The oral exam will start with one randomly chosen question from this list, and continue with questions that might not be on the list.

(1) How is the tensor product of modules defined?
(2) How do you compute tensor products of finitely generated abelian groups?
(3) Which short exact sequences remain exact when tensored with a module?
(4) How does one construct homology with coefficients?
(5) What does it mean that the connecting homomorphism for homology with coefficients is natural?
(6) Show that $\mathbb{R}P^m$ is not a retract of $\mathbb{R}P^n$ for $1 < m < n$.
(7) State the theorem of Borsuk–Ulam. What is the idea of the proof?
(8) How is Ext defined?
(9) How does one prove that Tor is commutative? Why does this proof not work for Ext?
(10) Does the Euler characteristic depend on the coefficient field?
(11) Compute $H_\bullet(\mathbb{R}P^n;\mathbb{F}_2)$ from $H_\bullet(\mathbb{R}P^n;\mathbb{Z})$ using the universal coefficient theorem for homology.
(12) Prove that $H^1(X)$ is torsion-free for all spaces X.
(13) How is the relative cup product defined?
(14) Compute $H^\bullet(S^k)$.
(15) What does it mean that "the cup product is non-singular"?
(16) Give an example for spaces with isomorphic cohomology groups, but non-isomorphic cohomology ring.
(17) How does one compute the cohomology ring of the torus?
(18) What can you say about the fundamental group of an orientable manifold?
(19) What is the fundamental class?
(20) Is there an orientation reversing homeomorphism of $\mathbb{C}P^2$?
(21) Can two manifolds of different dimension be homotopy equivalent?
(22) Is there a relationship between $\smile$ and $\frown$?
(23) State Poincaré duality, also for non-compact manifolds.
(24) What can you say about the Euler characteristic of a 5-manifold?
(25) Compute the cohomology ring $H^\bullet(\mathbb{R}P^n;\mathbb{F}_2)$.
(26) Give an example of a direct limit.
(27) How is cohomology with compact support H^k_c defined?
(28) How is H^k_c covariantly functorial?
(29) What does Alexander duality say? What is the idea of the proof?
(30) Does there exist an embedding of the Klein bottle into $\mathbb{R}^3$?