Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**CS301**	**Title of the Course**	**Design and Analysis of Algorithm**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**V**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	To analyze the problem and design an efficient algorithm to solve it by using & modifying classical design techniques or creating a new solution technique						

Course Outcomes	
CO1	Would be able to analyze the problem and design an efficient algorithm to solve it by using & modifying classical design techniques or creating a new solution technique.
CO2	For an algorithm given all the required parameters, would be able to analyze the algorithm and evaluate its utility in the given situation, able to apply the approach where problem can be solved by smaller input then apply for larger perspective.
CO3	Given more than one solutions for the problem, would be able to evaluate and compare those using standard mathematical techniques and select the best solution.
CO4	For a design problem given, would be able to compare and evaluate different Data Structures available and modify or create new them for the same.
CO5	For given different problems, would be able to categorize the different kind of complexities and develop non deterministic solution to problems having large complexities.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction:**	Introduction: Algorithms, Analysis of Algorithms, Growth of Functions: Asymptotic Notations, Standard Notations and Common Functions; Recurrence Methods: Substitution Method, Iteration Method, Recursion Tree Method, Master's Method.	8	1
2	**Designing of Algorithms and Advanced Data Structure**	Divide & Conquer: Heap Sort, Quick Sort, Sorting in Linear Time, Medians and Order Statistics. Red-Black Trees, Augmenting Data Structure, Binomial Heaps, Fibonacci Heaps.	8	2
3	**Advanced Design and Analysis Techniques**	Greedy Algorithms: Knapsack Problem, Travelling Salesperson Problem, Minimum Cost Spanning Trees: Kruskal's Algorithm, Prim's Algorithm. Dynamic Programming: Longest Common Subsequence, Matrix Chain Multiplication, 0/1 Knapsack Problem, Single Source Shortest Path: Dijkstra's Algorithm, Bellman Ford Algorithm.	8	3
4	**Amortized Analysis, Back Tracking: and Branch & Bound**	Accounting Method, Aggregate Method, Potential Method, Introduction, Subset Sum Problem, n-Queens problem and Introduction, 0/1 Knapsack, 15 Puzzle problem.	8	4
5	**String Matching and Complexity Theory**	Algorithm, The Rabin-Karp Algorithm, The Knuth-MorrisPratt Algorithm. Class P and NP, NP-hard Problems, NP-Complete Problems, Polynomial Reduction, Approximation Algorithm	8	5

Reference Books:

1. Coremen, Rivest, Lisserson, "Algorithms", PHI.
2. Horwitz & Sahani, Fundamental of Computer Algorithm, Galgotia.
3. Michael T. Goodrich and Roberto Tamassia, Algorithm Design: Foundation, Analysis and Internet Examples, John Wiley Publications.

e-Learning Source:

https://nptel.ac.in/courses/106106131

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	3	1	3		3	1	1			1	1	3	
CO2	2	2	3	3	1	1	2	2	1			2	2	2	1
CO3	1	1	1	2	3	1		2	2			1		3	1
CO4	2	2	1	2	2	1	2	1	3		1		2	1	1
CO5	1	2	1	3	1		1		2	3	1	1	1	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	CS302	**Title of the Course**	Design and Analysis of Algorithm Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	0	0	2	1
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To learn the detail about DAA and about of Recursive binary and linear search. • To learn basic concepts of divide and conquer techniques and the Optimal Spanning tree. • To learn Greedy approach through various problem. • Study on sorting Network and NP complete theory. • Learning backtracking and Spanning tree.						

Course Outcomes	
CO1	Able to understand about DAA and implementation of Recursive Binary and linear search.
CO2	Able to implement divide and conquer techniques and optimal spanning tree. .
CO3	Able to analyze Greedy solution and implementation.
CO4	Able to implement Backtracking problem and shortest path.
CO5	Study on Sorting network and NP-Complete theory.

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Introduction	2	1
2	Implement Recursive Binary & Linear Search.	2	1
3	Implement Quick Sort (Divide & Conquer)	2	2
4	Find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.	2	2
5	Implement Knapsack Problem (GREEDY ALGO.	2	3
6	Implement of Directed and Undirected Graph.	2	3
7	Implement Shortest Path by Dijkstra's Algorithm.	2	4
8	Implement 8-Queen Problem (Backtracking).	2	4
9	Study of Sorting Network.	2	5
10	Study of NP-Complete Theory.	2	5

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2		3	1	3	1					2	1	1
CO2	2	1	3	2	1	2	3					1	2	1	1
CO3	1	2	2	2			3	2				2	2	1	1
CO4		2	2	2	1	2	3	2					2	1	1
CO5	1	2	1		1		3					1	2	1	1

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**CS-303**	**Title of the Course**	**Principles of Operating System**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**V**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	To introduce students with basic concepts of Operating System, its functions and services. To critique how memory management is implemented by the operating system, including concepts of paging, segmentation, paged segmentation etc. To introduce the concepts of Processes in Operating System and various algorithms to schedule these processes. To provide the knowledge of basic concepts towards process synchronization, deadlock and related issues. To gain insight on file management, disk management etc and to become familiar with the protection and security mechanisms taken by operating system.						

Course Outcomes	
CO1	The basic concepts of Operating System, its functions and services.
CO2	Design and effective memory management scheme for the operating system where there is less wastage and the response time is quick.
CO3	The basic concepts of Processes in Operating System and the application of various CPU scheduling algorithms.
CO4	Analyse the basic concepts of process synchronization, deadlock and related issues.
CO5	The basic components of file management, disk management etc and will become familiar with the protection and security mechanisms taken by operating system.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Desktop OS and Mobile OS**	Importance of Operating Systems; Basic Concepts and Terminology; Evolution of Operating Systems: Batch, Interactive, Time Sharing & Real Time Systems. Operating System Structure: Simple Structure, Layered Approach; System Calls; Kernels: overview, objectives of kernel, types of kernels. Architecture, Android OS, iOS, Virtual OS, Cloud OS and their design.	8	1
2	**Process, Threads, CPU Scheduling and Real Time Scheduling**	Introduction, Process Model, Process State, Process Control Block. Overview, benefits of threads, types of threads. Basic Concepts, Scheduling Criteria, And Types of Scheduling, Scheduling Algorithms: FCFS, SJF, Round Robin, Priority Scheduling, Multilevel Queue Scheduling, Multilevel, Feedback Scheduling. Introduction, Uniprocessor scheduling, Multiprocessor Scheduling.	8	2
3	**Process Synchronization and Deadlock**	Principles of Concurrency, Race Condition, Critical Section, Critical Section Problem, Synchronization Mechanism, Semaphores and Classical Problems of Synchronization: Bounded Buffer Problem, Readers Writers Problem.Principles, System Model, Deadlock Characterization, Methods of Deadlock Handling: Prevention, Avoidance, Detection & Recovery from Deadlock	8	3
4	**Memory Management and Virtual Memory Management**	Introduction, logical vs. physical address space, swapping, contiguous memoryallocation, paging, segmentation, segmentation with paging. Introduction, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU, Optimal), allocation of frames, thrashing.Other Memory Management Schemes: Swapping, Overlays.	8	4
5	**Device Management, Disk Scheduling and Protection & Security**	Introduction, types of devices, FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK Scheduling File Systems: file concept, Access Mechanism, directory structure, file system structure, allocation methods (Contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), Directory implementation (linear list, hash table), efficiency & performance.	8	5

Reference Books:

1. Galvin, Silberchatz “Operating Systems Principles”, Addision Wesley.
2. Milenekovie, “Operating System Concept”, McGraw Hill.
3. Dietal, “An Introduction to Operating System”, Addion Wesley.
4. Tannenbaum, “Operating System Design And Implementation”, PHI.
5. Galvin, Silberchatz “Operating Systems Principles”, Addision Wesley.

e-Learning Source:

https://nptel.ac.in/courses/106105214

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1		3			1	2	1		1	3	3		
CO2	2	3	3	2				1	2	1	2	2	2	2	1	2
CO3	2	2	1	3	2		1	2	2	2	3	3	1	2	3	1
CO4	3	3	1	2			1			3	2	2	3	2	2	
CO5	3	1	1	1	2			1	1	2		2	2	3		1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**CS312**	**Title of the Course**	**Digital Image Processing**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**V**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	To explain basics of digital signal processing such as Fourier analysis To expose students to different low level image processing tasks such as filtering, edge detection etc. To impart knowledge of image compression as well as various image Segmentation techniques. To introduce advanced image processing algorithms for face detection and recognition.						

Course Outcomes	
CO1	Explain basic image processing techniques for solving real problems
CO2	Apply image processing techniques for solving problems in computer science
CO3	Evaluate algorithms for higher level image processing.
CO4	Develop understanding for object registration and recognition
CO5	Develop an application using existing image processing algorithms

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction and Fundamentals**	Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception,A Simple Image Model, Sampling and Quantization.	8	1
2	**Image Enhancement in Spatial Domain**	Introduction; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching;Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/LogicOperations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.	8	2
3	**Color Image Processing**	Color Fundamentals, Color Models, ConvertingColors to different models, Color Transformation, Smoothing andSharpening, Color Segmentation. **Morphological Image Processing** Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing,Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, ConvexHull, Thinning, Thickening.	8	3
4	**Registration**	Introduction, Geometric Transformation – Plane to Plane transformation, Mapping, Stereo Imaging – Algorithms toEstablish Correspondence, Algorithms to Recover Depth Segmentation Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge ElementsExtraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.	8	4
5	**Feature Extraction**	Representation, Topological Attributes, Geometric Attributes. Description Boundary-based Description, RegionbasedDescription, Relationship. **Object Recognition** Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching	8	5

Reference Books:

1. Digital Image Processing 2nd Edition, Rafael C. Gonzalez and Richard E. Woods. Published by: PearsonEducation.
2. Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: John Wiley and Sons, NY.
1. Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall, Upper Saddle River, NJ.

e-Learning Source:

https://nptel.ac.in/courses/106106131

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	1	3	1	1	3	1	2	1	1	2	3	2			2
CO 2	3	2	3	2	1	1			2		2	1	3			3
CO 3	2	2	1	1	2	2	3		1		3			3		2
CO	3	2	2	2	3	3					2			3		3

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	CS336	**Title of the Course**	Full Stack Development- Backend	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	CS290, CS291	**Co-requisite**	None				
Course Objectives	The learners understand the methodical approach for MERN Full Stack Software Development with the MongoDB and performing validation.						

Course Outcomes	
CO1	Comprehensive understanding of the role and importance of Backend development in web applications
CO2	Basics of NoSQl, Mongo DB and basics of data validation and error handling
CO3	Comprehensive understanding of Middleware and basic routing concepts for handling error.
CO4	Applying Authentication and Authorization using API's and understanding basic roles.
CO5	Connecting React js with the database and performing debugging in Full Stack Application

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Introduction**	Basics of backend development and its role in web applications, Node.js:- Introduction, Basic Concepts, Setting up a simple server using Express.js, Handling basic HTTP requests and responses, Understanding RESTful API principles.	**8**	**1**
2	**Working with MongoDB Basics**	Introduction to NoSQL databases and MongoDB, Basics of designing collections and documents in MongoDB, Performing basic CRUD operations in MongoDB, Connecting Node.js to MongoDB using Mongoose, Basic data validation and error handling.	**8**	**2**
3	**Middleware and Basic Routing**	Middleware:- Introduction of middleware in Express.js, Basic routing concepts for handling endpoints, logging and error handling, Basic validation and request processing.	**8**	**3**
4	**Authentication and Authorization**	Introduction, Basic user registration and login functionality, Securing APIs with simple token-based authentication, Basic user roles and access control.	**8**	**4**
5	**Integration with Frontend and Final Project**	Connecting a simple React frontend to the backend, Passing data between frontend and backend, Basic error handling and debugging in a full-stack application, Final project: Building a simple MERN stack application.	**8**	**5**

Reference Books:

1. Nabendu Biswas, Mern Projects for beginners
2. Vasan Subramanian, Pro Mern Stack
3. Eddy Wilson Iriarte Koroliova, MERN Quick Start Guide
4. Shama Hoque, Full-Stack React Projects
5. Vishal Kamal, Beginner's Guide to MERN Technology

e-Learning Source:

1. https://www.udemy.com/course/fullstack-web-development-course-projects-base/

		Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	2	1	1	1	3		1	2	1	3	3
CO2	1	2	1	2	2	1	1	2	2	1	1	2	1	2	1	1
CO3	3	1	2	3	1		3	2		2		1	3	1	1	2
CO4	2	3	1	2	2	1		1	1		2		1	3	2	
CO5	1	3	2	1	3	2	2		3	1	1	2				1

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	CS337	**Title of the Course**	Full Stack Development- Backend Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	0	0	2	1
Pre-Requisite	CS290, CS291	**Co-requisite**	None				
Course Objectives	To facilitate the graduates with the technical skills that prepare them for immediate employment and providing a deeper understanding of the technology in advanced areas of computer science.						

Course Outcomes	
CO1	Develop expertise in designing scalable and secure backend systems.
CO2	Acquire skills in API design and implementation, facilitating seamless communication between frontend and backend components.
CO3	Implement robust error handling and debugging practices for maintaining code reliability.
CO4	Develop and optimize database interactions, utilizing CRUD operations,
CO5	Promoting cohesiveness and code management in a full stack development environment.

Experiment No.	**Name of Experiment**	**Contact Hrs.**	**Mapped CO**
1	Write a program to Create ,Read and Update in file System using NoteJs..	2	1
2	Write a program to Create a url module using NoteJs..	2	1
3	Write a program to Create a basic HTTP server using Node.js to handle incoming requests and send responses.	2	2
4	Write a program to Set up a RESTful API endpoint using the Express.js framework to handle GET requests.	2	2
5	Write a program to Connect to a MongoDB database and perform basic CRUD operations.	2	3
6	Write a program to Implement user authentication using JSON Web Tokens (JWT).	2	3
7	Write a program to Create custom middleware in Express to log request details.	2	4
8	Write a program to Implement error handling middleware in Express to manage runtime errors.	2	4
9	Write a program to Schedule and execute periodic tasks using the Node-cron library.	2	5
10	Write a program to Create a real-time chat application using Socket.io for WebSocket communication.	2	5

e-Learning Source:

1. https://www.udemy.com/course/fullstack-web-development-course-projects-base/
2. https://www.udemy.com/course/full-stack-crash-course/learn/lecture/35198512#overview

		Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	3	1	3		3	1	1		1	1	1	3		3
CO2	2	2	3	3	1		2	2	1		1	2	2	2	1	
CO3	1	1	1	2	3			2	2		2	1		3	1	2
CO4	2	2	1	2	2		2	1	3		3		2	1	1	1
CO5	1	2	1	3	1	3	1		2	3	2	1	1	2	3	1

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	CS338	**Title of the Course**	Mobile App Development Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	0	0	2	1
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	The Mobile App Development Lab aims to empower students with the practical skills and knowledge required to conceive, develop, and deploy innovative mobile applications that address real-world challenges and user needs.						

Course Outcomes	
CO1	Utilize industry-standard development environments, integrated development environments (IDEs), and software development kits (SDKs) for mobile platforms.
CO2	Understand the fundamental concepts of mobile app development, including user interface design, data management, and application lifecycle.
CO3	Implement essential features in mobile apps
CO4	Debug and troubleshoot common issues in mobile app development, employing debugging tools and techniques effectively.
CO5	Understand foundational concepts of mobile app development approaches.

Experiment No.	**Name of Experiment**	**Contact Hrs.**	**Mapped CO**
1	Develop an application that uses GUI components, Font, and Colors.	2	1
2	Develop an application that uses Layout Managers and event listeners.	2	1
3	Write an application that draws basic graphical primitives on the screen.	2	2
4	Develop an application that makes use of databases.	2	2
5	Develop an application that makes use of Notification Manager.	2	3
6	Implement an application that uses multi-threading.	2	3
7	Develop a native application that uses GPS location information.	2	4
8	Develop a mobile application to send an email.	2	4
9	Implement an application that writes data to the SD card.	2	5
10	Develop a Mobile application for simple needs (Mini Project).	2	5
e-Learning Source:			

		Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	3	1	3		3	1	1		1	1	1	3		3
CO2	2	2	3	3	1		2	2	1		1	2	2	2	1	
CO3	1	1	1	2	3			2	2		2	1		3	1	2
CO4	2	2	1	2	2		2	1	3		3		2	1	1	1
CO5	1	2	1	3	1	3	1		2	3	2	1	1	2	3	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	**CS339**	**Title of the Course**	**Introduction to Artificial Intelligence**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**V**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	**1.** Explain the basic problem-solving techniques, knowledge representation methods and learning methods of Artificial Intelligence. **2.** Assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving particular engineering problems. **3.** Understand the role of knowledge representation, problem solving, and learning in intelligent system engineering. **4.** Develop intelligent systems by assembling solutions to concrete computational problems. **5.** Develop an interest in the field sufficient to take more advanced subjects.						

Course Outcomes	
CO1	Design an intelligent agent to solve real world problems.
CO2	Identify the best heuristic for problem solving that will lead to find the optimal solution within constraints and adverse conditions.
CO3	Represent knowledge using logic programming, create knowledge base and apply inference mechanisms.
CO4	Apply statistical and probabilistic machine learning techniques for a real-world problem in order to solve it.
CO5	Design and develop an expert system, solve problems using evolutionary programming, using swarm intelligence and develop programs using PROLOG

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**INTRODUCTION**	Introduction to AI, Current Trends in AI, Intelligent Agents: - Agents and Environments, Nature of Environments, Structure of Agents, Problem-Solving, Problem-Solving Agents, Example Problems, Searching for Solutions, Uniformed Search Strategies (BFS, DFS, DLS, IDS).	8	1
2	**SEARCHING TECHNIQUES**	Informed (Heuristic) Search Strategies: - Heuristic Function, Greedy best first search, A* search, Local Search Algorithms and Optimization Problems (Hill Climbing & Genetic Algorithm), Introduction to Constraint Satisfaction Problems (CSP), Adversarial Search: - Optimal Decisions in Games (Minimax algorithm), Alpha – Beta Pruning.	8	2
3	**KNOWLEDGE AND REASONING**	Introduction to logical Agents, propositional calculus, Predicate logic,- Representation, Syntax and Semantics, Forward Chaining, Backward Chaining, CNF, Resolution, First Order Logic: –Representation, Syntax and Semantics, Inference in First Order Logic: – Unification, Forward Chaining, Backward Chaining, Resolution.	8	3
4	**LEARNING**	Forms of Learning, Inductive Learning: - Learning Decision Trees, Statistical learning methods: - learning by taking advice, learning in problem solving, explanation-based learning, Naïve bayes models, Bayesian network.	8	4
5	**INTELLIGENT SYSTEMS**	Expert System- Stages in the Development of an Expert System, Difficulties in Developing Expert System, Application of Expert System, Introduction to Evolutionary Programming, Swarm Intelligent Systems, Introduction to PROLOG.	8	5

Reference Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", 2nd Edition, Pearson Education / Prentice Hall of India, 2004.
2. George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", Pearson Education / PHI, 2002.
3. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.
4. N.P. Padhy, "Artificial Intelligence and Intelligence systems", Oxford Press.

e-Learning Source:

https://nptel.ac.in/courses/106105077

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	1		2						1	2	3		
CO2	3	3	3	2		2						3			2	1
CO3	3	2	3	2	3							3	1	2		
CO4	3	2	2	2	3	3						2		2	2	2
CO5	3	3	3	3	3	2	1	1	1			2		3		1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2021-22							
Course Code	**CS341**	**Title of the Course**	**Introduction to Internet of Things**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**V**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	1. To understand the concepts of Internet of Things. 2. To introduce the concept of M2M (machine to machine) with necessary protocols 3. To illustrate diverse methods of deploying smart objects and connect them to network. 4. To introduce the Raspberry PI platform, that is widely used in IoT applications 5. To Infer the role of Data Analytics and Security in IoT						

Course Outcomes	
CO1	Understand the concepts of Internet of Things and can able to build IoT applications.
CO2	Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules
CO3	Student must be able to understand the specialized aspects of IoT Devices
CO4	Elaborate the need for Data Analytics and Security in IoT
CO5	Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	1	1	2	1	2			1	1	2	2	3	1	2	
CO 2	3	3				2	2		2		1		3	2	2	1
CO 3	2	3	3	2	2	1				2	1	2	3	3	1	2
CO 4	3	3	2	2	1	3	2		2	2	3	3		3	3	1
CO 5	3	2	3	3	3	2	2		3	2	2	3	3	2	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	**CS342**	**Title of the Course**	**DATA COMPRESSION**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**V**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	1. Basic knowledge of Data compression 2. Types of data compression 3. Various techniques o f Data compression 4. Application of data compression						

Course Outcomes	
CO1	Understand the importance of compressions, and different compression models
CO2	Solve the various problems based on lossless compression approach such as Huffman, adaptive Huffman models
CO3	Solve problems using arithmetic and dictionary based compression techniques.
CO4	Apply partial prediction matching, and learn to transformation of source basedon Transform algorithms
CO5	Represent the various dynamic model in the form of structured vector representation

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction**	Compression Techniques: Loss Less Compression, Lossy Compression, Measures of Performance, Modeling and Coding. Mathematical Preliminaries for Lossless Compression: A Brief Introduction to Information Theory: - Models: Physical Models, Probability Models, Markov Models, Composite Source Model, Coding:-Uniquely Decodable Codes, PrefixCodes	8	1
2	**Huffman Coding**	The Huffman Coding Algorithm: Minimum Variance Huffman Codes, Adaptive Huffman Coding: Update procedure, Encoding procedure, decoding procedure. Golomb Codes, Rice Codes, Tunstall codes. Application of Huffman Coding. Text compression, Audio Compression.	8	2
3	**Arithmetic Coding**	Coding a Sequence, Generating a Binary Code, Comparison of Binary and Huffman Coding, Applications: Bi-Level Image Compression-JBIG and JBIG2 Standards. Dictionary Techniques: Introduction, Static Dictionary: - Diagram Coding, Adaptive Dictionary: The LZ77 Approach, The LZ78 Approach Applications. Image Compression: The Graphics Interchange Format (GIF), Compression over Modem.	8	3
4	**Prediction with Partial Match**	The Basic Algorithm, The ESCAPE SYMBOL, Length of Context, The Exclusion Principle, The Burrows-Wheeler Transform, Move-to- Front Coding, CALlC, JPEG-LS, Multi-resolution Approaches, Facsimile Encoding, Dynamic Markov Compression.	8	4
5	**Quantization**	Introduction of Scalar and Vector Quantization, Advantages of Vector Quantization Over Scalar Quantization, The Linde-Buzo-Gray Algorithm, Tree Structured Vector Quantizes, Structured Vector Quantizes.	8	5

Reference Books:

1.Introduction to Data Compression, Second Edition, Khalid Sayood, The Morgan Kaufmann Series

2. Data Compression: The Complete Reference 4th Edition by David Salomon, Springer

3. Text Compression1st Edition by Timothy C. Bell Prentice Hall

4. Elements of Data Compression, Drozdek, Cengage Learning

e-Learning Source:

https://nptel.ac.in/courses/106105166

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**3**	**2**	**2**	**2**								**3**	**2**	**2**	
CO2	**2**	**2**	**2**	**2**	**2**								**2**	**2**	**1**	
CO3	**2**	**2**	**1**	**1**	**2**								**3**	**2**	**1**	
CO4	**3**	**2**	**1**	**2**	**1**	**2**	**1**						**3**	**2**	**1**	
CO5	**2**	**2**	**3**	**2**	**2**	**1**	**1**	**1**					**3**	**2**	**2**	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	**CS334**	**Title of the Course**	**Cloud Computing**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**V**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	1. To study the the various paradigm of cloud computing and computing techniques. 2. To study the concepts ,key technologies, strength and limitation of cloud computing and possible application 3. To understand the architecture and infrastructure of cloud computing including SaaS, PaaS,Iaas, public cloud, private cloud and hybrid cloud. 4. To study Interpretation of various data, scalability and cloud services to acquire efficient database for cloud storage.						

Course Outcomes	
CO1	Explain the various paradigm of cloud computing and computing techniques.
CO2	Articulate the concepts ,key technologies, strength and limitation of cloud computing and possible application
CO3	Identify the architecture and infrastructure of cloud computing including SaaS, PaaS, Iaas, public cloud, private cloud and hybrid cloud.
CO4	Interpret various data, scalability and cloud services to acquire efficient database for cloud storage.
CO5	Describe the appropriate cloud computing solutions and recommendations according to application used.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction:	Historical development, Vision of Cloud Computing, Characteristics of cloud computing as per NIST, Cloud computing reference model, Cloud computing environments, Cloud services requirements, Cloud and dynamic infrastructure. Overview of cloud applications: ECG Analysis in the cloud, Protein structure prediction, Gene Expression Data Analysis, Satellite Image Processing, CRM and ERP ,Social networking.	8	1
2	Cloud Computing Architecture:	Cloud Reference Model, Types of Clouds, Cloud Interoperability & Standards, Scalability and Fault Tolerance; Cloud Solutions: Cloud Ecosystem, Cloud Business Process Management, Cloud Service Management. Cloud Offerings: Cloud Analytics, Virtual Desktop Infrastructure.	8	2
3	Cloud Management & Virtualization Technology:	Resiliency, Provisioning, Asset management, Concepts of Map reduce, Cloud Governance, High Availability and Disaster Recovery. Virtualization: Fundamental concepts of compute ,storage, networking, desktop and application virtualization .Virtualization benefits, server virtualization, Block and file level storage virtualization Hypervisor management software, Infrastructure Requirements , Virtual LAN(VLAN) and Virtual SAN(VSAN) and their benefits.	8	3
4	Cloud Security:	Cloud Information security fundamentals, Cloud security services, Design principles, Secure Cloud Software Requirements, Policy Implementation, Cloud Computing Security Challenges, Virtualization security Management, Cloud Computing Security Architecture.	8	4
5	Market Based Management of Clouds, Federated Clouds/Inter Cloud:	Characterization & Definition, Cloud Federation Stack, Third Party Cloud Services. Case study: Google App Engine, Microsoft Azure, Hadoop, Amazon.	8	5

Reference Books:

1. Buyya, Selvi ," Mastering Cloud Computing ",TMH Pub.
2. Kumar Saurabh, "Cloud Computing" , Wiley Pub.
3. Krutz , Vines, "Cloud Security " , Wiley Pub.
4. Velte, "Cloud Computing- A Practical Approach" ,TMH Pub.
5. Sosinsky, "Cloud Computing" , Wiley Pub.

e-Learning Source:

https://nptel.ac.in/courses/106105196

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	1	-		-	-	1	-	1	2	2	2	1	-
CO2	2	3	1	2	-	-	-	-	1	-	-	2	2	3	2	-
CO3	1	2	3	1	-	-	-	-	2	-	-	2	2	3	1	-
CO4	1	2	2	1	-	-	-	-	1	-	1	1	2	1	1	-

CO5	1	2	2	1	-	-	-	-	2	-	2	2	1	2	2	-

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17								
Course Code	**CS300**	**Title of the Course Industrial Training/ internship/Apprentices -II**						
Year	III	**Semester**	V	**L**	**T**	**P**	**C**	
Pre-Requisite	**None**	**Co-requisite**	**None**	0	0	1	1	
Course Objectives	Learn project management, technical skills, and teamwork. Apply advanced computer science knowledge for innovative solutions. Gain practical experience in software development. Improve communication and documentation skills.							

Minor Project, students will work on exploring, experimenting, or analyzing technical problems in different areas of Computer Science and Engineering. This includes tasks like software development, algorithm design, system design, software testing, data analysis, cybersecurity, artificial intelligence, network systems, or computer applications. The assessment for the project will be done both within the department and externally, following the established procedures. Students will also need to submit a detailed project report by the end of the seventh semester

Course Outcomes	
CO 1	Develop practical skills relevant to the industry through hands-on training and exposure to real-world tasks and challenges.
CO 2	Enhance professional competencies such as communication, teamwork, problem-solving, and adaptability within an industrial setting.
CO 3	Apply theoretical concepts learned in academic studies to solve practical problems and contribute effectively to projects within the industry, bridging the gap between academic learning and real-world applications.
CO 4	Demonstrate Proficient Communication and documentation Skills in Reports and Presentations Throughout and Following Industrial Training / Internship.

S.No	Skill Set	Content	Mapped CO
1	**Practical Skill Development**	Develop practical skills relevant to the industry through hands-on training and exposure to real-world tasks and challenges.	CO-1
2	**Professional Growth**	Enhance professional competencies such as communication, teamwork, problem-solving, and adaptability within an industrial setting.	CO-2
3	**Application of Theoretical Knowledge**	Apply theoretical concepts learned in academic studies to solve practical problems and contribute effectively to projects within the industry, bridging the gap between academic learning and real-world applications.	CO-3
4	**Documentation Communication Proficiency**	Demonstrate Proficient Communication and documentation Skills in Reports and Presentations Throughout and Following Industrial Training / Internship.	CO-4

CO-PO Mapping																
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO 1	2	3	1	3	1	0	1	2	3	0	1	3	3	3	2	2
CO 2	3	2	2	1	1	0	1	2	3	2	3	3	2	3	3	3
C03	2	2	1	2	2	1	1	2	2	3	2	3	3	3	3	3
C04	1	2	2	2	0	0	1	0	2	3	2	2	2	2	0	3

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CS305	**Title of the Course**	COMPUTER NETWORK	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To inculcate the conceptual & practical knowledge of computer networking right from "Basic" to a "Higher-Level understanding" of the course. • Helping to acquire the know-how of designing & organization computer networks, understanding the communication process and use of networking devices. • Imparting knowledge of Network Models, its working principles and functioning of various protocols associated thereto. • Enabling students to gain the practical knowledge of designing efficient networks, its implementation, monitoring and troubleshooting of computer network						

Course Outcomes	
CO1	Students will grasp communication and networking fundamentals, demonstrating recognition of transmission media, switching techniques, network components, and the ability to differentiate OSI and TCP/IP models.
CO2	Demonstrate proficiency in utilizing error handling techniques, analyzing flow control methods at the Data Link layer, and applying access control mechanisms for secure and efficient network operations
CO3	Demonstrate understanding of routing mechanisms, apply IP addressing for network design, and implement routing algorithms using simulation tools.
CO4	Proficient in TCP understanding, congestion control, distinguishing connectionless/connection-oriented services, and applying flow and congestion control techniques to evaluate network performance
CO5	Students will be able to recognize and evaluate factors affecting network performance, analyze Quality of Service, understand application layer protocols, and resolve networking issues.

S. No.	**Title of the Units**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Basics of Network & Physical Layer**	Data communication, Components, Data representation, Data flow. Performance criteria, topologies, category: LAN. MAN & WAN. OSI layered architecture, TCP/IP protocol suite. Physical Layer: Transmission Media Guided media, Twisted pair, coaxial cable, fiber optics. Unguided media: radio waves, microwaves & infrared waves. Circuit switching network, Packet Network & Virtual Circuit. Connecting Devices: Repeater, Hub, Switch, Bridge, Router and Gateway.	8	1
2	**Data Link Layer**	**Error Handling**: types of error, Block Coding, Hamming distance, Linear Block Codes, Cyclic Codes. Flow control: Stop & wait, **Sliding Window Protocols**: Designing and functioning of Go-Back-N, Selective Repeat method. **Random Access Protocol**: ALOHA, CSMA, CSMA/CD. Channelization: Frequency Division Multiple Access, Time Division Multiple Access, Code Division Multiple Access. Overview of Fast Ethernet: FDDI.	7	2
3	**Network Layer**	IPv4 Addressing, Classfull addressing, net-id, hosted, mask, subnet. Classless addressing, subnetting using classless addressing. Datagram formats for IPv4 and IPv6 addresses. **Address mapping protocols**: ARP and RARP. Packet delivery and packet forwarding. Unicast routing: Distance vector routing-RIP and Link state routing-OSPF. Path vector routing-BGP	10	3
4	**Transport Layer**	Process to process delivery, Connectionless versus connection oriented services. User data gram protocol(UDP) , frame format of datagram. **Transmission Control Protocol**: TCP services, TCP features, Segment format. Congestion Control: Open loop techniques (Retransmission, window and acknowledgement policies.), Closed loop techniques (Back pressure and choke packet).	8	4
5	**Quality of Service**	**Flow characteristics:** Reliability, Delay, Jitter and bandwidth. **Traffic Scheduling**: FIFO technique, Weighted fair queuing. Traffic shaping: Leaky bucket and token bucket. **Application Layer:** Domain name System: Name space, Domain Name space, Distribution of domain name space. DNS in internet, Resolution. Electronic Mail: SMTP, IMAP, POP3. File Transfer: FTP. Telnet, WWW: architecture, Client, URL, Cookies.	8	5

Reference Books:	
1	Forouzen, **"Data Communication and Networking",** TMH
2	A.S.Tanenbaum**, "Computer Networks",** 3rd Edition,Prentice Hall India,1997
3	W. Stallings, **"Data and Computer Communication",** Macmillan Press,1989.
e-Learning Resources:	
1	**https://nptel.ac.in/courses/106105080** by Prof. Ajit Pal (**IIT Kharagpur**)
2	**https://nptel.ac.in/courses/106106091** by Prof. Hema A Murthy **(IIT Madras**)
3	**https://nptel.ac.in/courses/106106243** (Video lectures) by **IIT Indore (** Advance Computer Network)

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	1	1	1	-	1	1	1	1	2	**3**	**1**	**3**	**1**
CO2	3	3	3	3	1	1	1	1	1	1	1	2	**3**	**2**	**3**	**2**
CO3	3	3	3	3	2	1	1	2	1	1	2	2	**1**	**3**	**2**	**2**
CO4	3	2	2	2	2	1	1	1	2	1	1	2	**2**	**3**	**1**	**1**
CO5	2	3	2	2	2	2	2	2	2	1	2	2	**3**	**2**	**2**	**1**

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	CS306	**Title of the Course**	Computer Networks Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	0	0	2	1
Pre-Requisite	None	**Co-requisite**	Computer Networks				
Course Objectives	Resource sharing in a Computer network is the main objective of this Lab. The objective of this lab course is to get practical knowledge of working principles of various communication protocols. Analyze structure and formats of TCP/IP layer protocols using network tools such as Cisco packet Tracer.						

Course Outcomes	
CO1	Understand the installation and basic functionalities of Cisco packet tracer.
CO2	Understand network layers, structure/format and role of each network layer.
CO3	Able to design and implement various network application such as data transmission between client and server, file transfer, VLAN.
CO4	Understand the various Routing Protocols/Algorithms and Internetworking.
CO5	Understand the structure and organization of computer networks; including wired and wireless communication.

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Simulation of Basic Router Configuration and its security in cisco packet tracer	2	1
2	To analyze the performance of various configurations and protocols in LAN.	2	1
3	To construct a Wireless LAN and make the PCs communicate wirelessly.	2	5
4	To construct simple LAN and understand the concept and operation of Address Resolution Protocol (ARP)	2	3
5	Simulation of telnet in Cisco packet tracer	2	3
6	Simulation of DHCP in Cisco packet tracer	2	3,4
7	Simulation of RIP in cisco packet tracer	2	3
8	Simulation of OSPF in cisco packet tracer	2	2
9	Simulation of crate and add VLAN in cisco packet tracer	2	3
10	Simulation of STP in cisco packet tracer	2	5
11	Simulation of two router communication in cisco packet Tracer	2	2
12	To understand the operation of SSH by accessing the routers remotely by PCs	2	1,4

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2		3		3						2	1	3
CO2	1	1	1	2	1		1						1	3	1
CO3	3	2	2	2			3						3	1	2
CO4	2	1	3	1			2						1	2	1
CO5	1	2	1				3						2	1	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**CS311**	**Title of the Course**	**Software Project & Quality Management**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**VI**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	1. Explain the basic understanding of software, its characteristics, and importance of following engineering principles to develop software. 2. Assess the applicability, strengths, and weaknesses of the different development life cycle models to provide real world software solutions. 3. To understand various processes of each phase of SDLC and make the students capable to prepare quality documentation for software development.						

Course Outcomes	
CO1	Analyze the systematically stepwise project planning.
CO2	Have knowledge of strategic program management, analysis of technical assessment of projects and study and analysis of different Cost-Benefit Evaluation Techniques.
CO3	Apply, analyze and compare effort estimation and different network planning models.
CO4	Evaluation and analysis of different resources and Critical Path, monitoring and control, Prioritizing monitoring and change control.
CO5	Compare and analyze modern project management, contract management, ISO Standards, CMM, Six Sigma Approach.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction to Project Planning**	Overview of Software Project Planning Software Project, Categorization of Software Project, Introduction to Stepwise Project Planning: Identify Project Scope and objectives, Identify Project Infrastructure, Project Products and Activities, Activity risks, Resource Allocation, Project Plan Execution	8	1
2	**Project Evaluation**	Project Evaluation: Strategic Program Management, Technical Assessment, Cost Benefit Analysis, Cash Flow Forecasting, Cost-Benefit Evaluation Techniques: Net profit, Payback Period, Return on Investment, Net Present Value, Internal Rate of Return, Risk Evaluation, Selection of Technologies, overview of software development models.	8	2
3	**Activity Planning and Risk Management**	Software Effort Estimation an Overview, Project Schedules, Network Planning Models, Activity Duration Estimation, and Risk Management: Identification, Analysis and Abatement of Risk	8	3
4	**Project Monitoring**	Resource Allocation: Nature of resources, Identifying Resource Requirements, Scheduling Resources, Creating Critical Path, Counting the Cost, Cost Schedules. Monitoring and Control: Visualizing progress, Cost Monitoring, Prioritizing Monitoring, Getting Project Back to Target, Change Control	8	4
5	**Software Quality Assurance**	Contract Management, Human Resource Management, Software Quality Definition, Software Quality Assurance, Quality Assurance Plan, Quality Matrices, ISO Standards, CMM, Six Sigma Approach	8	5

Reference Books:

1. Software Project Management by Bob Hughes and Mike Cotterell, Third Edition, TMH.
2. Information Technology Project Management by Kathy Schwalbe, International Student Edition, THOMSON Course Technology, 2003.
3. Software Quality by Mordechai Ben-Menachem/Garry S Marliss. Thomson Learning Publication
4. Software Project Management A Unified Framework by Walker Royce. Pearson Education.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	2	2	1		2			1	1			3	1		
CO 2	3	3		1		2	2		2	1	2		3	2		
CO 3	2	3	3	2	2	1				2	1		3	3	1	1
CO 4	3	3	2	2	1	3	2		1	2	3	3		3	1	2
CO 5	3		2	2	3	2	1			2	2	2	3			2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**CS313**	**Title of the Course**	**Microprocessor and its Applications**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**VI**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	This course deals with the systematic study of the Architecture and programming issues of 8 bit 8085-microprocessor and interfacing with other peripheral ICs and co-processor. In addition, a 16-bit microprocessors and other chips (8255, 8251, 8253 and 8257) are introduced. The aim of this course is to give the students basic knowledge of the microprocessors (8085 and 8086) needed to develop the systems using it.						

Course Outcomes	
CO1	Understand the basic architecture of 8085 and 8086.
CO2	Impart the knowledge about the instruction set of Microprocessor and assembly language Programming
CO3	Understand the basic idea about the data transfer schemes and its applications
CO4	Know about the concepts of Microprocessor interfacing
CO5	Understand advance microprocessor, microcontroller and Embedded System.

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	`1			1		2	2	3	3	2	1
CO2	3	3	2			2			3		1		3	2	2	2
CO3	2	3	3	1	1	1			1	2	1	2	3	3	1	2
CO4	3	3	2	2	1	3			2	2	3	3		3	3	1
CO5	3	2	3	3	3	2			3	2	2	3	3	2	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	CS314	**Title of the Course**	Microprocessor Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	0	0	2	1
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To expose students to the operation of typical microprocessor (8086) trainer kit. • To prepare the students to be able to solve different problems by developing different programs. • To develop the quality of assessing and analyzing the obtained data.						

Course Outcomes	
CO1	Understanding the working of 8086 practice training kit and simulator and Introduction to ARDUINO
CO2	Set up programming strategies and select proper mnemonics and run their program on their training boards.
CO3	Practice different types of programming keeping in mind technical issues and evaluate possible causes of discrepancy in practical experimental observations in comparison.
CO4	Develop testing and experimental procedures on Microprocessor and Microcontroller analyze their operation under different cases.
CO5	Prepare professional quality textual and computational results, incorporating accepted data analysis and synthesis methods, simulation software, and word processing tools.

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Write a program to two add 16-bit Hexadecimal numbers with and without carry	2	1
2	Write a program to multiply two 16-bit numbers result should be greater than 16 bit.	2	1
3	Write a program to find the greatest number from an array of 10 numbers	2	2
4	Write a program to multiply two 8-bit signed - numbers.	2	2
5	Write a program to input 5 numbers and arrange them in descending order.	2	3
6	Write a program to convert the string data it's Two's complement form	2	3
7	Write a program to read 8-bit data from Port B. Complement this data & send it back to Port A.	2	4
8	Write a program to move a block of data from one memory location to another.	2	4
9	Write a program to run the stepper motor for any number of steps and to stop it.	2	5
10	Practice basic programs on IoT kit such as raspberry and ARDUINO	2	5

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	-	1	-	-	2	2	2	2	2	1	1
CO2	3	3	1	2	2	1	1	1	2	2	2	2	2	1	1
CO3	1	2	3	2	-	3	-	2	2	3	1	-	2	1	1
CO4	2	3	-	2	2	1	-	1	2	2	-	2	2	1	1
CO5	1	2	1	¤	3	-	2	-	2	2	1	2	2	1	1

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**CS315**	**Title of the Course**	**Compiler Design**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**VI**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	The course curriculum helps to understand the concepts of compiler and phases, various translation schemes, the complexity of the input program, machine dependent code and machine independent code, optimization theory, syntax directed translation scheme of the input jobs, role and responsibility of pre-processor in compiler designing and compiling of the input jobs.						

Course Outcomes	
CO1	Know about the concepts of a preprocessor, translation rule, cross compiler, assembler loader and linker.
CO2	To know about the basic principles of the compiler, and its constituent parts, algorithms, and data structures required to be used in the compiler.
CO3	Know about the concepts of the function and complexity of modern compilers.
CO4	Know about the concepts of code generation algorithms to get the machine code for the optimized code.
CO5	Know about the concept flow graph, machine-dependent, and machine-independent optimization, intermediate code .

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	
1	**Introduction:**	Introduction to Compiler, Phases and Passes, Bootstrapping, Finite State Machines and Regular Expressions and their Applications to Lexical Analysis, Implementation of Lexical Analysers, Lexical analyser Generator, LEX-compiler, Formal Grammars and their Application to Syntax Analysis, BNF Notation, Ambiguity, YACC.	8	
2	**Context Free Grammars**	The Syntactic Specification of Programming Languages: Context Free Grammars, Derivation and Parse Trees, Capabilities of CFG. Basic Parsing Techniques: Parsers, Top Down Parsing, Predictive Parsers, LL(1), Shift Reduce Parsing, Operator Precedence Parsing, Elimination of left recursion	8	
3	**Parsing**	Automatic Construction of Efficient Parsers: LR Parsers, the Canonical Collection of LR(O) Items, Constructing SLR Parsing Tables, Constructing Canonical LR Parsing Tables, Constructing LALR Parsing Tables, using Ambiguous Grammars, an Automatic Parser Generator, Implementation of LR Parsing Tables, Constructing LALR Sets of Items.	8	
4	**Syntax-Directed Translation**	Syntax-Directed Translation: Syntax-Directed Translation Schemes, Implementation of Syntax-Directed Translators, Intermediate Code, Postfix Notation, Parse Trees & Syntax Trees, Three Address Code, Quadruple & Triples, Translation of Assignment Statements, Boolean Expressions, Statements that Alter the Flow of Control, Postfix Translation, Translation with a Top Down Parser. More About Translation: Array References in Arithmetic Expressions, Procedures Call, Declarations, Case Statements.	8	
5	**Symbol Tables**	Symbol Tables: Data Structure for Symbols Tables, Representing Scope Information. RunTime Administration: Implementation of Simple Stack Allocation Scheme, Storage Allocation in Block Structured Language. Introduction to Code Optimization: Loop Optimization, the DAG Representation of Basic Blocks, Value Numbers and Algebraic Laws, Global Data-Flow Analysis. Introduction to Code Generation.	8	

Reference Books:

1- Aho, Sethi & Ullman, “Compiler Design”, Addison Wesley.

e-Learning Source:

1. https://onlinecourses.nptel.ac.in/noc21_cs07/preview

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	2	2	3		3							3	3		
CO2	2	2		3		2						1	3	2	3	
CO3	1	3	2	3		2							1	2	3	
CO4	3	3	3	3		2							3	3	3	
CO5	3	3	3	3		3			1				2	3	3	

1- **Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	CS316	**Title of the Course**	COMPILER DESIGN LAB	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**0**	**0**	**2**	
Pre-Requisite	OOPS concept and basic C programming	**Co-requisite**	Hands-on on lex and yacc tools.				
Course Objectives	Students will be exposed to compiler writing tools, they will learn to implement the different Phases of compiler, get familiar with control flow and data flow analysis, and will learn simple optimization techniques.						

Course Outcomes	
CO1	Able to understand the basic concepts TOKEN and lexeme, the flow of control
CO2	Able to design and implement LL and LR parsers.
CO3	Able to analyze the control flow and data flow of a typical program
CO4	Able to design and develop the backend of compiler.
CO5	Able to optimize and run program faster on the designed compiler.

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Develop a lexical analyzer to recognize few pattern in C. (to implement TOKENIZER to identify tokens such as identifiers, constant, comments, operators etc.)	2	1
2	Implementation of Lexical Analyzer using Lex Tool	2	1
3	Write a program to find out FIRST / FOLLOW of grammar.	2	2
4	Design a parser like RECURSIVE DESCENT PARSER.	2	2
5	Design LR(0) PARSER.	2	3
6	Evaluate POSTFIX and PREFIX expression with the help of stack.	2	3
7	Implementation of type checking.	2	4
8	Implement a compiler backend that generates machine code for the given intermediate code.	2	4
9	Implementation of symbol table.	2	5
10	Implementation of code optimization techniques.	2	5

Reference Books:

1. Modern Compiler Implementation in C, Andrew W. Appel, Cambridge University Press
2. Modern Compiler Design- Dick Grune, Henry E. Bal, Cariel T. H. Jacobs, Wiley dreamtech

e-Learning Source:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		1			2	2					1	2	2	1	1
CO2	3	3	2	1	2	1	3		1	1	2	2	3	3	2	3
CO3	2	3	2	3	1	2	2		2	2	1	1	2	3	2	2
CO4	1	2	3	3	1		2		1		2	2	2	2	3	2
CO5	2	3	3	3	2	3	3	1	2	1	3	2	2	3	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**CS320**	**Title of the Course**	**Real Time Systems**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**VI**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	To give knowledge and understandings of Real time Systems and their applications						

Course Outcomes	
CO1	Apply the knowledge of operating system concepts to understand real time system concepts like tasks and scheduling.
CO2	Analyze the various parameters related to the different types of scheduling in single processor and multiprocessor environments.
CO3	The basic concepts of real time databases and their applications.
CO4	Apply the basic concepts of fault tolerance and clocks to design an effective real time system.
CO5	Identify the various protocols for effective resource sharing.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	
1	**Introduction:**	Introduction to Real Time Systems, Structure of Real Time System, Various Classification of Real Time Systems, Embedded System, Characterizing Real Time System & Task, Various Issues in Real Time System	8	
2	**Task Assignment & Scheduling**	Classical Uniprocessor Scheduling Algo- Rate Monotonic, EDF. Uniprocessor Scheduling of IRIS Tasks, Identical and Nononidentical Linear & Concave Reward Function, 0/1 Reward Function. Task Assignment Algorithms- Utilization Balancing, A Next-Fit Algorithm for RM Scheduling, A Myopic Offline Scheduling FAB Algorithm & Buddy Strategy	8	
3	**Real Time Database**	Real Time vs. General purpose Database, Main Memory database, Concurrency Control Issues, Real Time OS- Threads and Tasks, Kernel, Case Study of QNX, VRTX, Vx Works.	8	
4	**Fault Tolerance Techniques**	Introduction Fault, Fault Detection and Error Containment, Redundancy Data Diversity, Reversal Checks, Malicious & Integrated Failure Handling. Clock Synchronization: Introduction Clocks, A Nonfault Tolerant Synchronization Algorithms, Impact of Fault, Fault Tolerant Synchronization in H/Wand S/W	8	
5	**Real Time Communication**	Introduction, N/W Topologies, Protocols: Internet & Resource Reservation Protocols, Real Time Protocol, Contention-Based Protocol.	8	

Reference Books:

1. C.M. Krishna & Shin. “Real Time Systems”, Mc Graw Hill 1985.
2. Jane W.S. LIU, “Real Time Systems”, Pearson Education.
3. Levo & Agarwal, “Real Time Systems”, Mc Graw Hill.

e-Learning Source:

1. https://onlinecourses.nptel.ac.in/noc21_cs98/preview
2. https://www.coursera.org/learn/real-time-systems

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	1		1		1	2	1	1		2	2	3	2		2
CO2	3	3	3	3	3	2	1	1			2	2	3	2	2	2
CO3	3	3			3	1	1	1	2		2	3	3			2
CO4	3	3	3		2	1	1	1			3		3	2	2	2
CO5	3	3			1				2		3		2		2	

1- **Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

Integral University, Lucknow

Effective from Session: 2021-22							
Course Code	**CS345**	**Title of the Course**	**Advance Computer Architecture**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**VI**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	The main aim of the course is to help students understand the effect of modern computer architectures on software and program performance, and the new developments in computer architecture and how it affects algorithm design. Main themes include: memory hierarchy, caching, pipelining, parallelism and multiprocessors						

Course Outcomes	
CO1	Registers, bus as well as memory and its hierarchy and input/output devices.
CO2	Division based algorithms for different representation of data and discuss I/O interfaces, ports and Data Transfer modes
CO3	Register and stack organization and construct different control units.
CO4	Types of memory and memory mapping of one type with other
CO5	Knowledge about Interconnection Network, non-blocking network, cross bar network, and shuffle exchange network.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Introduction**	Introduction to Computer Architecture, Evolution of Computer Architecture, Parallel Computing, Parallel Architectural Classification Schemes: Flynn's, Shores, Feng's Classification; Performance of Parallel Processors: Speedup Performance Laws, Amdahl Law, and Gustafson Law, Performance Metrics and Measures.	8	1
2	**Pipeline Processing:**	Pipeline Processing: Introduction to Pipeline Processing, Arithmetic Pipelines, Pipelined Instruction Processing, Instruction Level Parallelism. Interlocks, Hazards, and Hazards Detentions & Resolution, Scheduling of Pipelines	8	2
3	**Processor Architectures:**	Processor Architectures: Superscalar Architecture, Vector Architecture and VLIW Architecture, Super pipeline design, Memory Technology: Cache Architecture; Cache Coherence and Synchronization Mechanisms, Shared-Memory Organizations	10	3
4	**Synchronous parallel processing**	Synchronous parallel processing, SIMD Architecture and programming principals, SIMD parallel algorithm, Data mapping and memory in Array Processor	10	4
5	**Interconnection Network**	Interconnection Network, introduction to permutations, group of mapping, decomposition of a permutation into cycles, elementary permutation used in interconnection network, complete non-blocking network, cross bar network, clos network, Benes's network, shuffle exchange network	8	5

Reference Books:

1. Peterson & Heresy, "Quantitative approach to computer Architecture"
2. Kai Hwang, "Advanced Computer Architecture", McGraw Hill International
3. "Morgan Kaufman". Quin, "Parallel computing, Theory & Practices", McGraw Hill
4. Bhujde, "Parallel Computing", New Age International Hwang, "Advance ComputerArchitecture

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	3	1	1	1		1	3	1	2	2
CO2	3	3	3	2	1	1	1	1	1		1	2		2	1
CO3	3	2	1	1			1	1	1		1	3		1	2
CO4	3	2	2		3	2	1	1	1		1	2	3	2	3
CO5	3	1	1	1	1	2	3	1	1	1	1	2	1	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	**CS346**	**Title of the Course**	**Concepts in Advanced Database System**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**VI**	**3**	**1**	**0**	**4**
Pre-Requisite	**DBMS**	**Co-requisite**	**None**				
Course Objectives	To give the knowledge of Advance SQL Queries, which help the student to learn the working of Internal processing of DBMS, when the query imputed. To give knowledge and understandings of Distributed database. To give the knowledge about database tuning and explain basic issues of Database security. To give the knowledge of database tuning and database security. To give the knowledge about data warehouse, connectivity and different types of emerging databases.						

Course Outcomes	
CO1	To understand and apply principles of database management systems for query processing and query optimization.
CO2	To understand object-oriented database, model, database tuning, benchmarks, and search key performance.
CO3	To have knowledge about Distributed Database's structure, query processing, recovery, and protocols.
CO4	To understand and apply the concept of database security techniques.
CO5	To have knowledge of emerging databases as Temporal, Spatial, Multimedia, Data Mining, and web databases concept.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Query Processing and Optimization**	Clustering & Indexing, Query Processing, Estimations for Query Processing Cost Algorithms for executing selection Operations, Algorithms for executing Join Operations, Algorithm for executing Project Operations. Query Optimization: Heuristics for Query Optimizations, Query Evaluation Plans, Pipelined Evaluations, System Catalogue in RDBMS	8	1
2	**Object Oriented databases**	Database Tuning: Database Workloads, Tuning Decisions, DBMS Benchmarks, Multiple Attribute Search Keys, Extended Relational Model & Object Oriented Database System: Requirement, Properties, Structured Types, Object Identity, Containment, and Class Hierarchy, Logic Based Data Model, and Nested Relational model.	8	2
3	**Distributed databases**	Distributed Database System: Structure of Distributed Database, Data Fragmentation, Data Model, Query Processing, Semi Join, Parallel & Pipeline Join, Concurrency Control in Distributed Database System, Recovery in Distributed Database System, Distributed Deadlock Detection and Resolution, Commit Protocols	8	3
4	**Database Security**	Database Securities: Database Security, Access Control and Grant & Revoke on Views and Integrity Constraints, Mandatory & Discretionary Access Control, Role of DBA, Security in Statistical Databases	8	4
5	**Enhanced databases**	Enhanced Data Model for Advanced Applications: Database Operating System, Introduction to Temporal Database Concepts, Introduction to Spatial and Multimedia Databases, Introduction to Data Mining, Introduction to Active Database System & Deductive Databases, Database Machines, Web Databases.	8	5

Reference Books:

1- Majumdar & Bhattacharya, "Database Management System", TMH.

2- Korth, Silberchatz, Sudarshan, "Database Concepts", Addison Wesley

3- Elmastri, Navathe, "Fundamentals of Database Systems", Addison Wesley

4- Date C.J., "An Introduction to Database System", Addison Wesley.

PO-PS O / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	3	3	3	2	2		2	3		2	2	3	3	3	1
CO 2	3	3	3	3	3	2		2	3		1	2	3	3	3	1
CO 3	3	3	3	3	2	2		2	2		2	2	3	1	3	1
CO 4	3	3	2	3	3	2		2	2		2	2	3	3	1	2
CO 5	3	3	2	3	2	2		2	3		1	2	1	3	3	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2021-22							
Course Code	**CS347**	**Title of the Course**	**Green Computing**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**VI**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	To reduce the environmental impact of computing through sustainable practices and technologies.						

Course Outcomes	
CO1	Understand Green IT fundamentals, enabling them to develop and implement strategies for reducing environmental impact in IT operations.
CO2	Learn the life cycle of green devices and evaluating software impact on platform power.
CO3	Develop expertise in implementing sustainable practices across various assets and apply best practices for green PCs.
CO4	Acquire the knowledge of Socio-cultural dimensions of Green IT and Understand the concept of Green Compliance.
CO5	Develop the ability to apply green IT strategies and understanding of the regulatory environment impacting IT.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction**	Green IT Fundamentals: Business, IT, and the Environment –Environmental Impacts of IT, Green IT, Holistic Approach to Greening IT, Greening IT, Applying IT for enhancing. Environmental sustainability, Green IT Standards and Eco-Labelling of IT, Enterprise Green, IT strategy, Green IT: Burden or Opportunity?	8	1
2	**Green Devices and Hardware with Green Software**	Green Devices Hardware/Software: Introduction, Life Cycle of a device or hardware, Reuse, Recycle and Dispose, Energy-saving software techniques, Evaluating and measuring software Impact to platform power	8	2
3	**Green Assets and Modeling and Grid Framework**	Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration –Green Information Systems: Design and Development Models. Virtualization of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center – Green Grid framework	8	3
4	**Green Compliance and Social Aspects**	Socio-cultural aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, and Audits – Emergent Carbon Issues: Technologies and Future. Introduction, Strategizing Green Initiatives, Implementation of Green IT, Information Assurance, Communication and Social media	8	4
5	**Regulating the Green IT and CASE STUDIES**	Introduction, The regulatory environment and IT manufacturers, Non regulatory government initiatives, Industry associations and standards bodies, Green building standards, Green data centers, Social movements and Greenpeace. Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.	8	5

Reference Books:

1- BhuvanUnhelkar, ―Green IT Strategies and Applications-Using Environmental Intelligence‖, CRC Press, June 2014.

2- Woody Leonhard, Katherine Murray, ―Green Home computing for dummies‖, August 2012.

3- Harnessing Green IT Principles and Practices , San Murugesan, G.R. Gangadharan, Wiley Publication, ISBN:9788126539680

e-Learning Source:

Integral University, Lucknow

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2		2	1	3	3		2		2	1		2	2
CO2	3	2	2		2	2	3			1		2	3		1	2
CO3	3	3	2		3	2	3			2		2	2		3	2
CO4	3	2	1		2	3	3	2		1					1	2
CO5	3	1	1		1	3	3	2		1		1			1	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2021-22							
Course Code	**CS348**	**Title of the Course**	**Human Computer Interaction**	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	**VI**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	To give the knowledge of TCP/IP protocol. To give the knowledge of packet switching and message switching. To give the knowledge of sliding window protocol. To give the knowledge of the CDMA. To give the knowledge of network layer protocols viz. Ipv4, ARP, RARP. To give the knowledge of routing. To give the knowledge of TCP & UDP. To give the knowledge of congestion control. To give the knowledge of quality of service. To give the knowledge of DNS, FTP, TELNET and remote logging.						

Course Outcomes	
CO1	Acquire fundamental concepts of computer components functions regarding interaction with human and vice versa
CO2	Analyze interface problems to recognize what design approach and interaction styles are required in the light of usability standards and guidelines.
CO3	Utilize basic concepts to construct a user-interaction strategy for a given problem its usability evaluation and to meet desired needs within realistic constraints such as social, political and ethical norms.
CO4	Ability to design and develop an interface by using appropriate HCI techniques that are preferred by the user.
CO5	Ability to apply different evaluation technique with case studies.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to user-centric design	Introduction to user-centric design – case studies, historical evolution, issues and challenges and current trend, Engineering user-centric systems – relation with software engineering, iterative life-cycle, prototyping, guidelines, case studies	8	1
2	User-centric computing	User-centric computing – framework, introduction to models, model taxonomy, Computational user models (classical) – GOMS, KLM, Fitts' law, Hick-Hymans law.	8	2
3	Computational user models	Computational user models (contemporary) 2D and 3D pointing, constrained navigation, mobile typing, touch interaction, Formal models – case study with matrix algebra, specification and verification of properties, formal dialog modeling.	8	3
4	Empirical research	Empirical research – research question formulation, experiment design, data analysis, statistical significance test. Case Study 1- Multi-Key press Hindi Text Input Method on a Mobile Phone.	8	4
5	User-centric design evaluation	User-centric design evaluation – overview of evaluation techniques, expert evaluation, user evaluation, model-based evaluation with case studies. Case Study 2 – GUI design for a mobile phone based Matrimonial application.	8	5

Reference Books:

1- Samit Bhattacharya (July, 2019). Human-Computer Interaction: User-Centric Computing for Design, McGraw-Hill India, Print Edition: ISBN-13: 978-93-5316-804-9; ISBN-10: 93-5316-804-X, E-book Edition: ISBN-13: 978-93-5316-805-6; ISBN-10: 93-5316-805-8.

2- Dix A., Finlay J.,Abowd G. D. and Beale R. Human Computer Interaction, 3rd edition, Pearson Education, 2005.

3- Preece J., Rogers Y., Sharp H., Baniyon D., Holland S. and Carey T. Human Computer Interaction,Addison-Wesley, 1994.

4- B. Shneiderman; Designing the User Interface,Addison Wesley 2000 (Indian Reprint).

e-Learning Source:

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**2**	**1**	**2**		**1**		**2**		**3**	**2**	**2**	**3**	**2**	
CO2	**2**	**3**	**1**	**1**	**3**	**2**			**2**	**1**	**2**		**3**	**2**	**2**	
CO3	**2**	**3**	**3**	**2**	**2**		**1**	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**1**	
CO4	**2**	**3**	**2**	**1**	**1**	**3**	**2**		**2**	**2**	**3**	**3**	**1**	**3**	**3**	
CO5	**3**		**3**	**3**	**3**	**2**	**3**			**2**	**2**	**2**	**3**	**2**	**1**	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation