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	100 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		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	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		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	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		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	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	1-03-23
3	Truth Tables, Tautologies	C&T	**1**	T1	3-03-23
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	10-03-23
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	14-03-23
11	Inference Theory for Predicate Calculus.	C&T	**1**	T1	15-03-23
Total Periods required for Unit-1			**11**		
UNIT 2: Set Theory					
12	Operations on Binary Sets	C&T	**2**	T1	17-03-23
13	Principle of Inclusion and Exclusion	ICT	**1**	T1	20-03-23
14	Properties of Binary Relations	ICT	**1**	T1	21-03-23
15	Relation Matrix and Digraph	C&T	**1**	T1	24-03-23

16	Operations on Relations, Partition and Covering	ICT	**1**	T1	24-03-23
17	Transitive Closure	C&T	**1**	T1	27-03-23
18	Equivalence	ICT	**1**	T1	28-03-23
19	Compatibility and Partial Ordering Relations	ICT	**1**	T1	29-03-23
20	Hasse Diagrams	C&T	**1**	T1	31-03-23
21	Bijective Functions, Composition of Functions	ICT	**1**	T1	31-03-23
22	Inverse Functions	C&T	**1**	T1	3-04-23
23	Permutation Functions	C&T	**1**	T1	3-04-23
24	Recursive Functions	C&T	**1**	T1	5-04-23
25	Lattice and its Properties	C&T	**1**	T1	10-04-23
	Total Classes required for Unit-2		**15**		
	UNIT 3: Algebraic Structures and Number Theory				
26	Algebraic Systems	ICT	**1**	T1	11-4-23
27	Examples,	ICT	**1**	T1	12-04-23
28	General Properties	ICT	**1**	T1	14-04-23
29	Semi Groups and Monoids	ICT	**½**	T1	14-04-23
30	Homomorphism of Semi Groups and Monoids	ICT	**½**	T1	14-04-23
31	Group, Subgroup	ICT	**1**	T1	17-04-23
32	Abelian Group, Homomorphism	ICT	**1**	T1	18-04-23
33	Isomorphism.	ICT	**1**	T1	19-04-23
34	Properties of Integers	ICT	**1**	T1	21-04-23
35	Division Theorem, The Greatest Common Divisor	ICT	**1**	T1	21-04-23
36	Euclidean Algorithm, Least Common Multiple	C&T	**2**	T1	1-05-23
37	Testing for Prime Numbers	ICT	**1**	T1	3-05-23
	The Fundamental Theorem of Arithmetic	ICT	**1**	T1	5-05-23
	Modular Arithmetic (Fermat's Theorem and Euler's Theorem).	ICT	**1**	T1	5-05-23
	Total Classes required for Unit-3		**14**		
	UNIT 4: Combinatorics				
38	Basic of Counting, Permutations	C&T	**1**	T1	8-05-23
39	Permutations with Repetitions	C&T	**1**	T1	9-05-23
40	Circular Permutations	C&T	**1**	T1	10-05-23
41	Restricted Permutations	ICT	**1**	T1	12-05-23
42	Combinations, Restricted Combinations	ICT	**1**	T1	12-05-23
43	Generating Functions of Permutations and Combinations	ICT	**1**	T1	15-05-23
44	Binomial and Multinomial Coefficients	ICT	**1**	T1	16-05-23
45	Binomial and Multinomial Theorems	ICT	**1**	T1	17-05-23
46	The Principles of Inclusion–Exclusion	ICT	**1**	T1	19-05-23
47	Pigeonhole Principle and its Application	C&T	**2**	T1	19-05-23
	Total Classes required for Unit-4		**11**		
	UNIT 5: Graph Theory				
48	Basic Concepts of Graphs, Sub graphs	C&T	**½**	T1	22-05-23
49	Matrix Representation of Graphs	C&T	**½**	T1	22-05-23
50	Adjacency Matrices	C&T	**½**	T1	23-05-23
51	Incidence Matrices,	C&T	**½**	T1	23-05-23
52	Isomorphic Graphs	C&T	**1**	T1	24-05-23
53	Paths and Circuits	ICT	**1**	T1	26-05-23
54	Eulerian and Hamiltonian Graphs	ICT	**1**	T1	26-05-23
55	Multigraphs, Planar Graphs,	ICT	**1**	T1	29-05-23
56	Euler's Formula	ICT	**1**	T1	30-05-23

57	Graph Coloring and Covering	C&T	**1**	T1	31-05-23
58	Chromatic Number	C&T	**1**	T1	01-06-23
58	Spanning Trees	ICT	**1**	T1	5-06-23
59	Algorithms for Spanning Trees.	ICT	**1**	T1	6-06-23
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**