

# BSc (Hons) Computer Science (F/T) - E318

## 1. Aims and Objectives

Computer Science spans a wide range, from its theoretical and algorithmic foundations to cutting-edge developments in robotics, computer vision, intelligent systems, bioinformatics, and other novel areas. The field of Computer Science is, today, evolving at an unprecedented pace and is contributing massively to improve our everyday life.

The aim of this programme is to produce graduates with the required theoretical and algorithmic skills required in industry to develop software in wide variety of areas from systems level to specific application areas ranging from general business applications to specific high-tech areas as listed above. The programme also ensures that the students develop sufficient theoretical and practical abilities to pursue research in Computer Science and related areas.

Graduates from this programme can work in software development and systems administration and can aspire to be team and project leaders. They will have the necessary skills and knowledge to easily adapt to new technologies and emerging software development areas.

The programme is based on the recommendations of Computing Curricula 2005 proposed by a joint task force of the Association for Computing Machinery (ACM), the Association for Information Systems (AIS) and the IEEE Computer Society (IEEE-CS).

## 2. General Entry Requirements

As per General Entry Requirements for admission to the University for Undergraduate Degrees.

## 3. Programme Requirements

At least 2 GCE 'A' Level Passes including:

(i) Mathematics

and

(ii) Computing or a Science subject

## 4. Minimum Requirements for Awards

### (i) Degree Award

<u>MODULES</u>	<u>CREDITS</u>
GEM	6
Humanities & Management	3
Departmental (Including final Year Project)	99
<b>TOTAL</b>	<b>108</b>

For the award of the **BSc (Hons) Computer Science**, the student must obtain at least 108 credits including 84 credits from all the core modules prescribed by the department and at least 24 credits from the departmental elective modules.

### (ii) Diploma Award

<u>MODULES</u>	<u>CREDITS</u>
Humanities & Management	3
Departmental	54
Diploma Project (CSE 2000(3))	6
<b>TOTAL</b>	<b>63</b>

The diploma is provided as a possible exit point in the programme. A student may opt for a Diploma in Computer Science, by making a written request, provided s/he satisfies the minimum

requirements, as specified above. The Diploma project would normally be of 8 weeks duration for an input of at least 90 hours.

## 5. Programme Duration

	Normal (Years)	Maximum (Years)
Degree:	3	5

6. **Credits per Academic Year:** Maximum 48 credits, Minimum 18 credits, subject to section 5.  
**Credits per Semester:** Maximum 24 credits, Minimum 9 credits, subject to section 5.

Semester modules to be registered for on a semester basis.

Yearly modules to be registered for only once, normally at the beginning of academic year.

*Note: For Yearly modules, for the purpose of calculation of minimum and maximum credits, the credits will be considered as half for each semester.*

## 7. Assessment

Each module will be assessed over 100 marks (i.e. expressed as %) with details as follows (unless otherwise specified):

Assessment will be based on written examination and continuous assessment. The written examination will be of 3-hour duration for yearly modules and of 2-hour duration for semester modules.

The continuous assessment will count for 20%-30% of the overall percentage mark of the module(s), except for the following modules:

		Continuous Assessment	Exams
CSE 1041(1)	Web Technologies I	50%	50%
CSE 2041(3)	Web Technologies II	50%	50%

Continuous assessment may be based on laboratory work and/or assignments and **should include at least two (2) assignments/ tests per semester/year per module.**

An overall total of **40%** for combined assessment and written examination components would be required to pass the module, without minimum thresholds within the individual continuous assessment and written examination.

Written examinations for the semester modules will be carried out at the end of the respective semester while for yearly modules they will be carried out at the end of the academic year.

## 8. List of Modules - BSc (Hons) Computer Science

### CORE MODULES

		Hrs/Wk L+P	Credits
<b>Humanities and Management (Including GEMs)</b>			
COMS 1010(1)	Communication Skills	DE	3
GEM			6
<b>Departmental</b>			
CSE 1003(1)	Computer Programming	2+2	3
CSE 1005(1)	Database Systems I	2+2	3
CSE 1041(1)	Web Technologies I	2+2	3
CSE 1131(1)	Mathematics for Computing	3+0	3
CSE 1142(1)	Formal Logic	3+0	3
ELEC 1105(1)	Digital Logic	3+0	3
CSE 1200	Practical Training		0
CSE 1242(1)	Human Computer Interaction	2+2	3
CSE 1243(1)	Programming Paradigms	2+2	3
CSE 1244(1)	Computer Architecture	3+0	3
CSE 1255(1)	Discrete Mathematics	3+0	3
CSE 2031Y(3)	Object-Oriented Software Development	2+2	6
CSE 2032Y(3)	Data Structures and Algorithms	2+2	6
CSE 2033Y(3)	Computer Networks and Open Systems	3+0	6
CSE 2041(3)	Web Technologies II	2+2	3
CSE 2142(3)	Software Engineering	3+0	3
CSE 2143(3)	Operating Systems	2+2	3
CSE 2242(3)	Computer Graphics	2+2	3
CSE 2243(3)	Theory of Computation and Compilers	3+0	3
CSE 2255(3)	Database Systems II	2+2	3
CSE 3000(5)	Project		9

### ELECTIVES

#### **Departmental**

CSE 3012(5)	Machine Learning	2+2	3
CSE 3013(5)	Mobile Network Architectures	3+0	3
CSE 3014(5)	Operations Research	2+2	3
CSE 3015(5)	Parallel Processing	2+2	3
CSE 3018(5)	Simulations	2+2	3
CSE 3019(5)	Software Testing and Quality Assurance	2+2	3
CSE 3020(5)	Ubiquitous Computing	3+0	3
CSE 3021(5)	Virtual Reality	2+2	3
CSE 3022(5)	Wireless Networking	2+2	3
CSE 3032(5)	Semantic Web	2+2	3
CSE 3041(5)	Artificial Intelligence	2+2	3
CSE 3042(5)	Bioinformatics	2+2	3
CSE 3043(5)	Computer Security	3+0	3
CSE 3044(5)	Concurrent Programming	2+2	3
CSE 3045(5)	Data Mining	2+2	3
CSE 3046(5)	Distributed Systems	2+2	3
CSE 3047(5)	Embedded Systems	2+2	3
CSE 3048(5)	Enterprise Resource Planning	2+2	3
CSE 3049(5)	Game Development	2+2	3
CSE 3050(5)	Geometric Modelling and Animation	2+2	3
CSE 3051(5)	Internet Architectures	3+0	3
CSE 3056(5)	Robotics	2+2	3
CSE 3142(5)	Introduction to Real-time Systems	3+0	3
CSE 3145(5)	Digital Image Processing	2+2	3
CSE 3202(5)	Real-Time Multiprocessing Systems	3+0	3
CSE 3241(5)	Computer Vision	2+2	3

*Note: The offer of electives will be subject to availability of resources and existence of a critical mass of demand for the modules.*

## 9. Programme Plan – BSc (Hons) Computer Science

Level 1									
Semester 1				Semester 2					
Code	Module Name	Hrs/Wk	Credits	Code	Module Name	Hrs/Wk	Credits		
CSE 1003(1)	Computer Programming	2+2	3	CSE 1041(1)	Web Technologies I	2+2	3		
CSE 1005(1)	Database Systems I	2+2	3	CSE 1255(1)	Discrete Mathematics	3+0	3		
CSE 1131(1)	Mathematics for Computing	3+0	3	CSE 1242(1)	Human Computer Interaction	2+2	3		
CSE 1142(1)	Formal Logic	3+0	3	CSE 1243(1)	Programming Paradigms	2+2	3		
ELEC 1105(1)	Digital Logic	3+0	3	CSE 1244(1)	Computer Architecture	3+0	3		
COMS 1010(1)	Communication Skills	DE	3	CSE 1200	Practical Training*		0		
							GEM		6
Level 2									
Semester 1				Semester 2					
Code	Module Name	Hrs/Wk	Credits	Code	Module Name	Hrs/Wk	Credits		
CSE 2031Y(3)	Object-Oriented Software Development					2+2	6		
CSE 2032Y(3)	Data Structures and Algorithms					2+2	6		
CSE 2033Y(3)	Computer Networks and Open Systems					3+0	6		
CSE 2041(3)	Web Technologies II	2+2	3	CSE 2255(3)	Database Systems II	2+2	3		
CSE 2142(3)	Software Engineering	3+0	3	CSE 2242(3)	Computer Graphics	2+2	3		
CSE 2143(3)	Operating Systems	2+2	3	CSE 2243(3)	Theory of Computation and Compilers	3+0	3		
Level 3									
Semester 1				Semester 2					
Code	Module Name	Hrs/Wk	Credits	Code	Module Name	Hrs/Wk	Credits		
	Elective 1		3		Elective 6		3		
	Elective 2		3		Elective 7		3		
	Elective 3		3		Elective 8		3		
	Elective 4		3						
	Elective 5		3						
CSE 3000(5)	Final Year Project							9	

\* Note: The Practical Training will be conducted after Semester 2 Exams

## 10. Outline Syllabus

**Note: PQ** – Pre-requirement, PR - Pre-requisite

- (i) A student will be allowed to follow module **y** of which module **x** is a *pre-requisite* (PR) provided Grade E or G or above has been achieved in module **x** unless decided otherwise by the Faculty/ Centre/ Cluster Board and Senate.
- (ii) A student will be allowed to follow module **y** of which module **x** is a *pre-requirement* (PQ) provided s/he has followed module **x** and sat for the examinations in module **x** unless decided otherwise by the Faculty/ Centre/ Cluster Board and Senate.

### **CORE MODULES**

#### **Humanities And Management**

##### **COMS 1010(1)- COMMUNICATION SKILLS (DE -3)**

Writing Skills, Non-verbal Communication, Modes of Speech Delivery and Presentation Aids, Speeches, Perception and Listening Skills, Business and Technical Writing.

#### **Departmental**

##### **CSE 1003(1)-COMPUTER PROGRAMMING (L/P- 3)**

Variables, Data Types, Flowcharts and Pseudo-codes, Simple Programming Constructs, Functions, Control Structures, Arrays, File-Access, User-defined Types, Introduction to Classes.

##### **CSE 1005(1)-DATABASE SYSTEMS I (L/P - 3)**

Introduction to DBMS, Database Abstractions, Data Model (ERD), Relational Model, Relational Algebra, Relational Calculus, Query Language (SQL), Normalization, Transaction Processing Concepts, Object and Object Relational Databases.

##### **CSE 1041(1)-WEB TECHNOLOGIES I (L/P – 3) (PQ: CSE 1003, CSE 1005)**

Internet and the WWW, Web Servers (Apache, IIS), HTML and DHTML, Cascaded Style Sheets, Client-Side Programming (VBScript, JavaScript, JQuery), Server-Side Programming, Connecting to Databases, Introduction to AJAX, Developing Applications using Web Framework

##### **CSE 1131(1)-MATHEMATICS FOR COMPUTING (L - 3)**

Matrices, Matrix Operations, Solution of Equations, Iterative Solutions, Series, Descriptive Statistics, Distribution Shapes, Types of Probability, Probability Distributions, Sampling, Calculation of Population Parameters, Significance Testing, Chi-Squared Test, Regression and Correlation.

##### **CSE 1142(1)-FORMAL LOGIC (L-3)**

Propositional Logic: Syntax, Semantics, Truth tables, Equivalence and Simplification Rules, Normal Forms and Proofs; First Order Logic: Syntax, Semantics and Proofs, Logic Programming.

##### **ELEC 1105(1)-DIGITAL LOGIC (L-3)**

Fundamentals (Number Systems, Boolean Algebra, Logic gates), Combinational Logic Circuits (SOP and POS Forms, Map Minimisation, MUX & DEMUX), Encoder & Decoder, Programmable Logic Devices (ROM, PAL, PLA, fusemaps), Sequential Logic Circuits ( Flip-Flops, Registers, Counters, Sequential Machines), Basic Computer Operations (Design of ALU, Data Processor), Practical Issues (Logic Families, Digital ICs).

##### **CSE 1200 – PRACTICAL TRAINING (P-0)**

OS Installation and Configuration, Installing and Managing Devices/Peripherals, Management of User Accounts, Resource Sharing and Management, Network/Internet Setup and Configuration, Basic Email Configuration, PC Maintenance and Upgrade, Recovery Tools and Procedures, PC Security.

**CSE 1242(1)-HUMAN COMPUTER INTERACTION (L/P-3)**

Introduction to HCI, Human Characteristics, The computer and I/O Devices Capabilities, Principles of Good Screen Design, Development of System Menus and Navigation Schemes, Interaction Styles, Characteristics of Graphical and Web User Interfaces, HCI in the Software Process, Implementation Support, Evaluation Techniques, Cognitive Models, Tasks Analysis, UI and Data Visualisation, Designing User Interfaces for Embedded Devices.

**CSE 1243(1)-PROGRAMMING PARADIGMS (L/P-3) (PQ: CSE 1003)**

Syntax and Semantics of Programming Languages, Type Systems, Programming Constructs, Evolution of Programming Languages, and Different types of Programming Languages including Imperative Programming, Object-Oriented Programming, Functional Programming, Declarative Programming and Scripting.

**CSE 1244(1)-COMPUTER ARCHITECTURE (L-3)**

Basic Structure of Computers, Instruction Set, Instruction Execution, CPU structure, Control Unit Organization, Microinstructions, Pipelining and Performance, Memory Organization, I/O Organization, Interrupt Processing, I/O interfaces.

**CSE 1255(1)-DISCRETE MATHEMATICS (L – 3)**

Sets, Functions, Matrices, Growth of Functions, Relations, Integers and Prime Numbers, Applications of Number Theory, Applications of Graph Theory.

**CSE 2031Y(3)-OBJECT-ORIENTED SOFTWARE DEVELOPMENT (L/P-6) (PQ: CSE 1003)**

OO Analysis, OO Modeling with UML, Design by Contract, Design Patterns, Implementation of Design Patterns, Software Components, Pluggable Architectures, Reuse, Software Frameworks, Using and Creating Frameworks, OO Programming Languages, OO Platforms, OO Programming, Generics, Annotation, Abstraction, Encapsulation, Inheritance and Polymorphism, Class Libraries, Collections, Unit-Testing, Debugging, Refactoring, Documentation Generation, Open Source Software Development, Test-Driven Development.

**CSE 2032Y(3)-DATA STRUCTURES AND ALGORITHMS (L/P - 6) (PQ: CSE 1003)**

Introduction to Data Structures and Algorithms, Mathematical Preliminaries, Types of Algorithms (Simple Recursive Algorithms, Backtracking Algorithms, Divide and Conquer Algorithms, Dynamic Programming Algorithms and others), Algorithm Analysis (Empirical and Asymptotic), Recurrence Relations, Fundamental Data Structures (Lists, Stacks, Queues, Binary Trees, Graphs), Elementary Sorting Algorithms, QuickSort, MergeSort, HeapSort, Radix Sorting, Elementary Searching Algorithms, Balancing Binary Search Trees, Radix Searching, Hashing, String Searching, Graph Searching Algorithms.

**CSE 2033Y(3)-COMPUTER NETWORKS AND OPEN SYSTEMS (L-6)**

Reference Models (OSI and TCP/IP), Guided/Unguided Transmission Media. PSTN, Mobile Telephone System, Data Link Layer Design Issues, Error Detection and Correction, Data Link Protocols, MAC Sublayer, Channel Allocation Problem, Multiple Access Protocols, Ethernet, Wireless LANs, Network Layer Design Issues, Routing Algorithms, Congestion, QoS, Internetworking, The Transport Service, Elements of Transport Protocols, Application Layer, DNS, Electronic Mail, WWW, Multimedia.

**CSE 2041(3)-WEB TECHNOLOGIES II (L/P-3) (PQ: CSE 1041)**

XML as Data Representation, Well Formed and Valid XML (XSD and schema's), Transforming XML (XSLT), Applications of XML in Web 2.0 (RSS feeds), XML and Web Services (SOAP, WSDL, UDDI), Orchestration and BPEL-WS, Protocols for Web Services, WS-Transactions, WS-Security.

**CSE 2142(3)-SOFTWARE ENGINEERING (L-3)**

Software Engineering Concepts and Practices, Software Processes, Software Process Models, Software Process Improvement, Requirements Engineering, Requirements Analysis Techniques, Software Modeling, Design Strategies and Techniques, Software Architectures, Web Engineering, Software Quality Assurance, Product Metrics for Software, Quality standards, Software Project Management, Software Testing and Validation, Software Maintenance, Configuration Management, Software Procurement, SEI CMMI.

**CSE 2143(3)-OPERATING SYSTEMS (L/P -3) (PQ: CSE 1003)**

Overview of Operating Systems, Processes, Threads, Interprocess Communication, CPU Scheduling, Memory Management, Virtual Memory (Paging, Page Replacement, Segmentation), File Systems (File and Directories, File System Implementation, File System Management), Deadlocks, Computer Security, Systems Programming.

**CSE 2242(3)-COMPUTER GRAPHICS (L/P – 3) (PQ: CSE 1003)**

Graphics Hardware, Homogeneous Coordinates, 2D and 3D Transformations (Translation, Rotation, Scaling), Graphics Rendering Pipeline, Viewing Transformation, Clipping, Visible Surface Detection, Colour Models, Illumination Models, Using Graphics API.

**CSE 2243(3)-THEORY OF COMPUTATION AND COMPILERS (L - 3)**

Languages, Grammars, Finite-State Machines, Turing Machines, Compilation and Interpretation, Specifying Syntax, Scanning, Parsing.

**CSE 2255(3)-DATABASE SYSTEMS II (L/P – 3) (PQ: CSE 1005)**

Hashing and Indexing Structures, Concurrency Control and Recovery Techniques, Serializability, Procedural SQL, Introduction to Distributed Databases, Schema Integration, Data Fragmentation and Replication, Distributed Query Processing: Query Decomposition and Localization, Query Optimisation.

**CSE 3000(5)-FINAL YEAR PROJECT**

Students will work on an individual or group project to implement a software for a real-life or research-based problem. The project will include analysis, design, implementation and testing of a software and a written report that describes the work. The report should also include a proper literature survey around the problem being treated in the project.

**ELECTIVES****Departmental****CSE 3012(5)-MACHINE LEARNING (L/P – 3) (PQ: CSE 1131, CSE 1142, CSE 2032Y)**

Supervised and Unsupervised Learning, Genetic Algorithms, Genetic Programming, Artificial Neural Networks, Learning Theory, Rule Based Learning, Decision Trees, Bayesian Learning, Support Vector Machines, Clustering, Reinforcement Learning.

**CSE 3013(5)-MOBILE NETWORK ARCHITECTURES (L-3) (PQ: CSE 2031Y, CSE 2032Y)**

Spectrum Management, Mobility Management, Handoff Management, Mobile Address Portability, Roaming and International Procedures, Operational Management.

**CSE 3014(5)-OPERATIONS RESEARCH (L/P-3)**

Introduction to Linear Programming, Simplex Algorithm, Integer Programming, Sensitivity Analysis: An Applied Approach, Transportation Problems, Network Models: CPM and PERT, Game Theory, Markov Chains, Queuing Theory.

**CSE 3015(5)- PARALLEL PROCESSING (L/P-3)**

Parallel Programming Platforms, Parallel Algorithm Design, Basic Communication Operations, Analytical Modelling of Programs, The Message-Passing Paradigm, Message-Passing Interface (MPI), Collective Communication, Grouping Data, Communicators and Topologies.

**CSE 3018(5) - SIMULATIONS (L/P-3)**

Introduction to Simulation and Modelling, Probability and Statistics, Simulation and Modelling Perspectives, Applications of Simulation, Discrete Event Modelling and Simulation, Continuous Modelling, Statistical Aspects of Modelling.

**CSE 3019(5) - SOFTWARE TESTING AND QUALITY ASSURANCE (L/P - 3)**

Introduction to Testing, Test Phases, Test Strategy, Test Automation, Test Design Techniques (Black-Box, White-Box), Software Inspections (Cleanroom), Software Quality, Quality Control, Software Quality Models, Quality Assurance( Activities and Processes).

**CSE 3020(5)- UBIQUITOUS COMPUTING (L- 3)**

Introduction to Pervasive and Ubiquitous Computing, Mobile Phone and Visual Tags, Context Awareness in Ubiquitous Computing, Model-Driven Development for Pervasive Information Systems, Device Locations in Ubiquitous Computing Environments, Enabling Ubiquitous Computing Environments, User Acceptance Issues in Ubiquitous Computing, Designing for Tasks in Ubiquitous Computing, Kinetic User Interfaces, Innovative Ubiquitous Applications, Activity-Oriented Computing, Privacy Threats in Emerging Ubiquitous Applications.

**CSE 3021(5) – VIRTUAL REALITY (L/P – 3) (PQ: CSE 2242)**

History of VR, The Senses: Vision, Auditory, Haptic, Gustative & Smell, Tracking, Augmented Reality, Design of Virtual Worlds, Human & Health Issues, Evaluating Virtual Worlds, Applications of Virtual worlds, Software and Hardware for Virtual Reality.

**CSE 3022(5)-WIRELESS NETWORKING (L/P-3) (PQ: CSE 2033Y)**

Wireless Communications, Wireless Personal Area Networks, 802.11 Standard, Wireless LANs Applications, Wireless LANs Protocols, Wireless Cellular Networks, Design of Wireless Networks, TCP over Wireless, Adhoc Wireless Networks: Issues and Routing, Satellite Communication, Wireless Sensor Networks, RFID, Wireless Internet, Current Trends.

**CSE 3032(5) - SEMANTIC WEB (L/P-3) (PQ: CSE 2041)**

Introduction to Semantic Web, Ontology Languages for Semantic Web, Web Ontology Languages, Conceptual Modelling and languages, Logic and Inference in Semantic Web, Integration of Rules and Ontologies, Ontological Engineering, The Semantic Web and its Applications.

**CSE 3041(5)-ARTIFICIAL INTELLIGENCE (L/P - 3) (PQ: CSE 2032Y)**

Intelligent Agents, Search, Game Playing, Constraint Satisfaction Problems, Knowledge Based Systems, Planning, Machine Learning, Natural Language Processing, Trends in AI.

**CSE 3042(5)-BIOINFORMATICS (L/P-3) (PQ: CSE 1003)**

Introduction to Molecular Biology, Overview of Bioinformatics, Introduction to Biological Databases, Pairwise Sequence Alignment, Alignment Algorithms, BLAST, Phylogenetics, Multiple Sequence Alignment, Structural Bioinformatics.

**CSE 3043(5)-COMPUTER SECURITY (L-3)**

Concept of Secure Computing, Domain of Protection, Social Engineering, Attacks and Defenses, Defining Security Policy, Classical Ciphers, Encryption and Decryption, Symmetric and Asymmetric Ciphers, Operating System Holes, Application Security (Web, e-mail, Databases), Viruses, Privacy, and Digital Rights Management, Intrusion Detection Systems, Secure Protocols, Security of Middleware, Software Protection, Web Security and Wireless Network Security.

**CSE 3044(5)-CONCURRENT PROGRAMMING (L/P-3) (PQ: CSE 1003)**

Introduction to Concurrency, Concurrent Programming Abstraction, The jBACI Concurrency Simulator, The Critical Section Problem, Verification of Concurrent Programs, Introduction to Erlang, Concurrency in Erlang, Basic Multithreading in Java.

**CSE 3045(5)- DATA MINING (L/P-3) (PQ: CSE 2255)**

Data Mining Process, Data Preprocessing, Classification, Decision Trees, Bayesian Methods, Neural Networks, Rule-based Classification, Clustering Methods, Cluster Evaluation, Association Rule Mining, Statistical Methods, Visual Methods, Text Mining, Web Mining.

**CSE 3046(5) - DISTRIBUTED SYSTEMS (L/P-3) (PQ: CSE 2143)**

Characterization of Distributed Systems, System Models, Interprocess Communication, Remote Method Invocations, OS Support for Distributed Systems, Distributed File Services, Security, Name Services.

**CSE 3047(5)-EMBEDDED SYSTEMS (L/P -3) (PQ: CSE 2143)**

Introduction to Embedded Systems, Kernel Debugging Techniques, Memory, Peripherals, Interrupts, Interfacing, Program Modelling Concepts, Software Engineering Practices for Embedded Systems.



**CSE 3048(5)-ENTERPRISE RESOURCE PLANNING (L/P- 3) (PQ: CSE 1003)**

ERP Systems, Core Business Processes, System Thinking, Transition from MRP to ERP, Basic ERP model, Benefits and Challenges of ERP, BPR, ERP System Selection, ERP Design, ERP Implementation, ERP Bolt-ons, ERP System Maintenance, Technology and International Considerations, Change Management, ERP and Supply Chain.

**CSE 3049(5)-GAME DEVELOPMENT (L/P – 3) (PQ: CSE 2242)**

History of Games and Societal issues, Game Design, Game Development Process, Game Programming: Graphics, Animation, Audio and Networking, Collision Detection, Game AI and Physics.

**CSE 3050(5)-GEOMETRIC MODELLING AND ANIMATION (L/P – 3) (PQ: CSE 2032Y, CSE 2242)**

Parametric Curves and Surfaces, Fractals (Mandelbrot and Julia sets, L-Systems, IFS: Particle Systems), Flocks and Boids, Cellular Automata, Natural Phenomena (Smoke, Fire, Waves, Snow, Clouds, Hair, Cloth), Human Animation (Inverse & Forward Kinematics, Skeletal Animation, Ragdoll Character Animation, Facial Animation).

**CSE 3051(5)-INTERNET ARCHITECTURES (L-3) (PQ: CSE 2032Y, CSE 2031Y)**

Internet Addressing, Intra-domain Routing, Inter-domain Routing, QoS Provision versus Congestion Control, Domain Name Systems, Public Key Architectures, Web and Multimedia Applications' Management.

**CSE 3056(5)-ROBOTICS (L/P-3)**

Definition and History of Robotics, Sensors and Actuators: (Types of Actuator, Types of Sensor), Robotic Systems, Robot Design, Biologically Inspired Robotics, Kinematics, Dynamics, Locomotion, Control, Autonomous Mobile Robotic Systems, Machine Learning and Navigation, Simulation of Robot and its Environment, Model Acquisition and Validation.

**CSE 3142(5) – INTRODUCTION TO REAL-TIME SYSTEMS (L- 3) (PQ: CSE 2143)**

Real-Time Applications, Hard Versus Soft Real-Time Systems, Reference Model of Real-Time Systems, Commonly Used Approaches to Hard Real-Time Scheduling, Clock-Driven Scheduling, Priority-Driven Scheduling of Periodic Tasks, Resources and Resource Access Control, Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems.

**CSE 3145(5)-DIGITAL IMAGE PROCESSING (L/P-3) (PQ: CSE 1003)**

Image Sensing and Representation, Image Analysis (Preprocessing), Image Enhancement (Gray Scale Model, Histogram Model, Sharpening, Smoothing), Finding Edges and Lines, Image Transforms (Fourier, Discrete Cosine, Walsh-Hadamard, Haar, PCT, Filtering), Image Restoration (System Model, Noise Removal, Degradation Model, Inverse Filter), Image Compression (System Model, Lossless Methods, Lossy Methods, Texture).

**CSE 3202(5)- REAL-TIME MULTIPROCESSING SYSTEMS(L-3) (PQ: CSE 3142)**

Models/Characteristics of Multiprocessor and Distributed Systems, Multiprocessor Scheduling Algorithms, Task Precedence Constraints, Minimising Interprocessor Communication, Resource Access Control in a Multiprocessor Environment, Real-time Communication Protocols, Fault-tolerance Techniques.

**CSE 3241(5) COMPUTER VISION (L/P-3) (PQ: CSE 3145)**

AI, Human Visual Perception, Computer Vision, and Robots Sensing, Seeing, and Perceiving, Role of Vision, Computer Vision Paradigms, Finding and Grouping Lines (Boundary Tracing, Line Fitting, Hough Transform), Finding and Processing Regions (Merging, Splitting, and Grouping Regions, Grouping and Analyzing Lines and Regions), Stereo, and Motion (Optical Flow and FOE, Motion Understanding), Mobile Robots (Simple Robot Control, Planning for Navigation), Using Computer Vision (Applications in Medicine, Industry and Surveillance).