Maulana Abul Kalam Azad University of Technology, West Bengal
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Syllabus for B. Tech in Data Science
(Applicable from the academic session 2020-2021)

Semester-IV

Discrete Mathematics
Code: PCC-CS401
Contacts: 3L+1T

Name of the Course:	Discrete Mathematics		
Course Code: PCC-CS401	Semester: IV		
Duration:6 months	Maximum Marks:100		
Teaching Scheme		**Examination Scheme**	
Theory:3 hrs./week		Mid Semester exam: 15	
Tutorial: 1 hour/week		Assignment and Quiz : 10 marks	
		Attendance : 5 marks	
Practical: NIL		End Semester Exam :70 Marks	
Credit Points:	4		

Unit	Content	Hrs/Unit
1	Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well- Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.	8
2	Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination	5
3	Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.	8
4.	Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form	7

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5	Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi- connected component and Articulation Points, Shortest distances.	8

Text book and Reference books:

1. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation
2. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI
3. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
4. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH
5. J.K. Sharma, Discrete Mathematics, Macmillan
6. Winfried Karl Grassmann and Jean-Paul Tremblay, Logic and Discrete Mathematics, PEARSON.
7. S. K. Chakraborty and B. K. Sarkar, Discrete Mathematics, OXFORD University Press.
8. Douglas B. West, Introduction to graph Theory, PHI
9. C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000.
10. R. C. Penner, Discrete Mathematics: Proof Techniques and Mathematical Structures, World Scientific, 1999.
11. R. L. Graham, D. E. Knuth, and O. Patashnik, Concrete Mathematics, 2nd Ed., Addison-Wesley, 1994.
12. N. Deo, Graph Theory, Prentice Hall of India, 1974.
13. S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 1999.
14. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.
15. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation
16. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI
17. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
18. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH
19. S.B. Singh, Discrete Structures – Khanna Publishing House (AICTE Recommended Textbook – 2018)
20. S.B. Singh, Combinatorics and Graph Theory, Khanna Publishing House (AICTE Recommended Textbook – 2018)

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Database Management Systems
Code: PCC- DS401
Contact: 3L

Name of the Course:	**Database Management Systems**		
Course Code: **PCC- DS401**	Semester: IV		
Duration:6 months	Maximum Marks:100		
Teaching Scheme	**Examination Scheme**		
Theory:3 hrs./week	Mid Semester exam: 15		
Tutorial: NIL	Assignment and Quiz: 10 marks		
	Attendance: 5 marks		
Practical: hrs./week	End Semester Exam:70 Marks		
Credit Points:	3		
Unit	Content	Hrs/Unit	Marks/Unit
1	**Database system architecture:**Data Abstraction, Data Independence,Data Definition Language(DDL),Data ManipulationLanguage(DML). **Data models:** Entity-relationshipmodel, network model, relational and object oriented data models, integrity constraints, data manipulation operations.	9	
2	**Relational query languages:**Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. **Relational database design:** Domain and data dependency,Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. **Query processing and optimization:** Evaluation of relational algebra expressions,Query equivalence, Join strategies, Query optimization algorithms.	1 3	
3	**Storage strategies**: Indices, B-trees, hashing.	3	
4.	**Transaction processing:** Concurrencycontrol, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.	5	

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5	**Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.	3	
6	**Advanced topics:** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.	3	

Text book and Reference books:
1. "Database System Concepts" , 6th Edition by Abraham Silberschatz, Henry
F. Korth, S. Sudarshan,McGraw-Hill.
2. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D.
Ullman, Computer Science Press.
3. Database Management Systems, R.P. Mahapatra, Khanna Publishing House,
New Delhi (AICTE Recommended Textbook – 2018)
4. "Fundamentals of Database Systems" , 5th Edition by R. Elmasri and S.
Navathe,
5. Pearson Education "Foundations of Databases", Reprint by Serge
Abiteboul, Richard Hull, Victor Vianu,Addison-Wesley

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Formal Language & Automata Theory
Code: PCC-CS403
Contacts: 3L

Name of the Course:	**Formal Language & Automata Theory**	
Course Code: PCC-CS403	Semester: IV	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme	**Examination Scheme**	
Theory: 3 hrs./week	Mid Semester exam: 15	
Tutorial: NIL	Assignment and Quiz: 10 marks	
	Attendance: 5 marks	
Practical: NIL	End Semester Exam: 70 Marks	
Credit Points:	3	
Unit	Content	Hrs/Unit
1	Introduction: Alphabet, languages and grammars, productionsand derivation, Chomsky hierarchy of languages.	6
2	Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata)	7
3	Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic push down automata, closure properties of CFLs.	6
4.	Context-sensitive languages: Context-sensitive grammars(CSG) and languages, linear bounded automata and equivalence with CSG.	6
5	Turing machines: The basic model for Turing machines (TM), Turing recognizable(recursively enumerable) and Turing- decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMsas enumerators	6
6	Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages	6

Text books/ reference books:

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

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2. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
3. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
4. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
5. John Martin, Introduction to Languages and The Theory of Computation, TataMcGraw Hill., PEARSON.
6. Dr. R.B.Patel, Theory of Computation, Khanna Publishing House

Design and Analysis of Algorithms
Code: PCC-CS404
Contacts: 3L

Name of the Course:	**Design and Analysis of Algorithms**	
Course Code: PCC-CS404	Semester: IV	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme	**Examination Scheme**	
Theory: 3 hrs./week	Mid Semester exam: 15	
Tutorial: NIL	Assignment and Quiz: 10 marks	
	Attendance: 5 marks	
Practical: hrs./week	End Semester Exam: 70 Marks	
Credit Points:	3	
Unit	Content	Hrs/Unit
1	Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion treemethod and Masters' theorem	8
2	Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch and- Bound and Backtracking methodologies for the design of algorithms; Illustrations of thesetechniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics –characteristics and their application domains.	8
3	Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm. Tractable and Intractable Problems: Computability	6
4.	of Algorithms, Computability classes – P,NP, NP- complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.	10

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5	Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE	4

Text books/ reference books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.
3. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
5. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA
6. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House (AICTE Recommended Textbook – 2018)
7. Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai

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Data Mining

Code: PCC-DS 402
Contacts: 3L

Name of the Course:	**Data Mining**	
Course Code: **PCC-DS 402**	Semester: IV	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme	**Examination Scheme**	
Theory: 3 hrs./week	Mid Semester exam: 15	
Tutorial: NIL	Assignment and Quiz: 10 marks	
	Attendance: 5 marks	
Practical: hrs./week	End Semester Exam: 70 Marks	
Credit Points:	3	
Unit	Content	Hours
1	Introduction: Data Mining Concept, Origin, Process, Applications, Techniques, Challenges	3
2	Data Preprocessing: Data types, Quality, Descriptive data summarization – central tendency and dispersion measure, Data cleaning, Data integration & transform, Data reduction	6
3	Association Rule Mining: Market-basket analysis basics, Naïve algorithm, Apriori algorithm, Direct Hashing and Pruning (DHP), Software for Association Rule Mining, Classification and Prediction: Decision Tree, Classification by decision tree induction, Bayesian classification, Rule-based classification, Prediction – Linear and Nonlinear Regression, Classification software	8
4	Cluster Analysis: Types of data in cluster analysis, Partitioning methods, Hierarchical methods, Density-based methods, Quality & Validity of clustering methods Cluster analysis software	7
5	Web Data Mining: Web content mining, Web usage mining, Web structure mining, Hubs and Authorities, HITS algorithm, Web mining software Text Mining, Support Vector Machine.	7
6	Data Mining Application & Information Privacy: Applications and trends in data mining such as Web, finance, telecommunication, biology and medicine, science and engineering retail industry etc. Social impacts of data mining, information privacy and data security, IT Act overview.	9

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Biology
Code: BSC 401
Contacts: 2L+1T

Name of the Course:	**Biology**	
Course Code: BSC-401	Semester: IV	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme	**Examination Scheme**	
Theory: 2hrs./week	Mid Semester exam: 15	
Tutorial: 1 hour	Assignment and Quiz: 10 marks	
	Attendance: 5 marks	
Practical: NIL	End Semester Exam: 70 Marks	
Credit Points:	3	

Unit	Content	Hrs/Unit
1	To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline.Why we need to study biology? Discuss how biological observations of 18th Century thatlead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. Theseexamples will highlight the fundamental importance of observations in any scientific inquiry.	2
2	The underlying criterion, such as morphological, biochemicalor ecological be highlighted. Hierarchy of life forms at phenomenological level. A commonthread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c)energy and Carbon utilisation - Autotrophs, heterotrophs,lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic orterrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the studyof biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus	3

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3	To convey that "Genetics is to biology what Newton's laws areto Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis betaught as a part of genetics. Emphasis to be give not to the mechanics of cell division northe phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the singlegene disorders in humans. Discuss the concept of complementation using human genetics.	4
4.	Biomolecules: To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as onecan imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids andproteins. Nucleotides and DNA/RNA.Two carbon units and lipids.	4
5	Enzymes: To convey that without catalysis life would nothave existed on earth Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at leasttwo examples. Enzyme kinetics and kinetic parameters. Why shouldwe know these parameters to understand biology? RNA catalysis.	4
6	Information Transfer:The molecular basis of coding anddecoding genetic information is universal Molecular basis of information transfer. DNA as a geneticmaterial. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes.Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.	4
7	Macromolecular analysis: How to analyse biological processesat the reductionist level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary andquaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	5
8	Metabolism: The fundamental principles of energy transactions are the same in physical and biological world.Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of $K_{eq}$and its relation tostandard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to $CO_2 + H_2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding andenergy consuming reactions. Concept of Energy charge	4

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9	Microbiology Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	3

Text books/ reference books:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. General Biology, Uma Devi, Khanna Book Publishing.
3. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
4. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
5. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
6. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Environmental Sciences
Code: MC-401
Contacts: 1L

Name of the Course:	**Environmental Sciences**	
Course Code: MC-401	Semester: IV	
Duration:6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory:1hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz : 10 marks
		Attendance : 5 marks
Practical: NIL		End Semester Exam :70 Marks
Credit Points:	0	
Unit	Content	Hrs/Unit
1	Basic ideas of environment, basic concepts, man, society & environment, their interrelationship (1L) Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development. (2L) Materials balance: Steady state conservation system, steady state system with non-conservative pollutants, step function. (1L) Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering. (2L)	6

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2	Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem-components types and function. (1L) Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web.(2L) Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. (1L) Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.(2L)	6
3	Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. (1L) Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems.(1L) Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget.(1L) Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion).(2L) Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model.(2L) Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. (2L) Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green-house gases, effect of ozone modification. (1L) Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, baghouse, catalytic converter, scrubber (ventury), Statement with brief reference). (1L)	11

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4.	Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. (2L) River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. (2L) Lake: Eutrophication [Definition, source and effect]. (1L) Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)(1L) Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. (2L) Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic (1L)	9
5	Lithosphere; Internal structure of earth, rock and soil (1L) Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. Solid waste management and control (hazardous and biomedical waste).(2L)	3
6	Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise] (1L) Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, $L10$ (18hr Index) $,n$ Ld.Noise pollution control. (1L)	3
7	Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/agreement/ protocol. (2L)	2

Text books/ reference books:
1. M.P. Poonia & S.C. Sharma, Environmental Studies, Khanna Publishing House (AICTE Recommended Textbook – 2018)
2. M.P. Poonia, S.C. Sharma, Santosh Kumar, Environmental Engineering, Khanna Publishing House (AICTE Recommended Textbook – 2018)

3. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd.,1991.
4. De, A. K., "Environmental Chemistry", New Age International

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Design & Analysis of Algorithm
LabCode: PCC-CS494
Contact: 4P

Name of the Course:	**Design & Analysis Algorithm Lab**
Course Code: PCC-CS494	Semester: IV
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

Laboratory Experiments:	
Divide and Conquer:	
1	Implement Binary Search using Divide and Conquer approach Implement Merge Sort using Divide and Conquer approach
2	Implement Quick Sort using Divide and Conquer approach Find Maximum and Minimum element from a array of integer using Divide and Conquer approach
3	Find the minimum number of scalar multiplication needed for chain of matrix
4	Implement all pair of Shortest path for a graph (Floyed- Warshall Algorithm) Implement Traveling Salesman Problem
5	Implement Single Source shortest Path for a graph (Dijkstra , Bellman Ford Algorithm
Brunch and Bound:	
6	Implement 15 Puzzle Problem
Backtracking:	
7	Implement 8 Queen problem
8	Graph Coloring Problem Hamiltonian Problem
Greedy method	
9	Knapsack Problem Job sequencing with deadlines
10	Minimum Cost Spanning Tree by Prim's Algorithm Minimum Cost Spanning Tree by Kruskal's Algorithm
Graph Traversal Algorithm:	
11	Implement Breadth First Search (BFS)
	Implement Depth First Search (DFS)

Any experiment specially designed by the college
(Detailed instructions for Laboratory Manual to be followed for further guidance)

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Data Mining Lab
Code: PCC- DS492
Contact: 4P

Name of the Course:	**Data Mining Lab**
Course Code: PCC- DS492	Semester: IV
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

Manipulating strings, Processing Files, Manipulating Lists, Lists and Strings, Dictionary's, Counting with Dictionaries, Dictionaries and Files, Tuples, Tuples and Sorting, Regular Expressions, Networked programs, Sockets and Applications, parsing HTML with Beautiful soup, parsing XML by python, REST,JSON and APIs, Extracting data from JSON, Using database by python, Object oriented python, Geocoding, Page rank and web searching, Gm ,lane.

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Database Management System Lab
Code: PCC- DS491
Contacts: 4P

Name of the Course:	**Database Management System Lab**
Course Code: PCC- DS491	Semester: IV
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement:60
Practical: 4 hrs./week	Distribution of marks:40
Credit Points:	2

Laboratory Experiments:

Structured Query Language
1. Creating Database
    ➢ Creating a Database
    ➢ Creating a Table
    ➢ Specifying Relational Data Types
    ➢ Specifying Constraints
    ➢ Creating Indexes
2. Table and Record Handling
    ➢ INSERT statement
    ➢ Using SELECT and INSERT together
    ➢ DELETE, UPDATE, TRUNCATE statements
    ➢ DROP, ALTER statements
3. Retrieving Data from a Database
1. The SELECT statement
2. Using the WHERE clause
3. Using Logical Operators in the WHERE clause
4. Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING
Clause
5. Using Aggregate Functions
6. Combining Tables Using JOINS
    • SubqueriesDatabase ManagementCreating ViewsCreating Column Aliases
    • Creating Database Users
    • Using GRANT and REVOKE

Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for B. Tech in Data Science
(Applicable from the academic session 2020-2021)

Cursors in Oracle PL / SQL
Writing Oracle PL / SQL Stored Procedures

Any experiment specially designed by the college
(Detailed instructions for Laboratory Manual to be followed for further guidance)