Teaching Plan (DSC-7: Group Theory): B.Sc. (Hons.) Mathematics, Semester-3

Weeks 1 and 2: Permutation groups and group of symmetries, Cycle notation for permutations and properties, Even and odd permutations, Alternating groups.
[1]: Chapter 5 (up to Theorem 5.7, page 104).

Weeks 3 and 4: Cosets and its properties, Lagrange's theorem and consequences including Fermat's Little theorem, Number of elements in product of two finite subgroups.
[1]: Chapter 7 (up to Example 6, page 144).

Weeks 5 and 6: Normal subgroups, Factor groups, Cauchy's theorem for finite Abelian groups.
[1]: Chapter 9 (Theorems 9.1, 9.2, 9.3 and 9.5, and Examples 1 to 12).

Weeks 7 and 8: Group homomorphisms, isomorphisms and properties, Cayley's theorem.
[1]: Chapter 10 (Theorems 10.1 and 10.2, Examples 1 to 11).
[1]: Chapter 6 (Theorems 6.1, 6.2, 6.3, and Examples 1 to 10).

Week 9: First, Second and Third isomorphism theorems for groups.
[1]: Chapter 10 (Theorems 10.3, 10.4, Examples 12 to 15, and Exercises 41 and 42, page 208 for second and third isomorphism theorems for groups).

Weeks 10 and 11: Automorphism, Inner automorphism, Automorphism groups, Automorphism groups of cyclic groups, Applications of factor groups to automorphism groups.
[1]: Chapter 6 (Page 128 to132).
[1]: Chapter 9 (Theorem 9.4, and Example 16).

Weeks 12 and 13: External direct products of groups and its properties, The group of units modulo n as an external direct product, Applications to data security and electric circuits.
[1]: Chapter 8.

Weeks 14 and 15: Internal direct products; Fundamental theorem of finite Abelian groups and its isomorphism classes.
[1]: Chapter 9 (Section on internal direct products, pages 183 to 187).
[1]: Chapter 11 (Outline of the proof of Fundamental theorem of finite Abelian groups, and its application to determine the isomorphism classes of Abelian groups).

Essential Reading

1. Gallian, Joseph. A. (2017). Contemporary Abstract Algebra (9th ed.). Cengage Learning India Private Limited, Delhi. Indian Reprint 2021.

Teaching Plan (DSC-8: Riemann Integration): B.Sc. (Hons.) Mathematics, Semester-3

Weeks 1 and 2: Definition of upper and lower Darboux sums, Darboux integral, Inequalities for upper and lower Darboux sums.
[1]: Chapter 6 (Sections 32.1 to 32.4).

Weeks 3 to 5: Necessary and sufficient conditions for the Darboux integrability; Riemann's definition of integrability by Riemann sum and the equivalence of Riemann's and Darboux's definitions of integrability.
[1]: Chapter 6 (Sections 32.5 to 32.10).

Week 6: Definition and examples of the Riemann-Stieltjes integral.
[1]: Chapter 6 (Sections 35.1, and 35.2).

Weeks 7 to 9: Riemann integrability of monotone functions and continuous functions, Properties of Riemann integrable functions.
[1]: Chapter 6 (Sections 33.1, and 33.6).

Week 10: Definitions of piecewise continuous and piecewise monotone functions and their Riemann integrability; Intermediate value theorem for integrals,
[1]: Chapter 6 (Sections 33.7 to 33.9, and Exercise 33.14).

Week 11: Fundamental Theorems of Calculus (I and II).
[1]: Chapter 6 (Sections 34.1 to 34.3).

Weeks 12 and 13: Methods of integration: integration by substitution and integration by parts; Volume by slicing and cylindrical shells, Length of a curve in the plane and the area of surfaces of revolution.
[2]: Chapter 4 (Section 4.9), Chapter 7 (Section 7.2), and Chapter 5 (Sections 5.2 to 5.5).

Weeks 14 and 15: Improper integrals of Type-I, Type-II and mixed type, Convergence of improper integrals, The beta and gamma functions and their properties.
[3]: Chapter 7 (Section 7.8).
[4]: Chapter 9 [Sections 9.5 (up to examples 9.47, page 395), and 9.6 (pages 405 to 408).

Essential Readings

1. Ross, Kenneth A. (2013). Elementary Analysis: The Theory of Calculus (2nd ed.). Undergraduate Texts in Mathematics, Springer.
2. Anton, Howard, Bivens Irl and Davis Stephens (2012). Calculus (10th ed.). John Wiley & Sons, Inc.
3. Denlinger, Charles G. (2011). Elements of Real Analysis, Jones & Bartlett India Pvt. Ltd.
4. Ghorpade, Sudhir R. and Limaye, B. V. (2006). A Course in Calculus and Real Analysis. Undergraduate Texts in Mathematics, Springer (SIE). Indian Reprint.

Teaching Plan (DSC-9: Discrete Mathematics): B.Sc. (Hons.) Mathematics, Semester-3

Week 1: The cardinality of a set. [2] Chapter 3 (Section 3.3).

Weeks 2 and 3: Definitions, examples and basic properties of partially ordered sets, Order-isomorphisms, Covering relations, Hasse diagrams.
[1]: Chapter 1 (Sections 1.1 to 1.5, Section 1.6 (up to second bullet page 4), Sections 1.14 to 1.18).
[3]: Chapter 1 (Subsection 1.1).

Weeks 4 and 5: Dual of an ordered set, Duality principle, Bottom and top elements, Maximal and minimal elements, Zorn's lemma, Building new ordered sets, Maps between ordered sets.
[1]: Chapter 1 (Sections 1.19 to 1.24, Section 1.25 (only definition of product of partially ordered sets and diagrams to be done), Sections 1.26, 1.34, 1.35(1), and 1.36).
[1]: Chapter 2 (Sections 2.1 to 2.2); [3]: Chapter 1 (Subsections 1.2 to 1.4).

Weeks 6 and 7: Lattices as ordered sets, Lattices as algebraic structures, Sublattices, Products, Lattice isomorphism.
[1]: Chapter 2 (Sections 2.3 to 2.5, 2.6 (excluding portion on down-set and up-set), 2.7 (only definition of lattices Sub *G* and *N*-Sub *G* to be done), 2.8 to 2.19, 2.22 to 2.25; all results to be stated without proof).
[3]: Chapter 1 (Subsections 1.5 to 1.20).

Weeks 8 and 9: Definitions, examples and properties of modular and distributive lattices.
[1]: Chapter 4 (Sections (4.1 to 4.9); [3]: Chapter 1 (Subsections 2.1 to 2.6).

Week 10: The M_3–N_5 theorem with applications, Complemented lattice, Relatively complemented lattice, Sectionally complemented lattice.
[1]: Chapter 4 (Section 4.10 (result to be stated without proof), and Section 4.11).
[3]: Chapter 1 (Subsections 2.7, 2.8 (except example(v)), 2.9 -2.14).(Results in 2.12, and 2.13 to be stated without proof)

Weeks 11 and 12: Boolean algebras, De Morgan's laws, Boolean homomorphism, Representation theorem, Boolean polynomials, Boolean polynomial functions, Equivalence of Boolean polynomials.
[3]: Chapter 1 [Subsections 3.1 to 3.8, and 3.9 (example(i); example (ii) and (iii) both without proofs); For 3.10 to 3.16 (Definitions and examples to be done. All results to be stated without proofs.)].
[3]: Chapter 1 [Subsections 4.1 to 4.10 (Definitions and examples to be done. All results to be stated without proofs)].

Weeks 13 and 14: Disjunctive normal form and conjunctive normal form of Boolean polynomials; Minimal forms of Boolean polynomials, Quine-McCluskey method, Karnaugh diagrams.
[3]: Chapter 1 [Subsections 4.11 to 4.14, 4.16 to 4.18 (Definitions and examples to be done. All results to be stated without proofs)].
[3]: Chapter 1 [Subsections 6.1 to 6.6 (Definitions and examples to be done. All results to be stated without proofs)].

Week 15: Switching circuits and applications, Applications of Boolean algebras to logic, set theory and probability theory. [3]: Chapter 2 [Subsections 7.1 to 7.5; 8.1, 8.3 to 8.5; 9.1 to 9.13, 9.14{(i) to (iii)}].

Essential Readings

1. Davey, B. A., & Priestley, H. A. (2002). Introduction to Lattices and Order (2nd ed.). Cambridge University press, Cambridge.
2. Goodaire, Edgar G., & Parmenter, Michael M. (2006). Discrete Mathematics with Graph Theory (3rd ed.). Pearson Education Pvt. Ltd. Indian Reprint.
3. Lidl, Rudolf & Pilz, Gunter. (2004). Applied Abstract Algebra (2nd ed.), Undergraduate Texts in Mathematics. Springer (SIE). Indian Reprint.

Teaching Plan (DSE-1(i): Graph Theory): B.Sc. (Hons.) Mathematics, Semester-3

Week 1: Definition, Examples and basic properties of graphs, Subgraphs, Pseudographs, Complete graphs, Bipartite graphs. [1]: Chapter 9 (Sections 9.1, and 9.2).

Weeks 2 and 3: Isomorphism of graphs, Paths and circuits, Connected graphs, Eulerian circuits, Hamiltonian cycles.
[1]: Chapter 9 (Section 9.3), Chapter 10 (Sections 10.1, and 10.2) (Theorems 10.1.4, 10.1.5, 10.2.4, and 10.2.6 without proof, exclude 10.2.3).
[2]: Chapter 1 (Theorem 1.12).

Week 4: Adjacency matrix, Weighted graph, Travelling salesman problem, Shortest path, Dijkstra's algorithm.
[1] Chapter 10 (Sections 10.3, and 10.4) (Section 10.4 applications only)

Weeks 5 and 6: Applications of Path and Circuits: The Chinese Postman Problem, Digraphs, Bellman-Ford Algorithm. [1] Chapter 11 (Sections 11.1, and 11.2).

Week 7: Tournaments, Scheduling Problem. [1] Chapter 11 (Sections 11.4, and 11.5)

Week 8: Trees, Properties of Trees, Spanning Trees.
[1] Chapter 12 (Sections 12.1, and 12.2) (Theorem 12.2.3 statement only).
(do *Forest* from Exercise 12.1 question 26).

Week 9: Minimum spanning tree algorithms. [1] Chapter 12 (Section 12.3).
(Kruskal's algorithm, Prim's algorithm, and bound for minimum Hamiltonian cycle).

Weeks 10 and 11: Cut-vertices, Blocks and their characterization, Connectivity and edge-connectivity.
[2] Chapter 4 (Theorem 4.1), Chapter 5 (Section 5.1, 5.2 and Section 5.3 up to Theorem 5.11)

Week 12 and 13: Planar graphs, Euler's formula, Kuratowski theorem, Graph coloring and applications.
[1] Chapter 13 (Sections 13.1, and 13.2).

Weeks 14 and 15: Matchings, Hall's Theorem, Independent sets and covers.
[2] Chapter 8 (Section 8.1, exclude Theorem 8.4).

Essential Readings

1. Goodaire, Edgar G., & Parmenter, Michael M. (2006). Discrete Mathematics with Graph Theory (3rd ed.). Pearson Education Pvt. Ltd. Indian Reprint.
2. Chartrand, Gary, & Zhang, Ping (2012). A First Course in Graph Theory. Dover Publications.

Teaching Plan (DSE-1(ii): Mathematical Python): B.Sc. (Hons.) Mathematics, Semester-3

Weeks 1 and 2: Review of Python fundamentals; Drawing diverse shapes using code and Turtle.
[2]: Chapter 1 (Review: Fundamentals of Python).
[1]: Chapters 1 to 3.

Weeks 3 and 4: Using matplotlib and NumPy for data organization, Structuring and plotting lines, bars, markers, contours and fields, managing subplots and axes; Pyplot and subplots.
[3]: Chapter 2 (up to page 45).

- https://patrickwalls.github.io/mathematicalpython/scipy/numpy/
- https://patrickwalls.github.io/mathematicalpython/scipy/matplotlib/
- https://matplotlib.org/stable/gallery/lines_bars_and_markers/index.html
- https://matplotlib.org/stable/gallery/images_contours_and_fields/index.html
- https://matplotlib.org/stable/gallery/subplots_axes_and_figures/index.html
- https://matplotlib.org/stable/tutorials/introductory/pyplot.html

Week 5: Animations of decay, Bayes, Random walk.
[3]: Chapter 5 (Generating random numbers, pages 134 to 139; page 136 is optional).

- https://matplotlib.org/stable/gallery/animation/index.html
- https://matplotlib.org/stable/gallery/animation/animate_decay.html
- https://matplotlib.org/stable/gallery/animation/bayes_update.html
- https://matplotlib.org/stable/gallery/animation/random_walk.html

Week 6: NumPy for scalars and linear algebra on n-dimensional arrays; Computing eigenspace.
[2]: Chapter 4 (pages 226 to 229).

- https://numpy.org/numpy-tutorials/content/tutorial-svd.html
- https://patrickwalls.github.io/mathematicalpython/linear-algebra/eigenvalues-eigenvectors/

Week 7: Solving dynamical systems on coupled ordinary differential equations, Functional programming update fundamentals using NumPy.

- https://patrickwalls.github.io/mathematicalpython/differential-equations/first-order/
- https://patrickwalls.github.io/mathematicalpython/differential-equations/systems/
- https://realpython.com/python-functional-programming/

Weeks 8 and 9: Symbolic computation and SymPy: Differentiation and integration of functions, Limits.
[3]: Chapter 4 (up to page 96), and Chapter 7.

- https://docs.sympy.org/latest/guides/index.html
- https://docs.sympy.org/latest/tutorials/intro-tutorial/calculus.html

Week 10: Solution of ordinary differential equations, Computation of eigenvalues, Solution of expressions at multiple points (lambdify).

- https://docs.sympy.org/latest/guides/solving/solve-ode.html
- https://docs.sympy.org/latest/tutorials/intro-tutorial/matrices.html
- https://docs.sympy.org/latest/modules/utilities/lambdify.html

Week 11: Simplification of expressions, Factorization, Collecting and canceling terms, Partial fraction decomposition, Trigonometric simplification, Exponential and logarithms, Series expansion and finite differences, Solvers, Recursive equations.
[3]: Chapter 4
[2]: Chapter 5.
[1]: Chapter 6, and 10.
- https://docs.sympy.org/latest/modules/solvers/solvers.html

Weeks 12 and 13: Pretty printing using SymPy; Pandas API for IO tools: interfacing Python with text/csv, HTML, LaTeX, XML, MSExcel, OpenDocument, and other such formats.
[3]: Chapter 4 (pages 97-100).
- https://docs.sympy.org/latest/tutorials/intro-tutorial/printing.html

[2]: Chapter 2 (pages 73-83).
- https://pandas.pydata.org/docs/user_guide/io.html

Week 14 and 15: PyLaTeX and writing document files from Python with auto-computed values, Plots and visualizations.
- https://pypi.org/project/PyLaTeX/
- https://matplotlib.org/stable/tutorials/text/usetex.html
- https://pandas.pydata.org/docs/user_guide/visualization.html

Essential Readings
1. Farrell, Peter (2019). Math Adventures with Python. No Starch Press. ISBN Number: 978- 1-59327-867-0.
2. Farrell, Peter et al. (2020). The Statistics and Calculus with Python Workshop. Packet Publishing Ltd. ISBN: 978-1-80020-976-3.
3. Saha, Amit (2015). Doing Math with Python. No Starch Press. ISBN: 978-1-59327-640-9

<u>Computer Lab work:</u>

Weeks 1 to 4:
- Spyder Environment preparation with download, installation of required components.
- Implementation of turtle draw for polygonal shapes.
- Using lists and loops for common functions.
- List manipulation.
- Animating objects.
- Interactive grid.
- Drawing complex patterns.

Week 5: Animated plots for solution of problems: decay function w. r. t. time, conditional probability and bayes rule, random walk.
Week 6: Solution of linear algebra problems: Systems of equations, eigenvalues and eigenvectors.
Week 7: Newton's law of cooling, Coupled ODEs with initial conditions.
Weeks 8 and 9: Examples of limits, differentiation and integration of functions.
Weeks 10 to 15: Examples from text references, and similar to those from online sources.

Teaching Plan (DSE-1(iii): Number Theory): B.Sc. (Hons.) Mathematics, Semester-3

Week 1: The Euclidean Algorithm and linear Diophantine equation.
[1]: Chapter 2 (Section 2.4 up to page 28, and Section 2.5).

Weeks 2 and 3: Least non-negative residues and complete set of residues modulo n; Linear congruences, The Chinese remainder theorem, and system of linear congruences in two variables.
[1]: Chapter 4 (Section 4.2 page 64, and Section 4.4).

Week 4: Fermat's little theorem, Wilson's theorem and its converse, Application to solve quadratic congruence equation modulo odd prime p.
[1]: Chapter 5 (Section 5.2 up to before pseudo-prime at page 90, and Section 5.3).

Weeks 5 and 6: Number-theoretic functions for the sum and number of divisors, Multiplicative function, Möbius inversion formula and its properties; Greatest integer function with an application to the calendar.
[1]: Chapter 6 (Sections 6.1, 6.2, 6.3 up to page 118, and 6.4).

Weeks 7 and 8: Euler's Phi-function, Euler's theorem and some properties of the Phi-function.
[1]: Chapter 7 (Section 7.2, Theorem 7.2 without proof, Section 7.3, and Section 7.4, Theorem 7.6 without proof).

Weeks 9 to 11: The order of an integer modulo n and primitive roots for primes, Primitive roots of composite numbers n: when n is of the form 2^k, and when n is a product of two coprime numbers.
[1]: Chapter 8 (Sections 8.1, 8.2, and 8.3 (up to page 159)).

Week 12: The quadratic residue and nonresidue of an odd prime and Euler's criterion.
[1]: Chapter 9 (Section 9.1).

Weeks 13 and 14: The Legendre symbol and its properties, Quadratic Reciprocity law and its application.
[1]: Chapter 9 (Section 9.2 up to page 181, Statement of Theorems 9.3 and 9.5, and Section 9.3).

Week 15. Introduction to cryptography, Hill's cipher, Public-key cryptography and RSA encryption and decryption technique.
[1]: Chapter 10 (Section 10.1).

Essential Reading

1. Burton, David M. (2011). Elementary Number Theory (7th ed.). McGraw-Hill Education Pvt. Ltd. Indian Reprint 2017.

Teaching Plan (DSC-3, and DSE-1(iii): Theory of Equations and Symmetries):
B.A. (Prog.) with Mathematics as Major, and B.Sc. (Physical Sc./Mathematical Sc.), Sem-3.

Weeks 1 and 2: General properties of polynomials and equations; Statement of the Fundamental theorem of algebra and its consequences.
[1] Chapter I (Sections 8, 9 and 10); Chapter II (Sections 12 to 17).
[2] Chapter II (Sections 13 to 19)

Weeks 3 and 4: Theorems on imaginary, integral and rational roots; Descartes' rule of signs for positive and negative roots.
[1] Chapter II (Sections 18 to 22).
[2] Chapter II (Sections 21, 24, 25 and 27), and Chapter VI [Section 67]
(Proofs of theorems in the Chapters II and VI are omitted).

Weeks 5 and 6: Relations between the roots and coefficients of equations, Applications to solution of equations when an additional relation among the roots is given.
[1] Chapter III (Sections 23 and 24).
[2] Chapter II (Sections 20).

Weeks 7 and 8: De Moivre's theorem for rational indices, the *n*th roots of unity and symmetries of the solutions; Transformation of equations (multiplication, reciprocal, increase/diminish in the roots by a given quantity), Removal of terms.
[2] Chapter I (Sections 7 to 10).
[1] Chapter III (Section 26); Chapter IV (Sections 29 to 34).

Weeks 9 and 10: Cardon's method of solving cubic and Descartes' method of solving biquadratic equations.
[1] Chapter VI (Sections 56 and 64).
[2] Chapter IV (Sections 42, 43, 51 and 52).

Weeks 11 and 12: Elementary symmetric functions and symmetric functions of the roots of an equation; Newton's theorem on sums of the like powers of the roots.
[2] Chapter IX (Sections 103 to 106, methods only).
[1] Chapter VIII (Section 77, method only).

Weeks 13 to 15: Computation of symmetric functions such as:
$\sum\alpha^2\beta,\ \sum\alpha^2\beta^2, \sum\alpha^2\beta\gamma, \sum\frac{1}{\alpha^2\beta\gamma}, \sum\alpha^{-3}, \sum(\beta+\gamma-\alpha)^2,\ \sum\frac{\alpha^2+\beta\gamma}{\beta+\gamma},\ldots$ of polynomial equations;
Transformation of equations by symmetric functions and in general.
[1] Chapter III (Sections 27 and 28); Chapter IV (Sections 39, 41 and 44).
[2] Chapter IX (Section 109, methods only).

Essential Readings:

1. Burnside, W.S., & Panton, A.W. (1979). *The Theory of Equations* (11th ed.). Vol. 1. Dover Publications, Inc. (4th Indian reprint. S. Chand & Co. New Delhi).
2. Dickson, Leonard Eugene (2009). *First Course in the Theory of Equations*. John Wiley & Sons, Inc. The Project Gutenberg eBook: http://www.gutenberg.org/ebooks/29785

Teaching Plan (Discipline A-3, and GE-3(i): Differential Equations):
B.A. (Prog.) with Mathematics as Major, B.A./B.Sc. (Prog.) with Mathematics as non-Major, B.Sc. (Physical Sciences/Mathematical Sciences), and Generic Electives- Semester-3.

Weeks 1 and 2: First order ordinary differential equations: Basic concepts and ideas, First order exact differential equations, Integrating factors and rules to find integrating factors.
[2]: Chapter 1 (Sections 1.1, and 1.2), Chapter 2 (Sections 2.1, 2.2, and 2.4 up to page 64).

Week 3: Linear equations and Bernoulli equations, Initial Value Problems, Applications of first order differential equations: Orthogonal trajectories and Rate Problems.
[2]: Chapter 2 (Sections 2.3), Chapter 3 (Section 3.1 up to page 74, and Section 3.3 up to page 94).

Weeks 4 and 5: Basic theory of higher order linear differential equations, Wronskian and its properties.
[2]: Chapter 4 (Sections 4.1 up to page 115).

Weeks 6 and 7: Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, Method of undetermined coefficients.
[2]: Chapter 4 (Section 4.1 from page 120 onwards, Sections 4.2, and 4.3).

Weeks 8 and 9: Method of variation of parameters (only second order), Two-point boundary value problems, Cauchy- Euler equations, Systems of linear differential equations.
[2]: Chapter 4 (Sections 4.4, and 4.5).
[2]: Chapter 1 (Section 1.3 up to page 16).
[2]: Chapter 7 (Sections 7.1, and 7.3).

Weeks 10 and 11: Partial differential equations: Basic concepts and definitions, Classification and construction of first-order partial differential equations, Method of characteristics and general solutions of first order partial differential equations.
[1]: Chapter 2 (Sections 2.1 to 2.3, and 2.5).

Weeks 12 and 13: Canonical forms and method of separation of variables for first-order partial differential equations.
[1]: Chapter 2 (Sections 2.6, and 2.7).

Weeks 14 and 15: Classification and reduction to canonical forms of second-order linear partial differential equations and their general solutions.
[1]: Chapter 4 (Sections 4.1 to 4.4).

Essential Readings
1. Myint-U, Tyn and Debnath, Lokenath (2007). Linear Partial Differential Equations for Scientist and Engineers (4th ed.). Birkhäuser. Indian Reprint.
2. Ross, Shepley L. (1984). Differential Equations (3rd ed.). John Wiley & Sons.

Teaching Plan (DSE-1(i): Combinatorics): B.Sc. (Physical Sc./Mathematical Sc.), Sem-3.

Week 1: Basic counting principles.
[2]: Chapter 5 (Section 5.1).

Weeks 2 and 3: Permutations and Combinations (with and without repetitions), Binomial coefficients, Counting subsets of size *k.*
[2]: Chapter 5 [Sections 5.2 (up to Example 5), 5.3 (up to Theorem 2), 5.4 (Example 1, and Example 2), and 5.5 (up to Example 1)].

Weeks 4 and 5: Multinomial coefficients, Set-partitions, The inclusion-exclusion principle and applications.
[1]: Chapter 1 [Section 1.3 (Only Definition), Theorem 1.3.5].
[1]: Chapter 4 (Section 4.1).

Weeks 6 and 7: Generating functions: Generating function models, Calculating coefficients of generating functions, Polynomial expansions, Binomial identity.
[2]: Chapter 6 (Sections 6.1, and 6.2).

Weeks 8 and 9: Exponential generating functions, Recurrence relations: Recurrence relation models.
[2]: Chapter 6 (Section 6.4).
[2]: Chapter 7 [Section 7.1 (up to Example 5)].

Weeks 10 and 11: Divide-and-conquer relations, Solution of linear recurrence relations, Solutions by generating functions.
[2]: [Chapter 7 (Sections 7.2, 7.3, and 7.5).

Weeks 12 to 14: Partition theory of integers: Ordered partition, Unordered partition, Ferrers diagram, Conjugate of partition, Self-conjugate partition.
[1]: Chapter 13 (Sections 13.1.1 to 13.1.9).

Week 15: Durfee square, Euler's pentagonal theorem.
[1]: Chapter 13 (Definition 13.2.1, and Theorem 13.3.1).

Essential Readings

1. Sane, Sharad S. (2013). Combinatorial Techniques. Hindustan Book Agency (India).
2. Tucker, Alan (2012). Applied Combinatorics (6th ed.). John Wiley & Sons, Inc.

Teaching Plan (DSE-1(ii): Elements of Number Theory): B.Sc. (Physical Sc./Math Sc.), Sem-3.

Weeks 1 and 2: Revisiting: The division algorithm, divisibility and the greatest common divisor. Euclid's lemma; The Euclidean algorithm, Linear Diophantine equations.
[1]: Chapter 2 (Sections 2.2, 2.3, 2.4 (up to page 28), and 2.5. All Theorems without proofs).

Weeks 3 and 4: The Fundamental theorem of arithmetic, The sieve of Eratosthenes, Euclid's theorem and the Goldbach conjecture; The Fibonacci sequence and its nature.
[1]: Chapter 3 (Sections 3.1 (Theorem 3.2 without proof), 3.2 (Theorem 3.4), and 3.3 (up to p 53)).
[1]: Chapter 14 (Sections 14.1, and 14.2 (All results without proofs)).

Week 5: Congruence relation and its basic properties.
[1]: Chapter 4 (Section 4.2).

Weeks 6 and 7: Linear congruences and the Chinese remainder theorem, System of linear congruences in two variables.
[1]: Chapter 4 (Section 4.4, Theorems 4.8 and 4.9 without proofs).

Weeks 8 and 9: Fermat's little theorem and its generalization, Wilson's theorem and its converse.
[1]: Chapter 5 (Section 5.2 up to before pseudo-prime at Page 90, Section 5.3 before Theorem 5.5).

Week 10: Number-theoretic functions for sum and the number of divisors of a positive integer, Multiplicative functions.
[1]: Chapter 6 (Section 6.1, All Theorems without proofs).

Week 11: The greatest integer function; Euler's phi-function and its properties.
[1]: Chapter 6 (Section 6.3 up to page 118)
[1]: Chapter 7 (Section 7.2, Theorem 7.2 without proof).

Weeks 12 and 13: Basics of cryptography, Hill's cipher, Public-key cryptosystems and RSA encryption and decryption technique.
[1]: Section 10.1.

Weeks 14 and 15: Introduction to perfect numbers, Mersenne numbers and Fermat numbers.
[1]: Sections 11.2 (up to page 223), 11.3 (before Theorem 11.4), and 11.4 (before Theorem 11.10)).

Essential Reading

1. Burton, David M. (2011). Elementary Number Theory (7th ed.). McGraw-Hill Education Pvt. Ltd. Indian Reprint 2017.

Teaching Plan (GE-3(ii): Lattices and Number Theory): Generic Elective, Semester-3.

Weeks 1 and 2: Definitions, Examples and basic properties of partially ordered sets, Order isomorphism, Hasse Diagram, Maximal and minimal elements, Dual of an ordered set, Duality principle; Statements of Well Ordering Principle and Zorn's Lemma.
[1]: Chapter 1 (Sections 1.1 to 1.5, 1.14, 1.15, 1.19, 1.20, 1.21, and 1.23).
[2]: Chapter 1 (Subsections 1.1 to 1.4).

Weeks 3 to 5: Lattices as ordered sets, Lattices as algebraic structures, Sublattices, Products and homomorphisms, Distributive lattices.
[1]: Chapter 2 (Sections 2.1 to 2.5, 2.6 (excluding portion on down-set and up-set), 2.8 to 2.19, all results to be stated without proofs).
[2]: Chapter 1 (Subsections 1.5 to 1.18, and 2.1 to 2.6).

Weeks 6 and 7: Boolean algebras, Boolean polynomials, Minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, Switching circuits and applications.
[2]: Chapter 1 [Subsections 3.1 to 3.6, 4.1 to 4.3, and 6.1 to 6.6]. (Definitions and examples to be done. All results to be stated without proofs).

Weeks 8 and 9: The division algorithm: GCD, The Euclidean algorithm, Diophantine equation $ax + by = c$. Primes: The Fundamental Theorem of Arithmetic, Infinitude of primes, Twin primes and Goldbach conjecture.
[3]: Chapter 2 (Sections 2.2, 2.3, 2.4 (up to page 28), and 2.5). Theorems 2.1 to 2.9 without proofs.
[3]: Chapter 3 (Sections 3.1 (Theorem 3.2 without proof), 3.2 (Theorem 3.4), and 3.3 up to page 53).

Weeks 10 and 11: The theory of congruences: Basic properties and applications, Linear congruences and the Chinese Remainder Theorem, Fermat's Little Theorem and Wilson's Theorem.
[3]: Chapter 4 (Sections 4.2, and 4.4 (Theorems 4.7 to 4.9 without proofs)).
[3]: Chapter 5 (Section 5.2 up to before pseudo-prime at Page 90, Section 5.3 before Theorem 5.5). (All Theorems without proofs).

Weeks 12 and 13: Number-Theoretic Functions: Sum and number of divisors, Euler's Phi-function and Euler's generalization of Fermat's Little Theorem.
[3]: Chapter 6 (Section 6.1; All Theorems without proofs).
[3]: Chapter 7 (Sections 7.2, and 7.3; All Theorems without proofs).

Weeks 14 and 15: Primitive roots: The order of an integer modulo n, and primitive roots of an integer. Quadratic Reciprocity Law: Quadratic residue and nonresidue, Euler's Criterion, The Legendre symbol and its properties and Quadratic Reciprocity Law.
[3]: Chapter 8 (Sections 8.1, and 8.2 (Theorems and Corollaries without proofs).
[3]: Chapter 9 (Sections 9.1, 9.2 (up to page 181), and 9.3; All Theorems and Corollaries without proofs).

Essential Readings

1. Davey, B A., & Priestley, H. A. (2002). Introduction to Lattices and Order (2nd ed.), Cambridge University Press, Cambridge.
2. Lidl, Rudolf & Pilz, Günter. (1998). Applied Abstract Algebra (2nd ed.), Undergraduate Texts in Mathematics, Springer (SIE), Indian Reprint 2004.
3. Burton, David M. (2012). Elementary Number Theory (7th ed.), Mc-Graw Hill Education Pvt. Ltd. Indian Reprint.