

FACULTY OF COMPUTER SCIENCE
AND INFORMATION TECHNOLOGY
UNIVERSITI PUTRA MALAYSIA



POSTGRADUATE PROGRAMMES BY RESEARCH

MASTER OF SCIENCE
DOCTOR OF PHILOSOPHY



Introduction

The Master of Science (MSc.) and Doctor of Philosophy (PhD) programmes provide students with specialisation education in the various fields of computer science. This is achieved through the completion of academic coursework in the major fields with an independent research project. A student pursuing a Master of Science programme may complete the programme after a minimum period of one year and a maximum period of three years, while a PhD student may complete the programme after a minimum period of two years and a maximum period of five years.

Fields of Study

1. Computer Graphics
2. Computer Networks
3. Computer Vision
4. Data Science
5. Database Systems
6. Human Computer Interaction
7. Information Retrieval
8. Information Systems
9. Intelligent Systems
10. Multimedia Computing
11. Parallel and Distributed Computing
12. Security in Computing
13. Software Engineering

Entrance Requirements

a) Master of Science programme:

- i. Bachelor's degree or equivalent, in computing, science and technology or related to computing, with a minimum CGPA 3.00; or
- ii. Bachelor's degree or equivalent, in computing, science and technology or related to computing with a CGPA of 2.75 – 2.99 may be considered based on a minimum of 3 years of work experience in the related field; or
- iii. Bachelor's degree or equivalent, in computing, science and technology or related to computing with a CGPA of 2.000 – 2.749 may be considered based on a minimum of 5 years of work experience in the related field

b) Doctor of Philosophy programme:

The applicant should possess:

- i. A Master's Degree or its equivalent in the field related to the field of PhD applied for AND candidates must have completed at least one (1) of their earlier Degrees (Master's or Bachelor's) in Computing or related to computing; or
- ii. Bachelor's degree with a minimum CGPA 3.75 or equivalent to a First Class Bachelor's Degree and passed a rigorous internal assessment.

English Language Requirement

International applicants must have obtained a minimum score of 550 for the TOEFL Paper-based Test (Academic Version) or Band 6.0 for IELTS (Academic Training), or 79-80 for TOEFL Internet-based Test (Academic Version) or Level 109 for CIEP at ELS Language Centre.

Programmes Offered by Semester

First and Second Semester of every year.

a) Credit Requirements for **Master of Science** programme

A master student is required to register and pass six (6) credit hours of courses:

- i. A research methodology course; and
- ii. Any course listed by the Faculty.

Other Requirements

1. SPS5903 Seminar

- A Master student is required to take the SPS5903 course, which is a presentation of a research proposal (1 credit).
- The course should be registered at least on or before the 2nd semester.
- Each student is required to present his/her research proposal at the 'Proposal Defense Seminar'.
- The supervisory committee and an independent member will evaluate the proposal.
- The proposal report and similarity report (generated by Turnitin) should be sent to the supervisory committee not later than two (2) weeks before the date of presentation.
- The seminar will be held not later than the 15th week of a semester.
- This course will be evaluated as satisfactory (M) or unsatisfactory (TM) grade.

2. SPS5999 Master Research

A Master student is required to register the SPS5999 Master Research every semester. This is a research project whereby at the end of the study period the candidate will submit a thesis. The thesis will be examined, and a viva voce will be conducted to determine the student's competency in the field of study.

3. Literature Review Seminar

- The seminar will be held not later than the 15th week of a semester.
- Advisor / supervisor and at least one appointed assessor will evaluate the presentation.
- Students must produce a manuscript report on Literature Review and submit to the advisor/supervisor not later than one week after the date of presentation.
- Students are also required to submit the similarity report (generated using the plagiarism checking software such as Turnitin) together with the manuscript.
- Advisor / supervisor will evaluate the suitability of a manuscript to be sent at least to an international conference.
- Failure to present and / or submit the manuscript report on Literature Review shall result in an unsatisfactory (TM) grade for the SPS5999.

b) Credit Requirements for a **Doctor of Philosophy** programme

A PhD student is required to register and pass six (6) credit hours of courses:

- i. A research methodology course; and
- ii. Any course listed by the Faculty.

Other Requirements

1. SPS6903 Seminar

- A PhD student is required to take the SPS6903 course, which is a presentation of a research proposal (1 credit).
- The course should be registered at least on or before the 2nd semester.
- Each student is required to present his/her research proposal at the 'Proposal Defense Seminar'.
- The supervisory committee and an independent member will evaluate the proposal.
- The proposal report and similarity report (generated by Turnitin) should be sent to the supervisory committee not later than two (2) weeks before the date of presentation.
- The seminar will be held not later than the 15th week of a semester.
- This course will be evaluated as satisfactory (M) or unsatisfactory (TM) grade.

2. Comprehensive Examination

Students pursuing a doctoral programme must pass the comprehensive examination (both written and oral examinations), which should be taken only after completion of all coursework required for the programme, within four semesters.

3. SPS6999 Doctoral Research

The PhD candidate is required to register the SPS6999 Doctoral Research every semester. This is a research project whereby at the end of the study period, the candidate will submit a thesis. The thesis will be examined, and a viva voce will be conducted to determine the student's competency in the field of study.

4. Literature Review Seminar

- The seminar will be held not later than the 15th week of a semester.
- Advisor /supervisor and at least one appointed assessor will evaluate the presentation.
- Students must produce a manuscript report on Literature Review and submit to the advisor/supervisor not later than one week after the date of presentation.
- Students are also required to submit the similarity report (generated using the plagiarism checking software such as Turnitin) together with the manuscript.
- Advisor /supervisor will evaluate the suitability of a manuscript to be sent at least to an international conference.
- Failure to present and / or submit the manuscript report on Literature Review shall result in an unsatisfactory (TM) grade for the SPS6999.

Computer Graphics

Computer Graphics (CG) is a subfield of Computer Science which studies methods for digitally synthesising and manipulating visual content. It plays an important role in generating visuals effectively and meaningfully from multiple sources of data types, including images, videos, 3D models, multidimensional data, scientific data via sensors, or input data from various devices. The output will be displayed through computer or mobile screens, Virtual Reality, Augmented Reality, or hologram. CG has been a core technology in digital photography, film, video games, cell phone and computer display. In addition to IR4.0, CG research goes beyond entertainment through contributions in specialised fields such as medical data visualisation, scientific data simulation, teaching and learning application, big data visualisation, Internet of Things (IoT) data representation, virtual reality, augmented reality, extended reality, and GPU processing. Related studies include applied mathematics, computational geometry, computational photography, image processing, and information and scientific visualisation. Applications of computer graphics include special and visual effects, engineering and simulation, computer aided geometric design, teaching and learning, digital art and video games, extended reality, and geographical information visualisation.

Computer Networks

This area encompasses various research topics in computer networks which include (but not limited to) advanced computer networks, network design, network management, software-defined networking, network security, mobile and wireless networks, ad hoc networks (wireless sensor networks, vehicular ad hoc networks, mobile ad hoc networks, body area networks), internetworking, satellite and optical communications, Internet of Things (IoT) networks, machine to machine (M2M) communication, quantum computing, blockchain technology, real-time systems, and performance modelling of communication networks.

Computer Vision

Computer vision is a branch of artificial intelligence (AI) that enables computers and systems to extract useful information from digital photos, videos, and other visual inputs and to execute actions or make recommendations based on that information. The relevant information is automatically extracted, analysed, and understood from a single image or a series of images. Related studies include artificial intelligence, human-machine interaction, and image security. Applications of Computer Vision include biometric, industrial robot, autonomous vehicle, medical imaging, surveillance, precision agriculture, image-based modelling, and sport technology.

Data Science

Data science is a broad field that involves the collective processes, theories, concepts, tools and technologies that enable the review, analysis, and extraction of valuable knowledge and hidden information from raw data. Data science employs techniques and theories drawn from many fields within the broad areas of mathematics, statistics, information science, computer science, and other practical methods to study, evaluate and model data. Methods that scale to big data are of particular interest in data science, although the discipline is not generally considered to be restricted to such big data, and big data solutions are often focused on organizing and preprocessing the data instead of analysis.

Database Systems

Database has always been a crucial component in any information system. Current trends have shown the transition of the traditional centralized relational database approach to become more advanced database. Research interest in database area include the following leading sub-areas: semantic web; database (centralised, distributed, parallel, mobile, multimedia, bio-medical); data quality; data warehouse; query formulation, processing and optimisation; integrity, integration, privacy and security in databases; applications, models and frameworks for e-commerce, e-government; and ontology management.

Human-Computer Interaction

Human-Computer Interaction (HCI) focuses on the models, theories and practical insights of human-human interaction, human-computer interaction and system development that apply user-centered design approach. This area also addresses on issues and the interaction of technology and capacity to identify the needs of specific user groups such as elderly, the differently abled, children and children with special needs and other than general users. The core areas include design methodologies; the design of intuitive and natural user interface and interaction; usability studies and usability evaluation; user experience; social interaction design; ubiquitous computing; innovative learning; multimodal interaction interactive technology; security in HCI and humane artificial intelligence.

Information Retrieval

This research area focuses on the theory and foundation, techniques, and applications of information retrieval (IR). It includes researches on document representation and content analysis/ modeling, queries and relevance feedback, users and interactive IR, retrieval models and ranking, search engine architecture and scalability issues, information filtering and recommendation, evaluation aspect of IR, social media search and Web IR, XML and semantic search, and other application of IR such as digital libraries, mobile search and online advertising. This area will also cover a variety of search-related research topics applied to a broad range of unstructured data including text, images, video, audio, and recorded speech. Related studies include sentiment analysis, text mining, multimedia analytics, natural language processing, semantic technology, multimedia information retrieval, search engine architecture, and recommendation system.

Information Systems

This area focuses on studies that are related to information systems environment in the organizations by emphasising on core aspects such as strategic information systems planning, web-based information systems, management and enterprise information systems, information systems and business intelligence, e-commerce, techniques and methods of integrated information systems development, management of information technology, data warehousing and data mining.

Intelligent Systems

Intelligent Systems seeks to undertake research in the theory, design, implementation, and application of intelligent computing to solve a range of problems in a given domain. This includes establishing new techniques that can intelligently transform massive data into useful information and knowledge. The most important aspect in intelligent systems is the selection of AI and machine learning methods such as neural networks, genetic algorithms, evolutionary computing, deep learning and fuzzy logic, which provide the system with cognitive abilities. Research in Intelligent Systems covers the following sub areas: data mining, intelligent agents, evolutionary computation and optimization, computational linguistics, bioinformatics, semantics, text mining, natural language

Multimedia Computing

This field includes the analysis of multimedia data and digital media that can include image, audio, video, and text data. Research activities will involve a combination of mathematical models, machine learning techniques, intelligent data processing and practical skills in algorithm development and evaluation. The research aims at narrowing multimedia semantic gap, i.e., the large disparity between descriptions of multimedia content that can be computed automatically, the richness and subjectivity of semantics in user queries, and human interpretations of multimedia data. Multimedia data analysis in the domain such as health, sports, culture, geoscience, agriculture, security, etc. in a real-world context is highly needed. In addition to content-based multimedia data processing, application development and interaction technologies with multimedia data and content are also included such as hypermedia and educational multimedia applications. Related studies and applications include multimedia search and recommendation, multimedia information processing and retrieval, intelligent multimedia data processing, analysis and access, multimodal machine learning, image / video processing and sense-making, sound processing, speech and language processing, interaction with multimedia content and query technologies, conversational artificial intelligence, machine listening, hypermedia technologies, and e-learning technologies and multimedia.

Parallel and Distributed Computing

This area encompasses various domains which include cloud computing, fog computing, edge computing, Peer to Peer (P2P) systems, advanced distributed systems, distributed databases, High Performance Computing, multicore architectures, parallel programming, fault tolerance network, computational intelligence, data intensive computing, performance modelling, online social networks, and massively parallel computing.

Security in Computing

This research area focuses on the theoretical and technical aspects of digital security which mainly aim to protect and maintain the confidentiality, integrity, availability and privacy of information, applications, networks, and data, against unauthorized access and cyber-attacks from external as well as internal sources. It covers many sub-areas including IoT security, blockchain, Web security, network and cloud security, access control, mobile security, quantum security, malware analysis, forensics and incident response, cryptography and protocols, data privacy, security management, ethics and policy.

Software Engineering

Software Engineering is an engineering discipline that is concerned with every aspect of software production from the early stages of software requirements specification through to maintaining the software after it has gone into use. This area covers systematic, disciplined, quantifiable techniques and methods in designing, developing, implementing, and maintenance of quality software. Issues related to theoretical and formal aspects of software engineering, software architecture, software web services, software modeling, software quality, software engineering management, enterprise software engineering and integration, green software engineering, component-based software engineering, search-based software engineering, software measurement, estimation and metrics are among the popular topics in this research. This area also addresses emerging trends such as software engineering for artificial intelligence (SE4AI), the industrial revolution, and big data software engineering. Additionally, research is also carried out in the area of special-purpose embedded software engineering which involves multidisciplinary research disciplines such as educational study, agricultural science, and health science.



TUITION FEES

Applicable to all new students enrolled beginning First Semester 2021/2022 onwards.

MASTER OF SCIENCE

FEES IN RINGGIT MALAYSIA (RM)

SEMESTER	1 st SEMESTER (Pay during the registration)	2 nd - 3 rd SEMESTERS	4 th SEMESTER	5 th AND SUBSEQUENT SEMESTERS	STUDY COST FOR MAXIMUM 2 YEARS	STUDY COST FOR MAXIMUM 3 YEARS
LOCAL STUDENTS	2,250.00	2,000.00	1,500.00	2,000.00	7,750.00	11,750.00
INTERNATIONAL STUDENTS	6,700.00	4,450.00	3,950.00	4,200.00	19,550.00	27,950.00

Note:

1. If the thesis is submitted **BEFORE** the deadline the student is required to register and pay **RM500 (local) /RM550 (International)** only for the next semester.
2. If you have to resubmit your thesis, your thesis re-submission fee is **RM1,500**.

NOTE: The fee amount is subject to change from time to time WITHOUT prior notice by the University. Prospective and current students are advised to check the SGS website for any fee changes not earlier than one (1) month before the start of each semester/new students' registration. All fees must be paid upon registration.

OTHER COST: Please refer to School of Graduate Studies website at <http://www.sgs.upm.edu.my>

DOCTOR OF PHILOSOPHY

FEES IN RINGGIT MALAYSIA (RM)

SEMESTER	1 st SEMESTER (Pay during the registration)	2 nd - 4 th SEMESTERS	5 th AND 6 th SEMESTERS	7 th AND SUBSEQUENT SEMESTERS	STUDY COST FOR MAXIMUM 4 YEARS	STUDY COST FOR MAXIMUM 5 YEARS
LOCAL STUDENTS	2,812.50	2,562.00	2,000.00	3,000.00	20,500.00	26,500.00
INTERNATIONAL STUDENTS	7,312.50	5,362.50	4,800.00	5,300.00	43,600.00	54,200.00

Note:

1. If the thesis is submitted **BEFORE** the deadline the student is required to register and pay **RM500 (local) /RM550 (International)** only for the next semester.
2. If you have to resubmit your thesis, your thesis re-submission fee is **RM2,250**.

NOTE: The fee amount is subject to change from time to time WITHOUT prior notice by the University. Prospective and current students are advised to check the SGS website for any fee changes not earlier than one (1) month before the start of each semester/new students' registration. All fees must be paid upon registration.

OTHER COST: Please refer to School of Graduate Studies website at <http://www.sgs.upm.edu.my>



Application for Admission:

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For further information on academic programmes, please contact:

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