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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Title of the Course** | Discrete Mathematics | | | | |
| **Course Code** | R204GA05401 | | | | |
| **Class, Semester, Section** | II B. Tech II Sem – Sec - A | | | | |
| **Course Type** | Theory | | | | |
| **Regulation** | SRIT R-20 | | | | |
| **Course Structure** | Theory | | | Practical | |
| Lecture | Tutorials | Credits | Laboratory | Credits |
| 3 | 1 | 3 | - | - |
| **Course Coordinator** | Mr. M. Narasimhulu | | | | |

**1. Course Pre-requisites:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Level** | **Course Code** | **Semester** | **Prerequisites** |
| B. Tech | R204GA05401 | II B. Tech II Sem | A higher education mathematics is required to study this course |
| B. Tech |  |  |  |
| B. Tech |  |  |  |

# 2. COURSE OVERVIEW: (Write the description of the course in 30 to 40 words)

|  |
| --- |
| This course will introduce and illustrate in the elementary discrete mathematics for computer science and engineering students. To equip the students with standard concepts like formal logic notation, methods of proof, induction, sets, relations, graph theory, permutations and combinations, counting principles. |

**3. MARKS DISTRIBUTION:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Subject** | **SEE** | **CIE** | **CAA** | **Total Marks** |
| Fluid Dynamics | 70 marks | 20 marks | 10 marks | 1. marks |

# 4. CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Power Point Presentations |  | Chalk & Talk |  | Assignments | **x** | MOOC |
| **X** | Open Ended Experiments | **x** | Seminars | **x** | Mini Project | **x** | Videos |
| **X** | Course Project | **X** | Others |  |  |  |  |
|  |  | | | | | | |

**5. EVALUATION METHODOLOGY:**

The course will be evaluated for a total of 100 marks, with 40 marks for Continuous Internal Assessment (CIA) and 60 marks for Semester End Examination (SEE). CIA is conducted for a total of 40 marks, with 30 marks for Continuous Internal Examination (CIE), and 10 marks for Continuous Alternative Assessment (CAA).

**Semester End Examination (SEE):** End examination of theory courses shall have the following pattern:

a. There shall be 6 questions and all questions are compulsory.

b. Question 1 shall contain 5 compulsory short answer questions for a total of 10 marks such that each question carries 2 marks. There shall be 1 short answer questions from each unit.

c. In each of the questions from 2 to 6, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.

d. The questions from 2 to 6 shall be set by covering one unit of the syllabus for

each question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

|  |  |
| --- | --- |
| Percentage of Cognitive Level | Blooms Taxonomy Level |
| 25% | Remember |
| 30% | Understand |
| 45% | Apply |
| 0 % | Analyze |

# Continuous Internal Assessment (CIA):

CIA is conducted for a total of 40 marks, with 30 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | | Marks | Total Marks |
| **CIA** | Continuous Internal Examination – 1 (Mid-term) | 15 | 40 |
| Continuous Internal Examination – 2 (Mid-term) | 15 |
| CAA-1 | 10 |
| CAA-2 | 10 |
| **SEE** | Semester End Examination (SEE) | 60 | 60 |
| **Total Marks** | | | 100 |

# Continuous Internal Examination (CIE):

For each theory course, during the semester, there shall be two CIEs. Each CIE will be evaluated for 30 marks and will be converted to 20 marks. The first CIE will be conducted for around 50% of the syllabus and the second CIE will be conducted for the remaining syllabus. Final or consolidated CIE marks will be arrived by considering the marks secured by the student in both the CIEs with 80% weightage given to the better CIE and 20% to the other.

The duration of CIE examination is 120 minutes.

There shall be 4 questions and all are compulsory.

Question 1 contains 3 short answer questions from each unit with equal weightage for a total of 6 marks. The student has to answer all of them.

Questions 2-4 contains 3 either/ or type questions from each unit with equal weightage of 8 marks. The marks obtained by the student shall be out of 30 will be reduced to out of 20 marks. Any fraction shall be rounded off to next integer.

If the student is absent for the CIE examination, no re-exam shall be conducted and marks for that examination shall be considered as zero.

# Alternative Assessment Tool (AAT)

This CAA enables faculty to design own assessment patterns during the semester. The CAA enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices. If properly applied, the CAA converts the classroom into an effective learning centre. The CAA may include assignments, seminars, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

For each theory course, during the semester, there shall be two CAAs. Each CAA will be evaluated for 5 marks, the first CAA will be conducted before the first CIE and the second CAA will be conducted before second CIE. Final CAA marks will be arrived by adding the marks secured by the student in both the CAAs.

# The final marks for CIA (for 40 marks) = Consolidated CIE marks (for 30 marks) + Consolidated CAA marks (for 10 marks)

# 6. COURSE OBJECTIVES:

**From this course the students will try to learn:**

|  |  |
| --- | --- |
| I | To understand Fundamentals of Mathematic Logic, Set Theory, Relations, Functions and Combinatorics. |
| II | To use the Inference theory for Statements calculus. |
| III | To use number theory for evaluating arithmetic theorems and Algebraic Systems. |
| IV | To use Principles of Pigeon Hole, Inclusion and Exclusion for the Combinatorics. |

# 7. COURSE OUTCOMES:

**After successful completion of the course, students should be able to:**

|  |  |  |
| --- | --- | --- |
| **CO** | **Course Outcomes**  At the end of the course students will be able to: | **Cognitive Level** |
| CO 1 | Illustrate discrete mathematic components like statements, logic, sets, structures, numbers and combinatorics. | Understand |
| CO 2 | Evaluate and simplify propositional and predicate calculus using inference theory. | Apply |
| CO 3 | Perform the operations on Sets, Relations and functions and their properties. | Apply |
| CO 4 | Identify algebraic systems and use general properties on number theory. | Apply |
| CO 5 | Use combinatorics solving the counting problems. | Apply |
| CO 6 | Use graph algorithms for representing, identifying, generating and evaluating the Graphs. | Apply |

# COURSE KNOWLEDGE COMPETENCY LEVEL:

|  |  |  |  |
| --- | --- | --- | --- |
| **S. No.** | **Cognitive Level** | **No. of COs mapped** | **%** |
| **1** | Remember | **0** |  |
| **2** | Understand | **1** | **40** |
| **3** | Apply | **5** | **60** |
| **4** | Analyze |  |  |
| **5** | Evaluate |  |  |

# 8. Program Outcomes and & Program Specific Outcomes:

|  |  |
| --- | --- |
| **Program Outcomes** | |
| **PO 1** | **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| **PO 2** | **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| **PO 3** | **Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations |
| **PO 4** | **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| **PO 5** | **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations |
| **PO 6** | **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| **PO 7** | **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| **PO 8** | **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO 9** | **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO 10** | **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| **PO 11** | **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| **PO 12** | **Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change |
| **Program Specific Outcomes** | |
| **PSO1** | Design, implement, and test application software systems for desktop, web, and mobile platforms to meet the specified requirements. |
| **PSO2** | Use effectively and efficiently the functionality of systems software for building applications. |
| **PSO3** | Understand the organization and architecture of Computer Systems, Embedded Systems, and Networked Systems. |

**9. MAPPING OF EACH CO WITH PO(s),PSO(s):**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PROGRAM OUTCOMES** | | | | | | | | | | | | **PSO’S** | | |
| **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** | **PSO 3** |
| CO 1 | - | - | - | - | - | - | - | - | - | - | - |  | X | - | - |
| CO 2 | X | - | - | - | - | - | - | - | - | - | - | - | X | - | - |
| CO 3 | X | - | - | - | - | - | - | - | - | - | - | - | X | - | - |
| CO 4 | X | - | - | - |  | - | - | - | - | - | - |  | X | - | - |
| CO 5 | X | - | - | - | - | - | - | - | - | - | - | - | X | - | - |
| CO 6 | X | - | - | - |  | - | - | - | - | - | - | - | X | - | - |

# 10. JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

|  |  |  |  |
| --- | --- | --- | --- |
| **CO** | **POs/PSOs**  **mapped** | **Justification for mapping**  **(Students will be able to)** | **No. of key competencies** |
| CO 1 |  |  |  |
| CO 2 | **PO1, PSO1** | Use to evaluate statements by using predictive and Propositional calculus | **1, 2, 1** |
| CO 3 | **PO1, PSO1** | Use Mathematical and Scientific Fundamentals to Solve problems related to sets, Relations and Functions.  Use Engineering Fundamentals to derive theorems. | **1, 2, 1** |
| CO 4 | **PO1, PSO1** | Use Mathematical Fundamentals to identify algebraic systems and solve number theory problems. | **1, 2, 1** |
| CO 5 | **PO1, PSO1** | Use Mathematic principles and Scientific Fundamentals to solve problems on permutations, combinations, pigeonhole principles and principles of Inclusion and Exclusion | **1, 2, 1** |
| CO 6 | **PO1, PSO1** | Use Graph algorithms logically and Mathematically for solving real time programs graphically. | **1, 2, 1** |

**11. TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAP- PING:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PROGRAM OUTCOMES** | | | | | | | | | | | | **PSO’S** | | |
| **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** | **PSO 3** |
|  | 3 | 10 | 10 | 11 | 1 | 5 | 3 | 3 | 12 | 5 | 12 | 8 | 2 | 1 | 1 |
| CO 1 |  | - | - | - | - | - | - | - | - | - | - |  | - | - | - |
| CO 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| CO 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| CO 4 | 2 | - | - | - |  | - | - | - | - | - | - |  | 1 | - | - |
| CO 5 | 2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| CO 6 | 2 | - | - | - |  | - | - | - | - | - | - | - | 1 | - |  |

# 12. PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PROGRAM OUTCOMES** | | | | | | | | | | | | **PSO’S** | | |
| **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** | **PSO 3** |
| No. of Vital Features | | | | | | | | | | | | | | |
| 3 | 10 | 10 | 11 | 1 | 5 | 3 | 3 | 12 | 5 | 12 | 8 | 2 | 1 | 1 |
| CO 1 | - | - | - | - | - | - | - | - | - | - | - |  | - | - | - |
| CO 2 | 66.7 | - | - | - | - | - | - | - | - | - | - | - | 50 | - | - |
| CO 3 | 66.7 | - | - | - | - | - | - | - | - | - | - | - | 50 | - | - |
| CO 4 | 66.7 | - | - | - |  | - | - | - | - | - | - |  | 50 | - | - |
| CO 5 | 66.7 | - | - | - | - | - | - | - | - | - | - | - | 50 | - | - |
| CO 6 | 66.7 | - | - | - |  | - | - | - | - | - | - | - | 50 | - |  |

**13. COURSE ARTICULATION MATRIX (PO / PSO MAPPING):**

The Correlation levels of POs and PSOs are as follows.

Correlation **Level 3:** Percentage of vital features of PO/PSO >=60%

Correlation **Level 2:** Percentage of vital features of PO/PSO >40% and < 60%.

Correlation **Level 1:** Percentage of vital features of PO/PSO >5% and <= 40%.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PROGRAM OUTCOMES** | | | | | | | | | | | | **PSO’S** | | |
| **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** | **PSO 3** |
| No. of Vital Features | | | | | | | | | | | | | | |
| 3 | 10 | 10 | 11 | 1 | 5 | 3 | 3 | 12 | 5 | 12 | 8 | 2 | 1 | 1 |
| CO 1 | - | - | - | - | - | - | - | - | - | - | - |  | - |  | - |
| CO 2 | 3 | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO 4 | 3 | - | - | - |  | - | - | - | - | - | - |  | 2 |  | - |
| CO 5 | 3 | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO 6 | 3 | - | - | - |  | - | - | - | - | - | - | - | 2 | - |  |

# 14. ASSESSMENT METHODOLOGY-DIRECT:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CIE Exams |  | Laboratory Practices |  | Term Paper |  |
| SEE Exams |  | Student Viva |  | 5 minutes video |  |
| Seminars |  | Certification |  | Course Project |  |
| Assignments |  | Open ended experiments |  | Others |  |

**15. ASSESSMENT METHODOLOGY-INDIRECT:**

|  |  |  |  |
| --- | --- | --- | --- |
| Assessment of mini projects by experts |  | Course Exit Survey |  |

# 16. SYLLABUS:

|  |
| --- |
| **UNIT 1: Mathematical Logic (11 Periods)** |
| **Propositional Calculus:** Statements and Notations, Connectives, Well Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus, Consistency of Premises, Indirect Method of Proof.  **Predicate Calculus:** Predicative Logic, Statement Functions, Variables and Quantifiers, Free and Bound Variables, Inference Theory for Predicate Calculus. |
| **UNIT 2: Set Theory (15 Periods)** | |
| **Introduction:** Operations on Binary Sets, Principle of Inclusion and Exclusion, Relations: Properties of Binary Relations, Relation Matrix and Digraph, Operations on Relations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering Relations, Hasse Diagrams.  **Functions:** Bijective Functions, Composition of Functions, Inverse Functions, Permutation Functions, Recursive Functions, Lattice and its Properties. | |
| **UNIT 3:** **Algebraic Structures and Number Theory (14 Periods)** | |
| **Algebraic Structures**: Algebraic Systems, Examples, General Properties, Semi Groups and Monoids, Homomorphism of Semi Groups and Monoids, Group, Subgroup, Abelian Group, Homomorphism, Isomorphism.  **Number Theory:** Properties of Integers, Division Theorem, The Greatest Common Divisor, Euclidean Algorithm, Least Common Multiple, Testing for Prime Numbers, The Fundamental Theorem of Arithmetic, Modular Arithmetic (Fermat‘s Theorem and Euler‘s Theorem). | |
| **UNIT 4: Combinatorics (11 Periods)** | |
| Basic of Counting, Permutations, Permutations with Repetitions, Circular Permutations, Restricted Permutations, Combinations, Restricted Combinations, Generating Functions of Permutations and Combinations, Binomial and Multinomial Coefficients, Binomial and Multinomial Theorems, The Principles of Inclusion–Exclusion, Pigeonhole Principle and its Application. | |
| **UNIT 5: Graph Theory (12 Periods)** | |
| Basic Concepts of Graphs, Sub graphs, Matrix Representation of Graphs: Adjacency Matrices, Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs, Multigraphs, Planar Graphs, Euler‘s Formula, Graph Coloring and Covering, Chromatic Number, Spanning Trees, Algorithms for Spanning Trees. | |
| **Total Periods: 62** | |
| **4. Text Books:** | |
| 1. Discrete Mathematical Structures with Applications to Computer Science, J. P. Tremblay and P. Manohar, Tata McGraw Hill, 2015. 2. Elements of Discrete Mathematics-A Computer Oriented Approach, C. L. Liu and D. P. Mohapatra, 3rdEdition, Tata McGraw Hill,2008. | |
| **5. Reference Books** | |
| 1. Advanced Engineering Mathematics, by Erwin Kreyszig, 10thEdition, Wiley India, 2014. 2. Higher Engineering Mathematics, by B.V.Ramana, Sixth Reprint, Mc Graw Hill publishers, 2008. 3. Advanced Engineering Mathematics, by Alan Jeffrey, 1st Edition, Elsevier, 2010. | |

# Google Classroom Link:

|  |  |  |
| --- | --- | --- |
| SNO | Details about Classroom | Class Room Link |
| 1 | II B.Tech II Sem – Sec A | https://classroom.google.com/c/NTk2MTc5MDM5MTQ3?cjc=iojrlz2 |
| 2 | II B.Tech II Sem – Sec B | https://classroom.google.com/c/NTk2MTgwMDI1ODA3?cjc=46f7mm2 |

**17. Academic Calendar & Lesson Plan:**

**Academic Calendar:**

|  |  |  |
| --- | --- | --- |
| I Spell of instructions | 27-02-2023 to 23-04-2023 | 8 weeks |
| I CIE | 24-04-2023 to 30-04-2023 | 1 Week |
| I Spell of instructions | 1-05-2023 to 18-06-2023 | 7 weeks |
| II CIE | 19-06-2023 to 25-06-2023 | 1 week |
| Preparation and Practicals | 26-06-2023 to 5-07-2023 | 10 days |
| End Examinations | 6-07-2023 to 16-07-2023 | 2 weeks |

**Lesson Plan:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sr. No.** | **Topics to be covered** | **Mode of**  **Delivery** | **Periods**  **Required** | **Books**  **followed** | **Scheduled**  **Date** |
| **UNIT 1: Mathematical Logic** | | | | | |
| **1** | Statements and Notations | C&T | **1** | T1 | 28-02-23 |
| **2** | Connectives, Well Formed Formulas | C&T, ICT | **1** | T1 | 2-03-23 |
| **3** | Truth Tables, Tautologies | C&T | **1** | T1 | 2-03-23 |
| **4** | Equivalence of Formulas, Duality Law | ICT | **1** | T1 | 3-03-23 |
| **5** | Tautological Implications | C&T | **1** | T1 | 6-03-23 |
| **6** | Normal Forms | C&T | **1** | T1 | 7-03-23 |
| **7** | Theory of Inference for Statement Calculus,  Consistency of Premises | ICT | **1** | T1 | 9-03-23 |
| **8** | Indirect Method of Proof | C&T | **1** | T1 | 10-03-23 |
| **9** | Predicative Logic, Statement Functions | ICT | **1** | T1 | 13-03-23 |
| **10** | Variables and Quantifiers, Free and Bound Variables | ICT | **1** | T1 | 13-03-23 |
| **11** | Inference Theory for Predicate Calculus. | C&T | **1** | T1 | 14-03-23 |
| **Total Periods required for Unit-1** | | | **11** |  |  |
| **UNIT 2: Set Theory** | | | | | |
| **12** | Operations on Binary Sets | C&T | **2** | T1 | 16-03-23 |
| **13** | Principle of Inclusion and Exclusion | ICT | **1** | T1 | 17-03-23 |
| **14** | Properties of Binary Relations | ICT | **1** | T1 | 20-03-23 |
| **15** | Relation Matrix and Digraph | C&T | **1** | T1 | 21-03-23 |
| **16** | Operations on Relations, Partition and Covering | ICT | **1** | T1 | 23-03-23 |
| **17** | Transitive Closure | C&T | **1** | T1 | 23-03-23 |
| **18** | Equivalence | ICT | **1** | T1 | 24-03-23 |
| **19** | Compatibility and Partial Ordering Relations | ICT | **1** | T1 | 27-03-23 |
| **20** | Hasse Diagrams | C&T | **1** | T1 | 28-03-23 |
| **21** | Bijective Functions, Composition of Functions | ICT | **1** | T1 | 3-04-23 |
| **22** | Inverse Functions | C&T | **1** | T1 | 6-04-23 |
| **23** | Permutation Functions | C&T | **1** | T1 | 6-04-23 |
| **24** | Recursive Functions | C&T | **1** | T1 | 10-04-23 |
| **25** | Lattice and its Properties | C&T | **1** | T1 | 11-04-23 |
| **Total Classes required for Unit-2** | | | **15** |  |  |
| **UNIT 3: Algebraic Structures and Number Theory** | | | | | |
| **26** | Algebraic Systems | ICT | **1** | T1 | 13-04-23 |
| **27** | Examples, | ICT | **1** | T1 | 13-04-23 |
| **28** | General Properties | ICT | **1** | T1 | 14-04-23 |
| **29** | Semi Groups and Monoids | ICT | **½** | T1 | 17-04-23 |
| **30** | Homomorphism of Semi Groups and Monoids | ICT | **½** | T1 | 17-04-23 |
| **31** | Group, Subgroup | ICT | **1** | T1 | 18-04-23 |
| **32** | Abelian Group, Homomorphism | ICT | **1** | T1 | 20-04-23 |
| **33** | Isomorphism. | ICT | **1** | T1 | 20-04-23 |
| **34** | Properties of Integers | ICT | **1** | T1 | 21-04-23 |
| **35** | Division Theorem, The Greatest Common Divisor | ICT | **1** | T1 | 1-05-23 |
| **36** | Euclidean Algorithm, Least Common Multiple | C&T | **2** | T1 | 4-05-23 |
| **37** | Testing for Prime Numbers | ICT | **1** | T1 | 5-05-23 |
| **38** | The Fundamental Theorem of Arithmetic | ICT | **1** | T1 | 8-05-23 |
| **39** | Modular Arithmetic (Fermat‘s Theorem and Euler‘s Theorem). | ICT | **1** | T1 | 9-05-23 |
| **Total Classes required for Unit-3** | | | **14** |  |  |
| **UNIT 4: Combinatorics** | | | | | |
| **40** | Basic of Counting, Permutations | C&T | **1** | T1 | 11-05-23 |
| **41** | Permutations with Repetitions | C&T | **1** | T1 | 11-05-23 |
| **42** | Circular Permutations | C&T | **1** | T1 | 12-05-23 |
| **43** | Restricted Permutations | ICT | **1** | T1 | 12-05-23 |
| **44** | Combinations, Restricted Combinations | ICT | **1** | T1 | 16-05-23 |
| **45** | Generating Functions of Permutations and Combinations | ICT | **1** | T1 | 18-05-23 |
| **46** | Binomial and Multinomial Coefficients | ICT | **1** | T1 | 18-05-23 |
| **47** | Binomial and Multinomial Theorems | ICT | **1** | T1 | 19-05-23 |
| **48** | The Principles of Inclusion–Exclusion | ICT | **1** | T1 | 22-05-23 |
| **49** | Pigeonhole Principle and its Application | C&T | **2** | T1 | 22-05-23 |
| **Total Classes required for Unit-4** | | | **11** |  |  |
| **UNIT 5: Graph Theory** | | | | | |
| **50** | Basic Concepts of Graphs, Sub graphs | C&T | **½** | T1 | 26-05-23 |
| **51** | Matrix Representation of Graphs | C&T | **½** | T1 | 26-05-23 |
| **52** | Adjacency Matrices | C&T | **½** | T1 | 29-05-23 |
| **53** | Incidence Matrices, | C&T | **½** | T1 | 29-05-23 |
| **54** | Isomorphic Graphs | C&T | **1** | T1 | 30-05-23 |
| **55** | Paths and Circuits | ICT | **1** | T1 | 1-06-23 |
| **56** | Eulerian and Hamiltonian Graphs | ICT | **1** | T1 | 1-06-23 |
| **57** | Multigraphs, Planar Graphs, | ICT | **1** | T1 | 2-06-23 |
| **58** | Euler‘s Formula | ICT | **1** | T1 | 5-06-23 |
| **58** | Graph Coloring and Covering | C&T | **1** | T1 | 6-06-23 |
| **59** | Chromatic Number | C&T | **1** | T1 | 8-06-23 |
| **60** | Spanning Trees | ICT | **1** | T1 | 8-06-23 |
| **61** | Algorithms for Spanning Trees. | ICT | **1** | T1 | 9-06-23 |
| **Total Classes required for Unit-5** | | | **11** |  |  |
| **Total Number of Classes Required : 62+3=65** | | | | | |

**18. Content beyond the Syllabus**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Topics covered beyond the syllabus** | **COs Mapped** |
| 1 | Contradiction and Contingency | CO1 |
| 2 | Closures of Relations | CO2 |
| 3 | Planar Graph Vs Non-Planar Graphs | CO6 |

# Course Coordinator Head of the Department