Title of module	**VI Genetic Engineering**
Module coordinator	**PD Dr. Holm Zähres**

Credit points	5	**Semester(s) in which the module is taught**	2
Contact hours	3	**Workload**	150 hours

Lecturer(s)	Zähres
Type of teaching	Lecture: 2 hours per week; exercises: 1 hour per week. Lectures and exercises will be assisted by power point presentations and e-learning facilities (Moodle). Development of understanding is supported in team exercises. Interactive presentation in front of an audience, note-taking during lectures, unsolicited post-preparation of module contents and of relevant literature.
Relation to curriculum	Compulsory; For master students of Biochemistry of RUB also suitable as elective lecture.
Recommended prerequisites	Module II Bioinformatics should be successfully passed; Students taking this module will be expected to have a basic understanding of molecular genetics.
Aims	Students will acquire up to date background of molecular genetics, genomic organization and evolution, genomic sequencing, genetic engineering, genes in medicine and disease in context with cells, tissues and laboratory animals.
Learning outcome	Knowledge: Students have learnt: Cloning 1 (Enzymes, Prokaryotic vector systems), Cloning 2 (RNA, cDNA, Ligation / Recombination techniques), Gene expression / Protein analysis, Sequencing / Epigenetic analysis Skills: Students have acquired skills in gene and genome analysis, skills in cloning of gene constructs, cell and animal manipulation, protein expression Competencies: Students have acquired concepts and strategies for gene and genome analysis and manipulation according to experimental requirements
Contents of module	• Essentials of cloning in prokaryotic vector systems: DNA restriction by natural and by artificial, custom made enzymes, modification systems, • Prokaryotic vector systems, selection modes, cDNA synthesis, ligation, recombination site associated exchange of gene cassettes • Gene expression in E. coli / Protein analysis • State of the art sequencing techniques / Epigenetic genome analysis • In vitro / in vivo mutagenesis • Gene transfer and expression (Eukaryotic vector systems, viral, non-viral, episomal expression vectors) • Gene targeting / RNA interference (HR, shRNAs, nucleases) • Transgenic animals (Constitutive, conditional, inducible mice) • RNA methods (Modification, mRNA transfer, miRNAs) • Cell physiology methods 1 (FACS) • Cell physiology methods 2 (Electrophysiology)
Study and examination requirements;	Discussion and interaction during lectures and presentation of exercises are required.

Forms of examination	The assessment is based on an end of term written exam. The mode of examination will be as follows: 8 questions in free text have to be answered within 2 hours to obtain the full number of points.
Literature	Mavrommatis L., Zaben A., …Zähres (2023) CRISPR/Cas9 Genome Editing in LGMD2A/R1 Patient-Derived Induced Pluripotent Stem and Skeletal Muscle Progenitor Cells. Stem Cells International Volume 2023, Article ID 9246825 Mavrommatis L, Jeong HW, Kindler U, Gomez-Giro G, Kienitz MC, Stehling M, Psathaki OE, Zeuschner D, Bixel MG, Han D, Morosan-Puopolo G, Gerovska D, Yang JH, Kim JB, Arauzo-Bravo MJ, Schwamborn JC, Hahn SA, Adams RH, Schöler HR, Vorgerd M, Brand-Saberi B, Zaehres H. Elife. 2023 Nov 14;12:RP87081. doi: 10.7554/eLife.87081. PMID: 37963071 Human skeletal muscle organoids model fetal myogenesis and sustain uncommitted PAX7 myogenic progenitors Kim E. et al., Precision genome engineering with programmable DNA-nicking enzymes. Genome Res. 2012 Jul;22(7):1327-33 Manrao E.A. et al., Reading DNA at single-nucleotide resolution with a mutant MspA nanopore and phi29 DNA polymerase. Nat Biotechnol. 2012 Mar 25;30(4):349-53 Liu X. & Fortin K., MicroRNAs: Biogenesis and Molecular Functions. Brain Pathology 18 (2008) 113–121 Naldini L. et al., In Vivo Gene Delivery and Stable Transduction of Nondividing Cells by a Lentiviral Vector. Science. 1996 Apr 12;272(5259):263-7 Takahashi K. & Yamanaka S., Induction of Pluripotent Stem Cells from Mouse Embryonic and Adult Fibroblast Cultures by Defined Factors. Cell. 2006 Aug 25;126(4):663-76 Soldner F. et al., Generation of Isogenic Pluripotent Stem Cells Differing Exclusively at Two Early Onset Parkinson Point Mutations. Cell. 2011 Jul 22;146(2):318-31