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I am honored to be given the opportunity to write a forward in this guidebook.

First of all, I would like to welcome all new graduate students to the Faculty of Science and becoming new members of the Faculty.

This guidebook serves to assist students in understanding the academic systems; including the semester system, registration and choosing the curriculum that best suit the program of study. Through this guidebook I hope that students will be able to choose suitable courses as well as to maximize the use of the facilities provided in this University in order to gain knowledge, skills and expertise in the respective programmes. The ability to wisely plan the study program will lead to a successful completion of the study.

Being one of the Research Universities (RUs) in the country, graduate students are expected to perform and deliver their research findings in accordance to the RU standard.

As the aim of the University to be a World Class University, the Faculty is committed to move in tandem with the University by producing excellent and well-balanced graduates with sound knowledge-base and competency in research and development who will serve the society effectively.

Last but not least, I would like to extend my thanks and gratitude to the Postgraduate Committee and all the staff involved in the preparation of this Guide Book and hope it will be reviewed from time to time in order to serve its purpose.

PROFESSOR DR. ZAINAL ABIDIN TALIB

Dean
UNIVERSITI PUTRA MALAYSIA

Universiti Putra Malaysia (UPM), formerly known as Universiti Pertanian Malaysia, was founded in 1971 through the merger of the Faculty of Agriculture, University Malaya and the Agriculture College in Serdang. The three founder faculties were the Faculty of Agriculture, Faculty of Forestry and Faculty of Veterinary Medicine and Animal Science. They were complemented by the Division of Basic Sciences. UPM has maintained its traditional role in education by focussing its tertiary level research on agriculture and related areas.

In the early 80’s, UPM expanded its scope by including science and technology into its areas of study. UPM aspired to be the University of the Next Millennium and in line with its vision, the name of Universiti Pertanian Malaysia was changed to Universiti Putra Malaysia by Malaysia’s Prime Minister, Dato’ Seri Dr. Mahathir Mohamed on April 3, 1997. This is looked upon as a strategic move in preparing UPM as a versatile institution of higher learning in tandem with Malaysia’s dynamic technology.

Vision

To become a university of international repute

Mission

To make meaningful contributions towards wealth creation, nation building and universal human advancement through the exploration and dissemination of knowledge.

Goals

UPM has established six (6) goals to realize its vision. Each goal has its own specific objective. The achievement of each objective depends on the execution of the respective action plan. The ten goals are as follows:

1. To attract outstanding students and to produce knowledgeable and competitive graduates
2. To elevate achievements in research and innovation to international levels
3. To intensify community involvement for the generation and sharing of knowledge
4. To strengthen UPM as a centre of excellence in education, research and services in agriculture and tropical bioresources
5. To improve the governance and management of resources based on best practice
6. To reinforce the position of the Graduate School of Management as a Top Business School (TBS)
FACULTY OF SCIENCE

The Faculty of Science, which was first established as the Division of Basic Sciences in 1972, has been through several restructuring processes, and now consists of four departments: Department of Biology, Department of Chemistry, Department of Mathematics and Department of Physics. Our vision, inline with the University's objectives, is to be an internationally renowned science faculty.

As an established faculty in a research university the Faculty of Science is now well equipped to mold and transform ambitious science students into critical and creative thinking graduates who are ready for the job markets or to continue their studies at the postgraduate levels. Undergraduate study programmes are designed to provide solid background in their respective fields of study and to develop scientific perspective. Knowledge and skill are transferred to the students by well trained and experienced academic staff using the latest effective teaching and learning techniques supported by up to date facilities. The faculty is also offering postgraduate programmes in various fields of basic and applied sciences. These postgraduate programmes train science graduates to be qualified scientists in their chosen fields.

The quality of our lecturers and the research work conducted in the faculty are recognized nation and internationally. Each year, the faculty's academic staff publish hundreds of journal research articles and win various research awards. The faculty has been one of the largest recipients of research grants in the University and is striving to improve on the excellent record.

Mission

The Faculty strives to be a leading Centre in teaching and learning, research and professional services in the fields of basic and applied sciences.

Vision

The Faculty aims to be an internationally renowned science faculty.

Quality Policy

The Faculty of Science, Universiti Putra Malaysia is committed towards excellence in teaching and research in basic and applied sciences through a quality management system that is being continuously improved to fulfill the expectations of our clients in accordance with MS 9001:2008.

We, the staff of the Faculty of Science, will execute our responsibilities in our effort to achieve the Faculty's stipulated quality objectives and to ensure that the objectives are constantly reviewed in accordance with the vision, mission, and the quality policy of the Faculty.
Department of Biology

The Department of Biology offers a combination of modern and multi-disciplinary coverage of the vast area of Biology. The aim of the Department is to provide the essential requirements for a solid undergraduate education in various biological disciplines to produce knowledgeable and competitive graduates to advance to professional or graduate programmes, or enter employment in the public and private sectors.

The Department offers undergraduate, graduate, and postdoctoral programmes in the fields of aquatic and terrestrial biology, pollution, biomonitoring and microbial biology. The undergraduate and graduate programmes offer students numerous research opportunities in well-equipped laboratories with state-of-the-art facilities. These programmes emphasize practical experience in the laboratory section of the courses as well as during fieldwork. The students are also exposed to the necessary research experience, skills in scientific writing and seminar presentations. The courses offered in the Department are designed to provide a solid background in the biological sciences and to develop an integrated scientific perspective.

The academic staff of the Department are highly trained with professional experience gained through research activities and networking with Government agencies, the private sector and international bodies.

Department of Chemistry

Much of our understanding of the material world is based on chemistry. Chemistry is central to disciplines such as biotechnology, materials science, environmental science, medicine, pharmacology and physics. Chemistry is conventionally divided into inorganic, organic, physical and analytical chemistry. This breadth is reflected in our research.

The Department is one of the largest and liveliest departments in the University. About one third of the academic staff has been recruited in the past ten years and more than ten professors have been appointed since 1990. The new staff have brought expertise in important areas of teaching and current research in chemistry. This enabled us to provide a number of new research areas and to maintain a consistently high level of research funding and postgraduate student enrollment over many years. The Department consists of a large number of strong research groups covering a broad spectrum ranging from theoretical to materials chemistry.

Department of Physics

One of the goals of the Department of Physics is to produce competent graduates ready for the job market or to pursue related postgraduate programmes. The undergraduate programmes are Bachelor of Science (Honours) with majors in physics, materials science and instrumentation science, and Bachelor of Science with Education (Honours) in physics. The Department emphasizes creative teaching in a stimulating learning environment in classes and laboratories.
The Department also offers postgraduate and postdoctoral programmes in a wide range of research areas including applied optics, applied radiation, magnetic materials, materials science, microwaves, nanomaterials, quantum science and technology, sensors and instrumentation, superconductors, theoretical physics, and ultrasonic and glasses. It has state-of-the-art research facilities including an ellipsometer, UV-Visible spectrophotometers, RF magnetron sputtering, XRD and AFM.

**Department of Mathematics**

The mission of the Department of Mathematics is to be an exemplary provider of education in modern mathematics based on research and innovative teaching and to pursue outstanding research in mathematics and statistics. It provides training which is focused on field of research of current interest so as to forge and support excellence. The outstanding results achieved are evidenced by consistent contribution to various scholarly journals by the academic staff and through their performance in consultancy work.

The Department has interests in many areas of mathematical science, including Algebra, Numerical Analysis, Financial Mathematics, Differential Equations, Graph Theory, Probability Theory, Survival Analysis, Spatial Time Series, Experimental Design and Robust Statistics. It conducts research that supports the on-going development of theoretical mathematical science, simultaneously promoting the interdisciplinary use of mathematics and statistics in science, engineering and other fields.

In addition to collaboration with postdoctoral fellows, visiting scholars, and graduate and undergraduate students, Department members enjoy close collaborative relationships with scientists from other departments and research institutes, nationally and internationally. Many Department members are affiliated to the Institute of Mathematical Research (INSPEM).
The Faculty offers Awards for Graduate Students in recognition of excellence in their respective programmes of study. It is envisaged that, this recognition will spur students to work hard in order to achieve academic excellence for themselves, the Faculty, the University and their country. Criteria for excellence include publications in cited/impact factored journals, awards, patents and reports from examiners of their theses as well as recommendations from the individual Departments and candidate’s supervisory committee. Criteria for Master of Applied Statistics Award are excellence in studies based on the student’s CGPA and recommendation by the Department.

Faculty Awards

Dean’s Gold Medal Award (PhD)
Dean’s Gold Medal Award (Master of Science)
Master of Applied Statistics Award

Department Awards

Biology Award (PhD)
Biology Award (Master of Science)

Chemistry Award (PhD)
Chemistry Award (Master of Science)

Physics Award (PhD)
Physics Award (Master of Science)

Mathematics Award (PhD)
Mathematics Award (Master of Science)
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<td>PROF. DR. ZAINAL ABIDIN TALIB</td>
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<td>DR. NOR AZOWA IBRAHIM</td>
<td>Timbalan Dekan Akademik</td>
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<td>PROF. DR. HABSHAH MIDI</td>
<td>Timbalan Dekan Pembangunan dan Kewangan</td>
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<td>4</td>
<td>PROF. DR. MOHD BASYARUDDIN ABDUL RAHMAN</td>
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<td>PUAAN FAIRUZ BAWAZE’ER MUCHTAR</td>
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<td>PROF. DR. AHMAD ISMAIL</td>
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<td>PROF. MADYA DR. ZAIDAN ABDUL WAHAB</td>
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<td>PROF. MADYA DR. IRMAWATI RAMLI</td>
<td>Ketua Jabatan Kimia</td>
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<td>PROF. MADYA DR. NIK MOHD ASRI NIK LONG</td>
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**PENTADBIR**

- **DR. ROSMAH NULIT**  (PENGAJIAN SISWAZAH)
- **DR. AZWADY ABD. AZIZ**  (PENGAJIAN PRASISWAZAH)
- **PROF. MIAHIA DR. SITI HASANA SAFAR**  (PENYELIDIKAN & PENGAJIAN SISWAZAH)
- **PN. JUITA MD TAHIR**  (PEN. PENDAFTAR KANAN PENYELIDIKAN & PEN. SISWAZAH)
- **PN. KHADZAMAH KHALID**  (PEN. PENDAFTAR PEMBANGUNAN & KEWANGAN)
- **PN. NORLIDA ZAMBERI**  (PEN. PENDAFTAR AKADEMIK & KEP.)
### ADMINISTRATIVE OFFICERS OF THE POSTGRADUATE PROGRAMME
#### FACULTY OF SCIENCE

#### Deputy Dean
Prof. Dr. Mohd Basyaruddin Abdul Rahman

#### Coordinator of Postgraduate Programmes
Dr. Rosimah Nulit

#### Department of Biology

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<td>Dr. Rosimah Nulit</td>
<td>Dr. Rosimah Nulit</td>
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#### Department of Physics

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<td>Associate Prof. Dr. Halimah Mohamed Kamari</td>
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#### Department of Chemistry

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<td>Prof. Dr. Mohd Aspollah Hj. Md Sukari</td>
<td>Dr. Norhazlin Zainuddin</td>
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#### Department of Mathematics

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<td>Associate Prof. Dr. Leong Wah June</td>
<td>Associate Prof. Dr. Leong Wah June</td>
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#### Coordinator of Master of Applied Statistics
Associate Prof. Dr. Jayanthi Arasan

#### Administrative Officer and Support Staff (Office of the Dean)

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<td>Ms. Fairuz Bawaze’er Muchtar</td>
<td>Ms. Juita Md Tahir</td>
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Department of BIOLOGY

Head:

Ahmad Ismail
B.Sc. (Hons.) (UKM), PhD (Essex)
Enterotoxicology of Heavy Metals & Wildlife Ecology

Professors:

Japar Sidik Bujang
B.Sc.(Hons.) and PhD (USM)
Ecology & Biology of Sea grass & Mangroves

Umi Kalsom Yusuf
B.Sc. (Hons.) (UKM), PhD (Reading)
Plant Biodiversity and Biosystematics

Ahmad Ismail
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Enterotoxicology of Heavy Metals & Wildlife Ecology

Associate Professors:

Rusea Go
B.Sc (Hons.), M.Sc. and PhD (UKM)
Plant Taxonomy & Conservation

Siti Khalijah Daud
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Molecular Biology, Mycology & Biochemistry

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B.Sc. with Ed. (Hons), PhD (UPM)
Enterotoxicology

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Plant Conservation & Molecular Biology

Senior Lecturers:

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Ecological Chemistry

Christina Yong Seok Yien
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Enterotoxicology & Pedobiology

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Biostatistics & Epidemiology

Syaizwan Zahir Zulkifli
PhD (Tokyo)
Isotope Ecology, Mangrove Ecology

Mohammad Noor Amal Azmai
PhD (UPM)
Epidemiologi/Biologi Ikan

Mashitah Shikh Maidin
PhD (UM)
Animal Reproduction

Shahrizim Zulkifly
PhD (Wisconsin)
Aquatic & Marine Botany

Lecturers:

Azman Jali
MMedSc (UM)
Parasitology

Hishamuddin Omar
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Enterotoxicology

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PhD (UPM)
Agrotechnology
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Head:

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B.Sc., M.Sc. (Iowa), PhD (UMIST)
*Solid State Physics & Photothermal*

Professors:

W. Mahmood Mat Yunus
SmSn (Kep) (UKM), M.Sc., PhD (Wales)
*Ionization Physics & Applied Optics*

Abd. Halim Shaari
Cert. Ed. (Malaya), SmSn (Kep) (UKM),
M.Sc. (Southampton, UK), PhD (Hull)
*Cryogenics, Magnetic Materials & Superconductors*

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SmSn (Kep) (UKM), M.Sc. (Surrey), PhD (St. Andrews)
*Radiation & Medical Physics*

Mohd. Maarof H.A. Moksin
SmSn (Kep) (UKM), M. Tech (Brunel), PhD (Strathclyde)
*Thermal Wave & Laser Spectroscopy*

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SmSn (Kep) (UKM), MS (UPM), PhD (Bath)
*Materials Sciences*

Azmi Zakaria
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*Optoelectronics & Photothermal Physics*

Zainal Abidin Talib
B.Sc., M.Sc., PhD (Southern Illinois)
*Materials Sciences & Dielectric Physics*

Associate Professors:

Hishamuddin Zainuddin
B.Sc. (Hons) (Adelaide), PhD (Durham)
*Theoretical Physics*

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PhD (UPM)
*Surface Physics & Dielectrics Physics*
(Microwave & Low Frequency)

Zaidan Abdul Wahab
B.Sc., M.Sc. (Iowa), PhD (UMIST)
*Solid State Physics & Photothermal*

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B.Sc. (Hons) (Malaya), MS (UPM),
PhD (Leeds)
*Microwaves*

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*Magnetic Materials.*

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*Ultrasonic*

Ionel Valeriu Grozescu
PhD (UPM)
*Applied Optics/Instrumentation*

Chen Soo Kien
B.Sc. (Hons) (UKM), M.Sc. (UKM),
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Superconductor, Magnetic Materials

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*Ultrasonic*

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PhD (Osaka)
*Theoretical and Computational Physics*

Suriati Paiman
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*Semiconductors*

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*Materials Science*

Nizam Tamchek
PhD (UM)
*Photonics*
Mohd Mustafa Awang Kechik  
PhD (Birmingham)  
High Temperature Superconductor

Nurul Huda Osman  
PhD (Surrey)  
Biophysics

Josephine Liew Ying Chyi  
PhD (UPM)  
Material Science

Yap Wing Fen  
PhD (UPM)  
Applied Optics/Sensors

Che Azurahanim Che Abdullah  
PhD (Surrey)  
Biophysics

Nor Kamilah Sa’at  
PhD (Leeds)  
Photonic

Abdul Rahman sarmani  
BS (K), MS (St Andrews)  
PhD (St Andrews)

Md Shuhazlly Mamat  
PhD (Nottingham)  
kejuruteraan Bahan & Pembuatan

Norlaily Mohd. Saiden  
BS (K), MS (UPM)  
Materials Science

Lecturers:

Nurhidayaty Mokhtar  
BS (K), MS (UPM)  
Magnetic Materials

Department of CHEMISTRY

Head:

Irmaawi Ramli  
B.Sc. (Hons.) (UPM), PhD (UMIST)  
Petroleum Chemistry & Heterogeneous Catalysis

Professors:

Mahiran Basri  
B.S., M.Sc. (INIU), PhD (UPM)  
Biocatalysis & Oleochemistry

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B.Sc (Hons.),(UKM) PhD (Reading)  
Materials Chemistry

Mansor Ahmad Hj, Ahmad @Ayob  
B.Sc. (Indiana), M.Sc. (Kentucky), PhD (Salford)  
Analytical Chemistry & Polymer Chemistry

Zulkarnain Zainal  
SmSn (Kep.) (UKM), PhD (UMIST)  
Physical Chemistry & Materials Chemistry

Mohd. Aspollah Hj, Sukari  
B.Sc., Drs. (Gajah Mada Universiti), PhD (York,UK)  
Organic Chemistry & Natural Products Chemistry

Taufiq Yap Yun Hin  
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Natural Product Chemistry/Catalysis

Hj Mohd. Basyaruddin Abdul Rahman  
PhD (Southampton)  
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Gwendoline Ee Cheng Lian  
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Organic Chemistry & Natural Products Chemistry

Khozirah Shaari  
B.Sc. (Swansea), M.Sc. (Malaya)  
PhD (Strathclyde)  
Organic Chemistry & Natural Products Chemistry

Nor Azah Yusof  
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Biosensors


**Associate Professors:**

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B. Sc. (N. Brunswick), PhD (Dundee)
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**Tan Wee Tee**
B.Sc., M.Sc. (Canterbury), PhD (Dalhousie)
*Electrochemistry/ Electro Analysis/Analytical Chemistry*

**Irmawati Ramli**
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*Petroleum Chemistry & Heterogeneous Catalysis*

**Intan Safinar Ismail**
PhD (Okayama)
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**Mohamed Ibrahim Mohamed Tahir**
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**Tan Yen Ping**
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**Siti Mariam Mohd. Nor**
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*Synthesis Organic Chemistry*

**Norhazlin Zainudin**
PhD (Imperial College)
*Materials Science*

**Emilia Abd Malek**
DPhil (Oxford)
*Synthesis Organic Chemistry*

**Rogayeh Abedi Karjiban**
PhD (UPM)
*Computation and Theoretical Chemistry*

**Haslina Ahmad**
PhD (Sheffield)
*Inorganic Chemistry*

**Thahira Begum**
PhD (UPM)
*Organic Metallic/ Bioorganic Chemistry*

**Shahrul Ainliyah Alang Ahmad**
PhD (Sheffield)
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**Ernee Noryana Muhamad**
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*Catalysis for Fuel Cell/ Electrochemistry*

**Yusran Sulaiman**
PhD (Durham)
*Electrochemistry*

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**Janet Lim Hong Ngee**
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B.S (UPM), M.Sc (UPM)
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*Material Chemistry / Nano Materials*

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**Mohd Izham Saiman**
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*Heterogeneous Catalysis*

**Siti Salwa Abdul Ghani**
B.S (EDU) (UKM)
*PhD (UKM)***
Jaafar Abdullah
PhD (UKM)

Norizah Abdul Rahman

Md Saiful Islam
PhD (UNIMAS)
Polymer Composite Materials

Siti Elfiza Ashari
Department of MATHEMATICS

Head:

Nik Mohd. Asri Nik Long
BS (K) (UPM), M.Sc. (Leeds),
PhD (Manchester)
Elasticity Theory & Integral Equations

Professors:

Dato’ Kamel Ariffin Mohd. Atan
B.A. (Malaya), M.A. (Western Ontario)
PhD (New South Wales)
Number Theory

Adam Kilicman
B.Sc, M.Sc (Turkey), PhD (UK)
Functional Analysis and Topology

Noor Akma Ibrahim
B.Sc., M.Sc. (Western Michigan),
PhD (UPM)
Survival Analysis

Habshah Midi
B.A. (Drew), M. App. Stat. (Ohio State)
PhD (UKM)
Robust Regression, Quality Control, Design & analysis of Experiments

Fudziah Ismail
B.A. (Macalister College) M.Sc. (Washington State),
PhD (UPM)
Numerical Analysis

Associate Professor:

Mat Rofa Ismail
SmSn (Kep.) (UKM), M.Sc. (Wales)
PhD (Malaya)
Singular ity Theory / History & Philosophy of Mathematics

Mohamad Rushdan Md. Said
B.Sc. (LSU), M.Sc. (S. Western Louisiana)
PhD (Macquarie)
Number Theory & Cryptography

Mohd. Rizam Abu Bakar
B.A. (Macalester College) M.Sc. (N.Carolina State),
PhD (Bradford)
Operations Research & Survival Analysis

Mahendran Shitan
B.Sc. (Hons.) (USM), M. App. Sc.,
PhD (Royal Melbourne I.T)
Spatial Processes & Time Series

Norihan Md. Ariffin
BS (K) (UPM), M.Sc. (Strathclyde),
PhD (UKM)
Industrial Mathematics

Nik Mohd. Asri Nik Long
BS (K) (UPM), M.Sc. (Leeds),
PhD (Manchester)
Elasticity Theory & Integral Equations

Leong Wah June
BS (K), MS, PhD (UPM)
Optimization

Zanariah Abdul Majid
PhD (UPM)
Numerical Analysis

Zarina Bibi Ibrahim
B.A., M.A. (CSU Long Beach), PhD (UPM)
Numerical Analysis

Isamiddin S. Rakhimov
M.Sc., PhD (Leningrad)
Algebra

Ibragimov Gafurjan
B.Sc. (Taskent), M.Sc. (Moscow)
PhD (Academy of Science, Uzbekistan)
Differential Equations

Zainidin K. Eshkuvatov
MS (Tashkent), PhD (N.U.Uzbekistan)
Integral Equations

Jayanthi Arasan
B.Sc. (USM), MS (UPM), PhD (Oxford)
Applied Statistics

Lee Lai Soon
B.Sc. (Hons.) (USM), MS (UPM),
PhD (Southampton)
Operations Research

Muhammad Rezal Kamel Ariffin
Ph.D. (UKM)
BS (K), MS (UPM)
Functional Analysis
Senior Lecturers:

Fauziah Maarof
Applied Statistics

Shamsiah Mohamed
B.Sc. M.Sc. (Western Michigan)
Applied Statistics

Mohd. Bakri Adam
BS (K), MS (UPM)
Applied Statistics

Siti Hasana Sapar
BS (K), MS, PhD (UPM)
Number Theory

Isthrinayagy Krishnarajah
BS, MS (UPM),
PhD (Heriot-Watt)
Mathematical Biology

Idham Arif Hj. Alias
BS (K) (UPM), M.Sc. (Exeter)
PhD (Australia)
Group Theory

Norazak Senu
PhD (UPM)
Numerical Analysis

Anwar Fitrianto
PhD (UPM)
Robust Regression

Mansor Monsi
SmSn (Kep.) (UKM) M.Sc. (Aston)
PhD (St. Andrews)
Interval Analysis & Optimization

Md Sohel Rana
PhD (UPM)
Robust Regression

Fadzilah Md. Ali
PhD (UKM)
Statistik Gunaan (Applied Statistics), Fluid Mechanics

Mai Zurwatul Ahlam Mohd Jaffar
PhD (Dundee)
Functional Analysis

Kartini Ahmad
Lecturers:

Nazihah Mohamed Ali
SmSn (Kep.), MS (UKM)

Quality Control

Fadzilah Md. Ali
Dip. Actuarial Sc. (Heriot-Watt), BS (K) (UPM),
MS (UPM)

Applied Statistics

Haliza Rosali
BS (K) (UPM), M.Sc. (UKM)

Applied Mathematics

Sharifah Kartini Said Husain
PhD (UPM)

Algebra

Faridah Yunos
BS (K), MS (UPM)

Number Theory

Norfifah Bachok @ Lati
MS (UPM)

Fluid Dynamics

Aniza Abd. Ghani
B.Sc. (Wisconsin Madison), MS (UKM)

Applied Mathematics

Yong Faezah Rahim
B.Sc. (Bishop), MS (UPM)

Numerical Analysis

Witriany Basri
BS (K) (UPM), MS (UKM)

Pure Mathematics

Nor Aliza Abd. Rahmin
MS (UPM)

Applied Mathematics

Mohamat Aidil Mohamat Johari
BS (K) (UPM), MS (UKM)

Pure Mathematics

Ahmad Nazri Mohamed Som
MS (UKM)

Cryptography
ACADEMIC PROGRAMMES

Postgraduate Programmes

The Faculty offers two postgraduate research programmes: Master of Science and Doctor of Philosophy and Master of Applied Statistics programme (by coursework).

MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY

The Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) programmes are designed to give the candidates a strong background in fundamental science by coursework and in-depth study of a specific research problem. A candidate for the degree of Master of Science or Doctor of Philosophy shall pursue a course of research under the direct supervision of academic staff in the Faculty. Must present a thesis on a topic related to his field of study which shall embody the results of original research and must give evidence of a high level of scholarship.

Admission Requirements (Research Programmes)

- An applicant for the Master of Science programme should possess a Bachelor of Science Degree in Biology, Chemistry, Mathematics, Physics or other related Degree with a cumulative grade point average (CGPA) of at least 2.50. An applicant for Doctor of Philosophy Programme should possess a Masters degree in Biology, Chemistry, Physics or Mathematics. A candidate possessing a Bachelor of Science Degree with first class honours may be considered for direct admission into this programme. Candidates with CGPA less than the minimum requirement, but having at least 3 years working experience in the related field may also apply.

  i) PhD

<table>
<thead>
<tr>
<th>No</th>
<th>Admission Requirements</th>
<th>Coursework</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A Master's degree with thesis (full research) in the same field applied</td>
<td>Without coursework</td>
</tr>
<tr>
<td>2.</td>
<td>A Master's degree with thesis in different field applied</td>
<td>Minimum 3 credits of coursework</td>
</tr>
<tr>
<td>3.</td>
<td>A Master Degree without Thesis (Coursework)</td>
<td>Minimum 3 credits of coursework</td>
</tr>
<tr>
<td>4.</td>
<td>A bachelor's degree in science with CGPA ≥ 3.75 (First Class)</td>
<td>Minimum 6 credits of coursework</td>
</tr>
</tbody>
</table>

  Note: Courses to be taken is determined by advisor

  ii) Master with Thesis

<table>
<thead>
<tr>
<th>No</th>
<th>Admission Requirements</th>
<th>Coursework Offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A bachelor's degree in science with CGPA ≥ 3.50</td>
<td>Determined by the Advisor</td>
</tr>
<tr>
<td>2.</td>
<td>A bachelor's degree in science with CGPA 3.0 – 3.49</td>
<td>Minimum 3 credits of coursework</td>
</tr>
<tr>
<td>3.</td>
<td>A bachelor's degree with CGPA 2.50 - 3.00 and at least 3 years of working experience in the related field</td>
<td>Minimum 9 credits of coursework</td>
</tr>
</tbody>
</table>

  Note: Courses to be taken is determined by advisor

Duration
- The duration for the degree of Master of Science is between 2 to 6 semesters while for the Doctor of Philosophy degree is between 4 to 10 semesters.
STUDY PROGRAMME

Students pursuing the Master of Science or Doctor of Philosophy degree must follow the study programme suggested by the respective Departments. All students must present a seminar in the first semester and a final seminar in the last semester. Doctor of Philosophy candidates are expected to present their progress seminar (preferably) in their 4th semester. Students must register for their Masters thesis or Ph.D. thesis each semester. Students are also required to fulfill their credit requirements by taking courses related to their fields of study with the consent of their supervisory committee. A total of 9 credits are required for MS and 12 credits for PhD.

TABLE 1: STUDY PROGRAMME

<table>
<thead>
<tr>
<th>Department of Biology</th>
<th>Department of Physics</th>
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<tbody>
<tr>
<td><strong>First Semester (PhD)</strong></td>
<td><strong>First Semester (PhD)</strong></td>
</tr>
<tr>
<td>Seminar (SPS 6903)</td>
<td>Seminar (SPS 6903)</td>
</tr>
<tr>
<td>Coursework* 1-2 Subjects 3-6 Credits</td>
<td>Coursework* 1-2 Subjects 3-6 Credits</td>
</tr>
<tr>
<td><strong>Interim Semester (PhD)</strong></td>
<td><strong>Interim Semester (PhD)</strong></td>
</tr>
<tr>
<td>Coursework* 1-2 Subjects 3-6 Credits</td>
<td>Coursework* 1-2 Subjects 3-6 Credits</td>
</tr>
<tr>
<td><strong>4th Semester (PhD)</strong></td>
<td><strong>4th Semester (PhD)</strong></td>
</tr>
<tr>
<td>Seminar (FSA 6903)</td>
<td>Seminar (FSA 6903)</td>
</tr>
<tr>
<td><strong>Last Semester (PhD)</strong></td>
<td><strong>Last Semester (PhD)</strong></td>
</tr>
<tr>
<td>Seminar (FSA 6904)</td>
<td>Seminar (FSA 6904)</td>
</tr>
<tr>
<td><strong>First Semester (MS.)</strong></td>
<td><strong>First Semester (MS.)</strong></td>
</tr>
<tr>
<td>MS. Thesis (SPS 5999)</td>
<td>MS. Thesis (SPS 5999)</td>
</tr>
<tr>
<td>Seminar (SPS 5903)</td>
<td>Seminar (SPS 5903)</td>
</tr>
<tr>
<td>Coursework* 1-2 Subjects 3-6 Credits</td>
<td>Coursework* 1-2 Subjects 3-6 Credits</td>
</tr>
<tr>
<td><strong>Interim Semester (MS.)</strong></td>
<td><strong>Interim Semester (MS.)</strong></td>
</tr>
<tr>
<td>MS. Thesis (SPS 5999)</td>
<td>MS. Thesis (SPS 5999)</td>
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</tr>
<tr>
<td><strong>Last Semester (MS.)</strong></td>
<td><strong>Last Semester (MS.)</strong></td>
</tr>
<tr>
<td>MS. Thesis (SPS 5999)</td>
<td>MS. Thesis (SPS 5999)</td>
</tr>
<tr>
<td>Seminar (FSA 5903)</td>
<td>Seminar (FSA 5903)</td>
</tr>
<tr>
<td>Department of Chemistry</td>
<td>Department of Physics</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td><strong>First Semester (PhD)</strong></td>
<td><strong>First Semester (PhD)</strong></td>
</tr>
<tr>
<td>Seminar (SPS 6903)</td>
<td>Seminar (SPS 6903)</td>
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<td>3-6 Credits</td>
<td>3-6 Credits</td>
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<tr>
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<td><strong>Interim Semester (PhD)</strong></td>
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<tr>
<td>Coursework* 1-2 Subjects</td>
<td>Coursework* 1-2 Subjects</td>
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<tr>
<td>3-6 Credits</td>
<td>3-6 Credits</td>
</tr>
<tr>
<td><strong>4th Semester (PhD)</strong></td>
<td><strong>4th Semester (PhD)</strong></td>
</tr>
<tr>
<td>Seminar (FSA 6903)</td>
<td>Seminar (FSA 6903)</td>
</tr>
<tr>
<td><strong>Last Semester (PhD)</strong></td>
<td><strong>Last Semester (PhD)</strong></td>
</tr>
<tr>
<td>Seminar (FSA 6904)</td>
<td>Seminar (FSA 6904)</td>
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<tr>
<td><strong>First Semester (MS.)</strong></td>
<td><strong>First Semester (MS.)</strong></td>
</tr>
<tr>
<td>MS. Thesis (SPS 5999)</td>
<td>MS. Thesis (SPS 5999)</td>
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<tr>
<td>Seminar (SPS 5903)</td>
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</tr>
<tr>
<td>Coursework* 1-2 Subjects</td>
<td>Coursework* 1-2 Subjects</td>
</tr>
<tr>
<td>3-6 Credits</td>
<td>3-6 Credits</td>
</tr>
<tr>
<td><strong>Interim Semester (MS.)</strong></td>
<td><strong>Interim Semester (MS.)</strong></td>
</tr>
<tr>
<td>MS. Thesis (SPS 5999)</td>
<td>MS. Thesis (SPS 5999)</td>
</tr>
<tr>
<td>Coursework* 1-2 Subjects</td>
<td>Coursework* 1-2 Subjects</td>
</tr>
<tr>
<td>3-6 Credits</td>
<td>3-6 Credits</td>
</tr>
<tr>
<td><strong>Last Semester (MS.)</strong></td>
<td><strong>Last Semester (MS.)</strong></td>
</tr>
<tr>
<td>MS. Thesis (SPS 5999)</td>
<td>MS. Thesis (SPS 5999)</td>
</tr>
<tr>
<td>Seminar (FSA 5903)</td>
<td>Seminar (FSA 5903)</td>
</tr>
<tr>
<td>1 Credits</td>
<td>1 Credits</td>
</tr>
</tbody>
</table>
MASTER OF APPLIED STATISTICS

Master of Applied Statistics is a 40 credit postgraduate programme by coursework inclusive of a 6 credit mini project.

The objective of this programme is to produce graduates who are knowledgeable and skillful in statistics and also offers an opportunity for advanced studies and career development in the field of statistics. It offers a curriculum that provides a balanced approach to the training and education of statistics professionals. This programme prepares students with advanced knowledge and professional expertise through coursework and application. It exposes them to the latest developments in the field of Applied Statistics. Graduates from this field can have career opportunities in planning, management, research, academia and related industries. A student pursuing a Master of Applied Statistics may complete the programme in a minimum period of one year and a maximum period of three years.

Admission Requirements

An applicant for the master programmes should posses a Bachelor degree recognized by UPM in the field of Mathematics, Statistics or other related fields with a Cumulative Grade Point Average (CGPA) of at least 2.50. An applicants for the Ph.D. programmes should posses a Master degree recognized by UPM in the field of Mathematics Statistics or other related fields.

Additional Requirement

Holders of other degrees such as engineering and accounting with CGPA of at least 3.00 will be also considered. Candidates with CGPA less then the minimum requirement, but having at least 3 years working experience in the related fields may also apply.

Duration

The duration for Master of Applied Statistics is between 2 to 4 semesters.
Credit Requirements (Master of Applied Statistics)

The total credit requirement for graduation is 40. The credits are distributed among the compulsory and elective courses as follows:

<table>
<thead>
<tr>
<th>Compulsory courses</th>
<th>19 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective courses</td>
<td>21 credits</td>
</tr>
</tbody>
</table>

Compulsory Courses (19 credits)

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Code</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mathematical Statistics</td>
<td>MTH 5401</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Survey Sampling</td>
<td>MTH 5402</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>Design and Analysis of Experiments</td>
<td>MTH 5403</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Regression Analysis</td>
<td>MTH 5404</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>Project</td>
<td>MTH 5989</td>
<td>6</td>
</tr>
<tr>
<td>6.</td>
<td>Seminar</td>
<td>MTH 5903</td>
<td>1</td>
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</table>
Elective Courses (21 credits)

Students are required to choose seven courses from the list below as elective courses.

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Code</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Interactive Data Analysis</td>
<td>MTH 5405</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>2.</td>
<td>Quality Control Techniques</td>
<td>MTH 5406</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>3.</td>
<td>Exploratory Data Analysis</td>
<td>MTH 5407</td>
<td>3 (3+0)</td>
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<tr>
<td>4.</td>
<td>Categorical Data Analysis</td>
<td>MTH 5408</td>
<td>3 (3+0)</td>
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<tr>
<td>5.</td>
<td>Econometrics</td>
<td>MTH 5409</td>
<td>3 (3+0)</td>
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<tr>
<td>6.</td>
<td>Survival Analysis</td>
<td>MTH 5410</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>7.</td>
<td>Applied Statistical Modeling</td>
<td>MTH 5411</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>8.</td>
<td>Robust Statistics</td>
<td>MTH 5412</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>9.</td>
<td>Theory of Non-Parametric Statistics</td>
<td>MTH 5413</td>
<td>3 (3+0)</td>
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<tr>
<td>10.</td>
<td>Applied Stochastic Processes</td>
<td>MTH 5414</td>
<td>3 (3+0)</td>
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<tr>
<td>11.</td>
<td>Multivariate Analysis</td>
<td>MTH 5415</td>
<td>3 (3+0)</td>
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<td>12.</td>
<td>Time Series Analysis</td>
<td>MTH 5416</td>
<td>3 (3+0)</td>
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<td>13.</td>
<td>Forecasting Techniques in Finance</td>
<td>MTH 5417</td>
<td>3 (3+0)</td>
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<tr>
<td>14.</td>
<td>Spatial Statistical Techniques</td>
<td>MTH 5418</td>
<td>3 (3+0)</td>
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</tbody>
</table>

A student may take additional courses offered within or outside the Faculty as electives to support their field of study. These courses must be approved by the programme coordinator and the Faculty Graduate Studies Committee.
FIELD OF STUDY

The field of study for the Master of Science and Doctor of Philosophy programmes are shown below:

**Department of Biology**

- Biodiversity And Conservation Of Natural Resources
- Ecology
- Genetics
- Plant Physiology

**Department of Physics**

- Applied Physics
- Material Science
- Physics
- Theoretical And Computational Physics

**Department of Chemistry**

- Analytical Chemistry
- Catalysis
- Inorganic Chemistry
- Organic Chemistry
- Physical Chemistry
- Theoretical And Computational Chemistry

**Department of Mathematics**

- Applied Mathematics
- Numerical Analysis
- Pure Mathematics
- Statistics
LIST OF COURSES IN FACULTY OF SCIENCE

Department of Biology

<table>
<thead>
<tr>
<th>No</th>
<th>Code</th>
<th>Courses</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>BGY5701</td>
<td>Advanced Biostatistics</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>2.</td>
<td>BGY5402</td>
<td>Marine Benthic Ecology</td>
<td>3 (3+0)</td>
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<tr>
<td>3.</td>
<td>BGY5107</td>
<td>Biodiversity Conservation</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>4.</td>
<td>BGY5403</td>
<td>Advanced Limnology</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>5.</td>
<td>BGY5509</td>
<td>Conservation Genetics</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>6.</td>
<td>BGY5310</td>
<td>Advanced Ichthyology</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>7.</td>
<td>BGY5401</td>
<td>Advanced Ecotoxicology</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>8.</td>
<td>BGY5901</td>
<td>Research Methodology</td>
<td>3 (3+0)</td>
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<tr>
<td>9.</td>
<td>BGY5906</td>
<td>Special Topics in Biological Sciences</td>
<td>3 (3+0)</td>
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<tr>
<td>10.</td>
<td>BGY6001</td>
<td>Recent Advances in Biological Science Research</td>
<td>3 (3+0)</td>
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</table>

Department of Physics

<table>
<thead>
<tr>
<th>No</th>
<th>Code</th>
<th>Courses</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>PHY5201</td>
<td>Techniques in Microscopy and Spectroscopy</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>2.</td>
<td>PHY5321</td>
<td>Sensors and Signal Conditioning</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>3.</td>
<td>PHY5327</td>
<td>Instrument Interfacing and Digital Signal Processing</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>4.</td>
<td>PHY5402</td>
<td>Electrical and Optical Properties of Materials</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>5.</td>
<td>PHY5501</td>
<td>Applied Radiation Methodology</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>6.</td>
<td>PHY5502</td>
<td>Elements of Solar Energy</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>7.</td>
<td>PHY5601</td>
<td>Advanced Mathematical Physics</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>8.</td>
<td>PHY5901</td>
<td>Research Methodology</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>9.</td>
<td>PHY6001</td>
<td>Recent Advances in Physics</td>
<td>3 (3+0)</td>
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</tbody>
</table>
### Department of Chemistry

<table>
<thead>
<tr>
<th>No</th>
<th>Code</th>
<th>Courses</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1.</td>
<td>CHM5002</td>
<td>Safety in the Chemistry Laboratory</td>
<td>3 (3+0)</td>
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<tr>
<td>2.</td>
<td>CHM5102</td>
<td>Advanced Electrochemical Analysis</td>
<td>3 (3+0)</td>
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<tr>
<td>3.</td>
<td>CHM5201</td>
<td>Spectroscopy I</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>4.</td>
<td>CHM5301</td>
<td>Solid State Characterization</td>
<td>3 (3+0)</td>
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<tr>
<td>5.</td>
<td>CHM5401</td>
<td>Spectroscopy II</td>
<td>3 (3+0)</td>
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<td>6.</td>
<td>CHM5402</td>
<td>Chromatography</td>
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<td>7.</td>
<td>CHM5901</td>
<td>Research Methodology in Chemistry</td>
<td>3 (3+0)</td>
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<td>8.</td>
<td>CHM6001</td>
<td>Current Advancements in Chemical Research</td>
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### Department of Mathematics

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<thead>
<tr>
<th>No</th>
<th>Code</th>
<th>Courses</th>
<th>Credits</th>
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<td>1.</td>
<td>MTH5101</td>
<td>Partial Differential Equations</td>
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<td>2.</td>
<td>MTH5102</td>
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<td>MTH5103</td>
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<td>MTH5202</td>
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<td>7.</td>
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<td>Graph Theory</td>
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<td>Elements of Mathematics for Finance</td>
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<td>15.</td>
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<td>Differential Geometry</td>
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<td>MTH5308</td>
<td>Normed Spaces</td>
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<td>Survey Sampling</td>
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<td>Design and Analysis of Experiments</td>
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<td>MTH5406</td>
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<td>MTH5702</td>
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<td>MTH5901</td>
<td>Research Methods in Mathematics</td>
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<td>MTH5902</td>
<td>Research Topics in Mathematics</td>
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<td>Wavelet Theory</td>
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<td>49.</td>
<td>MTH6982</td>
<td>Latest Developments in Mathematical Research</td>
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<tr>
<td>50.</td>
<td>MTH6983</td>
<td>Latest Developments in Statistical Research</td>
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</table>
SYNOPSIS OF COURSES

Code  :  BGY5902
Credits :  3(3+0)
Title :  Special Techniques in Biological Sciences

This course covers the importance and application of various techniques used in the biological sciences. Observations of biological specimens using various instruments and application of nano techniques are also emphasized.

Code  :  FSA5905
Credits :  1(0+1)
Title :  Master's Research Final Seminar

This course involves presentation of research results of Master's with thesis. The presentation covers introduction, project justification, objectives, literature review, materials and method, results, discussion and conclusion.

Code  :  FSA6905
Credits :  1(0+1)
Title :  Doctoral's Research Final Seminar

This course involves the presentation of research results of PhD with thesis. The presentation covers introduction, project justification, objectives, literature review, materials and method, results, discussion and conclusion.

Code  :  BGY5107
Credits :  3(3+0)
Title :  Biodiversity Conservation

This course covers current issues in biodiversity conservation within and outside the country. The impact of human activities and climate changes on biological diversity at different levels are emphasized. Aspects pertaining to conservation are also discussed through case studies.

Code  :  BGY5310
Credits :  3(3+0)
Title :  Advanced Ichthyology

This course covers a systematic approach to the diversity of marine and freshwater fishes in Malaysia. Classification systems based on morphology and molecular methods are also emphasized. Fish nomenclature method and International Code of Zoological Nomenclature are also discussed. The current status of Malaysian fish diversity and conservation strategies are emphasized.

Code  :  BGY5401
Credits :  3(3+0)
Title :  Advanced Ecotoxicology

This course covers the sources, ways of transportation and the impacts of toxicants on organisms, populations and communities in ecosystem. Techniques on pollution determination and the effects of pollutants on genetic variation are also discussed. Current issues on environmental pollution and impacts on living organisms are also emphasized.

Code  :  BGY5402
Credits :  3(3+0)
Title :  Marine Benthic Ecology

This course covers the structures and functions of marine benthic communities from the intertidal zone to the deep sea. The productivity and material cycling in benthic systems, including the relative importance of grazing and detritus in different benthic ecosystems will also be discussed.

Code  :  BGY5403
Credits :  3(3+0)
Title :  Advanced Limnology

This course covers physico-chemical, biological and ecological processes that occur in various inland aquatic ecosystems. Roles and impacts of various ecosystem changes on biodiversity and productivity are discussed. The application of fundamental limnology to solve aquatic environmental problems and important issues in limnology related to the importance of sustainable development, management and conservation of inland aquatic environment and resources are also emphasized.
Code : CHM6001  
Credits : 3(3+0)  
Title : Recent Advances in Chemical Research

This course covers selected topics of current research interest, new developments in research methods and new findings in chemistry. The choice of topics is determined by the Department.

Code : CHM5201  
Credits : 3(3+0)  
Title : Spectroscopy I

This course encompasses various techniques in molecular spectroscopy. Topics include infrared, visible and ultraviolet spectroscopy, nucleus magnetic resonance and mass spectrometry. This course focuses on structure elucidation based on spectroscopic data.

Code : CHM5301  
Credits : 3(3+0)  
Title : Solid State Characterisation

This course encompasses various techniques of solid phase analysis. Topics include thermal methods, surface area and porosity characterizations, X-ray and electron microscopic techniques.

Code : CHM5401  
Credits : 3(3+0)  
Title : Spectroscopy II

This course encompasses instrumentation, analytical techniques and spectral studies in atomic absorption/emission spectroscopy and X-ray spectroscopy.

Code : CHM5402  
Credits : 3(3+0)  
Title : Chromatography

This course encompasses sample preparation techniques, theory, instrumentation and application of various chromatography techniques.

Code : CHM901  
Credits : 3(3+0)  
Title : Research Methodology in Chemistry

This course encompasses topics related to research characteristics, retrieval of chemical information, writing research proposal, research design and experimental method, data analysis and interpretation, presentation of results and writing research output.

Code : CHM5002  
Credits : 3(3+0)  
Title : Laboratory Safety

This course covers various aspects of safety related to laboratory hazardous chemicals. Topics include regulations pertaining to hazardous chemicals, handling, storage and disposal of hazardous chemicals, emergency procedures and ionizing radiation safety. Visits to selected organizations and invited lectures are included.

Code : CHM5102  
Credits : 3(3+0)  
Title : Advanced Electroanalytical Chemistry

This course covers advanced methods of electroanalytical chemistry and related electrochemical techniques. The most recent techniques for the analysis of various types of industrial and environmental samples and current development in chemical analysis are discussed.
### Course Information

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>MTH5101</td>
<td>Partial Differential Equations</td>
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<tr>
<td>MTH5102</td>
<td>Ordinary Differential Equations</td>
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<td>MTH5103</td>
<td>Selected Topics in Integral Equations</td>
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<td>MTH5203</td>
<td>Graph Theory</td>
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<td>MTH5204</td>
<td>Cryptography</td>
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<tr>
<td>MTH5205</td>
<td>Algebraic Structures</td>
<td>3(3+0)</td>
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</table>

#### Partial Differential Equations

This course covers the characteristic of partial differential equation, Laplace, Poisson, wave, heat, hyperbolic, elliptic and parabolic equations. Scattering problems and solutions of the hyperbolic equations with two independent variables using Riemann technique are discussed.

#### Ordinary Differential Equations

The course covers pure and approximate quantitative theory, qualitative theory, Sturm-Liouville theory and the existence and uniqueses theorem of solutions of ordinary differential equations. Theory of matrix differential equation and concepts of fundamental matrix, stability and the behavior of the solutions of the differential equations using Liapunov's direct method are discussed.

#### Selected Topics in Integral Equations

The course covers the linear and non-linear integral equations. Classification of integral equations, connection with differential equations which consist of initial and boundary value problems, solution using successive approximations and resolvent equations, Fredholm theory and Hilbert-Schmidt theorem are discussed.

#### Integral Transforms

The course covers the discussion of several integral transforms. Various applications in physical problems and finite transforms are discussed.

#### Selected Topics In Abstract Algebra

The course covers the selected topics in abstract algebra. Concepts on groups and rings, the theory of ideals, operating involving ideals, types of rings, fields and their extensions are discussed.

#### Algebraic Number Fields

The course covers the group \((\mathbb{Z}/n\mathbb{Z})^*\), definition and applications of the Legendre Jacobi-Kronecker symbol and solutions to polynomial equations in the \(p\)-adic field. The Galois group and the family of number fields, elliptic curves and polynomials of Hilbert class, modular equations, zeta functions, Taniyama-Weil conjecture and the tests of primality are discussed.

#### Graph Theory

The course covers the properties, the enumeration and application of trees, graphs and its applications, vertex coloring, chromaticity, edge coloring, digraphs and related theorems.

#### Cryptography

This course covers the classical, conventional and public-key cryptosystem. Cryptographic tools to design a "secure systems", definitions, theoretical foundations, and proofs of security, private and public key encryption, pseudo-random number generation, digital signatures, identification and key exchange are discussed.

#### Algebraic Structures

The course covers the theory of groups, rings and fields. The details of groups, rings and field theories, their algebraic properties and applications are discussed.
This course begins with the introduction of the properties of PDE and the techniques that have been proven in analyzing them. The Laplace, Poisson, wave, heat, hyperbolic, elliptic and parabolic equations will be discussed in detail. This course ends with the discussions of the scattering problems and the solution of the hyperbolic equation with two independent variables using Riemann technique.

The course covers pure and approximate quantitative theory, qualitative theory, Sturm-Liouville theory and the existence and uniqueness of solutions of ordinary differential equations. Theory of matrix differential equation and concepts of fundamental matriks, stability and the behavior of the solutions of the differential equations using Liapunov’s direct method are discussed.

The course covers the linear and non linear integral equations. Classification of integral equations, connection with differential equations which consist of initial and boundary value problems, solution using successive approximations and resolvent equations, Fredholm theory and Hilbert-Schmidt theorem are discussed.

The course covers the discussion of several integral transforms. Various applications in physical problems and finite transforms are discussed.

The course is concerned with linear integral equations although a brief discussion of simple non-linear equations is given. Topics discussed include the classification of integral equations, connection with differential equations which consist of initial value problems and boundary value problems. Solution by method of successive approximations, resolving equations. Fredholm theory and Hilbert-Schmidt theorem are also discussed.

This course covers sets and numbers, functions and convergence, measure, integration and stochastic processes. Topics on Martingales and stochastic convergence are discussed.

This course covers the concept of real number system, real valued functions, continuity, algebra of functions, sequences of functions and convergence. Riemann integral theory, Euler and improper integrals are discussed.

The course covers the main concepts of measure theory. Lebesgue integral, measurable functions, Lebesgue measure on $\mathbb{R}^n$, sequences of measurable functions and $L^p$ spaces are discussed.
Code : MTH5304  
Credits : 3(3+0)  
Title : Selected Topics in Functional Analysis

The course covers the concepts and theory of metric space, linear, normed linear and Banach spaces. The linear operators in normed and Banach and their applications to differential and integral equations, the Hilbert spaces, spectrum theory, Fourier analysis and Lebesgue’s theorem are discussed.

Code : MTH5305  
Credits : 3(3+0)  
Title : Selected Topics in Topology

The course covers the concept and theory topological space and subspaces. Compact spaces, products of Hausdorff, connected spaces, pseudometric, complete spaces, Baire category theorem, uniform continuity, completion of a pseudo-metric spaces are discussed.

Code : MTH5306  
Credits : 3(3+0)  
Title : Complex Analysis and Its Applications

This course covers complex number, complex functions and integration and analytic continuation. Application of conformal mappings, transforms of applied mathematics and their applications in differential equations are discussed.

Code : MTH5307  
Credits : 3(3+0)  
Title : Differential Geometry

The course covers the Euclidean spaces, curves in $\mathbb{R}^3$. The concept of Euclidean geometry, surfaces in $\mathbb{R}^3$ and manifolds are discussed.

Code : MTH5308  
Credits : 3(3+0)  
Title : Normed Spaces

This course covers normed and Hilbert spaces. Hahn-Banach theorem, weak topology, differentiation and integration in normed spaces, theory of distributions and its applications in differential equations are discussed.

Code : MTH5501  
Credits : 3(3+0)  
Title : Numerical Techniques in Finance

This course covers the floating-point number systems, solution of equations in one variable, interpolation and polynomial approximation. The initial value problems for the ordinary differential equations, stochastic differential equations and the direct methods for solving systems of linear equations and the Monte Carlo simulations are discussed.

Code : MTH5502  
Credits : 3(3+0)  
Title : Numerical Methods for Differential Equations

This course covers the numerical methods, convergence, consistency and zero-stability, local and global truncation errors and Adams methods together with predictor-corrector methods. The Runge-Kutta methods, error estimation and the stability theory are discussed.
Discussed optimizations, of this course covers the applications of mathematical models to problems in business and industry. The solution procedures for linear models with real, integer and \{0,1\} variables, the modeling of the practical problems and their solutions using computer packages, the problems of unconstrained and non-linear constrained are discussed.

<table>
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<tr>
<td>Title</td>
<td>Optimum Theory And Application</td>
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</table>

This course covers the analysis and design of linear and nonlinear dynamic systems. The optimal control theory, calculus of variations, dynamic programming, Pontryagin’s principles and linear control systems are discussed.

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<td>Credits</td>
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<tr>
<td>Title</td>
<td>Selected Topics in Optimal Control</td>
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This course covers the operational research techniques. The inventory problem, queueing theory, solution of problems using computer packages and the simulation modelling are discussed.

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<th>Code</th>
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<td>Operation Research</td>
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This course covers the theory and application of optimization methods in detail. Classic optimizations, methods in non-constraint optimizations and constraint optimizations are discussed.

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This course covers the financial and pricing derivatives. The integration and differentiation in stochastic environment, calculus for Brownian motion, white noise, partial differential equation in finance and stochastic games are discussed.

<table>
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<td>Title</td>
<td>Theory of Financial Mathematics</td>
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The course covers the Brownian motion, white noise, infinitesimal and stochastic calculus. The Black-Scholes model, diffusion process and pricing by no arbitrage, interest rates model, Girsanov’s theorem, likelihood ratios and processes with jumps are discussed.

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This course covers joint life function concept, reserves and multiple decrement table. The financial calculation using multiple decrement tables, profit-testing for unit-linked policies, the general insurance processes, loss distribution and risk models are discussed.

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<td>Credits</td>
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<td>Title</td>
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The course covers the discussion on the historical development in mathematics and statistics. The skills in library and information retrieval, techniques of creative problem solving and an introduction to mathematical and statistical methods, the art of writing a good thesis and the methods in presentations and publications are discussed.

<table>
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<tr>
<td>Title</td>
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</table>
Code    : MTH5902
Credits  : 3(3+0)
Title    : Research Topics in Mathematics

This course covers the philosophy and the development of the history of mathematics. Research topics are discussed. Students are required to write the thesis proposal.

Code    : MTH6102
Credits  : 3(3+0)
Title    : Wavelet Theory

This course covers an overview, notation of wavelets and filters. The matrices for downsampling and upsampling, orthogonal filters bank, multiresolutions, finite length signals and M-channels filters, the Desing methods and its applications are discussed.

Code    : MTH6201
Credits  : 3(3+0)
Title    : Selected Topics In Graph Theory

The course covers the selected topics in graph theory. Perfect, triangulated, comparability, split, permutation, superperfect, not so perfect graphs and perfect Gaussian elimination are discussed.

Code    : MTH6601
Credits  : 3(3+0)
Title    : Liapunov Stability Theory

The course covers the study of the stability of a system of differential equations by using the direct method of Liapunov and methods for generating Liapunov functions are discussed.

Code    : MTH6982
Credits  : 3(3+0)
Title    : Recent Advances in Mathematical Research

The course covers recent development of methods and findings in mathematics.

Code    : MTH6983
Credits  : 3(3+0)
Title    : Recent Advances in Statistical Research

The course covers recent development of methods and findings in statistics.
This course covers techniques of electron microscopy, electron spectroscopy and photon spectroscopy. Discussion includes interaction of electron and photon with solids, electron optics, and image formation in electron microscopy.

This course covers fundamental concepts of sensors. Physical principles, characteristics, and applications of signal conditioning and signal processing for computer-assisted data acquisition are discussed in detail.

This course stresses the use of personal computers to control external electrical devices. Finite impulse response (FIR), infinite impulse response (IIR) digital filters and the advantages of signal averaging and noise reduction are discussed.

This course covers the techniques that probe the electronic, optical, and dielectric properties of solids. The physics and instrumentation of the different techniques with emphasis to its value, potential and limitation are discussed.

This course covers the principles of interaction of ionising radiation with matter, chemicals and biological materials. Principle of measurements using various types of detectors, radiation dosimetry, radiobiology and radiation protection are emphasized. Radiation applications in industry and medicine are discussed.

This course covers solar geometry and its effects on meteorological parameters. The various methods of harnessing solar energy, including the use of passive and active thermal principles and photovoltaic are emphasized. Storage of solar energy using batteries and their environmental impact is also included. System performance and cost analysis of solar energy installation are discussed.

This course covers advanced topics in mathematical physics and the important methods in algebra and analysis. The inter-relationship between the different topics of analysis and algebra are emphasized.

This course covers the philosophy, methodology, concept and theory of research processes. Planning and writing research proposal as well as exercise in the form of assignments, discussion and presentations are emphasized.
Code : PHY6001
Credits : 3(3+0)
Title : Recent Advances in Physics

This course covers selected topics of current research interest, new developments in research methods and findings in physics.
GRADUATE STUDIES COMMITTEE

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