Admission Test for Graduate Programs

Date: Tuesday, 22 April 2025

Time: 3:00pm-5:00pm

Location: Khaldiya Campus - The Library

Notes:

- **Only simple, non-financial/non-programmable calculators are allowed.**
- **The test is administered in a paper-based format and consists of multiple-choice questions.**

I) Masters in Energy Systems Engineering and Masters in Biomedical Engineering

Below is a detailed proposal for the topics that should be included in the MCQ admission exam for the Energy Systems Engineering and Biomedical Engineering MSc programs. The topics are organized by domain as follows:

1. Mathematics

- Calculus : Differentiation, integration, partial derivatives, multiple integrals, and applications (e.g., optimization, area/volume calculations).
- Linear Algebra : Matrix operations, determinants, eigenvalues/eigenvectors, systems of linear equations.
- Differential Equations : First-order and second-order ODEs, Laplace transforms, and their applications in modeling physical systems.
- Complex Numbers : Polar and Cartesian forms, Euler's formula.
- Numerical Methods : Root-finding methods (e.g., Newton-Raphson), numerical integration, and solving differential equations numerically.

2. Physics

- Mechanics : Newton's laws, work-energy theorem, conservation of energy, and momentum.
- Electricity and Magnetism : Coulomb's law, electric fields, magnetic fields, Faraday's law, and electromagnetic induction.

3. Statics
    - Force Systems : Resultant forces, moments, and couples.
    - Equilibrium : Conditions for static equilibrium, free-body diagrams.
    - Structural Analysis : Trusses, beams, and frames; shear force and bending moment diagrams.
    - Friction : Static and kinetic friction, angle of repose.

4. Dynamics
    - Kinematics : Rectilinear and curvilinear motion, velocity, acceleration, and relative motion.
    - Kinetics : Newton's second law, work-energy principle, impulse-momentum principle.

5. Thermodynamics
    - Basic Concepts : Properties of pure substances, state postulate, and processes.
    - First Law of Thermodynamics : Energy balance, internal energy, enthalpy, and work.
    - Open and Closed Systems.

6. Electrical Circuits
    - Circuit Elements : Resistors, capacitors, inductors, and sources (voltage/current).
    - Circuit Analysis : Kirchhoff's laws, node-voltage method, mesh-current method.
    - AC Circuits : Impedance, phasors, power factor, and resonance.
    - Transient Analysis : RC, RL, and RLC circuits; time constants.
    - Applications : basic Op Amp circuits (inverting, non-inverting, adders, subtractors, etc.).

7. Statistics and Probability
    - Descriptive Statistics : Mean, median, mode, variance, standard deviation.
    - Probability : Basic rules, conditional probability, Bayes' theorem.
    - Random Variables : Discrete and continuous distributions (e.g., binomial, normal, exponential).
    - Regression Analysis : Linear regression, correlation coefficient.

II) Masters in FinTech and Risk Management

1. Mathematics & Quantitative Reasoning

This section will evaluate applicants' analytical and problem-solving skills through questions on Algebra, Probability & Statistics, Data Visualization and Calculus Basics.

a. *Algebra and Calculus Basics*

Suggested Reference: Mathematics for Economics and Business, 10th edition, Pearson, Ian Jacques

- Linear equations (Chapter 1)
- Quadratic, Exponential & logarithmic functions (Chapter 2)
- Percentages, Geometric Series (Chapter 3)
- Differentiation & Optimization (Chapter 4)

b. *Probability, Statistics and Data Visualization*

Suggested Reference: Essentials of Business Statistics, Communicating with Numbers, Jaggia/Kelly, McGraw Hill

- Understanding and analyzing graphs, charts, and numerical trends (Chapter 2)
- Numerical Descriptive Measures (Chapter 3)
- Distributions: Normal, binomial, Poisson (Chapters 5, 6)
- Confidence Intervals (Chapter 8)
- Hypothesis Testing (Chapter 9)
- Regression Analysis (Chapter 12)

2. Economics

This section will assess applicants' understanding of fundamental economic concepts, including Microeconomics and Macroeconomics.

a. *Microeconomics*

Suggested Reference: *Principles of Microeconomics, 13th edition, Case, Fair, Oster, Pearson*

- The scope and method of economics (Chapter 1)
- The economic problem: scarcity and choice (Chapter 2)
- Demand & Supply Analysis (Chapter 3)
- Elasticity of Demand & Supply (Chapter 5)
- The behavior of profit maximizing firms (Chapter 7)
- Short run and long run costs and output decisions (Chapters 8,9)

b. Macroeconomics

Suggested Reference: *Principles of Macroeconomics, 13th edition, Case, Fair, Oster, Pearson*

- Introduction to Macroeconomics (Chapter 5)
- Measuring National Output and National Income (Chapter 6)
- Unemployment, Inflation and Long run Growth (Chapter 7)
- Money and Interest Rates (Chapter 10)

3. Finance

Suggested Reference: Brealey, Myers, & Allen, *Principles of Corporate Finance, 14th edition*

- Present Value, Future Value, Simple vs. Compound Interest (Chapter 2)
- Valuing Bonds and Stocks (Chapter 3, 4)
- Risk and Diversification (Chapter 7)
- Net Present Value and Other Investment Criteria (Chapter 5)

4. Fintech & Risk Management Awareness

This section will measure applicants' ability to grasp fintech concepts rather than recall specific financial theories. The questions will focus on Digital Payments & Blockchain Technology, Cryptocurrencies, Artificial Intelligence & Automation in Finance, Cybersecurity & Fraud Prevention, Types of Financial Risks (Market Risk, Credit Risk, Operational Risk).

a. Fintech

Suggested Reference: Financial Services Technology: Processes, Architecture and Solutions, 2nd Edition, Cengage

- Introduction (Chapter 1)
- Business Process Management (Chapter 2)
- Technology Solution Delivery (Chapter 4)
- Market Risk Management (Chapter 18)
- Operational and Compliance Risk (Chapter 19)

b. Risk Management

Suggested Reference: Fundamentals of Risk Management: Understanding, Evaluating, and Implementing Effective Enterprise Risk Management by Paul Hopkin & Clive Thompson, 6th Edition, Publishers: Kogan Page London

- What is risk and why is it important? (Chapter 1, Pages: 15-19, 26)
- Origin of risk management, taking calculated risk, enterprise risk management, principles of risk management, objectives of risk management, risk management activities (Chapter 03, Pages: 42,45,48,52-54)
- Use of risk management standards for listed companies, Risk management process, updating risk management terminologies (Chapter 04, Pages: 60,61,67)
- Defining Enterprise risk management (ERM), ERM in practice, ERM & business continuity practices (Chapter 06, Pages: 85-87)
- Assessing Risk: Consideration, Causes, & Consequences (Chapter 10, Pages: 115-117)