**CMP2201 Discrete Mathematics and Random Processes**

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| --- | --- | --- | --- | --- | --- |
| Period perWeek | ContactHour perSemester | WeightedTotal Mark | WeightedExam Mark | WeightedContinuous Assessment Mark | CreditUnits |
| LH | PH | TH | CH | WTM | WEM | WCM | CU |
| 45 | 00 | 15 | 60 | 100 | 40 | 100 | 4 |

**Rationale**

The area is discrete mathematics is foundational material for computer engineering. The material is pervasive in the areas of data structures and algorithms.

**Course Content**

***1. History and Overview of Discrete Mathematics***

 Knowledge themes include sets, logic, functions, and graphs

 Contributors to the subject

 Purpose and role of discrete structures in computer engineering

 Contrasts between discrete-time models vs. continuous-time models

***2. Functions, Relations, and Sets***

 Functions (one-to-one, onto, inverses, composition)

 Relations (reflexivity, symmetry, transitivity, equivalence relations)

 Discrete versus continuous functions and relations

 Sets (Venn diagrams, complements, Cartesian products, power sets)

 Cardinality and countability

***3. Basic Logic***

 Propositional logic

 Logical connectives

 Truth tables

 Use of logic to illustrate connectives

 Normal forms (conjunctive and disjunctive)

 Predicate logic

 Universal and existential quantification

 Limitations of predicate logic

 Boolean algebra

***4. Applications of logic to computer engineering Proof Techniques***

 Notions of implication, converse, inverse, negation, and contradiction

 The structure of formal proofs

 Direct proofs

 Proof by counterexample, contraposition, and contradiction

 Mathematical induction and strong induction

***5. Basics of Counting***

 Permutations and combinations

 Counting arguments rule of products, rule of sums

 The pigeonhole principle

 Generating functions

 Applications to computer engineering

***6. Graphs and Trees***

 Trees

 Undirected graphs

 Directed graphs

 Spanning trees

 Shortest path

 Euler and Hamiltonian cycles

 Traversal strategies

***7. Recursion***

 Recursive mathematical definitions

 Developing recursive equations

 Solving recursive equations

 Applications of recursion to computer engineering

***8****.* ***Probability Basic***

 Introduction: Basic concepts Random experiments & events

 Elementary Theorems

 Probabilistic Modelling

 Independence

 Transformations

 Moments

 Reliability and failure rates

 Transforms of PDF

 Tail inequalities

 A vector Random variable

 Joint CDF & Joint PDF Conditional Probabilities & Densities

 Expectation, Covariance & correlation coefficient

 Joint distributions.

***9. Estimation Theory***

 Definitions: Estimators, Point-Estimators, Interval Estimators

 Properties of Point Estimators

 Types of Estimation: Estimation of a Distribution’s Unknown Parameter; Estimating the value of an inaccessible variable in terms of an accessible variable

 Maximum Likelihood Estimator

 Bayesian Estimator

 Mean Square Linear Estimator: Univariate Linear Regression; Orthogonality; Basic extension to Multivariate Linear Regression

**10. Random Processes**

 Definition of a random process, qualitative discussion of examples of random processes: Poisson process

 Markov process, Brownian motion process

 Digital modulation using phase-shift keying

 Stationary and Ergodic processes

 Power spectral density (PSD): Properties of PSD, PSD applied to base band signals; PSD of white noise process

 Gaussian random processes and their application in communication theory.

**Recommended and Reference Books**

*[1]* Edgar.G. Goodaire, Michael M. Parmenter. *Discrete Mathematics with Graph*

*Theory*, 3rd Edition.

*[2]* Hwei Hsu. *Probability, Random Variables & Random Processes*. Schaum’s

Outlines. ISBN 0-07-030644-3

*[3]* Yannis Viniotis. *Probability & Random Processes for Electrical*

*Engineers,*McGraw Hill.

*[4]* Papoulis. *Probability, Random Variables & Stochastic Processes*, 3rd Edition., McGraw Hill.

*[5]* Jorge I Aunon, V. Chandrasekar: *Introduction to Probability & Random*

*Processes*, McGraw Hill

 *[6]* Venkatarama Krishnan, 2006. *Probability and Random Processes* (Wiley Survival Guides in Engineering and Science), Wiley-Interscience; 1 Edition. ISBN-10: 0471703540, ISBN-13: 978-0471703549

*[7]* Donald G. Childers, 1997. *Probability and Random Processes: Using Matlab with Applications to Continuous and Discrete Time Systems*. Richard D Irwin. ISBN-10: 0256133611, ISBN-13: 978-0256133615

*[8]* Leon Garcia, 1993. *Probability and Random Processes for Electrical*

*Engineering*. Addison Wesley Publishing Company; 2 Sol Edition. ISBN-10:

020155738X, ISBN-13: 978-0201557381

*[9]* Roy D. Yates, David J. Goodman, 2004. *Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers*. Wiley; 2

Edition. ISBN-10: 0471272140, ISBN-13: 978-0471272144

*[10] Seymour Lipschutz, Marc Lipson, 2007. Schaum's Outline of Discrete*

*Mathematics, 3rd Ed. (Schaum's Outlines). McGraw-Hill; 3 Edition. ISBN-10:*

*0071470387 . ISBN-13: 978-0071470384*

*[11] Seymour Lipschutz, 1991. 2000 Solved Problems in Discrete Mathematics.*

*McGraw-Hill; 1 Edition. ISBN-10: 0070380317. ISBN-13: 978-0070380318 [12] Kenneth* Rosen, 2006. *Student's Solutions Guide to accompany Discrete Mathematics*

*and Its Applications*. McGraw-Hill Science/Engineering/Math; 6 Edition. ISBN-10:

0073107794. ISBN-13: 978-0073107790