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 Finance/Risk Management/FinTech

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)