

Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for B. Tech in CSE (Internet Of Things)
(Applicable from the academic session 2022-2023)
FORTH SEMESTER

❖ **Mathematics –IV (Discrete Mathematics) [3 0 0 3] -PCCCS40 1**

Unit	Content	Hrs/Unit	Marks/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	
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	

Textbook 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

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6. WinfriedKarlGrassmannand Jean-Paul Tremblay,Logicand DiscreteMathematics,PEARSON.
7. S.K.ChakrabortyandB. K.Sarkar,DiscreteMathematics,OXFORD UniversityPress.
8. Douglas B.West,Introduction to graphTheory,PHI
9. C. L.Liu,ElementsofDiscreteMathematics,2ndEd.,TataMcGraw-Hill,2000.
10. R.C.Penner,DiscreteMathematics: ProofTechniques and MathematicalStructures,WorldScientific,1999.
11. R.L.Graham,D. E.Knuth, andO. Patashnik,ConcreteMathematics,2ndEd.,Addison-Wesley,1994.
12. N.Deo,GraphTheory,Prentice Hall ofIndia,1974.
13. S.LipschutzandM.L.Lipson,Schaum's OutlineofTheoryandProblems ofDiscrete Mathematics,2ndEd.,TataMcGraw-Hill, 1999.
14. J.P.TremblayandR. P.Manohar,DiscreteMathematics withApplications toComputer Science, TataMcGraw-Hill, 1997.
15. RussellMerris,Combinatorics,Wiley-InterscienceseriesinDiscreteMathematicsandOptimisation
16. N.ChandrasekaranandM.Umaparvathi,DiscreteMathematics,PHI
17. GaryHaggard,JohnSchlipfandSueWhitesides,DiscreteMathematicsforComputerScience,CENGAGE Learning
18. GaryChartrand andPingZhang – IntroductiontoGraphTheory,TMH
19. S.B. Singh,DiscreteStructures– Khanna PublishingHouse(AICTERRecommendedTextbook–2018)
20. S.B. Singh,Combinatoricsand GraphTheory,KhannaPublishingHouse(AICTERRecommendedTextbook–2018)

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❖ **DESIGN & ANALYSIS OF ALGORITHMS [3 0 0 3]- PCCCS40 4**

Fundamentals of Algorithms, Important Problem Types, Analysis of algorithm efficiency. Analysis Framework: Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Nonrecursive and Recursive Algorithms. Brute force Techniques, Divide and Conquer, Decrease and Conquer: Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting. Transform and Conquer: Presorting, BST, Heapsort. Space and Time tradeoffs: Input Enhancement in String Matching. Dynamic Programming: Warshall's and Floyd's Algorithms, The Knapsack Problem. Greedy Techniques: Prim's, Kruskal's and Dijkstra's Algorithm, Huffman Trees. Coping with limitations of algorithmic power, P, NP and NP-complete Problems, Backtracking: n-Queens problem, Hamiltonian Circuit Problem, Subset-Sum Problem. Branch and Bound: Assignment Problem, Knapsack Problem, TSP.

References:

1. Anany Levitin, *Introduction to the Design and Analysis of Algorithms*, (3e), Pearson Education, 2011
2. Ellis Horowitz and Sartaj Sahni, *Computer Algorithms/C++*, (2e), University Press, 2007.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms*, (2e), PHI, 2006

❖ **DATA COMMUNICATION AND NETWORKS [3 0 0 3]- PCCICB40 1**

Basic concepts of computer networks, Layered architecture and comparison between ISO/OSI, TCP/IP layered models. Significance of Datalink layer and protocols. Network layer functionalities, classful, classless IP addressing, address allocation and role of forwarding module in forwarding the packet using routing table. Roles played by IP, ARP, RARP, ICMP & IGMP protocols in network layer. Inter-domain and intra-domain routing algorithms for routing tables. Importance of transport layer in achieving process-to-process communication. Insight of connection oriented protocol TCP and connectionless protocol UDP. Features of TCP in achieving flow control, error control and congestion control. Requirement of different timers in TCP. Drawbacks of IPv4 addressing and new IP addressing scheme IPv6. Migrating from IPv4 to IPv6. Introduction to application layer, a client/server application program and a case study. Client-server application program-Dynamic Host Configuration Protocol (DHCP).

References:

1. Behrouz A. Forouzan, *TCP/IP Protocol Suite*, 4th Edition, Tata McGraw Hill, 2010.
2. Tannenbaum, A.S, *Computer Networks*, 5th Edition, Prentice Hall of India EE Edition, 2011.
3. Behrouz A. Forouzan, *Data Communications and Networking*, 5th Edition, Tata McGraw Hill, 2013.
4. Leon Garcia and Widjaja, *Communication Networks*, 5th Edition, Tata McGraw Hill, 2017.

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❖ **Environmental Science [2 0 0 2]- MC401**

Unit	Content	Hrs/Unit
1	<p>Basic ideas of environment, basic concepts, man, society & environment, their interrelationship. (1L)</p> <p>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)</p> <p>Materials balance: Steady state conservation system, steady state system with non-conservative pollutants, step function. (1L)</p> <p>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)</p>	6
2	<p>Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem-component types and function. (1L)</p> <p>Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundarban); Food chain [definition and one example of each food chain], Food web. (2L)</p> <p>Biogeochemical Cycle- definition, significance, flowchart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. (1L)</p> <p>Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threat to biodiversity, Conservation of biodiversity. (2L)</p>	6

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3	<p>Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. (1L)</p> <p>Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems. (1L)</p> <p>Greenhouse effects: Definition, impact of greenhouse gases on the global climate and consequent rise in sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget. (1L)</p> <p>Lapse rate: Ambient lapse rate, Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). (2L)</p> <p>Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model. (2L)</p> <p>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 of ozone layer: CFC, destruction of ozone layer by CFC, impact of other greenhouse gases, effect of ozone modification. (1L)</p> <p>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)</p>	11
4.	<p>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)</p> <p>River/Lake/groundwater 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)</p> <p>Lake: Eutrophication [Definition, source and effect]. (1L)</p> <p>Groundwater: Aquifers, hydraulic gradient, groundwater flow (Definition only) (1L)</p> <p>Standard and control: Wastewater standard [BOD, COD, Oil, Grease],</p> <p>Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Wastewater treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. (2L)</p> <p>Water pollution due to toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic (1L)</p>	9
5	<p>Lithosphere; Internal structure of earth, rock and soil (1L)</p> <p>Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes;</p> <p>Recovery and disposal method- Open dumping, Landfilling, incineration, composting, recycling.</p> <p>Solid waste management and control (hazardous and biomedical waste). (2L)</p>	3

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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), <i>nLd</i> . 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

Textbooks/reference books:

1. M.P. Poonia & S.C. Sharma, Environmental Studies, Khanna Publishing House (AICTE Recommended Textbook-2018)
2. Masters, G.M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
3. De, A.K., "Environmental Chemistry", New Age International

❖ **DESIGN & ANALYSIS OF ALGORITHMS LAB [0 0 4 2]- PCCCS49 4**

Exercises to implement doubly linked list & Binary Search Tree, GCD Techniques. Sorting algorithms. String Matching, DFS, BFS, Topological sorting, AVL tree, 2-3 tree, Horspool algorithm, Open hash table, Floyd's algorithm, Warshall's algorithm, Greedy Techniques, Dijkstra's algorithm, Backtracking.

References:

1. Anany Levitin, *Introduction to the Design and Analysis of Algorithms*, (3e), Pearson Education, India, 2011.
2. Ellis Horowitz and Sartaj Sahni, *Computer Algorithms/C++*, (2e), University Press, 2007
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms*, (2e), PHI, 2006.

❖ **Formal Language & Automata Theory [3 0 0 3]- PCCCS40 3**

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: Alphabet, languages and grammars, productions and 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 pushdown automata, closure properties of CFLs.	6	
4.	Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.	6	

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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, non-deterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as 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	

❖ **Biology [2 1 0 3]- BSC401**

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 that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.	2

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2	<p>The underlying criterion, such as morphological, biochemical or ecological behavior highlighted. Hierarchy of life forms at phenomenological level. A common thread 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, lithotrophs (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitat - aquatic or terrestrial (e) Molecular taxonomy - three major kingdoms of life.</p> <p>As given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E. coli, S. cerevisiae, D. Melanogaster, C. elegans, A. Thaliana, M. musculus</p>	3
3	<p>To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics.</p> <p>Emphasis to be given to the mechanics of cell division not the 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 single gene disorders in humans.</p> <p>Discuss the concept of complementation using human genetics.</p>	4
4.	<p>Biomolecules: To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine. Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.</p>	4

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5	Enzymes: To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.	4
6	Information Transfer: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. 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 processes at the reductionist level Protein structure and function. Hierarchy in protein structure. Primary, secondary, tertiary and quaternary 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 exergonic reactions. Concept of K_{eq} and its relation to standard 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 and energy consuming reactions. Concept of Energy charge	4
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

Textbooks/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. Outlines of Biochemistry, Conn, E. E.; Stumpf, P. K.; Bruening, G.; Doi, R. H. John Wiley and Sons
3. Principles of Biochemistry (VEdition), By Nelson, D. L.; and Cox, M. M. W. H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W. H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L. M. J. P. Harley and C. A. Klein 1995. 2nd edition Wm, C. Brown Publishers

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❖ **Data Communication and Networking Lab -PCCICB49 1**

Objectives :

- Student should be able to configure peer-to-peer network. This will help to understand different issues involved in peer-to-peer network.
- Apply computer engineering discipline specific knowledge to solve core computer engineering related problems.
- Function effectively as a leader and team member in diverse/multi disciplinary teams.
- Ability to install and configure TCP/IP protocol. Ability to configure peer to peer network.

List of Experiments

- 1) Configure Peer-to-Peer Network at least three Host.
- 2) Create desired standard network cable including cross cable and test it by using cable tester
- 3) Connect computer using given topology with wired media.
- 4) Connect Computers Using Wireless Media
- 5) Write a C Program for CRC Error Detection
- 6) Create a Network Using Bluetooth. Setting up wireless network
- 7) Configure File Server. Configure client to file server and use file services
- 8) Configure static and dynamic IP addresses. Configure DHCP server
- 9) Run basic utilities and network commands: ipconfig, ping, tracert, netstat, path ping, route.
- 10) Create two subnets and implement it with calculated subnet masking
- 11) Set access rights and security permissions for user.
- 12) Create IPv6 environment in a small network using simulator
- 13) Linux network configuration, measurement and analysis tool: Wireshark
- 14) Socket Programming: TCP and UDP, peer to peer applications
- 15) Client Server using RPC using threads or processes
- 16) Simulation of LAN and Wi-Fi

Reference Books :

- 1) "Data and Computer Communication" by William Stallings
- 2) "Data Communication and Networking" by Behrouz A Forouzan
- 3) "Internetworking with TCP/IP, Volume 1" by Douglas Comer
- 4) "Computer Networks 5th Edition" by Tanenbaum