University of Kerala

Discipline	Mathematics				
Course Code	UK1DSCMAT100				
Course Title	Foundations of Mathematics				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical	Total Hours per week
	4	3	-	2	5
Pre-requisites	1. Basic understanding on the concepts and operations on matrices 2. Understanding on the concept of a system of linear equations. 3. Basic knowledge of the set number system.				
Course Summary	This course includes set theory, determinants and matrices, number theory and solution of system of equations using matrices and number theory				

Detailed Syllabus

Module	Unit	Contents	Hrs
I	**Fundamental Terminology in Proof Techniques**		**9**
	1	Statements, statements with quantifiers, negation of statements with quantifiers, statements involving multiple quantifiers, compound statements, negation of compound statements, implications, converse, if and only if, contrapositive of implications, Proofs in Mathematics (Indirect proofs: proof by contradiction, proof by Induction, counter examples can be omitted) (Chapter 1: Sections 1.1 to 1.5 Text[1])	

Module	Unit	Contents	Hrs
II	**Proof techniques and elementary number theory**		**9**
	2	Mathematical induction, The division algorithm, Pigeonhole principle, divisibility relation, inclusion-exclusion principle, prime and composite numbers, infinitude of primes– Sections 1.3, 2.1 (exclude the topics marked as optional), 2.5 (Topics Primes and Pi and exclude the rest in this section) from Text [3])	
III	**Primes and composites**		**9**
	3	GCD, linear combination of integers, pairwise relatively prime integers, the Euclidean algorithm for finding GCD, The fundamental theorem of arithmetic, canonical decomposition of an integer into prime factors Section 3.1 (excluding Lemma 3.1, Theorem 3.2, Theorem 3.3), section 3.2 (Excluding the topics marked as optional, excluding Lemma 3.2, Theorem 3.12), Section 3.3 (Excluding Theorem 3.14) from Text [3])	
IV	**System of linear equations and solutions**		**9**
	4	Systems of Linear Equations, Gaussian Elimination, Elementary Matrices and a Method for Finding A^{-1}, Number of Solutions of a Linear System, Applications of Linear Systems –Network Analysis (Chapter 1: Section 1.1, 1,2, 1.5, 1.9 (Network analysis only) of Text[2])	
V	**Suggestions for the teacher designed module**		**9**
	5	Relation: Product sets, Relations, Types of Relations, Equivalence Relations, Partial Ordering Relations Functions: Functions, One–to-One, Onto and Invertible Functions., Different types of matrices – diagonal, triangular, symmetric, Solving system of equations using Cramer's rule, Solving Linear Systems by Matrix Inversion,Applications of linear systems - balancing chemical equations, polyomial interpolation, LCM and related problems	

Practical sessions – 30 hours

All the topics (including those in the suggestions for the teacher designed module) can be used for practical sessions.

Problems for the practical examination

1. Costructing sets, operations on them like union, intersection, complements
2. Demonstrating basic arithmetic operators $+, -, *, \hat{}$, , modulo operator%
3. Forming matrices of different orders
4. Forming identity, zero, scalar matrices
5. Operations on matrices (multiplication, inverses, transposes, cofactor, adjoint)

6. Forming systems of linear equations using symbolic variables
7. Forming matrices for systems, forming augmented matrices
8. Row reduction operations on matrices
9. Finding remainder and quotient
10. Problems using inclusion-exclusion principle
11. Determining if a number is a prime, finding list of primes
12. Using Euler ϕ function
13. Canonical decomposition

A record should be maintained with atleast 7 problems from the above. Each problem in the record must have a description of the problem, algorithm (step by step procedure), commands used, input given and output obtained accordingly. For the ESE, from the list of above 10 problems, the student should be able to answer two selected (from the 7 available in the record) by the examiner.

Textbooks

1. Ajit Kumar, S Kumaresan, B K Sarma, A foundation course in Mathematics, Narosa Publications, New Delhi 2018
2. H Anton, C Rorres. Elementary linear algebra, 11th Edition, John Wiley & Sons.
3. Thomas Koshy, Elementary Number Theory with Applications, 2nd Edition, Academic Press, 2007.

References

1. David M. Burton, Elementary Number Theory, Seventh Edition, McGraw-Hill, 2011.
2. Gilbert Strang, Introduction to Linear Algebra , 5th Edition, 2005.
3. G A Jones, J M Jones, Elementary Number Theory, Springer, 1998.
4. Lee W. Johnson, R Dean Riess, Jimmy T. Arnold, Introduction to Linear Algebra, Fifth Edition, Addison Wesley, 2019.
5. Seymour Lipschutz. Set Theory and Related Topics, 3rd Edition, Schaum's outline, 1998.

Resources for practical sessions

P1. Sagemath documentation – Introductory Sage Tutorial https://doc.sagemath.org/html/en/prep/Intro-Tutorial.html

P2. Saskia Roos, Michael Jung, *An Introductory Course on Sage, Lecture Notes* https://www.math.uni-potsdam.de/fileadmin/user_upload/An_Introductory_Course_on_Sage.pdf

P3. Sagemath documentation – Symbolic variables https://doc.sagemath.org/html/en/reference/calculus/sage/calculus/var.html

P4. P. Zimmermann *et al*, Computational Mathematics with SageMath, https://www.sagemath.org/sagebook/english.html

P5. Gregory V. Bard, Sage for Undergraduates http://www.people.vcu.edu/~clarson/bard-sage-for-undergraduates-2014.pdf

P6. Robert A. Beezer, *A First Course in Linear Algebra* http://linear.ups.edu/html/sage.html

P7. Sagemath documentation – Linear Algebra https://doc.sagemath.org/html/en/tutorial/tour_linalg.html

Course Outcomes

CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Describe the basic concept of set theory, determinants, Matrices and numbers	PSO1, PO1, 2, 4, 8	U	F,C	L	
CO 2	Solve system of linear equations using determinants, Matrices	PSO2, PO1, 2, 3, 4, 7, 8	Ap	P	L	
CO 3	Illustration of Mathematical Induction, Division Algorithm and Euclidean Algorithm	PSO1, PO1, 2, 3, 4, 6, 7, 8	U	F,C	L	
CO 4	Categorise functions based on the properties	PSO4, PO1	An	F,C	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	2	1	1	2	2	2	1	3	1	1	2	2
CO2	2	3	2	2	1	1	2	3	1	2			1	2
CO3	3	2	2	1	1	1	3	2	1	3			1	1
CO4	2	2	1	3	1	1	3	1	1	1		1	1	1

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam