Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	BM-226	**Title of the Course**	Human Values & Professional Ethics	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	•To understand the moral values that ought to guide the Management profession, Resolve the moral issues in the profession, •To justify the moral judgment concerning the profession. •To create an awareness on Management Ethics and Human Values. •To inspire Moral and Social Values and Loyalty. Intended to develop a set of beliefs, attitudes, and habits that engineers should display concerning morality. •To create awareness about the important global issues: . Multinational corporations - Environmental ethics - computer ethics - weapons development						

Course Outcomes	
CO1	Know about the concepts of database, their types, design concepts and ER-models
CO2	Know about the concepts of relational databases, working with SQL for frontend development
CO3	Know about the concepts of query optimization, transaction processing and concurrency control
CO4	Know about the concepts of database technologies, distributed database environment
CO5	Know about the concept of data warehouse, data cleaning and data integration

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Human Value Education	Understanding the need, basic guidelines, content and process for Value Education, Self Exploration - Its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly.	6	1
2	Introduction to Ethical Concept	Definition of industrial ethics and values, Ethical rules of industrial worker. Values and Value Judgments. Moral Rights and Moral rules, Moral character and responsibilities. Privacy, Confidentiality, Intellectual Property and the Law. Ethics as Law	6	2
3	Professional Responsibility	The basis and scope of Professional Responsibility, Professions and Norms of Professional Conduct, Ethical Standards versus Profession, Culpable mistakes, the Autonomy of professions and codes of ethics. Employee status and Professionalism. Central Professional Responsibilities of Engineers: The emerging consensus on the Responsibility for safety among engineers, hazards and risks.	6	3
4	Engineers Ethics	Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles- theories about right action - Self-interest - customs and religion - uses of ethical theories. Valuing Time – Co- operation – Commitment	6	4
5	Global Issues	**A Glimpse of Life Stories:** Life story of **Prophet Mohammad**, Mahatma Gandhi, Swami Vivekananda, Marie Curie and Steve Jobs. Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - moral leadership	6	5

Reference Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Value Education.
2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

e-Learning Source:

1. Value Education website, http://www.uptu.ac.in . 2. Story of Stuff, http://www.storyofstuff.com
2. **https://www.youtube.com/watch?v=nlh9V5gd8hg&list=PLbMVogVj5nJQ20ZixllzM69agBq-m8ndV**
3. **https://www.youtube.com/watch?v=9LSEBK03CiY&list=PLysZquKdjuWSv87TaE7pByn5TE_e46O2C**

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

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

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CS 206	**Title of the Course**	Discrete Structure	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	Explain the basic components of computer, their interconnection and data representation techniques in computer systems • To assess the working of CPU and become familiar with computer arithmetic's. • Understand the control unit design using hardwired and micro programmed approach. • To study the memory organization and articulate design issues in each element of memory hierarchy. • Understand the input output organization, data transfer, and modes of communication.						

Course Outcomes	
CO1	Describe the basic organization of computer and data representation techniques used in computer systems.
CO2	Use the computer arithmetic in designing of CPU.
CO3	Design the control unit using hardwired and micro programmed approach.
CO4	Resolve the issues arising in the design of elements of memory hierarchy.
CO5	Design the input output organization and resolve the issues arising in data transfer.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Set Theory	Definition of Sets, Countable and Uncountable Sets, Venn Diagrams, Proofs of Some General Identities on Sets **Relation:** Definition, Types of Relation, Composition of Relations, Pictorial Representation of Relation, Equivalence Relation, Partial Ordering Relation. **Function:** Definition, Type of Functions, One to One, Into and Onto Function, Inverse Function, of Functions, Recursively Defined Functions. Theorem Proving Techniques: Mathematical Induction Simple and Strong), Pigeonhole Principle, Prove by Contradiction.	9	1
2	Algebraic Structures	Definition, Properties, Types: Semi Groups, Monoid, Groups, Abelian Group, Properties of Groups, Subgroup, Cyclic Groups, Cosets, Factor Group, Permutation Groups, Normal Subgroup, Homomorphism and Isomorphism of Groups, Example and Standard Results, Rings and Fields: Definition and Standard Results.	8	2
3	Posets, Hasse Diagram and Lattices	Introduction, Ordered Set, Hasse Diagram of Partially, Ordered Set, Isomorphic Ordered Set, Well Ordered Set, Properties of Lattices, Bounded I and Complemented Lattices. **Boolean Algebra:** Basic Definitions, Sum of Products and Product of Sums, Form in Boolean Algebra, Logic Gates and Karnaugh Maps. **Tree:** Definition, Rooted Tree, Properties of Trees, Binary Search Tree, Tree Traversal.	9	3
4	Propositional Logic	Proposition, First Order Logic, Basic Logical Operation, Truth Tables, Tautologies, Contradictions, Algebra of Proposition, Logical Implications, Logical Equivalence, Predicates, Universal And Existential Quantifiers.	7	4
5	Combinatorics & Graphs	Recurrence Relation, Generating Function, Simple Graph, Multi Graph, Graph Terminology, Representation of Graphs, Bipartite, Regular, Planar and Connected Graphs, Connected Components in a Graph, Euler Graphs, Hamiltonian Path and Circuits, Graph Coloring, Chromatic Number, Isomorphism and Homomorphism of Graphs.	8	5

Reference Books:

1. Liptschutz, Seymour, "Discrete Mathematics", McGraw Hill.
2. Trembley, J.P & R. Manohar, "Discrete Mathematical Structure with Application to Computer Science", McGraw Hill.
3. Kenneth H. Rosen, "Discrete Mathematics and its applications", McGraw Hill.
4. Deo, Narsingh, "Graph Theory With application to Engineering and Computer.Science.", PHI.
5. Krishnamurthy, V., "Combinatorics Theory & Application", East-West Press Pvt. Ltd., New Delhi.

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc20_cs82/preview

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

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

Integral University, Lucknow

Effective from Session: Session 2016							
Course Code	BM-225	**Title of the Course**	Principle of Management And Engineering Economics	**L**	**T**	**P**	**C**
Year-	2nd	**Semester-**	3rd	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	The course curriculum helps to understand about the basic knowledge of Engineering Economics, Management skills and its functions. It also helps in understanding the banking system and its function.						

Course Outcomes	
CO1	Knowledge of engineering economics
CO2	Basic Knowledge of concept and functions of economics
CO3	Knowledge of Banking sector and Functions of Money
CO4	Knowledge of Management & its Functions
CO5	Knowledge of Personality Development,Learning and Group behaviour

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Industrial Economics**	Nature and Significance of Economics, Meaning of Science, Engineering and Technology and their relationship with Economic Development	8	1
2	**Concepts of Demand, Supply and Indifference curve analysis**	The Concept of Demand and Supply, Elasticity of Demand and Supply, Indifference curve Analysis, Price Effect, Income Effect and Substitution Effect	8	2
3	**Money and Banking system**	Functions of money, Value of money, Inflation and Measures to control it, Brief idea of Functions of Banking system viz Commercial and Central Banking ,Business Fluctuations.	8	3
4	**Evaluation of Management Thought**	Definition, Nature and Significance of Management, Evaluation of Management Thought, Contributions of Max weber, Taylor and Fayol.	8	4
5	**Factors of Individual Behavior, Learning and Personality development**	Factors of Individual Behaviour, Perception, Learning and Personality Development. Interpersonal Relationship and Group Behaviour.	8	5

Reference Books:

1. Dewett, K.K./Modern Economic Theory/ S.Chand.
2. Luthers Fred /Organizational Behaviour.
3. Prasd l.M./ Principles of Management
4. A.W. Stonier & D.C.Horgne / A Textbook of Economics Theoy / Oxford publishing House Pvt.Ltd.

e-Learning Source:

https://youtu.be/nK7Xo3v0i7M

https://youtu.be/CpC9E0oc2Cc

https://youtu.be/a6fgzjPd_7w

https://youtu.be/z1L9Ye6cK6U

https://youtu.be/DBwqr2UPVtk

https://youtu.be/xBaLgJZ0t6A

https://youtu.be/dhYoZ4lORYA

	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	PSO6	PSO7
CO1	3	2	2	3	3	2	1	3	1	2	1	2	-	2	2	2	-	-
CO2	3	2	1	1	1	2	2	2	2	2	3	1	1	2	1	1	-	-
CO3	2	2	2	2	1	1	3	2	3	1	1	2	1	1	1	1	-	-
CO4	2	1	1	2	3	1	1	2	2	2	1	3	-	-	1	2	-	-
CO5	1	1	2	3	1	2	1	3	1	2	1	2	1	1	1	2		

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CS-203	**Title of the Course**	Cyber Law And Information Security	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	Knowledge about cyber law, intellectual property and cyber crimes(internet security threats), trademarks and domain theft • Knowledge on the disciplines of technology, E-business and law to allow them to minimize the occurrence and severity of information security incidents. • Knowledge about Information System and principles of Information Security (as confidentiality, integrity, and availability) • Knowledge of cryptography and techniques used to detect and prevent network intrusions.						

Course Outcomes	
CO1	Understand key terms and concepts in cyber law, intellectual property and cybercrimes(internet security threats), trademarks and domain theft.
CO2	Keep an appropriate level of awareness, knowledge and skill on the disciplines of technology, E-business and law to allow them to minimize the occurrence and severity of information security incidents.
CO3	Understand about Information System and principles of Information Security (as confidentiality, integrity, and availability)
CO4	Understand about cryptography and techniques used to detect and prevent network intrusions.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Fundamentals of Cyber Law	Jurisprudence of Cyber Law, Object and Scope of the IT Act 2000, Introduction to Indian Cyber Law, Unicitral Model Law, ISP Guideline. Intellectual property issues and cyber space, Indian perspective, Overview of Intellectual property related legislation in India, Patent, Copy Right, Trademark law, Law related to semiconductor layout &design.	7	1
2	E - Commerce	Security Threats to E - Commerce, Virtual Organization, Business Transactions on Web, E-Governance and EDI, Concepts in Electronics payment systems, E-Cash, Credit/Debit Cards, E- Agreement, Legal recognition of electronic and digital records, E- Commerce Issues of privacy, Wireless Computing- Security challenges in Mobile devices. Digital Signatures - Technical issues, legal issues, Electronic Records, Digital Contracts, and Requirements of Digital Signature System.	8	2
3	Investigation and Ethics	Cyber Crime, Cyber jurisdiction, Cyber crime and evidence act, Treatment of different countries of cyber crime, Ethical issues in data and software privacy, Plagiarism, Pornography, Tampering computer documents, Data privacy and protection, Domain Name System, Software piracy, Issues in ethical hacking. Internet security threats: Hacking, Cracking, Sneaking, Viruses, Trojan horse, Malicious Code & logic bombs.Introduction to biometric security and its challenges, Finger prints.Cyber crime forensic: CASE STUDY in Cyber Crime.	9	3
4	Information security	Information Systems and its Importance, Role of Security in Internet and Web Services, Principles of Information Security, Classification of Threats and attacks, Security Challenges, Security Implication for organizations, Security services - Authentication, Confidentiality, Integrity, Availability and other terms in Information Security, Information Classification and their Roles. Introduction to Cryptography, Issues in Documents Security, Keys: Public Key, Private Key, Firewalls, Basic Concepts of Network Security, Perimeters of Network protection & Network attack, Need of Intrusion Monitoring and Detection.	9	4

Reference Books:

1. Harish Chander "Cyber Law and IT Protection" , PHI Publication, New Delhi
2. Merkov, Breithaupt," Information Security", Pearson Education
3. "Cyber Law in India" - Farooq Ahmad-Pioneer books.
4. K. K. Singh, Akansha Singh "Information Security and Cyber law", Umesh Publication, Delhi

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CS-204	**Title of the Course**	Data Structure Using C	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	Explain the basics of Data Structure, their Managements and Operations such as array, string manipulations and various operation over linked list. Programming implementation • To learn stack, queue and various operations, different application based on given data structure such as, recursion, polish and reverse polish conversion parenthesis management, priority Queue. Programming implementations • Understand the deep knowledge of tree data structure and its various applications to control the operation complexity management. Programming implementation • To study the various sorting and searching strategy and different algorithms approach, know hashing and collision resolving techniques. Programming implementation • Understand the new range of hierarchical data structure such as Graph and various routing and traversal algorithms over the graph. Introduction to file and record handling						

Course Outcomes	
CO1	Describe the basics of Data structure operation and programming implementation skills
CO2	Stack and Queue and various application based on these data structures
CO3	Learning the different types of tree and learn its augmentation to control the operation complexity.
CO4	Learn different sorting and searching algorithms and analyze their performances.
CO5	Learning File and record management, implementing various searching and routing applications on graph.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Data Structures	Basic Terminology, Elementary Data Organization, Data Structure Operations. Algorithms, Analysis of Algorithms, Complexity of Algorithms, Time-Space Tradeoff. **Arrays:** Array Definition, Representation and Analysis, Single and Multi-Dimensional Arrays, Address Calculation, Application of Arrays, Character String Representation, Character String Operation, Sparse Matrices & Vectors. **Linked List:** Representation and Implementation of Singly Linked List, Traversing, Searching of Linked List, Insertion & Deletion to/from Linked List, Underflow & Overflow. Circular Linked List, Doubly Linked List, Two- way Header List, Polynomial Representation & Addition, Generalized Linked List, Garbage Collection and Compaction.	9	1
2	Stacks	Array Representation and Implementation of Stack, Operations on Stacks: Push & Pop, Linked Representation of Stack, Application of Stack: Conversion of Infix to Prefix and Postfix Expressions, Evaluation of Postfix Expression using Stack. **Recursion:** Recursive Definition and Processes, Recursion in C, Example of Recursion, Tower of Hanoi Problem. **Queues:** Array and Linked Representation and Implementation of Queues, Operations on Queue: Create, Add, Delete, Full and Empty; Circular Queues, D-queues and Priority Queues**.**	9	2
3	Trees	Basic Terminology, Binary Trees, Binary Tree Representation, Algebraic Expressions, Complete Binary Tree, Extended Binary Trees, Array and Linked Representation of Binary Trees, Traversing Binary Trees, Threaded Binary Trees, Traversing Threaded Binary Trees, Huffman Algorithm, Binary Search Tree (BST), Insertion and Deletion in BST, Path Length, AVL Trees, B-trees.	8	3
4	Searching and Hashing	Sequential Search, Binary Search, Comparison and Analysis, Hash Table, Hash Functions, Collision Resolution Strategies, Hash Table Implementation. **Sorting:** Insertion Sort, Bubble Sort, Quick Sort, Two Way Merge Sort, Heap Sort.	7	4
5	Graphs	Terminology & Representations, Graphs & Multi-Graphs, Directed Graphs, Sequential Representations of Graphs, Adjacency Matrices, Traversal, Connected Component and Spanning Trees, Minimum Cost Spanning Trees. **File Handling:**Physical Storage Media File Organization, Organization of Records into Blocks, Sequential Files, Indexing and Hashing, Primary Indices, Secondary Indices	7	5

Reference Books:

1. A. M. Tannenbaum. “Data Structure Using C/C+”
2. Horowitz And Sahani “Fundamental of Data Structure”, Galgotia Publication
3. Lipschutz “Data Structure”, Schaum series.

e-Learning Source:

https://nptel.ac.in/courses/106102064

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CS208	**Title of the Course**	DATA STRUCTURE USING C LAB	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	0	0	2	1
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	1. To develop skills to design and analyze simple linear and non linear data structures. 2. To design and implement various data structure algorithms. 3. To introduce various techniques for representation of the data in the real world. 4. To identify and apply the suitable data structure for the given real world problem 5. To write algorithms for solving problems with the help of fundamental data structures						

Course Outcomes	
CO1	Able to handle operations like insertion, deletion, traversing mechanism etc. on various data structures.
CO2	Able to implement the stack, Queue and their applications
CO3	Able to implement different types of trees and Binary Tree Traversal.
CO4	Able to implement different Sorting and Search methods
CO5	Able to perform basic operations (creation and traversal) on graphs and determine minimum spanning tree

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	To implement traversing, insertion and deletion in arrays.	2	1
2	To implement, addition, Multiplication of Two sparse Matrices.	2	1
3	To implement insertion, deletion and pattern matching of a substring in a given string using linked list.	2	2
4	To implement Insertion and deletion in Singly Linked List at Given Location as well as for a Given Item in sorted List.	2	2
5	To Implement Insertion and deletion in Circular Linked List.	2	3
6	To implement insertion and Deletion in Stack and Queue using arrays and pointer.	2	3
7	To implement Fibonacci Series and Tower of Hanoi Using Recursion.	2	4
8	Creation of Trees and Tree Traversal Algorithms: Recursive and Non-Recursive.	2	4
9	Creation of Graphs and Graph Traversal Algorithms.	2	5
10	Sorting: a) Insertion Sort b) Quick Sort c) Merge Sort d) Bubble Sort e) Heap Sort	2	5
11	Implementation of Sparse Matrix and Polynomial using Linklist.	2	5

Reference Books:

4. A. M. Tannenbaum. "Data Structure Using C/C+"
5. Horowitz And Sahani "Fundamental of Data Structure", Galgotia Publication
6. Lipschutz "Data Structure", Schaum series.

e-Learning Source:

https://nptel.ac.in/courses/106102064

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CS-264	**Title of the Course**	Fundamentals of Machine Learning (Watson)	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To understand the basic theory underlying machine learning. To be able to formulate machine learning problems corresponding to different applications. To understand a range of machine learning algorithms along with their strengths and weaknesses. To be able to apply machine learning algorithms to solve problems of moderate complexity. To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.						

Course Outcomes	
CO1	Student must be able to characterize Machine Learning algorithm as Supervised and Unsupervised
CO2	Student must be able to preprocess data by handling missing values, encoding categorical data etc.
CO3	Student must be able to use regression algorithm.
CO4	Understand and apply Unsupervised algorithm for clustering.
CO5	Student must be able to design and implement machine learning model to solve real world problem.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Machine Learning	Application of Machine Learning, Supervised vs Unsupervised Learning, Python libraries suitable for Machine Learning	8	1
2	Data Pre-processing and Data:	What is a Data Mining application? Strategy for data mining: CRISP-DM, Identify nodes and streams, The framework of a Data – mining project, Brief the unit of analysis, and Explain the type of dialogue box	8	2
3	Regression	Linear Regression**,** Non-Linear Regression**,** Model evaluation methods	8	3
4	Classification	K-Nearest Neighbour, Decision Tree, Logistic Regression, Support Vector Machines, Model Evaluation	8	4
5	Unsupervised Learning and Recommender Systems	K-means Clustering**,** Hierarchical Clustering**,** Density-Based Clustering, Content-based recommender system, and Collaborative Filtering	8	5

Reference Books:

1. Machine Learning by Tom M. Mitchell, O`Reilley
2. Python Machine Learning by Sebastian Raschka and Vahid Mirjalili, Manning Publications
3. Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Technique to Build Intelligent Systems by Aurélien Géron
4. Understanding Machine Learning by Shai Shalev-Shwartz and Shai Ben-David La

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	CS270	**Title of the Course**	Object Oriented Concepts using Java	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	1	0	4
Pre-Requisite	none	**Co-requisite**	none				
Course Objectives	Explain the basics of Data Structure, their Managements and Operations such as array, string manipulations and various operation over linked list. Programming implementation • To learn stack, queue and various operations, different application based on given data structure such as, recursion, polish and reverse polish conversion parenthesis management, priority Queue. Programming implementations • Understand the deep knowledge of tree data structure and its various applications to control the operation complexity management. Programming implementation • To study the various sorting and searching strategy and different algorithms approach, know hashing and collision resolving techniques. Programming implementation • Understand the new range of hierarchical data structure such as Graph and various routing and traversal algorithms over the graph. Introduction to file and record handling.						

Course Outcomes	
CO1	Describe the basics of Data structure operation and programming implementation skills
CO2	Stack and Queue and various application based on these data structures
CO3	Learning the different types of tree and learn its augmentation to control the operation complexity.
CO4	Learn different sorting and searching algorithms and analyze their performances.
CO5	Learning File and record management, implementing various searching and routing applications on graph.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Programming language Types and Paradigms, Computer Programming Hierarchy, Features of Java Language, JVM –The heart of Java, Java's Magic Bytecode. **The Java Environment:**Installing Java, Java Program Development, Java Source File , Structure, Compilation, Executions. **Basic Language Elements:**Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Data types, Operators Assignments.	9	1
2	Object Oriented Programming using Java	Class Fundamentals , Object & Object reference , Object Life time & Garbage Collection, Creating and Operating Objects , Constructor & initialization code block, Access Control, Modifiers, methods Nested , Inner Class &Anonymous Classes ,Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism , Method Overloading, Recursion, Dealing with Static Members, Finalize() Method, Native Method. Use of "this"reference, Use of Modifiers with Classes &Methods.	8	2
3	Extending Classes and Inheritance	Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods , Role of Constructors in inheritance , Overriding Super Class Methods ,Use of "super", Polymorphism in inheritance ,Type Compatibility and Conversion Implementing interfaces. **Package:** Organizing Classes and Interfaces in Packages , Package as Access Protection , Defining Package , Making JAR Files for Library Packages Import and Static Import Naming Convention For Packages.	8	3
4	Exception Handling	Exceptions & Errors ,Types of Exception ,Control Flow In Exceptions, ,Use of try, catch, finally, throw, throws in Exception Handling ,In-built and User Defined Exceptions, Checked and Un-Checked Exceptions. **Array & String:**Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array, Operation on String, Mutable & Immutable String, Creating Strings using StringBuffer.	8	4
5	Thread	Understanding Threads, Needs of Multi-Threaded Programming, Thread Life-Cycle, Thread Priorities, Synchronizing Threads, Inter Communication of Threads. **I/O Classes:**Input/output Operation in Java(java.io Package),Streams and the new I/O Capabilities ,Understanding Streams, The Classes for Input and Output, The Standard Streams, Working with File Object, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel.	9	5

Reference Books:

7. T.Budd"An Introduction to OOP" Pearson Education
8. Naughton, Schildt, "The Complete Reference JAVA2", TMH
9. Balagurusamy E, "Programming in JAVA", TMH
10. "Head First Java" by Kathe Sierra.
11. "A Beginner's Guide (Sixth Edition)" by Herbert Schildt

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc19_cs48/preview

https://nptel.ac.in/courses/106105191

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CS271	**Title of the Course**	OBJECT ORIENTED CONCEPT USING JAVA LAB	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	0	0	2	1
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To learn the basic concepts and syntax of object oriented programming. • To be able to develop logics which help them to create programs and applications using java language. • To learn the use of exception handling . • To learn the use of methods and threads. • After learning the object oriented programming they can easily create desktop based projects.						

Course Outcomes	
CO1	Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.
CO2	Read and make elementary modifications to Java programs that solve real-world problems.
CO3	Validate input in a Java program.
CO4	Identify and fix defects and common security issues in code.
CO5	Document a Java program using Java doc.

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Create a class named 'Student' with String variable 'name' and integer variable 'roll_no'. Assign the value of roll_no as '2' and that of name as "John" by creating an object of the class Student.	2	1
2	Print the average of three numbers entered by user by creating a class named 'Average' having a method to calculate and print the average.	2	1
3	Write a program that would print the information (name, year of joining, salary, address) of three employees by creating a class named 'Employee'.	2	2
4	Write a program to print the area and perimeter of a triangle having sides of 3, 4 and 5 units by creating a class named 'Triangle' with constructor having the three sides as its parameters.	2	2
5	Create a class called 'Matrix' containing constructor that initializes the number of rows and number of columns of a new Matrix object. The Matrix class has the following information: a. number of rows of matrix b. number of columns of matrix c. elements of matrix in the form of 2D array	2	3
6	Write a program to print the names of students by creating a Student class. If no name is passed while creating an object of Student class, then the name should be "Unknown", otherwise the name should be equal to the String value passed while creating object of Student class.	2	3
7	Create a class named 'Member' having the following members: Data members 1. Name 2. Age 3. Phone number 4. Address 5. Salary It also has a method named 'printSalary' which prints the salary of the members. Two classes 'Employee' and 'Manager' inherits the 'Member' class. The 'Employee' and 'Manager' classes have data members 'specialization' and 'department' respectively. Now, assign name, age, phone number, address and salary to an employee and a manager by making an object of both of these classes and print the same.	2	4
8	Create a class with a method that prints "This is parent class" and its subclass with another method that prints "This is child class". Now, create an object for each of the class and call 1. method of parent class by object of parent class 2. method of child class by object of child class 3. method of parent class by object of child class	2	4
9	Write a program to perform inheritance where animal is the superclass and cat is the subclass.	2	4
10	Write a java program to calculate the average value of array elements where array elements are {20,30,25,25,-16,60,-100}	2	5
11	Program to calculate any shape area while using Encapsulation	2	5
12	Program to perform Overloading by changing datatypes of parameters	2	5

Reference Books:

12. T.Budd"An Introduction to OOP" Pearson Education
13. Naughton, Schildt, "The Complete Reference JAVA2", TMH
14. Balagurusamy E, "Programming in JAVA", TMH
15. "Head First Java" by Kathe Sierra.

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc19_cs48/preview

https://nptel.ac.in/courses/106105191

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CS272	**Title of the Course**	Python Programming LAB	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	0	0	2	1
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	1. To build a strong foundation of python and its IDEs. 2. Study of various object oriented programming constructs and data structures available in Python. 3. Writing and using functions and modules. 4. Developing file handling applications. 5. Exploring the use of libraries in developing real-world applications.						

Course Outcomes	
CO1	Install and configure python and its IDEs.
CO2	Write basic programs using the various data structures provided in python.
CO3	Develop small modules and components using object-oriented methodology.
CO4	Use the libraries and develop file handling applications.
CO5	Develop some working applications using python.

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Understanding Python installation and its Integrated Development Environments (IDEs).	2	1
2	Write a program to illustrate various data types & concepts of variables/Constant in Python.	2	1
3	Write a program to perform different Arithmetic Operations on numbers in Python (Addition, Subtraction, Multiplication, Division, etc.)	2	1
4	Write a program in python to demonstrate the concept of "Loop" and print the following pattern of prime numbers if input is number of lines. e.g.; if n=3, output should be:	2	1
5	Write a program to implement the concept of "List" (create, append, and remove lists in python).	2	2
6	Write a program to search an input number in a list of n numbers and print a "YES" along with its position (index) otherwise print a "No".	2	2
7	Write a program to create, concatenate and print a "String" and accessing sub-string from a given string.	2	2
8	Write a program to demonstrate working of "Tuples" in python.	2	2
9	Write a program to illustrate the working of "Dictionaries" in python.	2	3
10	Write a program to check whether input string is "Pangram" or not.	2	3
11	Write a program to find factorial of a number using "Recursion".	2	3
12	Write a program implement the concept of "Functions" in python and sort „n" numbers in ascending and descending order after taking input (Integer number) from user.	2	4
13	Write a program to define a "module" and import a specific function in that module to another program.	2	4
14	Write a program that reads an input text "File" and prints all of the unique words in the file in (alphabetical order).	2	4
15	Write a program that depicts the implementation of Python "Class" which reverse a string word by word.	2	4
16	Write a python script to print the current date in the following format "Sun May 29 02:26:23 IST 2017"	2	5
17	Write a Python class to implement pow(x, n)	2	5
18	Write a program to implement the working of "NumPy" in python.	2	5

Reference Books:

1. Guido van Rossum and Fred L. Drake Jr., ―An Introduction to Python – Revised andupdated for Python 3.2, Network Theory Ltd., 2011
2. Kenneth A. Lambert, ―Fundamentals of Python: First Programs, CENGAGE Learning,2012
3. Timothy A. Budd, ―Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming inPython: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

e-Learning Source:

https://nptel.ac.in/courses/106106145

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

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

Integral University, Lucknow

Effective from Session:							
Course Code	EC209	**Title of the Course**	Digital Electronics	**L**	**T**	**P**	**C**
Year	II	**Semester**	III/IV	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To understand the concepts of digital electronics and their applications. To provide a conversion in mathematical form. Can identify type of complements, can apply 1's and 2's complements. • To learn the Boolean Expression, K- Map method. To understand the basic concepts of various combinational circuit including gates, adders, subtractor, multiplexer and encoders. • To learn the analysis of various sequential circuits, flip flops, counters and various shift register. • To understand the concept and design of asynchronous sequential logic. • To understand the concepts of various logic devices programming logic array, programming array logic PROM and various memories.						

Course Outcomes	
CO1	Given a number, students shall be able to represent various conversion in mathematical form, identify type of complements, apply 1's and 2's complements and formulate conversion of any radix to decimal and decimal to any radix and solve 1's, 2's, 9's and 10's complements.
CO2	Given a Boolean Expression, student shall be able to analyze and evaluate various axioms and theorems also K- Map method. For a given Combinational circuit, student shall be able to understand its various building blocks and examine, analyze and evaluate various gates, adders, subtractor, multiplexer and encoders.
CO3	Given concept of sequential logic would be able to select suitable design of various flip flops, shift registers and counters.
CO4	Given concept of asynchronous sequential logic would be able to understand and analyze transition table, flow table, reduction of states and circuit with latches.
CO5	Given a AND and OR array, student shall be able to define various logic devices. Solve, analyze, and modify different PLD based design.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Boolean algebra and Number System	Digital System and Binary Numbers: Singed binary numbers, fixed and floating point numbers, binary codes, cyclic codes, gray codes, error detecting and correcting codes, parity check and Hamming codes. Boolean Algebra and logic gates: Basic definition, axiomatic definition of Boolean algebra, basic theorem and properties of Boolean algebra, canonical and standard forms, other logic expressions.	8	1
2	Combinational Logic	Gate- Level Minimization: K-Map, don't care conditions, NAND and NOR implementation, Quine Mc-Clusky method (Tabular Method) Combinational Logic: Combinational circuits, Analysis procedure, design procedure, binary adder subtractor, decimal adder, binary multiplier, magnitude comparator, decoder, encoder.	8	2
3	Sequential Circuits	Latches, Flip-Flop, Shift Registers, Counters: Synchronous and Asynchronous sequential circuits.	8	3
4	Asynchronous Sequential Logic	Analysis Procedure: circuit with latches, design procedure, reduction of state and flow table, race Free State assignment, Hazards.	8	4
5	Memory	ROM: PROM, EPROM & EEPROM RAM: SRAM & DRAM PLD: PLA, PAL & FPGA	8	5

Reference Books:

- Mano M Morris / Digital Design / Person Education India
- Mano M Morris/ Digital Logic and Computer Design/ Person Education India
- G. K Kharate / Digital Electronics/ Oxford University Press India
- Gopalan, K Gopal/ Introduction to Digital Microelectronics Circuits/ Mc Graw- Hill Education India
- Jacob Millman and Herbett Taub/ Pulse, Digital & Switching wave forms/ Mc- Graw- Hill Education India
- Bignell James/ Digital Electronics: Logic and Systems/ Cengage Learning

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc21_ee75/preview

https://youtu.be/X7M3rUxUpOc

https://onlinecourses.nptel.ac.in/noc22_ee55/preview

https://youtu.be/oNh6V91zdPY

	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	3	1		1			1			2	3	2		1
CO2	3	3	3	1		1	1		1			1	3		1	
CO3	3	2	3	2	1	1			2			2	3		1	
CO4	3	3	2	2	1				1			2	3	2		
CO5	3	3	2	1					1			2	3		1	

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

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CS-212	**Title of the Course**	Database Management System	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	none	**Co-requisite**	none				
Course Objectives	• To describe a sound introduction to the discipline of database management systems and introduce concepts of the Entity-Relationship model. • To build concepts of relational data model design by writing database queries using Relational Algebra and basic SQL as a universal database language • To demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization. • To provide an overview of the concept of transactions, serializability, recoverability, deadlock, and how to recover from deadlock. • To understand database locks, timestamps and various concurrency control protocols.						

Course Outcomes	
CO1	Explain the features of database management systems and relational database. Design conceptual models of a database using ER modeling for real life applications
CO2	Create and populate a RDBMS for a real life application, with constraints and keys, using SQL. Retrieve any type of information from a database by formulating complex queries in SQL & Relational Algebra.
CO3	Analyze the existing design of a database schema and apply concepts of normalization to design an optimal and efficient database.
CO4	Analyze the concepts of indexing, hashing, database transactions, serializability, recoverability, deadlock, and ways to recover from deadlock.
CO5	Explain database locks, timestamps and various concurrency control protocols to manage concurrent database access.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	An Overview of Database Management System, Database System Vs File System, Database System Concepts and Architecture, Data Models Schema and Instances, Data Independence and Data Base Language and Interfaces, Data Definitions Language, DML, Overall Database Structure. **Data Modeling Using the Entity Relationship Model:** ER Model Concepts, Notation for ER Diagram, Examples based on E-R diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams to Tables, Extended ER Model, Relationships of Higher Degree.	8	1
2	Relational Data Model and Language	Relational Data Model Concepts, Integrity Constraints: Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus. **Introduction to SQL:** Characteristics of SQL, Advantage of SQL. SQL Data Types and Literals. Types of SQL Commands. SQL Operators and Their Procedure. Tables, Views and Indexes. Queries and Sub Queries. Aggregate Functions. Insert, Update and Delete Operations. Joins, Unions, Intersection, Minus, Cursors in SQL.	8	2
3	Data Base Design & Normalization	Functional Dependencies, Normal Forms, First, Second, Third Normal Forms, BCNF, Inclusion Dependences, Loss Less Join Decompositions, Normalization using FD, MVD, and JDs, Alternative Approaches to Database Design. **Storage and File Structure:** Overview of Physical Storage Media, File Organization, Organization of Records in File, Data Dictionary Storage.	8	3
4	Indexing & Hashing	Basic Concepts, B+ Tree Index Files, B- Tree Index Files, Static Hashing, Dynamic Hashing. **Transaction Processing Concepts:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling.	8	4
5	Concurrency Control Techniques	Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi Version Schemes, Recovery with Concurrent Transaction.	8	5

Reference Books:

1.Korth, Silbertz, Sudarshan, "Data base concepts", McGraw-Hili

2. Elmasari, Navathe, "Fundamentals of Database Systems", Addison Wesley

3. Date C.J., "An Introduction to Database Systems", Addison Wesley

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc22_cs51/preview

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

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

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CS220	**Title of the Course**	DBMS LAB	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	0	0	2	1
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	1. To explain basic database concepts, applications, data models, schemas and instances. 2. To demonstrate the use of constraints and relational algebra operations. 3. Develop solutions for database applications using procedures, cursors and triggers 4. Describe the basics of SQL and construct queries using SQL. 5. To familiarize issues of concurrency control and transaction management.						

Course Outcomes	
CO1	Able to understand the basics of SQL and construct queries using SQL in database creation and interaction.
CO2	Able to using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping.
CO3	Ability to formulate queries using SQL DML/DDL/DCL commands.
CO4	Understand various advanced queries execution such as relational constraints, joins, set operations, trigger.
CO5	Able to design a commercial relational database system by writing SQL using the system.

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Database design using E-R Model and Normalization.	2	1
2	Write the queries for DDL, DML & DCL.	2	1
3	Write Queries using Logical Operators (=, <, > etc.)	2	2
4	Write queries using SQL operators (BETWEEN…AND, IN(list), LIKE, ISNULL and along with Negation expressions.)	2	2
5	Write SQL query using Character, Number, Date and Group Functions.	2	3
6	Write SQL Queries for Relational Algebra (UNION, INTERSECT and MINUS etc.)	2	3
7	Write queries for extracting data from more than one table (Equi-Join, Non-Equi Join, Outer Join)	2	3
8	Write SQL Queries for Sub queries, Nested queries.	2	3
9	Concept of COMMIT, ROLLBACK and CHECK POINTS.	2	4
10	Creation of Views.	2	4
11	Write programs by the use of PL/SQL (Procedures and Functions.)	2	4
12	High-level language extension with Cursor and with Triggers.	2	5
13	Creation of Forms & Reports.	2	5
14	Design and Implementation of the Mini Project.	2	5

Reference Books:

1.Korth, Silbertz, Sudarshan, "Data base concepts", McGraw-Hili

2. Elmasari, Navathe, "Fundamentals of Database Systems", Addison Wesley

3. Date C.J., "An Introduction to Database Systems", Addison Wesley

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

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

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	CS-261	**Title of the Course**	Cloud Application Development	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	none	**Co-requisite**	none				
Course Objectives	This course will prepare students to provide an overview of an exciting field of Cloud Computing and introduce tools require building, deploying, running and managing applications on a cloud platform. This course will also enable students to develop the cloud application development skills, such as Node.js, REST architecture, JSON, Cloud Foundry and DevOps services and will help them to solve complex real-world problems.						

Course Outcomes	
CO1	Understand the vision of Cloud Computing from a global context.
CO2	Understand various computing options on IBM Cloud by market perspective of Cloud Computing
CO3	Analyze architecture and implementation of APIs with services of IBM Cloud in Cloud Computing.
CO4	Integrate the Node.js application with Watson services over IBM Cloud.
CO5	Build and create state of the art architecture in Kubernetes cluster

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Definition with Real Time Examples, Introduction to cloud computing and its characteristics, Benefits of cloud, Models of Cloud, IBM Cloud resources, Cloud Foundary concepts.	8	1
2		What is DevOps? Capabilities of IBM Cloud Continuous Delivery, Architecture of REST, IBM Watson services, Databases types and capabilities, APIs interaction with Cloudant database.	8	2
3		The architecture of REST, Best practices for using REST in your application, Advantages of using JSON format, IBM Watson services and Watson services REST APIs. Databases types and capabilities, Main data services on IBM Cloud and benefits of IBM Cloudant, APIs to interact with Cloudant database.	8	3
4		JavaScript and origin and purpose of Node.js, Web server with JavaScript, Node.js module, Synchronous and Asynchronous callback, Express framework and its benefits, Use of middleware functions, Handle routes and request.	8	4
5		Understand business problems and goals, Functional and non-functional requirements, IBM Cloud services App ID, Watson Services. Introduction to Kubernetes, Introduction to Containers, Dockers and Docker Hub, Container Registry with IBM Cloud, Container orchestration (Kubernetes), key capabilities of Kubernetes, Kubernetes building blocks: Pods, Deployment and Service, Kubernetes cluster	8	5

Reference Books:

1. AnubhavHanjura , “Cloud Application Development”,Packt Publishing Ltd, 2014.
2. Gautam Shroff, “Enterprise Cloud Computing Technology Architecture Applications”, Cambridge University Press;2014.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach” McGraw-Hill Osborne Media; 2015.
4. Dimitris N. Chorafas, “Cloud Computing Strategies” CRC Press; 2016

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

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

Integral University, Lucknow

Effective from Session: 2018-2019							
Course Code	CS-266	**Title of the Course**	Cloud Application Development Lab	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	0	0	2	1
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	This course will prepare students to provide an overview of an exciting field of Cloud Computing and introduce tools require building, deploying, running and managing applications on a cloud platform. This course will also enable students to develop the cloud application development skills, such as Node.js, REST architecture, JSON, Cloud Foundry and DevOps services and will help them to solve complex real-world problems.						

Course Outcomes	
CO1	Understand the vision of Cloud Computing from a global context.
CO2	Understand various computing options on IBM Cloud by market perspective of Cloud Computing
CO3	Analyze architecture and implementation of APIs with services of IBM Cloud in Cloud Computing.
CO4	Integrate the Node.js application with Watson services over IBM Cloud.
CO5	Build and create state of the art architecture in Kubernetes cluster

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Configuring IBM Cloud account and create an application using Cloud FoundryService on IBM Cloud.	2	1
2	Mention all commands use in IBM cli to push an application from local system toIBM cloud environment.	2	1
3	Configuring Cloudant and managing the datasets on IBM Cloud.	2	2
4	Configuring secure a web-application with single sign-on (APP ID) on IBM cloud.	2	2
5	Create Rest API using NodeJs; Apply rest method to perform CRUD operations on resources at Server.	2	3
6	Developing NodeJs application for displaying weather information using IBM Cloud DevOps service and Deploying through delivery pipeline and manifest file configuration.	2	3
7	Create Watson services(text to speech /speech to text)	2	4
8	Build Chatbot applications for more than one sector like: Hospital, Industry, Banking etc, using Artificial Intelligence (AI) services	2	4
9	Create Docker container for deploying on containerized platform	2	5
10	Implementation of container orchestration using Kubernetes.	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	2	1	3	1	2	1	2	1	2	2
CO2	3	2	1	1		2			2	2	3	1	3	2	2
CO3	2	2	2	2	1		3	2		1		1		1	2
CO4	3	2	1		3	1	1		2						1
CO5	1	2	2	3	1	2	1	3	1	2	1	2	1	2	2

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CS-281	**Title of the Course**	Graph Theory & Applications	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	none	**Co-requisite**	none				
Course Objectives	Learn the fundamental concepts in graph theory in view of its applications in modern science. Learn to understand and create mathematical proofs, including an appreciation of its significance in computer science. Use the concepts of Graph theory in subsequent courses in the design and analysis of algorithms, computability theory, software engineering and computer systems .Apply concepts of the theory of probability in study of random phenomena, analyzing and interpreting data that involve uncertainties.						

Course Outcomes	
CO1	Demonstrate the knowledge of fundamental concepts in graph theory, including properties and characterization of graphs and trees.
CO2	Apply models of Graph theory, Probability theory respectively to solve problems of connectivity and uncertainty.
CO3	Analyzing graphs, trees and random phenomena occurring in real life situations using Graph theory.
CO4	Interpret the models of Graph theory, Probability theory for real life and engineering problems.
CO5	Develop efficient algorithms for graph related problems in different domains of engineering and science.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Fundamental concepts in graph theory	Graphs, Sub Graphs, Walks, Path & Circuits, Connected Graphs, Disconnected Graphs, Operations on Graphs, Euler Graphs, Hamiltonian Paths and Circuits, Trees, Pendant Vertices in Trees, Distance & Centers in Trees; Spanning Trees, Fundamental Circuits. Finding all Spanning Trees of a Weighted Graphs.	8	1
2	Models of Graph theory	Cut Sets and Cut Vertices, Properties of all Cut Sets in a Graph, Fundamental Circuit & Cut Set, Connectivity and Separability, Network Flows, Isomorphism. Planar Graphs, Combinatorial and Geometric Dual, Kuratowski's two Graph, Detection of Planarity	8	2
3	Vector Space	Introduction to Vector Space of a Graph and Vectors, Matrix Representation of Graph: Incidence Matrix and its Sub Matrices, Circuit Matrix and Cut Set Matrix, Path Matrix and Relationship Among Ar, Bf and Cf, Adjacency Matrices, Rank-Nullity Theorem.	8	3
4	Graph Coloring	Colouring, Covering & Partitioning of a Graph: Chromatic Number, Chromatic Partitioning, Chromatic Polynomials, Matching, Covering, Four Colour Problem. Directed Graphs: Definitions, Types, Digraphs and Binary Relations	8	4
5	Graph Theory Applications	Applications of Graph Theory: Analysis and Synthesis of Contact Network, Activity Networks in Project Planning: Analysis of an Activity Network, Graphs in Game Theory, Graphs in Computer Programming.	8	5

Reference Books:

16. DeoNarsingh, Graph Theory with Applications to Engineering and Computer Science, PrenticeHall, India, 1974.
17. Bondy J.A. and U.S. Murthy, Graph Theory with Applications, The Macmillan Press Ltd.,1976.
18. Harary F., Graph Theory, Addison-Wesley publishing Co., 1972.

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc22_ma10/preview#:~:text=Graph%20theory%20began%20in%201736,science%20and%20network%20information%20science.

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	3	2		3
CO2	3	3	3	2	3		3	1			3	3			
CO3	3	2	1	1	2				2		1			1	
CO4	3	2	2		3	3					3	3			
CO5	3	1	1	1	2	2	1		1	2	1	2		2	

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	CS282	**Title of the Course**	ADVANCE JAVA PROGRAMMING LAB	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	0	0	2	1
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To learn the basic concepts and syntax of advance java programming. • To be able to develop logics which help them to create programs and applications using java language. • To learn the use of JDBC-ODBC. • To learn the use of jsp and servlet . • After learning the advance java programming they can easily create web projects.						

Course Outcomes	
CO1	Able to understand the basic concepts of Advance java Programming..
CO2	Able to design and develop various web pages using applet.
CO3	Able to analyze and develop programs on Servlet and JSP.
CO4	Able to develop programs on different project using Swing and Bean.
CO5	Able to implement programs using JDBC-ODBC

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Create GUI application using AWT & Applet classes.	2	1
2	Design & develop the client-server application using NET package.	2	1
3	Implement database application using JDBC package.	2	2
4	Create client server Application using RMI.	2	2
5	Introduction to Java Beans and EJB program.	2	3
6	Describe & develop Java Servlet ,HTTP request and response program.	2	3
7	Create a Servlet program for cookies	2	4
8	Create application using Java Swing package.	2	4
9	Introduction to Java Server Pages and its sample programs.	2	5
10	. Design program for JSP by using JSP Exception and JSP Action Elements.	2	5

Reference Books:

19. T.Budd"An Introduction to OOP" Pearson Education
20. Naughton, Schildt, "The Complete Reference JAVA2", TMH
21. Balagurusamy E, "Programming in JAVA", TMH
22. "Head First Java" by Kathe Sierra.

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc19_cs48/preview

https://nptel.ac.in/courses/106105191

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CS-284	**Title of the Course**	Computer Organization & Architecture	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	2
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	Explain the basic components of computer, their interconnection and data representation techniques in computer systems. To assess the working of cpu and become familiar with computer arithmetic's. Understand the control unit design using hardwired and micro programmed approach. To study the memory organization and articulate design issues in each element of memory hierarchy						

Course Outcomes	
CO1	Describe the basic organization of computer and data representation techniques used in computer systems.
CO2	Resolve the issues arising in the design of elements of memory hierarchy.
CO3	Explain and design the control unit using hardwired and micro programmed approach.
CO4	Acquire the knowledge of advanced concepts of performance measure and parallel processing.
CO5	Explain and compare high performance processors.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Computer Organization & Architecture	Elements of Digital Computer, Bus Architecture and Bus Arbitration, Micro-operation, Register Transfer, Bus and Memory Transfer, Data Representation, Addition and Subtraction of Signed Numbers, Booth Algorithm.	8	1
2	Memory and Processor Organization	Memory: Main, Cache, Auxiliary and Virtual Memory, Concept of Address Mapping, Addressing Modes, Central Processing Unit (CPU): Single Accumulator, General Register, and Stack Organization. RISC and CISC Characteristics.	8	2
3	Hardwired and Micro Programmed Control	Instruction Formats, Instruction and Interrupt Cycle, Timing and Control, Hardwired Control Design: Design of Computer Registers, Execution of a Computer Instruction, MicroProgrammed Control Design: Basic Concept of MicroProgrammed Control design, Microprogram Sequencer.	8	3
4	Parallel and Pipeline Processing	Introduction to Parallel Processing, Parallel Architecture Classification, Performance of Parallel Processors, Pipelining: Introduction, Arithmetic Pipeline, Instruction Pipeline, Introduction to different types of available computers.	8	4
5	High Performance Processors	Superscalar, Vector, and VLIW Architecture, Cache Architecture: Cache Coherence and Synchronization Mechanism, Interconnection Network for Parallel Computers.	8	5

Reference Books:

1. "Computer System Arch." By- Morris Mano, Prentice Hall India, New Delhi.
2. "Computer Organization." By- Vranesic&Hamacher, Tata Mgraw Hill, New Delhi
3. "Kai Hwang", Advanced Computer Architecture, McGraw Hill International.
4. "Moreshwar R. Bhujade", Parallel Computing, New Age International.

e-Learning Source:

https://nptel.ac.in/courses/106105163

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	CS285	**Title of the Course**	Computer Organization & Architecture Lab	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	0	0	2	1
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To learn the basic concepts of flip flops. To learn about adders and registers. To learn the working of counters and multipliers. To learn the working of associative memory cell. To learn the working of multiplexer and demultiplexer.						

Course Outcomes	
CO1	Design & Implement various flip flop SR, JK, D and T
CO2	Design & Implement half adder and full adder circuit.
CO3	Design & Implement counter and register.
CO4	Design & Implement associative memory cell.
CO5	Design & Implement multiplexer and demultiplexer.

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Design & Implementation of various flip flop SR, JK, D and T.	2	1
2	Design & Implementation of Half adder and Full adder circuit.	2	1
3	Design & Implementation of Half Subtractor and Full Subtractor circuit.	2	2
4	Design & Implementation counters.	2	2
5	Design & Implementation Registers.	2	3
6	Register level design of 4 bit magnitude comparator.	2	3
7	Design & Implementation of 2*2 bit unsigned multiplier.	2	4
8	Design & Implementation of associative memory cell.	2	4
9	Design & Implementation of MUX & DEMUX.	2	5
10	Design & Implementation of ADC & DAC circuit	2	5

Reference Books:

5. "Computer System Arch." By- Morris Mano, Prentice Hall India, New Delhi.
6. "Computer Organization." By- Vranesic&Hamacher, Tata Mgraw Hill, New Delhi
7. "Kai Hwang", Advanced Computer Architecture, McGraw Hill International.
8. "Moreshwar R. Bhujade", Parallel Computing, New Age International.

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					2				2					
CO2	3		3	3		1	2		2				3		4
CO3	1	1								3				2	
CO4		2	2	3		1			1				1		3
CO5	1		1				3			1					

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

Integral University, Lucknow

Effective from Session:2016-17							
Course Code	**ES202**	**Title of the Course**	Disasters, Management	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	2	1	**-**	**3**
Pre-Requisite	10+2 having a minimum of 45 % marks in the aggregate from a recognized Board/University	**Co-requisite**					
Course Objectives	• To Study the types of Disasters and its profile in India. • Knowledge of causes and impacts of Disasters, and Case studies of National and Global Disasters. • To learn about risk reduction approaches of Disasters with safety issues in mitigating Industrial disasters. • Basic concepts of Disaster Management Cycle and its Risk Reduction Measures. • To know the National Acts and policies for mitigating disasters. Role of Army, Police, Community, Corporate, Media etc. for post Disaster Management.						

Course Outcomes	
CO1	Students are able to learn types of disasters and its profile in India
CO2	Students are able to understand the causes and impacts of disasters on environment
CO3	Students are able to learn about risk reduction approaches of disasters with safety issues in mitigating industrial disasters.
CO4	To understand the concept of Disaster Management Cycle and its Risk Reduction
CO5	To understand the concept of Disaster Management Cycle and its Risk Reduction

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to disaster	Introduction to Disasters, Concepts, Definition and types (Natural and Man-made), Disaster profile of India.	8	CO1
2	Impact of Disaster	Causes and Impacts of Disasters, Global and National Perspective, Case studies from Disasters, Large Hydro projects and its risks for Disasters	8	CO2
3	Disaster Risk Reduction	Approaches to Disaster risk Reduction, Safety issues in mitigating Industrial disasters, Case studies, EHS etc.	8	CO4
4	Disaster Management	Disaster Management Cycle, Risk Reduction Measures (Preparedness, Mitigation, Response	8	CO3
5	Disaster Act. and Policies	National Acts and policies for mitigating Disasters (Disaster Management Act 2005, NDRF,	8	CO3

Reference Books:

(1) Gupta Harsh K., Disaster Management, Hyderabad University Press.
Publications-Meerut.

(2) Sethi, V.K., Disaster Management, New Delhi Maxford Books

(3) Bhattacharya, Tushar, Disaster Science and Management, New Delhi Tata Mc Graw Hill.

(4) Nidhi Gauba, Dhawan/ Ambrina Sardar Khan, Disaster Management and Preparedness, CBS

e-Learning Source:

https://www.youtube.com/watch?v=9WIwlljva_s

https://www.youtube.com/watch?v=uA_OLKfQpYA

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	PSO5	PSO6
CO1	2	1	1	1	1	1	3	2	1	1	2	1	1	1	1	-	-	-
CO2	2	2	2	1	2	3	3	2	2	2	2	2	1	1	1	-	-	-
CO3	3	2	2	1	2	2	3	2	2	2	1	2	1	1	1	-	-	-
CO4	3	2	2	1	2	2	3	2	2	1	1	2	1	1	1	-	-	-
CO5	3	1	3	2	2	2	2	2	3	2	1	2	1	1	1	-	-	-

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	MT206	**Title of the Course**	Mathematical Analysis	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	none	**Co-requisite**	none				
Course Objectives	To understand the concepts of algebraic and transcendental equations Gain basic of numerical integration and solution of ordinary differential equation Understanding the concepts of binomial distribution, poison distribution and normal distribution.						

Course Outcomes	
CO1	Define normalization and state its consequences.
CO2	Explain various methods of numerical analysis
CO3	Demonstrate integral transformation of an equation using Fourier transformation.
CO4	Analyze correlation and regression of a coefficient.
CO5	Compare Euler's Method and Modified Euler's Method

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Errors**	Bisection Method, Iteration Method, False Position Method, Newton-Raphson Method. Rate of Convergence of Methods. Solution of system of linear equations by LU decomposition method	8	1
2	**Algebraic & Transcendental Equations**	Finite differences, Newton's forward & backward formula, Gauss forward and backward formula forequal intervals. Lagrange's and Newton's divided difference formula for unequal intervals, Numerical differentiation.	8	2
3	**Interpolation**	Numerical Integration by Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Boole's & Weddle's Rule. Numerical solution of ordinary differential equations by Euler's Method, Modified Euler's Method and Runge-Kutta Method.	8	3
4	**Numerical Integration & Solution of Ordinary Differential Equations**	Analytic functions, C-R equations, Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions, Conformal mapping, Bilinear transformation.	8	4
5	**Integral Transform & Complex Analysis**	Correlation and Regression Analysis, Definition of Probability: Classical and Axiomatic, Conditional Probability, Baye's theorem, Binomial Distribution, Poisson distribution and Normal Distribution.	8	5

Reference Books:

1. Sastry, Introductory method of Numerical Analysis, PHI, New Delhi.
2. Balaguruswamy, Numerical method, TMH, New Delhi.
3. Jain, Iyengar, Jain, Numerical Methods for Scientific & Engineering Computations, New Age International, New Delhi.
4. P. Kandasamy, Numerical Methods, S. Chand & Company, New Delhi.

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

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