MASTER OF SCIENCE IN COMPUTER SCIENCE (MSC)

Overview

The Computer Science Department is a leading department in the College of Computing. It was established in 1424 H. The department has graduated hundreds of students from its BS programs.

Mission

We provide high-quality education in Computer Science, fostering research, critical thinking, and ethics. Our goal is to prepare graduates for meaningful contributions to technology, emphasizing community involvement and continuous learning.

Objectives

1. Continuous Learning: Graduates will commit to ongoing professional development, integrating the latest advancements to elevate education quality.
2. Ethical Conduct: Graduates will uphold professionalism and ethics, ensuring integrity in research and professional activities.
3. Leadership: Graduates will demonstrate leadership, initiating and guiding teams. They will actively engage in community participation, fostering collaboration and program impact on society.
4. Professional Skills: Graduates will excel as computing professionals, applying research findings to enhance project quality.

Learning Outcomes

The MSC program at FBSU strives to achieve success by ensuring that graduates demonstrate the following:

Knowledge and Understanding:

- **K1** Describe and illustrate knowledge of fundamental Mathematics, Science, and CS in Real life.
- **K2** List and describe major modern CS-related problems and reproduce acquired education to understand the impact of computer solutions to these problems in a global, economic, environmental, and societal context.
- **K3** List and define current up to date techniques, skills, and tools necessary for CS research and practices to meet desired needs within realistic constraints (economic, environmental, social, ethical, health and safety, manufacturability, and sustainability).
- **K4** Reproduce acquired skills to use CS in a business environment to gain a competitive advantage, improve performance, and increase the profitability of a business enterprise.

Skills:

- **S1** Examine and analyze issues related to the design and implementation of a computer-based system, process, or program to meet desired needs within realistic constraints.
- **S2** Demonstrate the ability to use mathematical foundations and system principles, of CS in the modelling and design of computer-based systems in a way that demonstrates

comprehension of the trade-offs involved in design choices

S3 Research the problems in a field of study and judge the efficiency and usefulness of acquired computing knowledge to solve them.

S4 Show the ability to practice design and development principles in the construction of software systems needed to carry out a research study.

Values:

V1 Demonstrate communication skills such as writing, reading, presenting, negotiating and debating

V2 Demonstrate understanding of professional and ethical responsibilities when working independently or as part of a team, and exhibit leadership characteristics

V3 Choose and judge resources, time and team members' management needed to accomplish teamwork promptly.

Program Tracks

1) Project Track (42 credit hours)

   Successful completion of a minimum of 39 credit hours of graduate courses.

   Completion and successful defense of a research project of 3 credit hours.

Thesis Track (42 credit hours)

   Successful completion of a minimum of 30 credit hours of graduate courses.

   Completion and successful defense of a research project of 12 credit hours.

Career Opportunities

1) Data Scientist/Analyst:

   Analyze and interpret complex datasets to extract valuable insights.

   Utilize statistical and machine learning techniques to inform business decisions.

Software Development Engineer/Programmer:

   Design and develop software solutions for diverse industries.

   Contribute to the creation of innovative applications and systems.

Cybersecurity Specialist:

   Safeguard computer systems and networks from cyber threats.

   Implement security measures and conduct vulnerability assessments.

AI/Machine Learning Engineer:

   Develop and implement machine learning algorithms and models.

   Contribute to cutting-edge advancements in artificial intelligence.

Network Engineer/Architect:

- Design, implement, and manage computer networks.
- Ensure the security and optimal functioning of data communication systems.

IT Consultant:

   Provide expert advice on IT strategies and solutions for businesses.

   Assist organizations in optimizing their IT infrastructure and processes.

Project Manager (IT):

Plan, execute, and oversee IT projects from inception to completion.

Coordinate teams and resources to ensure the successful delivery of projects.

Degree Requirements

The Master of Computer Science program spans two years and awards students with a Master of Science in Computer Science upon successful completion. In the first year, students focus on core courses. In the second year, they have the option to choose electives and engage in either a project or thesis during the last two terms.

Program structure:

The Master of Computer Engineering curriculum is a two-year program designed to grant students the Master of Science in Computer Engineering upon the successful completion of the requirements. In the first year; the students study the required core courses, then in the second year students are allowed to determine which electives they prefer along with writing project or thesis distributed in the last two terms of the program.

A) Project Track :

5 Required Courses	15 credit hours
8 Elective Courses	24 credit hours
Project (MSC 598)	3 credit hours
Total	**42 credit hours**

Curriculum Study Plan Table

Semester	Course Code	Course Title	Credit Hours
Semester 1	MSC 501	Advanced Design and Analysis of Algorithms	3
	MSC 502	Software Engineering	3
	MSC 503	Database Systems	3
	MSC 504	Computer Networks and Security	3
	Total		**12**
Semester 2	MCS 514	Research Methodology	3
		Elective course 1	3
		Elective course 2	3
		Elective course 3	3
	Total		**12**
Semester 3		Elective course 4	3
		Elective course 5	3
		Elective course 6	3
	CEN 598	Project	3
	Total		**12**
Semester 4		Elective course 7	3
		Elective course 8	3
	Total		**6**
Total			**42**

B) Thesis Track :

5 Required Courses	15 credit hours

5 Elective Courses	15 credit hours
Research Thesis (MCS 600 A, B, C and D)	12 credit hours
Total	**42 credit hours**

Curriculum Study Plan Table

Semester	Course Code	Course Title	Credit Hours
Semester 1	MSC 501	Advanced Design and Analysis of Algorithms	3
	MSC 502	Software Engineering	3
	MSC 503	Database Systems	3
	MSC 504	Computer Networks and Security	3
	Total		**12**
Semester 2	MCS 514	Research Methodology	3
		Elective course 1	3
		Elective course 2	3
		Elective course 3	3
	Total		**12**
Semester 3		Elective course 4	3
		Elective course 5	3
	MCS 600	Research Thesis (A, B)	6
	Total		**12**
Semester 4	MCS 600	Research Thesis (C, D)	6
	Total		**6**
Total			**42**

Tracks Elective Courses:

1. Artificial Intelligence and Machine Learning

Course Code	Course Title	Credit Hours
MSC 520	Artificial Intelligence	3
MSC 522	Web Database and Information Retrieval	3
MSC 526	Data Warehouse and Mining Systems	3
MSC 534	Expert Systems and Knowledge Engineering Applications	3
MSC 536	Selected Topics in Artificial Intelligence	3

2. Computer Systems and Databases

Course Code	Course Title	Credit Hours
MSC 522	Web Database and Information Retrieval	3
MSC 523	Advanced computer Graphics	3
MSC 526	Data Warehouse and Mining Systems	3
MSC 530	High-Performance Computation	3
MSC 533	Selected Topics in Databases	3
MSC 538	Designing Software Systems	3
CEN 570	Simulation and Modelling	3
CEN 580	Programmable System-on-Chip	3

3. Computer Networks and Security

Course Code	Course Title	Credit Hours
MSC 521	Computer Security	3
MSC 530	High-Performance Computation	3

MSC 531	Distributed Systems	3
MSC 532	Interconnection Network	3
MSC 538	Designing Software Systems	3
MSC 541	Selected Topics in Cybersecurity	3

4. **Software Engineering**

Course Code	Course Title	Credit Hours
MSC 524	Graphical User Interface	3
MSC 525	Software Project Management	3
MSC 535	Software Quality Management	3
MSC 537	Selected Topics in Software Engineering	3
MSC 538	Designing Software Systems	3
MSC 540	Database System Implementation	3
CEN 570	Simulation and Modelling	3

Course Descriptions

A) Required Core Courses:

MCS 501 Advanced Design and Analysis of Algorithms (3 Credits)

The course provides a comprehensive review of fundamental data structures and essential design techniques. The course explores key methodologies such as Divide and Conquer, Greedy Method, Backtracking, and Dynamic Programming. Additionally, it covers advanced topics including Parallel Algorithms, Analysis of Algorithms, Orders of Magnitude, Lower Bound Theory, Time and Space Complexity, NP-hard and NP-complete problems, along with practical applications and examples. The course also addresses the correctness of algorithms and explores the structural aspects of algorithm development.

MCS 502 Software Engineering (3 Credits)

The course emphasizes the knowledge needed to be able to model, design, implement and evaluate larger software systems effectively. Software engineering is an inherently practical subject and applying the concepts being taught is a vital component of developing expertise in this area. The course aims to enable you to achieve the following: develop a deep understanding of the nature and impact of current challenges faced by the IT industry, Develop an awareness of the methodologies and technologies that are available within computer science to address these challenges, by evaluating and analyzing specific situations, and convey knowledge and develop practical skills in the use of some of these technologies, including both fundamental concepts and state-of-the-art support tools.

MCS 503 Database Systems (3 Credits)

To explain the concepts of Database systems, DBMS functions; database architecture and data independence, the different issues involved in the design and implementation of a database system, Data modeling, relational, hierarchical, manipulation and control languages to design and manage the database. Also, this course aims to explain the Database query languages: Overview of database languages; SQL; query optimization; 4th-generation environments; embedding non-procedural queries in a procedural language; introduction to Object Query Language and to design and build a simple database system and demonstrate competence with the fundamental tasks involved with modelling, designing, and implementing a DBMS, Relational databases, the essential DBMS concepts and relational database design.

MCS 504 Computer Network and Security (3 Credits)

To provide comprehensive knowledge of the concepts of hardware and networking, expose the students to the various networking components and their organization, provide the in-depth knowledge of the principles of routing and semantics and syntax of IP, an overview of the design and implementation aspects of networks, familiarize the student with current topics such as security, network management, sensor networks, and/or other topics, this course unit aims also to develop skills needed to go out and setup secured networks in small and medium sized organizations.

MCS 514 Research Methodology (3 Credits)

This course aims to pay attention to all dimensions of research including, literature survey, design and implementation, findings and results, conclusion and research methodology. The course will enable the researchers to develop the most appropriate methodology for their research studies. The mission of the course is to impart research skills to the postgrads and help them improve the quality of their research by the existing researchers. The course also focuses on foundations of research such as objectives, motivation, and concept of theory, deductive and inductive theories. Characteristics of the scientific method, understanding the language of research, research process, problem identification and formulation, research question, research design such as concept and importance in research and features of a good research design.

Prerequisite: Senior standing

MCS 599 Project (3 Credits)

A dissertation project that is accomplished via the formal, academic, and scientific approach under the supervision of an academic advisor.

Prerequisite: MSC 514

MCS 600 Research Thesis (12 Credits)

A dissertation thesis is accomplished via the formal, academic, and scientific approach under the supervision of an academic advisor.

Prerequisite: MSC 514

B) Elective Courses:

MCS 520 Artificial Intelligence (3 Credits)

This course's focus is on the application of advanced techniques to address challenges in artificial intelligence. The course covers various aspects, including knowledge representation, evolutionary algorithms, supervised learning, learning by analogy, learning by discovery, self-reference, and self-production. It also explores reasoning, encompassing causal reasoning, common-sense reasoning, Bayesian networks, logical agents, approaches to reasoning with uncertainty, confirmation theory, belief theory, necessity and possibility theory, and the theory of endorsements. The course further explores spatial and temporal reasoning in the context of artificial intelligence problem-solving.

Prerequisite: MSC 501

MCS 521 Computer Security (3 Credits)

The course addresses a range of critical topics related to the security of computer systems. It delves into the realm of threats and vulnerabilities, emphasizing the importance of identification and authentication. The course covers access control mechanisms, strategies for intrusion detection, and the vital aspects of encryption and privacy within the realm of computer security. Furthermore, it explores the formulation and evaluation of security policies, providing a comprehensive understanding of the principles and practices essential for safeguarding computing environments.

Prerequisite: MSC 504

MCS 522 Web Databases and Information Retrieval (3 Credits)

This course commences with an examination of modeling principles, followed by a detailed study of query operations and the practical use of markup languages. The course extensively covers XML technologies and their applications, offering insights into effective web searching strategies. Additionally, it addresses Information Retrieval (IR) models and languages, focusing on indexing and searching techniques. A significant aspect involves the exploration of digital libraries. The course concludes with a hands-on project, where students actively engage in designing and developing components for Information Retrieval Systems.

Prerequisite: MSC 503

MCS 523 Advanced Computer Graphics (3 Credits)

Explores a comprehensive range of topics in the realm of computer graphics. The curriculum begins with a focus on the mathematics underpinning computer graphics in three dimensions. It then progresses to hierarchical representation and fundamental shapes, surfaces, and curves in three dimensions. The course extensively covers three-dimensional modeling, including solid body modeling and three-dimensional viewing. It addresses crucial aspects such as visible surface determination, illumination, shades, and texture mapping. Additionally, the curriculum delves into the practical application of Computer Graphics Systems, particularly Open GL. The course also encompasses animation techniques and concludes with a case study providing real-world application scenarios.

Prerequisite: Advisor Consent

MCS 524 Graphical User Interface (3 Credits)

This course aims to introduce the foundations of human computer interaction, examine and teach structured approaches to the design of human computer interaction and how it fits into overall system development, show how concepts from different disciplines are applied to the design of interactive SW systems, implement the techniques and skills to develop usable interactive SW systems, to be aware of the different interaction styles that can be used in the design of interactive software systems, to enable students to make sound judgments about the design of the user interface and its usability based on usability attributes and evaluation.

Prerequisite: MSC 502

MCS 525 Software Project Management (3 Credits)

In this course, students are introduced to fundamental principles of project management in the context of software development. The curriculum covers essential activities inherent in software project management, emphasizing the utilization of charts for effective project oversight. It explores the evaluation and acceptance criteria for different project phases, including advanced techniques relevant to project maintenance. The course delves into project scheduling, insurance, and arbitrage strategies. Practical aspects involve the use of project management tools. The learning experience is enriched through a comprehensive case study that provides real-world insights into the application of software project management principles.

Prerequisite: MSC 502

MCS 526 Data Warehouse and Mining Systems (3 Credits)

This course provides a comprehensive exploration of Decision Support Systems (DSS). It begins with an introduction to DSS and traces the development process. The curriculum covers data modeling techniques and the creation of a Data Warehouse within an architectural environment. A thorough examination of various Data Warehouse architectures and development techniques is included, along with a focus on user interfaces tailored for Data Warehouses. The course delves into the field of Data Mining, exploring its applications across different domains. As a practical component, students engage in a project involving the development of a prototypical Data Warehouse/Mining System, enhancing their hands-on experience in the subject matter.

Prerequisite: MSC 502, MSC 503

MCS 528 Selected Topics in Computer Science (3 Credits)
Students explore emerging trends and methodologies within the field of computer science. The course explores new developments and trends, offering insights into the methodologies of their application. It also encompasses an exploration of current research topics, providing students with a comprehensive understanding of the evolving landscape of computer science.

Prerequisite: Advisor Consent

MCS 530 High-Performance Computations (3 Credits)
This course undertakes a thorough examination of significant factors contributing to performance degradation in scientific computing. The curriculum begins with a comprehensive review of these factors. It delves into the intricacies of the scheduling problem, including its classification and potential solutions. The course explores task scheduling and load-balancing algorithms to optimize computational efficiency. Additionally, it addresses the specific challenges of real-time systems, focusing on deadline scheduling to meet critical time constraints.

MCS 531 Distributed Systems (3 Credits)
This course covers the foundational principles of operating systems, exploring key concepts in distributed systems. Topics include the architecture of distributed systems, control mechanisms (centralized vs. distributed), transparency forms, naming schemes, inter-process communication, resource allocation, load-sharing implications, load balancing, process migration, clock synchronization, and concurrency control in distributed environments.

Prerequisite: MSC 504

MCS 532 Interconnection Networks (3 Credits)
This course explores networking, covering LAN/WAN, token ring management, ISO model, and network standards. The course includes urban/large bandwidth networks, gate management, network programming, error detection, and security/privacy. It adopts a graph-theoretical approach, classifying networks like Mesh, Binary Tree, Hypercube, and more. Students examine computational speedup, factors limiting speedup, and laws such as Grosch's and Amdahl's, addressing the need for higher-performance computers.

Prerequisite: MSC 504

MCS 533 Selected Topics in Database Systems (3 Credits)
Students explore contemporary issues and recent research directions within the field of database systems.\

Prerequisite: Advisor Consent

MCS 534 Expert Systems and Knowledge Eng. Applications (3 Credits)
Introduces students to expert systems and knowledge representation paradigms, with an emphasis on rule-based systems. The curriculum covers inference rules, resolution, and basic aspects of reasoning under uncertainty. Case studies, including MYCIN and CLIPS, are explored, along with application modeling in CLIPS.

Prerequisite: MSC 520

MCS 535 Software Quality Management (3 Credits)
An introduction to Quality Management Systems and Total Quality. The course explores the ISO Quality System and its application to the software industry. Students delve into the Capability Maturity Model (CMM) and its five levels, along with the Tick IT system. The curriculum covers Quality Assurance, the practical application of Quality Systems, and the utilization of software tools for quality. The course concludes with a case study to reinforce the concepts learned.

Prerequisite: MSC 502

MCS 536 Selected Topics in Artificial Intelligence (3 Credits)
Explores contemporary and research-oriented aspects of Artificial Intelligence. The course explores the methodology of applying AI concepts to real-world scenarios and addresses current research topics within the field.

Prerequisite: Advisor Consent

MCS 537 Selected Topics in Software Engineering (3 Credits)
Explores emerging trends in software engineering. The course explores the methodology of applying these trends in practical applications and addresses current research topics within the field.

Prerequisite: Advisor Consent

MCS 538 Designing Software Systems (3 Credits)
Reviews established methodologies and principles of Object Engineering. The curriculum emphasizes the Unified Modeling Language (UML) and includes a comparative study of available methodologies. The course covers the conversion methodology to object design, evaluation of object design using metrics, and practical applications of object methodology. The learning experience is enriched through a comprehensive case study illustrating the principles discussed.

Prerequisite: MSC 502

MCS 539 Neural Network and Machine Learning Applications (3 Credits)
Covers diverse machine learning approaches, including explanation-based learning, observation-based learning, and case-based learning. The course explores learning models, algorithm evaluation, and practical methodologies. It includes reinforced learning, genetic algorithms, and neural computations with examples and applications. The curriculum delves into the history and fundamental concepts of artificial neural systems and discusses applications, including simulations and emerging uses of neural algorithms.

Prerequisite: MSC 520

MCS 540 Database System Implementation (3 Credits)
In this course we will study four major topics relating to database system implementation. The emphasis is on the systems components of a database management system. To better understand these components, a database implementation project will be required where you will build some of the basic ``system'' components for a simple database management system. We start with a brief overview of the basic components of a database system and discuss a set of open issues in designing and implementing a database management system, including relational DBMS and NoSQL database system before we detail the four core system components: Storage, Query Processing, Transaction Management and Distributed Data Management.

Prerequisite: MSC 503

MCS 541 Selected Topics in Cybersecurity (3 Credits)
This course explores advanced technological techniques and tools in cybersecurity. Students will use these technologies and skills to identify different categories of threats and implement corresponding countermeasures. Students will build knowledge of the tools needed to perform, encryption and authentication of data, operating system and application security, malware operation and analysis, reverse engineering, security design principles, techniques for reducing complexity, and formal security models.

Prerequisite: MSC 504