Faculty of Technology and Bionics

HOCHSCHULE RHEIN-WAAL
Rhine-Waal University of Applied Sciences

Module Descriptions

Science Communication & Bionics B.A.

and

Science Communication & Bionics B.Sc.

Rev. 2 as of 24th June 2016

Content:

History and Introduction (COMM I)

Module title:	History and Introduction (COMM I)
Module code:	SCB_1
Courses:	• History of Science & Technology (SCB_1.1) • Introduction to Science Communication (SCB_1.2)
Semester:	1st Semester
Module coordinator:	Prof. Alexander Gerber
Lecturer:	• Dr. David Ludwig, Vrije Universiteit Amsterdam, Guest Lecturer • Prof. Alexander Gerber
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	<u>History of Science & Technology</u> Lectures: 1 HPW Exercises: 1 HPW <u>Introduction to Science Communication: Theory & Ethics</u> Lectures: 3 HPW
Workload:	<u>History of Science & Technology:</u> 30 h attendance 20 h preparation and review 10 h exam preparation <u>Introduction to Science Communication: Theory & Ethics:</u> 45 h attendance 35 h preparation and review 10 h exam preparation
Credits:	History of Science & Technology: 2 Introduction to Science Communication: Theory & Ethics: 3 Sum: 5
Recommended	None

prerequisites:	
Module objectives:	Upon successful completion of this module, students will be able to: 1. understand the main objectives, formats and methods of communicating science 2. apprehend the career prospects and professional opportunities in science communication in the past, present and in the near future 3. contextualise technological development and scientific progress historically 4. contextualise different approaches, methods and tools for science communication historically 5. apply the principles of technological determinism and social constructivism to issues of “Responsible Research and Innovation” (RRI) 6. understand to basic mechanisms of a socio-technical system and the methodologies of technology assessment 7. differentiate between concepts such as science popularisation / outreach, dissemination 8. understand and basically apply the most important theories in Communication Science and particularly Media Studies 9. appreciate and apply general rules of how to communicate ethically responsible in different context (journalism, PR, Public Affairs, informal science education, etc.) 10. recognize historical patterns in recent scientific and historical developments as in the models of White (energy use) and Lenski (knowledge processing) 11. understand the historic changes in societal acceptance of science and technology 12. demonstrate journalistic skills in writing a ‘holistic’ historical feature story about a technological innovation
Content:	<u>History of Science & Technology:</u> How have science, technology and culture influenced each other over the centuries? How has the societal acceptance of progress changed? And what can we learn from this history about today’s

	challenges and prospects we are facing in an increasingly technology-dependent world. The course focuses particularly on the changing social contexts in which science and technology have been dealt with over time. Students reflect the false image of the "lone inventor" transforming society from the outside. From the Renaissance court inventors and the so-called industrial revolution to the links among technology, imperialism, and trade in the nineteenth century, the course also focuses on contemporary issues, such as the industrial application of scientific discoveries in chemistry and physics and the impact which the introduction of mass-produced consumer goods have had on our lives as we live them today. Regarding theory, the course also discusses concepts such as technological determinism and social constructivism. <u>Introduction to Science Communication: Theory & Ethics</u> The major challenges in science communication today lie in the diversity of its objectives and approaches, methods and tools. From "Public Understanding" to "Public Engagement", the presumptions, expectations, and therefore also the activities and job opportunities have dramatically changed within the past 20 years. The course provides students with a historical context, and introduces them to the relevant structures (scientific institutions and government agencies, civil society and NGOs, schools, etc.) and processes (evidence-based policy-making, regulation of technologies, informal science education). The most important communication formats are introduced and discussed. On a more general level, the basic theories in Communication Science and particularly Media Studies, such as Agenda Setting, Framing, Media Effects, Spiral of Silence, Bullet and Cultivation Theory are introduced and put into the context of their application in practice and research. In order to provide the students with an ethical framework for the different aspects of their future roles in science communication, the course furthermore deals with issues of individual responsibilities as well as self-regulation of mass media (e.g. the Leveson Inquiry in the UK), phenomena like wiki-leaks, and the moral dimensions of assessing the limits of PR and marketing for scientific institutions and technology companies. In addition to setting no less than the agenda for the entire degree programme, one of the most important learning objectives of this module is to give orientation as to which career paths in science

	communication are promising, well-paid or rewarding, and which are not.
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector, video, online research, editing of an interactive online time-line, collaborative animations and presentations
Literature:	Core texts (History of Science & Technology): Misa, Thomas J. (2011): Leonardo to the Internet: Technology & Culture from the Renaissance to the Present. Johns Hopkins UP McClellan, James E. & Dorn, Harold (2006): Science and Technology in World History. Johns Hopkins UP Core texts (Introduction to Science Communication): Bodmer, Walter et al. (1985): The Public Understanding of Science. Royal Society. Bucchi, Massimiano / Trench, Brian (2008). Handbook of Public Communication of Science and Technology. Routledge. Other texts (History of Science & Technology): Green, John (2011): "Crash Course History". Khan Academy. (a) The Renaissance, was it a Thing? (b) Coal, Steam, and the Industrial Revolution (c) Imperialism Johnson, Bethany (2012): "Gerhard Lenski's Theories of Sociocultural Evolution, Social Stratification & Technology", The Educational Portal. Jonas, Hans (1985). The Imperative of Responsibility: In Search of an Ethics for the Technological Age. University of Chicago Press. Lenski, Gerhard E. (1984). Power and Privilege: A Theory of Social Stratification. Lenski, Gerhard E. (2010). Human Societies: An Introduction to Macrosociology. ISBN 978-1594518805 Seidensticker, Bob (2006). Future Hype: The Myths of

	Technology Change. Timmer, John (2012). Most of what you read was wrong: how press releases rewrote scientific history -- Repeating myths may make good stories, but it breeds confusion. In: ars technica. Watkins Jr., John Elfreth (1900): What may happen in the next 100 years. (John Herrman, BuzzFeed FWD) <u>Other texts (Introduction to Science Communication):</u> Bauer, Martin (2009): "The evolution of public understanding of science – Discourse and comparative evidence". Science, Technology and Society, 14 (2). pp. 221-240. Bultitude, K. (2011): "The Why and How of Science Communication". In: P. Rosulek (ed.): Science Communication. Pilsen: European Commission. Freedman, David H. (2013): "Survival of the Wrongest – How personal-health journalism ignores the fundamental pitfalls baked into all scientific research and serves up a daily diet of unreliable information". Columbia Journalism Review 2013 (1). Knight, David (2011). Public Understanding of Science: A History of Communicating Scientific Ideas. Routledge Studies in the History of Science, Technology and Medicine. ISBN 978-0415591676 Mejlgaard, N. et al. (2012): Monitoring Policy and Research Activities on Science in Society in Europe (MASIS) – Final synthesis report. European Commission. Renn, O. et al. (2013): "Science for an informed, sustainable and inclusive, knowledge society". Policy paper by President Barroso's Science and Technology Advisory Council. Aug 2013. Scheufele, Dietram A. / Tewksbury, David (2007): "Framing, Agenda Setting, and Priming – The Evolution of Three Media Effects Models". *Journal of Communication,* Vol. 57, pp. 9–20 Vastag, Brian (2013): "The Ethical Science Writer". In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 246-258

International Media and Institutions (COMM II)

Module title:	International Media and Institutions (COMM II)
Module code:	SCB_2
Courses:	• Comparative International Media Studies (SCB_2.1) • Communicating for Institutions: Marketing, PR, Events, Exhibitions (SCB_2.2)
Semester:	1st Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Prof. Alexander Gerber • Ulrike Reimann, Head of Strategy, European Universities Association, Brussels, Guest Lecturer • Dr. Paul Hix, Project Manager Nano Communication, Deutsches Museum, Munich, Guest Lecturer
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Comparative International Media Studies: Lectures: 3 HPW Exercises: 1 HPW Communicating for Institutions: Lectures: 2 HPW Exercises: 2 HPW
Workload:	Comparative International Media Studies: 60 h attendance 50 h preparation and review 10 h exam preparation Communicating for Institutions: 60 h attendance 20 h preparation and review 10 h exam preparation

Credits:	Comparative International Media Studies: 4 Communicating for Institutions: 3 Sum: 7
Recommended prerequisites:	none
Module objectives:	Upon successful completion of this module, students will be able to: 1. differentiate and categorise national media systems and assess these systems from a comparative perspective 2. analyse the impact which national media structures and the respective media usage have on communication practise 3. localise communication strategies to specific cultures, and understand the different national approaches towards Europeanization 4. apply theories from Media Studies to comms practice 5. understand how scientific institutions, public administration, and civil society organise their outreach activities 6. reflect these strategies and activities critically with respect to societal expectations 7. assess strategies, methods, and tools of trade for science PR and marketing, science events and exhibitions
Content:	<u>Comparative International Media Studies:</u> This course approaches Media Studies from an explicitly transnational perspective, in order to assess the differences and similarities between the media systems in different cultures. This also includes issues such as systemic diversity (duopoly vs. private sector monopolies etc.), media deregulation, and horizontal vs. vertical Europeanization. Students are introduced to country-specific analyses as well as to a comparative analysis of certain issues in media research, practice and usage, such as editorial independence, economic influences, differing formats, etc. More generally the course introduces the students to relevant approaches in communication research, such as the Frankfurt School, Political Economy or Uses & Gratifications.

	Communicating for Institutions: Marketing, PR, Events, Exhibitions: This course addresses an area in which most science communicators nowadays make a living: institutionalised outreach activities by institutions, both in academia (mainly universities and extramural research organisations), public administration (ministries, national, regional and local governments, regulatory bodies, etc.), and civil society (mainly NGOs). Students learn about strategies, methods, and tools of trade for science PR and marketing, events and exhibitions about science, by going through case studies and accounts from practitioners. Usually there is also at least one field trip to a science centre with the opportunity to discuss museum strategies with the curators. The course also encourages the students to reflect critically whether the state of the art approaches for outreach activities in science come up to the societal expectations.
Assessment:	Oral presentation (30 min.)
Forms of media:	Board and projector, video, online research, social media (blog editing, wiki, etc.), collaborative animations and presentations, HSRW cross-media laboratory
Literature:	Core texts (Comparative International Media Studies): Albertazzi, Daniele / Cobley, Paul (2009) eds: The Media: An Introduction. Part 3 (chapters 19-22, pp. 277-332). Routledge. Dobek-Ostrowska, Boguslawa et al. (2010): Comparative Media Systems: European and Global Perspectives. Central European University Press. pp. 23-282 Hallin, Daniel C. / Mancini Paolo (2012): Comparing Media Systems Beyond the Western World. Chapters “Introduction” and “Conclusion“,pp. 1-7, 278-304. Cambridge University Press. Iosifidis, Petros (2011): Global Media and Communication Policy. Palgrave Macmillian. pp. 93-165 Core texts (Communicating for Institutions: Marketing, PR,

	Events, Exhibitions): Borchelt, Rick E. (2008): “Public relations in science”. In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge.pp. 147 – 157 Other texts (Comparative International Media Studies): Dichristina, Mariette. (2006): “Science Editing". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 100-106 Dunwoody, Sharon (2008). “Science Journalism”. In: Handbook of Public Communication of Science and Technology. Routledge. pp. 15-26 Hopkins Tanne, Janice. (2006): “Popular Magazines“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 62-67 Hotz, Robert Lee. (2006): “Large Newspapers“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 55-61 Norman, Colin. (2006): “Trade and Science Journals“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 68- 72 Palca, Joe. (2006): “Broadcast Science Journalism“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 73-78 Seely, Ron. (2006): “Small Newspapers“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 49- 54 Shute, Nancy. (2006): “Taking Your Story to the Next Level“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 34-37 Siegfried, Tom. (2006): “Reporting From Science Journals“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 11-17 Yam, Philip M. (2006): “Finding Story Ideas and Sources“.

	In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 5-10 <u>Case Studies for Comparative International Media Studies:</u> Peri, Yoram (2012): “The Case of Israel”. In: Daniel C. Hallin / Paolo Mancini. Comparing Media Systems Beyond the Western World. Cambridge University Press. pp. 11-25 Dobek-Ostrowska, Boguslawa (2012): “Italianization (or Mediterranieanization) of the Polish Media System?” In: Daniel C. Hallin / Paolo Mancini. Comparing Media Systems Beyond the Western World. Cambridge University Press. pp. 26-50 Balcytiene, Aukse (2012): “Culture as a Guide in Theoretical Explorations of Baltic Media”. In: Daniel C. Hallin / Paolo Mancini. Comparing Media Systems Beyond the Western World. Cambridge University Press. pp. 51-71 De Albuquerque, Alfonso (2012): “On Models and Margins”. In: Daniel C. Hallin / Paolo Mancini. Comparing Media Systems Beyond the Western World. Cambridge University Press. pp. 72-95 Hadland, Adrian (2012): “Africanizing Three Models of Media and Politics”. In: Daniel C. Hallin / Paolo Mancini. Comparing Media Systems Beyond the Western World. Cambridge UP. pp. 96-118 Hadland, Adrian (2010): A Perspective from the South.In: Bogusława Dobek-Ostrowska / Michał Głowacki (2010): Comparative Media Systems: European and Global Perspectives. Central European University Press. pp. 77-95 Uce, Volkan / De Swert, Knut (2010): Introducing Turkey to the Three Media System Models. In: Bogusława Dobek-Ostrowska / Michał Głowacki (2010): Comparative Media Systems: European and Global Perspectives. Central European University Press. pp. 63-75 Vartanova, Elena (2012): “The Russian Media Model in the Context of Post-Soviet Dynamics”. In: Daniel C. Hallin / Paolo Mancini. Comparing Media Systems Beyond the Western World. Cambridge University Press. pp. 119-142 Zhao, Yuezhi (2012): “Understanding China’s Media System in a World Historical Context”. In: Daniel C. Hallin / Paolo Mancini. Comparing Media Systems Beyond the Western World.

	Cambridge University Press. pp. 143-173 Other texts (Communicating for Institutions): Blanchard, Frank (2006): “Nonprofits“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 287- 292 Borchelt, Rick E. (2008): “Public relations in science”. In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge. pp. 147-157 Henrichsen, Colleen (2006): “Government Agencies“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 280-286 Holland, Earle (2006): “Universities“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP.pp. 267-272 Miller, Mary (2006): “Museums“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 293-298 Schiele, Bernard (2008): “Science museums and science centers“. In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge. pp. 27-39 Yearly, Steven (2008): “Environmental action groups and other NGOs as communicators of science”. In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge. pp. 159-171

Communication Clinic I

Module title:	Communication Clinic I (Focus: Fundamental Research)
Module code:	SCB_3
Semester:	1st Semester
Module coordinator:	Prof. Alexander Gerber
Lecturer:	• Guest Lecturers
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h attendance 35 h preparation and review 10 h attestation preparation
Credits:	3
Recommended prerequisites:	none
Module objectives:	Upon successful completion of this module, students will be able to: 1. apply the appropriate writing styles to different journalistic formats, such as reportage or news piece 2. identify his/her own strengths and weaknesses in writing 3. produce an accurate text in English, particularly if English in not his/her native language
Content:	This course is meant to fulfil three functions: (a) to teach every student a basic level of journalistic writing skills in English (which is often not their native language); the focus is first on accuracy and authenticity (word order, linking words, sentence structures, continuous / non-continuous tenses, countable / non-countable, verbs that demand gerundive vs. verbs that demand infinitive, etc.) then eventually more on elements of stylistic creativity;

	(b) to assess every student's individual strengths and weaknesses in journalistic writing and to make the students aware of their stylistic capabilities, talents and limitations (comparable to an 'anamnesis' in the context of this "Clinic" by which the lecturer finds out what the proper 'treatment' is that has to be prescribed individually); (c) to provide a certain personalized 'remedy' for weaknesses and 'stimuli' to develop strengths (students then work in small groups on their assignments, written in different journalistic formats, particularly news pieces, reportages and features, and receive individual feedback from the coach
Assessment:	Final report (10-20 pages); oral presentation (20 min.)
Forms of media:	Board and projector
Literature:	<u>Core text</u> Zinsser, William (2006): On Writing Well (30th Anniversary Edition). Harper Perennial. <u>Other texts</u> Blum, Deborah et al. eds. (2006): A field guide for science writers. New York: OUP. pp. 26-33 Chui, Glennda (2006): "Earth Sciences". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 236 - 242 Johnson, George (2006): "Explanatory Writing". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 132-137 Lemonick, Michael D. (2006): "Space Science". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 216-221 Mcfarling, Usha Lee (2006): "Climate". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 243-250 Shreeve, Jamie (2006): "Narrative Writing". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 138-144

Bionics I (STEM I)

Module name:	Bionics I (STEM I)
Module code:	SCB_4
Semester:	1st Semester
Module coordinator:	Prof. Dr. William Megill
Lecturers:	• Prof. Dr. William Megill
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Lectures: 4 HPW
	60 h attendance 45 h preparation and review 45 h exam preparation
Credits:	5
Recommended prerequisites:	none
Module objectives:	Students should gain an appreciation for the underlying physics, materials, and designs which enable the transfer of biological solutions to engineering problems.
Content:	Muscles & Actuators: Natural muscle - form & function, actin/myosin cross-bridges, muscle tissue geometries, red/white muscle characters and roles, distribution in animals. Artificial muscle - overview of technologies and applications: hydraulics, pneumatics, electroactive polymers, shape memory alloys. Basics of cell biology: organelles in animals and plants – form and function: nucleus, membranes, filaments, microtubules, endoplasmic reticulum, mitochondria, chloroplasts; cytoskeleton and cell mobility, actin motors; flagella & cilia; gap junctions; cell membranes, pumps and gates.

	Mendellian genetics: Mendel's ideas; law of segregation; alleles; dominance; Punnett squares; genotypes & phenotypes; law of independent assortment; co-dominance; pleiotropy; genetics & probability; Nature & nurture; Mendellian heredity; pedigrees; inherited genetic disorders; Natural selection & Evolution: Darwin, his ideas & their historical context; descent with modification & natural selection; homology; biogeography; evolution of populations; gene pools & allele frequencies; Hardy-Weinberg equilibrium; mutations; sexual recombination; genetic drift; bottleneck & founder effects; geographic genetic variation; fitness; selection; sexual selection. Origin of species: species concepts; reproductive isolation; pre/post-zygotic barriers; allo/sym-patric speciation; adaptive radiation; punctuated equilibrium model of evolution; genetics of speciation; intro to animal diversity & systematics.
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector, Moodle
Literature:	<u>Core text:</u> Ahlborn, B. (2004): Zoological Physics. Springer. Campbell, Reece. Biology. 6th edition. Benjamin Cummings.

Physics of Locomotion (STEM II)

Module title:	Physics of Locomotion (STEM II)
Module code:	SCB_5 BM_5
Semester:	1st Semester
Module coordinator:	Prof. Dr. Georg Bastian
Lecturers:	• Prof. Dr. Georg Bastian • Prof. Dr. Alexander Struck
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Lectures: 2 HPW Exercise: 1 HPW Laboratory: 1 HPW
Workload:	60 h attendance 70 h preparation and review 20 h exam preparation
Credits:	5
Recommended prerequisites:	None
Module objectives:	Upon successful completion of this module, students will be able to: 1. Understand and explain technical and scientific phenomena on the basis of their acquired theoretical knowledge. 2. Recognise the connection between theory and practical applications. 3. Approach and solve new kinds of problems with the methods learned. 4. Present their own results in exercise classes; lab reports can be completed with proper terminology in English.
Content:	• Physical units, measurement errors • Mechanics and kinematics

	• Oscillations and waves • Optics
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector
Literature:	Core text: Paul A. Tipler (2008): Physics for Scientists and Engineers Freeman.

Chemistry and Maths (STEM III)

Module title:	Chemistry and Maths (STEM III)
Module code:	SCB_6
Courses:	• Basics of Chemistry (SCB_6.1) • Mathematics I (SCB_6.2)
Semester:	1st Semester
Module coordinator:	Prof. Dr.-Ing. Stefanie Dederichs
Lecturers:	• Prof. Dr.-Ing. Stefanie Dederichs • Prof. Dr. Neil Shirtcliffe
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	<u>Basics of Chemistry</u> Lectures: 2 HPW Exercises: 1 HPW Laboratory: 1 HPW <u>Mathematics I</u> Lectures: 2 HPW Exercises: 2 HPW
Workload:	<u>Basics of Chemistry</u> 60 h attendance 15 h preparation and review 15 h Laboratory preparation and review <u>Mathematics I</u> 60 h attendance 30 h preparation and review 30 h attestation preparation
Credits:	Basics of Chemistry: 3 Mathematics I 4 Sum 7

Recommended prerequisites:	None
Module objectives:	Basics of Chemistry: Students will know and master concepts and terms of general chemistry. They will have an understanding of basic inorganic reactions and the relevance of general chemistry to materials in daily life. They are able to work safely in the laboratory using basic laboratory techniques Mathematics I: The students are able to acquire knowledge in different ways and organize their study. The students know fundamental mathematical concepts and approaches, especially differentiation and its applications as well as the possibilities of visualizing mathematical expressions. After studying the module, the students possess the ability of exact thinking, working and presenting and have the feeling of handling numbers. They are able to find solutions independently and validate them. They are able to apply computational and graphical solution approaches for different tasks and interpret mathematical formulas. The students are familiar with not only standard methods but also the strategies of solving problems.
Content:	Basics of Chemistry: • Structure of matter, atoms, elements and compounds. • History of atomic models • Types of chemical bonds (covalent, ionic, metallic) • Chemical equilibrium • Acids and bases, pH-value, strong and weak acids and bases, neutralisation, buffer solutions • Redox reactions, oxidation and reduction, creating redox equations, corrosion • Electrochemistry, standard potentials, electrolysis, generation of current, applications: • Electrolytic processes; Accumulators • Complex chemistry, nomenclature, structure, applications in technology • Chemistry of elements with regard to technical applications, metals, non-metals

	Mathematics I • Numbers: irrational numbers and the problem in calculation with pocket calculator or computer, Heron-approach as an example of iterative algorithms – calculation till the desired accuracy, complex numbers in rectangular and polar forms, complex roots, the fundamental theorem of algebra • Systems of equations: Gaussian elimination approach • Vectors and spaces: linear combination, dot product, cross product, lines and planes in a space • Limits: definition, limit laws, continuity, Bisection algorithm • Differentiation: definition of derivatives, differentiation rules, tangent, Newton approach, monotonicity and concavity • Integration: inverse process of differentiation – indefinite Integral, Calculation of areas – definite integral, the fundamental theorem of calculus
Assessment:	Final written exam, 120 min.
Forms of media:	Board and projector
Literature:	Core text (Basics of Chemistry): McMurry, John E / Fay, Robert C. (2009): General Chemistry – Atoms First. Prentice Hall Core texts (Mathematics I) Stewart, James / Redlin, Lothar / Watson, Saleem (2012): Algebra and Trigonometry. 3rd international Edition. Brooks/Cole Stewart, James (2008): Calculus – Early Transcendentals. Metric International Version. 6th Edition. Brooks/Cole Other texts (Mathematics I) Strang, Gilbert (2006): Linear Algebra and Its Applications. 4th Edition. Brooks/Cole (Video lectures available at MIT (*OpenCourseWare*)

Science in Society and Political Communication (COMM III)

Module title:	Science in Society and Political Communication (COMM III)
Module code:	SCB_7
Courses:	• Political Communication: Systems, Policies, Public Affairs (SCB_7.1) • Public Engagement, Scientific Citizenship, Citizen Science (SCB_7.2)
Semester:	2nd Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Prof. Alexander Gerber • Jon Rae, Engagement Lead, Nottingham City Council • Dr. David Ludwig, Vrije Universiteit Amsterdam
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	<u>Political Communication: Systems, Policies, Public Affairs:</u> Lectures: 2 HPW <u>Public Engagement, Scientific Citizenship, Citizen Science:</u> Lectures: 2 HPW
Workload:	<u>Political Communication: Systems, Policies, Public Affairs:</u> 30 h attendance 40 h preparation and review 20 h exam preparation <u>Public Engagement, Scientific Citizenship, Citizen Science</u> 30 h attendance 20 h preparation and review 10 h exam preparation
Credits:	Political Communication: Systems, Policies, Public Affairs: 3 Public Engagement, Scientific Citizenship, Citizen Science 2 Sum 5

Recommended prerequisites:	none
Module objectives:	Upon successful completion of this module, students will be able to: 1. understand decision processes in modern societies, particularly with regard to the various influences on evidence-based decisions by policy-makers 2. identify characteristics of political systems in different countries and compare those in order to make appropriate strategic decisions for public affairs in science and technology 3. assess the opportunities, challenges, and risks of public engagement initiatives and apply the most common tools and methods, dialogue formats and campaigns 4. critically reflect potential exploitations of engagement formats and the limitations of "evidence-based" decision-making 5. understand the objectives and consequences of newly-designed knowledge creation processes such as through 'Open Science' and 'Scientific Citizenship' 6. understand the role of CSOs in transparency issues and as advocates for societal 'grand challenges' 7. understand the frameworks of deliberation / consultation processes and "science debates" 8. responsibly apply the above mentioned concepts, cases, and tools to Public Engagement and Citizen Science projects
Content:	Political Communication: Systems, Policies, Public Affairs: Considering that science and technology are more than ever political, this course introduces the students to the systems, structures and players involved in science-policy making, some of whom the students will even encounter in person as guest lecturers. Trans-cultural comparisons of political systems are a unique feature of this course. Academic institutions are nowadays in the minority among stakeholders trying to influence public opinion on science-related issues. By analysing the strategies and activities of these players (trade unions, NGOs, foundations,

	religious groups, etc.), the students learn how political communication gains valuable influence on decision processes. Whereas concepts such as Decision Theory are explained on an abstract level, the students are also addressing the topic more practically in group presentations and role plays (a panel discussion for instance). <u>Public Engagement, Scientific Citizenship, Citizen Science:</u> The historical development of science communication in the past two decades reflects the tensions and subsequent negotiations between science, politics and citizens. The more citizens rejected the notion that scientific evidence was necessarily an 'objective truth', the more policy-makers advocated participatory means of communication in order to balance expert knowledge with laypeople's experiences, expectations, and anxieties. It is exactly this democratization of policy-making for science-related issues which is changing science communication fundamentally, leading from "Public Understanding" to "Public Engagement". In this course we are analysing the expectations and realities for having more participation, accountability and transparency in science communication, based on what has been learned in SCB 1.2 ("Introduction"). Students understand the pros and cons of different forms of public engagement, and apply these prototypically in concepts and role plays. Considering that certain stakeholders are increasingly trying to exploit the idea of "engagement" for their own particular interests, the students are encouraged to reflect very critically that there is also a flip side: obvious opportunities of cultivating trust have to be balanced with the risk of reducing the 'quality' of scientific expertise, delaying critical political decisions, and failing to legitimise pseudo-democratic 'downstream' engagement campaigns. At this Science-Society interface, the course also addresses new approaches for improving the knowledge creation process by involving laypeople directly in scientific practice, namely Citizen Science. The ethical, legal and social implications of such initiatives, for instance the issue of quality assurance for 'crowd-sourced' knowledge creation, are also dealt with in class. The course furthermore introduces the students to the 'democratic' dimension of a mission-oriented science communication, such as aligning research agendas to societal 'grand challenges', and making science policy more transparent, leading to discussions

	about ideals and paradigms such as 'Open Science' and 'Scientific Citizenship' compared to the out-dated concept of "Science Literacy". The intensity which science policy-makers, funding agencies and (maybe most of all) pressure-groups have displayed by increasingly calling for Engagement in recent years, shows how important it is that the course compares both the expectations and the refined strategies of this 'discursive' form of communicating science to former stages of development in science communication, especially PUSH. Students will train to conceptualise, plan and practice specific PEST formats and campaigns, such as public debates as well as Citizen Science initiatives, also by means of role plays and in group projects.
Assessment:	Final report (10-20 pages); oral presentation (20 min.)
Forms of media:	Board and projector, video, online research
Literature:	Core texts (Political Communication): Beck, U. (1992): Risk society. Towards a new modernity. London: Sage. pp. 19-50, 155-236 (ch. 1, 7, 8: "On the logic of wealth distribution and risk distribution", "Science Beyond Truth and Enlightenment", "Opening Up the Political") Nowotny, H. (2003): "Democratising expertise and socially robust knowledge". In: Science and Public Policy 30:3, pp. 151-156. Core text (Public Engagement, Scientific Citizenship, Citizen Science): Wilsdon, James / Willis, Rebecca (2005): See-through Science – Why Public Engagement Needs to Move Upstream. Other texts (Political Communication: Systems, Policies, Public Affairs): Aviv, Rachel (2014): "A Valuable Reputation". Annals of Science, 10 Feb. Bijker, W. / Hendriks, R./Bal (2009): The Paradox of Scientific Authority. Boston: MIT Press. pp. 1-21 (Introduction) & 137-167 (Conclusions). Chassy, Bruce (2014): "Turning Science into a Circus". Academics Review, 7 March. Long Martello, Marybeth / Jasanoff, Sheila (2004): "Globalization and Environmental Governance". In Jasanoff, S. / Long, M.

	(Eds.): Earthly Politics – Global and Local in Environmental Governance. Cambridge: MIT Press. pp. 1-29. McNair, Brian (2011): "An introduction to political communication". London and New York: Routledge. Chapter 4 – The Political Media. pp.41-66. Nath, Chandrika (2012): "How to tell policymakers about scientific uncertainty". *SciDev Network*. Pielke, Roger A. (2004): "When scientists politicize science – Making sense of controversy over The Skeptical Environmentalist." *Environmental Science & Policy* 7, pp. 405–417 Stirling, A. (2010): *"Keep it complex".* Nature, Vol. 468. pp. 1029-1031 "Biology Fortified"; "The GMO Crop (mis)Information Page". Other texts (Public Engagement, Scientific Citizenship, Citizen Science): Bauer, Martin W. & Jensen, Pablo (2011): "The mobilization of scientists for public engagement". *Public Understanding of Science*, Vol. 20, 3. Bucchi, Massimiano (2008): "Of deficits, deviations and dialogues". In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge. pp. 57 - 76 Bucchi, Massimiano (2008): "Scientisti e Antiscientisti". Theatre script. (Orig. in Italian; unpublished English translation provided within the course). See youtube animation. Economic and Social Research Council (2007): Re-modelling science communication. (ESRC Science in Society Programme). Einsiedel, Edna F. (2008): "Public participation and dialogue". In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge. pp. 173 – 184 Escobar, Oliver (2011): Public Dialogue and Deliberation. A communication perspective for Public Engagement practitioners. Hart, Roger (1992): Children's Participation, from tokenism to citizenship.

	Nisbet, Matthew C. & Scheufele, Dietram A. (2009): “What’s Next for Science Communication? Promising Directions and Lingering Distractions.” *American Journal of Botany,* 96 (10) pp. 1767–1778. 2009. Otto, Shawn Lawrence (2011): Fool Me Twice: Fighting the Assault on Science in America. Rodale Books. Peters, Hans Peter (2008): “Scientists as public experts“. In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge. pp. 131 – 146 Poliakoff, Ellen & Webb, Thomas L. (2007): “What Factors Predict Scientists’ Intentions to Participate in Public Engagement of Science Activities?” *Science Communication,* Vol. 29, 2. pp. 242-263 “InformalScience” timeline (a project initially organized by Sherry Hsi at University of Berkely, now hosted by ASTC, the Association of Science-Technology Centers and the Center for the Advancement of Informal Science Education, CAISE) UN Convention on the Rights of the Child, UNICEF

Science & Innovation Journalism, Freelancing (COMM IV)

Module title:	Science & Innovation Journalism, Freelancing
Module code:	SCB_8
Courses:	• Print & Web, TV & Radio (SCB_8.1) • Interactive & Social Media, Data-driven Journalism (SCB_8.2) • Freelance Journalism: Pitch, Sell, Edit (SCB_8.3)
Semester:	2nd Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Prof. Alexander Gerber • Claudia Garád, Wikimedia Foundation / Austria • Jens Degett, Freelance Science Journalist / Denmark, President of the European Science Journalists Association
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Print & Web, TV & Radio Lectures: 1 HPW Exercises: 2 HPW Interactive & Social Media, Data-driven Journalism Lectures: 1 HPW Exercises: 2 HPW Projects: 2 HPW Freelance Journalism: Pitch, Sell, Edit: Lectures: 1 HPW Exercises: 1 HPW
Workload:	Print & Web, TV & Radio: 45 h attendance 10 h preparation and review 5 h attestation preparation Interactive & Social Media, Data-driven Journalism: 75 h attendance 30 h preparation and review 15 h exam preparation

	<u>Freelance Journalism: Pitch, Sell, Edit:</u> 30 h attendance 20 h preparation and review 10 h exam preparation
Credits:	Print & Web, TV & Radio 2 Interactive & Social Media, Data-driven Journalism 4 Freelance Journalism: Pitch, Sell, Edit 2 Sum 8
Recommended prerequisites:	Media Studies (SCB_2.1)
Module objectives:	Upon successful completion of this module, students will be able to: 1. understand and use basic internet technologies, such as html, JavaScript, wikipedia code and spreadsheet macros 2. apply these technological skills to innovative science communication concepts 3. identify opportunities for unique selling propositions in online PR and journalism, e.g. innovative means of digital storytelling, activation mechanisms and user involvement 4. develop stories by means of data-driven journalism 5. assess the potential of online concepts and technologies with regard to communication impact and usage patterns 6. identify science stories which are appropriate for freelance contributions 7. match science stories to suitable publications 8. research stories thoroughly but with an eye on the deadline 9. pitch to and build relationships with editors 10. interview successfully and get quotes to illustrate a story 11. use different formats and combine different types of media to provide / sell a more comprehensive package 12. build up and present a portfolio of work

	13. understand different editorial constraints and deliver invoices 14. find different opportunities for freelancers other than mainstream media 15. demonstrate writing, research and presentation skills
Content:	<u>Print & Web, TV & Radio:</u> The students are introduced to the main formats, requirements, styles, editorial structures and processes in each of the four main types of media: print (particularly special interest magazines and newspaper sections for popular science and technology trends), web (particularly commercial online news sites, whereas the more interactive and social media applications are covered in-depth in the course "Interactive Media", which is also taught in this module), and last not least radio (particularly online radio, visual radio, podcasting and slidecast formats). Teaching the journalistic basics in one course offers the unique opportunity to approach each of the four strains explicitly from a cross-media perspective. Considering how fast the borders between these types of media are becoming blurred, this introductory course is meant to encourage the students to think 'out of the box' and start experimenting with new formats at the fringes of traditional genres. The "Freelance Journalism" course, which is also offered within this module, support this 'innovation spirit' by providing the future science writers with the necessary know-how turn their ideas into revenue, at least potentially. The module on "Innovative Formats" and "Entrepreneurial Journalism" (SCB 13) follows up on this in the next semester. To apply practically what is being learned in theory about journalism in this course, the students can contribute and eventually even publish in cooperating webzines such as The Euroscientist, blogs such as Scienceblogs, broadcasting institutions such as our own "Campus TV" and "Campus FM" or in the English-speaking programme of "Deutsche Welle". <u>Interactive & Social Media, Data-driven Journalism:</u> Considering the disruptive structural changes in the media landscape and the information behaviour of both laypeople and professionals, this course addresses the most relevant drivers for this change. Starting with developing a basic understanding of

	internet technologies, we are going to apply what you have learnt to web prototypes. Freelance Journalism: Pitch, Sell, Edit: Freelance journalism is a very different career from what it was ten years ago. The rise of digital media and the structural changes in the classical publishing industry have brought both an increase and a loss of opportunities, particularly for science and innovation journalists. With the growing need for content, staff journalists have become less specialised and less investigative, meaning that freelancers can step into these niches providing thoughtful and well-informed copy. However there has also been a decrease in the traditional feature which was the freelancer's bread-and-butter, but instead there are different forms of feature and exciting ways of combining different media. There are also other opportunities for using journalistic skills in places other than the newsroom and the features desk. The course looks at possible opportunities and creative ideas for freelance journalism. It also covers very practical aspects in terms of the etiquette of pitching, providing different forms of content in a coherent package, building relationships with editors and scientists, timekeeping and the all important aspect of payment. Furthermore it looks at other opportunities for freelancers beyond mainstream journalism.
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector, PC pool, video, online research, interactive learning tools for programming skills, HSRW cross-media lab
Literature:	Core text (Interactive & Social Media, Data-driven Journalism): Brock, George (2013): Out of Print – Newspapers, Journalism and the Business of News in the Digital Age. Kogan Page. Readings (Interactive & Social Media, Data-driven Journalism): Boyd-Barrett, Oliver / Rantanen, Terhi (2009): "News Agencies". In: Daniele Albertazzi, Paul Cobley (eds.) The Media: An Introduction. Routledge. Boyle, Alan. (2006): "Popular Audiences on the Web". In: Deborah Blum et al. (eds.) A field guide for science writers. New

	York: OUP. pp. 90 - 96 Cantoni, Lorenzo / Tardini, Stefano (2009): “The Internet and the Web”. In: Daniele Albertazzi, Paul Cobley (eds.) The Media: An Introduction. Routledge pp. 220-232 Chang, Kenneth. (2006): “Technology and Engineering“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 209 – 215 Fox, Douglas (2013): “Excavating the Evidence“ In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press.pp. 59 - 74 Gough-Yates, Anna (2009): “Magazines”. In: Daniele Albertazzi, Paul Cobley (eds.) The Media: An Introduction. Routledge. pp. 153-164 Hobson, Dorothy (2009): “Television”. In: Daniele Albertazzi, Paul Cobley (eds.) The Media: An Introduction. Routledge. pp. 176-189 Kuhn, Raymond (2009): “Newspapers”. In: Daniele Albertazzi, Paul Cobley (eds.) The Media: An Introduction. Routledge. pp. 140-152 Nijhuis, Michelle (2013): “Sculpting the story“. In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 75 - 86 Powledge, Tabitha M. (2006): “Science Audiences on the Web“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 97 - 99 Regalado, Antonio. (2006): “Investigative Reporting”. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 118 - 125 Sohn, Emily (2013): “Finding Ideas“. In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 9 - 22 Starkey, Guy (2009): “Radio”. In: Daniele Albertazzi, Paul Cobley (eds.) The Media: An Introduction. Routledge. pp. 165-175 Von Bubnoff, Andreas (2013): “Getting the Story, and getting it right“. In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 40 – 52

	Other texts (Interactive & Social Media, Data-driven Journalism) Boyle, Alan (2006): "Popular Audiences on the Web". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 90 – 96 Branch, John (2013): "Snow Fall – The Avalanche at Tunnel Creek", *New York Times*. (http://bit.ly/HRW-Interact-1) Delviscio, Jeffery et al. (2013): "The Life and Legacy of Nelson Mandela", *New York Times*. (http://bit.ly/HRW-Interact-2) Doig, Stephen, O'Reilly, Richard (2010): Pulitzer Programming: How Investigative Reporters are Using SAS. SUGI Proceedings, Date Warehousing and Solutions. Gerber, Alexander (2014): "Science Caught Flat-footed: How Academia Struggles with Open Science Communication". In: S. Bartling / S. Friesike (Eds.) *Opening Science: The Evolving Guide on How the Internet is Changing Research, Collaboration and Scholarly Publishing.* Wiesbaden: Springer. [Pre-print | OA] Kouper, Inna (2010): "Science blogs and public engagement with science: practices, challenges, and opportunities". In: Journal of Science Communication, JCOM 9 (1) Naughton, John (2012): "Technology is a double-edged sword", *The Guardian*. (http://bit.ly/HRW-Interact-3) Powledge, Tabitha M. (2006): "Science Audiences on the Web". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 97 – 99 Smit, Lynne (2012): "Using digital tools for journalism". SciDev Network. (http://bit.ly/HRW-Interact-4) Trench, Brian (2008): "Internet". In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge. pp. 185 - 198 Other Resources (Interactive & Social Media, Data-driven Journalism): European Journalism Centre (2014): Doing Journalism with Data. MOOC, starting on 19 May. http://datajournalismcourse.net Google tools in journalism: http://www.google.com/get/mediatools Basics of HTML: Codeacademy.com

	Readings (Freelance Journalism: Pitch, Sell, Edit): Baker, Monya / Marshall, Jessica. (2013): “Working with Editors – and Their Edits“. In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 87-98 Brown, Kathryn. (2006): “Freelance Writing“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 79-82 Cook, Gareth. (2006): “Deadline Writing“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 111-117 Frederick, Robert (2013): “Multilancing“. In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 116-122 Fröhlich, Romy (2013): “What’s the harm in moonlighting? A qualitative survey on the role conflicts of freelance journalists with secondary employment in the field of PR”. In: *Media Culture Society,* 2013 (35): 809. (also available online: http://mcs.sagepub.com/content/35/7/809.full) Hayden, Thomas (2013): “Making the Pitch“. In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 23-39 Hoag, Hannah (2013): “Creating Creative Space". In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 167-174 Kanigel, Robert. (2006): “The Science Essay“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 145-150 Ladendorf, Martina (2012): “Freelance Journalists’ Ethical Boundary – Settings in Information Work”. In: *Nordicom Review* 33, 1. pp. 83-98. (also available online: http://www.nordicom.gu.se/sites/default/files/kapitel-pdf/359_ladendorf.pdf) Marris, Emma (2013): “Going Long“. In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 99-115 Ornes, Stephen (2013): “The Loneliness of the Science Writer”.In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers

	handbook. Da Capo Press. pp. 137-141 Rosner, Hillary (2013): “Good Luck Placing This Elsewhere”. In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 142-148 Sasso, Anne (2013): “Just Write the Friggin’ Thing Already!". In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 123-135 Schrope, Mark (2013): “Contract Literacy“. In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 230-245 Zimmer, Carl. (2006):”Science Books“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 83-89

Communication Project I (Focus: Bionics)

Module title:	Communication Project I (Focus: Bionics)
Module code:	SCB_9
Semester:	2nd Semester
Module coordinator:	Prof. Dr. William Megill
Lecturers:	• Prof. Dr. William Megill • Prof. Dr. Neil Shirtcliffe
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Project: 5 HPW
Workload:	75 h attendance 30 h preparation and review 15 h attestation preparation
Credits:	4
Recommended prerequisites:	Bionics I (SCB_4)
Module objectives:	Students learn to apply their writing skills to laboratory experiments. The main goal is to bring the communication and the science and technology together.
Content:	The course consists of a set of experiments from different courses encompassing aspects of science and technology. The students reflect their discoveries and thereby internalise how different ways of presenting the same results can be used.
Assessment:	Final report (10-20 pages); oral presentation (20 min.)
Forms of media:	Board and projector
Literature:	Core text Day, Robert A. & Gastel, Barbara (2006): How To Write & Publish a Scientific Paper: 5th Edition

Mathematics II (STEM IV)

Module title:	Mathematics II (STEM IV)
Module code:	SCB_10
Courses:	Mathematics II
Semester:	2nd Semester
Module coordinator:	Prof. Dr.-Ing. Stefanie Diedrichs
Lecturer:	Chifen Akah Neh
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Lectures: 2 HPW Exercises: 2 HPW
Workload:	60 h attendance 65 h preparation and review 25 h attestation preparation
Credits:	5
Recommended prerequisites:	Mathematics I (SCB_6.2)
Module objectives:	The students are able to apply advanced mathematical concepts and methods and especially handle multivariable functions. They are able to carry out modelling with the help of differential equations. The students train their general social competences in the framework of group work. Their ability to communicate with the help of exact mathematical formulations will be trained. By doing homework the students will further develop their problem-solving thinking.
Content:	• Integration: Substitution rule, integration by parts, partial fraction decomposition, improper integrals • Series: Taylor series, approximation by partial sums, numerical aspects • Differentiation of multivariable functions: partial differentiation,

	gradient, maximum and minimum values • Ordinary differential equations: direction fields, separation of variables, first-order and second-order linear differential equations • Linear algebra: matrices, determinant, inverse matrix
Assessment:	attestation (final written exam, 120 min.)
Forms of media:	Board and projector
Literature:	Core text: Stewart, James (2008): Calculus – Early Transcendentals. Metric International Version. 6th Edition. Brooks/Cole Other texts: Strang, Gilbert (2006): Linear Algebra and 1st Applications. 4th Edition. Brooks/Cole (Video lectures available at MIT (*OpenCourseWare* or through iTunes U) Mattuck, Arthur (2008): Differential Equations. Videos of a lecture at MIT (*OpenCourseWare* or through iTunes U)

Biomedical Science & Physics of Sensing (STEM V)

Module title:	Biomedical Science & Physics of Sensing (STEM V)
Module code:	SCB_11 BM_10
Courses:	• Biomedical Science and Engineering (SCB_11.1) • Physics of Sensing (SCB_11.2)
Semester:	2nd Semester
Module coordinator:	Prof. Dr. Georg Bastian
Lecturers:	• Prof. Dr. Alexander Struck • Prof. Dr. Georg Bastian • Dr. Ramona Kirsch
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	<u>Biomedical Science and Engineering</u> Lectures: 2 HPW <u>Physics of Sensing</u> Lectures: 2 HPW Exercise: 1 HPW Laboratory: 1 HPW
Workload:	<u>Biomedical Science and Engineering</u> 30 h attendance 40 h preparation and review 20 h attestation preparation <u>Physics of Sensing</u> 60 h attendance 70 h preparation and review 20 h exam preparation
Credits:	Biomedical Science and engineering 3 Physics of Sensing 5 Sum 8

Recommended prerequisites:	Physics of Locomotion (SCB_5)
Module objectives:	Upon successful completion of this module, students will be able to: • know the role the engineering played for different medical treatments and how changes in medicine have enhanced the human life span and quality of life • understand the relationship between the study of Biomedical Engineering and the study of medicine or human physiology • describe the common components of modern biomedical systems and understand the different types of sensors and the mechanism by which they convert the detected signals into electrical signals • understand the principles of operation of modern instruments used to monitor patient body and used in the laboratory • understand the theory and application of advanced techniques used in modern biomedical devices • understand and explain technical and scientific phenomena of Physics of Sensing on the basis of their acquired theoretical knowledge • recognize the connection between theory and practical applications • approach and solve new kinds of problems with the methods learned • present own results in exercise classes • produce lab reports with proper terminology in digital form and in English
Content:	<u>Biomedical Science and Engineering</u> • History of Medical Devices • Diagnostic Devices • Diagnostic Imaging • Treatment Devices • Biomedical Testers and Tools • Introduction into Regulations and Standards <u>Physics of Sensing</u> • Electricity and Magnetism • Atomic physics • Nuclear physics

	• Solid State Physics • Sensor applications of physics (Using examples from Bionics where possible)
Assessment:	Final written exam (90 min.); additional lab reports / mid-term exam in Physics as a prerequisite for the final examination
Forms of media:	Board and projector
Literature:	Core text (Biomedical Science and Engineering): Saltzman, W. Mark (2009): Biomedical Engineering. Cambridge UP Other texts (Biomedical Science and Engineering): Street, Laurence (2012): Introduction to Biomedical Engineering Technology. CRC Press Baura, Gail D. (2012): Medical Device Technologies. Academic Press Culjat, Martin et al. (2013): Medical Devices. Wiley (Additional course materials provided) Core Text (Physics of Sensing): Tipler, Paul A. (2008): Physics for Scientists and Engineers. Freeman

Risk Communication and Legal Frameworks (COMM V)

Module title:	Risk Communication and Legal Frameworks (COMM V)
Module code:	SCB_12
Courses:	• Risk & Crisis Communication (SCB_12.1) • Legal Frameworks of Media and PR (SCB_12.2)
Semester:	3rd Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Prof. Alexander Gerber • Tony Jaques, SC Consultant / Australia • Jennifer Metcalfe, SC Consutant / Australia • Michelle Riedlinger, SC Researcher / Canada • Natalia Theissen, Lawyer / Hannover, Germany
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Risk & Crisis Communication: Lectures: 2 HPW Exercises: 1 HPW Legal Frameworks of Media and PR Lectures: 1 HPW
Workload:	Risk & Crisis Communication: 45 h attendance 60 h preparation and review 15 h exam preparation Legal Frameworks of Media and PR 15 h attendance 5 h preparation and review 10 h exam preparation
Credits:	Risk & Crisis Communication 4 Legal Frameworks of Media and PR 1 Sum 5

Recommended prerequisites:	None
Module objectives:	<u>Risk & Crisis Communication:</u> Upon successful completion of this module, students will be able to: 1. explain how science assesses natural and technological risks and how this differs from public perceptions of risk and hazard 2. explain the principles of risk communication, particularly when the scientific topics have been politicized 3. describe the communication process in the context of a crisis 4. demonstrate the basic requirements of a risk communication / crisis response plan 5. demonstrate skills in interpreting risk or hazard for a lay audience 6. demonstrate skills in journalistic writing about risk or crisis situations, including the interpretation of research papers and statistics 7. recognize the conditions under which authorities define a social problem as a crisis 8. assess how the public and private sectors use perceptions of risk and hazard to effect policy changes 9. describe cultural differences in how perceptions of risk vary between regions, including Europe, Asia and North America 10. demonstrate research, observation, scholarly-writing and presentation skills <u>Legal Frameworks of Media and PR:</u> Upon successful completion of this module, students will be able to: 1. act legally responsibly in science communication practise, particularly with regard to copyright and branding issues 2. take into account which implications communication has in terms of intellectual property rights, considering technology transfer, patenting issues, market launches and the localisation of products in different parts of the word 3. avoid the most relevant legal risks as a practising journalist in different parts of the world 4. comprehend how the internet changes legal frameworks in communication practise 5. differentiate between the legal implications which different topics have in different countries or genres

	6. act legally responsibly in a leadership position in communication management, both in public sector and in business, in different countries and cultures
Content:	<u>Risk & Crisis Communication:</u> Risk is an inherent part of science communication. The very nature of scientific investigation or assessment means that there is always a risk or a percentage probability that the research results have a margin of error. This has implications for journalists and communicators who write and talk about scientific and technological research and its products, particularly where such research may have a direct impact on society such as health, medical, technological and environmental research. Crises are unexpected threats for which response time is short. Their origins can be natural (as with ice storms or tsunamis) or human (as with acts of terrorism or oil spills or in reaction to some activists' claims about the toxicity of a product which then has to be recalled globally). This course explores how to (and how not to) communicate scientific risk and how to deal with serious challenges to public safety during a crisis. To do so, it draws on both theoretical and practical approaches to communicating with diverse audiences about scientific risk or in risk-related crisis situations. <u>Legal Frameworks of Media and PR</u> Every activity in science communication bears specific legal rights, risks and responsibilities, which often differ significantly between countries, genres or topics. Communicating about pharmaceutical issues, for instance, is tensely regulated in many countries, particularly in PR, whereas most engineering topics often lack such limitations in how and what can be communicated about new technologies and products. Apart from investigating and comparing such specific legal implications on a global scale, this course, of course, also covers the basic legal frameworks in which every communicator nowadays works, such as copyright issues and branding, particularly in terms of pictures and video content, anonymous sources and intellectual property rights, also with regard to technology transfer, patenting issues, market launches and localisation of products in different parts of the word. Considering journalism, the course addresses the different degrees of constitutional rights in different parts of the world, and

	the global differences in how courts and companies deal with legal practises in publishing. Obviously the internet changes these legal frameworks fundamentally, stretching the boundaries of who can actually claim special rights as 'a journalist' now and in the future. Furthermore the students are introduced to the legal implications of leadership in communication management, both in public sector and in business, which again differ a lot between countries and cultures.
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector, videos, online research
Literature:	<u>Core text (Risk & Crisis Communication):</u> Heath, Robert L. / O'Hair, H. Dan (2010): Handbook of Risk and Crisis Communication. <u>Other texts (Risk & Crisis Communication):</u> Boholm, Åsa (2009): "Speaking of Risk: Matters of Context, Environmental." *Communication*, 3 (3), pp. 335-354, Friedman, S.M. (2011): "Three Mile Island, Chernobyl, and Fukushima: An analysis of traditional and new media coverage of nuclear accidents and radiation." *Bulletin of the Atomic Scientists*, 67(5): 55-65. Friedman, S.M., Gorney, C.M., and Egolf, B.P. (1992): "Chenobyl coverage: how the US media treated the nuclear industry." *Public Understanding of Science*, 1, 304-323 Irwin, Alan (2008): "Risk, science and public communication". In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge. pp. 199-212 Kanigel, Robert (2006): "The Science Essay". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 145-150 Murdoch, G. (2010): "Shifting anxieties, altered media: Risk communication in networked times". *Catalan Journal of Communication and Cultural Studies*, 2(2). pp. 159-176 Miller, B. M. et al. (2011): "Reporting risk: Perceptions of fear and risk from health news coverage." *Communication Research*

	Reports, 28 (3), pp. 244-253 Rodgers, Joann Ellison (2006): “Institutional Communications During Crisis“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 273-279 Russel, Cristine (2006): “Risk Reporting“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 251-256 Slovic, Paul (1987): “Perception of Risk”. *Science*, Vol. 236, 4799. pp. 280-285 Weingart, P. Engels, A. and Pansegrau, P. (2000). „Risks of communication: discourses on climate change in science, politics and the mass media.” *Public Understanding of Science*, 10. pp. 260-281. Wynne, Brian (1996): “Misunderstood misunderstandings: Social identities and public uptake of science”. In: Irwin, A. / Wynne B.: Misunderstanding Science? The Public Reconstruction of Science and Technology. Cambridge UP, pp. 19-46. <u>Core text (Legal Frameworks of Media and PR):</u> to be defined

New Formats and Entrepreneurship (COMM VI)

Module title:	New Formats and Entrepreneurship (COMM VI)
Module code:	SCB_13
Courses:	• Innovative Online Formats, Apps, Serious Games (SCB_13.1) • Entrepreneurship, Entrepreneurial Journalism, Self-marketing (SCB_13.2)
Semester:	3rd Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Prof. Alexander Gerber • Ulrike Langer, Freelance Journalist, Seattle / USA
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Innovative Online Formats, Apps, Serious Games Lectures: 1 HPW Exercises: 2 HPW Entrepreneurship, Entrepreneurial Journalism, Self-marketing Lectures: 1 HPW Exercises: 3 HPW
Workload:	Innovative Online Formats, Apps, Serious Games 45 h attendance 50 h preparation and review 25 h exam preparation Entrepreneurship, Entrepreneurial Journalism, Self-marketing 60 h attendance 80 h preparation and review 10h attestation preparation
Credits:	Innovative Online Formats, Apps, Serious Games 4 Entrepreneurship, Entrepreneurial Journalism, Self-marketing 5 Sum 9

Recommended prerequisites:	Interactive & Social Media, Data-driven Journalism (SCB_8.2) Freelance Journalism: Pitch, Sell, Edit (SCB_8.3)
Module objectives:	Upon successful completion of this module, students will be able to: 1. apply their media skills and strategic training to out-of-the-box online communication projects in the area of science communication 2. use state-of-the-art project management practises to reach the objectives of group tasks, including needs assessment, fundraising and evaluation of results 3. integrate innovative formats, such as apps and serious games, in science communication strategies 4. develop self-marketing strategies to strive in today's science communication landscape 5. assess the business impact of new-media ventures
Content:	<u>Innovative Online Formats, Apps, Serious Games</u> Following up on course SCB 8.2 ("Interactive & Social Media, Data-driven Journalism") this course gives students the opportunity to experiment in small groups and several weeks of intensive training with different kinds of new online formats in science communication. Smartphone apps, cross-media applications, serious games, etc. are developed prototypically. Real-life standards for project management are applied, including Gantt charts, reporting mechanisms and shared work-spaces, budgets and actual fundraising. <u>Entrepreneurship, Entrepreneurial Journalism, Self-marketing</u>: Whilst experimenting creatively with real new-media endeavours in realistic business-like situations in the other course of this module ("Innovative Formats"), this course rounds up the experimental approach with knowledge and training about how to use novel formats to become economically successful in the media environment. Whereas "Freelance Journalism" (SCB 8.3) focuses more on the day-to-day routines and challenges of surviving economically in the increasingly hostile media landscape, this particular course cultivates the students' entrepreneurial spirit by means of excursions, live-interviews and case studies about successful media innovators.

Assessment:	Final report (ca. 15-30 pages)
Forms of media:	Board and projector, video, online research, editing of an interactive online time-line
Literature:	Readings (Innovative Online Formats, Apps, Serious Games) Fahy, D. / Nisbet, M. (2011): "The science journalist online: Shifting roles and emerging practices". In: *Journalism* 12: 778. + Blog posting by Mathew Nisbet on "ClimateShift" Readings (Entrepreneurship, Entrepreneurial Journalism, Self-marketing) Elmore, C. / Massey, B. (2012): "Need for Instruction in Entrepreneurial Journalism". In: Journal of Media Practice 13 (2). pp. 109-124.

Communication Clinic II (Focus: Applied Research)

Module title:	Communication Clinic II (Focus: Applied Research)
Module code:	SCB_14
Semester:	3rd Semester
Module coordinator:	Prof. Alexander Gerber
Lecturer:	• Brett Ellis • Sharon Gerber-Crawford
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Exercises: 4 HPW
Workload:	60 h attendance 50 h preparation and review 10 h attestation preparation
Credits:	4
Recommended prerequisites:	Communication Clinic I (SCB_3)
Module objectives:	Upon successful completion of this module, students will be able to: 1. switch writing styles with ease if confronted with different journalistic challenges 2. use his/her own strengths to develop a unique writing style 3. use typical stylistic elements in English writing authentically, even if English in not his/her native language
Content:	Following up on the first “Communication Clinic” (SCB 3), this course is meant to fulfil three functions: (a) to teach students advanced journalistic writing skills; the focus is more on stylistic creativity than in the first “Clinic” (b) to build upon every student’s individual strengths in writing, now also applying their knowledge from three semesters of science and particularly bionics teaching;

	(c) to provide both personalized ‘remedy’ for weaknesses and ‘stimuli’ to develop strengths
Assessment:	Final report (10-20 pages); oral presentation (20 min.)
Forms of media:	Board and projector
Literature:	Core text Zinsser, William (2006): On Writing Well (30th Anniversary Edition). Harper Perennial. Other texts Begos, Kevin (2006): “The Biology of Behavior“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 183 - 188 Everett, David (2006): “Finding a Voice and a Style“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 39 - 44 Jenkins, Mckay (2006): “Nature“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 229 - 235 Kanigel, Robert (2006): “The Science Essay“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 145 - 150 Kunzig, Robert (2006): “Gee Whiz Science Writing“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 126 - 131 Revkin, Andrew C. (2006): “The Environment“. In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 222 - 228

Statistics in Communication Practise (COMM VII)

Module title:	Statistics in Communication Practise (COMM VII)
Module code:	SCB_15
Semester:	3rd Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Prof. Dr. Eric Jensen, University of Warwick, Visiting Professor • Dr. Raimund Clever, Guest Lecturer • Prof. Alexander Gerber
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Lectures: 2 HPW Exercises: 2 HPW
Workload:	60 h attendance 40 h preparation and review 20 h exam preparation
Credits:	4
Recommended prerequisites:	None
Module objectives:	Upon successful completion of this module, students will be able to: 1. understand the challenges of dealing with uncertainty when communicating science to lay audiences and identify such challenges in scholarly publications 2. reflect the general methodological and human errors involved in statistical measurement processes 3. be aware of the ethical dimension of withstanding the temptation of manipulating methodologies in order to produce the intended data 4. comprehend the concepts and methods behind statistical terms such as ‘significance’, ‘confidence intervals’, ‘odds

	ratio', 'p-values', 'response bias' etc. 5. identify the weaknesses and mistakes with regard to statistical evidence in science coverage 6. apply this knowledge to producing texts for lay audiences
Content:	As an inherent aspect of the scientific method, uncertainty is one of the biggest challenges in communicating science responsibly, i.e. without (intentionally or unintentionally) distorting data and research results. This course is making students aware of the ethical dimension of both practising science and communicating it, as a response to the 'certainty of uncertainty'. On the basis of developing this sense of responsibility, the students are introduced to the basic concepts using statistics in science. They practise their statistical skills by calculating probabilities and standard deviations, drawing curves etc.
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector, video, PC
Literature:	Readings Cope, Lewis (2006): "Understanding and Using Statistics". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 18 - 25 Ornes, Stephen (2013): "By the Numbers". In: Thomas Hayden / Michelle Nijhuis (eds.) The science writers handbook. Da Capo Press. pp. 53 – 58 SciDev Network (2014): "Hans Rosling on depicting global trends accurately"

Bionic Engineering (STEM VI)

Module title:	Bionic Engineering (STEM VI)
Module code:	SCB_16 BM_2.2
Courses:	Bionics II (SCB_16.1) Introduction to Engineering Design (SCB_16.2)
Semester:	3rd Semester
Module coordinator:	Prof. Dr. Stephane Danjou
Lecturers:	• Prof. Dr. William Megill • Prof. Dr.-Ing. Stephane Danjou
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Bionics II Lectures: 2 HPW Practical: 2 HPW Introduction to Engineering Design Lectures: 2 HPW Exercise: 1 HPW
Workload:	Bionics II 60 h attendance 60 h preparation and review 30 h exam preparation Introduction to Engineering Design: 45 h attendance 30 h preparation and review 15 h attestation preparation
Credits:	Bionics II: 5 Introduction to Engineering Design 3 Sum 8

Recommended prerequisites:	Bionics I (SCB_4)
Module objectives:	Bionics II Students should gain an appreciation for the underlying physics, materials, and designs which enable the transfer of biological solutions to engineering problems. Introduction to Engineering Design Upon successful completion of this module, students will be able to: • analyse technical demands and structure them, • find technical solutions based on a function oriented structuring of the task, • evaluate the solutions in order to find the best for a given target • describe the design process and analyse influences on the progress • Communicate to marketing, design, production und operation departments in order to improve the design process of a product.
Content:	Bionics II Movement in Water: Intro to fluid dynamics, fish body design, Animal swimming, underwater flight, introduction to the design of submersibles. Movement in Air: Flight in birds and aircraft: bird body design, lightweight materials, musculature; forces on a bird, gliding flight, flapping flight, overview of biomimetic flying machines. Movement on Land: Evolution of walking (lungfish to tetrapod), mechanics of walking (inverted pendulum) and running (ground contact force, leg springs, torso springs), Overview of biomimetic walking machines. Introduction to Engineering Design • Analysis of requirements and demands for technical products • Generation of a function structure for technical products under consideration of energy, signal and material flow • Solution search and evaluation based on demands and

	requirements • Combination of solutions for sub-functions to a product • Designing products • Cost consideration during design, importance and potential • Communication und documentation of design processes
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector
Literature:	Core text (Bionics II): Ahlborn, B. (2004): Zoological Physics. Springer. Campbell, Reece. Biology. 6th edition. Benjamin Cummings. Core text (Introduction to Engineering Design): Jensen, Cecil / Helsel, Jay D. / Short, Dennis R. (2007): Engineering Drawing & Design, 7th revised edition. McGraw-Hill Higher Education Other texts (Introduction to Engineering Design): Budynas, Richard G. (2009): Shigley's Mechanical Engineering Design, Student international edition, 8th revised edition.McGraw-Hill College Course materials from the lecturer Exercises from the lecturer Lecture notes compiled by class (open source)

Prerequisites for the 4th Semester are:

- Having passed Communication Clinic I (SCB_3) and Communication Clinic II (SCB_14)
- Having gained at least 30 ECTS credit points on both the COMM and the STEM side

Governance and Behaviour (SWITCH I)

Module title:	Switch I (Governance and Behaviour)
Module code:	SCB_EC_C1 / SCB_EC_S1
Courses:	• Corporate Communication Management, Governance & Controlling • Introduction to Behavioural Sciences
Semester:	4th Semester
Module coordinator:	Prof. Alexander Gerber / Prof. Dr. William Megill
Lecturers:	• Prof. Alexander Gerber • Prof. Dr. William Megill
Language:	English
Place in curriculum:	Elective / Switch Module
Timetabled hours:	Lectures: 2 HPW Exercises: 2 HPW
Workload:	60 h attendance 15 h preparation and review 15 h exam preparation
Credits:	3
Recommended prerequisites:	None
Module objectives:	<u>Corporate Communication Management, Governance & Controlling</u> Upon successful completion of this module, students will be able to:

	1. put the increasing diversity of tasks in institutional science and innovation communication into a larger strategic context 2. understand, reflect and apply the most important methods and tools in communication governance and controlling 3. differentiate between methodologies for evaluating communication activities and apply these to specific projects deal with staffing and outsourcing issues as well as leadership in larger communication departments <u>Introduction to Behavioural Sciences</u> Students will be able to analyse and investigate human and animal behaviour through controlled and naturalistic observation, and disciplined scientific experimentation
Content:	<u>Corporate Communication Management, Governance & Controlling</u> The days are long-gone in which the institutionalised communication of science and innovation was limited to media relations and good 'storytelling', i.e. producing easy-to-understand material about presumed success stories from research projects. Nowadays communication managers both in academic institutions and in companies are facing an increasingly wide-ranging spectrum of tasks, from internal communication and knowledge repositories to exhibitions and event formats, from public engagement and citizen science activities to public affairs and science advocacy, from corporate publishing and social media outreach to branding and fund-raising, from student marketing and MOOCs in teaching to accompanying grant-writing processes or knowledge- and technology-transfer by means of targeted communication efforts. This multitude of responsibilities has been changing the role and 'standing' of communication managers fundamentally, at least in some, larger academic institutions, and most of the bigger research-intensive enterprises. Together with the increased resources available and their expected impact, science communicators are also going to face major accountability issues in the future: pecuniary communication controlling and project evaluation will require strategic governance structures and reporting processes. This course will make students aware of the most relevant theories and strategies, methods and tools to meet these management

	challenges. Furthermore the students are prepared for staffing and outsourcing issues, challenges with leadership and group dynamics in communication departments, which today often consist of dozens of employees Introduction to Behavioural Sciences This course is an introduction to and survey of the science of human behaviour and mental processes. There is a primary emphasis on the application of scientific reasoning and the empirical method to the study of topics such as learning and cognition, the biological bases of behaviour, personality, motivation and emotion, social and group dynamics, developmental processes, and behavioural disorders and treatment.
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector, video, online research
Literature:	Readings (Corporate Communication Management, Governance & Controlling): Glick, Marion E. (2006): "Corporate Public Relations". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 299 – 309 Neresini, Federico / Pellegrini, Giuseppe (2008): "Evaluating public communication of science and technology". In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge. pp. 237 - 251 Core Text (Introduction to Behavioural Sciences): Fred N. Kerlinger (1979), Behavioral Research: A Conceptual Approach, New York: Holt, Rinehart & Winston

Empirical Research and Economies (COMM VIII)

Module title:	Empirical Research and Economies (COMM VIII)
Module code:	SCB_17
Courses:	• Empirical Research Methodologies for Science Communication (SCB_17.1) • Global Economies (SCB_17.2)
Semester:	4th Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Prof. Alexander Gerber • Prof. Dr. Dirk Berndsen
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	<u>Empirical Research Methodologies for Science Communication:</u> Lectures: 1 HPW Exercises: 3 HPW <u>Global Economies:</u> Lectures: 1 HPW
Workload:	<u>Empirical Research Methodologies for Science Communication</u> 60 h attendance 100 h preparation and review 20 h exam preparation <u>Global Economies:</u> 15 h attendance 30 h preparation and review 15 h exam preparation
Credits:	Empirical Research Methodologies for Science Communication 6 Global Economies 2 Sum 8
Recommended	None

prerequisites:	
Module objectives:	<u>Empirical Research Methodologies for Science Communication:</u> Upon successful completion of this module, students will be able to: 1. differentiate between the most relevant research methods in science communication, such as different qualitative and quantitative, prospective and retrospective studies, epidemiological and experimental approaches, etc. 2. comprehend the specific strengths and limitations of different methods used in science communication research, 3. apply such research results to reflect communication campaigns and projects, and 4. appreciate the potential value of basing strategic decisions in communication upon empirical research, thus making decisions in science communication practise more 'evidence-based' <u>Global Economies:</u> Upon successful completion of this course, students will be able to: 1. explain the factors leading to differential economic performance in different countries 2. describe prevalent cultural differences and their impact on differential economic performance between regions 3. demonstrate skills in retrieving and analysing country-specific macroeconomic information 4. recognize positive and negative country performance indicators in a set of varied economic data 5. demonstrate the ability to roughly assess a country's economic situation and prospects 6. explain the concept of comparative advantage 7. explain the benefits of inter-country trade, both on a country- and on a global level 8. describe the challenges to businesses operating across borders and their alternative organization models 9. demonstrate research, observation, analytical and presentation skills

Content:	<u>Empirical Research Methodologies for Science Communication:</u> As constantly documented by journals like PUS, SC or JCOM and large-scale conferences such as PCST, science communication has long matured as a research field in its own right. Starting with rather narrow national surveys about science literacy in the 1970s, which then widened towards more attitudinal approaches from the late 1980s, today's spectrum of empirical research covers a much wider and particularly interdisciplinary range of questions. Methodologically this width inevitably results in a quite complex multitude of approaches, ranging from empirical social sciences, behavioural and decision sciences, sociology and psychology to education, political sciences and even philosophy. Understanding these methodologies, also in terms of knowing their specific strengths and limitations, is a crucial precondition for future graduates to be aware of the potential, if not the necessity of taking empirical research results into account, when making strategic decisions in communication, instead of basing such decisions mainly on intuition and personal experience. This 'science of science communication' as it has been dubbed in the U.S., so to speak 'evidence-based communication strategies' is what this course is meant to encourage and enable. In other words: to be as scientific about communication strategies as we are about the science which these strategies are meant to communicate. Additionally this course prepares students to focus their own research questions methodologically towards a potential final thesis. <u>Global Economies</u> This course covers the economic and business environments in different countries, their policies, and their performance. Students will learn where to find data about countries and how to use it to assess economic and business conditions, now and in the future. The course also touches on the challenges to businesses operating across national boundaries. Topics include: • Long-term economic performance (e.g. why is Germany more prosperous than Greece and less prosperous than Switzerland?) • What is economic development? And what is the role of international trade in it?

	• What are the challenges of doing business in China, Russia, or India? • What are short-term fluctuations (e.g. where are selected economies going to head in the next twelve months?) • How to get into and out of macroeconomic crises (e.g. what is going on in Southern Europe?). • What makes business global? The course provides perspectives and useful background for students interested in government, international business, finance, consulting, and non-profit organisations.
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector, video
Literature:	<u>Readings (Empirical Research Methodologies for Science Communication)</u> Allum, N. et al. (2008): "Science knowledge and attitude across cultures – a meta-analysis". *Public Understanding of Science*, 17. pp. 35–54. Bauer, M. / Allum, N. / Miller, S. (2007): What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda. *Public Understanding of Science*, 16, pp. 79-95 Bauer, Martin W. (2008): "Survey research on public understanding of science". In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge. pp. 111 – 128 Jensen, Eric (2016): Doing Real Research. + Video documentation from the two "Sackler Colloquia" on the "Science of Science Communication", held in Washington, 2012 and 2013. <u>Core texts (Global Economies):</u> Backus, Dave / New York University (2013): The Global Economy. Course Materials, version 2.0, last revised August 2013. New York University Stern, Center for Global Economy and Business. Cowen, Tyler / Tabarrok, Alexander (2012): Modern Principles of

	Economics. 2nd edition, Freeman. 978-1464128745 Core texts (Global Economies): Atzori, Daniel (2013): The Political Economy of Oil and the Crisis of the Arab State System (July 11, 2013). FEEM Working Paper No. 61.2013. Caballero, Ricardo J., A Caricature (Model) of the World Economy (2010): MIT Department of Economics Working Paper No. 10-17. Denis, Diane K. and McConnell, John J. (2003): International Corporate Governance. ECGI - Finance Working Paper No. 05/2003; and Tuck-JQFA Contemporary Corporate Governance Issues II Conference. Martinsons, Maris G. (2001): Comparing the Decision Styles of American, Chinese and Japanese Business Leaders: Best Paper Proceedings of Academy of Management Meetings, Washington, DC, August 2001 Schoenherr, Tobias (2013): Outsourcing Decisions in Global Supply Chains: An Exploratory Multi-Country Survey (July 9, 2013). International Journal of Production Research, 48: 2, 343-378, 2010 Sezek, Senem / Koufopoulos, Dimitrios N. (2012): Corporate Ethics Governance - The Role of Stakeholders in a Framework beyond Codes and Borders (April 20, 2012).

Communication Clinic III (Focus: Bionics)

Module title:	Communication Clinic III (Focus: Bionics)
Module code:	SCB_18
Semester:	4th Semester
Module coordinator:	Prof. Alexander Gerber
Lecturer:	• Brett Ellis • Sharon Gerber-Crawford
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h attendance 60 h preparation and review 15 h attestation preparation
Credits:	4
Recommended prerequisites:	none
Module objectives:	Upon successful completion of this module, students will be able to: 1. master the different writing styles in journalism 2. write with a refined unique 'voice' and writing style 3. use the English language creatively, as in playing with new terminologies for headlines, or modify analogies
Content:	Following up on the first and second "Communication Clinic" (SCB_3 and SCB_14), this course is meant to fulfil three functions: (a) to improve the students' advanced writing skills further, now with a particular focus and expertise in bionics (b) enable the students to use the English language creatively but also within the usual constraints of the media landscape, such as being aware of the necessities to adapt one's personal style to

	different genres, media outlets or content management systems (c) to provide personalized coaching to develop individual strengths in journalistic writing
Assessment:	Final report (10-20 pages); oral presentation (20 min.)
Forms of media:	Board and projector
Literature:	Core text Zinsser, William (2006): On Writing Well (30th Anniversary Edition). Harper Perennial. ISBN 978-0060891541. Other texts Brownlee, Shannon. (2006): "Medicine". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 155 - 161 Chase, Marilyn. (2006): "Infectious Diseases". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 162 - 167 Hall, Stephen S.. (2006): "Human Cloning and Stem Cells". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 197 - 203 Hellsten, Iina / Nerlich, Brigitte (2008): "Genetics and genomics". In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge. pp. 93 - 109 Regalado, Anton. (2006): "Human Genetics". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 189 - 196 Raeburn, Paul. (2006): "Mental Health". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 176 - 182 Squires, Sally. (2006): "Nutrition". In: Deborah Blum et al. (eds.) A field guide for science writers. New York: OUP. pp. 168 – 175

Bionics and Biomechanics (STEM VII)

Module title:	Bionics and Biomechanics (STEM VII)
Module code:	SCB_19
Courses:	Bionics III (Zoological Physics) (SCB_19.1) Fundamentals of Biomechanics (SCB_19.2)
Semester:	4th Semester
Module coordinator:	Prof. Dr.-Ing. Henning Schütte
Lecturers:	• Prof. Dr. William. Megill • Prof. Dr. Ing. Henning Schütte
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Bionics III Lecture: 2 HPW Exercise: 2 HPW Practical: 2 HPW Fundamentals of Biomechanics Lecture: 2 HPW Exercises: 1 HPW
Workload:	Bionics III 90 h attendance 30 h preparation and review 30 h exam preparation Fundamentals of Biomechanics: 45 h attendance 45 h preparation and review 30 h exam preparation
Credits:	Bionics III 5 Biomechanics 4

	Sum 9
Recommended prerequisites:	Physics of Locomotion (SCB_ 5) Physics of Sensing (SCB_11.2) Bionics I (SCB_4) Bionics II (SCB_16.1)
Module objectives:	<u>Bionics III:</u> Students learn a physicists view of life <u>Fundamentals of Biomechanics</u> Upon successful completion of this module, students will be able to: • analyse simple biomechanical systems for the flux of forces, bearing forces and deformations • analyse the mechanical strength of parts of a mechanical system • analyse the behaviour of dynamical systems, e.g. sport-mechanical systems
Content:	<u>Bionics III:</u> The primary life functions of animals, such as eating, growing, reproducing and getting around all depend on motion: Motion of materials through the body, motion of limbs and motion of the entire body through water, air and on land. These activities are driven by internal information stored in the genes or in the brain and by external information transmitted by the senses. This book models these life functions with the tools of physics. It will appeal to all scientists, from the undergraduate level upwards, who are interested in the role played by physics in the animal kingdom. <u>Fundamentals of Biomechanics</u> • Graphical methods of statics • Central systems of forces • General systems of forces • Free-body diagrams • Translation and rotation in the plane • Concept of stress • Deformation and strength of bodies • Tension rods • Material properties of bodies • Beding of beams

	• Principle of tension wiring • Fundamental principles of muscoloscelletal biomechanics • Bone structure as lightweight construction
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector, video, online research
Literature:	Core text (Bionics III): Ahlboom B-K. (2006): Zoological Physics: Quantitative Models of Body Design, Actions, and Physical Limitations of Animals Core text (Fundamentals of Biomechanics): Brinkmann P. / Frobin W. / Leiveseth G. (2002): Muscoloskeletal Biomechanics. Thieme Kerr, A. (2010): Introdutory Biomechanics. Churchill Livingstone Other texts (Fundamentals of Biomechanics): Fung, Y.C. (1990): Biomechanics – Motion, Flow, Stress and Growth. Springer Fung, Y.C. (1993): Biomechanics – Mechanical Properties of Living Tissues. Springer Beer & Johnston (2011): Statics and Mechanics of Materials. McGraw Hill Meriam, J.L. / Kraige,L.G. (2012): Engineering Mechanics – Statics 7th ed. Wiley Meriam & Kraige (2012): Dynamics, 7th ed. Wiley

Elective Course: Communication Design

Module title:	Elective Course: Communication Design
Module code:	SCB_EC_C2
Semester:	4th Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Sebastian Michailidis, Designer, Duesseldorf / Germany
Language:	English
Place in curriculum:	Elective
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h attendance 30 h preparation and review 15 h exam preparation
Credits:	3
Recommended prerequisites:	None
Module objectives:	Upon successful completion of this module, students will be able to: 1. use the basic techniques and functions of the most common tools and applications of designing media 2. combine these graphical skills with a strategic approach of determining the appropriate means of visual communication 3. organise, manage and oversee production processes and design projects, including the planning and controlling of budgets
Content:	Communication design generally seeks to increase people's motivation to respond to messages by means of graphical representations, such as illustrations, photography or typography. Ideas and information are translated through a variety of media, the choice of which is often difficult to make. This course enables students to make these distinctions, also taking strategic considerations into account by using market research and

	problem-solving techniques. In addition to learning about basic design principles, this knowledge is applied and trained in a project- and practise-oriented way. Students thereby train to combine the ‘craftsmanship’ of ‘producing’ media with strategic skills to come to the right decision. Additionally students will be introduced to ways of organizing, managing and overseeing complex design projects and production processes.
Assessment:	Presentation (20 min.); final report (ca. 10-20 pages)
Forms of media:	Board and projector, PC (particularly design applications)
Literature:	Weinschenk, Susan M. (2011): 100 Things Every Designer Needs to Know about People. Lidwell, William / Holden, Kritina / Butler, Jill (2003): Universal Principles of Design. Rockport Publishers.

Elective Course: Media Production Technologies

Module title:	Elective Course: Media Production Technologies
Module code:	SCB_EC_C3
Semester:	4th Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Louisa Field, Freelance Journalist / UK, Guest Lecturer • Prof. A. Gerber
Language:	English
Place in curriculum:	Elective
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h attendance 30 h preparation and review 15 h exam preparation
Credits:	3
Recommended prerequisites:	Science & Innovation Journalism (SCB_8)
Module objectives:	Upon successful completion of this module, students will be able to: 1. operate the most common tools and applications for producing audio-visual content 2. differentiate between audio-visual styles and formats and produce such content themselves 3. facilitate media production on a low-cost basis, particularly for freelance purposes, by using shareware applications and semi-professional equipment 4. anticipate the special requirements of TV and radio journalists at a press conference or event and organise such processes 5. brief and supervise PR service-providers for video productions 6. advice scientists wanting to produce amateur footage 7. understand the opportunities and requirements of new online formats such as videoscribes, ‘kinetic type’, slidecasts and podcasts

Content:	Irrespective of whether students intend to become science journalists or whether they want to work in other areas of communication, a basic understanding of how audio-visual media are technically produced is highly valuable to everyone in the field. PR agencies, for instance, have to be briefed and supervised properly, when they are contracted to produce image trailers or other material. Also scientists often ask the central communications department for advice, when the want to produce their own amateur footage, record lectures or design a MOOC. Journalists usually appreciate it when PR colleagues are both willing and capable of considering the specific requirements of TV and radio at a press conference or event. This course offers students the possibility to discuss and reflect such scenarios, learn about the different styles and formats, and particularly train the use of different media technologies. Students are introduced both to the processes and to the tools for producing audio-visual content. They learn about different camera and microphone systems, cutting and editing software, streaming software and low-cost freeware / shareware options for media production. Opportunities for practically applying these skills and possibly even broadcasting the results will be offered in the context of Rhine-Waal “Campus Radio” and “CampusTV”. Furthermore the course also covers online formats such as video scribes, ‘kinetic type’, slide casts and podcasts.
Assessment:	Journalistic Assignment (radio / tv piece, ca. 10 min.)
Forms of media:	Board and projector, PC (particularly media applications), digital cameras, microphones, social media
Literature:	Weinschenk, Susan M. (2011): 100 Things Every Designer Needs to Know about People. Lidwell, William / Holden, Kritina / Butler, Jill (2003): Universal Principles of Design. Rockport Publishers.

Elective Course: Data Visualisation

Module title:	Elective Course: Data Visualisation
Module code:	SCB_EC_C4
Semester:	4th Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Sebastian Michailidis, Kuen Design, Duesseldorf
Language:	English
Place in curriculum:	Elective
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h attendance 30 h preparation and review 15 h exam preparation
Credits:	3
Recommended prerequisites:	None
Module objectives:	Upon successful completion of this module, students will be able to: 1. understand the basics of the human visual system and how visual input is interpreted, appreciating that our perception of visualizations can differ, and take this into account when designing or overseeing the development of visualizations 2. identify the details of illustrations or diagrams and thereby have an eye for design problems and ways solve these 3. critically assess visualizations, identify misleading design in diagrams, and apply design principles when creating own visualizations 4. understand how the same information should be presented in different ways according to different stakeholders 5. react to the target audience and determine the appropriate level of detail in schematic illustrations 6. decide which types of data can be visualized in which types of diagrams, being aware of the different types of encoding quantitative information and know which ones are more

	effective than others
Content:	Visualizations are one of the most powerful ways to communicate complex ideas and to display data. They achieve an information density which words can hardly reach. However, in order to be efficient, visualizations should follow certain design principles. Special emphasis in this course is put on how good design can help to visually communicate science and how to avoid design mistakes which obscure the meaning rather than emphasizing it. The first part (“Seeing is believing?”) covers some basic principles of the human visual system. With the help of many examples the students will discover how visual sensory input is interpreted by the brain. On the one hand, it will be explained what the short-comings of this automatic interpretation are. On the other hand, we will see how powerful it is when we are able to intuitively draw comparisons or identify trends and outliers. In the second part (“Visualizations in detail”) we will discuss the different elements of scientific visualizations. Elements covered include the use of colour, creating patterns and salience, meeting expectations, sticking to conventions and being consistent. The target audience and on which level of detail we would like to communicate a scientific concept influences the level of abstraction which is appropriate. In this forth part (“Target Audience and Abstraction”) we will experiment with different levels of abstraction in schematic illustrations. Starting with the same story we will develop different visualizations, with different target audiences in mind. In the last part of the course (“From bar graphs to treemaps”) a review of the different types of diagrams is given. We take a look at which diagrams can be used for which data. Possible visual encoding for quantitative information is covered and it is discussed how accurately gradual differences in the underlying data are perceived. Finally, we discuss what visual integrity means and which common misleading measures should be avoided by all means.
Assessment:	Final written exam (90 min.)
Forms of media:	Board and projector, PC (particularly design applications)

Literature:	Lankow, Jason / Ritchie, Josh / Crooks, Ross (2012): Infographics – The Power of Visual Storytelling. Cases (infographics etc.) will be provided electronically: - Nobel prizes and laureates 1901-2012. - Brain Drain

Elective Course: Fundamentals of Biotechnology

Module title:	Elective Course: Fundamentals of Biotechnology
Module code:	SCB_EC_S2
Semester:	4th Semester
Module coordinator:	Prof. Dr. Neil Shirtcliffe
Lecturers:	• Prof. Dr. Neil Shirtcliffe
Language:	English
Place in curriculum:	Elective
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h Attendance 30 h preparation and review 15 h Exam preparation
Credits:	3
Recommended prerequisites:	Basics of Chemistry (SCB_6.1) Bionics I (SCB_4)
Module objectives:	Upon successful completion of this module, students will be able to: 1. understand enough biotechnology so far as to converse with biologists 2. understand sterilisation and carry out experiments under microbiologically clean conditions 3. culture bacteria 4. understand the properties of plasmids, their function and how they can be used for genetic engineering and how this relates to other genetic carriers for genetic engineering 5. consider ethical and safety questions in bioengineering, thus enabling the students to understand some of the moral implications of genetic research as well as to work safely on simple experiments
Content:	• Introduction into basic genetics • How genes effect the properties of proteins and therefore those of the whole organism

	• Preparation of cell culture media • Basic chromatography and different types of chromatography will be considered • Biochemical tests will be studied
Assessment:	Final written exam (90 min.)
Forms of media:	Board and projector
Literature:	Core text Gonick, Larry (1991): Cartoon Guide to Genetics. HarperCollins Other texts Ratledge, Colin et al. (2006): Basic Biotechnology. Cambridge UP. Khan, Firdos Alam (2011): Biotechnology Fundamentals. CRC Press

Elective Course: Natural History and Bionic Inspiration

Module title:	Elective Course: Natural History and Bionic Inspiration
Module code:	SCB_EC_S3
Semester:	4th Semester
Module coordinator:	Prof. Dr. Neil Shirtcliffe
Lecturers:	• Prof. Dr. Julian Vincent
Language:	English
Place in curriculum:	Elective
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h Attendance 30 h preparation and review 15 h Exam preparation
Credits:	3
Recommended prerequisites:	None
Module objectives:	Upon successful completion of this module, students will know the history of bionics
Content:	• Introduction to natural history • Role of natural history in bionic inspiration • Concepts of niche & species • Evolution & adaptation • Genes, demes, and heredity • Describing & measuring biodiversity • Biogeography & its rules • Organising Nat Hist knowledge • Inspiration from knowledge • TRIZ & BioTRIZ • Applying inspiration: making it work • Bioinspiration and the engineering design process

Assessment:	Final written exam (90 min.)
Forms of media:	Board and projector
Literature:	Core text A. Mukherjee (2010): Biomimetics Learning from Nature, InTech

Elective Course: Theory in Bionic Engineering

Module title:	Elective Course: Theory in Bionic Engineering
Module code:	SCB_EC_S4
Semester:	4th Semester
Module coordinator:	Prof. Dr. Neil Shirtcliffe
Lecturers:	• Prof. Dr. Julian Vincent
Language:	English
Place in curriculum:	Elective
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h Attendance 30 h preparation and review 15 h Exam preparation
Credits:	3
Recommended prerequisites:	None
Module objectives:	Upon successful completion of this module, students will be able to: Understand some of the aspects of Biomimetic materials Understand the basics of how animals use complex structures to swim Have a basic understanding of control systems
Content:	• Stiffness and flexibility in bionic structures. Why a grass stem flexes but does not break. • Flow dynamics how liquids behave. Why this is important to walruses and dolphins, dimples and turbulent wave trains • Introduction to control systems in machines and biology • Theory of functional materials, why cups shatter but bone

	does not.
Assessment:	Final written exam (90 min.)
Forms of media:	Board and projector
Literature:	Core text P. Gruber et.al. (2011):Biomimetics -- Materials, Structures and Processes, Springer

Sustainable Futures (COMM IX)

Module title:	Sustainable Futures (COMM IX)
Module code:	SCB_20
Courses:	• Sustainability in Science and Industry & Corporate Social Responsibility (SCB_20.1) • Communicating Ethical, Legal, and Social Issues in Science (ELSI) (SCB_20.2)
Semester:	5th Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Prof. Alexander Gerber • René´von Schomberg, European Commission / Belgium
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Sustainability in Science and Industry & CSR Lectures: 3 HPW Exercises: 1 HPW Communicating Ethical, Legal, and Social Issues in Science Lectures: 1 HPW Practical: 1 HPW
Workload:	Sustainability in Science and Industry & CSR 60 h Attendance 45 h preparation and review 15 h Exam preparation Communicating Ethical, Legal, and Social Issues in Science 30 h attendance 30 h preparation and review 30 h exam preparation
Credits:	Sustainability in Science and Industry & CSR 4 Communicating Ethical, Legal, and Social Issues in Scienc 3 Sum 7

Recommended prerequisites:	Global Economies (SCB_17.2) Political Communication: Systems, Policies, Public Affairs (SCB_7.1)
Module objectives:	<u>Sustainability in Science and Industry & CSR</u> Upon successful completion of this module, students will be able to: 1. reflect the concept of sustainability in its historical context 2. link the ecological concept holistically with the socio-political challenges and economic issues involved 3. put case studies into the context of common theoretical models for sustainability 4. incorporate their understanding of standards such as "Fairtrade" or UTZ into communication strategies 5. reflect the historical development of sustainably, including the philosophical and methodological frameworks of Sustainability Science 6. deal with different kinds of measuring and reporting about sustainability 7. develop strategies for Corporate Social Responsibility (CSR), including considerations of reputation management and ethical compliance 8. link specific business strategies to CSR and RRI in order to acquire a "social license" <u>Communicating Ethical, Legal, and Social Issues in Science</u> Upon successful completion of this module, students will be able to: 1. comprehend the challenges and opportunities of communicating ethical, legal and social implications (ELSI) actively 2. communicate science and technology responsibly, particularly in industrial contexts and for politicised issues, thereby responding to the paradigm of “RRI” 3. act as trustworthy mediators between societal and institutional interests
Content:	<u>Sustainability in Science and Industry & CSR</u> Often the concept of sustainability is seen as being limited to ecology, reflecting how biological systems remain diverse and productive. The mimicry of biological systems, however, which are regarded as sustainable ‘by nature’, enable us to widen this

	perspective, particularly in an economic or political sense, i.e. the endurance of systems and processes in general. It is this holistic view of sustainability which our course intends to encourage: students reflect the concept as a socio-political challenge which also includes aspects of international policy-making and standardisation, urban planning and logistics, lifestyles and ethical consumerism. Theoretical models such as the one illustrated by the Venn diagram are used to discuss the confluence of 'bearable', 'equitable' and 'viable' development. We look at how different stakeholders apply scientific knowledge for making agriculture, architecture, energy systems and other areas more sustainable. Highly politicised issues, such as climate change, overconsumption, or the concept of striving for economic growth, are discussed in role plays. Students learn to analyse how standards such as "Fairtrade" or the UTZ certification refer to the concept of the three pillars of sustainability by using science for evidence-based reasoning in public communication. We critically review historical developments which illustrate the pitfalls of not acting sustainably, e.g. depending on fossil fuels first in the so-called Industrial Revolution, then during the energy crises in the 1970s, and now in the context of climate change. This is explicitly being analysed in a global context, particularly regarding the fact that environmental degradation is mainly driven by issues of poverty and inequality. Furthermore the course traces the philosophical and methodological frameworks of Sustainability Science back to their historical roots, from the "I=PAT" formula to today's attempts of simulating the global biosphere. Based on these insights into sustainability as an environmental, political and socio-economical issue, students are introduced to different kinds of measuring and reporting in this area, such as indexes of national sustainability governance (ESI, EPI, HPI, etc.), the concept of "Carbon Footprint", including biodiversity initiatives like MEA, such as well as audits and corporate reports. Industrial PR, in particular, increasingly uses such reports to demonstrate Corporate Social Responsibility (CSR), which this course finally focusses on by approaching CSR not only from a branding point of view but also in a wider context of reputation

	management, considering the criticism of presumed corporate self-regulation and ethical compliance as 'window-dressing'. We look at how concepts like the "Tripe P" bottom line are meant to link business strategies to CSR in the context of acquiring a "Social license" in order to improve technology acceptance. Students will learn how RRI sometimes explicitly acknowledges trade-offs between short-term profitability and social or environmental goals. Communicating Ethical, Legal, and Social Issues in Science Communicating science and technology in today's complex stakeholder environments involves responsibilities which may easily clash with institutional interests, particularly in the for-profit industrial context. Therefore "Responsible Research and Innovation" (called "RRI" in the context of EU-funding policies) requires appropriate means of proactively communicating the ethical, legal and social implications (ELSI) of science. Compared to former concepts of marketing science and technology, today's challenge lies in an authentic and trustworthy mediation between societal and institutional interests in the context of Open Science and Open Innovation. Based on case studies and trained by means of role plays, the students in this course will be enabled to develop personal strategies for reflecting such 'ELSI' issues in their future communication practise
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector
Literature:	Core texts: Adams, W.M. (2006): The Future of Sustainability – Re-thinking Environment and Development in the Twenty-first Century. – Report of the IUCN Renowned Thinkers Meeting, 29–31 January 2006. Porter, Michael / Kramer, Mark (2006): "The Link Between Competitive Advantage and Corporate Social Responsibility". Harvard Business Review Other texts:

	Bakari, Mohamed El-Kamel. (2014). “Sustainability's Inner Conflicts: From 'Ecologism' to 'Ecological Modernization'.” *Journal of Sustainable Development Studies* 6(1): 1-28. Barnett, Michael (2014): “The new CSR -- This time it's profitable.” *Marketing Week*. Brower, M. / Leon, W. (1999): The Consumer's Guide to Effective Environmental Choices – Practical Advice from the Union of Concerned Scientists. New York, Three Rivers Press. Brundtland Commission / UN (1987): “Our Common Future, From One Earth to One World”. United Nations. Huesemann, M.H. / Huesemann, J.A. (2011): Technofix -- Why Technology Won’t Save Us or the Environment. Canada, New Society Publishers Meadows, D.H. et al. (1972): The Limits to Growth. New York, Universe Books Scott Cato, M. (2009): Green Economics. London, Earthscan Turner, Graham (2008): “A comparison of 'The Limits to Growth' with thirty years of reality”. Commonwealth Scientific and Industrial Research Organisation Sustainable Ecosystems United Nations General Assembly (2005): Resolution A/60/1. University of Michigan (2012): “Fact Sheets”. Center for Sustainable Systems. Visser, Wayne et al. Eds. (2007): The A to Z of Corporate Social Responsibility. New York, Wiley…

Foresight and Conservation (SWITCH II)

Module title:	Foresight and Conservation
Module code:	SCB_EC_C6/S6
Courses:	• Technology Assessment & Corporate Foresight, Storytelling & Science Fiction • Ecology and Conservation
Semester:	5th Semester
Module coordinator:	Prof. Alexander Gerber / Prof. Dr. William Megill
Lecturers:	• Prof. Alexander Gerber • René von Schomberg, European Commission / Brussels
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Lectures: 2 HPW Exercises: 2 HPW
Workload:	60 h attendance 60 h preparation and review 30 h exam preparation
Credits:	5
Recommended prerequisites:	For Technology Assessment: Political Communication (SCB_7.1) For Ecology and Conservation: Bionics I (SCB_4) and Bionics II (SCB_16.1)
Module objectives:	<u>Technology Assessment:</u> Upon successful completion of this module, students will be able to: 1. understand the processes and methods of assessing new technologies and developing corporate long-term technological perspectives 2. apply this knowledge to strategies for public communication and Science Advocacy, including participatory approaches 3. develop scenarios for communication by using the storytelling

	method and relating to best practises from science fiction Ecology and Conservation By the end of the module students should be able to: 1. Safely conduct ecological fieldwork. 2. Explain the structure and process in ecosystems. 3. Evaluate the changes in habitat structure in an ecosystem due to natural succession and understand the extent to which conservation management is the management of successional processes. 4. Assess the relative importance of abiotic factors influencing ecosystems in contrast to biotic factors from within the systems. 5. Make a balanced assessment of the conflicts between conservation and other competing land uses. 6. Appreciate the nature of landscape ecology and the importance of spatial relationships of such features as corridors & mosaics. 7. Adopt a global attitude towards natural ecosystems in biomes and the large-scale processes which govern their diversity
Content:	Technology Assessment: Considering that science and innovation are inevitably oriented towards solutions for the future, their public communication also relies heavily on framing this progress in appropriate ways. Four dimensions of doing so are covered in this course: First, we analyse the processes and methods which governmental bodies use to assess the opportunities and risks of new technologies, including issues of evidence-based policy-making and regulatory processes. By looking at the communication between NGOs, industry and policy-makers on the one hand, and the public research institutions they assign to conduct “Technology Assessment” (TA), on the other, we address the increasingly important topic of “Science Advocacy”. Another main aspect of TA, discussed in this course, is the so-called “Collingridge Dilemma”, which describes the difficulties of predicting the impact of a technology until it is more or less fully developed or even widely used, on the one hand, and the difficulties to regulate and standardise a technology or even influence its development once it was communicated publicly, on the other. With their background in “Public Engagement” methods, students are also introduced to Participatory TA with

	stakeholders and/or lay-people. As a second dimension, mainly from an industrial perspective, but nowadays just as relevant for larger research institutions such as MIT or Fraunhofer, TA is closely connected to “Corporate Foresight”, which this course not only covers as a process but also as a source or even means of public communication, as in Siemens’ “Pictures of the Future” series. Assessing future technologies and developing long-term corporate perspectives, always involves scenarios, which in one way or another, internally and/or externally have to be communicated. This is where the “Storytelling” method and the “Science Fiction” genre in particular come into play, which are both also trained practically in the course. <u>Ecology and Conservation</u> 1. Abiotic factors and their effects 2. Sil formation and structure. 3. Physical effect of solar radiation on water bodies - Lake stratification and mixing; oxygen distribution as a result of euphotic zone. 4. Seasonal change which results leading to the “paradox of the plankton”. 5. Downstream changes in river ecosystems expressed as “the river continuum concept” 6. Intertidal systems structured according to the physical pressures of disturbance, salinity, exposure (key information is expressed in in the kite diagrams of gradients). 7. “Competition exclusion principle” – examples from rocky shore barnacles, rock pool winkles, planktonic algae.
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector, video, online research, editing of an interactive online time-line
Literature:	<u>Readings (Technology Assessment & Corporate Foresight, Storytelling & Science Fiction)</u>: Huesemann, Michael H. & Huesemann, Joyce A. (2011): “The Positive Biases of Technology Assessments and Cost Benefit Analyses” (Chapter 8) In: Technofix – Why Technology

	Won't Save Us or the Environment. Canada, New Society Publishers Hu, Jane (2012): The future as foretold in the past. Additionally infographics will be provided electronically van Est (2010): "Technology assessment as an analytic and democratic practice". In: Encyclopaedia of Applied Ethics.

Communication Project II (Focus: Engineering)

Module title:	Communication Project II
Module code:	Communication Project II SCB_21 Mechanical Engineering: ME_26 Mechatronic Systems Engineering: SE_26 Industrial Engineering: IE_26 Electronics: EL_26
Semester:	5th Semester
Module coordinator:	Prof. Alexander Gerber Prof. Dr. Neil Shirtcliffe
Lecturers:	(Depending on the project)
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Project work: 4 HPW
Workload:	60 h attendance 120 h preparation and review
Credits:	6
Recommended prerequisites:	Global Economics (SCB_17.2)
Module objectives:	Upon successful completion of this module, students will be able to: 1. work on solutions for a given task in teams (in exceptional cases individually) 2. create a functional specifications document and calculate project costs and necessary capacities 3. present their self-designed concepts to their clients and are able to defend these concepts 4. react constructively to suggestions and criticism and further develop their approaches into a marketable product 5. determine implementation and product costs and are able to estimate market potentials

	6. contact suppliers and decide on purchase of material and components 7. master documenting and presenting the results and thereby interact with potential customers, including considerations about the launch strategy, PR events, etc.
Content:	Contents are course- and project-specific
Assessment:	Final report (10-20 pages); oral presentation (20 min.)
Forms of media:	Board and projector
Literature:	Course- and project-specific

Materials & Nature (STEM VIII)

Module title:	Materials & Nature (STEM VIII)
Module code:	SCB_22 BM_2
Courses:	• Bionics of Surfaces (SCB_22.1) • Ecology of Materials (SCB_22.2)
Semester:	5th Semester
Module coordinator:	Prof. Dr. Neil Shirtcliffe
Lecturers:	• Prof. Neil Shirtcliffe • Prof. Matthias Kleinke
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	<u>Bionics of Surfaces</u> Lecture: 2 SWS Practicals: 1 SWS <u>Ecology of Materials</u> Lecture: 2 SWS
Workload:	<u>Bionics of Surfaces</u> 45 h Attendance 30 h preparation and review 15 h Exam preparation <u>Ecology of Materials</u> 30 h Attendance 15 h preparation and review 15 h Exam preparation
Credits:	Bionics of Surface 3

	Ecology of Materials 2 Sum 5
Recommended prerequisites:	Basics of Chemistry (SCB_6.1)
Module objectives:	<u>Bionics of Surface</u> Upon successful completion of this module, students will be able to: 1. compare natural and artificial solutions in surface preparation 2. identify and understand to some extent the driving forces for top down and bottom up structuring 3. basically understand soft materials and how they interact with the environment <u>Ecology of Materials</u> Upon successful completion of this module, students will be able to: 1. identify ecological aspects for the design of substances and materials 2. allocate material properties and applicability for the materials 3. understand the ecological compatibility for different materials 4. recognise that the knowledge of the material properties is decisive for the selection of an appropriate one from the range of materials 5. ecologically evaluate a “bio” product
Content:	<u>Bionics of Surfaces</u> • Superhydrophobicity as an effect (howtextures are formed in plants; how it is formed in animals; how it can be copied using similar or different methods) • Directional wetting • Antireflection • Adhesion • Exchange surfaces • Redox adhesives • Silk <u>Ecology of Materials</u> • Ecological basics for the design with materials and substances • Overview of industrial application of substances with regard

	to the “objects of protection” air, water, soil • Handling harmful substances • Methods for pollution-free environment • Basics of product and product-integrated environmental protection • Basics of recycling management and ist application • Ecological consequences when using different substances / materials
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector
Literature:	Core text (Bionics of Surfaces) Kumar, Challa (2010): Biomimetic and Bioinspired Nanomaterials. Wiley VCH Gorb, Stanislav (2007): Functional Surfaces in Biology. Springer Core texts (Ecology of Materials) Bank, Matthias (2006): Basiswissen Umwelttechnik – Wasser, Luft, Abfall, Lärm und Umweltrecht. Vogel-Verlag Schwister, Karl (2009): Taschenbuch der Umwelttechnik. Carl Hanser-Verlag Other texts (Bionics of Surfaces) Mann, Stephen (1996): Biomimetic Materials Chemistry. VCH

Elective Course: Communicating Social Science and Humanities

Module title:	Elective Course: Communicating Social Science and Humanities
Module code:	SCB_EC_C7
Semester:	5th Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Angela Cassidy
Language:	English
Place in curriculum:	Elective
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h attendance 60 h preparation and review 15 h exam preparation
Credits:	4
Recommended prerequisites:	None
Module objectives:	Upon successful completion of this module, students will be able to: 1. reflect the berries, deficits and opportunities of communicating social sciences and humanities, compared to STEM 2. identify different patterns of media coverage depending on the discipline in question 3. incorporate the concept of the 'public intellectual' in communication strategies 4. consider social science communication in journalism or PR as a concrete career option
Content:	Compared to STEM and technology in general, the communication of social sciences and humanities is very much a fringe phenomenon both in PR practise and in communication research. By limiting science communication mainly to physical, chemical, biological, medical and engineering sciences, communicators risk that they don't do justice to science in wider

	sense. Obviously most universities encompass social science faculties as well. As content analyses indicate, special-interest media coverage differs between so-called 'hard' and 'soft' sciences not only in quantity but also in terms of a 'mainstream' pattern in which results and researchers are often covered. This course analyses how broader, non-specialist media covers social sciences (e.g. crime figures, census data, political theory) without earmarking this as science coverage. The same goes for 'public intellectuals' who over-proportionally stem from humanities, often without being identified by recipients as scientists. Students analyse institutional and structural barriers to the public communication of social sciences. We discuss the different images of disciplines, both reflected in academia and in popular culture, and develop strategies of how to respond in communication. By making students aware of the deficits and pitfalls of communicating social sciences, this course specifically encourages and prepares them for such career prospects.
Assessment:	Presentation (20 min.); final report (ca. 10-20 pages)
Forms of media:	Board and projector
Literature:	Böhme-Durr, K. (1992): "Social and natural sciences in German periodicals". In: Communications – The European Journal of Communication Research, 17. pp. 167–76 Cassidy, Angela (2008): "Communicating the social sciences". In: Massimiano, Bucchi / Brian, Trench. Handbook of Public Communication of Science and Technology. Routledge. pp. 225 – 236 ESRC (2005): "Communications Toolkit". Economic and Social Research Council. Schmierbach, M. (2005): "Method matters: the influence of methodology on journalists' assessments of social science research". In: Science Communication, 26. pp. 269–87

Elective Course: Intercultural Communication

Module title:	Elective Course: Intercultural Communication
Module code:	SCB_EC_C8
Semester:	5th Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Prof. Alexander Gerber
Language:	English
Place in curriculum:	Elective
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h attendance 60 h preparation and review 15 h exam preparation
Credits:	4
Recommended prerequisites:	None
Module objectives:	Upon successful completion of this module, students will be able to: 1. prepare themselves and others for potential communication problems when interacting with people from different cultures 2. comprehend that such misunderstandings occur just as much within organizations as they do between countries 3. anticipate how certain people will possibly encode, transmit and interpret messages differently 4. take customs and cultural traditions into account when localising communication camapigns 5. make use of the relevance of nonverbal communication particularly in intercultural contexts 6. apply auditing frameworks such as ICCA 7. put challenges about intercultural communication into a theoretical context
Content:	This course addresses the challenges associated with sharing knowledge across cultures. Students learn that misunder-

	standings are by no means limited to occurring between countries, but are just as relevant for internal communication within organizations with people from different religious, social, ethnic, and educational backgrounds. We analyse to which extent culture can determine how individuals encode messages, what medium they choose for transmitting them, and the way messages are interpreted. Case studies illustrate that, in addition to language issues, intercultural communication also includes customs and traditions, general thought patterns, beliefs and expectations. Students train in role plays how to deal with such causes for intercultural problems, focussing particularly on nonverbal communication. The course also covers auditing frameworks such as ICCA, and relevant theories such as Trevisani's four dimensions of intercultural empathy.
Assessment:	Presentation (10 min.); final report (ca. 15-30 pages)
Forms of media:	Board and projector
Literature:	Lauring, Jakob (2011): "Intercultural Organizational Communication -- The Social Organizing of Interaction in International Encounters". In: Journal of Business and Communication 48.3. pp. 231–255 Trevisani, Daniele (2005): Intercultural Negotiation -- Communication Beyond Cultural Barriers. Franco Angeli Wiseman, Richard L. (1995): Intercultural Communication Theory. Sage

Elective Course: Moderation Techniques

Module title:	Elective Course: Moderation Techniques
Module code:	SCB_EC_C9
Semester:	5th Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	• Prof. Alexander Gerber • Quentin Cooper, BBC
Language:	English
Place in curriculum:	Elective
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h attendance 60 h preparation and review 15 h exam preparation
Credits:	4
Recommended prerequisites:	None
Module objectives:	Upon successful completion of this module, students will be able to: 1. chair and moderate different forms of discussions and events 2. animate und involve the plenary in panel discussions 3. apply certain questioning techniques to provoke authentic answers and statements from experts on stage 4. develop a personal, unique style of moderating
Content:	Some journalists have very successfully discovered that moderating an international conference panel or acting as a host at a prestigious launch event can be a lucrative way of earning extra money with comparatively little effort, particularly for free-lancers suffering from insufficient and irregular payment via classical publishing. Some science journalists meanwhile even earn most of their income from such assignments, mainly on the

	basis of further personal recommendation. In terms of self-marketing, being a moderator also sharpen one's personal profile and increases visibility within the community, particularly by focussing on events in the same field. Often the moderator can access networks which are otherwise closed, and make high-level contacts, most of which are at the same time potential interviewees or sources for exclusive stories. Last but not least such occasions offer the opportunity to travel, visit interesting locations and possibly combine the paid trip with interviews or photo shootings in the area. Being good at moderating, however, means more than just chairing a session, time-keeping and organising a couple of questions from the plenary. Good moderators are known for being able to put elaborate statements into a nutshell, and linking different presentations with humour and some valuable information instead of just introducing the next speaker. Good moderators manage to lure even panel-experienced experts out of their comfort zone by posing a thought-provoking question at the right time. These skills are exactly what this course is covering. After having learned and experimented with the basic rules, the students train the more sophisticated forms of moderating by means of role plays, which may be recorded for later video-analysis. In addition to classic formats such as panel discussions, keynote sessions or award ceremonies, this course also covers more modern formats such as "fish-bowls" or "science slams".
Assessment:	Presentation (30 min.)
Forms of media:	Board and projector, camera equipment

Elective Course: Fundamentals of Electrical Engineering

Module title:	Elective Course: Fundamentals of Electrical Engineering
Module code:	SCB_EC_S7
Semester:	5th Semester
Module coordinator:	Prof. Dr.-Ing. Gerrit Gehnen
Lecturers:	• Prof. Dr.-Ing. G. Gehnen
Language:	English
Place in curriculum:	Elective
Timetabled hours:	Exercises: 3 HPW
Workload:	Electrical Engineering 45 h attendance 45 h preparation and review 30 h exam preparation
Credits:	4
Recommended prerequisites:	Physics of Locomotion (SC_5) Physics of Sensing (SCB_11.2) Mathematics I (SCB_6.2) Mathematics II (SCB_10)
Module objectives:	Electrical Engineering: Upon successful completion of this module, students will be able to: 1. apply the fundamental laws of Electrical Engineering 2. understand the dangers originating from electric current 3. analyse networks of passive linear components as well as to calculate currents and potentials in these networks 4. calculate transient processes in capacitors and inductances by means of ordinary differential equations 5. understand alternating currents, and thereby label and estimate frequency-dependent behaviour of a circuit
Content:	Electrical Engineering: • General introduction to Electrical Engineering, historical

	backgrounds • Electrostatics: atoms, electrons and charge • Coulomb‘s law • Current as charge movement • Electric potential and voltage • Resistors, Ohm’s law • Electric safety • Series and parallel circuit of resistors • Kirchhoff’s laws • Mesh Analysis • Electric power and energy • Heterodyne principle • Thevenin’s theorem, alternative sources • Fundamentals of capacitors • Transient processes at capacitors • Induction law • Inductivities and their Analoguey to capacitors • Transient processes at inductivities • Fundamentals of alternating currents engineering • Calculating with complex numbers in alternating currents engineering, pointer indication • Root mean squares and peak values • Calculation of impedance and admittance • Networks in complex notation, phasor • Energy and power in alternating current nets • Frequency-dependent behaviour (The learned abilities are trained and attested in accompanying tutorials and in the laboratory.)
Assessment:	Final written exam (90 min.)
Forms of media:	Board and Projector / Laboratory
Literature:	Core texts (Electrical Engineering) Boylestad, R.L. (2010): Introductory Circuit Analysis, 12th edition. Pearson Hagmann, G. (2011): Grundlagen der Elektrotechnik (Fundamentals of Electrical Engineering), 15th edition. AULA Verlag

	Incl. “Aufgabensammlung zu den Grundlagen der Elektrotechnik” (Set of exercises regarding Fundamentals of Electrical Engineering), 14th edition. AULA Verlag, 2010. <u>Other texts (Electrical Engineering):</u> Course materials from the lecturer Laboratory documents und exercises from the lecturer

Elective Course: Materials in Biomimetics

Module title:	Elective Course: Materials in Biomimetics
Module code:	SCB_EC_S8
Semester:	5th Semester
Module coordinator:	Prof. Dr. Neil Shirtcliffe
Lecturers:	• Prof. Dr. Neil Shirtcliffe
Language:	English
Place in curriculum:	Elective
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h attendance 45 h preparation and review 30 h exam preparation
Credits:	4
Recommended prerequisites:	Basics of Chemistry (SCB_6.1)
Module objectives:	Upon successful completion of this module, students will be able to: 1. understand the importance of hierarchy in biomaterials and nanomaterials 2. investigate structure-function relations in materials in nature and science 3. consider the shapes and chemistry of structures and how they function 4. understand the basics of smart materials
Content:	• Toughness and strength, how they are related in bulk and in nano-materials • Crack propagation and pressure sensitive adhesives • How dispersions are made, what properties define them and how nature makes them • Anisotropic materials for load • The chemistry of degradation, hydrolysis and strength

Assessment:	Final written exam (90 min.)
Forms of media:	Board and projector / Laboratory
Literature:	Core text Mann, Stephen (1996): Biomimetic Materials Chemistry. VCH Wiley Other texts Hudgins, Kate A. / Dillow, Angela K./ Lowman, Anthony M. (2002): Biomimetic Materials And Design, Biointerfacial Strategies, Tissue Engineering And Targeted Drug Delivery. Taylor and Francis Santin, Matteo / Phillips, Gary (2012): Biomimetic, Bioresponsive, and Bioactive Materials. Wiley

Elective Course: Biothermodynamics and Architecture

Module title:	Elective Course: Biothermodynamics and Architecture
Module code:	SCB_EC_S9
Semester:	5th Semester
Module coordinator:	Prof. Dr.-Ing. Joachim Gebel
Lecturers:	• Prof. Dr.-Ing. Joachim Gebel
Language:	English
Place in curriculum:	Elective
Timetabled hours:	Exercises: 3 HPW
Workload:	45 h attendance 45 h preparation and review 30 h exam preparation
Credits:	4
Recommended prerequisites:	Basics of Chemistry (SCB_6.1) Physics of Locomotion (SC_5) Physics of Sensing (SCB_11.2) Mathematics I (SCB_6.2) Mathematics II (SCB_10)
Module objectives:	Upon successful completion of this module, students will be able to: 1. understand the terminology of intensive and extensive state variables (temperature, pressure, density or enthalpy, entropy, exergy and anergy) and are able to apply them correspondingly 2. apply the first and second law of thermodynamics for solving thermodynamic problems 3. analyse thermodynamic cycles 4. analyse vapour and gas power systems such as car engines or gas turbines and to determine thermal efficiencies
Content:	• detailed elaboration of the fundamentals of thermodynamics • first and second law of thermo-dynamics • thermodynamic processes like vapour and gas power

	systems, refrigeration and heat pump systems
Assessment:	Final written exam (120 min.)
Forms of media:	Board and projector / Laboratory
Literature:	Core text (Biothermodynamics) Moran, Michael J. / Shapiro, Howard (2010): Fundamentals of Engineering Thermodynamics, SI-Version. Other texts (Biothermodynamics) Balmer, Robert (2011): Modern Engineering Thermodynamics Cengel, Yunus A. / Boles, Michael A. (2010): Thermodynamics – An Engineering Approach, 7th edition in SI-Units Borgnakke, Claus / Sonntag, Robert E. (2012): Fundamentals of Thermodynamics, International Student Version, 7thedition.

Module „Internship or Semester abroad“

Module name:	Internship or Semester abroad
Module code:	SCB_23
Semester:	6th Semester
Module coordinator:	Prof. Alexander Gerber Prof. Dr. Neil Shirtcliffe
Lecturer:	Supervisor of the internship or Head of Study course
Language:	English
Place in curriculum	Core
Timetabled hours:	none
Workload:	900 h
Credits:	30
Module objectives:	Students spend either 20 weeks or more in a real science communication work environment or study for one semester, applying their previously acquired knowledge, skills and methods. Both the semester abroad and the work-placement need to be in the context of the curriculum, and in an English-speaking context. Either way. the students are expected to also benefit profoundly from the intercultural experience and thereby will significantly improve their language skills. The students also learn how to deal with office matters, project management practice, and intercultural communication.
Content:	The contents of the work-placement are based on the business activities and the business environment of the company, whereas the content of a semester abroad cater more to the interests of the individual student. Contents / tasks during the time abroad are closely coordinated in advance between the partner university / institution and the Examination Board at Rhine-Waal.
Assessment:	Internship report (30 CP)

Module "Practical Science Communication Skills Application"

Module name:	Practical Science Communication Skills Application
Module code:	SCB_24
Semester:	7th Semester
Module coordinator:	Prof. Alexander Gerber
Lecturer:	• Prof. Alexander Gerber
Language:	English
Place in curriculum	Core
Timetabled hours:	None
Workload:	180 h
Credits:	6
Recommended prerequisites:	Introduction to Science Communication (SCB 1.2) Science & Innovation Journalism, Freelancing (SCB_8)
Module objectives:	Students apply what they have learned so far in their degree course in practice. They propose science communication projects themselves or are otherwise provide with a choice of projects. The module gives them the opportunity to gain first-hand experience.
Content:	The contents of the projects are different for every student and cater most effectively to her / his talents, interests, and skills.
Assessment:	Documentation of project results

Workshop: Scientific Methods

Module title:	Workshop Scientific Methods
Module code:	SCB_25
Semester:	7th Semester
Module coordinator:	Prof. Dr. Neil Shirtcliffe Prof. Alexander Gerber
Lecturers:	Lecturers to be defined
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	Seminar: 4 HPW
Workload:	60 h attendance 90 h preparation and review 30 h exam preparation
Credits:	6
Recommended prerequisites:	None
Module objectives:	Upon successful completion of this module, students will be able to: 1. understand to the ethics and logic of science 2. differentiate between the most relevant methods helpful for the investigation of technical questions 3. understand their ethic responsibility as a scientist and reflect their work based on social impacts and scientific rules 4. understand scientific misconduct like fabrication, falsification, copyright violation, wrong citation, plagiarism, violation of ethical standards etc. 5. get a full overview over their topic and use literature research for this 6. practically implement their knowledge on a scientific question 7. be aware of the differences between theory and empiricism

	as well as between deductive and inductive reasoning 8. reflect their work accordingly 9. structure their test program (in case experimental validations of phenomena are required) using design of experiments 10. evaluate the limits for testing 11. define and rate the required simplifications 12. analyse research results statistically and reflect them critically in order to evaluate the quality of the results 13. prepare the results specific to a target groups
Content:	Methodological principles encompass the entire process of the scientific questioning: • Science ethics (what is allowed, what shall remain unexplored) • Ethical standards in science • Social impacts of science • Analysis of the scientific question • Literature research • Definition state of the art • Introduction to the logic of science • Inductive vs. deductive reasoning • Formulation of hypotheses • Verification and falsification of hypotheses • Degree of testability • Simplification and probability • Design of experiments • Numerical and graphical data analysis • Descriptive and analytical statistics • Presentation of data / results Publication of the results in different forms (report, paper, poster, web pages etc.)
Assessment:	Presentation (20 min.); final report (ca. 10-20 pages)
Forms of media:	Board and projector

Literature:	Core text Popper, Karl R. (2004): The Logic of Scientific Discovery. Taylor & Francis Montgomery, Douglas / Runger, George (2011): Applied Statistics and Probability for Engineers. SI Version. 5th edition. Wiley Other texts: Vining, Geoffrey / Kowalski, Scott (2011): Statistical Methods for Engineers. 3rd edition. Brooks/Cole. Montgomery, Douglas (2005): Introduction to Statistical Quality Control. 5th edition. Wiley

Bachelor Thesis (3 months)

Module title:	Bachelor Thesis
Module code:	SCB_26
Semester:	7th Semester
Module coordinator:	Prof. Alexander Gerber, Prof. Neil Shirtcliffe
Lecturers:	Dependant on the thesis / project
Language:	English
Place in curriculum:	Core subject
Workload:	360 h
Credits:	12
Recommended prerequisites:	Min. 175 credit points in the respective courses
Module objectives:	Upon successful completion of this module, students will be able to: 1. demonstrate their capability to work independently on a subject in alignment with their course of studies, meeting all topical and scientific requirements in a pre-defined period of time 2. organize their workflow in order to meet the demands of the problems formulated in their theses, as well as to monitor progress and make necessary amendments 3. are able to document their approach and their results to meet the requirements of a scientific publication
Content:	Content is aligned with the content of the Bachelor Thesis, in addition methodological discussions
Assessment:	Written thesis in the range of 50 - 100 DIN A4 pages
Forms of media:	Document

Colloquium

Module title:	Colloquium
Module code:	SCB_27
Semester:	7th Semester
Module coordinator:	Prof. Alexander Gerber
Lecturers:	Dependant on the thesis / project
Language:	English
Place in curriculum:	Core subject
Timetabled hours:	(to be defined)
Workload:	90 h
Credits:	3
Recommended prerequisites:	Min. 207 Credits
Module objectives:	Upon successful completion of this module, students will be able to: 1. defend the results of the Bachelor Thesis 2. place their work in a context of practical applications 3. present their results in a proper form for the audience 4. motivate their approach and make estimations, how assumptions and simplifications may affect the validity of their results 5. are able to analyse questions concerning their thesis and results and answer them properly in the context of professional and extra-professional reference
Content:	Content is aligned with the content of the Bachelor Thesis, in addition methodological discussions
Assessment:	Final exam (oral)