1. **Groups: basic concepts. D**: Semigroup, group, abelian group, subgroup, generated subgroup, normal subgroup, order of a group, order of an element, set product, cosets, transversal, index of a subgroup, factor group, homomorphism and isomorphism, kernel and image. **T**: **Lagrange theorem**. Divisiblity relations between orders of elements, of groups, and of homomorphic images of elements. Normal subgroups and kernels. **Homomorphism theorem**. Isomorphism theorems. Order of an element in a factor group.
2. **Special groups. D**: cyclic groups, dihedral groups, quaternion group, $GL_n(K)$, $SL_n(K)$. **T**: **Subgroups of a cyclic group are cyclic**, Number of subgroups and number of elements of a given order in C_n, Groups of order p^2 and of 8.
3. **Symmetric groups. D**: S_Ω, S_n, cycles, disjoint cycle decomposition (dcd), operations on permutations, transpositions. **T**: Disjoint cycle decomposition. Order of a permutation. Conjugating a permutation. **Conjugacy classes of S_n. Transpositions generating S_n.**
4. **Alternating groups. D**: permutation matrix $M(g)$, even and odd permutations, A_n, **T**: Even and odd permutations by their dcd. 3-cycles generating A_n. **Simplicity of A_n.**
5. **Group actions. D**: Group action, stabilizer, fixed-points, orbit, transitive action, faithful action, kernel of a group action. Conjugation as a group action on elements and on subgroups. Conjugacy class, center $Z(G)$ of a group G, centralizer $C_G(g)$, normalizer $N_G(H)$ (also in terms of the group action). **T**: **Orbit-stabilizer lemma**, **Orbit-counting lemma**, **Class equation.**
6. **Direct products and decompositions. D**: Direct product of groups, inner characterization. **T**: Order of elements in a direct product. Direct product of cyclic groups of coprime order. Krull–Schmidt theorem. Fundamental theorem of finite abelian groups.
7. **p-groups and p-subgroups. D**: p-group (finite and infinite), Sylow p-subgroup. **T**: **Cauchy theorem**. Sylow's theorems (**prove only the existence**). **Number of Sylow p-subgroups.** Normality of a Sylow p-subgroup.
8. **Rings: basic concepts. D**: Ring, commutative ring, division ring, field, quaternions, group algebra, subring, ideal, generated ideal, ring homomorphisms and isomorphisms, kernel, image, factor ring, simple ring, direct sum of rings. **T:** Inner characterization of a direct sum of rings. Homomorphism theorem for rings. **Simplicity of the matrix ring.** Generated ideal of a ring with identity. Connection between fields and simple rings. When is a factor ring a field?
9. **Commutative rings. D**: Integral domain, principal ideal, euclidean ring, PID, UFD, divisor, unit, irreducible element, greatest common divisor. **T**: **Connection between euclidean ring and PID.** Connection between PID and UFD. Relationship between artithmetic properties of elements and properties of ideals in a PID, **of these, prove the theorem about irreducibility of elements**. Factor rings of PID's. Factor rings of a polynomial ring $K[x]$.
10. **Fields. D**: Characteristic of a field, prime field, field extension, degree $(L : K)$ of a field extension $L|K$, algebraic and transcendental elements, algebraic extension, simple extension, minimal polynomial. **T**: Existence of the characteristic. Prime field depending on the characteristic. **Multiplicativity theorem of field extensions**. **Simple algebraic extension as a factor ring of a polynomial ring**. Simple transcendental extension. Isomorphic extensions. Algebraic extensions and finite degree extensions **prove the implication which is true in general. The field of algebraic elements.** Algebraic closedness of $\mathbb{A}$.
11. **Finite fields. D**: Splitting field. **T**: The multiplicative group of a finite field. Cardinality of a finite field, and existence of such fields. **Finite field as a splitting field.**

(D: definitions, T: theorems, With proofs: the theorems in boldface)