Introduction, Complex Web of Science, Politics, and Social Systems, Development of Science in Certain Areas and the Role of Wars, Technological Progress and Ethical Constraints, Human Experiences as Data, Impact and role of emerging AI-based trends on society, Nanotechnology, biotechnology, nanomaterials, and its applications in various fields including health, food security, climate change

Recommended Books:

1. Romm, J. J. (2022). Climate change: What everyone needs to know, Oxford University Press.
2. Gobo, G., Marcheselli, V. (2023). Science, Technology and Society: An Introduction, Springer Nature.
3. Kaltschmitt, M., Streicher, W., and Wiese, A. (2007). Renewable energy: technology, economics and environment, Springer Science & Business Media.



Department of Mathematics



Government College University, Faisalabad

4. Kumar, N., Singh, H., and Kumar, A. (2021). Renewable energy and green technology: principles and practices, CRC Press.
5. Owen JA, Punt J, Stranford SA, Jones PP. Kuby immunology. Seventh Edition New York: WH Freeman; 2013.
6. Tortora, G. J., Funke, B. R., Case, C. L., Weber, D., and Bair, W. (2015). Microbiology: An Introduction, Global Edition. USA: Pearson Education.
7. Thomas, J. K., Richard, A. G., Barbara, A. O., and Janis, K. (2006). Kuby immunology. Freeman and Co., WH.
8. Hornyak, G. L., Moore, J. J., Tibbals, H. F., and Dutta, J. (2018). "Fundamentals of nanotechnology," CRC press.
9. William J. T., Michael A. P... (2020). Introduction to Biotechnology. Pearson Publishers.

Course Code	Course Title	Credit Hours
UHQ-301	Understanding of Holy Quran-I	1(0-1)

- تیسواں پارہ - ناظرہ مع تجوید
- بنیادی عربی گرامر
- اسم اور اسکے متعلقات : اسم فاعل، مفعول، تفضیل، مبالغہ
 - فعل اور اسکی اقسام : ماضی، مضارع، امر، نہی
 - حرف اور اسکی اقسام : حروف علت، حروف جارہ، مشبہ بالفعل

List of Translations of the Holy Quran

اردو تراجم قرآن

نام ترجمہ	مترجم
موضح القرآن	شاہ عبدالقادر دہلوی
فتح القرآن	فتح محمد جالندہری



Department of Mathematics



Government College University, Faisalabad

اشرف علی تھانوی	ترجمہ بیان القرآن
سید ابو الاعلیٰ مودودی	ترجمہ قرآن مجید
محمد کرم شاہ الازہری	ترجمہ ضیاء القرآن
حافظ نذر احمد	ترجمہ قرآن
سید شبیر احمد	آسان ترجمہ القرآن
مولانا محمد جونا گڑھی	احسن البیان
غلام رسول سعیدی	ترجمہ تبیان القرآن
محمد تقی عثمانی	آسان ترجمہ قرآن
مولانا احمد سعید دہلوی	کشف الرحمن
ڈاکٹر عبدالرحمان طاہر	مصباح القرآن
دا رالسلام	معانی القرآن
ڈاکٹر طاہر القادری	عرفان القرآن
مولانا محمد بشیر فاروق قادری	احکام القرآن
دی علم فاؤنڈیشن کراچی	مطالعہ قرآن کریم برائے طلبہ وطالبات

English Translation s of the Holy Quran

Name	Translator
The Meaning of the Glorious Koran	Muhammad Marmaduke Pickthall
The Holy Quran	Abdullah Yousuf Ali
The Noble Qur'an	Dr. Muhammad Taqiuddin Al Hilali & Dr. M Muhsin Khan
The Noble Quran	Mufti Muhammad Taqi Usmani



Department of Mathematics



Government College University, Faisalabad

Towards Understanding the Ever Glorious Quran	Dr. Muhammad Mahmud Ghali
The Study Quran	Seyyed Hossein Nasr

Semester-II

Course Code	Course Title	Credit Hours
MTH-302	Calculus-II	3(3-0)

It covers conic sections, parametric equations, polar coordinates, and function of several variables' vectors, multivariable calculus. arc length; curvature; normal plane; osculating plane; partial derivatives; chain rule; gradient; double and triple integrals and surface integrals. The core objective of this course is enhancing the ability of students to understand the behavior of real-world problems linking with geometry and rate of change

Recommended Books:

1. Anton, H., Bivens, I. C., & Davis. S. (2021). *Calculus*, (12th Edition), Wiley.
2. Finney, R. L., & Weir, M. D. (2001). *Thomas calculus: early transcendentals*. Addison-Wesley.
3. Stewart, J., Clegg, D. K., & Watson. S. (2020). *Calculus: Early Transcendental*. Brooks/Cole Publishing Company, Pacific Grove, CA.
4. Thomas, G. B., & Finney, R. L. (1998). *Calculus and Analytical Geometry*. Addison Wesley.

Course Code	Course Title	Credit Hours
ENG-322	Expository Writing	3(3-0)

1. Introduction to Expository Writing:

- Understanding expository writing (definition, types, purpose and applications)
- Characteristics of effective expository writing (clarity, coherence and organization)
- Introduction to paragraph writing



2. The Writing Process:

- Pre-writing techniques (brainstorming, free-writing, mind-mapping, listing, questioning and outlining etc.)
- Drafting (three stage process of drafting techniques)
- Revising and editing (ensuring correct grammar, clarity, coherence, conciseness etc.)
- Proof reading (fine-tuning of the draft)
- Peer review and feedback (providing and receiving critique)

3. Essay Organization and Structure:

- Introduction and hook (engaging readers and introducing the topic)
- Thesis statement (crafting a clear and focused central idea)
- Body Paragraphs (topic sentences, supporting evidence and transitional devices)
- Conclusion (types of concluding paragraphs and leaving an impact)
- Ensuring cohesion and coherence (creating seamless connections between paragraphs)

4. Different Types of Expository Writing:

- Description
- Illustration
- Classification
- Cause and effect (exploring causal relationships and outcomes)
- Process analysis (explaining step-by-step procedures)
- Comparative analysis (analyzing similarities and differences)

5. Writing for Specific Purposes and Audiences:

- Different types of purposes (to inform, to analyze, to persuade, to entertain etc.)
- Writing for academic audiences (formality, objectivity, and academic conventions)
- Writing for public audiences (engaging, informative and persuasive language)
- Different tones and styles for specific purposes and audiences

6. Ethical Considerations:

- Ensuring original writing (finding credible sources, evaluating information etc.)
- Proper citation and referencing (APA, MLA, or other citation styles)
- Integrating quotes and evidences (quoting, paraphrasing, and summarizing)
- Avoiding plagiarism (ethical considerations and best practices)

Recommended Books:

1. "The St. Martin's Guide to Writing" by Rise B. Axelrod and Charles R. Cooper.



Department of Mathematics



Government College University, Faisalabad

2. "They Say /I Say: The Moves That Matter in Academic Writing" by Gerald Graff and Cathy Birkenstein.
3. "Writing Analytically" by David Rosenwasser and Jill Stephen.
4. "Style: Lessons in Clarity and Grace" by Joseph M. Williams and Joseph Bizup.
5. "The Elements of Style" by William Strunk Jr. and E.B. White.
6. "Good Reasons with Contemporary Arguments" by Lester Faigley and Jack Selzer.
7. "Writing to Learn: How to Write - and Think - Clearly About Any Subject at All" by William Zinsse.
8. "The Norton Field Guide to Writing" by Richard Bullock, Maureen Daly Goggin, and Francine Weinberg.
9. "The Art of Styling Sentences" by Ann Longknife and K.D. Sullivan.
10. "Writing Today" by Richard Johnson-Sheehan and Charles Paine.

Course Code	Course Title	Credit Hours
STA-642	Probability Theory	3(3-0)

Set theory, counting rules: multiplication, combination, permutation, random experiment, type of events, definitions of probability, laws of probability: complement, addition, multiplication, independence, conditional probability, total probability and Bayes' rule.

Discrete Probability Distributions: introduction, basic properties (mean and variance) and applications of uniform distribution, Bernoulli distribution, binomial distribution, Poisson distribution, hypergeometric distribution, geometric distribution, negative binomial distribution.

Continuous Probability Distributions: Introduction, properties (mean, median, mode, variance, mean deviation, quartile deviation, skewness and kurtosis) and application of the normal distribution.

Recommended Books:

1. Bluman, G. A. (2023). *Elementary Statistics: A Step by Step Approach*. 11th Ed., McGraw Hill, New York.
2. Walpole, R. E. (2020). *Introduction to Statistics*. 3rd Ed., Macmillan Publishing Company, New York.
3. Chaudhary, S. M., and Kamal, S. (2020). *Introduction to Statistical Theory*. Part-I, 6th Ed., Ilmi Kitab Khana, Lahore, Pakistan.
4. McLave, J. T., Benson, P.G., and Snitch, T. (2019). *Statistics for Business & Economics*.



Department of Mathematics



Government College University, Faisalabad

14th Ed., Prentice Hall, New Jersey.

5. Mathai, A. M., and Haubold, H. J. (2018). *Probability and Statistics*. Walter de Gruyter GmbH, Berlin/Boston.
6. Weiss, N. A. (2017). *Introductory Statistics*. 10th Ed., Pearson Education Limited, Essex, England.
7. Schiller, J. L., Sirinivasan, R. L., and Spiegel, M. R. (2012). *Probability and Statistics*. 4th Ed., Schaums Outlines Series. McGraw Hill. New York.
8. Clark, G. M., and Cooke, D. (2011). *A Basic Course in Statistics*. 5th Ed., Arnold, London.

Course Code	Course Title	Credit Hours
ICP-321	Ideology and Constitution of Pakistan	2(2-0)

1. Introduction to the ideology of Pakistan:

- Definition and significance of ideology.
- Historical context of the creation of Pakistan (with emphasis on socio-political, religious, and cultural dynamics of British India between 1857 till 1947).
- Contributions of founding fathers of Pakistan in the freedom movement including but not limited to Allama Muhammad Iqbal, Muhammad Ali Jinnah., etc.
- Contributions of women and students in the freedom movement for separate homeland for Muslims of British India.

2. Two-Nation Theory:

- Evolution of the Two-Nation Theory (Urdu-Hindi controversy, Partition of Bengal, Simla Deputation 1906. Allama Iqbal's Presidential Address 1930, Congress Ministries 1937 Lahore Resolution 1940).
- Role of communalism and religious differences.

3. Introduction to the Constitution of Pakistan:

- Definition and importance of a constitution.
- ideological factors that shaped the Constitution(s) of Pakistan (Objectives Resolution 1949).
- Overview of constitutional developments in Pakistan.

4. Constitution and State Structure:

- Structure of Government (executive, legislature, and judiciary).
- Distribution of powers between federal and provincial governments.
- 18th Amendment and its impact on federalism.

5. Fundamental Rights, Principles of Policy and Responsibilities:



Department of Mathematics



Government College University, Faisalabad

- Overview of fundamental rights guaranteed to citizens by the Constitution of Pakistan
 - 1973 (Articles 8-28).
 - Overview of Principles of Policy (Articles 29.40).
 - Responsibilities of the Pakistani citizens (Article 5)
6. Constitutional Amendments:
- Procedures for amending the Constitution
 - Notable constitutional amendments and their implications.

Recommended Books:

1. "The idea of Pakistan" by Stephen P. Cohen.
2. Ideology of Pakistan" by Javed Iqbal.
3. The Struggle for Pakistan" by I.H. Qureshi.
4. Pakistan the formative Phase" by Khalid Bin Sayeed.
5. Pakistan: Political Roots and Development by Safdar Mahmood
6. "ideology of Pakistan" by Sharif-ul-Mujahid.
7. "The Struggle for Pakistan: A Muslim Homeland and Global Politics" by Ayesha Jalal.
8. "Jinnah, Pakistan and Islamic identity: The Search for Saladin" by Akbar S. Ahmed.
9. "The Making of Pakistan: A Study in Nationalism" by K.K. Aziz.
10. Pakistan: A New History" by Ian Talbot.
11. "Pakistan in the Twentieth Century: A Political History" by Lawrence Ziring.
12. The Constitution of Pakistan 1973" Original.
13. "Constitutional and Political Development of Pakistan" by Hamid Khan.
14. "The Parliament of Pakistan" by Mahboob Hussain.
15. "Constitutional Development in Pakistan " by G.W. Choudhury
16. "Constitution-Making in Pakistan: The Dynamics of Political Order" by G.W. Choudhury.

Course Code	Course Title	Credit Hours
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Department of Mathematics



Government College University, Faisalabad

QTR-422	Quantitative Reasoning-II	3(3-0)
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1. Logic, Logical and Critical Reasoning

- Introduction and importance of logic;
- Inductive, deductive and abductive approaches of reasoning;
- Propositions, arguments (valid; invalid), logical connectives, truth tables and propositional equivalences;
- Logical fallacies;
- Venn Diagrams;
- Predicates and quantifiers;
- Quantitative reasoning exercises using logical reasoning concepts and techniques.

2. Mathematical Modeling and Analyses

- Introduction to deterministic models;
- Use of linear functions for modeling in real-world situations;
- Modeling with the system of linear equations and their solutions;
- Elementary introduction to derivatives in mathematical modeling;
- * Linear and exponential growth and decay models;
- Quantitative reasoning exercises using mathematical modeling.

3. Statistical Modeling and Analyses

- Introduction to probabilistic models;
- Bivariate analysis, scatter plots;
- Simple linear regression model and correlation analysis;
- Basics of estimation and confidence interval;
- Testing of hypothesis (z-test; t-test);
- Statistical inference in decision making;
- Quantitative reasoning exercises using statistical modeling.

Recommended Books:

1. Bennett, J., & Briggs, W. (2019). *Using & understanding mathematics: a quantitative reasoning approach*. Pearson.
6. Rehman, A., Mubeen, S., Imran, M., Imran M. (2024). *Tools for Quantitative Reasoning*, Allied Book Center.
2. Budnick, F. S., Quinn, S., Bowser, K., & Flaherty, E. H. (1993). *Applied mathematics for business, economics, and the social sciences*. New York: McGraw-Hill.
3. Epp, S. S. *Discrete Mathematics with Applications*.
4. Rosen, K. H. (2007). *Discrete Mathematics and its Application* (7th ed.), McGraw-Hill.
5. Aufmann, R. N., Lockwood, J. S., Nation, R. D., and Clegg, D. K. (2008). *Mathematical Thinking and Quantitative Reasoning*. Houghton Mifflin Company.
6. Bluman, A. (2014). *Elementary Statistics: A step by step approach 9e*. McGraw Hill.
7. Mann, P. S. (2010). *Introductory statistics*. John Wiley & Sons.



Department of Mathematics



Government College University, Faisalabad

8. Babones, S. Applied Statistical Modeling.

Course Code	Course Title	Credit Hours
PES-301	Physical Education and Sports	2(2-0)

1. Introduction to Physical Education
 - a. Definition and Scope of Physical Education
 - b. Aims, objectives and Importance of Physical Education
 - c. Scientific Foundations of day life Physical Education
2. Movement Education
 - a. Definition and Importance of Movement
 - b. Types of movement
 - c. Flexibility, Metabolic Functioning
 - d. Stretching, Jumping, Running, Balancing and weight bearing
3. Physical Motor Fitness
 - a. Definition of Motor Fitness
 - b. Importance of Physical Fitness
 - c. Components of Physical Fitness
Cardiovascular Endurance, Muscular Power, Muscular Endurance
 - d. Motor Fitness
Speed, Agility, Balance
4. Games And Sports
 - a. Systems of Tournaments
 - b. Knock our (Elimination) System
 - c. Combination System
5. Safety Education & First Aid
 - a. Importance and Scope of Safety Education
 - b. Importance of Home Safety
 - c. General principles of First Aid
 - d. Qualities of First Aider
 - e. Signs, Symptoms and First Aid of Fractures, Dislocation, Sprains, Strains, Cramps, Wounds, Shocks, Sun Stroke, Bites, Poisons.
6. Personal Hygiene
 - a. Islamic concept about personal hygiene
(Care of Eyes, Nose, Throat, Teeth, Feet, Finger,



Department of Mathematics



Government College University, Faisalabad

- Nails, Arm Pits, Skin, Hair and Dress)
- b. Drug Abuse, Effects of the following on human health:
Opium, Morphine, Hashish, Heroin, Charis, Alcohol.
7. Recreation
- a. Definition, need and importance.
 - b. Introduction of Recreational activities, mental recreation (Indigenous games, small area
Sports, indoor and outdoor games)
 - c. Utilization of Educational Institutions as Community Recreational Centers

Recommended Books:

1. Human Kinetics. (2013). *Introduction to recreation and leisure*. Human Kinetics.
2. Zeigler, F. Z. E. F. (2016). *Philosophy of physical activity education (including educational sport)*. Trafford Publishing.
3. Osada, N. (2019). *Theory of International Physical Education and Sports Studies for the Achievement of Peace*. CCB Publishing.
4. Barber, G. (2016). *Getting started in track and field athletics: Advice & ideas for children, parents, and teachers*. Trafford Publishing.
5. Griffin, L. L., & Butler, J. (2015). *Teaching games for understanding: Theory, research, and practice*. Human Kinetics.
6. Goldman, L. (2015). *Raising our children to be resilient: A guide to helping children cope with trauma in today's world*. Rutledge.
7. Lincoln, C. (2004). *Playing the game: Inside athletic recruiting in the Ivy League*. Nomad Press.
8. Kamlesh, M. L. (2004). *Athletic Personality: A psychological probe*. Khel Sahitya Kendra.
9. Guthrie, M. (2003). *Coaching track & field successfully*. Human Kinetics.
10. Carr, G., & Carr, G. A. (1999). *Fundamentals of track and field*. Human Kinetics.

Course Code	Course Title	Credit Hours
ISL-321	Islamic Studies	2(2-0)

1. Introduction to Islam:

- Definition of Islam and its core beliefs.



Department of Mathematics



Government College University, Faisalabad

- The Holy Quran (introduction, revelation and compilation).
 - Hadith and Sunnah (compilation, classification, and significance).
 - Key theological concepts and themes (Tawhid, Prophethood, Akhirah etc.).
2. Sirah of the Holy Prophet (Peace Be Upon Him) as Uswa-i-Hasana:
- Life and legacy of the Holy Prophet PBUH.
 - Diverse roles of the Holy Prophet PBUH (as an individual, educator, peace maker, leader etc.).
3. Islamic History and Civilization:
- World before Islam.
 - The Rashidun Caliphate and expansion of Islamic rule.
 - Contribution of Muslim scientists and philosophers in shaping world civilization.
4. Islamic Jurisprudence (Fiqh):
- Fundamental sources of Islamic jurisprudence.
 - Pillars of Islam and their significance.
 - Major schools of Islamic jurisprudence.
 - Significance and principles of ijthad.
5. Family and Society in Islam:
- Status and rights of women in Islamic teachings.
 - Marriage, family, and gender roles in Muslim society.
 - Family structure and values in Muslim society
6. Islam and the Modern World:
- Relevance of Islam in the modern world (globalization, challenges and prospects
 - Islamophobia, interfaith dialogue, and multiculturalism.
 - Islamic viewpoint towards socio-cultural and technological changes.

Recommended Books:

- 1 "The Five Pillars of Islam: A Journey Through the Divine Acts of Worship" by Muhammad Mustafa Al-Azami.
2. "The Five Pillars of Islam: A Framework for Islamic Values and Character Building" by Musharraf Hussain.



Department of Mathematics



Government College University, Faisalabad

3. "Towards Understanding Islam" by Abul A' la Mawdudi.
4. "Islami Nazria e Hayat" by Khurshid Ahmad.
5. "An Introduction to Islamic Theology" by John Renard.
6. "Islamic Civilization Foundations Belief & Principles" by Abul A' la Mawdudi.
7. "Women and Social Justice: An Islamic Paradigm" by Dr. Anis Alhmad.
8. "Islam: Its Meaning and Message by Khurshid Ahmad.

Course Code	Course Title	Credit Hours
ETH-321	Ethics (For non-Muslims only)	2(2-0)



Department of Mathematics



Government College University, Faisalabad

Semester-III

Course Code	Course Title	Credit Hours
MTH-401	Linear Algebra	3(3-0)

Prerequisites: Knowledge of sets, relations and functions

Matrices and its Algebra: Definition of Matrices, Algebra of matrices, partitioning of matrices, inverse of a matrices, elementary row and column operations, Systems of equations, equivalent equations and its solutions by Gaussian Elimination method, Gauss-Jorden Elimination method, Consistency criterion, network flow problems, Determinant of a square matrix, axiomatic definition of a determent, Determinant as sum of products of elements, Determinant of the transpose, Determinants and inverse of matrices.

Introductory concepts of Groups: Properties Binary operation, Algebraic structure, Groups, Construction of finite groups including Z_n , K_4 (Klein 4-group), S_3 , U_n , D_3 , D_4 , Q_8 , order of a group, Cayley's table, cyclic groups.

Introductory concepts of Vector spaces: Vector spaces, definitions and examples, Vector space and its properties, Linear span and related concepts, Dependent and independent sets in vector spaces, Basis of a vector spaces and its dimension.

Recommended Books:

1. Oliveria, L. (2022). *Linear algebra*. CRC Press, Chapman and Hall.
2. Friedberg, S. and Insel, A. (2003). *Linear Algebra* (4th Edition). Pearson Education, Canada.
3. Khanna, V. J. and Bhambri, S. K. (2017). *A Course in Abstract Algebra*. Vikas Publishing.
4. Fraleigh J. B. (2003). *A First Course in Abstract Algebra* (7th Edition). Pearson Education.
5. Terras, A. (2019). *Abstract Algebra with Applications*. Cambridge University Press.
6. Anton, H. and Rorres, C. (2010). *Elementary Linear Algebra, Applications* (10th Edition). John Wiley & Sons.

Course Code	Course Title	Credit Hours
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Department of Mathematics



Government College University, Faisalabad

MTH-403	Ordinary Differential Equations	3(3-0)
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Prerequisites: Calculus, Linear Algebra, Mathematical Methods.

Introduction: Definition and classification of differential equations, Formation of differential equations, Initial value problems (IVPs) and boundary value problems (BVPs), Applications of ordinary differential equations in real world problems.

First Order Ordinary Differential Equations: Differential equations with separable variables, Homogeneous differential equations, Differential equation reducible to homogeneous form, Exact differential equations, integrating factors, first order linear differential equations, the Bernoulli equation, Orthogonal trajectories, the Clairaut's equation, Envelop, Singular solutions, and the Ricatti equation.

Higher Order Ordinary Differential Equations: Higher order homogeneous and non-homogeneous linear differential equations with constant coefficients, the method of undetermined coefficients, Higher order linear differential equations with variable coefficients, the method of reduction of order, the Wronskian, the method of variation of parameters, Higher order exact linear differential equations, Simultaneous and total differential equations.

Laplace Transforms: Definition and properties of Laplace transform, the inverse Laplace transform, The Laplace convolution theorem and its applications, Solutions of differential equations using Laplace transform.

Recommended Books:

1. Zill, D. G. (2017). *Differential Equations with Boundary-Value Problems* (9th Edition). Cengage Learning Inc.
2. Amin, M. (2007). *Mathematical Methods*. Ilmi Kitab Khana.
3. Boyce, W. E., & DiPrima, R.C., (2012). *Elementary Differential Equations and Boundary Value Problems* (10th Edition). John Wiley and Sons.
4. Simmons, G. F. (2016). *Differential Equations with Applications and Historical Notes* (3rd Edition). CRC Press.
5. Shah, N. A. (2013). *Ordinary Differential Equations for Scientists and Engineers*. A-one Publishers.
6. Eisgolts, L. (2003). *Differential Equations and the Calculus of Variations*. University Press of the Pacific.

Course Code	Course Title	Credit Hours
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Department of Mathematics



Government College University, Faisalabad

MTH-405	Number Theory	3(3-0)
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Divisibility Theory: The division algorithms. Prime and composite numbers. Canonical decomposition. The greatest common divisor. The Euclidean algorithm. The fundamental theorem of arithmetic. Least common multiple. Divisibility tests.

Congruences: Basic concepts. Linear congruences. System of linear congruences. The Chinese remainder theorem. Solving polynomial congruences. Fermat's and Euler's theorems. Wilson's theorem.

Arithmetic Functions: Euler's phi-function. The functions of Tau and sigma. The Mobius functions. Perfect numbers. Fermat and Mersenne primes.

Quadratic Residues: Legendre symbols and its properties. The quadratic reciprocity law. Quadratic congruences with composite moduli. Pythagorean triples. Representing numbers as sum of two squares.

Recommended Books:

1. Burton, D. M. (2007). *Elementary Number Theory*.
2. S.B. Malik, (1995). *Basic Number Theory*, Vikas Publishing House.
3. Rosen, K. H. (2011). *Elementary number theory*. London: Pearson Education.
4. Freud, R., & Gyarmati, E. (2020). *Number theory*. American Mathematical Society, 48.
5. Singh, K. (2020). *Number Theory: Step by Step*. Oxford University Press.
6. Nagell, T. (2021). *Introduction to number theory*. American Mathematical Society, 163.

Course Code	Course Title	Credit Hours
MTH-407	Vector and Tensor Analysis	3(3-0)

Prerequisites: Calculus, Introductory Algebra

Geometry of Vectors: Geometric interpretation: vector, magnitude of vector, dot product, magnitude of cross products, magnitude of scalar triple product, vector derivative, gradient, curl, applications of vectors illustrating analytical geometry.

Curvilinear Coordinates: Definition and geometric interpretation of curvilinear coordinates, Scale factors, Arc length, Area and volume in curvilinear coordinates, Expansion formulas of Gradient, Divergence and Curl of point in curvilinear coordinate. Spherical and Cylindrical polar coordinates, Relationships between orthogonal bases. Gradient, Divergence and Curl of point in spherical polar and cylindrical polar coordinates, Relationships between curvilinear coordinates and polar coordinates, Applications of polar coordinates. Line, Surface and volume integral. Gauss's, Green's and Stokes theorem with their applications.

Cartesian Tensor: Summation convention, dummy and free indices, orthogonal rotation of axis, proper and improper transformations, Law of transformation from one coordinate system to another coordinates system. Cartesian tensors and their ranks, Algebra of tensor, Sum, Difference, Quotient, Inner product,



Department of Mathematics



Government College University, Faisalabad

Kronecker Tensor and Levi Civita Tensor, Relationship between these Tensors. Contraction, Contraction theorem with their application, Symmetric Tensor and Skew Symmetric Tensor, Isotropic tensor. Tensor calculus: First and Second order Differential Operators in Tensor. Application of tensors in vector analysis and integral theorems in tensor form.

Recommended Books:

1. Charlton, F. (1997). *Vector and Tensor Methods*, Ellis Harwood. Publisher, Chichester, U.K.
2. Bourne, D. E. (2018). *Vector analysis and Cartesian tensors*. Chapman and Hall/CRC.
3. Shah, N. A. (2011). *Vector and Tensor Analysis*, Third Edition, A One Publisher.
4. Mir, K. L. (2012). *An introduction to Vector Analysis*, Ilmi Kitab Khana.
5. Mir, K. L. (2012). *An introduction to Cartesian Tensors with Applications*, Ilmi Kitab Khana.
6. Spiegel, M. R. (1989). *Schaum's outline of theory and problems of vector analysis and an introduction to tensor analysis*. McGraw-Hill.

Course Code	Course Title	Credit Hours
MTH-409	Mechanics	3(3-0)

Prerequisites: Calculus-I, Vector Calculus

Forces: Fundamental concepts and principles, Newton's laws, Resultant of several concurrent forces, The parallelogram law of forces, Resolution of a forces, Triangle of forces, Lamy's theorem, Polygon of forces, Conditions of equilibrium for a particle, Moment of forces about a point, Varignon's theorem, Moment of a couple, equivalent couples

Friction: Fundamental concepts, Static, dynamic and limiting friction, Laws of friction, Coefficients of friction, angle of friction, Equilibrium of a particle on a rough inclined plane, Particle on a rough inclined plane acted on by an external force

Virtual Work: Virtual Displacement and virtual work, Workless constraints, Principle of virtual work

Rectilinear Motion: Motion with constant Acceleration. Motion with Variable Acceleration. Graphical Methods. Motion of a Free Particle along the vertical Line, Simple Harmonic Motion. The Nature of Simple Harmonic Motion. Geometrical Representation.

Projectile Motion: Trajectory of a Projectile, Speed of the Projectile, Parabola of Safety

Recommended Books:

1. Oppermann, R. H. (1942). *Principles of mechanics*. New York and London, McGraw-Hill Book Company, Inc.1-514.
2. Greenwood, D. T. (1988). *Principles of dynamics*. Englewood Cliffs, NJ: Prentice-Hall.21(6), 1301-1312.



Department of Mathematics



Government College University, Faisalabad

3. Alrasheed, S. (2019). *Principles of mechanics: Fundamental university physics*. Springer Nature. 173.
4. W. Huser, (1965). *Introduction to Principles of Mechanics*, Addison Wesley, New York.
5. Spiegel, M. R. (1967). *Theoretical mechanics. Schaum's outline series*. McGraw Hill.
6. Ghori Q.K., *Introduction to Mechanics*, West Pak Publishing Co.
7. Helliwell, T. M., & Sahakian, (2021). *Modern classical mechanics*. Cambridge University Press, 2021.
8. Craig Jr, R. R., & Taleff, E. M. (2020). *Mechanics of materials*. John Wiley & Sons.

Course Code	Course Title	Credit Hours
STA-509	Introduction to Data Science	3(3-0)

Overview of Data Science: Big data and data science hype, current landscape of perspectives, skill sets needed to be data scientist: data extraction tools, big data management tools, use of various databases to manage big data, data preprocessing.

Data Visualization: basic principles, ideas and tools for data visualization, examples of inspiring projects, overview of machine learning techniques: supervised and unsupervised machine learning algorithms.

Overview of Statistical Software R and Python: strengths and limitations of these analysis tools, data science and ethical issues, discussions on privacy, security, ethics, next generation data scientists.

Recommended Books:

1. Lakshmanan, V. (2022). *Data Science on the Google Cloud Platform*. O'Reilly Media, Inc.
2. Jo, T. (2021). *Machine Learning Foundations*. Springer International Publishing.
3. Martinez, I., Viles, E., and Olaizola, I. G. (2021). *Data Science Methodologies: Current Challenges and Future Approaches*. Big Data Research, 24, 100183.
4. Pierson, L. (2021). *Data Science for Dummies*. John Wiley & Sons.
5. Zumel, N., and Mount, J. (2020). *Practical Data Science with R*, 2nd Ed., Manning Publications Co.
6. Grus, J. (2019). *Data Science from Scratch*. 2nd Ed., O'Reilly Media, Inc.
7. Healy, K. (2018). *Data Visualization: A Practical Introduction*. Princeton University Press.
8. Van Der Aalst, W. (2016). *Process Mining: Data Science in Action* (Vol. 2). Heidelberg: Springer.
9. Zaki, M. J., and Miera, W. (2014). *Data Mining and Analysis: Fundamental Concepts*



Department of Mathematics



Government College University, Faisalabad

and Algorithms. Cambridge University Press.

Course Code	Course Title	Credit Hours
UHQ-II	Understanding of Holy Quran-II	1(0-1)

○ ایمانیات اور عبادات

اللہ پر ایمان، فرشتوں پر ایمان، رسولوں پر ایمان، آسمانی کتابوں پر ایمان

یوم آخرت پر ایمان، تقدیر پر ایمان نماز، روزہ، زکوٰۃ، حج، جہاد

○ خاندان کے حقوق

- خاندان کی تکوین، حق مہر
- رضاعت و حمل، اولاد کو قتل کرنے کے ممانعت
- شوہر کی نافرمانی، طلاق، بیوہ کی عدت کے احکام
- نکاح کا پیغام بھیجنا، عورت کی وراثت (اس کے شوہر کی طرف سے)
- والدین کے حقوق، بیویوں اور اولاد کے بیچ عداوت

○ معاشرے کے حقوق

- مہمان کی عزت، اجازت طلب کرنے کے اصول
- مجلس کے آداب، تعاون اور بھائی چارہ
- گروہ بندی، محبت، لوگوں کے درمیان صلح
- عفو و درگزر، غصہ پر قابو اور معاف کرنا
- شعوب و قبائل، لوگوں کے بیچ اختلافات، حمایت و نگہبانی

List of Translations of the Holy Quran

اردو تراجم قرآن

نام ترجمہ	مترجم
موضح القرآن	شاہ عبدالقادر دہلوی
فتح القرآن	فتح محمد جالندہری
ترجمہ بیان القرآن	اشرف علی تھانوی



Department of Mathematics



Government College University, Faisalabad

سید ابو الاعلیٰ مودودی	ترجمہ قرآن مجید
محمد کرم شاہ الازہری	ترجمہ ضیاء القرآن
حافظ نذر احمد	ترجمہ قرآن
سید شبیر احمد	آسان ترجمہ القرآن
مولانا محمد جونا گڑھی	احسن البیان
غلام رسول سعیدی	ترجمہ تبیان القرآن
محمد تقی عثمانی	آسان ترجمہ قرآن
مولانا احمد سعید دہلوی	کشف الرحمن
ڈاکٹر عبدالرحمان طاہر	مصباح القرآن
دا ر السلام	معانی القرآن
ڈاکٹر طاہر القادری	عرفان القرآن
مولانا محمد بشیر فاروق قادری	احکام القرآن
دی علم فاؤنڈیشن کراچی	مطالعہ قرآن کریم برائے طلبہ وطالبات

English Translations of the Holy Quran

Name	Translator
The Meaning of the Glorious Koran	Muhammad Marmaduke Pickthall
The Holy Quran	Abdullah Yousuf Ali
The Noble Qur'an	Dr. Muhammad Taqiuddin Al Hilali & Dr. M Muhsin Khan
The Noble Quran	Mufti Muhammad Taqi Usmani
Towards Understanding the Ever Glorious	Dr. Muhammad Mahmud Ghali



Department of Mathematics



Government College University, Faisalabad

Quran	
The Study Quran	Seyyed Hossein Nasr



Department of Mathematics



Government College University, Faisalabad

Semester-IV

Course Code	Course Title	Credit Hours
MTH-402	Differential Geometry	3(3-0)

Prerequisites: Calculus, Linear Algebra, Vector and Tensor Analysis

Theory of space curves: Representation of arc length parameter and space curve. The osculating plane, Principal normal and binormal. The osculating circle analysis and the osculating sphere, curvature and torsion of unit speed and non-unit speed curves, the moving trihedron, Serret-Frenet formulae. Helices, Spherical indicatrices.

First fundamental form and Geodesics on a surface: Evolutes. Representation of surface, curves on surfaces: Simple surface and coordinate patches. The tangent plane and the normal planes, the first fundamental form and the metric, families of curves, orthogonal trajectories, intrinsic properties, Coordinate transformations. Surface curves: the angle between two curves on a surface. Geodesic equation and its differential equations, geodesic curvature, Gaussian curvature.

Second fundamental form and fundamental equations of a surface: The second fundamental form, principal curvatures, lines of curvature, Asymptotic and principal direction, Euler's theorem, Dupin's indicatrices, developable and minimal surfaces. The Gauss, Weingarten, Mainardi-Codazzi equations.

Recommended Books

1. O'Neill, B. (2006). *Elementary differential geometry*. Elsevier.
2. Somasundaram, D. (2005). *Differential geometry: a first course*. Alpha Science Int'l Ltd.
3. Struik, D. J. (2014). *Lectures on classical differential geometry*. Addison- Wesley.
4. Klingenberg, W. (2013). *A course in differential geometry* (Vol. 51). Springer Science & Business Media.
5. Woodward, L., & Bolton, J. (2019). *A first course in differential geometry: surfaces in Euclidean space*. Cambridge University Press.
6. Pressley, A. N. (2010). *Elementary differential geometry*. Springer Science & Business Media.

Course Code	Course Title	Credit Hours
MTH-406	Cryptography	3(3-0)

Prerequisites: Number Theory



Department of Mathematics



Government College University, Faisalabad

Classical Ciphers and their analysis: Suit-case problem, Introduction to Cryptography and its applications, Advanced Topics in Number Theory (Solution of system of congruencies, Modular Arithmetic), classical ciphers and their deciphering

Public Key Cryptography (PKC): The Theoretical Model, Motivation and Set-up, Confidentiality, Digital Signature, Confidentiality and Digital Signature

Discrete Logarithm Based Systems: The Discrete Logarithm System, The Discrete Logarithm Problem (DLP), ElGamal's Public-Key Cryptosystems, ElGamal's Signature Scheme, How to Take Discrete Logarithms, Digital signature verification schemes

RSA: The RSA System, Setting Up the System, RSA for Privacy, RSA for Signatures

Recommended Book:

1. Spezia, S. (2020). *Number Theory with Applications to Cryptography*. Arcler Press.
2. Kraft, J., & Washington, L. (2018). *An introduction to number theory with cryptography*. CRC press.
3. Van Tilborg, H. C. (2006). *Fundamentals of cryptology: a professional reference and interactive tutorial* (Vol. 528). Springer Science & Business Media.
4. Katz, J., & Lindell, Y. (2007). *Introduction to modern cryptography: principles and protocols*. Chapman and Hall/CRC.
5. Menezes, A. J., Van Oorschot, P. C., & Vanstone, S. A. (2018). *Handbook of applied cryptography*. CRC press.
6. Buell, D. (2021). *Fundamentals of cryptography: introducing mathematical and algorithmic foundations*. Springer Nature.
7. Buchanan, W. (2022). *Cryptography*. CRC Press.

Course Code	Course Title	Credit Hours
MTH-408	Partial Differential Equations	3(3-0)

Prerequisites: Ordinary Differential Equations

First order PDEs: Introduction, formation of PDEs, solutions of PDEs of first order, First order nonlinear equations, Special types of first order equations.

Second order PDEs: Basic concepts and definitions, Mathematical problems, Linear operators, Superposition, Mathematical models: The classical equations, the vibrating string, the vibrating membrane, conduction of heat solids, canonical forms and variable, PDEs of second order in two independent variables with constant and variable coefficients,

Methods of separation of variables: Solutions of elliptic, parabolic and hyperbolic PDEs in Cartesian and cylindrical coordinates.



Department of Mathematics



Government College University, Faisalabad

Laplace transform: Introduction and properties of Laplace transform, transforms of elementary functions, periodic functions, error function and Dirac delta function, inverse Laplace transform, convolution theorem, solution of PDEs by Laplace transform, Diffusion and wave equations

Fourier Integral Method: Fourier integral representation, Fourier sine and cosine representation, Fourier transform pair, transform of elementary functions and Dirac delta function, solutions of heat, wave and Laplace equations by Fourier integral Method.

Fourier transforms: Introduction and properties of Fourier transforms, transforms of elementary functions, Finite Fourier transforms, solutions of heat, wave and Laplace equations by Fourier transforms.

Recommended Books:

1. Myint UT, *Partial Differential Equations for Scientists and Engineers*, 3rd edition, North Holland, Amsterdam, 1987.
2. Dennis G. Zill, Michael R. Cullen, *Differential equations with boundary value problems*, Brooks Cole, 2008.
3. J. Wloka, *Partial Differential Equations*, Cambridge University press, 1987.
4. John Polking, Al Boggess, *Differential Equations with Boundary Value Problems*, 2nd Edition, Pearson, July 28, 2005.
5. Walter A. Strauss, *Partial Differential Equations, An Introduction*, Jhon Wiley & Sons, Ltd, second Edition, 2007.
6. Nawazish Ali Shah, *Partial Differential Equations*, First Edition, A-One Publisher, 2013.
7. Abdul-Majid Wazwaz. *Partial Differential Equations and Solitary Waves Theory*, Springer Berlin, Heidelberg, Published: 13 August 2009.

Course Code	Course Title	Credit Hours
CCC-405	Artificial Intelligence	3(2-1)

Introduction to Common Lisp. AI classical systems: General Problem Solver, rules, simple search, means-ends analysis. ELIZA, pattern matching, rule-based translators, OPS-5. Knowledge Representation: Natural language, rules, productions, predicate logic, semantic networks, frames, objects, scripts. Search: Depth first search, breadth first search, best first search, hill climbing, min-max search, A* search. Symbolic Mathematics: student, solving algebra problems, translating English equations, solving algebraic equations, simplification rules, re-write rules, meta-rules, Macsyma, PRESS, ATLAS. Logic Programming: Resolution, unification, horn-clause logic, Prolog, Prolog programming. Sample case studies of shells and Knowledge Based Systems. A brief appreciation of state-of-the-art computational techniques like neural networks, genetic algorithm, fuzzy sets.

Recommended Books:



Department of Mathematics



Government College University, Faisalabad

1. Luger, G. F. (1998). *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, 5/e. Pearson Education India.
2. Russell, S. J., & Norvig, P. (2016). *Artificial intelligence: a modern approach*. Pearson Education
3. Cai, Z., Liu, L., Chen, B., & Wang, Y. (2021). *Artificial Intelligence: From Beginning to Date*.

Course Code	Course Title	Credit Hours
PST-321	Pakistan Studies	2(2-0)

1. Introduction to Pakistan:

- Geographical location and significance.
- Historical background: Ancient civilizations in the region.
- Factors leading to the creation of Pakistan.

2. Political History of Pakistan:

- Formative phase.
- Military interventions and democratic transitions.

3. Geography of Pakistan:

- Physiography: Mountains, plains, plateaus, deserts, valleys and coastal areas.
- River systems: Indus River and its tributaries.
- Climatic regions of Pakistan.

4. Society and Culture of Pakistan:

- Socio-cultural diversity.
- Languages and literature of Pakistan.

5. Economic Development of Pakistan:

- Agriculture and industrial sectors of Pakistan.
- Economic challenges of Pakistan

6. Contemporary Issues:

- Foreign relations of Pakistan.
- Security challenges: terrorism, extremism, and regional conflicts.
- Environmental problems and sustainable development (SDGs)



Department of Mathematics



Government College University, Faisalabad

- Media and social change.

Recommended Books:

1. Jinnah of Pakistan by Stanley Wolpert
2. "The Sole Spokesman: Jinnah, the Muslim League, and the Demand for Pakistan" by Ayesha Jalal
3. "The struggle for Pakistan" by Ishtiaq Husain Qureshi
4. "Pakistan, the Formative Phase, 1857-1948" by Khalid B. Sayeed
5. "Pakistan Studies: A Book of Readings" by Sikandar Hayat
6. "Constitutional and Political History of Pakistan" by Hamid Khan
7. "Trek to Pakistan" by Ahmad Saeed and Kh. Mansur Sarwar
8. "Pakistan: A Modern History" by Ian Talbot
9. "Politics in Pakistan: The Nature and Direction of Change" by Khalid B. Sayeed
10. "Physical Geography of Pakistan" by Umar Jahangir
11. "A Geography of Pakistan: Environment, People, and Economy" by Fazle Karim Khan
12. "Pakistan's Foreign Policy: An Historical Analysis" by S. M. Burke
13. "Separatism in East Pakistan" by Rizwan Ullah Kokab
14. "Being Pakistani: Society, Culture and the Arts" by Raza Rumi
15. "Pakistan's Cultural Heritage Socio-Economic and Technological Aspects" edited by Abdul Jabbar Khan
16. "Language and Politics in Pakistan" by Tariq Rahman
17. "Sociology" by Horton and Hunt
18. "Pakistan in the Twentieth Century: A Political History" by Lawrence Ziring
19. "Economic Development of Pakistan" by Ishrat Husain
20. "Issues in Pakistan's Economy" by S. Zaidi



Department of Mathematics



Government College University, Faisalabad

Course Code	Course Title	Credit Hours
CCE-321	Civics and Community Engagement	2(2-0)

1. Introduction to Civics and Citizenship:

- Definition of civics, citizenship, and civic engagement.
- Historical evolution of civic participation.
- Types of citizenship: active, participatory, digital, etc.
- The relationship between democracy and citizenship

2. Civics and Citizenship

- Concepts of civics, citizenship, and civic engagement.
- Foundations of modern society and citizenship.
- Types of citizenship: active, participatory, digital, etc.

3. State, Government and Civil Society

- Structure and functions of government in Pakistan.
- The relationship between democracy and civil society.
- Right to vote and importance of political participation and representation.

4. Rights and Responsibilities

- Overview of fundamental rights and liberties of citizens under Constitution of Pakistan 1973.
- Civic responsibilities and duties,
- Ethical considerations in civic engagement (accountability, non-violence, peaceful dialogue. civility, etc.

5. Community Engagement

- Concept, nature and characteristics of community.
- Community development and social cohesion.
- Approaches to effective community engagement.
- Case studies of successful community driven initiatives.

6. Advocacy and Activism

- Public discourse and public opinion.
- Role of advocacy in addressing social issues.



Department of Mathematics



Government College University, Faisalabad

- Social action movements.

7. Digital Citizenship and Technology

- The use of digital platforms for civic engagement.
- Cyber ethics and responsible use of social media.
- Digital divides and disparities (access, usage, socioeconomic, geographic, etc.) and their impacts on citizenship.

8. Diversity, Inclusion and Social Justice:

- Understanding diversity in society (ethnic, cultural, economic, political etc.).
- Youth, women and minorities' engagement in social development.
- Addressing social inequalities and injustices in Pakistan.
- Promoting inclusive citizenship and equal rights for societal harmony and peaceful co-existence.

Recommended Books

1. "Civics Today: Citizenship, Economics, & You" by McGraw-Hill Education
2. "Citizenship in Diverse Societies" by Will Kymlicka and Wayne Norman.
3. "Engaging Youth in Civic Life" by James Younis and Peter Levine.
4. "Digital Citizenship in Action: Empowering Students to Engage in Online Communities" by Kristen Mattson.
5. "Globalization and Citizenship: In the Pursuit of a Cosmopolitan Education" by Graham Pike and David Selby.
6. "Community Engagement: Principles, Strategies, and Practices" by Becky J. Feldpausch and Susan M. Omilian.
7. "Creating Social Change: A Blueprint for a Better World" by Matthew Clarke and Marie-Monique Steckel.

Course Code	Course Title	Credit Hours
BAM-422	Entrepreneurship	2(2-0)

1. Introduction to Entrepreneurship:

- Definition and concept of entrepreneurship:
- Why to become an entrepreneur?



- Entrepreneurial process;
- Role of entrepreneurship in economic development.

2. Entrepreneurial Skills:

- Characteristics and qualities of successful entrepreneurs (including stories of success and failures):
- Areas of essential entrepreneurial skills and abilities such as creative and critical thinking innovation and risk taking.

3. Opportunity Recognition and idea Generation:

- Opportunity identification, evaluation and exploitation:
- Innovative ideas generation techniques for entrepreneurial ventures.

4. Marketing and Sales

- Target market identification and segmentation:
- Four P of Marketing:
- Developing a marketing strategy:
- Branding.

5. Financial Literacy:

- Basic concepts of income, savings and investments.
- Basic concepts of assets, liabilities and equity:
- Basic concepts of revenue and expenses:
- Overview of cash-flows;
- Overview of banking products including Islamic modes of financing:
- Sources of funding for startups (angel financing, debt financing, equity financing etc.)

6. Team Building for Startups:

- Characteristics and features of effective teams
- Team building and effective leadership for startups.

7. Regulatory Requirements to Establish Enterprises in Pakistan:

- Types of enterprises (e.g., sole proprietorship: partnership, private limited companies etc.).
- Intellectual property rights and protection:
- Regulatory requirements to register an enterprise in Pakistan, with special emphasis export firms.



Department of Mathematics



Government College University, Faisalabad

- Taxation and financial reporting obligation.

Recommended Books

1. Barringer Bruce, R., & Duane, I. R. (2016). *Entrepreneurship: Successfully Launching New Ventures*.
2. Kuratko, D. F. (2011). Entrepreneurship theory, process, and practice in the 21st century. *International Journal of Entrepreneurship and Small Business*, 13(1), 8-17.
3. Timmons, J. A., Spinelli, S., Jr., & Adams, R. *New venture creation: Entrepreneurship for the 21st century*.
4. Abrams, R. (2017). *Entrepreneurship: A Real-World Approach*. Palo Alto, CA: Planning Shop.
5. Ries, E. (2011). How today's entrepreneurs use continuous innovation to create radically successful businesses. *The lean startup*.
6. Read, S., Sarasvathy, S., Dew, N., Wiltbank, R., & Ohlsson, A.-V. *Effectual entrepreneurship*.