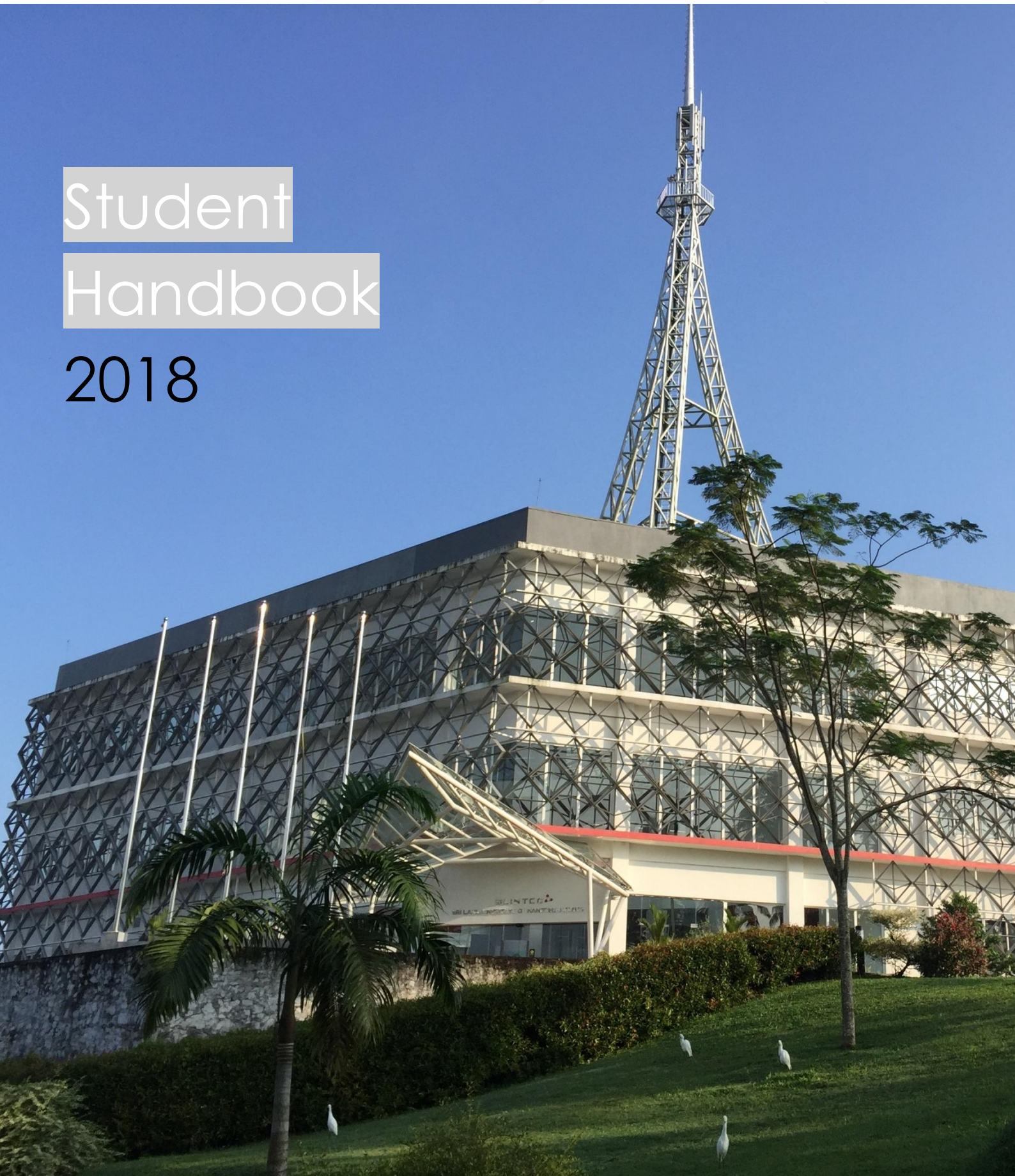
Educare et Educere

SLINTEC academy
Education and Discovery

Student Handbook 2018



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Contents

1.0 Introduction

Sri Lanka Institute of Nanotechnology (SLINTEC) is a recognized pioneer in Nanotechnology and Advanced technology research in Sri Lanka. Being the first public-private research institute in Sri Lanka, it has made significant progress over the past eight and a half years. It holds several ground breaking patents in the area of nanofertilizer where technology transfer to Nagarjuna Fertilizer Ltd., India, in 2012 was a pioneering event. In addition, research in the apparel sector has led to the filing of several more patents where one has been transferred to Lankem Ceylon PLC. In the mineral sector, SLINTEC has initiated a pilot plant to convert Ilmenite sand to TiO_2, a process to purify the Murunkan clay deposit, initiated a pilot plant to produce graphene oxide, pioneered futuristic research to convert TiO_2 sand to Ti metal and begun extracting Thorium from Monazite sand; the latter effort is envisaged to augment future nuclear energy needs of Sri Lanka. In addition, SLINTEC has now expanded its research portfolio to include synthetic organic chemistry and nutraceuticals. The focus of synthetic organic chemistry research is to develop Advanced Pharmaceutical Ingredients (APIs) and cater to the newly emerging pharma sector in Sri Lanka.

In this backdrop SLINTEC ACADEMY, has taken the initiative of introducing Master of Philosophy (M.Phil.) and Doctor of Philosophy (Ph.D.) Degree Programmes in Nano and Advanced Technology with the aim to providing high quality post graduate education to those interested in this field in Sri Lanka.

Nanotechnology and other Advanced Technologies are fast growing areas of Science and Technology which cover the entire spectrum of sciences (physical, chemical, biological, medical, engineering and agricultural). Specific areas include new materials, coatings, medicine, agriculture, textiles, nutraceuticals, water, food, biotechnology and synthetic biology. Many countries in the world, and particularly countries in the region, and Sri Lanka,

(through SLINTEC), have invested in these areas with a view to enhancing national development and training of scientists.

Recent innovations in technology and scientific approaches to Nano and Advanced Technologies make this an exciting time period to learn and do research in this area. In the proposed M. Phil./Ph.D. degree programme, the research-led teaching methods will allow students to gain cutting-edge knowledge from leading academics. Students also have the opportunity to conduct their own research, from design right through to experimentation. They will gather data using state of the art instruments ranging from Scanning Electron Microscope, Transmission Electron Microscope among a plethora of high end equipment. One of the main aims of this cutting edge research is to publish research papers in high impact journals. In addition, students will perfom research relevant to industry, working closely with research counterparts from the industry. In carrying out research with industry will maximize the chances of the research output moving into development and eventually to commercialization. Thus, the proposed M.Phil./Ph.D. degree programme will train research talent in Sri Lanka while serving the research needs of the industry at the same time.

It is envisaged that the recipients of the M.Phil degree will either work within the Sri Lankan industry or seek to advance to a Ph.D. in the best Universities in the world. Those who opt tp do their Ph.D. at the SLINTEC ACADEMY may either do research in the industry or join the academia or opt for post-doctoral training in Universities abroad.

SLINTEC is equipped with state of the art infrastructure facilities including lecture/seminar/reading rooms with high tech modern laboratories, as well as journal access to "Science Direct" to keep in touch with the latest scientific developments in the world. It also includes a wide range of co-curricular activities including annual events; group bonding sessions and training programmes as well as accommodation/hostel facilities. SLINTEC has the full capacity to offer the proposed M.Phil./Ph.D. degree programmes which

encompasses a high quality course content, effective delivery modes, industry related research and evaluation methods employing a highly competent and motivated team of professionals.

2.0 Degree of Master of Philosophy

The proposed degree is titled as the Master of Philosophy (M.Phil.) in Nano/ Advanced Technology. Successful M.Phil. candidates with a good publication record can seek an upgrade to a Ph.D. degree at the end of one and a half years into the M.Phil. programme. Such candidates will have at least one additional one and a half years of full time research. Submission and successful defense of a thesis will apply to both degrees. Prospective candidates are enabled to complete the programme of study in two years for M.Phil. and at least three years for Ph.D.

2.1 Entry requirements and programme structure

Entry requirements to the M.Phil programme is a Bachelors honours or special degree of Sri Lankan Quality Framework (SLQF) 6 in a relevant field or Bachelors honours of SLQF level 6 in a related field and successful completion of qualifying examinations or qualification of SLQF 7 or above. Additionally, a sound understanding of English [IELTS (6.50) or TOEFL (92)] is expected.

During the first year 10-15 students will be admitted to the proposed M.Phil degree programme. This number will be increased incrementally during the subsequent years. Modes of delivery of the M.Phil degree programme includes an extensive two year research componenet together with recommended course work depending on the background of the student. In the first year, students will attend lectures and practicals outside their normal working hours. Students will initiate their research component from the very first date of course commencement while in the second year, the programme will include one full year of research.

2.2 Application procedure

Applicants are advised to refer to advertisements in printed/electronic media or the SLINTEC ACADEMY web site (*http://www.slintec.academy.lk*) for details regarding the commencement of the M.Phil. programme. Applicants can be from Bachelors honours or special degree of Sri Lankan Quality Framework (SLQF) 6 in a relevant field or Bachelors honours of SLQF level 6 in a related field and successful completion of qualifying examinations or qualification of SLQF 7 or above with a minimum GPA of 3.0 from a recognized university/ institute. All applications for enrolement must be made on the prescribed form obtainable from the SLINTEC ACADEMY or downloaded from the web site. A prescribed processing fee should accompany the completed application. The relevant academic/professional qualifications of the candidate should be supported by academic transcripts (sent directly to the Provost) and authenticated copies of degree certificates. In addition, the applicant must ensure TWO letters of recommendations, where at least one should be from an academic referee. Documents submitted in support of an application shall become the property of the SLINTEC ACADEMY. When there is a discrepancy between the names appearing in the applicants transcripts and names given by the applicant in the application form, an affidavit by a Grama Seva Niladhari or a lawyer to the effect that the applicant is the one and the same person known by all names should be submitted.

2.3 Selection procedure

Applications which are incomplete or having false information will be rejected. Those who are eligible will be called for an interview. Overall aptitude of the applicant (qualifications and the performance at the interview) will be assessed. The applicants shall be informed of their acceptance or non-acceptance to the M.Phil. degree programme. In this regard, the decision of the SLINTEC ACADEMY shall be final.

2.4 Registration

Students selected to follow the M.Phil. degree in Nano/ Advanced technology shall be required to register for the given academic year in order to follow the programme of studies. The date of registration shall be specified by the SLINTEC ACADEMY.

2.4.1 Enrolment for courses

At registration, students are required to enroll for the courses he/she wishes to follow or recommended by the SLINTEC ACADEMY as qualifying requirements based on the student's background and qualifications. A maximum of 7 courses will be recommended based on the students academic and professional background. Students should submit a duly completed course enrolment form with the receipt of payment of the required fees.

2.4.2 Dropping/Adding courses

If a registered student wants to drop or add courses, it should be done by submiting a duly completed relevant application form before the date specified in the approved calander of dates. All such changes should be approved by the Provost.

2.4.3 Postponement from the program

A student who desires to postpone his/her registration can do so by writing to the Vice Chancellor giving reasons and indicating the duration of postponement. Each such case shall be considered on the recommendation of the Academic Senate of the SLINTEC ACADEMY.

2.4.4 Withdrawal from the program

A student wanting to withdraw from the programme can do so by writing to the Vice chancellor. In such withdrawals adjustment of fees for refunds will not be made.

2.4.5 Cancellation of registration

A registration may be cancelled by the SLINTEC ACADEMY on the recommendation of the Academic Senate and the Board of Management for inadequate academic progress, violation of rules and regulations of the SLINTEC ACADEMY, failure pay prescribed fees on time or any other reasons deemed applicable by the SLINTEC ACADEMY.

2.4.6 Leave of absence

Leave of absence may be granted only on medical grounds or any other valid reason accepted by the SLINTEC ACADEMY.

2.5 Examinations and evaluations

For all theory courses a minimum of 80% attendance is required and students are expected to pass the final examination of each course as a qualifying requirement. The courses will be graded as excellent, good, average, poor. Withdrawal from a course within the first two weeks of its commencement provided that the minimum credit requirement is not violated. Withdrawal after this period cannot be done except on medical grounds or any other valid reason.

2.5.1 Evaluation of the Research Component

To successfully complete both degrees students should submit the thesis followed by the viva vorce examination. The supervisor will allocate 60% of the marks while a panel appointed by the academy will evaluate the thesis and the viva vorce examination to offer the rest of the 40% of the marks.

The panel will include two external examiners and one internally appointed examiner. Supervisor can attend the viva vorce as an observer. The outcome of the thesis would be approved with,

1. Approved with minor corrections
2. Approved with major corrections
3. Further laboratory work needed
4. Unsatisfactory

2.5.2 Termination after one year

Any student who wishes to terminate the study programme after one year may opt for a Research based M.SC. in Nano/Advanced Technology provided that he/she has completed all the courses ascribed for the year one. Such students should pass each of the taught courses (as recommended in the SLQF 10) and complete the research component for the first year followed by submission of a thesis. Thesis evaluation will be according to the By-Laws given for M.Phil. Degree. They are also required to complete the seminar component.

2.5.3 Make up examinations

A make up examination may be given only to students who fail to sit a given examination due to medical or vaid reason (s) acceptable to the SLINTEC ACADEMY.

2.5.4 Repeat courses

If a student fails a course, he/she shall repeat the course and the examination at the next available opportunity. A student may be exempted from repeating the course and repeat only the examination if recommended by the lecturer-in-charge. A student is allowed to repeat four courses free of charge.

2.6 Research project

The M.Phil builds towards an extended project, which is an integral part of the programme: many projects are linked to industry or related to strategic research at SLINTEC. Our contacts with the industry and our research collaborations will make this a meaningful and valuable experience, offering the opportunity to apply one's newly learnt skills. To complete the M.Phil. degree, students must undertake a research project worth 2800 hours over a period of two years which will integrate subject knowledge and skills that are acquired during the M.Phil programme. The project is an important part of

the M.Phil. where one can apply the newly learnt skills and showcase one's ability to apply them to industrially relevant problems to future employers.

2.6.1 Research Progress Review

Progress of the research will be periodically reviewed internally by a pannel of two appointed by the SLINTEC ACADEMY. The composition of progress review panel will be as follows:

(1) Provost

(2) Two reviweres nominated by the Provost

(3) The supervisor(s) [as observer(s)]

2.6.2 Final submission of the thesis

After making the recommended revisions, the supervisor shall recommend that the thesis is ready for submission. The thesis should be formatted according to the guidelines given in the by-laws. Four or more copies (depending on the number of supervisors) of the revised thesis should be submitted to the Provost.

2.6.3 Evaluation of the thesis

The Provost shall appoint two thesis examiners. One thesis examiner, whereever possible, shall be external to the place where research was carried out. The examiners will send their reports to the Registrar, so that the candidate will be informed of the corrections suggested by the examiner.

2.6.4 Oral examination

If an M.Phil. thesis has been evaluated favourably, the Provost shall make arrangements to hold an oral examination. In cases where major revisions have been recommended, the oral examination may be held after the revised thesis has been favourably re-examined by the examiners.

Constitution of the panel of examiners:

(1) Provost

(2) Two examiners (including the thesis examiner)

(3) Supervisor(s) shall be present as observer(s).

The panel of examiners will submit a report on the suitability of the candidate for the award of the M.Phil degree.

2.6.5 Award of the M.Phil. Degree

The M.Phil degree may be awrded to a candidate who has satisfied the following criteria:

(1) Admission requirements set out in the handbook.

(2) Accepted by the SLINTEC ACADEMY as a candidate for the M.Phil. degree

(3) Duly registered and paid the fees for the prescribed duration (two years) for the programme

(4) Has satisfactorily completed the course work assigned by the SLINTEC ACADEMY

(5) Satisfactorily completed the research component

2.6.6 Effective date of the M.Phil. degree

The effective date of the degree shall be the date of the oral examination if the final copy of the thesis, after all revision and corrections, is submitted within one month after the oral examination. If submission takes more than one month, the effective date shall be the date of submission of the final copy of the thesis.

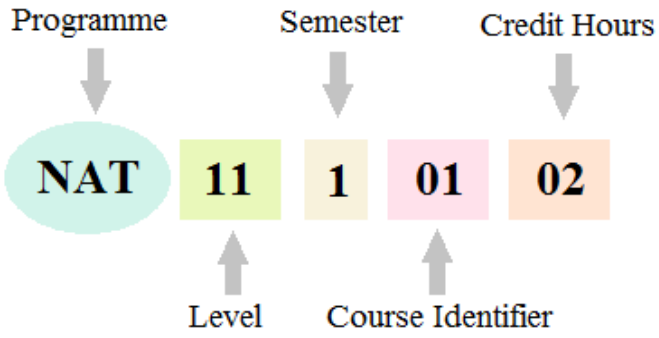
2.7 Upgrade to a Ph.D

Students who successfully complete the first year can request a transfer to a Ph.D. in approximately a year and a half into the M.Phil. programme. During the transfer, papers and conference abstracts published will be taken into consideration. Candidates who are upgraded will carry out further research for a minimum period of one and a half years in order to earn a Ph.D. degree.

3.0 STRUCTURE AND DESIGN OF CURRICULUM

The degree programme involves full time research for two years and in addition the students are required to follow some qualifying courses recommended by the SLINTEC ACADEMY during the first year in order to bridge the knowledge gap between the undergraduate degree and the MPhil degree programme. The following courses are on offer.

3.1 Course codes



NAT – Nano/ Advanced Technology

11 – First Year M.Phil.

1 – First Semester

01 – First Course

3.2 Course Titles

Course Code	Course
NAT 11101	Advanced nanoscience and nanotechnology
NAT 11102	Solid state physics
NAT 11103	Advanced characterization techniques
NAT 11104	Advanced organic spectroscopy
NAT 11105	Quantum mechanics
NAT 11106	Cell and molecular biology
NAT 11107	Molecular modelling and computational chemistry
NAT 11108	Synthetic organic chemistry
NAT 11209	Agriculture and development
NAT 11210	Smart Agriculture
NAT 11211	Photovoltics and energy devices
NAT 11212	Advanced materials and industrial applications
NAT 11213	Advanced materials laboratory
NAT 11214	Seminar Presentation

3.3. Course Description

NAT 11101 Advanced Nanoscience and nanotechnology – 30 L

Course content

Historical background of nanomaterials; natural nano-concepts; structural features of nanomaterials; size dependent properties of nanomaterials; structure-property relationships of nanomaterials; synthesis of nanomaterials; applications of nanomaterials, biomimetic nanotechnology, self-assembling monolayers; nanotoxicology

Recommended Reading

(1) M. Wilson, K. Kannargare, and G. Smith, "Nano Technology: Basic Science and Emerging Technologies", Overseas Press, (2005).

(2) C. P. Poole and F. J. Owens, "Introduction to Nanotechnology", Wiley Interscience, (2003).
(3) Nanotechnology: Understanding the Small Systems, Ben Roggers, CRC Press, (2008), ISBN 978-0-8494-8207-9.2008.
(4) T. Pradeep, "Nano: the Essentials: Nanoscience and Nanotechnology", Tata McGraw- Hill, (2007).

NAT 11102 Solid State Physics – 30 L

Course Content

Materials overview; crystallography; conducting properties of solids; magnetic properties of solids; optical properties of solids; materials thermodynamics

Recommended Reading

(1) C. Kittel, Introduction to Solid State Physics, Wiley India Pvt. Ltd., (2007).
(2) J. M. Ziman, Principles of the Theory of Solids, Cambridge University Press, (2011).
(3) N. W. Ashcroft, N. D. Mermin, Solid State Physics, Brooks/Cole Publishers, (2003).
(4) H. Ibach, Harald Luth, Solid-State Physics: An Introduction to Principles of Materials Science, Springer, (2003).

NAT 11103 Advanced Characterization Techniques – 30 L

Course Content

Spectroscopic techniques; diffraction techniques; thermal techniques; imaging techniques; particle size analysis; imaging techniques; surface techniques; elemental analysis; applications and case studies

Recommended Reading

(1) T. Pradeep, "Nano: The Essentials", Tata McGraw Hill, New Delhi, (2007).
(2) C. P. Poole Jr and F. J. Ownes, "Introduction to Nanotechnology", John Wiley Sons, (2003).

(3) M. Wilson, K. Kannangara, G. Smith, M. Simmons, B. Raguse, "Nanotechnology: Basic Sciences and Emerging Technologies", Overseas Press, (2005).
(4) W. Merritt, D. Settle "Instrumental Methods of Analysis", CBS PUBS & DISTS, New Delhi, (2007).
(5) Ewing. Et al, "Instrumental Methods for Chemical Analysis", Tata McGraw Hill Pub, New Delhi, (2010).

NAT 11104 Advanced Organic Spectroscopy – 30 L

Course Content

NMR spectroscopy; UV/Vis spectroscopy (application in organic chemistry); FTIR spectroscopy; Mass spectroscopy; applications and case studies

Recommended Reading

1. Spectrometric Identification of Organic compounds – R. M. Silverstein
2. Organic Chemistry – F. A. Carey
3. Organic Structure Determination using 2D NMR Spectroscopy – J. F. Simpson

NAT 11105 Quantum Mechanics – 30 L

Course Content

Limitation of classical mechanics; Plank's quantum hypothesis; Einstein's photoelectric effect; wave nature of particle; uncertainty principle; Schrodinger's time dependent and independent wave equations; Particle in a one dimensional box; Harmonic oscillator; Linear operator; Hermitian operator; linear harmonic oscillator; operator method; postulates of quantum mechanics; equations of motion; Ehrenfest's theorem; hydrogen atom; hydrogen orbitals; matrix representation of wave functions; Linear momentum operator; properties of Hermition operator; angular momentum operators; ladder operators; parity operator; commuting and non- commuting operators; commutation relation Lx and Ly commutation relation L^2 and Lx; commutation relation L+ and L-; Variation principle ; variation method for

ground state of hydrogen molecule; ground state of Helium atom; perturbation theory in non-degenerate case; first order perturbation; harmonic perturbation; transition to continuous states; Quantum mechanical explanation for material properties: conductivity, magnetic, and optical and hydrophobic.

Recommended Reading

(1) G. Aruldhass, "Quantum Mechanics", Prentice Hall of India pvt. Ltd. New Delhi, (2004).

(2) B.M. Mathew and K. Venkateshan, "A Text Book Quantum Mechanics", Tata McGraw Hill publications, New Delhi, (2007).

(3) L.I. Schiff, "Quantum Mechanics", McGraw Hill, (1968).

(4) Ghatak and Lokanathan "Quantum Mechanics", Macmillan Company of India Ltd., (1975).

(5) A. Goswami, "Quantum Mechanics", WCB Publishers, (1992).

NAT 11106 Cell and Molecular Biology – 30 L

Course Content

Cell theory: origin and evolution of cells; tools of cell biology (light microscopy, electron microscopy, subcellular fractionation); study of the living cells by fixation and staining, freeze drying and free substitution; microtomes and embedding; chemical basis of staining metachromatic; cytochemical methods; organization of cellular structures; prokaryotes and eukaryotes: molecular composition of cells (carbohydrates, lipids, nucleic acids, proteins, cell membranes, membrane lipids); cell wall and extra cellular matrix- cytoskeleton; cell membrane (including plasma membrane); endocytosis; cell-cell interactions; cell cycle (mitosis-meiosis, regulation of cell cycle and molecular basis; physical and chemical properties of DNA; chemical modifications; introduction of DNA nanotechnology- primary, secondary, super secondary, tertiary, quaternary structures; utilization of genomic databases; structure and reactions of amino acids; hydrophilic and hydrophobic amino acids; side chain properties; unnatural amino acids;

biochemistry of proteins and cellular functions of proteins; introduction to protein based nanotechnology; cell organelles: mitochondria, plastids, endoplasmic reticulum, ribosomes, endosomes, Golgi, lysosomes, peroxysomes, hydrogenosomes and centrosomes; cell nucleus; nuclear envelope, nucleolus and chromosomes; prokaryotic nucleoids (bacterial and plastid genomes); membrane functions; cell adhesions and cell junctions; membrane transport; neurotransmission; vesicular transport and membrane function (secretory and endocytic pathways); membrane proteins; transport across the membranes; cell signalling and cell transduction: signalling molecules and their receptors; functions of cell surface receptors; pathways of intracellular signal transduction; signal transduction and cytoskeleton-development and differentiation; regulation of programmed cell death; innate immunity and adaptive immunity; reticulo endothelial system; antigen presenting cells and their pathways; complement system and its pathways; tumour immunology; life cycle of HIV virus; monoclonal antibodies synthesis and applications.

Recommended Readings

(1) G. M. Copper, The Cell A Molecular Approach; 2nd Edition, ASM Press, Sinauer Associates, Inc.,Washington, (2000).

(2) H. Lodish, A. Berk: S. L. Zipursky, P. Matsudaira, D. Baltimore and J. Danell, Molecular Cell Biology; 4th Ed., W.H Freeman and Company, (2000).

(3) E.D.P. De Robertis, and E.M.F De Robertis, Cell and Molecular Biology. 8th Ed., Lippincott Williams and Wilkins, (2001).

(4) A. Bruce, A. Johnson, J. Lewis, M. Raff, K. Roberts, and P. Walter, Molecular Biology of the Cell", New York: Garland Science, (2002).

(5) J. Kuby, Immunology. W H Freeman, (2006).

NAT 11107 Molecular Modelling and Computational Chemistry – 30 L

Course Content

Molecular mechanics and force fields: Force fields; potential energy functions; inter and intramolecular interactions; empirical parameters; molecular mechanics calculations; energy minimization; conformational analysis; molecular simulations: Monte-Carlo method; molecular dynamic simulations; structure and dynamics: building models and energy calculations; molecular dynamics; solvation; free energy simulations; Quantum mechanical simulations: Gaussian and Gauss View; Hartree-Fock Theory and Basis Sets; Semi-empirical Methods; Electron Correlations; Density Functional Theory; Combined QM/MM Methods: Combine QM and MM; Solvation and Solvent Effects; Polarization; Reaction profiles in solution; Protein-Ligand Interactions; Modelling Enzymatic Reactions
Laboratory based practicals

Recommended Readings

1. Christopher J. Cramer, Essentials of Computational Chemistry: Theories and Models, 2nd Ed. Wiley & Sons, New York.
2. Daan Frenkel & Berend Smit, Understanding Molecular Simulation, AP, NY, (2002)
3. Andrew R. Leach, Molecular Modelling: Principles and Applications, 2nd Ed., Prentice Hall, (2001).

NAT 11108 Synthetic Organic Chemistry – 30 L

Course Content

Mechanisms in organic reactions; protecting groups; oxidations; reductions; alkylation of active methylene compounds; carbonyl condensations; double bond forming reactions; olefin metathesis; organo cuprates; cyclo additions; sigma tropic rearrangements; Retrosynthetic analysis and organic disconnections; 1,3-, 1,5-, 1,4-, difunctional molecules and their synthesis; 1,2-difunctional molecules and reversal of polarity; 1,6- difunctional molecules and reconnection strategy; asymmetric reactions in organic synthesis.

In-class: 25 hrs

Tutorials/mid-course exam/final exam: 5 hrs

Recommended Reading

(1) Essential Reagents for Organic Synthesis, Philip Fuchs, Andre B. Charest, Tomislav Rovis, Jeffrey W. Bode (First Edition) Wiley

(2) Organic Synthesis: The Disconnection Approach, Stuart Warren (Second Edition) Wiley

(3) Organic Synthesis: Strategy and Control, Paul Wyatt and Stuart Warren (Fiesta Edition) Wiley

(4) The Art of Writing Reasonable Reaction Mechanisms, Robert Grossman (First Edition)

NAT 11109 Agriculture and Development 30 L

Course Content

Evolution of agriculture; agriculture and economic development; productivity and production; agriculture and food systems; food security and water security; climate, climate change and agriculture; smart farming; policies, acts and regulations in agricultural development

In-class: 20 hrs

Assignments/tutorials/presentations: 10 hrs

Recommended Readings

(1) Agriculture, Environment and Development, Antonio Ioris, Palgrave Macmillan, DOI 10.1007/978-3-319-32255-1

(2) Smil, Vaclav, Enriching the Earth: Fritz Haber, Carl Bosch and the Transformation of World Food Production

NAT 11110 Smart Agriculture 30 L

Course content

Sustainable land and water management; managing risks in agriculture and food systems; climate-resilient agriculture systems; precision farming

technologies – concepts and applications; new frontier research in smart farming

In-class: 15 hrs

Practical/demonstration/presentations: 15 hrs

NAT 11211 Photovoltics and Energy Devices 30 L

Course Content

Photovoltic devices; architectures of PV devices; PV device principles; Efficiency improvement in PV devices; fabrication methods and application of PV devices; other types of Energy storage; electrochemical principles in batteries/supercapacitors; energetics and kinetics charge storage; factors affecting battery; supercapacitors their working principle, performance, modern advancements; Lithium ion battery technology; selection/ applications of supercapacitors /batteries and future trends; solid state energy devices and their modern advancements; advanced materials for energy applications and their modern advances

Recommended Readings

(1) Bube, R. H. *Photovoltaic Materials*. London, UK: Imperial College Press, 1998. ISBN: 9781860940651.

(2) Green, M. A. *Solar Cells: Operating Principles, Technology and System Applications*. Upper Saddle River, NJ: Prentice Hall, 1981. ISBN: 9780138222703.

(3) Wenham, S. R., M. A. Green, M. E. Watt, R. Corkish. *Applied Photovoltaics*. 2nd ed. New York, NY: Earthscan Publications Ltd., 2007. ISBN: 9781844074013.

(4) Green, M. A. *Silicon Solar Cells: Advanced Principles and Practice*. Sydney, Australia: Centre for Photovoltaic Devices & Systems, 1995. ISBN: 9780733409943.

(5) Green, M. A. *Third Generation Photovoltaics: Advanced Solar Energy Conversion*. New York, NY: Springer-Verlag, 2007. ISBN: 9783540265627.

(6) Luque, A., and S. Hegedus. *Handbook of Photovoltaic Science and Engineering*. Hoboken, NJ: John Wiley & Sons, 2003. ISBN: 9780471491965.

NAT 11212 Advanced Materials and Industrial Applications - 30 L

Course Content

Advanced electrical and electronic devices: electronic circuit chips, lasers, micro and nanoelectromechanical systems, sensors, actuators, optical switches, diodes and nano-wire transistors; data memory; lighting and displays, filters (IR blocking); quantum optical devices; batteries; fuel cells and photo-voltaic cells; electric double layer capacitors; lead-free solder; nanoparticle coatings for electrical products; smart materials: new trends in advanced materials; intelligent devices and adaptive structures; modern ceramics; metals and their smart composites; smart fibers; smart coatings; actuators and sensors; smart polymers; applications of smart materials; advanced catalytic systems: heterogenous nanostructures and composites; nanostructures for molecular recognition (quantum dots, nanorods, nanotubes); molecular encapsulation and its applications; nanoporous zeolites; self-assembled nanoreactors, organic electroluminescent displays; advanced technology in agriculture; precision farming, smart delivery systems; insecticides using nanotechnology; potential of nano-fertilizers; nanotechnology in food industry, packaging, food processing; food safety and biosecurity; contaminant detection; smart packaging; printing inks and their applications; advanced composites: polymer, metal and ceramic composites; their synthesis; properties and applications; advanced fibres: electrospinning; controlling morphologies of nanofibers, tissue engineering applications; polymer nanofibers; nylon-6 nanocomposites from polymerization; nano-filled polypropylene fibers; swim-suits with shark-skin-effect, soil repellence, lotus effect; nano finishing in textiles; modern applications of advanced materials

Recommended Readings

(1) M. A. Ratner and D. Ratner, Nanotechnology: A Gentle Introduction to the Next Big Idea, Pearson, (2003).

(2) B. Bhushan, Springer Handbook of Nanotechnology, Barnes & Noble, (2004).

(3) N. H. Malsch (Ed.), Biomedical Nanotechnology, CRC Press, (2005).

(4) U. H. Brinker, J.-L. Mieusset (Eds.), Molecular Encapsulation: Organic Reactions in Constrained Systems, Wiley Publishers, (2010).

(5) J. Kuzma and P. VerHage, Nanotechnology in Agriculture and Food Production, Woodrow Wilson International Center, (2006).

(6) Lynn J. Frewer, Willehm Norde, R. H. Fischer and W. H. Kampers, Nanotechnology in the Agri-food Sector, Wiley-VCH Verlag, (2011).

(7) P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, Cambridge, (2007).

(8) Y-W. Mai, Polymer Nano Composites, Woodhead publishing, (2006).

(9) W.N. Chang, Nanofibres: Fabrication, Performance and Applications, Nova Science Publishers Inc, (2009).

NAT 11213 Advanced Materials Laboratory (Practical Course)

Course Content

1. Synthesis of iron- iron oxide nanoparticles
2. Structural polymer composites : Fabricating carbon fiber reinforced thermoplastic composites
3. Synthesis and characterization of magnesium oxide nanoparticles from dolomitic crystalline limestone
4. Exploring catalytic nanomaterials: Synthesis and catalytic evaluation of dendrimer encapsulated Cu nanoparticles
5. Synthesis and characterization of multi-wall carbon nanotubes (MWCNT) using Sri Lankan vein graphite by arc discharge method
6. Preparation of nature inspired super hydrophobic surfaces

7. Synthesis and analysis of a colloidal nano silver solution using UV-Vis spectrophotometer
8. Fabrication of dye-sensitized solar cell
9. Chemo-selective reduction of 3-nitroacetophenone
10. Synthesis and characterization of template assisted hydroxyapatite nanoparticle and their hybrids

Recommended Readings

(1) Practical Hand Book for SLINTEC Academy

(2) Fedlheim, Daniel L., and Colby A. Foss. Metal nanoparticles: synthesis, characterization, and applications. CRC press, (2001)

(3) Rao, Chintamani Nagesa Ramachandra, Achim Müller, and Anthony K. Cheetham, eds. The chemistry of nanomaterials: synthesis, properties and applications. John Wiley & Sons, (2006)

(4) Cao, Guozhong. Nanostructures and nanomaterials: synthesis, properties and applications. World Scientific, (2004)

Research Projects – Thrust Areas

1. Nanomaterials and their applications
2. Value addition to minerals
3. Carbon based nanomaterials and their applications
4. Advanced materials for water purification
5. Advanced materials for textiles
6. Smart materials and sensors applications
7. Smart agriculture
8. Sensor applications in agriculture
9. Advanced materials for agriculture and crop enhancement
10. Advanced materials and food security
11. Photovoltics and energy devices
12. Nanomedicine/ advanced pharmaceuticals/natural medicine
13. Synthetic organic chemistry
14. Synthetic biology

15. Cosmoceuticals and nutraceuticals
16. Molecular modelling and computational applications
17. Polymers and advanced composites
18. Smart ceramics and their composites

4.0 PHYSICAL RESOURCES

Within a 50,000 sq. ft. area dedicated to the research institute, SLINTEC has state of the art laboratories housing scientific instruments unmatched in the whole world. The quality of the proposed M. Phil. programme (theory, practical and research) will be enhanced by the use of these instruments. In addition, SLINTEC has within its premises, a lecture hall, study area and a Board Room. Moreover, SLINTEC is unique because it is a subscriber to Science Direct, which gives access to much of the research journals essential to scientists/students who carry out research.

Wet Science Laboratories

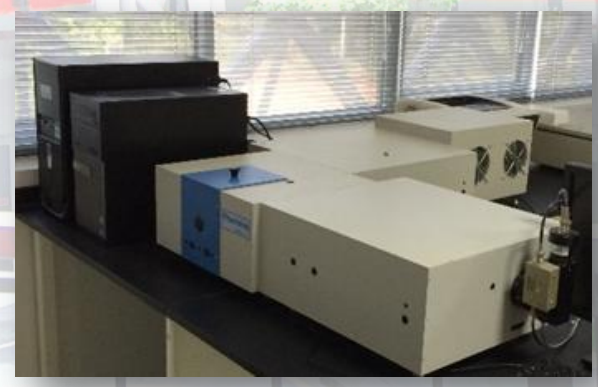
Organic Synthesis Laboratory

Industrial Laboratory

FT-IR

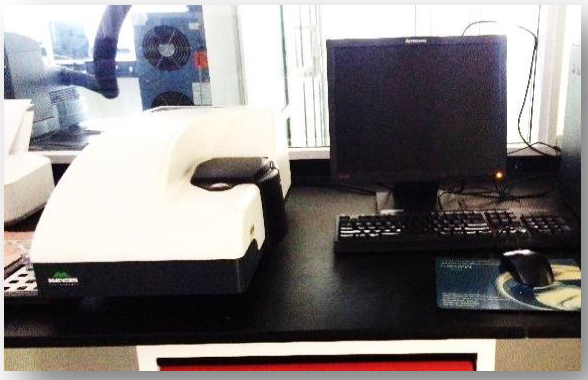
UV-Vis

Fluorometer



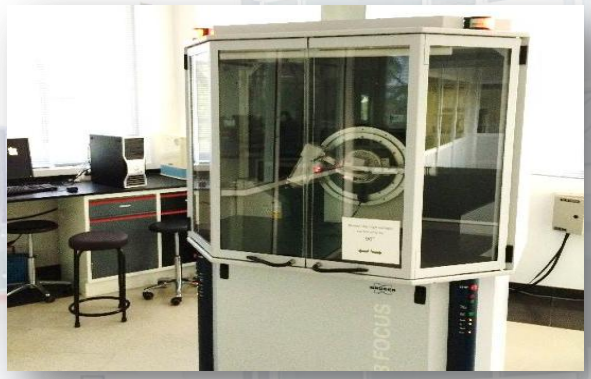
Optical Microscope

Particle size analyzer



XRF

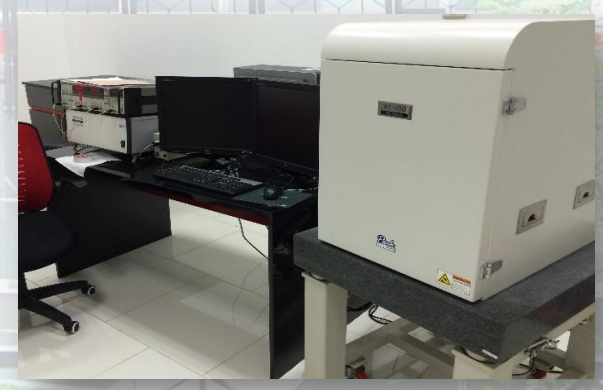
XRD



TEM

SEM

AFM



NMR

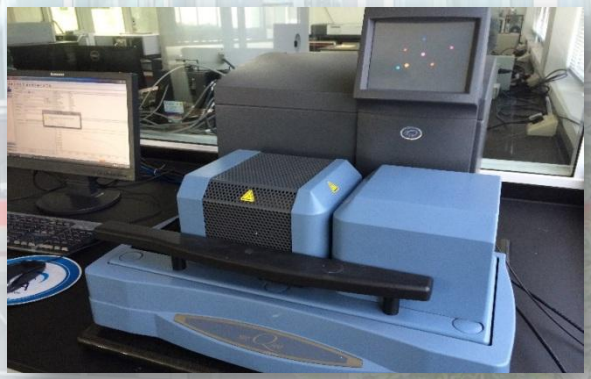
GC-MS

LC-MS

ICP-MS

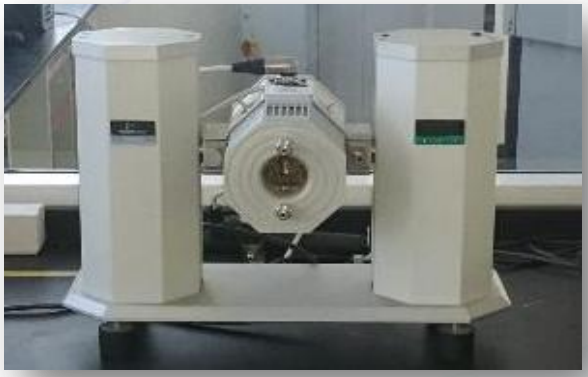
AAS

TGA



DSC

DMA



Internal Mixer

Moving Die Rheometer

Tensile testing machine

Hardness meter

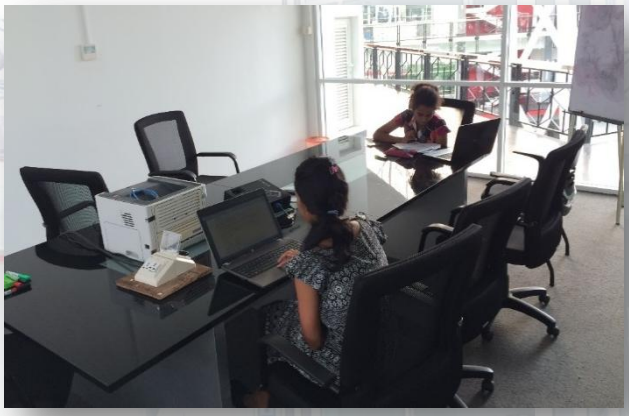
Clean room facility – Class 1000

Green House

Oven Room

Lecture Theater

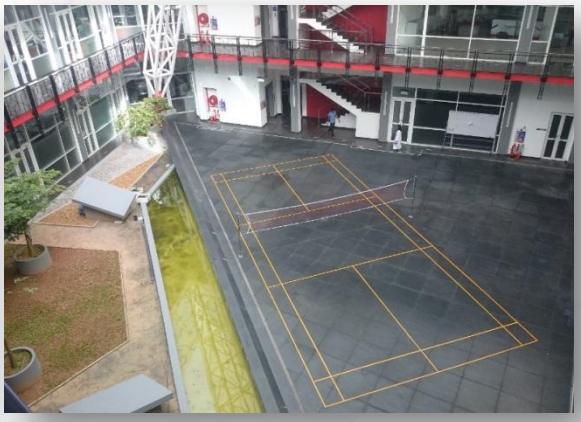
Study Rooms



Conference Room

Accommodation Unit

Recreation Facilities



Cafeteria

Library Facilities

Computer Facilities

Rest Rooms

Other Utility Infrastructure

5.0 ACADEMIC AND RESEARCH STAFF

A very well qualified academic staff at SLINTEC (given below) will conduct the lectures and practicals. They will also supervise research projects. In addition, smaller number of subject specialists from among the University sector will be employed to deliver some lectures.

Professor Veranja Karunaratne (Organic Chemistry, Nanotechnology)
Veranja Karunaratne obtained his B.Sc. in Chemistry from the University of Colombo and the Ph.D. from the University of British Columbia, Canada.

Professor Nalin De Silva (Physical Chemistry, Nanotechnology)
Nalin De Silva obtained his B.Sc. in Chemistry from the University of Colombo and the Ph.D. from the University of Cambridge, UK.

Professor Nilwala Kottegoda (Material Science)
Nilwala Kottegoda obtained her B.Sc. in Chemistry from the University and Peradeniya and the Ph.D. from the University of Cambridge, UK.

Dr. Dinara Gunasekara (Synthetic Organic Chemistry, Nanomedicine)
Dinara Gunasekara holds a B.Sc (Chemistry) from the College of Chemical Science and M.Sc. (Organic Chemistry) from the University of Minnesota and the Ph.D. from the Purdue University, USA.

Dr. Vinitha Thadhani (Natural Products Chemistry)
Vinitha Thadhani obtained B.Sc. in Chemistry and the M.Phil. from the University of Sri Jayawardenapura and her Ph.D. from the University of Peradeniya.

Dr. Laksiri Weerasinghe (Synthetic Organic Chemistry)
Laksiri Weerasinghe obtained his B.Sc. in Chemistry from the University of Colombo and his Ph.D. from the Washington state University, USA.

Dr. Vikum Premalal (Nanomaterials)

Vikum Premalal obtained his B.Sc. in Physics from the University of Peradeniya and the Ph.D. from the Graduate School of Science and Technology, Faculty of Engineering, Shizuoka University, Hanamatsu, Japan.

Dr. Nuwan De Silva (Material Chemistry)

Nuwan De Silva obtained his B.Sc. in chemistry from the University of Colombo and the Ph.D. from the University of Mississippi State University, USA.

Ruchira Wijesena (Nanotechnology in Textiles, Instrumentation)

Ruchira Wijesena obtained his B.Sc. (Textile and Process Engineering) from the University of Moratuwa.

Nadeeka Tissera (Nanotechnology in Textiles, Instrumentation)

Nadeeka Tissera obtained her B.Sc. (Textile and Process Engineering) from the University of Moratuwa and Master of Engineering from the University of Sydney, Australia.

Sunanda Gunasekara (Nanomaterials, Instrumentation)

Sunanda Gunasekara obtained his B. Sc. in Electrical Engineering and M.Phil. from the University of Moratuwa.

Dr. Lakshitha Pahalagedara (Material Science)

Lakshitha Pahalagedara obtained his B.Sc. in Chemistry at the University of Peradeniya and the Ph.D. from the University of Connecticut, USA.

Dr. Lahiru Wijenayake (Nanochemistry)

Lahiru Wijenayake obtained his B.Sc. in Chemistry at the University of Colombo and the Ph.D. from the University of Iowa, USA.

Dr. Prasanga Mantilaka (Nanomaterials)

Prasanga Mantilaka obtained his B.Sc. in Applied Sciences and the Ph. D. from the University of Peradeniya

Dr. Dhanushi Welideniya (Organic Chemistry)

Dhanushi Welideniya obtained her B.Sc. from the University of Colombo and the Ph.D. from the Kansas State University, USA.

Dr. Rangika De Silva (Polymer nanocomposites)

Rangika De Silva obtained his B.Sc. in Engineering and the Ph.D. from the School of Engineering, Monash University, Malaysia.

Gayan Priyadarshana (Material Science, Instrumentation)

Gayan Priyadarshana obtained his B.Sc. in Chemistry from the University of Sri Jayawardenapura and the M.Sc. from the University of Moratuwa.

A. D. M. Damayanthi (Instrumentation)

A. D. M. Damayanthi obtained her B.Sc. in Chemistry from the Institute of Chemistry, Ceylon and the M.Sc. from the University of Colombo.