

# POSTGRADUATE INSTITUTE OF SCIENCE

## UNIVERSITY OF PERADENIYA



### M.Sc. in Industrial Mathematics

### 2010/2011

#### 1. INTRODUCTION

Industrial Mathematics deals with developing mathematical models, finding solutions and interpreting the results of problems that come up in industry. The main objectives of this programme are to provide graduates with an adequate knowledge in Mathematics, Statistics, Operations Research and Scientific Computing, and to provide opportunities for research in applications of Mathematics to existing problems in industry. Although programmes of this nature are well-established in developed countries, it is not so in developing countries like Sri Lanka. Such programs are essential to narrow the gap that exists between scientists in industry and mathematicians.

#### 2. PROGRAMME ELIGIBILITY

The minimum requirement for enrolment is

- (a) a B.Sc. Special Degree in Mathematics or a B.Sc. Special/General degree with Mathematics as a subject  
or
- (b) any other equivalent qualifications acceptable to the Postgraduate Institute of Science (PGIS)

Candidates should be proficient in English as English will be the medium of instruction for the programme.

#### 3. PROGRAMME FEE

(N.B. The Programme fees given below may be revised.)

	M.Sc. programme fee
local candidates	Rs. 60,000/=
SAARC countries	US \$ 2000/=
other countries	US \$ 4000/=

Programme fees shall be paid in two instalments (50% at the registration and the balance 50% within six months from registration). Other payments including registration fee, medical fee, library subscription, examination fee and deposits (science and library) should be paid according to the procedure stipulated by the PGIS. Candidate will have to pay an additional fee of Rs. 2500/= for the preliminary courses.

#### 4. THE PROGRAMME STRUCTURE AND DURATION

This is a full-time programme consisting of course work and a research project. Course work will be conducted over a period of two semesters of 15 weeks each. The entire programme duration will be about 15-18 months inclusive of 3 - 6 months for the research project. Satisfactory completion of a minimum of 24 credits of course work (with a GPA of not less than 3.00) is required for the programme in addition to the 6 credits allocated for the full-time research project (*The student who does not satisfy the above criteria but obtains a GPA in the range 2.75 to 2.99 for course work is eligible for the Diploma in Industrial Mathematics but not the M.Sc. Degree*). Continuous attendance is compulsory during the period of research work. After successful completion of the research project, the student is eligible for the award of the M.Sc. Degree.

##### Programme Summary

Course Code	Course	Lecture hrs.	Practical hrs.	No. of Credits
<b>Preliminary Courses*<sup>1</sup></b>				
MT 401	Preliminaries in Mathematics	30	-	-
MT 402	Statistics	30	-	-
MT 403	Computer Applications	-	30	-
<b>Semester I</b>				
MT 501	Differential Equations	45	-	3
MT 502	Statistical Quality Control	30	-	2
MT 503	Numerical Analysis	45	-	3
MT 504	Stochastic Process and Applications*	30	-	2
MT 505	Operations Research	45	-	3
<b>Semester II</b>				
MT 516	Control Theory*	45	-	3
MT 517	Topics in Computer Science	45	-	3
MT 518	Optimization Theory*	30	-	2
MT 519	Special Topics in Industrial Mathematics*	30	-	2
MT 520	Theoretical Fluid Mechanics*	45	-	3
MT 597	Seminar	-	-	1
MT 599	Research Project	(3 - 6 months)		6

\*<sup>1</sup> *Compulsory for those without sufficient background knowledge.*

\* *Optional courses. Students are required to obtain 9 credits from optional courses.*

#### 5. PROGRAMME CONTENTS

##### MT 401: Preliminaries in Mathematics

Linear Algebra: Orthogonal and orthonormal sets, orthogonal projection, Linear functionals, Adjoint, Unitary and normal operators, Hermitian forms, Spectral theorem.

Analysis: Complete metric spaces, Compactness, Fixed point theorems, Banach spaces, Hilbert spaces.

##### MT 402: Statistics

Variability in observations. Parameters and statistics. Measures of location and spread. Frequency distributions, Histogram, Stem and Leaf plots. Discrete data: Probability structure and cumulative distributions. Continuous data: Distribution functions, Family of Normal distributions. Simple linear regression and correlation. Probability: Properties, Conditional probability, Independence. Discrete random variables: Probability mass functions and cumulative distributions. Some common discrete distributions, Bayes' Rule. Expectations and Central Limit Theorem. Sampling from the Normal distribution. Point and interval estimation. Test of hypotheses: Simple and composite hypothesis. Tests on means and variances.

**MT 403: Computer Applications**

Introduction to computers, Windows and Disk operating system and commands. Microsoft applications. Computer software applications depending on the requirements of the programme.

**MT 501: Differential Equations (3 credits)**

Ordinary differential equations: Existence and Uniqueness of solutions, Continuation of solutions, Linear and Non-linear systems of differential equations, Asymptotic behaviour, Limit cycles, Perturbation theorems, Stability and Control.

Partial differential equations: Envelopes, Characteristic strips, Legendre transformation, Complete integral and Eikonal function, Hamilton Jacobi equation, Finite - Element method, Pontryagin's minimum principle, Discontinuous solutions, Weak solutions, Burger's equation, Fourier series on the Quotient-group  $R / 2\pi Z$ , Series expansions and Fast Fourier transforms.

**MT 502: Statistical Quality Control (2 credits)**

Control charts for attributes, Control charts for variables, Single sampling planes for attributes, Acceptance sampling by variables.

**MT 503: Numerical Analysis (3 credits)**

Solution of system of linear equations, roots of non-linear algebraic and transcendental equations, System of non-linear equations, Polynomial interpolations, Numerical Integration (Quadrature), Gaussian quadrature, Solution of ordinary differential equations, Solution of partial differential equations, Parabolic equations, Elliptic equations, Hyperbolic equations.

**MT 504: Stochastic Process & Applications (2 credits)**

Recurrent events, Random walks, Markov chains, Transition probabilities, Limiting distributions, Discrete branching process, Markov processes in continuous time, poisson processes, Birth and death processes, Queuing theory, Epidemic processes, Competition and perdition.

**MT 505: Operations Research (3 credits)**

Convex analysis, Linear programming, Graph theory and Network optimization, Queuing theory, Dynamic programming, Integer programming.

**MT 516: Control Theory (3 credits)**

Linear Feedback control systems: Input-Output approach, Block diagrams and signal flow graphs, State space approach, Digital control systems: Digital systems, Sampling of continuous-time signals, Analysis of discrete-time systems, Digital PID controllers, digital polynomial controllers and state space, Introduction to advance digital controllers.

**MT 517: Topics in Computer Science (3 credits)**

Structured programming techniques, Data base management systems, System development strategies, Information processing systems, Intelligent systems.

**MT 518: Optimization Theory (2 credits)**

Kuhn-Tucker theory and nonlinear programming, Geometric programming, Direct search and gradient method; One-dimensional search, Multi-dimensional search.

**MT 519: Special Topics in Industrial Mathematics (2 credits)**

Topics selected will be based on the availability of resource persons.

**MT 520: Fluid Mechanics (3 credits)**

Viscous Fluid: Navier-Stokes equations, High Reynolds number flow, Low Reynolds number flow, Non-viscous Flow: Free streamline theory in discontinuous motions, Jets and currents in 2-D, Stokes stream function in 3-D, Axi-symmetric flows, Compressible Flow: Vortex motion in 2-D irrotational flow.

**MT 599: Research Project (6 credits)**

Each candidate is required to carryout a literature survey based on his/her research project and write a review article to be presented in a seminar at the end of the second semester. The candidate will carry out

a research project that requires a fair amount of Industrial Mathematics. At the end of the research project the results of the research project should be presented at a seminar and submitted in the form of a dissertation on or before the deadline set by the PGIS.

## 6. PROGRAMME EVALUATION

Programme evaluation will be as stipulated in the PGIS Handbook.

## 7. TEACHING PANEL

- Dr. W.B. Daundasekera, Dept. of Mathematics, Faculty of Science, Univ. of Peradeniya *B.Sc.(Perad.), M.A.(Alabama), Ph.D.(Alabama)*
- Mr. J.P.D. Dharmadasa, Dept. of Mathematics, Faculty of Science, Univ. of Peradeniya *B.Sc.(Cey.), M.Phil.(London)*
- Dr. U.N.B. Dissanayake, Dept. of Mathematics, Faculty of Science, Univ. of Peradeniya *B.Sc.(Cey.), Ph.D.(Alberta)*
- Dr. C.J. Jayawardene, Dept. of Mathematics, Faculty of Science, Univ. of Colombo *B.Sc.(Col.), M.Sc.(Ohio State), M.Sc.(Memphis), Ph.D.(Memphis)*
- Dr. M.U.M. Mampitiya, Dept. of Mathematics, Faculty of Science, Univ. of Kelaniya *B.Sc.(Kel.), M.Sc.(Ottawa), Ph.D.(Ottawa)*
- Dr. Munasinghe, Dept. of Eng. Mathematics, Faculty of Engineering, Univ. of Peradeniya *B.Sc. Eng.(Perad.), M.Eng.(A.I.T.), D.Eng.(Tokyo)*
- Dr. A.A.I. Perera, Dept. of Mathematics, Faculty of Science, Univ. of Peradeniya *B.Sc.(Perad.), M.Sc.(Oslo), Ph.D.(Melbourne)*
- Dr. A.A.S. Perera, Dept. of Mathematics, Faculty of Science, Univ. of Peradeniya *B.Sc.(Perad.), Ph.D.(SUNY/Albany)*
- Dr. S.M.N.A. Senanayake, Dept. of Computer Science & Statistics, Faculty of Science, Univ. of Peradeniya *M.Sc. Eng.(Havana), Ph.D.(Linz.)*
- Dr. K.M.S. Senanayake, Dept. of Computer Science & Statistics, Faculty of Science, Univ. of Peradeniya *M.Sc. Eng.(Havana), Ph.D.(Linz.)*
- Prof. H.H.G. Seneviratne, Dept. of Mathematics, Faculty of Science, Univ. of Peradeniya *B.Sc.(Cey.), Ph.D.(London)*
- Dr. S.B. Siyambalapatiya, Dept. of Eng. Mathematics, Faculty of Engineering, Univ. of Peradeniya *B.Sc.(Cey.), M.Sc., Ph.D.(NSW)*
- Dr. K.S. Walgama, Dept. of Engineering Mathematics, Faculty of Engineering, Univ. of Peradeniya *B.Sc. Eng.(Moratuwa), M.Eng.(Netherlands), M.Sc.(Alberta), Ph.D.(Lulea)*
- Dr. P. Wijekoon, Dept. of Computer Science & Statistics, Faculty of Science, Univ. of Peradeniya *B.Sc.(Kel.), Ph.D.(Dortmund)*

## PROGRAMME COORDINATOR

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