BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA

ROURKELA

Curriculum and Syllabus

B. Tech (Computer Science & Engineering) for the Batch

2018-19

Semester (5th)

B. Tech in Computer Science &Engineering (Admission Batch: 2018-2019)

5th Semester

Fifth Semester					
Theory					
Sl. No.	Category	Course Code	Course Title	L-T-P	Credit
1	PC 11		Formal Languages and Automata Theory	3-0-0	3
2	PC 12		Database Management Systems	3-0-0	3
3	PC 13		Operating Systems	3-0-0	3
4	PE2 (Any One)		Advanced Computer Architecture	3-0-0	
			Artificial Intelligence & Machine Learning	3-0-0	
			Mobile Computing	3-0-0	
5	PE 3 (Any One)		Parallel & Distributed Systems	3-0-0	3
			Object-Oriented Analysis & Design	3-0-0	
			Computer Graphics	3-0-0	
6	MC 5		Universal Human Values		0
Total Credit (Theory)					15
Practical					
1	PC 14		Formal Languages and Automata Theory Lab	0-0-3	2
2	PC 15		Database Management Systems Lab	0-0-3	2
3	PC 16		Operating Systems Lab	0-0-3	2
4	PSI 2		Evaluation of Summer Internship	0-0-3	1
Total Credit (Practical)					7
Total Semester Credit					22

5Th Semester

Formal Languages and Automata Theory

Objectives

- To introduce concepts in automata theory and theory of computation
- To identify different formal language classes and their relationships
- To design grammars and recognizers for different formal languages

Module I: **(8 hours)**

Introduction: Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata, Distinguishing one string from other, Myhill-Nerode Theorem

Module II: **(10 hours)**

Regular Expression (RE): Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

Module III: **(10 hours)**

Context Free Grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure proper ties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs

Module IV: **(6 hours)**

Push Down Automata (PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG,

Module V: **(6 hours)**

Turing machines (TM): Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Undecidability, Undecidable problems about TMs. Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory

Outcomes

- Ability to relate practical problems to languages, automata, and computability
- Ability to demonstrate an increased level of mathematical sophistication
- Ability to apply mathematical and formal techniques for solving problems

Books:

[1] Hopcroft and Ullman, "Introduction to Automata Theory, Languages and Computation",Pearson Education, 3rd edition, 2014

[2] Martin J. C., "Introduction to Languages and Theory of Computations", TMH, 4th edition, 2010

[3] Peter Linz, "An Introduction to Formal Language and Automata", Narosa Pub. House, 6th Edition, 2016

[4] Papadimitriou, C. and Lewis, C. L., "Elements of the Theory of Computation", PHI, 1997

Digital Learning Resources:

Course Name:	Formal languages and Automata Theory
Course Link:	https://nptel.ac.in/courses/111/103/111103016
Course Instructor:	Dr. K.V. Krishna and Dr.Diganta Goswami, IIT,Guwahati

Course Name:	Introduction to Automata, Languages and Computation
Course Link:	https://nptel.ac.in/courses/106/103/106103070/
Course Instructor:	Dr.Diganta Goswami, IIT,Guwahati

Course Name:	Theory of Automata and Formal languages
Course Link:	https://nptel.ac.in/courses/106/105/106105196
Course Instructor:	Dr.S. Mukhpadhyaya, IIT, Kharagpur

Course Name:	Theory of Automata, Formallanguages and Computation
Course Link:	https://nptel.ac.in/courses/106/106/106106049/
Course Instructor:	Prof. Kamala Krithivasan, IIT, Madras

Formal Languages and Automata Theory Lab

Implementation of following concept of Theory of computation using C-program:

1. DFAs for some regular languages
2. ϵ-NFA to DFA conversion
3. NFA to DFA conversion
4. Program for DFA minimization
5. PDAs for some Context free languages
6. CYK parsing algorithm for some specific Context free grammars
7. Turing machine for some Recursively Languages

Digital Learning Resources:

Virtual Lab Link:	http://vlabs.iitb.ac.in/vlabs dev/vlab_bootcamp/bootcamp/system_deligators/labs/index.php

5Th Semester

Database Management Systems

Objectives

- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques

Module I: **(5 hours)**

Introduction: Purpose of Database System –– Views of data – data models, database management system, three-schema architecture of DBMS, components of DBMS. E/R Model - Conceptual data modelling - motivation, entities, entity types, attributes relationships, relationship types, E/R diagram notation, examples.

Module II: **(10 hours)**

Relational Model: Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviours. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL

Module III: **(7 hours)**

Database Design: Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF

Module IV: **(10 hours)**

Transactions: Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.

Module V: **(8 hours)**

Implementation Techniques: Data Storage and Indexes - file organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi-level indexes, B+ trees.

Outcomes

- Ability to Install, configure, and interact with a relational database management system
- Ability to master the basics of SQL and construct queries using SQL
- Ability to design and develop a large database with optimal query processing

Books:

[1] A. Silberschatz, Henry F. Korth, and S. Sudharshan, "Database System Concepts", 7th Ed, Tata McGraw Hill, 2019.

[2] C. J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", 8th ed, Pearson Education, 2006

[3] Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson/Addisionwesley, 2016

[4] Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003

Digital Learning Resources:

Course Name:	Fundamentals of DatabaseSystems
Course Link:	https://nptel.ac.in/courses/106/104/106104135/
Course Instructor:	Dr. Arnab Bhattacharya, IIT,Kanpur

Course Name:	Introduction to DatabaseSystems
Course Link:	https://nptel.ac.in/courses/106/106/106106220
Course Instructor:	Prof. P.Sreenivasa Kumar, IIT, Madras

Database Management Systems Lab

Use of SQL syntax: insertion, deletion, join, updation using SQL. (1 class)
2. Programs on join statements and SQL queries including where clause. (1 class)
3. Programs on procedures and functions. (1 class)
4. Programs on database triggers. (1 class)
5. Programs on packages. (1 class)
6. Programs on data recovery using check point technique. (1 class)
7. Concurrency control problem using lock operations. (1 class)
8. Programs on ODBC using either VB or VC++. (1 class)
9. Programs on JDBC. (1 class)
10. Programs on embedded SQL using C / C++ as host language. (1 class)

Digital Learning Resources:

Virtual Lab Link:	http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php

5Th Semester

Operating Systems

Objectives

- To provide knowledge about the services rendered by operating systems
- To provide a detailed discussion of the various memory management techniques
- To discuss the various file-system design and implementation issues
- To discuss how the protection domains help to achieve security in a system

Module I: **(8 Hours)**

Operating Systems –Definition- Types- Functions -Abstract view of OS- System Structures –System Calls- Virtual Machines –Process Concepts –Threads –Multithreading

Module II: **(4 Hours)**

Process Scheduling- Process Co-ordination –Synchronization –Semaphores –Monitors Hardware Synchronization –Deadlocks –Methods for Handling Deadlocks

Module III: **(12 Hours)**

Memory Management Strategies –Contiguous and Non-Contiguous allocation –Virtual memory Management –Demand Paging- Page Placement and Replacement Policies

Module IV: **(6 Hours)**

File System –Basic concepts - File System design and Implementation –Case Study: Linux File Systems - Mass Storage Structure –Disk Scheduling –Disk Management –I/O Systems-System Protection and Security.

Module V: **(10 Hours)**

Distributed Systems –Distributed operating systems –Distributed file systems –Distributed Synchronization

Outcomes

- Ability to comprehend the techniques used to implement the process manager
- Ability to comprehend virtual memory abstractions in operating systems
- Ability to design and develop file system interfaces, etc.

Books:

[1] Silberschatz, Galvin, Gagne, "Operating System Concepts", John Wiley and Sons, 10th edition, 2018

[2] Stallings, “Operating Systems –Internals and Design Principles”, 9/E, Pearson Publications, 2018

[3] Andrew S. Tanenbaum, “Modern Operating Systems”, 4/E, Pearson Publications, 2015

Digital Learning Resources:

Course Name:	Introduction to Operating Systems
Course Link:	https://nptel.ac.in/courses/106/108/106108101
Course Instructor:	Prof. Chester Reberio. IIT Madras

Course Name:	Operating Systems
Course Link:	https://nptel.ac.in/courses/106/108/106108101/
Course Instructor:	Prof. P.C.P Bhatt, IISc, Bangalore

Course Name:	Operating Systems
Course Link:	https://nptel.ac.in/courses/106/102/106102132
Course Instructor:	Prof. SoravBansal, IITDelhi

Course Name:	Operating System Fundamentals
Course Link:	https://nptel.ac.in/courses/106/105/106105214
Course Instructor:	Prof. S.Chattopadhyaya. IIT Kharagpur

Course Name:	Operating Systems
Course Link:	https://swayam.gov.in/nd2_cec20_cs06/preview
Course Instructor:	Dr. S. Sasikala, University of Madras

Course Name:	Realtime Operating Systems
Course Link:	https://nptel.ac.in/courses/106/105/106105172
Course Instructor:	Prof. R. Mall, IIT Kharagpur

Operating System Lab

1. Basic UNIX Commands.
2. Linux Administrative commands.
3. UNIX Shell Programming.
4. Programs on process creation and synchronization, inter process communication including shared memory, pipes and messages.(Dinning Philosopher problem / Cigarette Smoker problem / Sleeping barberproblem)
5. Programs on UNIX System calls.
6. Simulation of CPU Scheduling Algorithms. (FCFS, RR, SJF, Priority,Multilevel Queuing)
7. Simulation of Banker's Algorithm for Deadlock Avoidance, Prevention
8. Program for FIFO, LRU, and OPTIMAL page replacement algorithm.
9. Android Programming for mobile application.

5Th Semester

Advanced Computer Architecture

Objectives

- To understand the advance hardware and software issues of computer architecture
- To understand the multi-processor architecture & connection mechanism
- To understand multi-processor memory mangement

Module-I: **(10 Hours)**

Microprocessor and Microcontroller, RISC and CISC architectures, Parallelism, Pipeliningfundamentals, Arithmetic and Instruction pipelining, Pipeline Hazards, Superscalar Architecture, Super Pipelined Architecture, VLIW Architecture, SPARC and ARM processors.

Module-II: **(10 Hours)**

Basic Multiprocessor Architecture: Flynn's Classification, UMA, NUMA, Distributed MemoryArchitecture, Array Processor, Vector Processors.

Module-III: **(10 Hours)**

Interconnection Networks: Static Networks, Network Topologies, Dynamic Networks, Cloud computing.

Module IV **(10 Hours)**

Memory Technology: Cache, Cache memory mapping policies, Cache updating schemes, Virtual memory, Page replacement techniques, I/O subsystems.

Outcomes

- Ability to analyze the abstraction of various advanced architecture of a computer
- Ability to analyze the multi-processor architecture & connection mechanism
- Ability to work out the tradeoffs involved in designing a modern computer system

Books:

[1] John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann, 6th edition, 2017

[2] Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, McGraw Hill, 5th Ed, 2014

[3] Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill, 3rd Ed, 2015

Digital Learning Resources:

Course Name:	Advanced Computer Architecture
Course Link:	https://nptel.ac.in/courses/106/103/106103206/
Course Instructor:	Prof.John Jose, IIT, Guwahati

Course Name:	High Performance Computer Architecture
Course Link:	https://nptel.ac.in/courses/106/105/106105033/
Course Instructor:	Prof.A. Pal, IIT, Kharagpur

5Th Semester

Artificial Intelligence & Machine Learning

Objectives

- To learn the concepts of Artificial Intelligence
- To learn the methods of solving problems using Artificial Intelligence
- To introduce the concepts of Expert Systems and machine learning

Module-I: **(12 hours)**

INTRODUCTION –The Foundations of Artificial Intelligence; - INTELLIGENT AGENTS – Agents and Environments, Good Behaviour: The Concept of Rationality, the Nature of Environments, the Structure of Agents, SOLVING PROBLEMS BY SEARCH – Problem-Solving Agents, Formulating problems, Searching for Solutions, Uninformed Search Strategies, Breadth-first search, Depth-first search, Searching with Partial Information, Informed (Heuristic) Search Strategies, Greedy best-first search, A* Search, CSP, Means-End-Analysis.

Module-II: **(12 hours)**

ADVERSARIAL SEARCH – Games, The Mini-Max algorithm, optimal decisions in multiplayer games, Alpha-Beta Pruning, Evaluation functions, Cutting off search, LOGICAL AGENTS – Knowledge-Based agents, Logic, Propositional Logic, Reasoning Patterns in Propositional Logic, Resolution, Forward and Backward chaining - FIRST ORDER LOGIC – Syntax and Semantics of First-Order Logic, Using First-Order Logic , Knowledge Engineering in First-Order Logic - INFERENCE IN FIRST ORDER LOGIC – Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution

Module-III: **(6 hours)**

UNCERTAINTY – Acting under Uncertainty, Basic Probability Notation, The Axioms of Probability, Inference Using Full Joint Distributions, Independence, Bayes' Rule and its Use, PROBABILISTIC REASONING – Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distribution, Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks

Module-IV: **(10 hours)**

LEARNING METHODS – Statistical Learning, Learning with Complete Data, Learning with Hidden Variables, Rote Learning, Learning by Taking Advice, Learning in Problem-solving, learningfrom Examples: Induction, Explanation-based Learning, Discovery, Analogy, FormalLearning Theory, Neural Net Learning and Genetic Learning. Expert Systems: Representingand Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.

Outcomes

- Ability to comprehend AI & ES to analyze and map real world activities to digital world
- Ability to identify problems that are amenably solved by AI methods
- Ability to design and carry out an empirical evaluation of different AI algorithms

Books:

[1] Elaine Rich, Kevin Knight, & Shivashankar B Nair, Artificial Intelligence, McGraw Hill,3rd ed.,2009

[2] Stuart Russell, Peter Norvig, *Artificial Intelligence -A Modern Approach*, 4/e, Pearson, 2003.

[3] Nils J Nilsson, *Artificial Intelligence: A New Synthesis*, Morgan Kaufmann Publications,2000

[4] Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI.,2010
[5] S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011

Digital Learning Resources:

Course Name:	Artificial Intelligence Search Methods For Problem Solving
Course Link:	https://swayam.gov.in/nd1_noc20_cs81/preview
Course Instructor:	Prof. D. Khemani, IIT Madras
Course Name:	Fundamentals of Artificial Intelligence
Course Link:	https://swayam.gov.in/nd1_noc20_me88/preview
Course Instructor:	Prof. S. M. Hazarika, IIT Guwahati
Course Name:	Introduction to Machine Learning
Course Link:	https://nptel.ac.in/courses/106/105/106105152
Course Instructor:	Prof. S. Sarkar, IIT Kharagpur
Course Name:	Machine Learning
Course Link:	https://nptel.ac.in/courses/106/106/106106202
Course Instructor:	Prof. Carl Gustaf Jansson, IIT Madras

5Th Semester

Mobile Computing

Objectives

- To understand the fundamentals of mobile communication.
- To understand the architecture of various Wireless Communication Networks.
- To understand the significance of different layers in mobile system

Module I: **(10 Hours)**

Introduction to Wireless Networks – Applications – History – Simplified Reference Model – Wireless transmission – Frequencies – Signals – Antennas – Signal propagation – Multiplexing – Modulation – Spread spectrum – Cellular Systems: Frequency Management and Channel Assignment- types of hand-off and their characteristics.

Module II: **(10 Hours)**

MAC – Motivation – SDMA, FDMA, TDMA, CDMA –Telecommunication Systems – GSM: Architecture-Location tracking and call setup- Mobility management- Handover- Security- GSM SMS –International roaming for GSM- call recording functions-subscriber and service data management – DECT – TETRA – UMTS – IMT-2000.

Module III: **(8 Hours)**

Wireless LAN – Infrared Vs Radio transmission – Infrastructure – Adhoc Network –IEEE 802.11WLAN Standards – Architecture – Services– HIPERLAN – Bluetooth Architecture & protocols.

Module IV: **(8 Hours)**

Mobile Network Layer – Mobile IP – Dynamic Host Configuration Protocol - Mobile Transport Layer – Traditional TCP – Indirect TCP – Snooping TCP – Mobile TCP – Fast retransmit / Fast recovery – Transmission / Time-out freezing – Selective retransmission – Transaction Oriented TCP.

Module V: **(4 Hours)**

WAP Model- Mobile Location based services -WAP Gateway –WAP protocols – WAP user agent profile- caching model-wireless bearers for WAP - WML - WML Scripts - WTA – iMode – SyncML

Outcomes

- Ability to develop a strong grounding in the fundamentals of mobile Networks
- Ability to apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network
- Ability to comprehend, design, and develop a lightweight network stack

Books:

[1] Jochen Schiller, " Mobile Communication", 2nd Edition,Pearson Education, 2009.

[2] Theodore and S. Rappaport, "Wireless Communications, Principles, Practice", 2nd Ed PHI, 2002

[3] William Stallings, "Wireless Communications and Networks", 2nd Edition, Pearson Education, 2004

Digital Learning Resources:

Course Name:	Mobile Computing
Course Link:	https://nptel.ac.in/courses/106/106/106106147
Course Instructor:	Prof. Pushpendra Singh and Prof. S. Iyer, IIT, Madras

5Th Semester

Parallel & Distributed Systems

Objectives

- To understand parallel computing algorithms and models
- To analyze parallel algorithms for PRAM machines and various interconnection networks
- To understand parallel programming in MPI and POSIX

Module I: (10 Hours)

Introduction: Implicit parallelism, Limitations of memory system performance, control structure, communication model, physical organization, and communication costs of parallel platforms, Routing mechanisms for interconnection networks, mapping techniques. **Parallel algorithm design**: Preliminaries, decomposition techniques, tasks and interactions, mapping techniques for load balancing, methods for reducing interaction overheads, parallel algorithm models.

Module II: (8 Hours)

Basic communication operations: Meaning of all-to-all, all-reduce, scatter, gather, circular shift and splitting routing messages in parts. Analytical modeling of parallel programs: sources of overhead, performance metrics, the effect of granularity on performance, scalability of parallel systems, minimum execution time, minimum cost-optimal execution time, asymptotic analysis of parallel programs.

Module III: (6 Hours)

Programming using message passing paradigm: Principles, building blocks, MPI, Topologies and embedding, Overlapping communication and computation, collective communication operations, Groups and communicators

Module IV: (6 Hours)

Programming shared address space platforms: Threads, POSIX threads, Synchronization primitives, attributes of threads, mutex and condition variables, Composite synchronization constructs, OpenMP Threading Building blocks; An Overview of Memory Allocators, An overview of Intel Threading building blocks.

Module V: (10 Hours)

Dense Matrix Algorithms: matrix vector multiplication, matrix-matrix multiplication, solving system of linear equations, Sorting: Sorting networks, Bubble sort, Quick sort, Bucket sort andother sorting algorithms Graph algorithms: Minimum spanning tree, single source shortest paths, all-pairs shortest paths, Transitive closure, connected components, algorithms for sparse graphs.

Outcomes

- Ability to analyze parallel algorithms for PRAM machines
- Ability to comprehend and apply parallel algorithms to real world applications
- Ability to design and develop optimal parallel algorithms

Books:

[1] Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar : Introduction to Parallel Computing, Second Edition Pearson Education, 2007

[2] Michael J. Quinn, Parallel Programming in C with MPI and OpenMP McGraw-Hill International Editions, Computer Science Series, 2004

Digital Learning Resources:

Course Name:	Distributed Computing Systems
Course Link:	https://nptel.ac.in/courses/106/106/106106107/#
Course Instructor:	Prof. Ananthanarayana V.S, IIT, Madras

5Th Semester

Object-Oriented Analysis & Design

Objective:

- To learn the concepts of Object-Oriented Analysis and Design;
- Exposing the development of OOAD based applications

Module I: **(8 Hours)**

Object Model – Evolution, Elements – Nature of Classes and Objects – Relationships among Classes - Classification – Identification of classes and objects – Key abstractions and mechanisms – Basic and Advanced Modeling techniques.

Module II: **(8 Hours)**

Methodology – Modeling and UML – Rambaugh's Method – Booch Method – Jacobson et al Method – Comparisons – UML – Static-Dynamic Models – Diagrams –Use Cases

Module III: **(8 Hours)**

Process of design, design principles, architectural patterns, design document, difficulties and risks in design - Frameworks: reusable subsystem. Design patterns – Singleton, observer, adapter, Façade, proxy with examples. - Pattern Categories - Relationships between patterns - Pattern descriptions – Patterns based Applications – Object Oriented Database

Module IV: **(8 Hours)**

Java - Features – Structure – Elements of Java – Array, String, String Buffer, Vectors –Methods – Object Oriented Features- Classes, Objects – Constructors – Package – Inheritance – Interface – Abstract Class - Special types of classes.

Module V: **(8 Hours)**

Applet Programming – AWT – Graphics - Event Handling – Exception Handling – Utilities and Collections – I/O Streams - Multithreaded Programming - Swings - J2EE Architecture

Outcome:

- Ability to define the fundamentals of OO approach
- Ability to design OO Application using design patterns.
- Ability to solve real world problems by applying OOAD principle
- Ability to acquire expertise in Java Programming

Books:

[1] Grady Booch, Michael W. Engel, Kelli A. Houston, Robert A. Maksimchuk, Bobbi J. Young, Jim Conallen, "Object-Oriented Analysis and Design with Applications", 3rd Edition, Pearson Education, 2009

[2] Michael Blaha and James Rumbaugh, "Object-Oriented Modeling and Design with UML", 2nd Edition, Pearson Education,2005

[3] Erich Gamma, Richard Helm, Ralph Johnson & John Vlissides, "Design Patterns: Elements of Reusable Object-oriented Software", Pearson Education India, 2004.

Digital Learning Resources:

Course Name: Object-Oriented Analysis & Design

Course Link: https://nptel.ac.in/courses/106/105/106105153
Course Instructor: Prof. ParthaPratim Das & Team, IIT Kharagpur

5Th Semester

Computer Graphics

Objectives:

- To understand the basics of various inputs and output computer graphics hardware devices.
- Exploration of fundamental concepts in 2D and 3D computer graphics.
- To know 2D raster graphics techniques, 3D modelling, geometric transformations, 3D viewing and rendering.

Module I: **(6 Hours)**

Basic of Computer Graphics: Applications of computer graphics, Display devices, Random and Raster scan systems, Graphics input devices, Graphics software and standards.*

Module II: **(10 Hours)**

Graphics Primitives: Points, lines, circles and ellipses as primitives, scan conversion algorithms for primitives, Fill area primitives including scan-line polygon filling, inside-outside test, boundary and flood-fill, character generation, line attributes, area-fill attributes, character attributers. *

Module III: **(8 Hours)**

2D transformation and viewing: Transformations, matrix representation, homogeneous coordinates, composite transformations, reflection and shearing, viewing pipeline and coordinates system, window-to-viewport transformation, clipping including point clipping, line clipping, polygon clipping.*

Module IV: **(12 Hours)**

3D concepts and object representation: 3D display methods, polygon surfaces, tables, equations, meshes, curved lies and surfaces, quadric surfaces, spline representation, cubic spline interpolation methods, Bazier curves and surfaces, B-spline curves and surfaces.*

3D transformation and viewing: 3D scaling, rotation and translation, composite transformation, viewing pipeline and coordinates, parallel and perspective transformation, view volume and general (parallel and perspective) projection transformations.*

Module V: **(4 Hours)**

Advance topics: visible surface detection concepts, back-face detection, depth buffer method, illumination, light sources, illumination methods (ambient, diffuse reflection, specular eflection), Color models: properties of light, XYZ, RGB, YIQ and CMY colormodels.*

*Programming assignments are mandatory

Outcomes

- Ability to understand the various computer graphics hardware and display technologies.
- Ability to implement various 2D and 3D objects transformation techniques.
- Ability to apply 2D and 3D viewing technologies into the real world applications

Books:

[1] Computer Graphics; Principles and practice; 3rd Edition in C; J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes; Addison Wesley, 2018

[2] Computer Graphics - C version; D. Hearn and M. P. Baker; Pearson Education, 2nd Edition, 2004

[3] Computer Graphics - OpenGL version; D. Hearn and M. P. Baker; Pearson Education, 4th Edition, 2013

[4] Mathematical elements for Computer Graphics; 2nd edn.; D. F. Rogers and J. A. Adams; McGraw-Hill International. Edn., 1990.

Digital Learning Resources:

Course Name:	Computer Graphics
Course Link:	https://nptel.ac.in/courses/106/103/106103224
Course Instructor:	Prof. S. Bhattacharya, IIT Guwahati
	Computer Graphics
Course Name:	
Course Link:	https://nptel.ac.in/courses/106/102/106102063
Course Instructor:	Prof. P.K. Kalra, IIT Delhi

Course Name:	Introduction to Computer Graphics
Course Link:	https://nptel.ac.in/courses/106/102/106102065
Course Instructor:	Prof. P.K. Kalra, IIT Delhi

Course Name:	Computer Graphics
Course Link:	https://nptel.ac.in/courses/106/106/106106090
Course Instructor:	Prof. S. Das, IIT Madras

5Th Semester

Universal HumanValues

(Self, Society and Nature)

Pre-requisites: Universal Human Values: Self & Family (desirable); 4-day Harmony-2 Workshop (co-requisite). Please refer to AICTE Model Curriculum-Vol-II.

1. Objective:

The objective of the course is four-fold:

A. Sensitization of student towards issues in society and nature.
B. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
C. Strengthening of self-reflection.
D. Development of commitment and courage to act.

(For elaboration on some of the above, consult course description for Universal Human Values 1: Self and Family, AICTE Model Curriculum-VOL-II).

2. Course Topics:

In this Universal Human Values course, the focus is more on understanding society and nature on the basis of self and human relationships.

i) Purpose and motivation for the course.
ii) Recapitulation (from the previous course) on ideas of self, pre-conditioning, and natural acceptance.
iii) Harmony in the self. Understanding human being as co-existence of self and body. Identifying needs and satisfying needs of self and body. Self-observations. Handling peer pressure.
iv) Recapitulation on relationships. Nine universal values in relationships. Reflecting on relationships in family. Hostel and institute as extended family. Real life examples.
v) Teacher-student relationship. Shraddha. Guidance. Goal of education.
vi) Harmony in nature. Four orders of nature – material order, plant order, animal order and human order. Salient features of each. Human being as cause of imbalance in nature. (Film **"Home"** can be used.)
vii) Human being as cause of imbalance in nature. Depletion of resources – water, food, mineral resources. Pollution. Role of technology. Mutual enrichment not just recycling.

viii) Prosperity arising out of material goods and understanding of self. Separation of needs of the self and needs of the body. Right utilization of resources. lkekU; vkdka{kk ,oaegRokdka{kk, Understanding the purpose they try to fulfil.

ix) Recapitulation on society. Five major dimensions of human society. Fulfilment of the individual as major goal. Justice in society. Equality in human relationships as naturally acceptable. Establishment of society with abhaya (absence of fear).

x) Ethical human conduct. Values, character and netikataa.

xi) Professional ethics. Conduct as an engineer or scientist.

Digital Learning Resources:

Course Name: Universal Human Values

CourseLink: https://nptel.ac.in/courses/109/104/109104068/

Course Instructor: Prof. A.K. Sharma, IIT, Kanpur