

**MATHEMATICAL SCIENCES, INFORMATION AND COMMUNICATION TECHNOLOGY
RESEARCH CLUSTER**

Head: **PROF. DATO' DR. KAMEL ARRIFIN MOHD ATAN**
 Leading PTJ: Institute for Mathematical Research, Universiti Putra Malaysia,
 43400 UPM Serdang, Selangor
 Contact: kamel@upm.edu.my/ dir.inspem@upm.my / Tel: 03-89466872

RESEARCH CLUSTER CODE	MSICT
NO. OF PROGRAMME	17
NO. OF GROUP	29
NO. RESEARCH CENTRE	1
SYNOPSIS	<p><i>The research cluster encompasses all disciplines that are mathematical in nature or are related to developments in information & communications technology (ICT) and are not limited to the traditional disciplines of mathematics and computer science. It will benefit all forms of sciences through mathematical structures and techniques, innovations in known technologies of ICT, or novel paradigms in mathematics and ICT.</i></p> <p>Kluster penyelidikan ini merangkumi semua disiplin yang bersifat matematik atau berkait dengan perkembangan teknologi maklumat & komunikasi (ICT) dan tidak terhad pula kepada disiplin tradisi matematik dan sains komputer. Ia akan memberi manfaat kepada semua bentuk sains melalui struktur dan teknik matematik, inovasi dalam teknologi ICT sedia ada, atau paradigma novel dalam matematik dan ICT.</p>
DESCRIPTION (with NABC elements)	<p>Need Quantitative development and advancement in most sciences have often relied upon progress in mathematical sciences and development in ICT</p> <p>Approach The cluster addresses the development of these sciences and technologies by advancing to a higher level with international partners</p> <p>Benefit Sciences will be based on strong footing with both qualitative and quantitative analysis and structures. Further enhanced by computational and communication technologies</p> <p>Competitor Presently, UPM leads in Mathematical Sciences and ICT publications reported from past SciVal spotlight with experienced researchers</p>

Code	Research Programme	Synopsis	Leader of Research Programme	Research Groups
MSICT01	Analytical Structural Modeling and Topological Networking	Analytical Structural Modeling and Topological Networking aims to identify and formulate the real network problems and determine the suitable method. Furthermore to solve the problem by using the analytical technique and study the mathematical properties. It is considered an interdisciplinary program and focus on the upfront of future analysis and topological network Keywords : analytical approached modeling, topological networking method	Prof. Dr. Adem Kilicman (INSPEM) akilicman@science.upm.edu.my	1. Functional Analysis And Topology - Prof. Dr. Adem Kilicman (INSPEM) 2. Structural Theory of Algebras – Assoc. Prof. Dr. Isamiddin Rakhimov (INSPEM)
MSICT02	Computational Operations Research	Research in Operations Research aims to model real world systems and analyze their behavior using a variety of mathematical and computational techniques. Although the term "operations research" stems from a study of military operations conducted during World War II, the scope of Operations Research today encompasses a variety of problems in business, engineering, and economics, as well as the social and physical sciences. This programme is broadly focused around the sciences of decision making in an effort to optimize profit/benefit/objective subjected to certain constraints using state-of-art methods and algorithms include Genetic Algorithm, Meta-heuristics, Data Envelopment Analysis, Supply Chain networks, etc. Ultimately, the research seeks to contribute to the advancement of design and innovations in industrial arenas using various mathematical tools. Keywords: Operations Research, Optimisation, Decision Sciences	Assoc. Prof. Dr. Leong Wah June (INSPEM) wjleong@science.upm.edu.my	1. Numerical Optimisation Group - Assoc. Prof. Dr. Leong Wah June (INSPEM) 2. Mathematical Programming and Heuristic Computation – Assoc. Prof. Dr. Lee Lai Soon (FS)
MSICT03	Multimedia Computing and Content Innovation	This multidisciplinary research program focuses on current research, development and commercialization within multimedia elements and content computing. Basically, this group bridges the theory and practice of Computer Graphics, Computer Vision, Information Visualization, Imaging, Video and Audio Processing, Computational Geometric, Human Computer Interaction, Information Access, Multimedia Databases, Content Design and Artificial Intelligent. The work also covers computational and mathematical techniques for retrieval of information and feature extraction, presentation, integration and computation of various media using multimodal interaction to create multimedia applications. This includes web-based, ubiquitous and interactive application, computer games, multimedia information encoding and data interchange formats, digital video and audio networking and communication. Studies on video streaming, multimedia content design, multimedia technology, 2D and 3D modeling, film and animation environment, simulation, tracking, recognition and detection of event, object and others also being done in this program. Keywords: Computer Graphics, Computer Vision, Visualization, Image Processing, Information Retrieval, Digital Media Processing, Content Creation and Multimodal Interaction.	Assoc. Prof. Dr Lili Nurliyana Abdullah (FSKTM) liyana@fsktm.upm.edu.my	1. Computer Graphics, Vision and Visualization – Assoc. Prof. Dr. Rahmita Wirza O.K. Rahmat (FSKTM) 2. Applied Informatics – Assoc. Prof. Dr. Rusli Abdullah (FSKTM) 3. Intelligent Computing – Assoc. Prof. Dr. Md Nasir Sulaiman (FSKTM) 4. Digital Information Computation and Retrieval – Assoc. Prof. Dr. Shyamala Doraisamy (FSKTM) 5. Human Computer Interaction (HCI) – Dr Evi Indriasari Mansor (FSKTM) 6. Database Technology and Application – Prof. Dr. Hamidah Ibrahim (FSKTM)
MSICT04	Data and Knowledge Engineering for Complex System	Data and Knowledge Engineering for Complex System is a research program that is focusing on building applications, tools and techniques that solve complex and knowledge-intensive tasks, as well as developing new solutions for the integrated management of data, information and knowledge in highly distributed environments. In order to accomplish this, we may use cutting edge approaches from intelligent computing and database technologies. Keywords: data-intensive application, knowledge-intensive, data integration, complex system	Prof. Dr. Hamidah Ibrahim (FSKTM) hamidah@fsktm.upm.edu.my	1. Database Technology and Applications – Prof. Dr. Hamidah Ibrahim (FSKTM) 2. Intelligent Computing – Assoc. Prof. Dr. Md Nasir Sulaiman (FSKTM)

MSICT05	Geospatial Information System	<p>This research programme focuses on the development and visualization of new geospatial methods and systems for the solution of infrastructure engineering, natural hazard monitoring and natural resources management. The programme covers research in the areas of remote sensing, Geographical Information System (GIS) and Global Navigation Satellite System (GNSS)</p> <p>Keywords: Remote Sensing, GIS, GNSS, Geospatial Engineering</p>	<p>Prof. Dr. Shattri Mansor (FK)</p> <p>shattri@eng.upm.edu.my</p>	<ol style="list-style-type: none"> 1. Geospatial Information Science Research Centre (GISRC) – Assoc. Prof. Dr. Abdul Rashid Mohamed Shariff (RC / FK) 2. Geographical Information System (GIS) – Assoc. Prof. Dr. Abdul Rashid Mohamed Shariff (FK) 3. Remote Sensing – Prof. Dr. Shattri Mansor (FK) 4. Computer Graphics, Vision and Visualization – Assoc. Prof. Dr. Rahmita Wirza O.K. Rahmat (FSKTM)
MSICT06	Information Security System	<p>This research programme aims to address the computer-related security issues and challenges, exploring areas in computer and system security, including cryptography and protocols, access control, operating system security, quantum key distribution, steganography and information hiding, network and communication security, intrusion detection systems, digital forensics, software security, malware analysis, cyber warfare, information security management, and formal methods application in computer security. Additionally, this programme covers mathematical-based security, exploring the mathematics behind modern secure information and communications systems, i.e. mathematical ideas and subjects namely number theory, geometric algebra, chaos theory and other related fields. Amongst the widespread research areas are to find cryptographic efficient algorithms, primarily testing, factoring large integers, lattice-based cryptography, sieve methods, elliptic curve cryptography discrete log problems and other related fields.</p> <p>Keywords: Computer security, information security, computer forensics, mathematical security.</p>	<p>Prof. Dr. Ramlan Mahmod (FSKTM)</p> <p>ramlan@fsktm.upm.edu.my</p>	<ol style="list-style-type: none"> 1. Information Security - Assoc. Prof. Dr Nur Izura Udzir (FSKTM)
MSICT07	Intuitive Information System	<p>Research in Intuitive Information System (IIS) aims to model real business or enterprise systems with regards to components of input, process and output as well as storage management, service quality and its level of agreement for the specific type of information system based on the recent technology such cloud computing environment. Besides that, the research will be focusing on how IS can be performing in science of informatics which related to other fields of study such as agriculture and bioinformatics.</p> <p>Furthermore, the research will also be given a special emphasis on information and knowledge management systems and its relation of research to a particular field of knowledge ontology, knowledge integration and security of applications for benefits of a community of practice (CoP) in locally and internationally.</p> <p>Keywords: Information System, Informatics, Knowledge Management System</p>	<p>Assoc. Prof. Dr. Rusli Abdullah (FSKTM)</p> <p>rusli@fsktm.upm.edu.my</p>	<ol style="list-style-type: none"> 1. Applied Informatics – Assoc. Prof. Dr. Rusli Abdullah (FSKTM) 2. Intelligent Computing – Assoc. Prof. Dr. Md Nasir Sulaiman (FSKTM) 3. Database Technology and Applications – Prof. Dr Hamidah Ibrahim (FSKTM) 4. Computer Graphics, Vision and Visualisation (CGV2) – Assoc. Prof. Dr. Rahmita Wirza O.K. Rahmat (FSKTM) 5. Digital Information

				Computation and Retrieval (DICR) – Assoc. Prof. Dr. Shyamala Doraisamy (FSKTM)
MSICT08	Mathematical Structures and Techniques in Physical Sciences	<p>Mathematical Structures and Techniques in Physical Sciences is the study of mathematical structures and techniques in physical sciences and engineering. This covers traditional areas of applied mathematics like fracture and continuum mechanics and fluid dynamics, as well as those from quantum sciences and relativity. Research interests include problems of cracks, fluid convection, flows in nanofluid and porous media, foundations of quantum theory and cosmological solutions. This program aims at analyzing the behavior of solutions at crack tips and edges, the behavior of fluid in media subject to various external factors, whereas in quantum theory and cosmological solutions, the aims is, respectively, to study the right mathematical framework for describing the microscopic objects and the properties of the whole universe. The research could provide some vital information on the material strength, fluid behavior in a particular medium, allows the microscopic understanding of matter and possible solution to describe the properties of the whole or part of the universe.</p> <p>Keywords: Cracks, Fluid Flows, Quantum Theory</p>	<p>Assoc. Prof. Dr. Nik Mohd. Asri Nik Long (INSPEM)</p> <p>nmasri@science.upm.edu.my</p>	<ol style="list-style-type: none"> 1. Mathematical Physics And Engineering – Assoc. Prof. Dr. Nik Mohd. Asri Nik Long (INSPEM) 2. Applied and Computational Mathematics – Assoc. Prof. Dr. Norihan Md Ariffin (FS) 3. Computational Mathematics and Scientific Computing - Dr. Norazak Senu (INSPEM)
MSICT09	Mathematical Values in Society	<p>Values in mathematics are derived from the philosophical epistemology. In the epistemology, cognitive knowledge is classified into three main categories: metaphysics, mathematics and natural sciences. The classification is generally described by terms of integrating the intellectual sciences and the transmitted sciences. In the classification, metaphysics is the ultimate destination for all branches of intellectual sciences. The implicit objective of metaphysical ultimate is considered the as values in the scheme. The mathematical values in society describe the intrinsic nature of the paradigm in teaching-learning of the subject in society.</p> <p>Keywords: mathematics, paradigm, values, education.</p>	<p>Assoc. Prof. Dr. Mat Rofa Ismail (INSPEM)</p> <p>mrofa@science.upm.edu.my</p>	<ol style="list-style-type: none"> 1. Ethnomathematics – Assoc. Prof. Dr. Mat Rofa Ismail (INSPEM)
MSICT10	Pedagogical Developments in Mathematics	<p>Studies related to theories and practices in mathematics teaching for the enhancement of mathematical understanding. Amongst the approaches to be investigated, are constructivism, mastery, collaborative, contextual learning and problem-based learning. Other pedagogical perspectives include cognitively-guided instruction, zone of proximal development, expert-novice paradigm, postmodern pedagogy, critical pedagogy, psychological issues, policy issues and current issues related to pedagogy of mathematics.</p> <p>Application of technological tools developed for teaching and learning of mathematics, designing of mathematical learning system, assessment in mathematics instructions, social, ethical and human issues related to use of technology in mathematics instruction.</p> <p>Keywords: Mathematics Pedagogy, Technology-mediated tools, Cognitive, Affective and Social Factors to Mathematics Learning.</p>	<p>Assoc. Prof. Dr. Rohani Ahmad Tarmizi (INSPEM)</p> <p>rht@educ.upm.edu.my</p>	<ol style="list-style-type: none"> 1. Didactics in Mathematics – Assoc. Prof. Dr. Rohani Ahmad Tarmizi (INSPEM)
MSICT11	Scalable and Dependable Distributed Computing Systems	<p>The flexible, scalable and dependable Distributed Computing Systems underpin research and development in many fields, such as, agriculture, engineering, finance, life and medical sciences, natural and physical sciences, and many more. In order to promote research advances in the rich field of distributed computing, the Scalable and Dependable Distributed Computing System research program is introduced. The goal of the research program is to motivate and provide the development of scholarly activities are pertaining to the different types and classes of high performance computing (HPC) and distributed computing. It also provide scientific exposure of the technological context of current distributed systems which could increase collaborative opportunities for researchers by providing a focal point for distributed HPC research that spans several disciplines, such as,</p>	<p>Prof. Dr. Mohamed Othman (FSKTM)</p> <p>mothman@fsktm.upm.edu.my</p>	<ol style="list-style-type: none"> 1. Network, Parallel and Distributed Computing - Prof. Dr. Mohamed Othman (FSKTM) 2. Wireless, Mobile and Quantum Computing – Assoc. Prof. Dr. Shamala Subramaniam (FSKTM) 3. Computational

		<p>algorithms, data mining, databases, green and cloud computing, computer networking, mobile and wireless, programming languages, and service science. The establishment of the program optimistically to support industry, academia, and government advances in large-scale distributed systems.</p> <p>Keywords: HPC architecture, Parallel and Distributed Processing, Network Algorithms and Protocols, Wireless & Mobile Networks, Green Networks, Intelligent Network & Optimization</p>		<p>Mathematics and Scientific Computing - Dr. Norazak Senu (INSPEM)</p> <p>4. Numerical Optimisation Group - Assoc. Prof. Dr. Leong Wah June (INSPEM)</p> <p>5. Mathematical Programming and Heuristic Computation - Assoc. Prof. Dr. Lee Lai Soon (FS)</p>
MSICT12	Statistical Modelling and Computational Statistics	<p>Statistical Modelling and Computational Statistics is useful in many fields like Environment, Agriculture, Finance, etc. This programme includes areas like time series, spatial modeling, robust statistics, diagnostics, bootstrapping, extreme value theory and environmetrics. Research is currently focused on Generalized Time Series Models. Spatial data are usually handled by investigating spatial autocorrelation and modeling the data by unilateral Spatial ARMA models. Robust statistics is an area in statistics with is useful for inference when classical statistical measures and inference fails. Extreme value theory is appropriate when handling extreme data and predicting extreme events. The field of extreme value theory is currently blended with other fields such as spatial modeling, Bayesian modeling and financial modeling. Currently research is undertaken in spatial extreme modeling and environmental modeling. Besides knowledge enhancement, the research conducted in this programme is useful for industries like MPOB and NAHRIM with whom linkages have been established.</p> <p>Keywords: Robust Statistics, Spatial and Time Series, Extreme Value Theory, Bayesian</p>	<p>Dr. Mohd. Bakri Adam (INSPEM)</p> <p>bakri@science.upm.edu.my</p>	<p>1. Reliability Analysis and Complex Systems – Assoc. Prof. Dr. Mohd Rizam Abu Bakar (INSPEM)</p> <p>2. Modelling and Computational Statistics - Dr. Mohd Bakri Adam (INSPEM)</p>
MSICT13	Structures and Techniques in Mathematics	<p>Structures and Techniques in Mathematics aims to serve as a reference point to the nation for interdisciplinary research in mathematics and to broaden the range of applications in which applied mathematics is used. This programme include functional analysis, number theory and cryptography, differential games and algebra, fluid dynamics and fracture mechanics, stability and optimization and numerical analysis,. The interest of the research group is to make connections between a broad spectrum of mathematicians and scientists, to make new collaborations, to better inform mathematicians and scientists about interdisciplinary problems. To foster communication among the mathematical sciences researchers in order to share the best practices, encourage coordination and cooperation, and pool resources when appropriate.</p>	<p>Assoc. Prof. Dr. Norihan Md Ariffin (FS)</p> <p>norihan@science.upm.edu.my</p>	<p>1. Theoretical Mathematics and Mathematical Sciences - Prof. Dr. Adem Kilicman (FS)</p> <p>2. Applied and Computational Mathematics – Assoc. Prof. Dr. Norihan Md Ariffin (FS)</p>
MSICT14	Systems and Software Quality	<p>Research in Systems and Software Quality concerns with methods and techniques for building high quality software systems. This not only includes software construction, but also requirements analysis, design, system integration, testing, deployment, and making changes to software systems after their first release. The focuses will be on investigating methods, techniques, and models for software development and maintenance with the aims of producing quality software with the support of software measurement.</p> <p>Keywords: Software Requirements, Software Design, Software Testing, Software Modeling, Software Quality, Software Measurement, Search-Based Software Engineering, Web-Based Development, Software Construction</p>	<p>Prof. Dr. Abdul Azim Abd Ghani (FSKTM)</p> <p>azim@fsktm.upm.edu.my</p>	<p>1. Software Engineering - Prof. Dr. Abdul Azim Abd Ghani (FSKTM)</p> <p>2. Applied Informatic - Assoc. Prof. Dr. Rusli Abdullah (FSKTM)</p> <p>3. Human Computer Interaction – Dr. Evi Indriasari Mansor (FSKTM)</p>
MSICT15	Wireless, Mobile and Remote Information	<p>Wireless Communications Research covers the fundamental and emerging issues impacting various types of wireless applications. This includes various categories of communications networks and near field</p>	<p>Prof. Dr. Borhanuddin Mohd Ali (FK)</p>	<p>1. Wireless System - Prof. Dr. Borhanuddin Mohd.</p>

	Systems	communications, namely 4G mobile network architecture, broadband wireless access, satellite and space communications, QoS and resource management, antennas and propagations, coding, ad-hoc, sensor and personal area networks, networked applications and RF technologies. The emphasis in this group now is to research on new environmental friendly approaches of wireless communications, besides increasing its capacity and Quality of Service to cater for ever more bandwidth hungry mobile applications, and making it more pervasive and heterogeneous to cater for many kinds of mobile devices and application domains.	borhan@eng.upm.edu.my	<p>Ali (FK)</p> <p>2. Network, Parallel and Distributed Computing - Prof. Dr. Mohamed Othman (FSKTM)</p> <p>3. Wireless, Mobile and Quantum Computing – Assoc. Prof. Dr. Shamala Subramaniam (FSKTM)</p>
MSICT16	Numeric and Algorithmic	<p>Numerics and Algorithmics is a study of a wide area covering the intersection of computer science and mathematics with applications in other sciences. This programme focuses into the development of new methods and algorithms in solving a mathematical or scientific problem numerically or otherwise. The need for faster solver for solving mathematical problem arises in a wide variety of applications. The knowledge gained, and the software developed in the research will benefit engineers, numerical analyst and other scientists. The focus areas are on parallel algorithms, numerical analysis for higher order ODEs, integral equations, information technology, parallel architecture and processing, high speed network, distributed computing and many others. This programme aims to address the most challenging and fundamental problems in the science and technology of computation and information, while providing a first-rate education for future scientists and engineers. Significant benefits can be achieved with the product's ability to accelerate development time, improve quality, and reduce development costs.</p> <p>Keywords: numerical analysis, parallel programming, computing network.</p>	<p>Dr. Norazak Senu (INSPEM)</p> <p>norazak@science.upm.edu.my</p>	<p>1. Computational Mathematics and Scientific Computing - Dr. Norazak Senu (INSPEM)</p> <p>2. Network, Parallel and Distributed Computing - Prof. Dr. Mohamed Othman (FSKTM)</p>
MSICT 17	Cryptography and Computational Number Theory	<p>Cryptography and Computational Number Theory programme covers the design of secure systems and their cryptanalysis, exploring the mathematics behind modern secure communications systems, and concerns with finding and implementing efficient computer algorithms for solving various problems in number theory. Number theory and algebra play an increasingly significant role in computing and communications, as evidenced by the striking applications of these subjects to such fields as public key cryptography and coding theory. Other mathematical subjects contributing to these researches are geometric algebra, chaos theory, dynamical systems, fractal geometry and other related fields. Amongst the widespread research areas are to find cryptographic efficient algorithms, primality testing, integer factorization problem, discrete log problems, lattice-based cryptography, elliptic curve cryptography, random number generation, and estimation of multiple exponential sums.</p> <p>Keywords: mathematical cryptography, coding theory, exponential sums</p>	<p>Dr. Muhammad Rezal Kamel Ariffin (INSPEM)</p> <p>rezal@science.upm.edu.my</p>	<p>1. Mathematical Cryptography - Dr. Muhammad Rezal Kamel Ariffin (INSPEM)</p> <p>2. Analytical Methods in Number Theory – Dr. Siti Hasana Sapar (INSPEM)</p>

Tarikh Kemaskini: 18 Jun 2013