COVENANT UNIVERSITY

COLLEGE OF SCIENCE AND TECHNOLOGY

Computer Science

M.Sc, M.Phil/Ph.D and Ph.D

NUC

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1.0 PREAMBLE

The Department started in 2002 when the University commenced. Postgraduate programme started in 2003 with two students. There were five postgraduate teachers at commencement of the programme. The Department has graduated 18 Ph.D students and over 100 Masters students to date.

NUC resource verification and accreditation exercise undertaken by NUC at different times were successful. The Computer Science programme at both M.Sc and Ph.D are fully accredited.

The Department is blessed with strong and functional postgraduate departmental committee members consisting of 8 Professors and 6 Senior lecturers.

1.1 VISION OF THE PROGRAMME

The programme is committed to becoming internationally recognized for research at the intersections of knowledge domains within computer science and between computer science and other disciplines, especially where such research can empower the human potential in service to science and society. We will reinforce, extend and diversify our strengths in interdisciplinary innovation and collaboration while striving to become recognized for addressing critical, scientifically important problems.We are comitted to creating a graduate research environment and culture that fosters excellence and diversity, and inspires a generation of computer scientist externally visible to the college, university, and international computing communities. Our postgraduate programme at masters and doctoral levels will be competitive for faculty appointments at peer or better departments or equivalent industry positions. We will achieve and sustain a level of M.Sc and Ph.D production competitive with peer departments and meeting college benchmarks.

1.2 MISSION OF THE PROGRAMME

The programme mission is to provide students and faculty with an open environment that fosters professional and personal growth. We will prepare our students for successful careers in the computing professions through flexible programmes of study that can be adapted to support individual career goals.We will also create and disseminate knowledge through research and education in the theory and application of computing, to better the state and nation, and to equip our students to succeed and contribute to the society.

1.3 PHILOSOHPY OF THE PROGRAMME

The Philosophy of the programme is to nurture graduates and post graduates students, by leveraging on sound foundational training and skills in the Computer and Information Sciences in order to become globally relevant in the industrial and academic domains, for emergence as future leaders. The programme is committed to producing highly creative and innovative post graduates that are competent enough to be self-employed in the field of Computer Science, Bioinformatics and Computational Biology, Management Information System and its allied disciplines, or in the least be immediately employable.

1.4 POSTGRADUATE PROGRAMMES AVAILABLE

The Department of Computer and Information Sciences offers two postgraduate degree programmes in Computer Science namely:

a. Master of Science (M.Sc) in Computer Science with options in:
   - Software Engineering
   - Artificial Intelligence, and
   - Bioinformatics.

b. Doctor of Philosophy (Ph.D) in Computer Science with options in:
   - Software Engineering
   - Artificial Intelligence, and
   - Bioinformatics.

1.5 AIM OF THE PROGRAMMES

The aim of the programme in the Department of Computer and Information Sciences is to produce computer scientists and information systems analysts whose professional and intellectual capabilities meet the ever-changing challenges of theInformation and Communications Technology (ICT) industry in terms of practice, teaching and research.

1.6 OBJECTIVES OF THE POSTGRADUATE PROGRAMMES

Specifically, the objectives of the postgraduate programmes are as follows:

i. To develop post graduates with skills and knowledge needed to meet the requirements of a rapidly advancing and challenging field of Information and Communications Technology (ICT).
ii. To produce post graduates with IT skills and prepare them for the industry and global competitiveness.
iii. To produce highly creative and innovative graduates and post graduates that are competent enough to be self employed in the field of Information Technology and its allied disciplines, or in the least be immediately employable.
iv. To develop human capital with emphasis on creating a knowledge-based society.
v. To develop manpower to pursue careers in a wide range of professions including software development, web design, and system administration, project management, and computational sciences, that would foster the attainment of the Vision 20:2020 and the Millennium Development Goals.
vi. To provide a broad and balanced foundation in Computer Science knowledge and practical skills.
viii. To provide students with knowledge and skills base for further studies in computer science or multi-disciplinary studies involving computer science.

Table 1: LIST OF ACADEMIC STAFF INVOLVED IN TEACHING ANDSUPERVISION OF POSTGRADUATE IN THE DEPARTMENT

S/N	NAME	ACADEMIC QUALIFICATION	PROFESSIONAL QUALIFICATION	DESIGNATION	AREA OF SPECIALISATION
1.	Prof. V. C. Osamor	B.Sc, PGD, M.Sc, Ph.D	ASBCB, MTA, MNCS, MCPN	Professor/ HOD	Computer Science/ Bioinformatics
2.	Prof. C. K. Ayo	B.Sc, M.Sc, Ph.D	MNCS, MCPN,MCP,CCNA	Professor	Computer Science/ MIS
3.	Prof. E. F. Adebiyi	B.Sc, M.Sc, Ph.D	MNCS, MCPN, ASBCB, ISCB, NISEB	Professor	Computer Science/ Bioinformatics
4.	Prof. N. A. Omoregbe	B.Sc, M.Sc, Ph.D	MNCS, MIEEE	Professor	Computer Science
5.	Prof. A. A. Adebiyi	B.Sc, MBA, M.Sc, Ph.D	MNCS, MCPN	Professor	MIS
6.	Prof. A. A. Azeta	B.Sc, M.Sc, Ph.D	MNCS, MCPN	Professor	Computer Science
7.	Dr. (Mrs.) O. O. Oladipupo	B.Sc, M.Sc, Ph.D	MNCS, MCPN	Associate Professor	Computer Science
8.	Dr. O. J. Oyelade	B.Sc, M.Sc, Ph.D	ASBCB, MNCS, MCPN	Associate Professor	Computer Science/ Bioinformatics
9.	Dr. Z. O. Omogbadegun	B.Sc, M.Sc, Ph.D	MNCS, MCPN, MIEEE, MGHWA	Senior Lecturer	Computer Science
14	Dr. I. A. Odun-Ayo	B.Sc, M.Sc, Ph.D		Senior Lecturer	Computer Science
10	Dr. Mrs. M.O. Adebiyi	B.Sc, MSc, Ph.D	ISCB, ASBCB, IEEE, MNCS	Senior Lecturer	Computerscience/ Bioinformatics
11.	Dr. I. T. Afolabi	B.Sc, M.Sc, Ph.D	MNCS, MCPN	Senior Lecturer	Computer Science
12.	Dr. A. A. Oni	B.Sc, M.Sc, Ph.D		Senior Lecturer	MIS
15	Dr. S. R. Okuboyejo	B.Sc, M.Sc, Ph.D		Lecturer I	MIS
16	Dr O. Iheanatu	B.Eng, M.Sc. Ph.D		Lecturer II	MIS
16	Dr. O. Emebo	B.Sc,M.Sc, Ph.D		Lecturer II	Computer Science
17	Dr. A. O. Adewumi	B.Sc. M.Sc, Ph.D		Lecturer II	Computer Science
18	Dr I. Isewon	B.Sc. M.Sc, Ph.D		Lecturer II	Computer Science/Bioinformatics

VISITING LECTURERS					
1.	Dr. P. A. Adewole	B.Sc, M.Sc, Ph.D		Associate Professor	Computer Science
ADJUNCT LECTURERS					
1.	Prof. Chinonye Moses	B.Sc, M.Sc, Ph.D		Professor	EDS
2.	Dr. Tuesday Owoeye	B.A, M.A, Ph.D		Senior Lecturer	TMC

2.0 ACADEMIC CONTENT

2.1 ADMISSION REQUIREMENTS

a. Master of Science (M.Sc) Computer Science

Admission Criteria

i. Admission is open to candidates with a good first degree in Computer Science (B.Sc Computer Science) with a minimum of Second Class Lower Division from Covenant University, or any other university recognized by the senate of Covenant University.

ii. Candidates with third class degree will be deemed eligible if such candidates have obtained a PGD in Computer Science from a recognized university.

iii. Candidates with at least a lower credit in Higher National Diploma (HND) and University PGD with a minimum CGPA of 3.50 may be considered for admission.

iv. In addition to the above qualification requirements, candidates shall be required to participate in a postgraduate screening exercise to qualify for admission.

b. M.Phil/Ph.D Computer Science

Admission Criteria

i. Admission is open to applicants who possess a Master of Science degree (M.Sc)in Computer Science or its equivalent with CGPA of 3.5 - 3.99 from Covenant University or any other recognized university.

ii. A candidate that has demonstrated sufficient academic promise may be considered for change of registration status from M.Phil to Ph.D after the successful completion of two semesters in the M.Phil. programme and having presented at least three seminars (including a proposal defense), in demonstration of that competence, subject to approval by the Faculty/Board of Postgraduate Studies and Senate. Such a candidate must have obtained a minimum CGPA of 4.0 after the two semesters of coursework.

iii. In addition to the above qualification requirements, candidates shall be required to participate in a postgraduate screening exercise to qualify for admission.

c. Ph.D Computer Science by Coursework and Research

Admission Criteria

i. A candidate with academic Master's degree (M.Sc) in Computer Science, with a cumulative Grade point Average (CGPA) of not less than 4.0 on 5 point scale or weighted average of 60% from a recognized university shall be eligible for admission into the Ph.D Computer Science programme.

ii. In addition to the above qualification requirements, candidates shall be required to participate in a postgraduate screening exercise to qualify for admission.

2.2 DURATION OF PROGRAMME

i. Master of Science (M.Sc) Computer Science

Full-time M.Sc Computer Science degree programme shall last for a minimum of four (4) semesters.

ii. M.Phil/PhD Computer Science

Full-time M.Phil/Ph.D Computer Scienceprogramme shall last for a minimum of eight (8) semesters. Two (2) semesters of coursework and six (6) semesters of research.

iii. Ph.D Computer Science by Coursework and Research

Full-time Ph.D Computer Science degree programme shall last for minimum of six (6) semesters. One (1) semester of coursework and five (5) semesters of research.

2.3 GRADUATION REQUIREMENTS

i. Master of Science (M.Sc) Computer Science

A candidate will be required to complete satisfactory a minimum of 47 prescribed course units, submit and defend orally, a dissertation of original research work on a previously approved topic for internal and external examination.

ii. M.Phil/PhD Computer Science

A candidate will be required to complete satisfactorily a minimum of **56** course units. A candidate, on successful completion of prescribed courses and defense of a research proposal may be recommended to proceed into the Ph.D programme. To be eligible for conversion into the Ph.D programme, the M.Phil Candidate must have passed all the stipulated courses with a minimum CGPA of 4.0 and successfully carried out the M.Phil./Ph.D Proposal defence.

iii. Ph.D Computer Science by Coursework and Research

The performance of the candidate shall be a combination of performance at coursework, seminars as well as quality of written thesis as well as performance at oral examination. The thesis of original research work on previously approved topic shall be assessed at both internal and external examination and defense. The minimum credit unit for the award of a Ph.D in Computer Science is **38**.

Table 2: Showing Graduation Requirements

Level	Core Courses	University Courses	Elective Courses	Ph.D Proposal/Post Field	Dissertation /Thesis	Total
M.Sc	33	2	6		6	47
M.Phil/Ph.D	33	2	3	6	12	56
Ph.D	15	2	3	6	12	38

2.4 COURSE STRUCTURE

Table 3: M.Sc Programme Year 1 by Semesters.

M.Sc I (Computer Science) (1st Year)											
	ALPHA SEMESTER					OMEGA SEMESTER					
	Course Code	Course Title	Status	Units	Pre-Requisite	Course Code	Course Title	Status	Units	Pre-Requisite	
Compulsory Courses	CSC811	Advanced Operating Systems	C	3		CSC821	Advanced Computer Architecture	C	3		
	CSC812	Advanced Computer Algorithms	C	3		CSC822	Advanced Programming Languages	C	3		
	CSC813	Advanced Software	C	3		CSC823	Advanced Internet	C	3		

		Engineering					Technology				
	CSC814	Advanced Artificial Intelligence	C	3		CSC824	Advanced Computer Communication & Network	C	3		
	CSC815	ICT and Research Methodology	C	3		CSC825	Database Management System	C	3		
						CSC857	M.Sc Seminar	C	3		
	Sub Total			15		*Sub Total*			18		33
University Courses	EDS811	Entrepreneurial Development Studies	U	1							
	TMC811	Total Man Concept	U	1							
	Sub Total			2							2
	Total			17		Total			18		35
Electives: One elective in the area of specialisation	*Software Engineering Option (Option 1) Select (3 Units) from Electives*					*Software Engineering Option (Option 4) Select (3 Units) from Electives*					
	CSC816	Requirements Engineering	E	3		CSC826	Software Testing & Quality Assurance	E	3		
	CSC817	Software Architecture and Design	E	3		CSC827	Mobile and Adaptive Systems	E	3		
	Sub Total			3		*Sub Total*			3		6
	Total			20		*Total*			21		41
Electives: One elective in the area of specialisation	*Artificial Intelligence Option (Option 2) Select (3 Units) from Electives*					*Artificial Intelligence Option (Option 5) Select (3 Units) from Electives*					
	CC818	Advanced Expert Systems	E	3		CC828	Natural Language Processing	E	3		
	CC819	Machine Learning	E	3		CC829	Artificial Neural Networks	E	3		
	Sub Total			3		*Sub Total*			3		6
	Total			20		*Total*			21		41
	Bioinformatics Option (Option 3) Select (3 Units) from Electives					*Bioinformatics Option (Option 6) Select (3 Units) from Electives*					
Electives: One elective in the area of specialisation	CC831	Bioinformatics I	E	3		CC841	Bioinformatics II	E	3		
	CC832	Introduction to Computation	E	3		CC829	Artificial Neural Networks	E	3		
	Sub Total			3		*Sub Total*			3		6
	Total			**20**		***Total***			**21**		**41**

NB:
***C – Compulsory Courses**
***E – Elective Courses**
***CC – Course Code**
***Area of specialisation here captures three(3) different areas**

Table 4: M.Sc Year 2 by Semesters

	ALPHA SEMESTER					OMEGA SEMESTER					
Compulsory Courses	Course Code	Course Title	Status	Units	Pre-Requisite	Course Code	Course Title	Status	Units	Pre-Requisite	
	CSC859	Research/Project Dissertation Begins				CC859	Research/Project Dissertation Continues	C	6		
		TOTAL					**TOTAL**		6		**6**
										TOTAL	**47**

Table 5a. M.Phil (Direct) Year 1 by Semesters.

M.Phil Year 1											
	ALPHA SEMESTER					OMEGA SEMESTER					
	Course Code	Course Title	Status	Units	Pre-Requisite	Course Code	Course Title	Status	Units	Pre-Requisite	
Compulsory Courses	CSC911	Advanced Operating Systems	C	3		CSC941	Cluster & Grid Computing	C	3		
	CSC912	Advanced Computer Algorithms	C	3		CSC944	Engineering of Intelligent Software Systems	C	3		
	CSC913	Advanced Software Engineering	C	3		CSC921	Advanced Database Management System	C	3		
	CSC914	Advanced Artificial Intelligence	C	3		CSC946	Data Mining and Warehousing	C	3		
	CSC915	ICT and Research Methodology	C	3		CSC947	Seminar 1- Current Topics in Computing	C	3		
						CSC948	Seminar 2- Technical Report Writing	C	3		
	Sub Total			**15**		**Sub Total**			**18**		**33**
University Courses	EDS911	Entrepreneurial Development Studies IX	U	1							
	TMC911	Total Man Concept	U	1							
	Sub Total			**2**							
	Total			**17**					**18**		**35**
	Software Engineering Option (Option 1) *Select (3 Units) from Electives*					*Software Engineering Option (Option 1)* *Select (3 Units) from Electives*					
Elective Course	CSC916	Requirements Engineering	E	3							
	CSC917	Software Architecture and Design	E	3							
	Sub Total			3		**Sub Total**					**3**
	Total			**20**		***Total***			**18**		**38**
	Artificial Intelligence Option (Option 2) *Select (3 Units) from Electives*					*Artificial Intelligence Option (Option 2)* *Select (3 Units) from Electives*					
	CSC916	Advanced Expert Systems	E	3							
	CSC916	Machine Learning	E	3							
	Sub Total			3							**3**
	Total			**20**					**18**		**38**
	Bioinformatics Option (Option 3) *Select (3 Units) from Electives*					*Bioinformatics Option (Option 3)* *Select (3 Units) from Electives*					
	CSC931	Bioinformatics I	E	3							
	CSC932	Introduction to Computation	E	3							
	Sub Total			3							**3**
	Total			**20**					18		**38**

Table 5b. M.Phil /PhD (Direct) Year 2.

M.Phil/Ph.D											
	ALPHA SEMESTER					OMEGA SEMESTER					
Compulsory Courses	Course Code	Course Title	Status	Units	Pre-Requisite	Course Code	Course Title	Status	Units	Pre-Requisite	
	CSC950	College Ph.D Proposal Defence	C	3							
		TOTAL					**TOTAL**		3		**3**
										TOTAL	**41**

Table 5c. M.Phil /PhD (Direct) Year 3.

M.Phil/Ph.D											
	ALPHA SEMESTER					OMEGA SEMESTER					
Compulsory Courses	Course Code	Course Title	Status	Units	Pre-Requisite	Course Code	Course Title	Status	Units	Pre-Requisite	
						CC953	College Ph.D Post Field Defence I	C	3		
		TOTAL					**TOTAL**		3		**3**
										TOTAL	**44**

Table 5d. M.Phil /PhD (Direct) Year 4.

M.Phil/Ph.D											
	ALPHA SEMESTER					OMEGA SEMESTER					
Compulsory Courses	Course Code	Course Title	Status	Units	Pre-Requisite	Course Code	Course Title	Status	Units	Pre-Requisite	
						CSC956	Thesis write-up (Ph.D Final Oral Defense) VIVA	C	12		
		TOTAL					**TOTAL**		12		**12**
										TOTAL	**56**

Table 6a: Ph.D Year 1 by Semesters.

PhD Year 1											
	ALPHA SEMESTER					OMEGA SEMESTER					
Compulsory Courses	Course Code	Course Title	Status	Units	Pre-Requisite	Course Code	Course Title	Status	Units	Pre-Requisite	
	CSC941	Cluster & Grid Computing	C	3		CSC950	College Ph.D Proposal Defence	C	3		
	CSC945	ICT and Research Methodology	C	3							
	CSC946	Data Mining and Warehousing	C	3							
	CSC947	Seminar 1- Current Topics in Computing	C	3							
	CSC948	Seminar 2- Technical Report Writing	C	3							
	Sub Total			**15**		**Sub Total**			**3**		**18**
	EDS911	Entrepreneurial Development	U	1							

University Courses		Studies IX									
	TMC911	Total Man Concept	U	1							
	Sub Total			**2**							
	Total			**20**							**20**
	Software Engineering Option (Option 1) Select (3 Units) from Electives					*Software Engineering Option (Option 1) Select (3 Units) from Electives*					
Elective Course	CSC916	Engineering of Intelligent Software Systems	C	3							
	Sub Total			3		**Sub Total**					**3**
	Total			**23**		***Total***					**23**
	Bioinformatics Option (Option 3) Select (3 Units) from Electives					*Bioinformatics Option (Option 3) Select (3 Units) from Electives*					
	CSC943	Computational Molecular BiologyI	C	3							
	Sub Total			3							**3**
	Total			**23**							**23**

Table 6b. PhD (Direct) Year 2.

Ph.D											
	ALPHA SEMESTER					OMEGA SEMESTER					
Compulsory Courses	Course Code	Course Title	Status	Units	Pre-Requisite	Course Code	Course Title	Status	Units	Pre-Requisite	
	CSC951	College Ph.D Post Field	C	3							
		TOTAL		3			**TOTAL**		3		**3**
										TOTAL	**26**

Table 6c. PhD (Direct) Year 3.

M.Phil/Ph.D											
	ALPHA SEMESTER					OMEGA SEMESTER					
Compulsory Courses	Course Code	Course Title	Status	Units	Pre-Requisite	Course Code	Course Title	Status	Units	Pre-Requisite	
						CSC956	Thesis write-up (Ph.D Final Oral Defense) VIVA	C	12		
		TOTAL					**TOTAL**		12		**12**
										TOTAL	**38**

2.5 COURSE DESCRIPTION (M.Sc & M.Phil/Ph.D and Ph.D)

CSC811/CSC911: Advanced Operating Systems (3 Units)
Structural design aspects of operating system: process model, inter-protocol communication, synchronization mechanisms, resources management, and scheduling. Protection issues. Implementation issues of modern operating systems. Distributed operating systems. Deadlock detection, recovery, and avoidance, Case studies, Project(s).

CSC812/CSC912: Advanced Computer Algorithms(3 units)
Review of data structures; linear data structures, hashing, tress, graphs, recursion. Complexity classes; empirical measurements of performance; time and space tradeoffs analysis. Algorithmic strategies: brute-force algorithms; greedy algorithms; divide-and-conquer; backtracking, branch-and –bound; minimum spanning tree, heuristics; pattern matching and string/ text algorithm; numerical approximation algorithms. Tractable and intractable problems.

CSC813/CSC913: Advanced Software Engineering (3 Units)
Software engineering and its place as an engineering discipline. Life cycle of software system: Requirements analysis, development, operation and maintenance. Software metrics: Portability, Re-usability, Correctness, Reliability, Efficiency, Usability, Integrity, Maintainability and Flexibility. Software quality and testing. Software architecture: architecture description languages, pattern-oriented software architecture, component-based development, distributed software architecture using middleware, enterprise application integration, architecture for mobile and pervasive systems and model driven architecture. Advanced modeling: UML extension mechanisms, object constraint language and model checking. Software project management: Study of interpersonal process decision making styles, problem solving concepts and procedure, creative effort, conflict resolution, leadership and assessment. Concepts of motivation, team work and group dynamics. Software engineering and law: intellectual property law, professional ethics and code of conduct. Patents, trademarks , copyright, trade secrets, privacy and confidentiality , contracts and licensing, government regulations, global legal issues including Internet law and cyber crime. Overview of Open Source Software.

CSC814/CSC914: Advanced Artificial Intelligence (3 Units)
Introduction to basic programming techniques of artificial intelligence (AI). Domain analysis; representation of knowledge and strategies; control on interference and search development of interactive intelligence CAI programs; the role of analogical reasoning. The main contents are symbol manipulations and AI problem solving techniques. Searching methods, informed search methods, game playing. Knowledge and Reasoning: Agents that reason logically, first order logic, building a knowledge base, inference in first-order logic, logical reasoning systems. Languages for AI problem solving: PROLOG, LISP. Acting Locally: Planning, practical planning, planning and acting. Uncertain Knowledge And Reasoning: Uncertainty, probabilistic reasoning systems, making simple decisions. Learning: Learning from observations, learning from neural network, reinforcement learning, and knowledge in

learning. Communicating, Perceiving And Acting: Agents that communicate, practical communication in English; perception, robotics.

CSC815/CSC915: ICT and Research Methodology (3 Units)
Overview of research methodologies, sampling techniques, Introduction to informatics research, overview of empirical research methods, technical writing – conducting literature reviews, problem formulation and synthesis, ethics of ICT research.

CSC816/CSC916: Requirements Engineering (3 Units)
The importance of requirements; The role of RE in Software Development Lifecycle; Requirements Elicitation; Requirements modelling – functional requirements, modelling requirements, overview of basic modelling paradigms; problem frames, Data flow diagrams (DFD), use cases, UML Class diagrams, Message sequence Charts (MSC), use case scenarios; Requirements Specification - How to write system requirements; Technical requirements from the perspective of developers; Enumerated Requirements; IEEE Standard for Software Requirements Specification; Requirements validation and verification - Criteria for validating requirements document, Validation Techniques, Verification Techniques; Requirements management - Planning, Monitoring Progress, Controlling Progress; Requirements Review Guidelines - Roles and Responsibilities of participants in the RE review.

CSC817/CSC917: Software Architecture And Design (3 Units)
The Software Architecture process - describing, evaluating, and designing systems at the architectural level. The role of architecture and the architect in the software development cycle. Architectural patterns and tactics, architecture assessment techniques, architecture driven design, and techniques for documenting architectures;Design patterns, Architectural design issues – reliability, performance, availability, scalability, architecture evaluation methods. Case studies of real-world software architectures; Advanced architecture topics - self-adaptation, service-oriented architectures, software-product lines, and product line architectures, domain-specific architectures, and agent-based architectures. Identification of open problems in software architecture.

It will introduce architectural patterns and tactics, architecture assessment techniques, architecture driven design, and techniques for documenting architectures. The course will involve design, development, and assessment activities.

CSC818/CSC918: Advanced Expert Systems (3 Units)

Review of Artificial Intelligence and its place in experts systems. Introduction to expert systems and expert support system. Characteristics of experts systems. Knowledge-based systems. Types of expert systems.

CSC 819/CSC919:Machine Learning (3 Units)
Introduction to soft computing methods – fuzzy logic and fuzzy systems, rough sets, evolutionary algorithms – Genetic Algorithms, Particle Swarm Intelligence, Ant Colony algorithms, Artificial Neural Networks, Bayesian networks, Support Vector Machines, application of soft computing to data mining.

CSC831/CSC931: Bioinformatics I (3 Units)
Basic concepts of molecular biology, importance of bioinformatics, Concept of Gene and Gene Gene Expression, Microarrays, Sequence Technology, Pair-wise sequence alignment (dynamic programming, heuristic methods and similarity matrices), multiple sequence alignment, BLAST, FASTA, Hidden Markov Model (HMM) (Construction,application in alignment and gene prediction), phylogenetic tree, fragment assembly, physical mapping, combinatoric application in sequencing, sequence analysis and annotating, genomic rearrangements, computational gene finding.

CSC832/CSC932: Introduction To Computation (3 Units)
Formal languages, Chomsky hierarchy, formal computation and machine models, finite automata, pushdown automata, Turing machines, Church's Thesis, Recursively enumerable sets. Diagonal arguments. Reducibility, complexity classes.

CSC 821: Advanced Computer Architecture (3 Units)
Advanced computer architecture including discussion of instruction set design (RISC and CISC), virtual memory system design, memory hierarchies, cache memories, pipelining, vector processing, I/O subsystems, co-processors and multiprocessor architectures. Case studies of current systems. Prerequisite: U.G. Computer Architecture

CSC 822: Advanced Programming Languages (3 Units)
Comparative study of the organization and implementation of a variety of programming languages and language features. Design principles are explored and applied in a historical review of major languages. Procedural, functional, logic-based, object-oriented and parallel languages. Research issues such as polymorphism, formal semantics and verification explored in depth.

CSC823: Advanced Internet Technology (3 Units)
Introductory to internet, standards and specifications; survey of contemporary Internet technologies; Current Internet tools; Designing and publishing a web server; WWW programming Markup languages; Using alternative protocols in WWW, Adding multimedia features to WWW; Server side programming, client programming and database programming for web; security and privacy.

CSC824: Advanced Computer Communication and Network (3 Units)
Channels and channel capacity; introduction to information theory, sharing network resources, telecommunication history; circuit switching and packet switching; multiplexing;

FDM, TDM, statistical multiplexing; virtual circuits and datagrams; advantages and disadvantages; sharing the medium: Aloha, CSMA (persistent and non-persistent), CSMA-CD, token passing, CDMA, wireless LANs and simple performance analysis; dealing with errors: errors, coding and redundancy; hamming theory and codes; CRCs, ARQ protocols; CR selective retransmission and flow control; internetworking and internet: ISPs, datagram forwarding; the DNS; IPv4; addressing and forwarding; encapsulation and address resolution; TCP and UDP; ports and congestion controls; example applications,; modeling data networks: services and protocols; layered architectures; OSI 7-layer model; introduction to queue theory; physical media; LAN and bridging; WAN and point-to-point links; routing; addressing and routing in the internet; end-to-end communication in the internet; and application protocols. Cyber space technology: Cyber Crime, Cyber Security and models of Cyber Solution.

CSC825: Database Management Systems (3 Units)

A brief introduction to database concepts: file systems and database, and the relational database model; design concepts and implementation: entity relationship (E-R) modeling; normalization of database tables and structured query language; database design and implementation. Transaction management and concurrency control and distributed database management systems; database privacy, security, failure and recovery. Object-oriented databases; client/server systems; data warehouse; data mining; database in electronic commerce; web database development and database administration.

CSC921: Advanced Database Management Systems (3 Units)

E/R Model, Relational Model and Algebra, SQL, Functional Dependencies and Relational Database Design, Storage and File Systems, Tree and Hash Indexes, Query Processing and Implementation of Relational Operators, Query Optimization, Physical Database Design, Transactions, Concurrency Control Protocols. Introduction to Distributed Databases: Distributed DBMS (DDBMS) evolution, DDBMS components, Distribution transparency, Transaction transparency, Remote request, Remote transaction, Distributed transaction, Distributed request, 2PC protocol. Databases and Web Technologies: Client-server model: PHP, or Java, or ASP.Net. Database development with Microsoft Access, or Microsoft SQL server or Oracle DB.

CSC826: Software Testing And Quality Assurance (3 Units)

Test lifecycle planning, test design & coverage analysis, complexity, levels of testing - unit, integration, system, performance and stress testing. Best practice strategies in software testing such as verification & validation, early lifecycle testing, risk based testing and automation, test automation methods and tools; software quality, software metrics.

CSC827: Mobile And Adaptive Systems (3 Units)

Introduction and overview; properties of wireless; PANs, LANs and WANs: Ad-hoc and infrastructure networks; physical constraints and limitations(transmission and reception), network structures and architectures, including hand-off and mobility support at the physical

/link level; example technologies at the physical/link layers: PANA BLUETOOTH, LANs IEEE802.11, HiperLAN, basic GSM and GPRS network structures and protocol architectures, next generation wireless overview including UMTS, IMT-200 and W-CDMA; mobile IP: mobile IPv4 and mobile IPv6, problem with routing, quality of service and security; overview of use of intelligence in mobile systems and power management issues; file systems: CODA and the like and mobile infrastructure support. Adaptive and re-configurable systems, mobile multimedia and its relationship to proxying, context sensitive applications, ubiquitous computing, pervasive computing and ambient networking, overlay networks and vertical hand-offs, programming networking and applications for mobile systems – Android programming, i-Pad programming - , code mobility and control/signaling.

CSC828: Natural Language Processing (3 Units)
In depth study of a few major areas historically considered to be part of artificial intelligence. In particular, detailed coverage will be given to the design considerations involved in the following applications: automatic theorem proving, natural language understanding and machine learning.

CSC829: Artificial Neural Networks (3 Units)
Definition of artificial neural network. Similarities of neural network with human brain. Classification of ANN. Terms used in ANN: Input/output sets, weights, bias or threshold, supervised learning, network training, Convergence process, single layer vs. multilayer perception, Forward and Backward propagation, gradient descent rule. Back-propagation neural network, Variable term used in back propagation neural network: learning rate, momentum, hidden nodes, sigmoid activation function. Back propagation algorithm of ANN. Design of ANN model, training sets for ANN, test sets for ANN, network testing and performance. Applications of ANN. Programming of ANN, Other ANN models – Radial basis networks, functional link networks, Helman networks, Adaline, Mandaline, Unsupervised learning networks, recurrent networks, Hopfield networks, Boltzmann machine, Self-organizing maps (SOM), Hybrid neural network configurations; Learning in ANN – supervised, unsupervised, reinforcement learning, Hebbian learning.

CSC841: Bioinformatics II (3 Units)
Protein as initial structure prediction, protein homology modeling, protein molecular dynamic, RNA secondary structure prediction, integration of molecular biology data banks, experimentation biology support (sequence, structure prediction, DNA arrays etc), Metabolomics, Virtual Screening and Drug discovery.

CSC857: M.Sc Seminar (3 Units)
Students will participate in departmental seminars and join relevant research clusters. Students' are expected to present two seminars as part of the graduation requirement.

iv. M.Sc II - Omega Semester Courses

CSC859: Research / Dissertation II (6 Units)
A student applies different computer algorithms and methodologies to one of the research oriented real life problems. The student should choose one area of computer applications that is related to his area of specialization. The students will undertake research under the supervision of their supervisors towards the preparation of a Masters dissertation.

CSC941: Cluster and Grid Computing (3 Units)
The Purpose Of The Course Is To Provide Basic Knowledge On The Most Important Principles, Methods, Tools, Systems, Standards, Etc. Behind Cluster And Grid Technologies.
Course Outline:

Introduction To Distributed And High-Performance Computing. Basic Terms: Distributed Computing, Hpc, Hpcc, Network Computing, Internet Computing, Cluster, Grid, Meta-Computing, Middleware, Etc; Milestones Of The History, Some Representative Applications; Classification: Taxonomies, Mpp, Smp, Cc-Numa, Cluster: Dedicated High Performance (Hp), High Availability (Ha), Cops, Pops, Cows; Distributed, On-Demand, High-Throughput, Collaborative, Data-Intensive Computing; Basics Of Communication Media And Protocols: TCP/IP, Internet2, Qos, Atm, Fast Ethernet, Etc.; Programming Models: Message Passing, Client-Server, Peer-To-Peer, Broker Computing, Code Shipping, Proxy Computing, Mobile Agents. Toolkit And Oo Systems; Higher Level Communication: Light-Weight Communication, Sockets, Standard Apis, Active Messages; Storage And File Problems: Network Ram, Raid And Software Raid. Distributed File Systems: Nfs, Afs, Osf-Dsf, Rsf; Message Passing Standards: Pvm (Parallel Virtual Machine), Mpi (Message Passing Interface); Object-Oriented De Facto Standards Corba And Dcom; Java-Based Methods: Jvm, Rmi, Bytecode, Applet And Servlet, Javabean And Javaspaces, Jini; Grid Toolkit Approach: Globus Hourglass Concept, Communication, Resource And Process Management, Data Access, Security; Object-Oriented Approach: Legion Language Support, Component Wrapping, Program Support, Resource Management; Security: Confidentiality, Integrity And Availability. Authentication, Authori-Zation, Assurance, Auditing, Accounting; Scheduling: Algorithms, Policies And Techniques, High Performance And High Throughput Schedulers, Resource Scheduling; Grid Monitoring: Tasks, Types, Architecture, Components.

The course requires a student presentation on a selected topic by each participant. Students are provided by a reading list and copies of slides presented at the lectures in pdf or ps format. The course is aimed at bridging the gap between the distributed and high performance topics in computer science and engineering university education and the current hot research topics and activities of the field.

CSC915: ICTand Research Methodology (3 Units)
Overview of research methodologies, sampling techniques, Introduction to informatics research, overview of empirical research methods, technical writing – conducting literature reviews, problem formulation and synthesis, ethics of ICT research.

CSC946: Data Mining And Warehousing(3 Units)
Data warehouse and OLAP Technology for Data Mining, Data Mining primitives, Languages and System Architecture, Concept Description, Mining association rules in large database

classification and prediction problems, cluster analysis, Mining complex types of data, applications and trends in Data mining, Data mining algorithms: Apriori, hybrid apriori, COFI-tree, FP-tree, P-tree, Inverted matrix, Introduction to mining relation, Text, Sequence, Time-Series, web and Multimedia Data.

CSC947:Seminar 1 - Current Topics In Computing (3 Units)

A review of current work and theories in computing. Emphasis on latest work and theories in Software Engineering, Bioinformatics, Mobile Computing, Networking, Management Information System, Cloud computing, Big data, Internet of things etc. Each student is expected to present a seminar on any chosen topic.

CSC948: Seminar2 - Technical Report Writing (3 Units)

Each student is expected to submit a bound hard copy of the content of the seminar that was presented in CSC947.

CSC944: Engineering of Intelligent Software Systems (3 Units)

i. Introduction

It is becoming even more common that software-based system includes some form of "intelligent" (adaptive, reasoning, etc.) software. In addition, there is a clear tendency that such systems are getting more distributed (cf. Ambient Intelligence, Pervasive Computing, and Ubiquitous Computing). In order to develop the software for this type of systems, a wide knowledge of existing algorithms, methods, and technologies is desired. The idea behind the Intelligent Software Systems program is to provide a set of courses that together satisfy this demand.

ii. Aim

The goal is to give the students a broad view of the area of intelligent software systems including: algorithms, technologies, and methodologies for developing intelligent (distributed) software systems. In addition, the aim is to provide an introduction to research methodology in both theory and practice.

iii. Course Outline

Knowledge Engineering, Ontologies, Semantic Web Services, Applied Artificial Intelligence, Middleware Technologies, Evolutionary Computation, Neural Networks, Machine Learning, Software Agent Systems, Optimisation Techniques, Hybrid Intelligent Systems, Decision Support Systems (Fuzzy Logic and Fuzzy Expert Systems, CBR systems, Recommender Systems), Engineering of Internet Applications, Natural Language Processing & Applications, Human Computer Interaction , Automated Software Engineering, Automatic Verification, Intelligent Security Systems, Safety Critical Systems & Software Reliability, Formal Methods.

CSC943: Computational Molecular Biology (3 Units)

Basic concepts of molecular biology, importance of bioinformatics, pair-wise sequence alignment (Dynamic programming, heuristic methods and similarity matrices), multiple sequence alignment, BLAST, FASTA, Hidden Markov Model (Construction, application in alignment and gene prediction), phylogenetic tree, fragment assembly, physical mapping, combinatoric application in sequencing, sequence analysis and annotating, genomic rearrangements, computational gene finding. RNA secondary structure prediction, protein homology modeling, protein molecular dynamic, protein as initial structure prediction, integration of molecular biology data banks, experimentation biology support (sequence, structure prediction, DNA arrays), etc.