

# POSTGRADUATE INSTITUTE OF SCIENCE UNIVERSITY OF PERADENIYA



## M.Sc. in Science Education 2010/2011

### 1. INTRODUCTION

The postgraduate programme of study in Science Education seeks to provide an opportunity to students to achieve a perspective of science and science education. An understanding and a suitable adaptation to the future which is becoming more and more complex daily is what science education must strive at. The advancements in science and technology have changed the life style patterns of humans and, the nature of society. Science has come to be viewed as an aspect of human culture and, hence as an essential component in the school curriculum. Science plays a significant role in all human activities and therefore knowledge and the ability of its application would lead to greater effectiveness and fulfillment in our personal and social lives. Science educators should be competent to guide themselves, their colleagues and, above all their students to cope with the rapidly changing world. This programme will take into consideration the nature of the learner, the processes of learning and teaching and, the characteristics of the domain-Science. It will further stress the importance of orientation towards the future.

The course leading to the Degree of M. Sc. in Science Education is a full-time programme. It is designed especially for the science teachers, educationists and those who could contribute to the development of science education in Sri Lanka. The programme consists of two semesters of coursework, which include the professional general component of **Science Education**, and a special component which could be one of the four subject areas - **Biology Education, Chemistry Education, Mathematics Education** and **Physics Education**. In addition, practicals, a research project and a seminar in the special component are also included in the programme.

### 2. AIMS AND OBJECTIVES OF THE PROGRAMME

The programme is designed to provide students an opportunity to develop their teaching competency, to explore disciplines providing a theoretical framework for professional work and to extend individual interests, skills, talents, and career opportunities. The special component provides guidance and common experiences, which are flexible enough to meet the individual student's needs and career goals.

The students who follow the programme will be able to:

- \* develop competencies to "Learn to Learn" along with the other competencies
- \* develop concern for the betterment of oneself and of others
- \* engage in scientific activities deriving joy and satisfaction
- \* inculcate a "Habit of Mind" continuously to be sensitive, alert and curious
- \* develop intellectual attitudes such as open mindedness, whole heartedness and social responsibility
- \* develop personal and professional confidence of "Knowing about Knowing" to meet the challenges in the 21st century.

### 3. PROGRAMME ELIGIBILITY

The candidates possessing the following educational and professional qualifications are eligible to apply for the Master of Science programme in Science Education:

- I. (a) Bachelor's Degree in Science (B.Sc.) or  
 (b) Bachelor's Degree in Education (B.Ed.) with a strong science background acceptable to the Postgraduate Institute of Science
- and
- II. (a) Postgraduate Diploma in Education or  
 (b) Any other equivalent qualifications/experience acceptable to the Postgraduate Institute of Science

Candidates who meet eligibility requirements and successful at the selection test (aptitude, English and subject component) will be called for an interview. Employed candidates who are eligible for admission should produce evidence of leave granted to follow the programme and a letter of release from the relevant Heads of the Department/Institution.

#### 4. PROGRAMME FEE

	M.Sc. programme fee
Local candidates	Rs. 60,000/-
SAARC countries	US\$ 2,000/-
Other countries	US\$ 4,000/-

Programme fee shall be paid in two instalments (50% at 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.

#### 5. THE PROGRAMME STRUCTURE AND DURATION

This is a full-time programme consisting of coursework and a research project. Coursework will be conducted over a period of two semesters, each of 15 weeks (during weekends and/or weekdays). The entire programme duration will be about 15-18 months inclusive of a 3-6 month period for the research project. Satisfactory completion of a minimum of 24 credits of coursework (with a GPA of not less than 3.00) is required for the programme in addition to the six credits allocated for the full-time research project (If the student obtains a GPA in the range 2.75 to 2.99, then he/she is eligible for the Diploma in Science Education but not for the M.Sc. Degree). Continuous attendance is compulsory **throughout the programme of study**. After successful completion of the research project, the student is eligible for the award of the M.Sc. Degree. Based on the **overall** performance of students, PGIS may upgrade the registration of such students to M.Phil. or Ph.D. programmes.

#### Programme Summary

The programme of study consists of 225 lecture hours and 15 practical hours (15.5 credits) in the general component and 105 lecture hours (7 credits) and 45 practical hours (1.5 credits) in the special component. Credit value (6 credits) of the 3 - 6 month research project will not be counted in computing GPA.

	Lecture hrs.	Practical hrs.	No. of Credits
General Component (Science Education)			
Coursework	225	15	15.5
Special Component (Biology/Chemistry/Mathematics/Physics Education)			
Coursework	105	45	8.5
Research project (3 months)			6.0 *
<b>Total</b>			<b>24.0</b>

\* These credits will not be counted in computing GPA

**General Component - Science Education**

Course Code	Course	Lecture hrs.	Practical hrs.	No. of Credits
SE 501	Science in the Past, Present and Future *	15	-	1
SE 502	Science Teaching and Learning *	45	-	3
SE 503	Qualitative Research Methods in Science Education **	45	-	3
SE 504	Quantitative Research Methods in Science Education **	30	-	2
SE 505	Science Curriculum	30	-	2
SE 506	Science and Society	30	-	2
SE 507	Science and Information Technology *	15	15	1.5
SE 508	Measurement and Evaluation	30	-	2
SE 509	Philosophical Foundations of Education	15	-	1
SE 510	Psychological Foundations of Education	15	-	1
SE 511	Educational Management	15	-	1
SE 512	Action Research	15	-	1
SE 513	Energy and Environment	15	-	1
SE 514	School, university and industry relationships	15	-	1

\* *Compulsory courses*

\*\* *One of the courses in Research Methodology (SE 503 or SE 504) is compulsory*

*In addition to the compulsory courses each student must follow optional courses to meet the requirement of 15.5 credits.*

**Special Component**

The students are expected to select **one** of the following special subjects:

- (i) **Biology Education**
- (ii) **Chemistry Education**
- (iii) **Mathematics Education**
- (iv) **Physics Education**

All the special subjects have a theory component of 105 lecture hours (7 credits: compulsory 4 credits and optional 3 credits), a practical component of 45 practical hours (1.5 credits), a three month research project (6 credits).

**Research Project**

Every student should undertake a research project on a topic related to teaching/learning of the special subject. The students may seek guidance from their supervisors at the beginning of the academic year. The results of the project should be presented at a seminar and submitted in the form of a written report.

**SPECIAL COMPONENT - BIOLOGY EDUCATION**

Course Code	Course	Lecture hrs.	Practical hrs.	No. Of Credits
SE 516	Biology Education *	30	-	2
SE 517	Methods of Teaching Biology *	30	-	2
SE 518	Plants and Animals: Their evolution and Interactions	15	15	1.5
SE 519	Environmental Science	15	15	1.5
SE 520	Molecular Biology and its applications	15	15	1.5
SE 521	Histology and Hormones in living organisms	15	15	1.5
SE 522	Plant Systematics and Breeding	15	15	1.5
SE 523	Microbiology and Plant Pathology	15	15	1.5
SE 524	Food Science	15	15	1.5
SE 525	Functioning Plant	15	15	1.5
SE 599	Research Project *			6.0
SE 597	The seminar based on the research project			0.5

\* *Compulsory Courses*

Students are required to select any three optional courses from SE 518 - SE 525. All optional courses may not be offered in a given academic year. The optional courses offered will be announced at the beginning of each academic year.

### SPECIAL COMPONENT - CHEMISTRY EDUCATION

Course Code	Course	Lecture hrs.	Practical hrs.	No. of Credits
SE 531	Curriculum Development and Chemistry Education in Sri Lanka *	15	-	1
SE 532	Problems of Chemistry Teaching in Schools and Possible remedial measures	15	-	1
SE 533	Methods of Teaching Chemistry I *	15	-	1
SE 534	Methods of Teaching Chemistry II *	15	-	1
SE 535	Some Important Theoretical Concepts and Special Topics Relevant to Chemistry Teaching I	15	-	1
SE 536	Some Important Theoretical Concepts and Special Topics Relevant to Chemistry Teaching II	15	-	1
SE 537	Relevance of Principles of Chemistry in Selected Chemical Industries	15	-	1
SE 538	Chemistry and the Environment	15	-	1
SE 539	Laboratory Work *	-	45	1.5
SE 599	Research Project (3 months) *			6

\* *Compulsory Courses*

Students are required to select any three optional courses from SE 535 - SE 538.

### SPECIAL COMPONENT - MATHEMATICS EDUCATION

Course Code	Course	Lecture hrs.	Practical hrs.	No. of Credits
SE 546	Mathematics Education in Sri Lanka*	15	-	1
SE 547	Methods of Teaching Mathematics*	15	-	1
SE 548	Fundamental Concepts in Mathematics*	15	-	1
SE 549	Laboratory & Field Work*	-	45	1.5
SE 550	History of Mathematics*	15	-	1
SE 551	Complex-variable Theory	15	-	1
SE 552	Mathematical Modelling	15	-	1
SE 553	Metric Spaces and their Applications	15	-	1
SE 554	Linear Algebra	15	-	1
SE 555	Measure Theory	15	-	1
SE 556	Differential Equations	15	-	1
SE 557	Computer Mathematics	15	-	1
SE 558	Probability and Statistics	15	-	1
SE 559	Numerical Methods	15	-	1
SE 599	Research Project (3 months) *			6

\* *Compulsory courses*

Masters students are required to select any **three** optional courses from SE 551 - SE559.

### SPECIAL COMPONENT - PHYSICS EDUCATION

Course Code	Course	Lecture hrs.	Practical hrs.	No. of Credits
SE 561	Physics Education I *	30	-	2
SE 562	Physics Education II *	15	-	1
SE 563	Important Concepts and Principles in Physics *	15	-	1
SE 564	Energy and Environment	15	-	1
SE 565	Physics of Materials	15	-	1
SE 566	Astronomy	15	-	1
SE 567	Electronics and communication	15	-	1
SE 568	Topics in Applied Physics	15	-	1
SE 569	Practicals in Physics *	-	45	1.5
SE 599	Research Project (3 months) *			6

\* *Compulsory Courses*

Students are required to select any three optional courses from SE 549 - SE 553.

## 6. PROGRAMME CONTENTS

### SCIENCE EDUCATION

#### **SE 501: Science in the Past, Present and Future** (15h, 1 credit)

The nature of science; Static and dynamic views; Scientific method; Scientific way of thinking; Scientific inquiry; Developing the "Scientific Mind;" Development of science and scientific thought in relation to the socio-cultural, philosophic, moral and religious thought of various ages from ancient to modern including indigenous and traditional knowledge, roots and growth of science and technology.

#### **SE 502: Science Teaching and Learning** (45 h, 3 credits)

Use of constructive approach in teaching science for understanding and meaningful learning and to achieve scientific literacy; Science teaching as a scholarship; Criticisms of teacher-centred, subject-centred, child-centred teaching, teaching for conceptual change and changes in the emphasis of science teaching in Sri Lanka and outside referring to Nuffield, BSCS; Collaborative problem solving; Reciprocal teaching; Concept map as a tool in teaching, learning, research and in evaluation; Problem-based learning; Guiding students for self-directed and self-regulated learning.

#### **SE 503: Qualitative Research Methods in Science Education** (45 h, 3 credits)

Limitations of using scientific method in educational research; Selection of a sample in qualitative research; Selection of a site and early negotiations with the administrators. Rights and duties, Consent forms. Recording observations as an observer and participant observer (Field notes), Transcribing fieldnotes, Methods of conducting interviews, Transcribing interviews, Use of documents as data in qualitative research; Use of field notes, interviews and documents in data analysis; Data coding and indexing; Grounded theory; Content analysis; Triangulation  
Writing a research report

#### **SE 504: Quantitative Research Methods in Science Education** (30 h, 2 credits)

Use of scientific method in educational research; Types of educational research (Case-studies, descriptive, historical and philosophical); Research designs; Need for sampling, techniques of sampling, sampling designs--simple, random, stratified, proportionate, cluster, snow ball; Sampling error, sampling bias, and sampling size; Developing research instruments (Questionnaires, observation and interview schedules, survey instruments); Data coding and recording  
Percentages; Regression and correlation; Chi-square; t-tests; z-tests; Univariate, bivariate and multivariate analysis of variance; Use of research findings in policy formulation; Writing a research report

#### **SE 505: Science Curriculum** (30 h, 2 credits)

Research and changing emphasis in the development of science curriculum national as well as international; Types and definitions of curriculum, Place of science in the school curriculum referring to Nuffield and BSCS programmes; Use of integrated science approach and constructivist approach in the development of a science curriculum; Developing a unit plan for conceptual change, The concept of curriculum and curriculum development in relation to the three modes of operation-practical, quasi-practical and eclectic.

#### **SE 506: Science and Society** (30 h, 2 credits)

Science in day to day life--learning to live with natural hazards-earthquakes, cyclones, landslides, coastal erosion etc., safety of drinking water-surface and ground water-their quality and pollution aspects; Energy resources and their utilization; The role of Mines and Minerals Act No. 33 of 1992; Effects of mining (sand, minerals and, rocks) on society.

**SE 507: Science and Information Technology** (15 h T+ 15h P, 1.5 credits)

Contributions of technological revolutions in science learning and teaching; Use of print-based, radio, television, audio and video cassettes as media in science teaching and reaching people; Use of computers in educational research; Satellite communications; Use of internet in receiving information; Concept of "Global Village".

**SE 508: Measurement and Evaluation** (30 h, 2 credits)

Assessment (continuous, school-based, formative, summative, formal & informal), Scales of measurement; Measures of central tendency, Frequency distributions, Histograms, Stem and leaf plot, Box and whiskers plot, Normal distribution, Skewed distributions

Taxonomy of objectives in the three domains and its application in education; Cognitive and non-cognitive tests, Construction and validation of tests; Criteria for reporting student performance; Qualities of measuring instruments (Validity, reliability and practicability); Formative and summative evaluation; Diagnosis and remediation

**SE 509: Philosophical Foundations of Education** (15 h, 1 credit)

Some knowledge about individual philosophers of science. Popper, falsification, demarcation and critique of induction. Kuhn, normal science, revolutionary science, and paradigmatic change. Positivist view of science. Realist view of science. Pragmatism and idealism. Religious approach. Analytical traditions.

**SE 510: Psychological Foundations of Education** (15 h, 1 credit)

Cognitive and psycho-social development of the child; Language and thought (Piaget, Vygotsky & Chomsky); Metacognition; Cooperative and collaborative learning; The concept of "Learning Community"; Behavioural, cognitive and social learning, children with special needs (slow learners, backward, gifted and maladjusted); The role of computers and artificial intelligence.

**SE 511: Educational Management** (15 h, 1 credit)

Concept of Educational Management, an overview; Educational Management as a profession; Five functions of a manager, planning, decision making, organising, directing, and controlling; Leadership in Educational Management; Supervision in Educational Management; Legal basis for Public Education in Sri Lanka; Organisation and management of the Ministry of Education with special focus on Provincial levels; Recent Education Reforms and restructure (Policy and Programme of Action)

**SE 512: Action Research** (15 h, 1 credit)

Origins of action research, Definitions and models of action research, Classroom teaching and action research, The teacher as a researcher, Action research and reflective practice, Writing an action research report.

**SE 513: Energy and Environment** (15 h, 1 credit)

Energy development and utilization; Fossil fuels (oil, natural gas and coal), environmental effects of producing and using fossil fuels; Alternative energy sources: solar, wind, bio-gas, geothermal and ocean energy (wave and thermal), hydro and nuclear. Environmental effects of using alternative energy sources; Electrochemical power sources: batteries and fuel cells; hydrogen as a fuel (8L) Air pollution, greenhouse effect, ozone depletion, water pollution, waste management (5L) Noise pollution (2L)

**SE 514: School, university and industry relationships** (15 h, 1 credit)

Sociology of the school (Relationship between society's goals and those of the school, the socio-political and instructional organization of a school, roles and values of a teacher); Social relations in the classroom, school, community and their interactions, peers and social groups; Socialization process and its impact on education; Sociological theories and relevance to education; Ideology of Science; Social theory as Science. The impact of science and technology on human development; What is university-industry relationship? Technology transfer and commercialization; Models/concepts of innovations; Promotional mechanisms and features in developing countries

## **BIOLOGY EDUCATION**

### **SE 516: Biology Education** (30 h, 2 credits)

Aims and objectives of learning Biology; Problems of Biology teaching in schools; Curriculum development and Biology education in Sri Lanka; Assessment and evaluation in Biology

### **SE 517: Methods of Teaching Biology** (30 h, 2 credits)

Hypothesis testing and use of statistics; Physics in Biology; Mathematics in Biology; Modelling Biology lessons; Use of audio-visual aids, study packages, games etc.

### **SE 518: Plants and Animals - Their Evolution and Interactions**

(15 hours Theory & 15 hours Practicals, 1.5 credits)

The evolutionary history of biological diversity; Plants and animals-similarities and differences; Plant animal interactions; Practical

### **SE 519: Environmental Science** (15 T & 15 P, 1.5 credits)

Environment, environmental problems and environmental education; Problem solving in Biology in relation to school projects; Natural resources of Sri Lanka; Conservation and management of natural resources; Practical and field trips

### **SE 520: Molecular Biology and its Applications** (15 T & 15 P, 1.5 credits)

Molecular biology; Biotechnology; Genetics; Practical

### **SE 521: Histology and Hormones in Living Organisms** (15 T & 15 P, 1.5 credits)

Animal hormones in growth and development; Animal Histology Plant hormones in growth and development; Plant histology; Practical

### **SE 522: Plant Systematics and Breeding** (15 T & 15 P, 1.5 credits)

Gene expression and organization in Eucaryotes; Speciation and mechanisms of evolution; Wild crops; Breeding and development of new varieties; Plant systematics Practical

### **SE 523: Microbiology and Plant Pathology** (15 T & 15 P, 1.5 credits)

Microbiology; Diseases in plants and remedies; Practical

### **SE 524: Food Science** (15 T & 15 P, 1.5 credits)

Agriculture vs Agroforestry for sustainable development; Food and nutrition; Post-harvest technology; Practical

### **SE 525: Functioning Plant** (15 T & 15 P, 1.5 credits)

Plant water relations; Ionic relations (mineral nutrition); Carbon metabolism; Practical

### **SE 599: Research Project** (3-6 months, 6 credits)

### **SE 597: The seminar (based on the Research Project)** (0.5 credit)

## CHEMISTRY EDUCATION

### **SE 531: Curriculum Development and Chemistry Education in Sri Lanka (15h, 1 credit)**

Aims and Objectives of Learning Chemistry; Role of Chemistry in everyday life; Clothing and Sanitary needs, Household items, Transport etc.; Career opportunities involving the application of Chemical knowledge; History of Chemistry Education; Role of Chemistry from ancient times to modern period; Changes in the emphasis of teaching Chemistry in Sri Lankan schools and in the universities (undergraduate and postgraduate study); Curriculum development; Critical evaluation of the Chemistry component of General Certificate of Education (G.C.E.) Ordinary Level (O/L) Science curriculum, present G.C.E. Advanced level (A/L) Chemistry curriculum and present University first year Chemistry curricula; Bridging the gap of chemical knowledge between the different levels of Chemistry teaching as mentioned above

### **SE 532: Problems of Chemistry Teaching in Schools and Possible Remedial Measures**

*(15h, 1 credit)*

Evaluation of Obstacles encountered in Chemistry teaching in Sri Lanka; Critical evaluation of the degree to which the goals set by curriculum are achieved; Factors responsible for inability to reach set targets (syllabus, methods of teaching, textbooks, laboratory facilities etc.); Possible means of overcoming the relevant obstacles; Assessment and evaluation of student achievement; Objectives of assessment and evaluation; Different methods of evaluation and their suitability and drawbacks; Setting up of School Laboratories; Understanding the basic facilities required to carry out practical work in schools; Planning the setting up of a Chemistry laboratory with special emphasis on the facilities available in rural/urban environments; Design of laboratory buildings and furniture; Requirements in chemicals, glassware, burners etc. Low cost equipment for teaching Chemistry

### **SE 533: Methods of Teaching Chemistry - I (15h, 1 credit)**

Computer Assisted Learning; Introduction to computers; Software for preparing study packages; Information Technology

### **SE 534: Methods of Teaching Chemistry - II (15h, 1 credit)**

Audio-visual techniques; Use of simple demonstrations; Audiovisual aids; Games, study packages; Problem solving in Chemistry; Potential of numerical problem solving as a teaching technique; Techniques of numerical problem solving with special emphasis on stoichiometry; Industrial flow charts; Identification of bottle-necks in various manufacturing processes taking cement industry, tyre industry etc. as examples

### **SE 535: Some Important Theoretical Concepts and Special Topics Relevant to Chemistry**

**Teaching - I (15h, 1 credit)**

Structure of matter; Elementary concepts of quantum mechanics and chemical bonding, H-bond; Laws of thermodynamics with special emphasis on its relevance to Chemistry and the understanding of various day to day processes; The role of thermodynamics in industry; Chemical equilibria and their application; Phase equilibria and their application

### **SE 536: Some Important Theoretical Concepts and Special Topics Relevant to Chemistry**

**Teaching - II (15h, 1 credit)**

Basic concepts of Organic Chemistry; Isomerism; IUPAC nomenclature; Simple reaction mechanisms; Special topics in Inorganic Chemistry; Economically important minerals in Sri Lanka and their utilization with special emphasis on clays, mineral sands, apatite, iron ore, limestone; Potential future development for chemical industry in Sri Lanka; Gems and their chemistry, heat treatment of gem stones; Chemistry of the transition elements

### **SE 537: Relevance of Principles of Chemistry in Selected Chemical Industries**

*(15 h, 1 credit)*

Role of Chemistry in Detergent industry, Rubber product industry, Activated Carbon industry, Ceramics industry, Plastic industry, Beverage industry; Industrial gases; Electroplating etc.

**SE 538: Chemistry and the Environment** (15h, 1 credit)

Scientific and technological advances and environmental pollution; Pollution of air, water and soil; Monitoring air and water pollution; Green house effect and global warming; Health and toxicological aspects relating to pollution, their mitigation and control; Depletion of natural resources and the need for sustainable development; Energy crisis and alternate energy sources; Solid state, their accumulation and disposal; Field monitoring of pollutants with special emphasis on suitable student projects

**SE 539: Laboratory Work** (45h, 1.5 credits)

Working of simple instruments used in Chemistry teaching (with special emphasis on G.C.E. A/L Chemistry teaching;) Measurement of gas pressure and volume; Handling of glass ware; Simple glass blowing; Data collection and handling; Graph drawing; Evaluation of about 15 selected experiments from G,C,E. A/L curriculum with special emphasis on special usefulness of the experiment, drawbacks, methods of improving the experiment for obtaining better results and investigation of ways of incorporating these improvements in classroom situations

**SE 599: Research Project** (3- 6 months, 6 credits)

Some suggested areas of study:

Development of experiments to illustrate selected principles of Chemistry, Demonstrations to illustrate selected principles of Chemistry; Development of chemical experiments that can be carried out at home using readily available material; Development of evaluation procedures; Preparation of study packs for teaching selected topics; Use of computers for teaching selected topics in Chemistry; New approaches in teaching selected topics in Chemistry

## MATHEMATICS EDUCATION

**SE 546: Mathematics Education in Sri Lanka** (15 hrs; 1 credit)

Role of mathematics in everyday life, Teaching mathematics in schools, teacher-training colleges, technical colleges and universities, Critical evaluation of the mathematics syllabi of the G.C.E. (O/L), G.C.E. (A/L) and the first year (G.S.Q.) levels at universities, Bridging the gap of mathematics knowledge between different levels of mathematics teaching as mentioned above, Assessment and evaluation in mathematics, Career opportunities for mathematics graduates, Use of mathematical skills in other disciplines, Postgraduate studies in mathematics, Research and frontier developments in mathematics education.

**SE 547: Methods of Teaching Mathematics** (15 hrs; 1 credit)

Student-centered method, Teaching through problem solving, group discussions and presentations, Teaching through home-work problems, quizzes and traditional examinations, observations and understanding of nature related to mathematical theories, Model - building in mathematics, Mathematics clubs and quiz-competitions, Computer assisted learning and software packages, Audio-visual aids, Use of library facilities, Writing course-texts, Identification of mathematical problems in the industry.

**SE 548: Fundamental Concepts in Mathematics** (15 hrs; 1 credits)

Mathematical logic, Baby set theory, ZF+C Model, Construction of the real number system via Dedekind's cuts, Topics in Geometry, Algebraic structures (groups, rings, modules, fields, vector-spaces), Topology of  $\mathbb{R}^n$ , Transfinite numbers, Rigid-body dynamics, Validity of Newtonian mechanics, Four-vectors and Tensorial geometry.

**SE 549: Laboratory and Field Work** (45 hrs; 1.5 credit)

Designing and preparation of simple instruments and models related to G.C.E. (A/L) mathematics teaching, Data collecting and methods of representation, Identification of problems in teaching mathematics at school levels, Usage of software packages, Computer-aided teaching.

**SE 550: History of Mathematics** (15 hrs; 1 credit)

Origin of numbers, Role of numbers in the society, Euclidean geometry with original proofs, Cubic and quartic equations, historical approach to calculus, historic period from the eighteenth century covering the work of Brook Taylor, Colin Maclaurin, J.D'alembert, Augustine-Louis Cauchy, E.F. Gauss, J. Jacobi, Riemann, Lebesgue, Karl Weiestrass, J.W.K. Dedekind, George Cantor and Albert Einstein.

*The following optional courses (SE 551 - 559) are designed to stimulate and motivate Masters students to the excitement of the subject and to enhance their career opportunities.*

**SE 551: Complex-Variable Theory** (15 hrs; 1 credit)

Geometry of complex numbers, Riemann's sphere, Cauchy's Theorems (four), Winding number and homotopy, Rouché's theorem and its applications.

**SE 552: Mathematical Modeling** (15 hrs; 1 credit)

Dimensional analysis, Averaging (mean, median, mode), Curve fitting, Model-testing, Rational models, Optimization via calculus Optimization via linear programming, Income determination models and models related to banking sector.

**SE 553: Metric Spaces and their Applications** (15 hrs; 1 credit)

Distance functions, Diameter of a set, Open and Closed sets, Complete metric spaces, Fixed point theorems and their applications to differential and integral equations.

**SE 554: Linear Algebra** (15 hrs; 1 credit)

Vector spaces and linear transformations, Characteristic values, Functions of matrices, Stochastic matrices, Non-homogeneous linear systems; mechanical systems; Biological systems, Inner-product spaces, Linear functionals and dual spaces.

**SE 555: Measure Theory** (15 hrs; 1 credit)

Measurable sets and Lebesgue measure, Measurable functions, The Lebesgue integrals, Differentiation and integration,  $L_p$  - spaces, Probability measures and Random-variables, Stochastic independence.

**SE 556: Differential Equations** (15 hrs; 1 credit)

ODE : Second order differential equations and their practical importance, Autonomous systems, Limit cycles, Non-autonomous systems, Perturbation, theorems, Stability.

PDE :Eigenvalue problems, Hamilton-Jacobi equation, Finite-difference approximations and numerical methods.

**SE 557: Computer Mathematics** (15 hrs; 1 credit)

Binary number system, Computer codes, Algorithms, Flowcharts, Boolean algebra, Combinational analysis, Graphs and multigraphs, Finite state machines, Strings, Finite automata theory.

**SE 558: Probability and Statistics** (15hrs; 1 credit)

Probability spaces, Bayes' Theorem, Random variables, Distribution functions, Regression, Limit theorems, Sampling, Estimations, Testing Hypotheses.

**SE 559: Numerical Methods** (15hrs; 1 credit)

Solving Non linear equations: iteration method, Newton Raphson method, secant method, convergence concept.

Solving simultaneous equations: Gauss elimination method, iterative methods, Jacobi & Gauss sequential method, Diagonal dominant Interpolation.

Approximations: Taylor method, Least square method.

Integration: Solving Differential equations, forward difference method, Euler& Runge Kutta method.

**SE 599: Research Project** (3 – 6 months, 6 credits)

Each student is required to carry out an independent research project on a suitable topic in Mathematics Education under the guidance of a supervisor and write a project report.

**PHYSICS EDUCATION**

**SE 561: Physics Education - I** (30 h, 2 credits)

History of Physics Education; Aims and objectives of learning Physics; Methods of teaching/learning Physics; (a) Student-centred method of teaching Physics (b) Teaching Physics through problem solving, group discussions and tutorials, (c) Use of demonstration experiments for Physics teaching (d) Interactive Physics teaching through: audio-visual aids, videos, computer software and multimedia packages (e) Physics teaching through observation and understanding of nature, real world, and technology (f) Physics teaching by motivating students by their participation in Physical societies, quiz competitions, exhibitions, astronomy clubs, and environment clubs etc.

**SE 562: Physics Education - II** (15 h, 1 credit)

Problems of Physics teaching in schools; Development of Physics curricula at primary, secondary and tertiary levels in Sri Lanka and the relevance of Physics curricula to society; Assessment and evaluation in Physics

**SE 563: Important Concepts and Principles in Physics** (15 h, 1 credit)

Teaching Physics through understanding and appreciating important concepts and principles in Mechanics; Wave motion and optics; Thermal and statistical physics; Electromagnetic phenomena; Atomic and nuclear physics; Quantum Mechanics

*The following optional courses (SE 549 -553) are designed to stimulate students and motivate them into Physics and to expose them to the excitement and fascination of the subject and to appreciate its relevance in many areas of nature, universe and modern technology.*

**SE 564: Energy and Environment** (15 h, 1 credit)

Energy resources, non-renewable and renewable; Alternative energy resources; Environmental impact of energy utilization

**SE 565: Physics of Materials** (15 h, 1 credit)

Physics of technologically important materials: ceramics, glass, polymers, semiconductors and superconductors; Their synthesis, characterization, physical properties, and technological applications

**SE 566: Astronomy** (15 h, 1 credit)

Early astronomy, Solar system, Interstellar and intergalactic matter, Introduction to cosmology

**SE 567: Electronics and communication** (15 h, 1 credit)

Analogue and Digital electronics, Microprocessors, Data communications

**SE 568: Topics in Applied Physics** (15 h, 1 credit)

Physics in Medicine and Biology (5 h), Geophysics (4h), Atmospheric Physics and Meteorology (6h)

**SE 569: Physics Practicals** (45 h, 1.5 credits)

Planning and management of a Physics laboratory, Data recording and analysis, graphs, error analysis; Analysis of some selected experiments in Physics, Demonstration experiments in Physics, Computer interfacing of simple experiments.

**SE 599: Research Project** (3-6 months, 6 credits)

Each student is required to carry out an independent research project on a suitable topic in Physics Education under the guidance of a supervisor and write a project report.

## 7. PROGRAMME EVALUATION

Programme evaluation will be as stipulated in the PGIS Hand Book.

## 8. TEACHING PANEL

### General component -Science Education

- Dr. R. M. W. Amaradasa, Deputy Director, National Science Foundation  
*B.Sc. (Perad.), Ph.D. (Wollongong)*
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