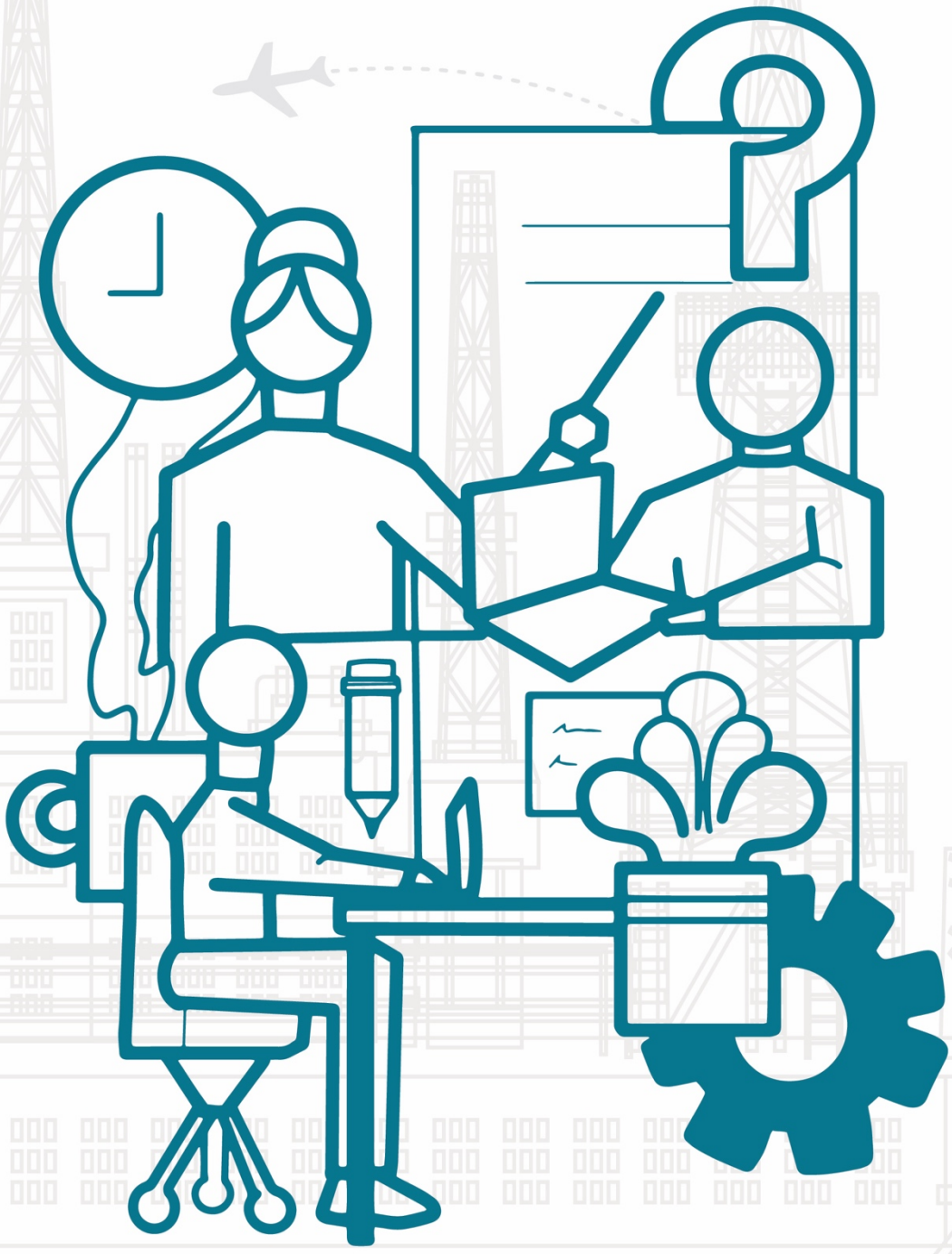
HUMAN FACTORS & ERGONOMICS

SYLLABUS FOR INDIAN UNIVERSITIES

M. Tech./ M. S./ M. Des./ M. Eng./ Ph. D.



Vivek Kant, Prathamesh Bachche, Rammohan Maikala (Eds.)

Human Factors and Ergonomics: Syllabus for Indian Universities

M.Tech./M.S./M.Des./M.Eng./Ph.D.

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FOREWORD

As noted in the executive Summary, "Human Factors (HF) and Ergonomics (E) is a discipline dedicated to enhancing the health, safety and well-being of people in terms of design, maintenance, management, regulation, and governance of technology and other systems and their interactions with humans." The holistic approach exemplified in this syllabus to the Human Factors and Ergonomics profession will create, in conjunction with other academic disciplines, trained practitioners for those areas that will see particular growth and emphasis in India and indeed the world. These areas include usability, health care, rehabilitation, and humans in complex systems and extreme environments all while providing considerable breadth and depth in the basic knowledge and practice of human factors and ergonomics. In addition to the thorough preparation of practitioners with MS degrees, the program should also provide an outstanding basis for future Ph.D. students in India. This should also serve to grow the academic strength of human factors and ergonomics programs in India's universities and of its practice in India's industry, services and government.

Robert Fox, Ph.D.

Michigan, USA

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Executive Summary

As India moves towards the "Vision 2047" in a quest for a better future, there is a growing need for the design of human-centered science, technology, and infrastructure to enable well-being, safety, and productivity for Indians. Human Factors and Ergonomics is one scientific discipline that supports people's health, safety, and well-being in the design, maintenance, management, regulation, and governance of a human-centered approach to technology and other systems. Although the importance of Human Factors and Ergonomics is acknowledged globally, India finds itself on the periphery of this essential development compared to mainstream fields in India: Engineering (e.g., Mechanical Engineering, Biomedical Engineering, Industrial Engineering), Physiology (e.g., Human Physiology), and Psychology (e.g., Educational Psychology, Clinical Psychology, Organizational Psychology). Due to the lack of disciplinary educational and training programs that address the totality of the discipline, specifically in the Indian sub-continent, there is a need for capacity building in the academic sector for training the next generation of Human Factors and Ergonomics practitioners.

While covering the breadth of the discipline, this sample syllabus also provides a foundation for Indian universities, and it can be creatively adapted to suit the specific masters degree programs beyond India. Thus, this syllabus provides a basis for the academic programs supporting next-generation Human Factors and Ergonomics professionals in their quest for a safe, productive, human-centered, sustainable future. The syllabus is also curated by considering the need for quality education and training in Human Factors and Ergonomics for achieving some of the 17 Sustainable Development Goals set by the United Nations in 2015 as part of the 2030 Agenda for Sustainable Development (e.g., Good Health and Well-being, Quality Education, Gender Equality, Decent Work and Economic Growth, Industry, Innovation, and Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, and Partnerships for The Goals). In summary, this book should serve as the premier source to grow the academic strength of human factors and ergonomics programs in India's universities and its practice in India's industry, services, and government.

1. Introduction

Developing a comprehensive and up-to-date curriculum in Human Factors and Ergonomics (HFE) is a crucial endeavor for any Indian educational institution aspiring to prepare students for the challenges of optimizing human-system interactions in today's complex world. HFE, a multidisciplinary field that combines elements of psychology, engineering, design, and more, plays a vital role in ensuring the safety, efficiency, and effectiveness of products, systems, and environments. This project aims to create a robust HFE syllabus for India by drawing inspiration from renowned universities worldwide that have established cutting-edge programs in this field. By examining the curricula of universities from different regions, we can distil the best practices, core concepts, and emerging trends to develop a template that can serve as a foundation for any Indian institution looking to offer a master's and PhD programs in HFE.

The burgeoning technological age has catapulted Human Factors and Ergonomics (HFE) from aperipheral academic interest to an indispensable discipline vital for national well-being. This importance is acknowledged globally, yet India finds itself on the periphery of this essential development. While HFE flourishes in academic institutions across North America, Europe, and parts of Asia (Summary provided in Appendix A), it remains a marginalized discipline in India, often subsumed under broader categories like engineering, design, physiology, or psychology, and working in their silos[1]. This section seeks to underline why it is pivotal for Indian universities to develop a comprehensive curriculum for HFE, emphasizing its relevance at both undergraduate and postgraduate levels, and provide a curriculum template that can be customized as per the institute's requirements. In addition, we specifically emphasize an India-centric approach to the creation of the syllabus. For example, we have included innovation management for human-centric systems as a part of the current syllabus with the stress in innovation in India. However, this particular course would not be typically found in major HFE programs worldwide.

In the increasingly interconnected and complex world, HFE has emerged as a key scientific discipline for designing systems and environments in sync with human capabilities and limitations. Developing a comprehensive curriculum in HFE is not just

[1] Kant, V. (2023). 'The spirit is willing, but the flesh is weak?': systemic unknown-knowns for ergonomics in India. *Ergonomics*, *66*(9), 1382-1397.

an academic requirement but a national imperative for India. The syllabus is thoughtfully curated to address the imperative for quality education and training in Human Factors and Ergonomics, contributing to the achievement of United Nations 2030 Sustainable Development Goals such as Good Health and Well-being, Quality Education, Gender Equality, Decent Work and Economic Growth, Industry, Innovation, and Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, and Partnerships for The Goals. It will harness known avenues and unearth unknown potentials, enhancing the country's capability to tackle contemporary and future challenges effectively and globally. With government endorsement and institutional commitment, India can not only catch up with global advancements in HFE but potentially lead in uncharted domains, thus meeting the needs of their communities and beyond. Therefore, the compelling case for a well-rounded HFE curriculum should be acted upon as a strategic step toward a more sustainable and efficient future.

A. Why does HFE matter in India?

Human Factors and Ergonomics as a discipline lies at the intersection of technology and human-centered design. With the rapid advancement of technology and its integration into every aspect of our lives, there is an increasing need for professionals who can ensure that these technologies are designed, developed, and adapted with the end-users in mind. Whether it is the usability of a mobile app, the safety of a vehicle, or the ergonomics of a workspace, HFE specialists are at the forefront of creating systems that enhance human well-being and both human and system performance. While technological design is necessary for our growth, human-centric approach to design will make the technology sustainable and adoptable by the end-user resulting in decrease in health disorders and increase in well-being.

B. The Importance of a Template Syllabus

An HFE syllabus involves a careful mix of the field's core principles, knowledge of the latest research, and awareness of industry demands. Furthermore, it is vital to strike a balance between theory and practical applications, ensuring that graduates from India are not only well-versed in HF&E theories but also capable of addressing continued challenges and transforming them into real-world solutions through sound competency-based educational curricula.

1. Using this template syllabus based on the best practices of established programs worldwide, Indian institutions can:

2. Save Time and Resources: Creating a curriculum from scratch can be time-consuming and resource-intensive. With a template such as that provided here, institutions can streamline the process and allocate resources more efficiently to bring a program to accepted international standards.
3. Ensure Relevance: HFE is a dynamic field. The template syllabus, based on the latest trends in science and technology and research, helps ensure that the program remains relevant and aligned with industry needs.
4. Maintain Quality: Universities known for their HFE programs have already invested in developing high-quality curricula. By using their experiences as a foundation, other institutions can maintain high competencies and standards.
5. Foster Collaboration: When multiple institutions use a similar template, it creates opportunities for collaboration, knowledge sharing, research partnerships, and adaptability, thus employability and ultimately benefiting the entire HFE community.

C. The Approach

Our syllabus project derives from HFE programs from universities in diverse regions, including Asia, Europe, and North America. Their syllabi, course structures, and key focus areas were explored. The key idea was to identify commonalities and unique strengths and create a template syllabus that encapsulates the essential elements of an HFE master's program and can serve as the basis of course work for PhD programs.

The template syllabus includes core courses, elective options, practical experiences, and a balanced mix of theory and application. It will also address emerging areas such as human factors in virtual reality, ethical considerations in automation and AI, and interdisciplinary approaches to HFE.

Developing a template syllabus based on the best practices of renowned institutions worldwide aims to facilitate the creation of high-quality HFE programs that equip students with the knowledge and skills needed to excel in this dynamic and vital field. As the demand for HFE specialists continues to grow in various industries, Indian universities need to offer comprehensive and up-to-date programs in this field.

D. Steps in Developing a Comprehensive HFE Education Syllabus Structure

1. The project commenced by conducting an extensive search for educational programs and courses at the bachelor's, master's, and doctoral levels that were pertinent to the field of human factors and ergonomics. This initial search was

conducted with demographic filters in mind to streamline the process. As the project progressed, a decision was made to simplify the search by categorizing universities offering these programs into four primary regions: Asia, Australia, North America, and Europe.

2. Subsequently, the program structures and curriculum components of these relevant universities were systematically analyzed and summarized. This analysis aimed to identify common themes and key features that characterized these programs. Several prominent themes emerged from this process, which included an emphasis on interdisciplinary approaches, practical application of knowledge, industry collaboration, a strong focus on research, active involvement of professional organizations, an international perspective, a dedicated focus on safety and health considerations, as well as considerations related to accreditation and certification.
3. In order to create a comprehensive syllabus template that encapsulated the holistic nature of human factors and ergonomics, the relevant courses were meticulously filtered from the overall course offerings. Only those courses that directly aligned with the identified themes were selected for further consideration. This selection process allowed for a focused examination of the courses that best embodied the principles of human factors and ergonomics.
4. Ultimately, drawing inspiration from the selected courses, new courses were conceptualized and developed. These new courses were designed to incorporate the valuable insights and characteristics gleaned from the existing programs, thereby contributing to the ongoing evolution and enhancement of education in the field of human factors and ergonomics.

E. Directions for Using the Model Syllabus:

In order to ensure that an educational curriculum remains valuable and aligned with the educational objectives, several key factors and directions of use can be considered. Here are some essential aspects to guide the continuous evaluation, improvement, and adaptation of the curriculum:

1. Continuous Evaluation, Improvement, and Adaptation: Establish a culture of continuous review and assessment and periodically evaluating the effectiveness of the curriculum in achieving its intended outcomes. Implement mechanics to gather feedback from students, professors, guest lecturers, and industry partners to identify areas for improvement. Compare the curriculum with similar programs globally to stay current and competitive. Clearly define the target audience and their specific

needs and expectations by considering the background, interests, and career goals of the students.

2. Adapting to university policies: Ensure that the curriculum complies with university policies, accreditation standards, and regulations.
3. Availability of Resources and Facilities: Regularly assess the availability and adequacy of resources, including expertise, technology, and physical facilities (laboratories). Also, allocate resources effectively to support curriculum delivery and student learning experiences.
4. Course modification/sequencing: Reassess the order in which courses are delivered to ensure a logical progression of knowledge and skills. Also, it allows flexibility in the curriculum to accommodate changes in industry trends and students' interests.
5. Changes in Learning Objectives: Continuously align learning objectives with industry demands and emerging trends. Also, regularly evaluate whether students are meeting the learning objectives.
6. Teaching Methods and Assessments: Explore new pedagogical approaches, such as experiential learning, project-based learning, amongst others. Diversify assessment methods to reflect real-world challenges and promote critical thinking.
7. Industry Collaborations and Guest Speakers: Foster collaborations with industry stakeholders to ensure that curriculum content remains relevant by inviting industry experts as guest speakers to provide insights into current practices and trends.
8. Feedback and Improvements from Students: Encourage students to provide feedback on course content, teaching methods, and overall learning experiences and act on student feedback to make timely improvements to the curriculum.
9. Promotion and Communication: Communicating curriculum changes and improvements to students, faculty, and relevant stakeholders. Also, promote the program's strengths and unique features to attract prospective students.
10. Implementation: Provide professional development opportunities for faculty to stay updated with industry trends and teaching methodologies.

By keeping these directions in mind, we anticipate the current curriculum created to not only meet the needs of the target audience but also to remain adaptable and responsive to the evolving educational and industry landscape. In addition, there is a severe lack of trained faculty in India to handle these courses; thus, training of human capital through international educational and research associations worldwide should be emphasized in the initial years to grow trained human resources in India.

F. Possible career pathways for graduates after the studies

After finishing the wide range of courses in the 'Human Factors and Ergonomics' program, students are prepared to pursue a number of career paths. Graduates can apply their experience in a variety of areas thanks to the curriculum's multidisciplinary nature, which offers up a wide range of job options. Here are a few recommended routes:

1. *Healthcare Sector:* Graduates can pursue professions in patient safety, medical device design, and healthcare systems improvement by utilizing their knowledge from courses like "Human Factors in Healthcare I (Foundation)" and "Human Factors in Healthcare II (Advanced)". Within medical facilities, they might find employment as patient experience analysts, healthcare usability specialists, or quality assurance personnel.
2. *Design and Innovation:* Programs such as "Innovation Management in Human-Centric Systems" and "Interactive System Design and Evaluation-I" train students for positions in interaction design, user experience (UX) design, and innovation management. Graduates can help technology firms innovate, build user-friendly interfaces, and improve product usability.
3. *Safety and Risk Management:* Careers in safety engineering, risk analysis, and policy creation are available to graduates who concentrate on "Risk, Safety, and Human Reliability" and "Human Factors and Safety: Policy, Regulations, and Governance". They might be employed in sectors that guarantee the highest levels of safety, including manufacturing, transportation, or aviation.
4. *Organizational Consulting:* Graduates with a grasp of "Innovative Management in Human-Centric Systems" and "Organizational Human Factors" may find employment in this field. They can assist companies in improving productivity, work satisfaction, and general performance by integrating human factors concepts into organizational designs.
5. *Environmental Design:* Programs such as "Human Factors in Built Environments" prepare graduates for professions in architecture and environmental design. When it comes to topics like workplace design or urban planning, they may help create settings that put accessibility and human well-being first.

In addition to opening doors to certain career pathways, completing the courses in the "Human Factors and Ergonomics" program gives students a thorough understanding of the various career streams available in the field of ergonomics and human factors. The curriculum cultivates a wide range of skills, guaranteeing that students are ready to contribute significantly in a variety of professional settings within this ever-evolving sector.

2. Model Syllabus

A. Program Objectives

Creating a comprehensive curriculum for Human Factors and Ergonomics (HFE) necessitates clearly defined objectives that encapsulate the program's breadth and depth. Below are the program objectives that aim to prepare institutions for the effective engagement and creative appropriation of the model. By meeting these objectives, the program aims to produce well-rounded professionals capable of advancing both the academic and practice-oriented dimensions of HFE.

1. Fundamental Understanding: To impart foundational knowledge of human capabilities and limitations, thereby enabling the design of systems, products, or environments that are compatible with human abilities and limitations.
2. Skill Development: To develop analytical and problem-solving skills for identifying, assessing, and resolving issues related to human interaction with systems and environments. In addition, equip students with practical skills, including laboratory techniques, usability testing, statistical analysis, and ergonomic assessments that are vital for real-world applications.
3. Interdisciplinary Exposure: To foster interdisciplinary thinking by integrating relevant aspects of psychology,engineering, healthcare, and safety systems into the curriculum, thereby enriching students' conceptual frameworks.
4. Research Competence: To instill research-oriented skills for engaging in original, applied, or theoretical research that contributes to the existing body of knowledge in HFE.
5. Ethical Considerations: To cultivate an understanding of ethical implications related to human-system interactions, ensuring students consider factors like inclusivity, accessibility, and ethical implications when making design decisions.
6. Industry Readiness: To prepare students for industry relevance by acquainting them with current tools,technologies, and methodologies used in the HFE field, including but not limited to software for simulation, modelling, and data analysis.
7. Global Context: To offer a global perspective on HFE, incorporating case studies,

research papers, and models from around the world to equip students for international collaborations and cross-cultural work environments.

8. National Significance: To emphasize the discipline's relevance to national well-being and development,thereby motivating students to apply their knowledge and skills in nationally significant sectors.
9. Lifelong Learning: To inculcate the practice of lifelong learning, encouraging graduates to stay updated with emerging trends, technologies, and research in the HFE domain.
10. Communication and Teamwork: To hone communication and teamwork skills, enabling students to articulate complex ideas effectively and to collaborate efficiently on multidisciplinary teams.
11. Societal Impact: To sensitize students to the societal impact of HFE, from improving healthcare outcomes to enhancing product usability, thereby inspiring them to contribute positively to the community and environment.

B. Program Outcomes

S.No.	Program Outcome	Attributes
1.	Demonstrate a deep understanding of core concepts, theories, and methodologies in Human Factors and Ergonomics, including human capabilities and limitations.	HF Mastery
2.	Apply critical thinking and problem-solving skills to analyze human-system interactions and recommend design improvements for enhancing performance, safety, and the user experience.	Analytical Proficiency
3.	Conduct empirical research and ergonomic assessments, utilizing appropriate tools, methods, and technologies.	Skill Competency
4.	Integrate knowledge from relevant disciplines, such as psychology, engineering, healthcare, and design, for a holistic approach to HFE problems.	Interdisciplinary Approach

5.	Design and execute original research projects, demonstrating a grasp of research methodologies, data analysis, and interpretation in the HFE domain.	Research Aptitude
6.	Adhere to ethical standards and guidelines when conducting research, assessments, and design improvements, taking into account considerations such as inclusivity and accessibility.	Ethical Conduct
7.	Demonstrate industry-relevant skills, including proficiency in software andtechnologies commonly used in the field of HFE.	Professional Readiness
8.	Exhibit an understanding of global trends and practices in HFE, along with the ability to adapt and collaborate in diverse cultural settings.	Global Awareness
9.	Apply HFE knowledge and skills in sectors of national importance, recognizing and articulating the discipline's contribution to national well-being.	National Contribution
10.	Engage in continuous professional development, showing the ability to adapt to emerging trends, technologies, and research findings in the HFE field.	Lifelong Learning
11.	Effectively communicate complex ideas and findings in both written and oral forms to different audiences, including experts, stakeholders, and the public.	Communication Skills
12.	Demonstrate the ability to apply HFE principles for societal benefit, including enhancing the usability of products, systems, and environments for diverse user groups.	Societal Impact

C. Structure of the program (Semester-wise breakup with credits)

It is a 4-semester program with credits depending on the structure of the university adopting this model syllabus. Semester 3 and 4 includes dissertation and industrial training/project.
T: Tutorial, L: Lecture, P: Practical

Semester I

Code	Course Title	Contact Hours (L-T-P)	Credits
HF601	Introduction to Human Factors	2-0-1	3
HF602	Cognitive Human Factors	2-0-1	3
HF603	Physical Human Factors	2-0-1	3
HF604	Philosophy of Humans, Technology, and Systems	2-0-1	3
HF605	Advanced Statistical Methods in Human Factors-I (Advanced Research Methods)	2-0-1	3
HF606	Organizational Human Factors	1-0-2	3
HF607	Systems Analysis, Design, and Management of Complex Technological Systems	2-0-1	3
HF608	Innovation Management in Human-Centric Systems	2-0-1	3
HF609	Human Performance	1-0-1	2
HF610	Modeling and Simulation in Human Factors	1-0-1	2

HF611	Advanced Methods in Human Factors (Application)	0-0-2	2
HF612	Risk, Safety, and Human Reliability	2-0-1	**3**

Semester II

Code	Course Title	Contact Hours (L-T-P)	Credits
HF613	Interactive System Design and Evaluation-I	2-1-0	3
HF614	Interactive System Design and Evaluation-II	2-1-0	3
HF615	Investigative and Legal Dimensions of HF	2-0-1	3
HF616	Advanced Statistical Techniques in HF-II	2-0-1	3
HF617	Human System Integration	2-0-1	3
HF618	Emergency Management and Critical Services	2-0-0	2
HF619	Qualitative Methods in Human Factors	2-0-0	2
HF620	Human-Centered Design	2-0-0	2
HF621	Human Factors in Healthcare-I	1-0-1	2
HF622	Human Factors in Healthcare-II	1-0-1	2
HF623	Ethics in Human Factors	2-0-0	2

Semester III

Code	Course Title	Contact Hours (L-T-P)	Credits
HF624	Human Factors in Built Environments	2-0-0	2
HF625	Human Factors in Complex Systems	1-0-1	2
HF626	Human Factors and Safety: Policy, Regulations, and Governance	2-0-0	2
HF627	Environment, Health, and Safety	1-1-1	3
HF628	Human Factors in Extreme Environments	1-1-0	2
HF629	Human Factors in Safety-Critical Domains	1-0-1	2
HF630	Human Factors in Rehabilitation Engineering and Specially-abled Populations	1-1-1	3
HF640	Seminar (independent study)	1-0-0	P/F

Semester IV

Course Code	Course Title	Contact Hours (L-T-P)	Credits
HF650	Human Factors Project		10

3. Course Contents

Semester I

Course Title: Introduction to Human Factors

Course Code: HF601

Credit Structure: L-T-P-Credit: 2-0-1-3

Course Summary:

This course provides an overview of human factors principles and their applications in various fields. Students will explore the interaction between humans and technology, systems, and environments, focusing on enhancing usability, safety, and overall performance.

Course Pre-requisites:

Foundation in psychology for understanding human behavior, a background in engineering or technology for grasping technical aspects, proficiency in statistics for data analysis, and knowledge of human anatomy. Additionally, familiarity with research methods, human-computer interaction concepts, systems thinking, and occupational health and safety principles is recommended for a holistic understanding of the field.

Course Objectives:

The main objective of this course is to provide an overview of HFE as a discipline:

- Understand Human Factors Fundamentals: Develop a foundational understanding of human factors concepts, principles, and their significance across various domains.
- Apply Human-Centered Design: Apply user-centered design principles to enhance the usability, safety, and overall user experience of products and systems.
- Explore Perception and Cognition: Explore how human perception and cognitive processes influence interaction with technology, design, and decision-making.
- Analyze Ergonomics and Physical Factors: Analyze ergonomic principles and biomechanical factors in designing comfortable and efficient workspaces and products.

- Evaluate Usability and User Experience: Learn usability evaluation methods and principles to improve product design and create engaging user experiences.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Human Factors[2,3]** Foundations of Human Factors Definition, scope, and significance of human factors in various domains. Historical evolution and key contributors to the field of human factors. Human-Centered Design Principles Introduction to user-centered design principles and their role in creating effective products and systems. Case studies highlighting successful implementation of human-centered design.
2.	**Perception and Cognition[4,5]** Human Perception and Sensation Understanding human sensory systems and their influence on perception. Exploring the role of perception in design, usability, and user experience. Cognitive Processes and Information Processing Overview of cognitive processes including attention, memory, decision-making, and problem-solving. Application of cognitive psychology principles in designing intuitive interfaces.
3.	**Ergonomics and Physical Factors[6]** Classification of Ergonomics (Physical, Cognitive, Organizational, Environmental, and other such classifications) Ergonomics and Workplace Design Introduction to ergonomics and its impact on workplace design and

[2] Course on Introduction to human factors, Cranfield University [1]
[3] MSc Human Centered Design, University of Washington [2]
[4] Online course on fundamentals of ergonomics and human factors, University of Derby [3]
[5] MSc Cognitive and Decision Science, University College London [4]
[6] MSc Technology, Work and Health, KTH University [5]

	efficiency. Analyzing ergonomic principles for designing comfortable and productive workspaces. Human Performance and Biomechanics Exploring biomechanical factors affecting human performance and comfort (physical injury risk assessment and reduction is included with physical factors). Applying biomechanical principles to the design of products and environments.
4.	**Usability and User Experience**[7,8] Usability Evaluation Methods Overview of usability evaluation techniques including usability testing, heuristic evaluation, and user surveys. Hands-on experience in conducting usability assessments. Enhancing User Experience Understanding the concept of user experience (UX) and its components. Designing for emotional engagement, satisfaction, and user delight.

Suggested Books

1. Wickens, C. D., Lee, J. D., Liu, Y., & Gordon-Becker, S. (2003). *Introduction to Human Factors Engineering*. Upper Saddle River, NJ. Pearson Education.
2. Norman, D. A. (2013). *The Design of Everyday Things*. New York, NY. Basic Books.
3. Nielsen, J. (1993). *Usability Engineering*. Boston, MA. Academic Press.
4. Hutchins, E. (1996). *Cognition in the Wild*. Cambridge, MA. MIT Press.
5. Proctor, R. W., & Van Zandt, T. (2008). *Human Factors in Simple and Complex Systems*. Boca Raton, FL. CRC Press.
6. Wickens, C. D., Lee, J. D., Liu, Y., & Becker, S. G. (2012). *Engineering Psychology and Human Performance*. Upper Saddle River, NJ. Pearson.
7. Guastello, S. J. (2017). *Human Factors Engineering and Ergonomics: A Systems Approach*. Boca Raton, FL. CRC Press.

[7] MSc User Experience, Arizona State University [6]
[8] MSc UX Design, Jonkoping University [7]

8. Dix, A., Finlay, J., Abowd, G., & Beale, R. (2004). Human-Computer Interaction. Harlow, England. Pearson Education.
9. Eysenck, M. W., & Keane, M. T. (2015). *Applied Cognitive Psychology: A Textbook*. New York, NY. Psychology Press

Course Title: Cognitive Human Factors

Course Code: HF602

Credit Structure: L-T-P-Credit: 2-0-1-3

Course Summary:

The course aims to provide a fundamental understanding of cognitive and perception processes underlying human behavior that helps to understand mind-based human performance and design for them. Its focal point lies in advancing cognitive processes like decision-making, problem-solving, perception, attention, and memory. This interdisciplinary realm integrates research from diverse domains, including artificial intelligence, cognitive psychology, linguistics, and established human factors studies.

Course Objectives:

The main objectives of the course are to:

- Understand Cognitive Processes: Gain a deep understanding of fundamental cognitive processes, including perception, attention, memory, decision-making, and problem-solving, and how they influence human performance and behavior in various contexts.
- Apply Cognitive Theories: Apply cognitive theories and principles to analyze and explain real-world scenarios and human interactions with technology, systems, and environments.
- Design User-Centered Systems: Develop the ability to design and evaluate user-centered systems, interfaces, and products by integrating cognitive principles to enhance usability, accessibility, and overall user experience.
- Identify Cognitive Workload: Learn techniques to assess cognitive workload and mental fatigue in complex tasks and systems, and implement strategies to optimize human performance and well-being.
- Mitigate Human Errors: Explore strategies and methodologies for preventing and mitigating human errors in design, operation, and decision-making processes, with a focus on improving system safety and efficiency.

Course Syllabus:

S.No.	Contents
1.	**Visual Sensory System**[9] Visual Environment: Properties of light: Wavelength, Color, Intensity, Light Sources, Illumination. Visual System: Eye as receptor system, Physiology of the Eye, Acuity, Contrast Sensitivity, Night Vision, Detection and Discrimination
2.	**Auditory, Tactile and Vestibular Systems I** [10,11] Auditory Environment: Sound, Amplitude, Frequency, Envelope, Location, Sound field. Auditory System: Receptor system, Anatomy, and physiology of ear Tactile: Tactile sense functions (perception and cognition),Physical manipulation with and without haptic feedback, Interactive applications, Guidelines for design of haptic systems, Evaluate haptic, tactual, and tangible interaction.
3.	**Auditory, Tactile and Vestibular Systems II** [12,13] Threshold, and threshold shifts. Auditory information processing characteristics: loudness and pitch, Noise, Detection and localization, alarms, speech.
4.	**Executive and control processes**[14,15] Macro-cognition, Embodied cognition, Distributed cognition, situated cognition, Decision making in uncertainty.

[9] MSc HCI, Rochester Institute of Technology [8]
[10] MSc in Audiology, University of Southampton [9]
[11] MSc in Cognitive andClinical Neuroscience, Goldsmiths, University of London [10]
[12] Master of Cognitive Science, University of Tübingen [11]
[13] MS in Human-Centred Design andEngineering, University of Washington [12]
[14] MSc in Cognitive and Brain Sciences, University of Amsterdam, Netherlands [13]
[15] Master of Artificial Intelligence Stanford University [14]

5.	**Emerging trends in human cognition**[16,17,18] Cognitive systems, Neuroengineering, Brain-machine interfaces, Cognitive computing.

Suggested Books:

1. Goldstein, E. B. (2014). *Cognitive Psychology: Connecting Mind, Research, and Everyday Experience*. Boston, MA. Cengage Learning.
2. Gopher, D., & Hoffman, D. (1982). *Attention and Performance*. NY. Psychology Press.
3. Wickens, C. D., Hollands, J. G., & Banbury, S. (2015). *Engineering Psychology and Human Performance*. NY. Psychology Press.
2. Eysenck, M. W., & Keane, M. T. (2005). *Applied Cognitive Psychology: A Textbook Themes and Variations*. NY. Psychology Press.
3. Gibson, J. J. (1986). *The Ecological Approach to Visual Perception*. NY. Psychology Press.
4. Kahneman, D. (2011). *Thinking, Fast and Slow*. NY. Farrar, Straus, and Giroux.
5. Reason, J. (1990). *Human Error*. UK. Cambridge University Press.

[16] MSc Cognitive Computing, Radboud University [15]
[17] MS in Human Factors and Systems Engineering, Embry-RiddleAeronautical University [16]
[18] MSc in Ergonomics, Loughborough University [17]

Course Title: Physical Human Factors

Course Code: HF603

Credit Structure: L-T-P-Credit: 2-0-1-3

Course Summary:

This course provides an in-depth exploration of the physical aspects of human factors, focusing on biomechanics, anthropometry, ergonomics, and their applications in design, workplace safety, and product development. Students will gain insights into how the human body interacts with its environment, understanding ergonomic principles and methods to enhance performance, reduce injury risks, and optimize workspaces (This course provides an introduction to physical human factors and further discussed in detail in course HF610).

Course Pre-requisites:

Fundamental knowledge in biomechanics, anthropometry, physics (especially mechanics), ergonomics, and basic principles of product design.

Course Objectives:

The main objectives of the course are to:

- Understand the principles of biomechanics and their relevance to human performance.
- Analyze and assess physical stresses that affect the human body in various contexts.
- Apply ergonomic design principles to optimize work environmentsand products.
- Perform anthropometric measurements and use data to inform design decisions.
- Identify ergonomic risk factors and propose effective interventions.
- Demonstrate the ability to conduct biomechanical analyses and interpret the results.
- Evaluate the impact of physical human factors on workplace safety and productivity.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Physical Human Factors**[19,20] Overview of physical human factors and its importance Historical context and evolution of ergonomic principles Relationship between physical factors and overall human performance
2.	**Biomechanics Basics**[21,22] Fundamental principles of biomechanics Musculoskeletal anatomy and structure Forces, moments, and load distribution on the human body
3.	**Anthropometry and Ergonomic Design**[20] Anthropometric measurements and data collection methods Design considerations based on human anthropometry Workspace design and layout optimization
4.	**Ergonomics and Workplace Safety**[23] Identification and assessment of ergonomic risk factors Workplace injuries (e.g., slips, trips, falls) Ergonomic guidelines for preventing workplace injuries Designing tools and equipment for safety and ease of use
5.	**Biomechanical Analysis**[24] Techniques for biomechanical analysis Motion analysis and its applications Biomechanical modeling and simulations

[19] MSc in Biomechanics, University ofWollongong [18]
[20] MSc in Human Movement Science, Vrije Universiteit Amsterdam [19]
[21] MS in Occupational Health, Safety, and Ergonomics, East Carolina University [20]
[22] MS in Kinesiology – Biomechanics, Iowa State University [21]
[23] MSc Human Factors and Systems Safety, Lund University [22]
[24] Masters in Philosophy of Science, Technology and Society, University of Twente [23]

6.	**Upper Extremity Ergonomics**[21] Ergonomics considerations for hand, wrist, and arm movements Musculoskeletal disorders related to upper extremities Interventions to prevent upper extremity injuries
7.	**Lower Extremity and Back Ergonomics**[21] Biomechanics of lower extremity movements Ergonomic challenges in standing, walking, and sitting Back disorders and interventions for preventing back injuries
8.	**Applications and Case Studies**[25] Application of physical human factors in real-world scenarios Case studies highlighting successful ergonomic design and interventions.

Suggested Books:

1. Chaffin, D. B., & Andersson, G. B. J. (1991). *Occupational Biomechanics*. NY. John Wiley & Sons.
2. Robertson, D. G. E., Caldwell, G. E., Hamill, J., Kamen, G., & Whittlesey, S. (2004). *Introduction to Biomechanics for Human Motion Analysis*. FL. CRC Press.
3. Marras, W. S. (2006). *Biomechanics of the Upper Limbs: Mechanics, Modeling, and Musculoskeletal Injuries*. FL. CRC Press.
4. Pheasant, S. (2016). *Body space: Anthropometry, Ergonomics, and the Design of Work*. FL. CRC Press.
5. Karwowski, W., & Marras, W. S. (Eds.). (2003). *Occupational Ergonomics: Principles of Work Design*. FL. CRC Press.
6. Fung, Y. C. (1993). *Biomechanics: Mechanical Properties of Living Tissues*. NY. Springer.
7. Bridger, R. S. (2003). *Introduction to Human Factors and Ergonomics*. FL. CRC Press.
8. Gallagher, S., & Barbie, M. (2022) and M. Barbie. *Musculoskeletal Disorders: The Fatigue Failure Mechanism,* Wiley, NY.

[25] Masters in Philosophy of Science, Technology and Society, Delft University of Technology [24]

Course Title: Philosophy of Humans, Technology, and Systems

Course Code: HF604

Credit Structure: L-T-P-Credit: 2-0-1-3

Course Summary:

This course delves into the philosophical foundations that underpin the interactions between humans, technology, and complex systems in the realm of human factors. Students will explore ethical, moral, and socio-cultural considerations that shape the design, use, and impact of technology on human well-being and system performance.

Course Pre-requisites:

Foundational knowledge in philosophy, ethics, and morality. Additionally, a basic understanding of sociology or cultural studies and exposure to technology and society studies is recommended to explore the ethical, moral, and socio-cultural considerations shaping the design, use, and impact of technology on human well-being and system performance.

Course Objectives:

The main objectives of the course are to:

- Understand Philosophical Foundations: Develop a deep understanding of the philosophical principles that shape the interactions between humans, technology, and complex systems in the context of human factors.
- Explore Ethical Considerations: Examine ethical and moral considerations that arise in the design, deployment, and impact of technology on individuals, societies, and cultures.
- Analyze Socio-Cultural Impact: Analyze how technological advancements influence socio-cultural norms, values, and behaviors, and evaluate their positive and negative consequences.
- Apply Ethical Design Principles: Learn how to apply ethical design principles to ensure technology respects user autonomy, privacy, and well-being in various systems and interfaces.
- Critically Examine Human-Machine Interaction: Critically assess the philosophical implications of human-machine collaboration, automation, and artificial intelligence on human autonomy, accountability, and decision-making.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Philosophy of Humans, Technology, and Systems**[26,27,28] Philosophical Inquiry and Human Factors Overview of philosophical inquiry and its relevance in understanding human-technology interactions. Understanding the philosophical foundations of human factors and system design. Ethics, Morality, and Technology Exploring ethical considerations in the development and deployment of technology. Analyzing moral dilemmas posed by emerging technologies invarious sectors. Postmodernity and Industrial Transitions
2.	**Human-Technology Relationships and Socio-Cultural Impact**[29,30] Technological Determinism vs. Social Constructivism Understanding the debate between technological determinism and social constructivism in shaping human-technology relationships. Analyzing how societal norms influence the design and adoption of technology. Socio-Cultural Impact of Technology Exploring the socio-cultural implications of technology onindividuals, communities, and societies. Evaluating the positive and negative effects of technologicaladvancements. Phenomenology and Technology

[26] Master's in Philosophy of Technology, Aarhus University [25]
[27] MA Society and Culture: Science and Technology, University of Exeter [26]
[28] MSc Social and Cultural Psychology, London School of Economics [27]
[29] MA Philosophy of Mind and Cognitive Science (Technology and Human Nature module), University of Birmingham [28]
[30] Masters in Philosophy, specialized tracks include Philosophy of Science and Technology, University of Vienna [29]

3.	**Human Factors and Ethical Design**[31,32,33,34,35,36,37] Ethical Design Principles Introduction to ethical design principles that prioritize user well-being, autonomy, and privacy. Applying ethical design considerations in interface design and system development. Privacy and Surveillance Analyzing the ethical dilemmas surrounding privacy, surveillance,and data collection in modern technological systems. Examining the balance between security and personal freedoms. Environmental Ethics and Industrial Hazards Philosophy of Risks and Society Persuasion and Consumer Protection
4.	**Human-Machine Collaboration and Autonomy**[38,39] Human-Centered Automation Understanding the philosophical underpinnings of human-centered automation and the role of humans in automated systems. Analyzing the implications of automation on human skill development and decision-making. Human Autonomy and AI Exploring the ethical considerations in the development of artificial intelligence (AI) systems that interact with humans. Evaluating the impact of AI on human autonomy, accountability, and decision-making.

Suggested Books:

1. Perez, C. (2002). *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*. Cheltenham, UK. Edward Elgar Publishing.

[31] Course on Introducing Existentialism and Phenomenology, University of Oxford [30]
[32] MSc Environmental Hazards, Cardiff University [31]
[33] MPhil. Health and Society, University of Wollongong [32]
[34] MA Philosophy, Politics and Society, Radboud University [33]
[35] MSc Applied Ethics, Linkoping University [34]
[36] MA Philosophy and AI, Northeastern University London [35]
[37] MSc Information Security and Privacy, University of Texas at Austin [36]

[38] MS in Human Factors and Ergonomics, San Jose State University [37]
[39] MS in Psychology - Experimental Psychology, University ofFlorida [38]

2. Ihde, D. (1990). *The Philosophy of Human-Technology Relations*. Urbana, IL. University of Illinois Press.
3. Tavani, H. T. (2018). *Ethics and Technology: Controversies, Questions, and Strategies for Ethical Computing*. NJ. Wiley.
4. Vallor, S. (2016). *Technology and the Virtues: A Philosophical Guide to a Future Worth Wanting*. UK. Oxford University Press.
5. Jasanoff, S. (2016). *The Ethics of Invention: Technology and the Human Future*. NY. W.W. Norton & Company.
6. Kaplan, J. (2015). *Humans Need Not Apply: A Guide to Wealth and Work in the Age of Artificial Intelligence*. New Haven, CT. Yale University Press.
7. Frischmann, B., & Selinger, E. (2018). *Re-Engineering Humanity*. UK. Cambridge University Press.
8. Norman, D. A. (2013). *The Design of Everyday Things*. NY. Basic Books.

Course Title: Advanced Statistical Methods in Human Factors-I

Course Code: HF605

Credit Structure: L-T-P-Credit: 2-0-1-3

Course Summary:

This course provides an in-depth exploration of advanced research methods, techniques, and applications within the field of human factors and ergonomics. Through theoretical discussions, hands-on activities, and case studies, students will gain proficiency in applying advanced methods to real-world human factors challenges. This course provides an in-depth exploration of advanced statistical techniques commonly used in human factors research and analysis. Students will develop a strong foundation in statistical theory and gain practical experience in applying these methods to real world human factors studies (More advanced topics covered in course HF606 which deals with epidemiological studies).

Course Pre-requisites:

Strong background in basic research methods, proficiency in statistics with a focus on advanced techniques, quantitative research skills, and familiarity with human factors principles.

Course Objectives:

The main objectives of the course are to:

- Understand and explain the fundamental principles of advanced statistical methods.
- Select and apply appropriate statistical techniques for different types of human factors research.
- Analyze and interpret complex data sets using advanced statistical software.
- Effectively communicate statistical findings and results to both technical and non-technical audiences.
- Critically evaluate research studies that employ advanced statistical methods.

Course Syllabus:

S.No.	Contents
1.	**Review of Basic Statistics** Recap of basic statistical concepts, including hypothesis testing, correlation, and regression The need for advanced statistical techniques in human factors research
2.	**Research Design and Experimental Methods**[40,41] Types of research designs: experimental, quasi-experimental,non-experimental Control groups, randomization, and internal validity Planning and conducting controlled experiments in human factorsresearch
3.	**Advanced-Data Collection Techniques**[42,43] Physiological measures in human factors research Eye tracking and gaze analysis Wearable sensors and their applications in assessing humanperformance
4.	**Advanced-Data Analysis Methods**[44,45] Multivariate statistical methods: ANOVA, MANOVA, repeatedmeasures ANOVA Factor analysis and principal component analysis (PCA) Hierarchical linear modeling (HLM) for nested data
5.	**Data Interpretation and Reporting**[41] Techniques for effectively interpreting and communicating advanced statistical findings. Presenting complex statistical results and reporting.

[40] MS inHuman-Computer, Interaction, CarnegieMellon University [39]
[41] MS inApplied Cognitive and BrainSciences, University of Kansas [40]
[42] MS in Statistics, University of California, Berkeley [41]
[43] MS in Quantitative Psychology, University of North Carolina at Chapel Hill [42]
[44] MSc in Human Factors and Industrial/Organizational Psychology, Wright State University [43]
[45] M.A. in Industrial Organizational Psychology from the Departmentof Psychology, Columbia University [44]

Suggested Books:

1. Witte, R. S., & Witte, J. S. (2013). *Statistics*. Hoboken, NJ. Wiley.
2. Donnelly, R. A., Jr. (2011). *Statistics*. Boston, MA. Pearson.
3. Creswell, J. W., & Creswell, J. D. (2017). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Thousand Oaks, CA. Sage Publications.
4. Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*. Boston, MA. Houghton Mifflin.
5. Maxwell, J. A. (2012). *Qualitative Data Collection: A Practical Guide*. Thousand Oaks, CA. Sage Publications.
6. Shalizi, C. R. (2013). *Advanced Data Analysis from an Elementary Point of View*. UK. Cambridge University Press.
7. Johnson, R. A., & Wichern, D. W. (2007). *Applied Multivariate Statistical Analysis*. Boston, MA. Pearson.
8. Yau, N. (2013). *Data Points: Visualization That Means Something*. Hoboken, NJ. Wiley.
9. Knaflic, C. N. (2015). *Storytelling with Data: A Data Visualization Guide for Business Professionals*. Hoboken, NJ. Wiley.

Course Title: Organizational Human Factors

Course Code: HF606

Credit Structure: L-T-P-Credit: 1-0-2-3

Course Summary:

This course provides an in-depth exploration of the role of human factors within organizations, focusing on organizational design, macroergonomics, psychosocial factors and their implications for productivity, safety, and well-being. Students will examine how organizational structures, processes, and culture impact human performance, and learn strategies to enhance workplace efficiency, effectiveness, and employee satisfaction.

Course Pre-requisites:

Foundational knowledge in organizational psychology, human resource management, and business or organizational behavior. Additionally, exposure to macroergonomics principles is recommended.

Course Objectives:

The main objectives of the course are to:

- Understand the principles of organizational design, macro ergonomics, and industrial/organizational psychology.
- Analyze the impact of organizational structures, processes, and culture on human performance and well-being.
- Apply ergonomic and psychological principles to optimize organizational systems and practices.
- Evaluate the influence of leadership, motivation, and employee engagement on workplace outcomes.
- Develop strategies for enhancing organizational effectiveness, safety, and employee satisfaction.
- Demonstrate the ability to conduct macroergonomics analyses and propose interventions.
- Identify challenges and opportunities for improving human factors within organizations.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Organizational Human Factors**[46,47,48] Overview of organizational human factors and its interdisciplinary nature Historical context and evolution of organizational design principles The interplay between organizational factors and human performance
2.	**Organizational Design and Structures**[49,50] Principles of effective organizational design Types of organizational structures and their implications Influence of structure on communication, decision-making, and collaboration
3.	**Macroergonomics and Systems Thinking**[51,52] Fundamentals of macroergonomics and its role in organizational improvement Systems thinking applied to macroergonomics and workplace design Approaches to optimize organizational processes and work systems
4.	**Industrial/Organizational Psychology and Psychosocial factors** [53,54,55] Introduction to industrial/organizational psychology and psychosocial factors Understanding human behavior in the workplace Application of psychological theories to enhance organizational outcomes

[46] M.A. and Ph.D. in Industrial-Organizational Psychology from the Departmentof Psychology, University of Minnesota [45]
[47] MSc in Organizational Design and Development, Radboud University [46]
[48] MSc in Organizational Dynamics, University of Pennsylvania [47]
[49] Course in Macroergonomics, UC Berkely [48]
[50] MSc in Human Factors Engineering and Ergonomics, Virginia Tech [49]
[51] M.S/Ph.D. in Industrial-OrganizationalPsychology from the Departmentof Psychological Sciences, Purdue University [50]
[52] M.S/Ph.D. in Industrial-OrganizationalPsychology from the Departmentof Psychology, University of Illinois at Urbana-Champaign [51]
[53] M.S. and Ph.D. in Psychological Sciences with a focus on Industrial-Organizational Psychology, Rice University [52]
[54] Masters in Management, Organization and Society, Stockholm University [53]
[55] MSc in Leadership and Organizational Development, University of Texas at Dallas [54]

5.	**Leadership and Organizational Culture**[56,57] Analysis of leadership styles and their impact on employee motivation Cultivating a positive organizational culture conducive to well-being and safety Strategies for promoting a culture of trust, transparency, and collaboration
6.	**Employee Engagement and Motivation**[58] Factors influencing employee engagement and job satisfaction The role of motivation theories in enhancing performance Designing tasks and rewards to promote motivation and productivity
7.	**Work-Life Balance and Well-Being**[59] Addressing work-life balance challenges in modern organizations Strategies for promoting employee well-being and managing stress The role of ergonomics in creating supportive work environments

Suggested Books:

1. Colquitt, J. A., LePine, J. A., & Wesson, M. J. (2019). *Organizational Behavior: Improving Performance and Commitment in the Workplace*. NY. McGraw-Hill Education.
2. Soares, M. M., & Soares, R. M. (2008). *Organizational Ergonomics: A Practical Approach*. Boca Raton, FL. CRC Press.
3. Hendrick, H. W., & Kleiner, B. M. (2001). *Macroergonomics: Theory, Methods, and Applications*. Mahwah, NJ. Lawrence Erlbaum Associates.
4. Woods, S. (2016). *The Psychology of Work and Organizations. Boston*, MA. Cengage Learning.
5. Grote, G., & Guest, D. E. (2002). *Organizational Psychology and Quality of Working Life: A Research Companion*. UK. Oxford University Press.
6. Cameron, K. S., & Quinn, R. E. (2006). *Diagnosing and Changing Organizational Culture: Based on the Competing Values Framework*. Hoboken, NJ. Wiley.

[56] Masters in Human Resource Management and Organization Behavior, University of Illinois Urbana-Champaign [55]

[57] MA in Leadership in Workplace Health and Wellbeing, Limerick Institute of Technology [56]

[58] Course on Introduction to Systems Thinking, UC San Diego ExtendedStudies [57]

[59] MSc Machine Design, KTH [58]

Course Title: Systems Analysis, Design, and Management of Complex Technological Systems

Course Code: HF607

Credit Structure: L-T-P-Credit: 2-0-1-3

Course Summary:

This course provides a comprehensive overview of systems analysis, design, and management principles as applied to complex technological systems. Students will learn the fundamentals of systems thinking, engineering methodologies, and decision-making processes required to manage and optimize complex technological systems efficiently.

Course Pre-requisites:

Fundamental understanding of systems thinking, knowledge in engineering fundamentals, familiarity with decision-making processes, and exposure to technology management principles.

Course Objectives:

The main objectives of the course are to:

- Develop Systems Thinking Skills: Enable students to understand and apply systems thinking principles to recognize the interconnectedness of components within complex technological systems.
- Master Systems Analysis and Design Methodologies: Equip students with the knowledge and skills to select and apply appropriate systems analysis and design methodologies.
- Apply Mathematical Modeling for Optimization: Teach students to use mathematical modeling techniques to analyze and optimize complex technological systems, considering factors like efficiency, cost, resource allocation, and their relation with HFE.
- Understand Requirements Engineering: Familiarize students with the requirements engineering process, enabling them to elicit, document, and validate system requirements effectively.
- Enhance Decision-Making Competencies: Empower students to make informed decisions in complex technological systems by introducing them to decision analysis, support systems, and risk management techniques.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Systems Thinking**[60,61] Overview of Systems Thinking Understanding principles of Complex Systems Exploring Systems Modeling and Analysis
2.	**Systems Analysis and Design Methodologies**[62,63] Overview of Systems Development Life Cycle (SDLC) and Requirements Engineering
3.	**Mathematical Modelling for Systems**[64,65] Mathematical Foundations for Systems Analysis Simulation Techniques Optimization Models
4.	**Systems Engineering Principles**[66,67] Introduction to Systems Engineering Systems Engineering Processes Systems Architecture and Design
5.	**Requirements Engineering** Eliciting and Documenting Requirements Requirements Analysis and Validation Traceability and Change Management

[60] MSc Data Science and Decisions, Naval Postgraduate School [59]
[61] Course on Information Systems Design, Karlstad University [60]
[62] MSc, Mathematics, Lund University [61]
[63] MSc Mathematical Modelling and Scientific Computing, University of Oxford [62]
[64] MSc Industrial Engineering, NTNU [63]
[65] MEng Management, RMIT [64]
[66] Course on Decision Analysis and Support, University of Pittsburgh [65]
[67] MSc Decision Analysis and Data Science, Stockholm University [66]

6.	**Decision Analysis and Support Systems**[68,69] Decision-Making Frameworks Decision Support Systems (DSS) Risk Management in Systems
7.	**Systems Optimization and Decision-Making**[70,71,72] Multi-Criteria Decision Analysis (MCDA) Heuristic and Metaheuristic Algorithms Case Studies in Optimization

Suggested Books

1. Kossiakoff, A., & Sweet, W. N. (2011). *Systems Engineering Principles and Practice*. Hoboken, NJ. Wiley.
2. Sauter, V. L. (2008). *Decision Support Systems for Business Intelligence*. Hoboken, NJ. Wiley.
3. Antoniou, A., & Lu, W.-S. (2007). *Practical Optimization: Algorithms and Engineering Applications*. NY. Springer.
4. Gharajedaghi, J. (2011). *Systems Thinking: Managing Chaos and Complexity*. Waltham, MA. Butterworth-Heinemann.
5. Blanchard, B. S., & Fabrycky, W. J. (2006). *Introduction to Systems Engineering*. Hoboken, NJ. Wiley.
6. Wasson, C. S. (2016). *Systems Engineering: Principles and Practice*. Hoboken, NJ. Wiley.
7. Whitten, J. L., Bentley, L. D., & Dittman, K. C. (2004). *Systems Analysis and Design Methods*. NY. McGraw-Hill Education.
8. Sommerville, I., & Sawyer, P. (1997). *Requirements Engineering: A Good Practice Guide*. Boston, MA. ACM Press/Addison-Wesley Publishing Co.

[68] Course on Optimization and Decision Modelling, University of Southampton [67]
[69] Course on Control and Optimization, Imperial College London [68]
[70] Certificate course on Optimization and Quantitative Decision Science, Princeton University [69]
[71] Masters in Creative Sustainability with a focus on Sustainable Design within the School of Arts, Design, and Architecture, Aalto University [70]
[72] Masters in Human-Centred Design & Engineering, with a focus on designing and managing technology for human use, University of Washington [71]

9. Checkland, P. (1981). *Systems Thinking, Systems Practice*. Chichester, UK. John Wiley & Sons.
10. Parnell, G. S., Driscoll, P. J., & Henderson, D. L. (2011). *Decision-Making in Systems Engineering and Management*. Hoboken, NJ. Wiley.

Course Title: Innovation Management in Human-Centric Systems

Course Code: HF608

Credit Structure: L-T-P-Credit: 2-0-1-3

Course Summary:

This course explores innovation management strategies and methodologies within the context of human-centric systems. Students will learn how to foster creativity, manage innovation processes, and develop user-centered solutions that enhance human experiences in various domains.

Course Pre-requisites:

Foundational knowledge in innovation management, familiarity with creativity and design thinking, understanding of human-centered design principles, and basic knowledge in project management.

Course Objectives:

The main objectives of the course are to:

- Understand Innovation Fundamentals: Develop a solid understanding of key innovation management principles and their significance in human-centric systems and design.
- Apply Design Thinking Methodologies: Learn to apply design thinking methodologies to identify user needs, generate creative solutions, and develop innovative products and services.
- Manage User-Centered Innovation: Gain skills in managing innovation processes that prioritize user-centered design, ensuring products and systems meet user needs and expectations.
- Analyze Innovation Impact: Develop the ability to assess the impact of user-centric innovations on user experiences, performance, and overall system effectiveness.
- Foster Collaborative Innovation: Explore strategies for fostering collaboration, open innovation, and interdisciplinary approaches to create meaningful and effective human-centric solutions.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Innovation Management in Human-Centric Systems**[73][74] Fundamentals of Innovation Management Overview of innovation management principles, theories, and their relevance in human-centric design. Understanding the role of innovation in enhancing user experiences and system performance. Creativity and Idea Generation Exploring techniques for fostering creativity and generating innovative ideas. Analyzing the impact of creative thinking on human-centric solutions.
2.	**User-Centered Design strategic designs and Innovation**[75] Design Thinking for Innovation Introduction to design thinking methodologies for user-centered innovation. Applying empathetic design approaches to uncover user needs and pain points. User Research and Prototyping Conducting user research to inform the innovation process. Developing prototypes to iteratively test and refine user-centered solutions.
3.	**Managing Innovation Processes**[76,77,78] Innovation Strategy and Road-mapping Developing innovation strategies that align with human-centric goals. Creating innovation roadmaps to guide the development of user-centered products and systems. Open Innovation and Collaboration

[73] Masters in Innovation Sciences from the School of Innovation Sciences, emphasizing innovation processes and their societal impact, Eindhoven University of Technology [72]
[74] MSc in Innovation Management & Business Development with a focus on innovation and entrepreneurship, Copenhagen Business School [73]
[75] Masters in Product-Service System Design, focusing on designing integrated systems that include both products and services, Polytechnic University of Milan [74]
[76] Master of Science in Innovation Management and Entrepreneurship, HEC Paris [75]
[77] Master of Environmental Management, Duke University [76]
[78] MSc in Innovation and Technology Management, University of Bath [77]

	Exploring open innovation models and the importance of collaboration in innovation ecosystems. Analyzing successful cases of collaborative innovation within human-centric contexts.
4.	**Implementation and Impact Assessment**[79] Innovation Implementation and Change Management Strategies for effectively implementing innovative solutions within organizations. Managing change and overcoming resistance during innovationadoption. Measuring Innovation Impact Evaluating the impact of user-centred innovations on user satisfaction, usability, and performance. Applying metrics and methodologies to assess the success of human-centric innovations.
5.	**Introduction to Economics of Innovation**[80] Understanding the economic context of innovation Relationship between innovation and economic growth Economic drivers of innovation in human-centric systems **Innovation Economics Theories** Classical and neoclassical theories of innovation Schumpeterian theory of creative destruction Innovation as a driver of market competition **Innovation and Market Structure** Analysis of different market structures in the context of innovation Monopoly, oligopoly, monopolistic competition, and perfect competition Innovation in regulated industries and its impact on markets

[79] MSc in Intellectual Property, University of Oxford [78]
[80] MSc in Sustainable Management, KTH Royal Institute of Technology [79]

6.	**Intellectual Property and Innovation** [81] Role of intellectual property rights (IPR) in fostering innovation Patents, copyrights, trademarks, and trade secrets Challenges and controversies in intellectual property management **Innovation and Technology Transfer** Understanding technology transfer and its economic implications Licensing, technology spin-offs, and joint ventures Economic benefits and challenges of technology transfer in human-centric systems
7.	**Introduction to Life Cycle Assessment (LCA)**[82] Understanding the principles and objectives of LCA Life cycle stages: extraction, production, use, and disposal Importance of LCA in evaluating environmental impacts **Life Cycle Inventory (LCI) Analysis** Collecting data on energy consumption, emissions, and resources Quantifying inputs and outputs at each life cycle stage LCI databases and tools for data collection **Impact Assessment and Interpretation** Identifying environmental impacts using impact categories Characterization, normalization, and weighting of impact data Interpreting LCA results and addressing uncertainties **Life Cycle Impact Assessment (LCIA) Methods** Analyzing environmental impacts using LCIA methods Comparative LCIA and benchmarking against reference scenarios Case studies illustrating different LCIA methodologies **Eco-design and LCA Integration** Integrating LCA in product and process design Eco-design principles and strategies for minimizing impacts Incorporating LCA results into decision-making processes **Life Cycle Cost Assessment (LCC)** Linking LCA with economic analysis through LCC Evaluating life cycle costs and benefits of products and systems

[81] Master's and Ph.D. in Human Performance, offering various specializations within the Department of Applied Physiology & Kinesiology, University of Florida [80]

[82] Master's and Ph.D. in Kinesiology with specializations in Biomechanics and Physiology, Penn State University [81]

	Identifying cost drivers and potential savings through LCC

Suggested Books:

1. Drucker, P. F. (2006). *Innovation and Entrepreneurship: Practice and Principles*. NY. Harper Business.
2. Van Der Pijl, P., Lokitz, J., & Wijnen, R. (2016). *Design a Better Business: New Tools, Skills, and Mindset for Strategy and Innovation*. Hoboken, NJ. Wiley.
3. Brown, T. (2009). *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. NY. Harper Business.
4. Kelley, T. (2001). *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*. NY. Currency.
5. Christensen, C. M., & Raynor, M. E. (2003). *The Innovator's Solution: Creating and Sustaining Successful Growth*. Boston, MA. Harvard Business Review Press.
6. Chesbrough, H. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology.* Boston, MA. Harvard Business Review Press.
7. Huijbregts, M. A. J., Matthews, H. S., Norris, G. C., et al. (2010*). Life Cycle Assessment: Principles, Practice and Prospects*. Hoboken, NJ. Wiley.
8. Curran, M. A. (2012). *Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products*. Hoboken, NJ. Wiley.
9. Sanders, N. R., & Mol, M. J. (2008). *Intellectual Property and Innovation Management in Small Firms*. Abingdon, UK. Routledge.
10. Scotchmer, S. (2004). *Innovation and Incentives.* Cambridge, MA. MIT Press.
11. Lockwood, T. (2009). *Design Thinking: Integrating Innovation, Customer Experience, and Brand Value.* NY. Allworth Press.
12. Croll, A., & Yoskovitz, B. (2013). *Lean Analytics: Use Data to Build a Better Startup Faster.* Sebastopol, CA. O'Reilly Media.

Course Title: Human Performance

Course Code: HF609

Credit Structure: L-T-P-Credit: 1-0-1-2

Course Summary:

This course delves into the intricate interplay between physical, cognitive, and psychological factors that influence human performance in various contexts. Through an exploration of physical and cognitive performance, as well as principles of engineering psychology, students will develop a holistic understanding of how individuals' function in complex environments.

Course Pre-requisites:

Foundational knowledge in psychology, particularly cognitive psychology, as well as biomechanics and principles of engineering psychology.

Course Objectives:

The main objectives of the course are to:

- Understand the multifaceted nature of human performance, encompassing physical, cognitive, and psychological dimensions.
- Analyze the factors influencing physical and cognitive performance in diverse environments.
- Evaluate the impact of ergonomic design on physical performanceand well-being.
- Explore cognitive processes and their implications for decision-making and task execution.
- Demonstrate the ability to conduct assessments of human performance and propose interventions.
- Identify challenges and opportunities for enhancing human performance within various domains.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Human Performance**[83] Overview of human performance and its multidimensional nature

[83] Master's and Ph.D. in Kinesiology, focusing on exercise physiology and human performance, University of Texas at Austin [82]

	Historical context and evolution of human performance theories The interplay between physical, cognitive, and psychological factors
2.	**Physical Performance and Ergonomics[84,85]** Factors influencing physical performance and endurance Ergonomic principles in designing tasks and workspaces Addressing ergonomic stressors to enhance physical well-being
3.	**Cognitive Performance and Decision-Making[86]** Exploration of cognitive processes and their impact on task execution Factors influencing attention, memory, and problem-solving Application of cognitive psychology to enhance decision-making
4.	**Engineering Psychology[87,88]** Introduction to engineering psychology and its relevance to human performance Designing user-centered systems and interfaces Human factors considerations in interface design and usability
5.	**Human-Technology Interaction and Workload[89,90,91]** Analysis of human-technology interaction and usability challenges Workload assessment and its impact on human performance Measuring and Evaluating workload: Performance, indirect, subjective and physiological measures. Strategies for designing intuitive and effective user interfaces
6.	**Human Performance Assessment[92]**

[84] MSc in Cognitive and Decision Sciences, UCL [83]
[85] MSc in Sport and Exercise Psychology with a focus on optimizing human performance in sport and exercise, Loughborough University [84]
[86] MSc in Human Factors and Engineering Psychology, University of Twente [85]
[87] MS in Human Factors in Aeronautics, Embry-Riddle Aeronautical University [86]
[88] MS in Human Factors and Ergonomics, Tufts University [87]
[89] MSc in Human Technology Interaction, TU Eindhoven [88]
[90] Master's and Ph.D. in Kinesiology with a variety of concentrations including exercise physiology and movement science, Ohio State University [89]
[91] MSc in Sports Science, Lund University [90]
[92] Master's and Ph.D. in Human Factors Psychology with research emphasis on modelling and

	Methods for assessing physical and cognitive performance Task analysis techniques and their role in optimizing performance Conducting performance evaluations and identifying improvement opportunities
7.	**Training and Skill Acquisition**[93] Principles of skill acquisition and motor learning Training methods to enhance physical and cognitive skills Cognitive task analysis for designing effective training programs
8.	**Applications and Case Studies** Application of human performance concepts in real-world scenarios Case studies showcasing successful interventions in physical and cognitive performance

Suggested Books:

1. Johnson, R. W. (2005). *Human Performance Engineering: Designing High-Quality Professional User Interfaces for Computer Products, Applications, and Systems*. Burlington, MA. Gulf Professional Publishing.
2. Goldstein, E. B. (2014). *Cognitive Psychology: Connecting Mind, Research, and Everyday Experience*. Boston, MA. Cengage Learning.
3. Wickens, C. D., & Hollands, J. G. (2000). *Engineering Psychology and Human Performance*. Hove, UK. Psychology Press.
4. Reason, J. (2008). *The Human Contribution: Unsafe Acts, Accidents and Heroic Recoveries*. Boka Raton, FL. CRC Press.
5. Parasuraman, R., & Hancock, P. A. (2000). *Human Error and Decision Making*. Boka Raton, FL. CRC Press.
6. Campbell, R. D., & Bagshaw, M. (2012*). Human Performance and Limitations in Aviation*. Chichester, UK. Wiley.
7. Stolovitch, H. D., & Keeps, E. J. (2009). *The Handbook of Human Performance Technology: Principles, Practices, and Potential*. San Francisco, CA. Pfeiffer.

simulation of human-system interactions, University of Central Florida [91]

[93] MSc in Design for Interaction with a specialization in Human-Technology Interaction, involving modelling and simulating user interactions, Delft University of Technology [92]

Course Title: Modelling and Simulations in Human Factors

Course Code: HF610

Credit Structure: L-T-P-Credit: 1-0-1-2

Course Summary:

This course provides an in-depth exploration of modeling and simulation techniques applied to human factors research and design. Students will learn how to create and utilize digital human models and understand how simulation can inform ergonomic, safety, and design decisions across various domains.

Course Pre-requisites:

Foundational knowledge in human factors studies HF603, basic understanding of programming and engineering principles, familiarity with ergonomic principles, and exposure to design principles.

Course Objectives:

The main objectives of the course are to:

- Understand the principles and benefits of modeling and simulation in human factors.
- Create and manipulate digital human models for ergonomic analysis and design.
- Apply simulation techniques to assess human performance, safety,and usability.
- Evaluate the role of modeling and simulation in various industries and domains.
- Analyze ethical considerations and limitations of modeling and simulation.
- Develop skills in using modeling and simulation tools effectively.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Modeling and Simulation in Human Factors**[94] Overview of modeling and simulation in human factors research and applications Historical context and evolution of digital human modeling and simulation Benefits and limitations of using simulation techniques
2.	**Digital Human Modeling (DHM) Basics**[95] Principles of digital human modeling and its role in ergonomic design Introduction to DHM software tools and platforms Creating and manipulating digital human models for various tasks
3.	**DHM for Ergonomics and Workplace Design**[96] Applying DHM for ergonomic assessments and workspace design Analyzing reach, posture, and biomechanical considerations usingDHM Incorporating anthropometric data into DHM simulations
4.	**Human Performance Simulation**[97] Using simulation to assess human performance and task execution Modeling cognitive processes and decision-making in simulations Evaluating usability and efficiency through performance simulations
5.	**Safety and Risk Assessment through Simulation**[98] Analyzing safety risks and hazards using simulation techniques Incorporating human behavior and interaction into safety simulations Simulating emergency situations and response scenarios

[94] DHM Research, Tsinghua University [93]
[95] Master's and Ph.D. in Human Factors with research emphasis on cognitive modelling and human performance, University of Illinois at Urbana-Champaign [94]
[96] MSc in Safety Engineering, University of Wuppertal [95]
[97] MSc in Medical Simulation, Linköping University [96]
[98] MSc in Health and Medical Simulation, University of Hertfordshire [97]

6.	**Simulation in Healthcare and Virtual Environments**[99,100] Application of simulation in healthcare training and medical device design Creating virtual environments for human factors analysis and user testing Simulation for training and assessment of healthcare professionals
7.	**Verification and Validation of models** Addressing accuracy and limitations of simulation models Validating simulation results through empirical studies
8.	**Industry Applications and Case Studies** Real-world applications of modeling and simulation in various industries Case studies showcasing successful utilization of simulation tools.

Suggested Books:

1. Duffy, V. G. (2019). *Digital Human Modeling: Applications in Health, Safety, Ergonomics, and Risk Management*. Boka Raton, FL. CRC Press.
2. Law, A. M., & Kelton, W. D. (2020). *Simulation Modeling and Analysis*. NY. McGraw-Hill Education.
3. Woodson, W. E., Tillman, P., & Tillman, B. (2006). *Human Factors and Ergonomics Design Handbook*. NY. McGraw-Hill Education.
4. Rausand, M., & Høyland, A. (2004). *Risk Assessment: Theory, Methods, and Applications*. Chichester, UK. Wiley.
5. Auslander, M. D., & Pew, R. W. (2011). *Human Factors Simulation and Testing*. Boka Raton, FL. CRC Press.
6. Law, A. M., & Kelton, W. D. (2020). *Simulation Modeling and Analysis*. NY. McGraw-Hill Education.
7. Kara, B. Y., & Alkassis, J. (2013). *Modeling and Simulation for Analyzing Global Events*. Boka Raton, FL. CRC Press.
8. Kelton, W. D., Sadowski, R. P., & Sturrock, D. T. (2015). *Simulation Modeling and Analysis with Arena*. NY. McGraw-Hill Education.
9. Beaverstock, M., Greenwood, A. G., & Lavery, E. (2014). *Applied Simulation: Modeling and Analysis Using FlexSim*. Boka Raton, FL. CRC Press.

[99] Masters of Simulation and Immersive Technology, UNSW Sydney [98]
[99] Master in Design and Creative Immersive Technology, Stockholm University [99]

Course Title: Application of Advanced Methods in Human Factors

Course Code: HF611

Credit Structure: L-T-P-Credit: 0-0-2-2

Course Summary:

This advanced course explores the application of cutting-edge methods and techniques in the field of Human factors to address complex challenges in various domains. Students will gain hand-on experience in utilizing advanced methodologies to enhance human performance, safety, and user experience in both design and evaluation contexts.

Course Pre-requisites:

Proficiency in advanced research methods, familiarity with technology and innovation studies, a strong foundation in human factors studies, and experience or knowledge in usability testing methodologies.

Course Objectives:

The main objectives of the course are to:

- Apply virtual reality (VR) in human factors research: Demonstrate the ability to utilize virtual reality technologies for conducting human factors research and assessments, including the design of VR-based experiments and data collection.
- Conduct Ergonomic Assessments: Apply advanced ergonomic principles and biomechanical analysis techniques to evaluate and improve complex work environments, considering factors like user comfort, safety, and efficiency.
- Design and Implement Complex User Studies: Plan, design, and execute user studies that involve complex variables and scenarios, considering ethical and practical considerations.
- Implement Advanced Ergonomic Assessments: Apply biomechanical and physiological assessments to evaluate ergonomics and propose improvements in various settings.
- Analyze Real-World Challenges: evaluate and dissect real-world human factors challenges by analyzing case studies and applying advanced human factors methods. Additionally, understand and discuss the ethical considerations and limitations associated with these advanced methods in practical applications.

Course Syllabus:

S.No.	Contents
1.	**Human Factors in Virtual Reality and Simulation**[101,102] Utilizing virtual reality for human factors research and assessment Human-in-the-loop simulations for usability testing and performance evaluation Challenges and considerations in virtual reality studies
2.	**Advanced Ergonomics and Workplace Design**[103,104] Applying biomechanical analysis in ergonomic design Ergonomic assessments for complex work environments Integrating digital human modeling into ergonomic interventions
3.	**Complex User Studies** Designing user studies with multiple variables Data collection and analysis for complex user studies (advanced statistical methods for analysis)
4.	**Advanced Ergonomic Assessments** Biomechanical assessments Physiological assessments Integrating ergonomic improvements
5.	**Case Studies and Real-World Applications** Analyzing real-world human factors challenges and case studies Presentations of student projects applying advanced methods Ethical considerations and limitations of advanced methods

[101] MSc in Tech, Work and Health, KTH [100]
[102] MSc Ergonomics and Human Factors, University of Derby [101]
[103] Master's and Ph.D. in Human-Computer Interaction within the School of Computer Science, Carnegie Mellon University [102]
[104] Master's and Ph.D. in Human-Centred Design & Engineering, focusing on the design and evaluation of interactive systems, University of Washington [103]

Suggested Books:

1. Young, M., & Stanton, N. (2019). *Advanced Human Factors Methods: A Practical Guide*. Boca Raton, FL. CRC Press.
2. Burdea, G. C., & Coiffet, P. (2003). *Virtual Reality Technology*. Hoboken, NJ. Wiley.
3. Fuchs, P., Moreau, G., & Moreau, G. (2016). *Virtual Reality and Augmented Reality: Myths and Realities*. Boca Raton, FL. CRC Press.
4. Kroemer, K. H. E., Kroemer, H. K., & Kroemer-Elbert, K. E. (2001). *Ergonomics: How to Design for Ease and Efficiency.* Upper Saddle River, NJ. Prentice Hall.
5. Konz, S., & Johnson, R. E. (2000). *Occupational Ergonomics: A Practical Approach*. Boca Raton, FL. CRC Press.
6. Hackos, J. T., & Redish, J. C. (1998). *User and Task Analysis for Interface Design*. Hoboken, NJ. Wiley.
7. Beyer, H., & Holtzblatt, K. (1997). *Contextual Design: Defining Customer-Centered Systems*. San Francisco, CA. Morgan Kaufmann.
8. Karwowski, W., & Marras, W. S. (2003). *Occupational Ergonomics: Principles and Applications.* Boca Raton, FL. CRC Press.
9. Shorrock, S., & Williams, C. (2016). *Human Factors and Ergonomics in Practice: Improving System Performance and Human Well-Being in the Real World*. Boca Raton, FL. CRC Press.

Course Title: Risk, Safety, and Human Reliability

Course Code: HF612

Credit Structure: L-T-P-Credit: 2-0-1-3

Course Summary:

This course explores the principles, methods, and practices related to risk assessment, safety management, and human reliability in complex systems. It focuses on understanding and mitigating potential hazards, ensuring occupational health and safety, and enhancing system performance through effective risk management strategies.

Course Pre-requisites:

Foundational knowledge in safety engineering, human factors studies, occupational health and safety principles, and an understanding of systems thinking.

Course Objectives:

The main objectives of the course are to:

- Understand Risk and Safety: Develop a solid understanding of risk assessment, safety management principles, and their significance incomplex systems across various industries.
- Apply Human Factors: Integrate human factors principles into riskassessment and safety management, considering ergonomic, cognitive, and psychosocial factors.
- Mitigate Hazards: Identify potential hazards and apply appropriate risk control measures to ensure occupational health and safety in diverse work environments.
- Analyze Human Reliability: Assess human error probabilities and apply human reliability analysis techniques to enhance system performance and safety.
- Implement Effective Safety Practices: Develop skills to design and implement Safety Management Systems (SMS), fostering a positive safety culture and continuous improvement in risk management practices.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Risk Management and Safety**[105,106] Fundamentals of Risk and Safety Defining risk and safety in the context of complex systems. Understanding the importance of risk assessment in various industries. Historical perspective and evolution of safety management Risk Assessment Techniques Overview of quantitative and qualitative risk assessment methods. Identifying and analyzing potential hazards, including human and organizational factors. Applying risk matrices, fault trees, and event trees.
2.	**Occupational Health and Safety**[107,108,109] Occupational Health and Safety Principles Understanding the importance of occupational health and safety (OHS) in the workplace. Legal and regulatory frameworks governing workplace safety. Identifying common occupational hazards and their impact on employee well-being. Hazard Identification and Risk Control Methods for identifying workplace hazards, including ergonomic, chemical, and physical hazards. Developing and implementing effective risk control measures. Incorporating human factors considerations in OHS risk management.
3.	**Safety Management Systems**[110,111] Safety Culture and Human Factors Understanding the role of organizational culture in promoting safety.

[105] MSc Tech, Work and Health, KTH [115]
[106] MSc Occupational Health and Safety Management, (NEBOSH), University of Hull [116]
[107] Course on Risk Management, Stockholm University [117]
[108] MSc Human Factors and Systems Safety, Lund University [118]
[109] MSc Aviation Safety Management, Risk and Regulations, Cranfield University [119]
[110] Certificate course on Reliability, University of Maryland [120]
[111] Course on CRM, Threat and Error Management, Swinburne University of Technology [121]

	Addressing human factors challenges in safety management. Strategies for fostering a positive safety culture within organizations. Safety Management Systems (SMS) Introduction to Safety Management Systems (SMS) and theircomponents. Integrating risk assessment, hazard identification, and incidentreporting into SMS. Case studies of successful SMS implementation in various industries.
4.	**Human Reliability and Error Management**[112,113] Human Reliability Analysis (HRA) Understanding human factors in reliability and error analysis. Understanding the first- and second-generation methods (SPAR-H, THERP, CREAM, etc.) Techniques for assessing human error probability in complex systems. Applying HRA methods to improve system performance and safety. Error Management and Human-Centered Design Strategies for preventing and mitigating human errors in design and operation. Incorporating human-centered design principles to reduce error likelihood. Designing interfaces and procedures to minimize cognitive workload and errors.
5.	**Case Studies and Real-World Applications** Case Studies in Risk and Safety Analyzing real-world case studies of risk assessment, safety management, and human reliability. Identifying lessons learned and best practices from various industries. Evaluating the role of human factors in preventing accidents and incidents. Ethical Considerations and Emerging Trends Discussing ethical considerations in risk management and occupational health and safety culture vs safety. Exploring emerging trends, technologies, and challenges in the field. Presenting student projects showcasing comprehensive understandingof

[112] Course on Forensic Psychology, Stockholm University [122]
[113] Course on Ethics and Standards in Psychology, Walden University [123]

	risk management and occupational health and safety.

Suggested Books:

1. Rausand, M., & Schjølberg, I. H. (2014). *Risk Assessment: Theory, Methods, and Applications*. Hoboken, NJ. Wiley.
2. Reason, J. (1990). *Human Error*. UK. Cambridge University Press.
3. Stolzer, A. J., Halford, C. D., & Goglia, J. J. (2008). *Safety Management Systems in Aviation*. Farnham, UK. Ashgate Publishing.
4. Petersen, D. (2016). *Safety Management: A Human Approach*. Boca Raton, FL. CRC Press.
5. Reese, C. D. (2001). *Occupational Health and Safety Management: A Practical Approach*. Boca Raton, FL. Lewis Publishers.
6. CCPS (Center for Chemical Process Safety). (2000). *Introduction to Process Safety for Undergraduates and Engineers*. Hoboken, NJ. Wiley-AIChE.
7. Fenton, N., & Neil, M. (2012). *Risk Assessment and Decision Analysis with Bayesian Networks*. Boca Raton, FL. CRC Press.
8. Flin, R., Mitchell, L., & O'Connor, P. (2008). *Safety Culture: Theory, Method and Improvement*. Farnham, UK. Ashgate Publishing.
9. Boring, R. L., & Domeshek, D. A. (2015). *Human Error and System Design and Management*. Boka Raton, FL. CRC Press.
10. Yoe, C. (2011). *Principles of Risk Analysis: Decision Making Under Uncertainty*. Boka Raton, FL. CRC Press.

Semester-II

Course Title: Interactive System Design and Evaluation-I (User Experience and Interaction Design)

Course Code: HF613

Credit Structure: L-T-P-Credit: 2-1-0-3

Course Summary:

This course provides an in-depth exploration of the principles, methods, and techniques for designing and evaluating interactive systems from a user experience (UX) and human-computer interaction (HCI) perspective. Through theoretical discussions, hands-on activities, and real-world case studies, students will gain the skills to create user-centered interactive solutions.

Course Pre-requisites:

Foundational knowledge in HCI, familiarity with usability testing methodologies, understanding of psychology in design, and exposure to graphic design or UI design principles.

Course Objectives:

The main objectives of the course are to:

- Understand the fundamental concepts of user experience (UX) and human-computer interaction (HCI), including their historical evolution and significance in modern technology.
- Apply user-centred design principles to identify and address user needs and goals, emphasizing usability, accessibility, and inclusivity in interactive system design.
- Demonstrate proficiency in interaction design fundamentals, including the creation of intuitive and efficient user interfaces through the utilization of affordances and feedback mechanisms.
- Apply visual and information design principles to enhance user experience, balancing aesthetics and usability in interface design while effectively presenting data.

- Develop competence in designing mobile and responsive interfaces, considering the challenges posed by various screen sizes and devices, and creating user-friendly mobile applications and websites.

Course Syllabus:

S.No.	Contents
1.	**Introduction to User Experience and HCI**[114] Overview of user experience and human-computer interaction concepts Historical context and evolution of interactive system design Importance of user-centered design principles in modern technology
2.	**User-Centered Design Principles**[115,116] Understanding user needs and goals in design Principles of usability and user-centered design Incorporating accessibility and inclusivity in interactive system design
3.	**Interaction Design Fundamentals**[117] Elements of effective interaction design: affordances, feedback, and more Mapping user tasks to interactive functionalities Designing intuitive and efficient user interfaces
4.	**Visual and Information Design**[118] Principles of visual design and its impact on user experience Data visualization techniques and effective information design Balancing aesthetics and usability in interface design

[114] MSc in Human-Computer Interaction, University College London (UCL) [104]
[115] MSc in Information Science and Technology - Human-Computer Interaction, Cornell University [105]
[116] MS in Human-Centred Computing, Georgia Institute of Technology [106]
[117] Course on Creative Digital Media, TU Dublin [107]
[118] MSc Web and Mobile Development Technologies, Northumbria University Newcastle [108]

5.	**Mobile and Responsive Design**[119,120] Design considerations for mobile and responsive interfaces Challenges and opportunities in designing for various screen sizes and devices Hands-on activities creating mobile-friendly interfaces

Suggested Books:

1. Norman, D. A. (2013). *The Design of Everyday Things*. NY. Basic Books.
2. Preece, J., Rogers, Y., & Sharp, H. (2015*). Interaction Design: Beyond Human-Computer Interaction*. Hoboken, NJ. Wiley.
3. Cooper, A., Reimann, R., & Cronin, D. (2014). *About Face: The Essentials of Interaction Design*. Hoboken, NJ. Wiley.
4. Shneiderman, B., & Plaisant, C. (2016). *Designing the User Interface: Strategies for Effective Human-Computer Interaction*. Boston, MA. Pearson.
5. Dix, A., Finlay, J., Abowd, G. D., & Beale, R. (2003). *Human-Computer Interaction (3rd ed.)*. Boston, MA. Pearson.
6. Rogers, Y., Sharp, H., & Preece, J. (2015). *Interaction Design: Beyond Human-Computer Interaction (3rd ed.)*. Hoboken, NJ. Wiley.
7. Garrett, J. J. (2011). *The Elements of User Experience: User-Centered Design for the Web and Beyond*. Berkeley, CA. New Riders.
8. Saffer, D. (2009). *Designing for Interaction: Creating Innovative Applications and Devices*. New Berkeley, CA. Riders.
9. Buley, L. (2013). *The User Experience Team of One: A Research and Design Survival Guide*. Brooklyn, NY. Rosenfeld Media.

[119] Course on Usability Evaluation Methods, University of Melbourne [109]
[120] MS in Human-Centred Design and Engineering, University of Washington [110]

Course Title: Interactive System Design and Evaluation-II (Evaluation and Usability Testing)

Course Code: HF614

Credit Structure: L-T-P-Credit: 2-1-0-3

Course Summary:

This course provides an in-depth exploration of the principles, methods, and techniques for designing and evaluating interactive systems from a user experience (UX) and human-computer interaction (HCI) perspective. Through theoretical discussions, hands-on activities, and real-world case studies, students will gain the skills to create user-centered interactive solutions. This course builds on the last course and extends the insights gained in terms of evaluation and theory.

Course Pre-requisites:

Successful completion of a preceding UX/HCI course HF613, an advanced understanding of HCI principles, proficiency in usability testing and evaluation, and further exposure to advanced graphic design or UI design principles.

Course Objectives:

The main objectives of the course are to:

- Enable students to comprehend the fundamentals of usability evaluation, including expert reviews and usability testing, and grasp their significance in the iterative design process.
- Equip students with the skills to perform heuristic evaluations, recognize usability issues within interactive systems, and propose enhancement solutions.
- Provide students with a thorough understanding of the role of usability testing in iterative design, emphasizing its value in gathering user feedback and driving user-centred improvements.
- Empower students with the capacity to employ various user research techniques, such as interviews, surveys, and contextual inquiry, to collect, analyze, and interpret user insights, behaviours, and needs for informed design decisions.
- Foster students' ability to create user personas and scenarios, facilitating the development of user-centred design solutions that address specific user expectations and requirements.

Course Syllabus:

S.No.	Contents
1.	**User Research Techniques**[121] Methods for gathering user insights: interviews, surveys, and contextual inquiry Analyzing user behaviors, needs, and expectations Creating user personas and scenarios to inform design decisions
2.	**Usability Evaluation Methods-I**[122] Introduction to usability evaluation techniques The procedure of conducting evaluations to identify usability issues Understanding the role of usability evaluation and usability testing in iterative design
3.	**Usability Evaluation Methods-II** Study of usability evaluation methods such as usability inspection, pluralistic walkthrough, cognitive walkthrough, heuristic walkthrough, metaphors of human thinking (MOT), persona-based inspection, usability inquiry, expert reviews, and heuristic evaluation
3.	**Prototyping and Iterative Design**[123] The importance of prototyping in interactive system design Hands-on experience with rapid prototyping tools Applying iterative design principles based on user feedback
4.	**User Experience Metrics and Evaluation**[124] Defining key performance indicators for user experience evaluation Collecting and analyzing user experience data Assessing the effectiveness of interactive solutions using user-centered metrics

[121] MSc in Interaction Design and Technologies, University of Paris-Sud [111]
[122] MSc in Human-Computer Interaction, Aalto University [112]
[123] MSc Eng in Risk Management and Safety Engineering, Lund University [113]
[124] Master in Risk Analysis, University of Stavanger [114]

5.	**Case Studies and Real-World Applications** Analyzing real-world user experience challenges and case studies Presentations of student projects showcasing user-centered design and evaluation. Ethical considerations in interactive system design and user data privacy

Suggested Books:

1. Benyon, D. (2019). *Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design*. London, UK. Pearson.
2. Nielsen, J. (1993). *Usability Engineering*. San Francisco, CA. Morgan Kaufmann.
3. Tidwell, J. (2010). *Designing Interfaces: Patterns for Effective Interaction Design*. Sebastopol, CA. O'Reilly Media.
4. Snyder, C. (2003). *Paper Prototyping: The Fast and Easy Way to Design and Refine User Interfaces.* San Francisco, CA. Morgan Kaufmann.
5. Rubin, J. (1994). *Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests.* NY. Wiley.
6. Barnum, C. M. (2010). *Usability Testing Essentials: Ready, Set... Test!* San Francisco, CA. Morgan Kaufmann.
7. Tullis, T., & Albert, W. (2013). *Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics.* San Francisco, CA. Morgan Kaufmann.
8. Krug, S. (2009). *Rocket Surgery Made Easy: The Do-It-Yourself Guide to Finding and Fixing Usability Problems.* Berkeley, CA. New Riders.

Course Title: Investigative and Legal Dimensions of Human Factors

Course Code: HF615

Credit Structure: L-T-P-Credit: 2-0-1-3

Course Summary:

This course explores the intersection of human factors with investigations, legal proceedings, and forensic applications. Students will gain an understanding of how human factors principles are applied in forensic analysis, accident investigations, and legal contexts. Emphasis will be placed on the role of human factors experts in legal cases and the ethical considerations involved in providing expert testimony.

Course Pre-requisites:

Foundational knowledge in human factors principles, basic familiarity with forensic science or investigations, exposure to legal studies or law principles, and knowledge of ethics in human factors HF623.

Course Objectives:

The main objectives of the course are to:

- Understand Forensic Human Factors: Develop a comprehensive understanding of how human factors principles are applied in forensic investigations, accident analysis, and legal proceedings.
- Comprehend Legal Contexts: Comprehend the legal system's role in integrating human factors expertise, including ethical considerations, expert testimony, and the impact of human factors analysis on legal outcomes.
- Analyze Accident Investigations: Apply human factors analysis techniques to accident investigations, identifying contributing factors, root causes, and human performance-related elements.
- Enhance Communication Skills: Develop effective communication skills for conveying complex human factors concepts to legal professionals, including the process of providing expert testimony.
- Explore Emerging Trends: Discuss emerging trends and challenges in the intersection of human factors and the legal system, such as technology's impact on digital forensics and ethical considerations.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Investigative and Legal Human Factors**[125,126] Human Factors in Forensic Context Overview of the role of human factors in forensic investigations and legal proceedings. Understanding how human performance, cognition, and behavior impact accidents and incidents. Legal and Ethical Considerations Introduction to the legal system and the role of human factors experts in legal cases.
2.	**Forensic Human Factors Analysis**[127,128,129] Accident Investigation Techniques Overview of accident investigation methods and their integration with human factors analysis. Applying root cause analysis, human error analysis, and contributing factors identification. Human Factors in Incident Reconstruction Integrating human factors principles into incident reconstruction and analysis. Analyzing the role of perception, attention, and decision-making in accident scenarios.
3.	**Expert Testimony and Communication**[130] Human Factors Expert Testimony Understanding the process of providing expert testimony in legal cases. Developing effective communication skills for presenting complexhuman factors concepts to legal professionals. Case Studies and Legal Applications

[125] MSc Safety and Accident Investigation, Cranfield University [124]
[126] MPhil in Aeronautical Accident Investigation, Capitol Technology University [125]
[127] Course on Traffic Crash Investigation and Reconstruction, Northwestern University [126]
[128] Masters in Global Health, University of Gothenburg [127]
[129] Research on Cognitive Interview, UCLA [128]
[130] MS in Digital Forensics, University of Central Florida [129]

	Analyzing real-world case studies where human factors played apivotal role in legal proceedings. Exploring the impact of human factors analysis on verdicts and legal outcomes.
4.	**Human Factors in Criminal Investigations**[131] Cognitive Interviewing Techniques Introduction to cognitive interviewing techniques for extractingaccurate information from witnesses and suspects. Applying cognitive principles to enhance investigative interviews. Human Factors in Criminal Profiling Exploring the role of human factors in criminal profiling and behavior analysis. Ethical considerations in using human factors insights for criminal investigations.
5.	**Emerging Trends and Future Directions**[132] Technology and Digital Forensics (Related to data analytics) Exploring the application of human factors principles in digital forensics and cybersecurity investigations. Analyzing human-computer interaction challenges in digital evidence collection. Ethical Consideration and Future Directions Discussing ethical challenges in forensic human factors analysis. Exploring emerging trends, technologies, and challenges in the field.
6.	**Product Liability**[133] Ethical considerations in providing expert testimony, maintaining objectivity, and adhering to professional standards.

Suggested Books:

[131] Course on Products Liability, University of Minnesota [130]

[132] MS in Statistics with courses relevant to advanced statistical techniques used in human factors research, Stanford University [131]

[133] Master's and Ph.D. programs in Psychology with research areas involving advanced statistical techniques, University of Texas at Austin [132]

1. Salmon, P. M., & Walker, G. H. (2017). *Forensic Human Factors and Ergonomics: Case Studies and Analysis*. Boka Raton, FL. CRC Press.
2. Salas, E., & Maurino, D. (2010). *Human Factors in Aviation*. San Diego, CA. Academic Press.
3. Cutler, B. L. (2007). *Expert Testimony on the Psychology of Eyewitness Identification*. UK. Oxford University Press.
4. Young, M. S., & Reed, M. P. (2009). *Forensic Human Factors and Ergonomics: An Introduction*. Boca Raton, FL. CRC Press.
5. Whyte, I. D. (2012). *Accident/Incident Investigation and Analysis*. Boka Raton, FL. CRC Press.
6. Fisher, R. P., & Geiselman, E. F. (2018). *Cognitive Interviewing: A Comprehensive Guide*. Abingdon, UK. Routledge.
7. Krishnamurthy, V. (2018). *Forensic Ergonomics: Principles, Applications, and Technologies*. Boka Raton, FL. CRC Press.
8. Boring, R. L., & Domeshek, D. A. (2015). *Human Error and System Design and Management*. Boka Raton, FL. CRC Press.

Course Title: Advanced Statistical Techniques in Human Factors - II

Course Code: HF616

Credit Structure: L-T-P-Credit: 2-0-1-3

Course Summary:

This course delves into advanced statistical techniques applicable to human factors and psychology research. Students will learn to analyze complex data, interpret findings, and apply advanced statistical methods to address human performance, cognition, and behavior. The course aims to enhance students' ability to conduct robust research and make evidence-based decisions in the field using the biostatistical and epidemiological case studies.

Course Pre-requisites:

Proficiency in basic statistics, successful completion of HF605, a strong background in research methods, familiarity with biostatistics and epidemiology HF627, and foundational knowledge in psychology or human factors studies.

Course Objectives:

The main objectives of the course are to:

- Master Advanced Statistical Methods: Develop a strong proficiency in utilizing advanced statistical techniques to analyze complex human factors and psychology data.
- Apply Multivariate Analysis: Apply multivariate analysis techniques to study intricate relationships among multiple variables in human performance, cognition, and behavior.
- Analyze Experimental Designs: Use advanced statistical methods to analyze factorial ANOVA, mixed-design ANOVA, and advanced regression techniques in experimental research settings.
- Employ Nonparametric Analysis: Utilize nonparametric tests to analyze data that may not meet parametric assumptions, ensuring robust analysis of human factors and psychological data.
- Model Complex Relationships: Apply structural equation modeling (SEM) to model complex relationships and interactions in human factors and psychology research, enhancing understanding of intricate factors.

Course Syllabus:

S.No.	Contents
1.	**Fundamentals of Advanced Statistics**[134,135] Review of Basic Statistics Recap of basic statistical concepts, including hypothesis testing, correlation, and regression. Introducing the need for advanced statistical techniques in human factors and psychology research. Introduction to Epidemiology and Biostatistics Multivariate Analysis Techniques[136] Introduction to multivariate analysis, including MANOVA, MANCOVA, and discriminant analysis. Applying multivariate techniques to study complex relationships in human factors studies. Time series and Trend analysis[137]
2.	**Experimental Design and Analysis**[138,139] Factorial ANOVA and Mixed-Design ANOVA In-depth exploration of factorial ANOVA, including main effects and interactions. Application of mixed-design ANOVA to analyze repeated measuresand between-subjects factors. Advanced Regression Techniques Regression analysis beyond linear regression, including logistic regression and hierarchical regression. Application of advanced regression techniques to predict and model human behavior.

[134] Course on Multivariate Analysis, University of Southampton [133]
[135] Course on Time Series Analysis, John Hopkins Engineering [134]

[136] Master's and Ph.D. in Industrial-Organizational Psychology with focus on quantitative methods and advanced statistical techniques, Purdue University [135]
[137] Course on Experimental Design and Data Analysis, University of Glasgow [136]
[138] Master's and Ph.D. in Human Factors with research emphasis on statistical modelling and analysis, University of Illinois at Urbana-Champaign [137]
[139] Master's and Ph.D. in Industrial-Organizational Psychology with research emphasis on advanced statistical analysis, University of Minnesota [138]

3.	**Nonparametric Methods and Advanced Topics**[140,141,142,143] Nonparametric Tests Understanding nonparametric tests, including Mann-Whitney U test, Kruskal-Wallis test, and Wilcoxon signed-rank test. Application of nonparametric tests to analyze data that do not meet parametric assumptions. Structural Equation Modeling (SEM) Introduction to structural equation modeling as a comprehensive statistical approach. Applying SEM to model complex relationships and interactions in human factors and psychology research.
4.	**Special Topics in Advanced Statistics**[144,145] Bayesian Statistics Introduction to Bayesian statistics and its application in human factors research. Understanding Bayesian hypothesis testing, parameter estimation, and model comparison. Meta-Analysis Understanding the concept of meta-analysis and its relevance in synthesizing research findings. Applying meta-analysis techniques to combine and analyze results from multiple studies.
5.	**Research Design and Interpretation**[146] Advanced Research Design Considerations Exploring experimental, quasi-experimental, and longitudinal research designs. Applying advanced research design concepts to address complex research questions. Data Interpretation and Reporting

[140] Course on SEM, University of Hong Kong [139]
[141] Course on Applied Nonparametric Stats, Ohio State University [140]
[142] Course on Bayesian Stats, Stanford Online [141]
[143] Course on Meta analysis, Vrije University Amsterdam [142]
[144] MSc in Education (Research Design and Methodology), University of Oxford [143]
[145] Master in Data Science and Decisions, Naval Postgraduate school [144]
[146] MSc System Thinking Practice, Cranfield University [145]

	Techniques for effectively interpreting and communicating advanced statistical findings. Presenting complex statistical results to non-technical audiences and peers.
6.	**Case Studies** Conducting case studies to showcase the understanding and implementation of the advanced statistical techniques using the epidemiological and biostatistical data

Suggested Books:

1. Johnson, R. A., & Wichern, D. W. (2007). *Applied Multivariate Statistical Analysis*. Upper Saddle River, NJ. Pearson.
2. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate Data Analysis*. Upper Saddle River, NJ. Pearson.
3. Darlington, R. B. (1990). *Regression Analysis and Linear Models: Concepts, Applications, and Implementation*. NY. Guilford Press.
4. Tabachnick, B. G., & Fidell, L. S. (2019). *Using Multivariate Statistics (7th ed.)*. Upper Saddle River, NJ. Pearson.
5. Kline, R. B. (2015). *Principles and Practice of Structural Equation Modeling (4th ed.)*. NY. Guilford Press.
6. Gelman, A., Carlin, J. B., Stern, H. S., Dunson, D. B., Vehtari, A., & Rubin, D. B. (2013). *Bayesian Data Analysis (3rd ed.)*. Boka Raton, FL. CRC Press.
7. Cooper, H. M., Hedges, L. V., & Valentine, J. C. (2009). *The Handbook of Research Synthesis and Meta-Analysis (2nd ed.)*. NY. Russell Sage Foundation.

Course Title: Human System Integration

Course Code: HF617

Credit Structure: L-T-P-Credit: 2-0-1-3

Course Summary:

This course explores the principles and practices of human system integration (HSI) in the context of human factors. Students will learn how to design and integrate complex systems by considering human capabilities, limitations, and interactions. The course covers the process of integrating human factors throughout the system lifecycle to optimize system performance, safety, and user satisfaction.

Course Pre-requisites:

Foundational knowledge in systems engineering, proficiency in human factors studies, familiarity with engineering psychology, and exposure to usability testing methodologies.

Course Objectives:

The main objectives of the course are to:

- Understand Human System Integration (HSI) Concepts: Gain a thorough understanding of the principles and significance of HSI in designing complex systems that optimize human capabilities and interactions.
- Apply Human-Centered Design Principles: Learn how to apply human-centered design methodologies to ensure systems are intuitive, efficient, and tailored to user needs.
- Integrate Human Factors Throughout the Lifecycle: Explore the process of integrating human factors considerations at various stages of system development, implementation, and maintenance.
- Design for Performance and Safety: Learn how to design systems that enhance human performance, cognitive tasks, and ergonomic considerations while prioritizing safety and risk management.
- Evaluate HSI Implementation: Develop skills to assess the effectiveness of HSI strategies through usability testing, case study analyses, and real-world application evaluations.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Human System Integration**[147,148,149] Fundamentals of Human System Integration Overview of human system integration concepts, history, and relevance. Understanding the importance of considering human capabilities and limitations in system design. Systems Thinking and Complexity Introduction to systems thinking and its role in understanding complex interactions. Analyzing how system complexity impacts human factors integration. System Design and Analysis Introduction to systems thinking and system engineering concepts. Analyzing system components, interfaces, and interactions.
2.	**HSI Process and Lifecycle**[150] Human-Centred Design Principles of human-cantered design and its role in human system integration. Applying user-centred methodologies in the design process. HIS Throughout the Lifecycle Integrating human factors considerations in system development, implementation, and maintenance. Addressing human factors challenges in different phases of the system life cycle.
3.	**Safety and Risk Management in System Integration**[151,152,153] Identifying safety hazards, risks, and mitigations in integrated systems. Strategies for ensuring system safety and minimizing human errors.

[147] MSc System Design and Management, MIT SDM [146]
[148] MS in Systems Engineering, John Hopkins Engineering [147]
[149] MSc Safety and Risk Management, University of Strathclyde [148]
[150] Course on Informatics and Decision Support Systems, Lund University [149]
[151] MSc System, Controls and Robotics, KTH [150]
[152] MSc Quantitative Methods for Risk Management, LSE London [151]
[153] MSc Integrated Systems Decision and Dynamics, Kansas State University [152]

	Automation and Decision Support Systems Understanding automation levels, human supervision, and trust in automation. Designing decision support systems for efficient human-computer collaboration.
4.	**Safety and Risk Management Principles**[154,155] Understanding safety and risk management concepts in complex systems. Legal and regulatory frameworks governing safety standards. Risk Assessment Techniques Quantitative and qualitative methods for identifying and analyzing potential hazards. Applying risk matrices, fault trees, and event trees.
5.	**Safety Integration in System Design**[156,157] Incorporating safety considerations into system architecture and design. Addressing human factors challenges in safety management Evaluation of HIS Implementation Assessing the effectiveness of human system integration strategies in real-world applications. Analyzing case studies of successful HSI implementations.

Suggested Books:

1. Levis, A. H. (2017). *Human Factors in Systems Engineering*. Hoboken, NJ. Wiley.
2. Shorrock, S., & Williams, C. (2016). *Human Factors and Ergonomics in Practice: Improving System Performance and Human Well-Being in the Real World*. Boca Raton, FL. CRC Press.
3. Boehm, B., & Buede, D. (2007). *Handbook of Human Systems Integration*. Hoboken, NJ. Wiley.
4. Sauter, V. L. (2017). *Decision Support Systems for Business Intelligence*. Hoboken, NJ. Wiley.
5. Kossiakoff, A., Sweet, W. N., et al. (2011). *Systems Engineering: Principles and Practice*. Wiley.

[154] Course on Colorado state University [153]
[155] HSI, Defence Acquisition University, DAU [154]
[156] Independent Study program, Federal Emergency Management Agency [155]
[157] MSc Human Factors and Systems Safety, Lund University [156]

6. Haesen, M., Lenoir, T., & Imarquès Barcelona, B. (2017). *Human-Centered Design*. Boka Raton, FL. CRC Press.
7. Stolzer, A. J., Halford, C. D., & Goglia, J. J. (2008). *Safety Management Systems in Aviation*. Burlington, VT. Ashgate Publishing.
8. Bahr, N. J. (2000). *System Safety Engineering and Risk Assessment: A Practical Approach*. Boka Raton, FL. CRC Press.
9. Rausand, M., & Høyland, A. (2004*). Risk Assessment: Theory, Methods, and Applications*. Hoboken, NJ. Wiley.

Course Title: Emergency Management and Critical Services

Course Code: HF618

Credit Structure: L-T-P-Credit: 2-0-0-2

Course Summary:

This course explores the integration of human factors principles in emergency management and critical service operations. Students will learn how to apply human factors expertise to enhance preparedness, response, and recovery in high-stress and time-sensitive environments. The course covers the design of systems, procedures, and interfaces to optimize human performance and decision-making during emergencies.

Course Pre-requisites:

Foundational knowledge in emergency management, proficiency in human factors studies, understanding of systems engineering principles, and exposure to crisis communication.

Course Objectives:

The main objectives of the course are to:

- Apply Human Factors in Crisis Response: Learn how to integrate human factors principles to optimize human performance, decision-making, and communication during emergencies.
- Design Human-Centered Emergency Systems: Acquire skills to design intuitive interfaces, decision support tools, and training programs that enhance emergency responders' effectiveness.
- Enhance Situational Awareness and Team Coordination: Explore strategies to improve situational awareness, teamwork, and communication under high-stress conditions to ensure coordinated emergency response.
- Analyze and Improve Post-Emergency operations: Develop the ability to conduct post-incident analyses, identify areas of improvement, and apply lessons learned to refine emergency procedures and human factors integration.
- Understand Emergency Management Concepts: Develop a comprehensive understanding of emergency management frameworks, components, and their relevance in critical service environments

Course Syllabus:

S.No.	Contents
1.	**Introduction to Emergency Management & Human Factors**[158,159,160] Fundamentals of Emergency Management Overview of emergency management concepts, frameworks, and components. Understanding the role of human factors in effective emergency response. Human Factors in Critical Services Exploring the application of human factors in critical service sectors such as healthcare, aviation, and transportation. Analyzing the impact of stress and urgency on human performance.
2.	**Human-Centered Design for Emergency Operations**[161] Designing Emergency Interfaces Principles of designing intuitive and effective interfaces for emergency response systems. Applying user-centered design to optimize information presentation and decision-making. Cognitive Workload and Decision Support Understanding cognitive workload during emergencies and the role of decision support tools. Evaluating the effectiveness of decision aids and automation in critical situations using the principles of resilience engineering and high-reliability organizations.
3.	**Human Performance in High-Stress Environments**[162,163] Situational Awareness and Teamwork Exploring situational awareness and its importance in team coordination during emergencies.

[158] MS in Emergency and Crisis Management, University of Nevada [157]
[159] MSc in Environment and Disaster Research, Tokoha University [158]
[160] Crew Endurance Research Portfolio on Human System Integration Program, Naval Postgraduate University [159]
[161] Master in Disaster Risk Management, Malaysian University of Technology [160]
[162] MSc in Disaster Risk Management and Climate Change Adaptation, Lund University [161]
[163] Disaster Management Training Centre, University of Tokyo [162]

	Analyzing factors affecting teamwork and communication under pressure. Stress Management and Resilience Strategies for managing stress, enhancing resilience, and maintaining cognitive performance during high-stress situations. Applying stress management techniques for emergency responders.
4.	**Training, Simulation, and Disaster Drills**[164,165] Training for Emergency Response Designing effective training programs to enhance human performance in emergencies. Analyzing the benefits of simulation-based training and disaster drills. Post-Emergency Analysis and Lessons Learned Conducting post-incident analyses to identify strengths, weaknesses, and opportunities for improvement. Applying lessons learned to refine emergency response procedures and human factors integration.

Suggested Books:

1. Owen, C. (2015). *Human Factors in Emergency Management*. Boka Raton, FL. CRC Press.
2. Fagel, M. J. (2011). *Crisis Management and Emergency Planning: Preparing for Today's Challenges*. Boka Raton, FL. CRC Press.
3. Hollnagel, E. (2011). *Resilience Engineering: Concepts and Precepts*. Burlington, VT. Ashgate Publishing.
4. Farber, D. (2012). *Decision Making in Emergency Management*. Boka Raton, FL. CRC Press.
5. Wenger, J. C., & Díaz, R. J. (2010). *Emergency Response Management of Offshore Oil Spills: Guidelines for Emergency Responders*. Hoboken, NJ. Wiley.
6. Zaremba, A. J. (2010). *Crisis Communication: Theory and Practice*. Routledge.
7. Erickson, P. A. (2006). *Emergency Response Planning for Corporate and Municipal Managers*. Boka Raton, FL. CRC Press.

[164] Course on Introduction to Qualitative Methods, Karolinska Institute [163]
[165] Course on Ethical Issues in International Health, University of Oslo [164]

8. Weick, K. E., & Sutcliffe, K. M. (2007). *Managing the Unexpected: Resilient Performance in an Age of Uncertainty*. Hoboken, NJ. Wiley.
9. Lindell, M., & Prater, C. (2007). *Teamwork and Collaboration in Emergency Management*. Boka Raton, FL. CRC Press.
10. Klann, G. (2003). *Crisis Leadership: Using Military Lessons, Organizational Experiences, and the Power of Influence to Lessen the Impact of Chaos on the People You Lead*. Greensboro, NC. Center for Creative Leadership.

Course Title: Qualitative Methods in Human Factors

Course Code: HF619

Credit Structure: L-T-P-Credit: 2-0-0-2

Course Summary:

This course explores qualitative research methods applied in the field of human factors. Students will learn how to design, conduct, and analyze qualitative studies to gain insights into human behavior, interactions, and experiences within various contexts.

Course Pre-requisites:

Strong foundation in research methods, proficiency in human factors studies, exposure to psychology or sociology principles, and familiarity with qualitative data analysis techniques.

Course Objectives:

The main objectives of the course are to:

- Apply Qualitative Data Collection Techniques: Learn to use qualitative data collection methods such as interviews, observations, and focus groups to gather rich insights from participants.
- Master Qualitative Data Analysis: Gain proficiency in analyzing qualitative data through coding, content analysis, and thematic interpretation to uncover patterns and themes.
- Interpret User Behaviors and Experiences: Develop skills to interpret qualitative findings and gain deeper insights into user behaviors, perceptions, and experiences.
- Apply Qualitative Insights to Design and Evaluation: Learn how to apply qualitative insights to inform the design, evaluation, and improvement of products, systems, and interfaces.
- Understand Qualitative Research Foundations: Develop a foundational understanding of qualitative research methodologies and their application in human factors research.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Qualitative Research**[166,167] Foundations of Qualitative Research Understanding the philosophical underpinnings of qualitative research and its relevance to human-centric system studies. Exploring the differences between qualitative and quantitative research paradigms. Ethical Considerations in Qualitative Research Examining ethical considerations specific to qualitative research, including informed consent, confidentiality, and participant well-being. Discussing strategies for addressing ethical challenges in human-centric system studies.
2.	**Qualitative Data Collection Methods** Interviews as Data Collection Exploring the use of interviews as a qualitative data collection method to capture rich insights from users. Learning techniques for conducting effective interviews, managing rapport, and eliciting meaningful responses. Observations and Field Notes Understanding the value of participant observations and field notes in studying user behaviors within human-centric systems. Analyzing strategies for conducting non-participant and participant observations in diverse contexts.
3.	**Qualitative Data Analysis**[168] Coding and Theme Development Developing skills in coding and categorizing qualitative data to identify patterns, themes, and meaningful insights. Exploring different coding techniques and software tools for qualitative analysis.

[166] Course on Qualitative Analysis and Coding, Lund University [165]
[167] Course on Qualitative Research Methods, Stockholm University [166]
[168] MS in Human Centred Design and Engineering, University of Michigan-Dearborn [167]

	Thematic Analysis and Interpretation Learning how to conduct thematic analysis to uncover deeper meanings and narratives within qualitative data. Discussing strategies for interpreting qualitative findings and drawing meaningful conclusions.
4.	**Qualitative Research Applications**[169] User Experience Studies Applying qualitative methods to study user experiences, emotions, and perceptions within human-centric systems. Analyzing how qualitative insights can inform design improvements and user-centered solutions. Case Studies and Presentations Analyzing real-world case studies where qualitative research was applied to human-centric system studies. Presenting and discussing individual or group projects applying qualitative methods.

Suggested Books:

1. Creswell, J. W. (2018). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. Thousand Oaks, CA. SAGE Publications.
2. Marshall, C., & Rossman, G. B. (2016). *Designing Qualitative Research*. Thousand Oaks, CA. SAGE Publications.
3. Berg, B. L. (2009*). Qualitative Research Methods for the Social Sciences*. Boston, MA. Pearson.
4. Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis: A Methods Sourcebook*. Thousand Oaks, CA. SAGE Publications.
5. Saldana, J. (2016*). The Coding Manual for Qualitative Researchers*. Thousand Oaks, CA. SAGE Publications.
6. Patton, M. Q. (2014). *Qualitative Research & Evaluation Methods*. Thousand Oaks, CA. SAGE Publications.
7. Bernard, H. R. (2011). *Analyzing Qualitative Data*. Thousand Oaks, CA. SAGE Publications.

[169] MSc in User Experience Design, Loughborough University [168]

8. Gargani, J. J. (2016). *Qualitative Methods in Human-Centered Evaluation*. Charlotte, NC. Information Age Publishing.
9. Silverman, D. (2013). *Interpreting Qualitative Data: Methods for Analyzing Talk, Text, and Interaction*. Thousand Oaks, CA. SAGE Publications.
10. Maxwell, J. A. (2013). *Qualitative Research Design: An Interactive Approach*. Thousand Oaks, CA. SAGE Publications.
11. Charmaz, K. (2014). *Constructing Grounded Theory*. Thousand Oaks, CA. SAGE Publications.
12. Thorne, S. (2008). *Interpretive Description: Qualitative Research for Applied Practice*. Abingdon, UK. Routledge.

Course Title: Human-Centred Design

Course Code: HF620

Credit Structure: L-T-P-Credit: 2-0-0-2

Course Summary:

This course provides an in-depth exploration of human-centered design to create innovative and user-centric products, systems, and experiences. Students will learn a range of design techniques, tools, and approaches to address user needs, enhance usability, and foster creativity.

Course Pre-requisites:

Foundational knowledge in user-centered design principles, familiarity with design thinking methodologies, exposure to usability testing, and basic knowledge in product design or engineering.

Course Objectives:

The main objectives of the course are to:

- Understand Human-Centered Design Principles: Develop a solid understanding of human-centered design principles, including empathy, user engagement, and iterative design, to create solutions that meet user needs.
- Apply User Research Techniques: Learn to plan and conduct effective user research using various methods such as interviews, observations,and surveys to gain insights into user behaviors and preferences.
- Generate Creative Design Concepts: Develop skills in generating andevaluating innovative design concepts through collaborative ideation sessions and brainstorming techniques.
- Create Prototypes for User Testing: Gain proficiency in prototyping techniques to create low-fidelity and high-fidelity prototypes for usability testing and iterative design.
- Apply Iterative Design Process: Learn the importance of an iterative design process, incorporating user feedback to refine and improve design solutions throughout the development cycle.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Human-Centered Design for products, services, and systems**[170] Fundamentals of Design Understanding the principles and importance of product , services, and systems design in creating user-friendly and impactful solutions. Product planning including developing a strategy for product or service in the context of the organizational goals, skill-sets, and resources. Exploring the design thinking process and its stages: empathize, define, ideate, prototype, and test. User-Centered Problem Framing Learning how to frame design challenges through the lens of userneeds and aspirations. Analyzing real-world examples of successful user-centered problem framing.
2.	**User Research and Empathy**[171] User Research Methods Exploring various user research methods, including interviews,surveys, and contextual inquiries, to gather insights about user behaviors and preferences. Learning how to plan and conduct effective user research studies. Building Empathy for Users. Understanding the importance of empathy in human-centered design. Practicing techniques to immerse oneself in users' perspectives and experiences. Project Planning by understanding user dynamics and interactions. User Needs Assessment
3.	**Ideation and Prototyping for Product Design**[172] Ideation Techniques Learning creative ideation techniques to generate a wide range of

[170] Course on Ideation and Prototyping, NYU [169]
[171] Course on Creativity and Design Thinking, Standford University [170]
[172] MS in Interaction Design, University of Technology Sydney [171]

	product design concepts. Collaborating in brainstorming sessions and idea generation activities. Concept Generation: Creativity, Brainstorming and Structured Methods such as Morphological Matrices, Functional Decomposition, etc. Product Architecture, Product Platforms and Technology Roadmaps. Design for the Environment and Whole Systems Design (Biomimicry Methods) Concept Selection (concept screening, concept scoring and testing) as a conjoint analysis for early-stage design decisions.
4.	**Prototyping for Product Design**[173] Prototyping (Early stage, live, 6-up sketches, service, experience, paper, and wireframe prototyping) and Iteration Understanding the role of prototyping in refining and validating design solutions. Developing skills in creating low-fidelity to high-fidelity prototypes for testing and iteration. Applying Rapid Innovation Cycle (Tangible Prototypes, Additive Manufacturing, Fused Deposition Modes, Water Jet Cutting, Laminated Object Manufacturing, Direct Shell Production Casting, and Laser Cutting)
5.	**Visualization and Communication** Methods and tools for communicating actionable design research, design results that can have impact. Developing design portfolio
4.	**Product Development and Testing**[174,175] Design for manufacturing and sustainability Patents and Intellectual property Product testing and liability Understanding the role of prototyping in refining and validating design solutions.

[173] MSc Patient Safety and Clinical Factors, University of Edinburgh [172]
[174] MSc in Healthcare Quality and Safety, Harvard Medical School [173]
[175] MSc in Human Factors and Ergonomics, Loughborough University [174]

Suggested Books:

1. Norman, D. A. (2013). *The Design of Everyday Things*. NY. Basic Books.
2. Lockwood, T., & Papke, E. (2010). *Design Thinking: Integrating Innovation, Customer Experience, and Brand Value*. NY. Allworth Press.
3. Brown, T. (2009). *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. NY. Harper Business.
4. Saffer, D. (2010). *Designing for Interaction: Creating Innovative Applications and Devices*. Berkeley, CA. New Riders.
5. Goodwin, K. (2009). *Designing for the Digital Age: How to Create Human-Centered Products and Services*. Hoboken, NJ. Wiley.
6. Ulrich, K., & Eppinger, S. (2011). Product Design and Development. NY: McGraw Hill.
7. Norman, D. A. (2005). *Emotional Design: Why We Love (or Hate) Everyday Things*. NY. Basic Books.

Course Title: Human Factors in Healthcare I (Foundation)

Course Code: HF621

Credit Structure: L-T-P-Credit: 1-0-1-2

Course Summary:

This course explores the application of human factors principles in healthcare settings. Students will learn how to optimize healthcare processes, technologies, and environments to improve patient safety, quality of care, and overall healthcare system performance.

Course Pre-requisites:

Foundational knowledge in healthcare systems, proficiency in human factors studies, familiarity with ergonomics in healthcare, and exposure to patient safety principles.

Course Objectives:

The main objectives of the course are to:

- Understand Human Factors Principles in Healthcare: Gain a comprehensive understanding of human factors concepts and their application in healthcare settings to enhance patient safety and quality of care.
- Analyze Medical Errors and Patient Safety: Develop the ability to analyze medical errors, their causes, and consequences, and implement proactive strategies to improve patient safety.
- Apply Ergonomics and User-Centered Design: Apply ergonomic principles and user-centered design approaches to healthcare environments, equipment, and technologies to optimize healthcare worker well-being and efficiency.
- Evaluate Healthcare Technology Usability: Acquire skills in evaluating the usability of healthcare technologies and medical devices, ensuring user-friendly interfaces and safe interactions.
- Integrate Human Factors in Healthcare Processes: Integrate human factors principles into healthcare processes, clinical decision-making,and system design to enhance overall healthcare system performance.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Human Factors in Healthcare**[176] Overview of Human Factors in Healthcare Understanding the role of human factors in healthcare systems, patient safety, and error prevention. Exploring historical incidents and the need for a human-centered approach in healthcare.
2.	**Human-Centered Design in Healthcare** Applying human-centered design principles to healthcare processes, workflows, and technologies. Analyzing case studies of successful human-centered design implementations in healthcare.
3.	**Patient Safety and Medical Error Reduction**[177] Understanding Medical Errors Examining the types, causes, and consequences of medical errors in healthcare. Discussing the impact of medical errors on patient safety and healthcare organizations.
4.	**Error Reporting and Analysis** Learning methods for reporting, investigating, and analyzing medical errors to identify root causes. Studying proactive strategies for error prevention, including safety culture and systems thinking.
5.	**Healthcare Ergonomics and User-Centered Design**[178] Ergonomics in Healthcare Environments Applying ergonomic principles to healthcare workspaces, equipment, and

[176] MSc Human Factors in Patient Safety, University of Medicine and Health Sciences [175]
[177] Course on Human Factors for Patient Safety, Staffordshire University [176]
[178] Project on Human Factors and Ethics, Trinity College Dublin [177]

	patient interactions. Designing ergonomic interventions to reduce healthcare worker injuries and improve efficiency.

Suggested Books:

1. Ma, S., & Wang, S. J. (2019). *Patient Safety and Healthcare Error Reduction: A Practical Guide*. Boca Raton, FL. CRC Press.
2. Bisson, T., & Crane, B. (2019). *Ergonomics in Healthcare and Rehabilitation*. Boca Raton, FL. CRC Press.
3. Kaplan, B., & Schiff, D. (2015). *Healthcare Human Factors: Design Considerations for Health IT*. Boca Raton, FL. CRC Press.
4. Antunes, P., & Roper, A. (2021). *Human Factors in Healthcare: Level Up Your Practice and Impact*. Boca Raton, FL. CRC Press.
5. Munger, E. C., & Wears, J. F. (2016). *Designing for Patient Safety: Developing Methods to Integrate Patient Safety Concerns with the Design Process*. Boca Raton, FL. CRC Press.
6. Waterson, P. (2016). *Patient Safety Culture: Theory, Methods, and Application*. Boca Raton, FL. CRC Press.
7. Higgs, J., et al. (2008). *Clinical Reasoning in the Health Professions*. Oxford, UK. Butterworth-Heinemann.
8. Nestel, D., & Kelly, M. (2015). *Healthcare Simulation Education: Evidence, Theory and Practice*. Hoboken, NJ. Wiley.
9. Youngberg, B. (2010). *Patient Safety Handbook*. Burlington, MA. Jones & Bartlett Learning.
10. Wiklund, M., & Dwyer, A. (2010). *Medical Device Use Error: Root Cause Analysis*. Boca Raton, FL. CRC Press.
11. Blandford, A., et al. (2013*). Improving Patient Safety: The Implementation of Clinical Human Factors*. Boca Raton, FL. CRC Press.
12. Levine, A. I., & Hui, J. (2018). *Teamwork and Collaboration in Medical Simulation*. NY. Springer.
13. Crawford, S. B., & Charnetski, M. G. (2018*). Legal and Ethical Issues in Healthcare Simulation*. NY. Springer.

Course Title: Human Factors in Healthcare II (Advanced)

Course Code: HF622

Credit Structure: L-T-P-Credit : 1-0-1-2

Course Summary:

This course explores the application of human factors principles in healthcare settings. Students will learn how to address advanced issues related to healthcare design.

Course Pre-requisites:

Proficiency in advanced human factors studies HF611, foundational knowledge in healthcare systems, familiarity with advanced ergonomics in healthcare, and exposure to patient-centered design principles.

Course Objectives:

The main objectives of the course are to:

- Understand Cognitive Biases and Decision-Making: Explore cognitive biases and their impact on clinical decision-making, and develop strategies to minimize errors and enhance diagnostic accuracy.
- Manage Human-Automation Interaction: Analyze the complexities of human-automation interaction in healthcare and design effective interfaces to support decision-making and patient care.
- Utilize Simulation for Training and Skill Development: Understand the role of simulation in healthcare training and implementation, scenario-based training, and enhance healthcare professionals' skills and competencies.
- Enhance Teamwork and Communication: Develop skills in fostering effective teamwork, communication, and collaboration among healthcare providers to improve patient outcomes and satisfaction.
- Apply Ethical and Legal Considerations: Explore ethical and legal implications of human factors in healthcare, addressing patient privacy, informed consent, and regulatory compliance.

Course Syllabus:

S.No.	Contents
1.	**Human Factors in Clinical Decision-Making**[179] Cognitive Biases and Clinical Decision Errors Exploring cognitive biases and heuristics affecting clinical decision-making. Discussing strategies to mitigate cognitive errors and improve diagnostic accuracy.
2.	**Human-Automation Interaction in Healthcare** Analyzing the role of automation in healthcare settings and its impact on decision-making and patient safety. Learning approaches to design effective human-automation interfaces in healthcare systems.
3.	**User-Centered Healthcare Technology** Evaluating the design and usability of healthcare technologies, electronic health records, and medical devices. Learning methods for involving healthcare providers and patients in technology design and evaluation.
4.	**Healthcare Simulation and Training**[180] Simulation in Healthcare Training Understanding the role of simulation in healthcare education, training, and skill development. Analyzing different types of healthcare simulation and their effectiveness.
5.	**Teamwork and Communication in Healthcare** Examining the importance of teamwork, communication, and collaboration in healthcare settings. Learning strategies to enhance interdisciplinary collaboration and patient-centered care.

[179] MSc in Data and AI Ethics, University of Edinburgh [178]
[180] MPhil in Ethics of AI, Data and Algorithms, University of Cambridge [179]

Suggested Books:

1. Ma, S., & Wang, S. J. (2019). *Patient Safety and Healthcare Error Reduction: A Practical Guide*. Boka Raton, FL. CRC Press.
2. Bisson, T., & Crane, B. (2019). *Ergonomics in Healthcare and Rehabilitation*. Boka Raton, FL. CRC Press.
3. Kaplan, B., & Schiff, D. (2015). *Healthcare Human Factors: Design Considerations for Health IT*. Boka Raton, FL. CRC Press.
4. Antunes, P., & Roper, A. (2021). *Human Factors in Healthcare: Level Up Your Practice and Impact*. Boka Raton, FL. CRC Press.
5. Waterson, P. (2016). *Patient Safety Culture: Theory, Methods, and Application*. Boka Raton, FL. CRC Press.
6. Higgs, J., et al. (2008). *Clinical Reasoning in the Health Professions*. Oxford, UK. Butterworth-Heinemann.
7. Nestel, D., & Kelly, M. (2015). *Healthcare Simulation Education: Evidence, Theory and Practice*. Hoboken, NJ. Wiley.
8. Youngberg, B. (2010). *Patient Safety Handbook*. Burlington, MA. Jones & Bartlett Learning.
9. Wiklund, M., & Dwyer, A. (2010). *Medical Device Use Error: Root Cause Analysis*. Boka Raton, FL. CRC Press.
10. Blandford, A., et al. (2013). *Improving Patient Safety: The Implementation of Clinical Human Factors*. Boka Raton, FL. CRC Press.

Course Title: Ethics in Human Factors

Course Code: HF623

Credit Structure: L-T-P-Credit : 2-0-0-2

Course Summary:

This course delves into ethical considerations and principles within the field of human factors. Students will explore the ethical implications of designing, implementing, and using technology, products, and systems, with a focus on promoting user well-being, safety, and societal values.

Course Pre-requisites:

Foundational knowledge in ethics related to technology, proficiency in human factors studies, and familiarity with legal and regulatory frameworks in the field HF627.

Course Objectives:

The main objectives of the course are to:

- Understand Ethical Frameworks: Gain a foundational understanding of ethical theories and frameworks applicable to human factors, and develop the ability to apply them in decision-making.
- Analyze Ethical Considerations in Design: Explore the ethical implications of design choices in creating technology, products, and systems, with a focus on user well-being and societal impact.
- Navigate issues of User Privacy and Data Ethics: Develop the skills to address ethical challenges related to user privacy, data collection, and informed consent in design and research.
- Evaluate Ethics in Automation and AI: Critically assess ethical issues surrounding automation, algorithms, and artificial intelligence, considering fairness, transparency, and human agency.
- Integrate Ethics in User Experience Design: Learn to incorporate ethical considerations in user experience design, ensuring user satisfaction, trust, and the responsible use of technology.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Ethics in Human Factors**[181] Understanding Ethical Frameworks Introduction to ethical theories and frameworks relevant to human factors. Discussing the application of ethical reasoning in decision-making processes. Ethics in Human-Centered Design Exploring the ethical considerations when designing products, systems, and interfaces. Analyzing case studies of ethical successes and failures in design and technology.
2.	**User Privacy and Data Ethics** Privacy and Data Protection Examining ethical concerns related to user privacy, data collection, and data sharing. Discussing regulations and guidelines for protecting user data and ensuring informed consent. Ethical Use of User Data Analyzing ethical implications of using user data for design, research, and personalization. Learning how to balance data-driven insights with user rights and autonomy.
3.	**Ethical Considerations in Automation and AI**[182,183] Ethics of AI Understanding ethical challenges posed by automated systems, algorithms, and artificial intelligence. Discussing biases, transparency, accountability, and fairness inautomated decision-making. Human-Automation Interaction Ethics Exploring ethical aspects of human-automation interaction, including

[181] Course on Human Factors, Teamwork and Communication, University of Oxford [180]
[182] MSc in Architecture, University of Kansas [181]
[183] Interior Architecture courses, University of Oregon, School of Architecture and Environment [182]

	delegation of tasks and control. Learning how to design interfaces that respect human agency and prevent automation complacency.
4.	**Ethical Issues in User Experience**[184] User Experience and Ethical Design Discussing the role of ethics in shaping user experiences andinteractions. Analyzing how ethical considerations influence user satisfaction, trust, and engagement. Ethical Testing and Evaluation Learning ethical guidelines for user testing and evaluation of products, systems, and interfaces. Exploring the balance between rigor and user well-being in usability testing. Human Factors, Teamwork and Communication

Suggested Books:

1. Bailey, J., & Burch, M. (2016). *Ethics for Behavior Analysts*. NY. Routledge.
2. Tavani, H. T. (2015). *Ethics and Technology: Ethical Issues in an Age of Information and Communication Technology*. Hoboken, NJ. Wiley.
3. Dix, A., et al. (2007). *Ethics in Human-Computer Interaction*. Burlington, MA. Morgan Kaufmann.
4. May, L., & Hoskins, Z. (2015). *Applied Ethics: A Multicultural Approach*. NY. Routledge.
5. Falbe, T., et al. (2020). *The Ethical Design Handbook*. Sebastopol, CA. O'Reilly Media.
6. Lin, P., et al. (2012). *Robot Ethics: The Ethical and Social Implications of Robotics*. Cambridge, MA. MIT Press.
7. Jasanoff, S. (2016). *The Ethics of Invention: Technology and the Human Future*. NY. Norton & Company.
8. Anderson, M., & Anderson, S. L. (2011). *Machine Ethics*. UK. Cambridge University Press.
9. Himma, K. E., & Tavani, H. T. (2008). *Ethics in the Age of Information*. NY. Routledge.

[184] MA in Architectural Design, University of Sheffield [183]

10. Allan, A., & Morris, M. H. E. (2010). *Ethical Practice in Psychology: Reflections from the Creators of the APS Code of Ethics*. Washington, DC. American Psychological Association.
11. Hoppe, E., & Dixon, A. (2014). *Ethical Issues in Aviation*. Farnham, UK. Ashgate Publishing.
12. Floridi, L. (2010). *The Cambridge Handbook of Information and Computer Ethics*. UK. Cambridge University Press.
13. Schneier, B. (2015). *Data and Goliath: The Hidden Battles to Collect Your Data and Control Your World*. NY. Norton & Company.
14. Johnson, D. G., & Nissenbaum, H. (1995). *Computer and Information Ethics*. Upper Saddle River, NJ. Prentice Hall.
15. Stallings, W. (2018). *Network Security Essentials: Applications and Standards*. Boston, MA. Pearson.

Semester-III

Course Title: Human Factors in Built Environments

Course Code: HF624

Credit Structure: L-T-P-Credit: 2-0-0-2

Course Summary:

This comprehensive course explores the intersection of human factors with architecture, universal design, accessibility, energy efficiency, and workplace environments. It emphasizes the role of human factors in creating functional, inclusive, and sustainable built environments and explains the relationship of the human body and space planning to the design process.

Course Pre-requisites:

Foundational knowledge in architecture or environmental design, proficiency in human factors studies, familiarity with universal design and accessibility principles, and exposure to sustainability in design.

Course Objectives:

The main objectives of the course are to:

- Understand the fundamental principles of architecture and design that impact human comfort, well-being, and productivity.
- Evaluate and apply universal design principles to create accessible and inclusive built environments.
- Analyze energy-efficient design strategies and their implications for sustainability and environmental impact.
- Examine workplace and office environments about ergonomics, productivity, and employee well-being.
- Develop critical thinking skills to address real-world design challenges in various built environments.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Human Factors in Built Environments**[185] Historical perspective: The evolution of architecture and design Human factors and their significance in architecture and built environments.
2.	**Principles of Human-Centered Architecture and Design**[186,187] Architectural design elements: space, for, function, aesthetics. Spatial organization and human perception. Design principles and their impact on user experience and comfort.
3.	**Universal Design and Accessibility** Universal design seven principles Accessibility standards and guidelines Case studies in inclusive design and accessible architecture Global concerns Proxemics
4.	**Energy Efficiency in Buildings**[188] Sustainable design and energy-efficient building concepts. Passive design strategies for energy conservation. Incorporating renewable energy sources and sustainable materials in building design.
5.	**Workplace and Office Environments I** Ergonomics in workplace design Productivity and employee well-being at the workplace Innovative office design Human diversity, special population **Workplace and Office Environments II**[189]

[185] MSc in Energy efficient and environmental building design, Lund University [184]
[186] MSc Technology, Work and Health, KTH [185]
[187] Course on Human in Complex Systems, Linkoping University [186]
[188] Course on Human Factors in Systems Design, NC State University [187]
[189] MS in Engineering Management, Embry Riddle Aeronautical University [188]

	Case studies of successful workplace designs (Residential and commercial, office, hospitality, healthcare, educational, retail design) Technology integration in workplace environments. Environmental psychology and its impact on workplace design.
6.	**Building Codes, Regulations, and Ethics** Building codes and regulations to accessibility and energy efficiency Ethical considerations in architectural design and decision-making. Legal and ethical responsibilities of architects and designers.

Suggested Books:

1. Lidwell, W., Holden, K., & Butler, J. (2003). *Universal Design Principles and Models*. Boka Raton, FL. CRC Press.
2. Kaplan, W., & Kotowski, J. A. (2008). *Building Science for a Cold Climate*. Hoboken, NJ. John Wiley & Sons.
3. Yudelson, J., & Meyer, U. (2007). *The Green Building Revolution*. Washington, DC. Island Press.
4. Konz, S., & Johnson, S. (2000). *Work Design: Occupational Ergonomics*. Boka Raton, FL. CRC Press.
5. Fisher, T. (2012). *Architectural Design and Ethics: Tools for Survival*. Oxford, UK. Architectural Press.
6. Nussbaumer, L. L. (1997). *Human Factors in the Built Environment*.
7. Pheasant, S. (2016). *Bodyspace: Anthropometry, Ergonomics, and the Design of Work*. Boka Raton, FL. CRC Press.
8. Coles, J. (2015). *The Fundamentals of Interior Architecture*. London, UK. Bloomsbury Visual Arts.
9. Ziemer, C. A., & Garvey, P. V. (2019). *Human Factors in the Built Environment*. NY. Routledge.

Course Title: Human Factors in Complex Systems

Course Code: HF625

Credit Structure: L-T-P-Credit: 2-0-0-2

Course Summary:

This advanced course delves into the multifaceted field of human factors as it applies to complex systems. Students will explore the challenges and nuances of designing, operating, and managing complex systems while considering resilience, reliability, and human errors.

Course Pre-requisites:

Proficiency in systems engineering principles, advanced knowledge in human factors studies, familiarity with risk management principles, and exposure to advanced research methods.

Course Objectives:

The main objectives of the course are to:

- Understand the theoretical foundations of human factors and their relevance to complex systems.
- Understand the key principles of high-reliability organizations (HROs) and their applications in complex systems.
- Apply human factors principles to improve the design and operation of complex systems.
- Analyze and apply concepts from resilience engineering to enhance system resilience, robustness, and adaptability.
- Investigate accidents and incidents using systematic methods to identify contributing human factors.
- Examine the factors contributing to human error and strategies for error prevention and mitigation.
- Develop critical thinking skills to address real-world challenges in complex systems.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Human Factors in Complex Systems**[190,191] Overview of human factors and its relevance in complex systems. Introduction to the concept of high-reliability organizations (HROs).
2.	**High Reliability Organizations (HROs)**[192,193,194] Principles of HROs and their characteristics. Case studies of HROs in various industries. Implementing HRO principles in complex systems.
3.	**Complexity and Systems Thinking**[195,196,197] Understanding complexity in systems. Systems thinking principles and tools. Complex systems in various domains (e.g. healthcare, transportation, nuclear)
4.	**Resilience Engineering**[198,199,200] Fundamentals of resilience engineering and its role in system safety. Resilience engineering principles and approaches. Analyzing complex systems failures and recovery.
5.	**Accident Analysis**[201,202]

[190] MS in Reliability, Availability, Maintainability and Safety, NTNU [189]
[191] MSc Reliability Engineering and Asset Management, University of Manchester [190]
[192] Course on Systems Thinking, UCL [191]
[193] MS in Complex Systems Science, Arizona State University [192]
[194] MSc in Complex Systems Modelling, Kings College Londen [193]
[195] Graduate Program in Resilience Engineering, University of Tokyo [194]
[196] Masters in Risk and Resilience Engineering, University of Tsukuba [195]
[197] Course on Human Factors in Risk Management, Singapore University of Social Sciences [196]
[198] MSc in Safety and Accident Investigation, Cranfield University [197]
[199] Course on HF in Accident Investigation, SUSS [198]
[200] Course on Human Error and Safety, Purdue University [199]
[201] Course on Human Performance: Understanding Human Error, Georgia Tech [200]
[202] NASA Case study on Human Performance [201]

	Introduction to accident investigation methodologies Case studies of major accidents and incidents. Root cause analysis and identifying human factors contributions.
6.	**Human Error: Causes and Mitigation**[203,204] Understanding human error: theories and classifications Human error reduction strategies and best practices. Designing for human error tolerance.
7.	**Safety Culture and Organizational Learning in Complex Systems** Building a safety culture in complex systems Organizational learning from accidents and incidents. Strategies for continuous improvement in complex environments.
8.	**Complex System Case studies**[205] Analyzing real-world complex system cases.

Suggested Books:

1. Cooke, N. J., & Durso, F. (2008). *Human Factors in Complex Systems*. Boka Raton, FL. CRC Press.
2. Checkland, P. (1981). *Systems Thinking, Systems Practice*. Chichester, England. John Wiley & Sons.
3. Hollnagel, E. (2013). *Resilience Engineering: Concepts and Precepts*. Farnham, England. Ashgate.
4. Weick, K. E., & Sutcliffe, K. M. (2015). *Managing the Unexpected: Resilient Performance in an Age of Uncertainty*. Chichester, England. John Wiley & Sons.
5. Oster, C., Braaten, J., & Roberts, K. (2017). *High-Reliability Organizations: A Healthcare Handbook for Patient Safety & Quality*. Boka Raton, FL. CRC Press.
6. Reason, J. (2008). *Human Error*. UK. Cambridge University Press.
7. Reese, C. D. (2001). *Accident/Incident Prevention Techniques*. Park Ridge, IL. American Society of Safety Engineers.
8. Dekker, S. (2014). *The Field Guide to Understanding Human Error*. Boka Raton, FL. CRC Press.

[203] MSc in Occupational Safety Management, Embry Riddle Aeronautical University [202]
[204] MS in Occupational Safety and Health, ILO [203]
[205] MS in Safety Engineering, KU Leuven [204]

9. Hudson, P. T. W. (2007). *Safety Cultu3re: Theory, Method, and Improvement*. Farnham, England. Ashgate.
10. Schein, E. H. (2017). *Organizational Culture and Leadership*. Hoboken, NJ. Wiley.

Course Title: Human Factors and Safety: Policy, Regulations, and Governance

Course Code: HF626

Credit Structure: L-T-P-Credit: 2-0-0-2

Course Summary:

This advanced course explores the interplay between human factors, safety, policy, regulations, and governance. Students will examine the regulatory framework, policies, and governance structures that influence safety in various industries and learn how human factors principles can be integrated to enhance safety productivity and well-being-based outcomes.

Course Pre-requisites:

Proficiency in safety management principles, foundational knowledge in policy and governance studies, advanced understanding of human factors studies, and familiarity with regulatory compliance principles.

Course Objectives:

The main objectives of the course are to:

- Understand the regulatory and policy landscape in various systemic sectors.
- Analyze the role of human factors in safety and its integration into policy and regulations.
- Evaluate the effectiveness of safety governance structures and processes.
- Apply human factors principles to enhance safety policy, regulation, and governance.
- Develop critical thinking skills to address real-world safety challenges.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Human Factors and Safety Policy**[206] Historical perspective on safety regulation. Overview of human factors' role in safety and its importance.

[206] MS in Regulatory Affairs, Northeastern University [205]

2.	**Standards, Regulatory Frameworks and Agencies**[207] Exploration of regulatory agencies and their functions. International safety standards and agreements (ISO45001, ISO14001, etc). The evolution of safety regulations in different industries.
3.	**Safety Policy and Development**[208,209] Principles of safety policy development. Case studies in safety policy formation.
4.	**Human Factors Integration in Policy and Regulation** Understanding how human factors and principles influence policy and regulations. Case studies of human factors integration in safety standards. Developing user-centered regulations.
5.	**Safety Governance and Management Systems**[210,211] Principles of safety governance. Safety management systems (SMS) and their implementation. Auditing and evaluating safety management systems. Analyzing real-world safety regulation and governance practices.

Suggested Books:

1. Stolzer, A. J., Halford, C. D., & Goglia, J. J. (2012). *Safety Management Systems in Aviation*. Hoboken, NJ. Wiley.
2. Breyer, S. G. (1982). *Regulation and Its Reform*. Cambridge, MA. Harvard University Press.
3. Lucinda, C. R., Morandi, V. R., & Brito, P. C. (2013). *Regulatory Governance in Infrastructure Industries: Assessment and Measurement of Brazilian Regulators*. NY. Springer.
4. Petersen, D., & Manuele, F. (1999). *Safety Management: A Human Approach*. Park Ridge, IL. American Society of Safety Engineers.

[207] MS in Safety Management, West Virginia University [206]
[208] MSc Occupational Health, Safety and Environment, Middlesex University London [207]
[209] MSc Health, Safety and Environment Management, University of Brimingham [208]
[210] Course in Environmental Science: Risk Assessment, Lund University [209]
[211] MSc Safety, Health and Environmental Management, University of South Wales [210]

5. Kavaler, F., & Smith, M. J. (2011). *Risk Management in Health Care Institutions: A Strategic Approach*. Burlington, MA. Jones & Bartlett Learning.
6. Coletta, F. J. (2002). *Safety, Health, and Environmental Auditing: A Practical Guide*. Boca Raton, FL. CRC Press.

Course Title: Environmental Health and Safety

Course Code: HF627

Credit Structure: L-T-P-Credit: 2-0-0-2

Course Summary:

This interdisciplinary course offers a comprehensive understanding of environmental health and safety principles, regulations, and practices. It equips students with the knowledge and skills to address environmental and occupational health challenges, ensuring the safety and well-being of individuals and communities.

Course Pre-requisites:

Foundational knowledge in environmental studies, proficiency in occupational health and safety principles, familiarity with public health principles, and exposure to regulatory compliance.

Course Objectives:

The main objectives of the course are to:

- Understand the fundamental principles of environmental health and safety.
- Analyze and assess environmental health risks and their impact on public health.
- Develop and implement effective environmental health and safety programs.
- Comply with relevant regulations and standards.
- Apply critical thinking and problem-solving skills to real-world environmental health and safety challenges.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Environmental Health and Safety**[212]
2.	**Environmental Health Risk Assessment**[213] Principles of risk assessment.

[212] MS in Occupational Environmental Hygiene, Johns Hopkins [211]

[213] MS in Occupational and Environmental Health, IOWA College of Public Health [212]

	Exposure assessment and toxicology. Epidemiological methods in risk assessment.
3.	**Environmental Health Regulations and Compliance**[214] Overview of environmental regulations (e.g., NIOSH, OSHA). Compliance and reporting requirements. Case studies in regulatory compliance.
4.	**Occupational Health, Safety, and Toxicology**[215,216] Occupational health hazards and their management. Workplace safety standards and regulations. Safety culture and organizational safety. Toxicological principles and exposure assessment. Occupational exposure to hazardous substances. Hazard communication and chemical safety.
5.	**Environmental Impact Assessment**[217,218,219] Environmental impact assessment (EIA) principles. EIA process and methods. Case studies in EIA.
6.	**Biostatistics in Environmental Health**[220,221] Introduction to biostatistics. Data collection, analysis, and interpretation in environmental health research. Statistical tools for risk assessment.
7.	**Environmental Management Systems (EMS)**[222 ,223]

[214] MSc Environmental Impact Assessment and Management, University of Manchester [213]
[215] Course on Environmental Impact Assessment, University of Gothenburg [214]
[216] Course on Environmental Management Systems, Stockholm University [215]
[217] MS Environmental Health Science with Industrial Hygiene concentration, University of Michigan [216]
[218] MSc in Biostatistics and Data Science, Stockholm University [217]
[219] Course on Environmental Management Systems, University of Gothenburg [218]
[220] MSc in Environmental Management and Sustainability Science, Aalborg University [219]
[221] MSc in Environmental Sciences, University of Wageningen [220]
[222] MSc in Environmental Change and Management, University of Oxford [221]
[223] MSc in Safety, Health and Environmental Technology, National University of Singapore [222]

	Principles of EMS (e.g., ISO 14001) Implementing and auditing EMS. Sustainability and corporate responsibility.
8.	**Emerging Environmental Issues**[224,225] Addressing emerging environmental challenges (e.g., climate change, pollution). Adaptation and mitigation strategies. Environmental justice and equity.
9.	**Environmental Health and Safety Program Development**[226,227] Designing and Developing EH&S programs. Hazard identification and risk management.
10.	**Epidemiology, Public Health, and Environmental Health**[228,229,230] Fundamentals of epidemiology Public health principles and practices. Environmental epidemiology. Environmental public health and policy.
11.	**Occupational Health and Safety Program Implementation**[231] Developing and implementing workplace safety programs. Safety training and education. Monitoring and evaluation.

Suggested Books:

1. Nolan, N. L., & Alm, R. A. (2002). *Introduction to Environmental Health*. Sudbury, MA. Jones & Bartlett Learning.

[224] Course in Occupational and Environmental Health, Monash University [223]
[225] MSc in Global Health Sciences and Epidemiology, University of Oxford [224]
[226] Master of Public Health (Epidemiology), The Ohio State University [225]
[227] MS Epidemiology, University of Buffalo [226]
[228] Master in Occupational Safety and Health, International Training Centre, ILO [227]
[229] Research on Extreme Environments, Northumbria University [228]
[230] Masters in Architecture and Extreme Environments [229]
[231] MSc in Environmental Risk Management, University of Glasgow [230]

2. Frumkin, H. (2016). *Environmental Health: From Global to Local*. Hoboken, NJ. Wiley.
3. Wong, G. C. T., & Peng, S. T. (2015). *Environmental Health Risk Assessment: Principles and Practice*. Boca Raton, FL. CRC Press.
4. Rausand, M., & Naess, A. (1998). *Risk Assessment: Theory, Methods, and Applications*. Hoboken, NJ. Wiley.
5. Percival, R. V., Schroeder, C. H., & Miller, A. S. (2012*). Environmental Regulation: Law, Science, and Policy*. NY. Wolters Kluwer.
6. Wang, L. K., Pereira, N. C., & Hung, Y. T. (2002). *Environmental Compliance: A Web-Enhanced Resource*. Totowa, NJ. Humana Press.
7. Goetsch, D. L., & Pritchard, P. C. (2015). *Occupational Safety and Health for Technologists, Engineers, and Managers*. Upper Saddle River, NJ. Pearson.
8. Klaassen, C. D. (2019). *Casarett & Doull's Toxicology: The Basic Science of Poisons*. NY. McGraw-Hill Education.
9. Wathern, P. (2017). *Environmental Impact Assessment: Theory and Practice*. Abingdon, UK. Routledge.
10. Eccleston, C. H., & Middleton, T. M. (2015). *Environmental Impact Assessment: A Guide to Best Professional Practices*. Hoboken, NJ. Wiley.
11. Ahlbom, A., & Goldman, N. (2019). *Biostatistics for Epidemiology*. Boca Raton, FL. CRC Press.
12. Daniel, W. W., & Cross, C. L. (2013). *Biostatistics: A Foundation for Analysis in the Health Sciences*. Hoboken, NJ. Wiley.
13. Sipe, G. F., & Wilbur, P. L. (2013). *Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations*. Boca Raton, FL. CRC Press.
14. Galea, C. J. (2007). *Environmental Management Systems (EMS): An Implementation Guide for Hospitals and Healthcare Organizations*. Lanham, MD. Government Institutes.
15. Cahill, L. B. (2003). *Environmental Health and Safety Audits*. Lanham, MD. Government Institutes.
16. Cheremisinoff, N. P. (1995). *Environmental Health and Safety Management: A Guide to Compliance*. Boca Raton, FL. CRC Press.
17. Rothman, K. J., Greenland, S., & Lash, T. L. (2008). *Epidemiology: An Introduction*. NY. Oxford University Press.
18. Reese, C. D. (2016). *Occupational Health and Safety Management: A Practical Approach*. Boca Raton, FL. CRC Press.

Course Title: Human Factors in Extreme Environments

Course Code: HF628

Credit Structure: L-T-P-Credit: 2-0-0-2

Course Summary:

This advanced course explores the complex interaction between human factors and extreme environments. Students will examine the challenges and opportunities presented by extreme environments, and how human factors principles can be applied to promote human well-being and safety in such environments.

Course Pre-requisites:

Proficiency in advanced human factors studies HF611, familiarity with environmental psychology, exposure to risk management principles, and foundational knowledge in safety engineering.

Course Objectives:

The main objectives of the course are to:

- Understand the unique characteristics and challenges of extreme environments.
- Analyze the impact of human factors on performance and safety in extreme environments.
- Apply human factors principles to design solutions for extreme environment scenarios.
- Evaluate sustainability practices and strategies in extreme environments.
- Develop critical thinking skills to address sustainability challenges in harsh conditions.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Human Factors in Extreme Environments**[232] Defining extreme environments and their characteristics. Role of human factors in extreme environments.

[232] Masters in Risk and Safety Management, Aalborg University [231]

2.	**Human Performance in Extreme Environments** Understanding human physiology and psychology in extreme conditions. Factors affecting human performance (e.g., fatigue, stress, isolation).
3.	**Human-Centered Design in Extreme Environments**[233] Principles of human-centered design. Designing for safety and efficiency in extreme conditions. Ergonomics and interface design.
4.	**Sustainable Practices in Extreme Environments** Introduction to sustainability concepts. Challenges and opportunities for sustainability in extreme environments. Case studies of sustainable practices.
5.	**Extreme Environment Safety and Risk Management**[234,235] Safety considerations in extreme environments. Risk assessment and mitigation. Regulatory frameworks for safety.
6.	**Communication and Teamwork in Extreme Environments**[236,237] Challenges of communication and teamwork in isolated or high-risk environments. Strategies for effective collaboration.
7.	**Resilience and Adaptation**[238,239] Building resilience in extreme environments. Adaptive strategies for changing conditions. Learning from failures and successes.

[233] MSc in Environmental Communication and Management, Swedish University of Agricultural Sciences [232]
[234] MSc in Strategic Communication, Lund University [233]
[235] Master in Environmental Resilience and Adaptation, University of Pennsylvania [234]
[236] MSc in Risk Analysis, Disasters and Resilience, King's College London [235]
[237] MSc in Polar Landscapes and Quaternary Climate, Lund University [236]
[238] MSc in Environmental Psychology, SLU [237]
[239] MSc in Spacecraft Design, Lulea University of Technology [238]

8.	**HF in Polar Environments**[240,241] Challenges specific to polar environments. Case studies in human factors research and sustainability efforts in the polar region.
9.	**HF in Space Exploration**[242,243] Human factors challenge space missions. Sustainability practices in space explorations. Future of human space exploration.
10.	**HF in Underwater Environments**[244,245] Underwater human factors challenges. Sustainable practices in underwater research. Case studies in deep-sea explorations.

Suggested Books:

1. Campbell, R. D., & Bagshaw, M. (2016). *Human Performance and Limitations in Aviation*. Boca Raton, FL. CRC Press.
2. Ryan, L. J. S., & Stanton, N. A. (2019). *Human Factors in the Maritime Domain*. Boca Raton, FL. CRC Press.
3. Wickens, C. A., & Tsang, P. S. (2019). *Human Performance in General Aviation*. Boca Raton, FL. CRC Press.
4. Tsang, P. S., Pew, R. W., & O'Neill, T. G. (2013). *Human Performance, Workload, and Situational Awareness Measures Handbook*. Boca Raton, FL. CRC Press.
5. Bagchi, A. (2015). *Sustainable Practices in Geoenvironmental Engineering*. Boca Raton, FL. CRC Press.
6. Larsen, J. N., Falkner, K. A., & Huntington, H. P. (2019). *Sustainable Development in the Arctic: A Resource Handbook of the Arctic Council*. Cham, Switzerland. Springer.
7. Gulati, R. (2018). *Safety and Risk Management in the Oil and Gas Industry: A Practical Approach*. Boca Raton, FL. CRC Press.

[240] Master of Space Operations, Embry-Riddle Aeronautical University [239]
[241] Master in Marine Science, University of Gothenburg [240]
[242] MSc in Marine Engineering, University of Strathclyde Glasgow [241]
[243] MSc Safety Critical Systems Engineering, University of York [242]
[244] MSc in Managing Risk and System Change, Trinity College Dublin [243]
[245] MSc Organizational and Social Psychology, London School of Economics [244]

8. Schwartz, D. E. N. (2007). *Resilience: A New Paradigm of Nuclear Safety*. Boca Raton, FL. CRC Press.
9. Hollnagel, E. (2014). *Resilience Engineering: Concepts and Precepts*. Farnham, UK. Ashgate.
10. Johnston, R. (2013). *Human Performance in Antarctic Operations*. Boca Raton, FL. CRC Press.
11. Wei, T. T., & Jabour, J. (2014). *Antarctic Futures: Human Engagement with the Antarctic Environment*. Cham, Switzerland. Springer.
12. Stern, J. M., & Thomas, S. L. V. (2010). *Human Performance in Space: From Psychological Selection to Decision Making*. Boca Raton, FL. CRC Press.
13. Mark, H. J., & Dunbar, B. J. (2018). *Principles of Human Spaceflight*. Cham, Switzerland. Springer.
14. Ericsson, A., & Denoble, P. J. (2019). *Human Factors in Diving*. Boca Raton, FL. CRC Press.
15. Gleason, K., & Caporaso, A. (2019). *Human Factors in Underwater Archaeology*. Boca Raton, FL. CRC Press.

Course Title: Human Factors in Safety-Critical Domains

Course Code: HF629

Credit Structure: L-T-P-Credit: 2-0-0-2

Course Summary:

This advanced course provides as in-depth exploration of human factors principles and their critical application in safety-critical domains, including maritime, railways, transportation, civil aviation, oil and gas, defense, and nuclear sectors. Students will gain the knowledge and skills necessary to design, assess, and optimize systems, interfaces, and procedures for enhanced safety and performance.

Course Pre-requisites:

Proficiency in advanced human factors studies HF611, foundational knowledge in the specific safety-critical domain (maritime, railways, transportation, civil aviation, oil and gas, defense, or nuclear sectors), proficiency in systems engineering principles, and familiarity with safety engineering.

Course Objectives:

The main objectives of the course are to:

- Understand the foundational principles of human factors in safety-critical sectors.
- Analyze and mitigate human error in these domains.
- Assess and design user-friendly interfaces and workplaces in safety-critical sectors.
- Evaluate and optimize team and organizational dynamics.
- Apply human factors-based thinking to safety-critical work sectors.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Human Factors in Safety Critical Domains**[246,247]

[246] MSc Maritime Management, Chalmers University [245]
[247] MSc Maritime Studies, Memorial University of Newfoundland [246]

	Historical perspective of human factors in safety-critical industries.
2.	**Overview of Human Factors** Human Perception and Cognition. Human-Computer Interaction. Human Factors Research Methods and Tools
3.	**Safety Culture and Organizational Behavior**[248] Safety culture development and assessment. Organizational behavior and its impact on safety. Leadership and safety management.
4.	**HF in Maritime Industry**[249,250] Challenges and safety issues in the maritime domain. Interaction design on ships. Fatigue management and crew resource management.
5.	**HF in Railways and Transportation**[251,252,253] Railway safety and human factors Driver behavior and train control systems. Passengers' experience and safety on public transportation.
6.	**HF in Civil Aviation**[254,255] Cockpit design and aviation human factors. Air traffic control and communication. Aviation safety culture and accident analysis.

[248] MSc Transportation, University of Southampton [247]
[249] MSc Transport, Imperial College London [248]
[250] MSc Railway Systems Engineering, University of Birmingham [249]
[251] MSc Safety and Human Factors in Aviation, Cranfield University [250]
[252] MSc Human Factors in Aviation, Coventry University [251]
[253] MSc Safety and Reliability for Oil and Gas, University of Aberdeen [252]
[254] MSc Oil and Gas Engineering, University of Central Lancashire [253]
[255] MSc Human Factors for Defense, Cranfield University [254]

7.	**HF in the Oil and Gas Industry**[256,257] Offshore platform safety and ergonomics. Human reliability in drilling operations. Crisis management and risk assessment.
8.	**HF in Defense**[258,259] Military systems design and human factors. Soldier performance and training. Stress and decision-making in combat.
9.	**HF in the Nuclear Industry**[260,261,262] Nuclear plant safety and human factors. Radiation protection and control room design. Emergency response and safety culture.

Suggested Books:

1. Salas, E., & Maurino, D. (2010). *Human Factors in Aviation*. Amsterdam, Netherlands. Elsevier.
2. Stolzer, A. J., Halford, C. D., & Goglia, J. J. (2008). *Safety Management Systems in Aviation*. Farnham, UK. Ashgate.
3. Ryan, L. J. S., & Stanton, N. A. (2019). *Human Factors in the Maritime Domain*. Boka Raton, FL. CRC Press.
4. Campbell, M. L. (2010). *Maritime Safety: The Human Factors*. Amsterdam, Netherlands. Elsevier.
5. Klep, A., & Geurs, K. (2010). *Railway Human Factors: Supporting Reliability, Safety, and Cost Reduction*. Boka Raton, FL. CRC Press.
6. Stanton, N. A., & Salmon, P. M. (2010). *Human Factors in Transportation: Social and Technological Evolution Across Maritime, Road, Rail, and Aviation Domains*. Boka Raton, FL. CRC Press.

[256] Course on Human Factors in Defense and Security, Singapore University of Social Sciences [255]
[257] MS in Nuclear Technology, Science and Engineering, International Atomic Energy Agency [256]
[258] MPhil in Nuclear Energy, University of Cambridge [257]
[259] MSc Nuclear Science and Engineering, University of Bristol [258]
[260] MSc Rehabilitation Engineering and Assistive Technologies, University College of London [259]
[261] MSc Medical Visualization and Human Anatomy, University of Glasgow [260]
[262] MSc Clinical Exercise Physiology, Northumbria University Newcastle [261]

7. Wald, A., Lawton, T. C., & Hall, C. M. (2019). *Introduction to Aviation Management*. Abingdon, UK. Routledge.
8. Allwood, J., & Major, S. J. (2003). *Human Factors in the Chemical and Process Industries: Making it Work in Practice*. Boka Raton, FL. CRC Press.
9. Gale, A. M., Clegg, D. G., & Clark, S. K. (1990*). Human Factors in Hazardous Situations: Proceedings of a Royal Society Discussion Meeting held on 28 and 29 June 1989*. London, UK. The Royal Society.
10. Stanton, N. A., & Walker, G. H. (2010). *Human Factors in Military Operations: Military Issues, Challenges, and Efforts*. Boka Raton, FL. CRC Press.
11. Stanton, N. A., Salmon, P. M., Walker, G. H., Jenkins, D. P., & Baber, C. (2007). *Human Factors in the Design and Evaluation of Central Control Room Operations*. Boka Raton, FL. CRC Press.
12. Dhillon, B. S., & Li, M. S. W. (2007). *Human Factors in Nuclear Safety*. Boka Raton, FL. CRC Press.

Course Title: Human Factors in Rehabilitation Engineering and Specially-abled populations

Course Code: HF630

Credit Structure: L-T-P-Credit: 2-0-0-2

Course Summary:

This advanced course focuses on the principles of rehabilitation engineering and its application to assist individuals with disabilities. It also covers physical therapy, sports rehabilitation, and design implications to provide students with a holistic understanding of rehabilitation. Students will gain the knowledge and skills needed to design, develop, and implement assistive technologies and rehabilitation interventions to enhance the quality of life and independence of individuals with disabilities.

Course Pre-requisites:

Proficiency in rehabilitation engineering principles, foundational knowledge in physical therapy or sports rehabilitation, familiarity with assistive technologies, and exposure to design principles.

Course Objectives:

The main objectives of the course are to:

- Understand the principles of rehabilitation engineering.
- Apply human factors principles to develop assistive technologies.
- Evaluate and adapt technologies to meet individual disability needs.
- Assess and implement rehabilitation interventions.
- Collaborate with multidisciplinary teams to provide holistic care.
- Consider design implications for rehabilitation and assistive technology.

Course Syllabus:

S.No.	Contents
1.	**Introduction to Rehabilitation Engineering and Disability**[263] Overview of rehabilitation engineering and its importance in disability

[263] Course on Assistive Technologies, NTNU [262]

	care. Historical perspective and emerging trends.
2.	**Anatomy and Physiology in Disability Care**[264,265] Review of human anatomy and physiology. Understanding the impact of disability on the body. Assistive technologies related to anatomy and physiology.
3.	**Assistive Technology Fundamentals**[266] Introduction to assistive technologies. Assistive technology related to anatomy and physiology.
4.	**Biomechanics and Mobility Devices**[267,268] Biomechanical principles and their application. Mobility devices and their design. Customizing devices for individuals with disabilities.
5.	**Augmentative and Alternative Communication (AAC)**[269,270] Communication challenges in disability. AAC devices and technologies. AAC assessment and implementation.
6.	**Cognitive Rehabilitation and Assistive Cognitive Technologies**[271,272] Cognitive impairments and rehabilitation. Assistive technologies for cognitive support. Cognitive rehabilitation strategies.

[264] MSc Sport and Clinical Biomechanics, Liverpool John Moores University [263]
[265] MSc Kinesiology, Biomechanics, Penn State University [264]
[266] MSc in Clinical Speech and Language Studies, Trinity College Dublin [265]
[267] MSc Augmentative and Alternative Communication, University of Dundee [266]
[268] MS in Movement and Cognitive Rehabilitation Science, University of Texas at Austin [267]
[269] Course on Assistive Design, Tufts University [268]
[270] MSc Advancing Practice Sensory Integration, Sheffield Hallam University [269]
[271] Master in Interventions in Childhood, Jonkoping University [270]
[272] Master in Welfare Policies and Management, Lund University [271]

7.	**Sensory Disabilities and Assistive Sensory Technologies**[273] Understanding sensory disabilities (visual, auditory, tactile). Assistive technologies for sensory support. Sensory rehabilitation interventions.
8.	**Pediatric Rehabilitation Engineering**[274] Special considerations in pediatric rehabilitation. Pediatric assistive technologies and interventions. Family-centered care in pediatric rehabilitation.
9.	**Geriatric Rehabilitation Engineering**[275,276] Aging-related disabilities and challenges. Assistive technologies for older adults. Geriatric rehabilitation interventions.
10.	**Physical Therapy and Sports Rehabilitation** Principles of physical therapy and rehabilitation. Sports injury assessment and rehabilitation. Integrating physical therapy into disability care.

Suggested Books:

1. Cooper, R. A., & Ohnabe, H. (2014). *Introduction to Rehabilitation Engineering*. Boca Raton, FL. CRC Press.
2. Mneimneh, S. (2014). *Design for Accessibility: A Cultural Responsibility*. Boca Raton, FL. CRC Press.
3. Tortora, G. J., & Derrickson, B. H. (2017). *Principles of Anatomy and Physiology*. Hoboken, NJ. Wiley.
4. Marieb, E. N., & Hoehn, K. (2017). *Human Anatomy & Physiology*. Boston, MA. Pearson.

[273] MSc in Gerontology, University of Wollongong Australia [272]
[274] MSc in Physical Therapy, University of Toronto [273]
[275] MSc Sports Technology, KTH [274]
[276] MSc in Sports Rehabilitation, University of Melbourne [275]

5. Cook, A. M., & Polgar, J. M. (2014). *Assistive Technologies: Principles and Practice*. St. Louis, MO. Elsevier.
6. Prentice, W. E. (2012). *Introduction to Assistive Technology.* Boston, MA. Pearson.
7. Peterson, D. R., & Bronzino, J. D. (2008). *Biomechanics: Principles and Applications*. Boca Raton, FL. CRC Press.
8. McGinnis, P. M. (2013). *Biomechanics of Sport and Exercise*. Champaign, IL. Human Kinetics.
9. Beukelman, D. R., Mirenda, P., & Light, J. (2012). *Augmentative and Alternative Communication: Supporting Children and Adults with Complex Communication Needs.* Baltimore, MD. Brookes Publishing.
10. Johnston, S. S., & Schwartz, C. M. (2016). *AAC Strategies for Individuals with Moderate to Severe Disabilities.* Baltimore, MD. Brookes Publishing.
11. Alexander, M. A., Matthews, D. J., & Palisano, T. H. (2019). *Pediatric Rehabilitation: Principles and Practice*. NY. Demos Medical.
12. Guccione, A. A., Avers, D., & Wong, R. (2012). *Geriatric Physical Therapy*. St. Louis, MO. Elsevier.
13. O'Sullivan, S. B., Schmitz, T. J., & Fulk, G. D. (2019). *Physical Rehabilitation*. Philadelphia, PA. F.A. Davis Company.

Course Title: Seminar (independent study)

Course Code: HF640

Credit Structure: L-T-P (Non-Credited): 2-1-0 P/F

Course Summary:

This course is designed to immerse students in the world of academic and practical human factors research. This seminar provides a platform for students to explore various research topics using the knowledge gained through the courses, engage in critical discussions, and develop their research skills. Students will analyze current literature, design their research studies, and present their findings on any topic in the realm of human factors. Each student will carry out this study under the tutelage of a mentor who will provide specially directed guidance to the student on this independent study. The course aims to foster a deeper understanding of human factors research methodologies and applications.

Course Objectives:

The main objectives of the course are to:

- Develop students' ability to critically evaluate and synthesize existing human factors research literature, enabling them to identify gaps in knowledge and contribute to the field.
- Equip students with the knowledge and skills required to design, conduct, and analyze human factors research studies, including data collection with ethical consideration.
- Enhance students' presentation and scientific writing skills, enabling them to communicate their research findings clearly and professionally to both academic and industry audiences.

Semester-IV

Course Title: Human Factors Project

Course Code: HF630

Credit Structure: L-T-P-Credit: 0-0-0-40

Course Summary:

This course is an immersive and hands-on experience that allows students to apply their knowledge of human factors principles and methodologies to real-world projects. Students will work individually or in teams to tackle complex human factors challenges in various domains of their choice. The course emphasizes practical problem-solving, project management, and the integration of human factors into product or system development with ethical boundaries. Students will have the opportunity to collaborate with industry partners or organizations to address real-world human factors issues.

Course Objectives:

The main objectives of the course are to:

- Enable students to apply their theoretical knowledge of human factors to real-world projects, fostering their ability to solve practical human factors challenges.
- Develop students' project management skills, including project planning, timeline management, resource allocation, and stakeholder communication, to complete the project.
- Enhance students' ability to collaborate effectively within multidisciplinary teams and communicate their findings and recommendations to project stakeholders, fostering their ability to drive meaningful change in various industries.

4. Appendix: Summary of global programs

A. Summary of programs in Europe

In European universities, the human factors and ergonomics curriculum is carefully crafted to provide students with a comprehensive skill set, combining critical and practical competencies with scientific methods for professional practice. The programs adopt a multidisciplinary approach, integrating knowledge from various fields like psychology, engineering, and design. Upon successful completion of the program, graduates possess expertise in information technology, numeracy, problem-solving, teamwork, and management. The curriculum emphasizes hands-on practical skills, ensuring students are proficientin accessing instructional materials and research tools on computers. They learn to conduct numerical data collection and present findings using tables and graphs. Additionally, students are trained in analyzing data with a range of statistical tools, enabling them to draw meaningful insights from their research.

A key aspect of the program is training students to clarify essential questions related to ergonomics and human factors. They are encouraged to consider alternative solutions and evaluate outcomes, developing their critical thinking abilities. Project management, leadership, and effective communication are also given significant emphasis throughout the curriculum. European universities offer specialized tracks within human factors and ergonomics, allowing students to focus on specific areas of interest. Examples of these specialized tracks include cognitive psychology, where students explore the intricacies of human cognition, automation psychology, which delves into the interaction between humans and automated systems, neuroergonomics, studying the brain's response to technology, and design for health and wellbeing, where students learn to create user-friendly environments that promote well-being. The curriculum places a strong emphasis on research skills, urging students to conduct studies and analyze quantitative and qualitative data related to occupational health and safety. Additionally, the programs highlight the social, environmental, sustainability, and safety aspects in the design of human-technology interactions, ensuring that graduates understand the broader implications of their work.

Examples of European universities with notable human factors and ergonomics programs include:

- Delft University of Technology, Netherlands: Delft offers a Master's program in Human-Machine Systems Design, focusing on the design and evaluation of interactive systems to enhance human performance and safety.
- Lund University, Sweden: Lund's Master's program in Human Factors and Systems Safety provides students with a solid foundation in human factors principles and systems safety, with a particular focus on aviation and transportation industries.
- University of Nottingham, United Kingdom: The University of Nottingham offers a Human Factors and Ergonomics MSc program, emphasizing the application of human factors principles in various sectors, including healthcare, manufacturing, and transportation.
- Technical University of Munich, Germany: The university offers a Human-Centred Engineering and Ergonomics MSc program, focusing on the design of user-friendly products, systems, and workplaces to improve human well-being and performance.
- KTH Royal Institute of Technology, Sweden: KTH's Ergonomics and Human-Technology-Organization program explores human-technology interactions, focusing on the design of safe and efficient systems in various domains.

Overall, the human factors and ergonomics curriculum at European universities equip students with a holistic understanding of human-system interactions, cognitive processes, and design principles, empowering them to tackle complex challenges and contribute to the creation of safer, efficient, and user-friendly systems and environments.

- Interdisciplinary Approach:
  Example: University of Twente, Netherlands - The Human Factors and Engineering Psychology program at the University of Twente offers an interdisciplinary curriculum that combines knowledge from engineering, psychology, and the social sciences. Students gain insights into human behavior and cognition, enabling them to design andoptimize systems and products for an improved user experience.
- Practical Application:
  Example: Aalborg University, Denmark - Aalborg University's Master's program in Human-Centered Informatics focuses on practical application through project-based learning. Students work on real-world projects in collaboration with industry partners, gaining hands-on experience in solving human factors and ergonomics challenges.
- Industry Collaboration:
  Example: Cranfield University, UK - The Human Factors Engineering program at this university collaborates closely with various industries, including automotive, aviation, and manufacturing. Students benefit from internships and research

projects with industry partners, providing valuable exposure to real-world applications.

- Involvement of Professional Organizations:
  Example: Loughborough University, United Kingdom - Loughborough's Human Factors and Ergonomics program maintains strong ties with professional organizations, such as the Chartered Institute of Ergonomics & Human Factors (CIEHF). Students have access to events, seminars, and resources offered by these organizations.
- Focus on Safety and Health:
  Example: University of Linköping (Sweden) - The Human Factors and Safety Engineering program at this university focuses on workplace safety and health. Students learn to design ergonomic workspaces, analyze safety risks, and develop strategies to improve workplace well-being.

These European universities exemplify the strengths mentioned above, offering exceptional human factors and ergonomics programs that prepare students for successful careers in addressing real-world challenges across various industries.

B. Summary of programs in North America

American and Canadian universities offer comprehensive and interdisciplinary programs in human factors and ergonomics, that blend knowledge from psychology, engineering, statistics, and other relevant fields. These programs aim to understand human behavior, cognition, and performance in various contexts and improve the design of systems, products, and environments to enhance user experience, safety, and productivity.

For example, one prominent university with a strong human factors and ergonomics program is Stanford University. Their program focuses on applying psychological science, cognitive science, and engineering principles to enhance human interactions with technology and systems. Students at Stanford receive training in areas like decision-making, human-computer interaction, usability, and safety. They gain expertise in cognitive psychology, social psychology, perception, and statistical analysis. Stanford's faculty members have diverse research interests, such as information visualization, team cognition, and assistive technologies.

Another example is the University of Michigan, which offers a comprehensive program in human factors and ergonomics. Their curriculum includes courses on human abilities, cognitive neuroscience, engineering psychology, and human systems engineering. The program encourages interdisciplinary collaboration, allowing

students to integrate knowledge from psychology, engineering, computer science, sociology, and mathematics. Graduates from the University of Michigan are well-prepared to work in academia, government organizations, and industry, with career opportunities in aviation, healthcare, transportation, and computing.

At the Georgia Institute of Technology, students in the human factors and ergonomics program gain hands-on training in usability design and evaluation, focusing on human-computer interaction and automation. They also have research opportunities in areas like workplace design, safety engineering, biomechanics, and user-centered design. Graduates from this program are equipped with a broad range of methodological tools and can pursue careers in academia, government, consulting, and research.

The University of California, Berkeley, is another example of an institution offering a top-notch human factors and ergonomics program. Their research focuses on human-machine systems engineering, studying how humans interact with complex systems in various domains such as aviation, healthcare, manufacturing, and information technology. Students at Berkeley receive training in cognitive processes, decision-making, human-machine interaction, human reliability, and safety.

The University of Toronto, Canada offers the MASc and PhD programs which are research oriented, emphasizing both theoretical and practical issues. Teaching covers a broad range of human factors issues and topics, whereas research typically focuses on cognitive and perceptual issues. Current research topics include user interface design, healthcare ergonomics, social computing, mobile computing, cognitive engineering, ecological interface design, supervisory control, human-automation interaction, teleoperation and control, augmented reality and virtual environments, 3D graphic and video displays, 6-degree-of-freedom control, human adaptation to technology, in-vehicle system design, crash risk assessment, driver distraction mitigation, mine traffic operations, unmanned vehicle displays, air traffic control displays, eHealth innovations, HF issues in health care and other biomedical applications, especially surgery and anaesthesiology. Fundamental research is emphasized, but applied research is also carried out, with extensive support from industry and government, both national and international.

The University of Waterloo also offers MASc and PhD in Human Systems Concentration in Systems Design Engineering. The emphasis of the program is a human factors engineering approach to improving the performance of humans in complex systems through engineering design. Cognitive engineering and user centered approaches to requirements specification are supplemented with techniques from human-computer interaction, visualization, and cognitive ergonomics to reach design solutions. Solutions are then evaluated with human factors methods such as experimentation and human performance modeling to assess viability in a systems

environment. Domains of interest are usually complex systems such as aviation, air traffic control, transportation, military, power systems, education, or healthcare. Solution technologies may include the design of displays, collaborative systems, novel input devices, adaptive interfaces, and novel display environments large or small, and augmented reality systems.

The University of Alberta also offers MSc and PhD courses in Human Factors and Ergonomics. The program emphasizes the scientist-practitioner model of training. Primary areas of research activity are in transportation human factors, aging and visual health, human error, human-computer interaction, health care human factors, attention and skill acquisition, visual processing. Numerous opportunities exist to develop multidisciplinary interests in conjunction with computer science, environmental design, kinesiology, and medicine faculties.

Overall, these universities provide comprehensive education and practical experiences in human factors and ergonomics, preparing graduates to become skilled professionals capable of addressing real-world problems and optimizing human performance, safety, and user experience in diverse technological and social systems.

- Interdisciplinary Approach:
  Example: Carnegie Mellon University's Human-Computer Interaction Institute (HCII) offers a renowned program that takes an interdisciplinary approach. Students combine knowledge from psychology, computer science, design, and engineering to address human factors and ergonomics challenges in the context of interactive technologies.
- Research Focus:
  Example: Massachusetts Institute of Technology (MIT) has a strong emphasis on research in their human factors and ergonomics program. Students actively engage in cutting-edge research projects at MIT's AgeLab, focusing on aging and technology, andthe MIT Media Lab, which explores innovative human-computer interaction.
- Practical Application:
  Example: The University of Wisconsin-Madison's Department of Industrial and Systems Engineering places a high value on practical application. Their students work on projects related to healthcare ergonomics, designing better work environments for healthcare professionals to improve safety and efficiency.
- Industry Collaboration:
  Example: Georgia Tech's School of Aerospace Engineering collaborates extensively with industries, including aviation and transportation. Their human factors program works closely with leading aviation companies to improve cockpit design and pilot training.

- Technological Integration:
  Example: Stanford University's Hasso Plattner Institute of Design integrates advanced technology into its human factors and ergonomics curriculum. Students use virtual reality and simulation tools to understand user experiences in various design contexts.
- Specialization Options:
  Example: The Ohio State University offers a diverse range of specialization options within its Human Factors and Ergonomics program. Students can choose to focus on cognitive ergonomics and work with cutting-edge neuroimaging technologies to study cognitive processes.
- Experiential Learning:
  Example: The University of Michigan's School of Kinesiology provides students with experiential learning opportunities through internships and cooperative education. Students work with companies in the automotive industry to design and evaluate ergonomically sound vehicle interiors.

These universities exemplify the strengths mentioned above and offer exceptional opportunities for students interested in pursuing human factors and ergonomics education in the United States.

C. Summary of programs in Australia and New Zealand

The Human Factors and Ergonomics curriculum offered by Australian and New Zealand universities encompasses a diverse range of topics, providing students with the necessary knowledge and skills to optimize human performance and well-being in different contexts. The program commences with foundational courses, including human factors theories, principles, human physiology, and individual and organizational psychology. As students' progress, they have the opportunity to specialize in specific application areas such as aviation safety, occupational health and safety, and extreme climate survival.

For instance, the University of Sydney in Australia offers a comprehensive Human Factors and Ergonomics program. Students can opt for tracks focusing on aviation safety or occupational health and safety. The aviation safety track delves into human performance analysis, physical hazard identification, and understanding human factors in transportation safety. On the other hand, the occupational health and safety track emphasizes workplace laws, regulations, policies, risk identification, prevention, and

management.

Similarly, the University of Otago in New Zealand offers a Human Factors and Ergonomics curriculum that covers essential topics like anthropometry, physical abilities, and constraints of the human body, as well as usability principles related to design. The program explores the interactions between psychology and engineering in high-risk industries like aviation, rail, and healthcare. Students also gain insights into major human factors considerations, including cognition, physiology, stressors, teamwork, and human error analysis.

Both universities provide a strong emphasis on practical experience. At the University of Sydney, students gain hands-on experience in design simulation, development, and communication through various mediums like text, oral presentations, three-dimensional model making, drawing, and graphic presentations. Similarly, at the University of Otago, students are equipped with risk management skills and report writing proficiency related to occupational/vocational rehabilitation theories, the Model of Human Occupation, and injury prevention.

Overall, the Human Factors and Ergonomics curriculum at Australian and New Zealand universities emphasizes understanding the interactions between humans and their environments to enhance performance, safety, and well-being across various fields.

- Regional Regulations and Standards:
  Example - University of New South Wales, Australia: The School of Aviation at UNSW offers a Human Factors and Safety Management program that places a strong emphasis on understanding and applying Australian aviation regulations and safety standards to enhance safety in the aviation industry.
- Indigenous Perspectives:
  Example - University of Otago, New Zealand: The Department of Preventive and SocialMedicine at the University of Otago integrates indigenous perspectives into their public health programs, including human factors and ergonomics. Students gain insights into the influence of traditional practices and cultural factors on health and safety.
- Practical Application:
  Example - Queensland University of Technology, Australia: The Faculty of Health at QUT offers a Human Factors and Safety Science program that focuses on practical application. Students engage in fieldwork and industry placements to apply human factors principles to real-world scenarios.
- Industry Collaboration:
  Example - University of Auckland, New Zealand: The Department of Mechanical Engineering at the University of Auckland collaborates with various industries,

including manufacturing and healthcare, to provide students with hands-on experience in addressing human factors challenges in these sectors.

- Specific Industry Focus:
  Example - Monash University, Australia: Monash offers a Master of Ergonomics, Safety, and Health that tailors its curriculum to address specific challenges in industries such as mining, construction, and transportation.
- Integration of Health and Safety:
  Example - University of Western Australia, Australia: The School of Population Health at UWA integrates health and safety principles into their human factors and ergonomicsprograms, emphasizing the importance of creating safe and healthy work environments.
- Research and Innovation:
  Example - University of Canterbury, New Zealand: The Human Interface Technology Laboratory New Zealand (HIT Lab NZ) at the University of Canterbury conducts cutting-edge research in human-computer interaction, virtual reality, and ergonomics, offering students opportunities to engage in research and innovation.

These examples demonstrate the diverse strengths and focus of Australian and New Zealand universities in the field of human factors and ergonomics, catering to regional needs and offering students a comprehensive education in addressing real-world challenges.

D. Summary of programs in Asia

The Human Factors and Ergonomics programs offered by Asian universities provide a comprehensive and diverse range of topics, equipping students with the essential knowledge and skills to optimize human performance and well-being in various contexts. The curriculum begins with foundational courses, encompassing human factors theories, principles, human physiology, and individual and organizational psychology. As students' progress, they have the opportunity to specialize in specific application areas, such as aviation safety, occupational health and safety, and extreme climate survival.

For example, the National University of Singapore (NUS) in Singapore offers an extensive Human Factors and Ergonomics program. Students can choose between tracks focusing on aviation safety or industrial safety. The aviation safety track delves into human performance analysis, physical hazard identification, and understanding human factors in transportation safety. Conversely, the industrial safety track emphasizes workplace regulations, policies, risk identification, prevention, and management. Similarly, Kyoto Institute of Technology in Japan provides a Human Factors and

Ergonomics curriculum that covers essential topics like anthropometry, physical abilities, and constraints of the human body, as well as usability principles related to design. The program explores the interactions between psychology and engineering in high-risk industries such as automotive design, product development, and healthcare. Students also gain insights into significant human factors considerations, including cognition, physiology, stressors, teamwork, and human error analysis. Both universities prioritize practical experience. At NUS, students gain hands-on experience in design simulation, development, and communication through various mediums like text, oral presentations, three-dimensional model making, drawing, and graphic presentations.

Similarly, at Kyoto Institute of Technology, students acquire risk management skills and report writing proficiency related to occupational/vocational rehabilitation theories, the Model of Human Occupation, and injury prevention. The interdisciplinary approach at these Asian universities integrates anatomy, biomechanics, design, physiology, psychology, and sociology, empowering graduates to apply their knowledge effectively in real-world contexts. In summary, the Human Factors and Ergonomics curriculum at Asian universities underscores the significance of understanding the interactions between humans and their environments to enhance performance, safety, and well-being across various fields.

Overall, these universities provide a holistic perspective on disaster and crisis management along with various aspects of human factors and ergonomics research.

- Interdisciplinary Approach:
  The National University of Singapore (NUS) stands out for its interdisciplinary approach to Human Factors and Ergonomics. The Master of Science in Industrial and Systems Engineering program emphasizes collaboration across fields, combining engineering, psychology, and design principles. This approach ensures that students gain a holistic understanding of how to optimize systems for human interaction.
- Research Focus:
  Tsinghua University places a strong emphasis on research in its Master's program in Human Factors Engineering. Students have the opportunity to engage in cutting-edge research projects that address real-world challenges. Research areas include user-centred design, cognitive psychology, and advanced ergonomics, allowing students to contribute to the field's evolving knowledge. Beihang University formerly known as Beijing University of Aeronautics and Astronautics offers a Master's program in Human Factors and Ergonomics Engineering, focusing on aviation and aerospace applications, among others. Harbin Institute of Technology offers a Master's program in Human Factors and Ergonomics, emphasizing research and practical skills development. Students have opportunities to work on real-world projects.

- Industry Collaboration:
  Zhejiang University has strong ties with industry partners in its Ergonomics and Cognitive Engineering program. This collaboration provides students with opportunities for internships and real-world projects, giving them a firsthand understanding of how Human Factors and Ergonomics are applied in various industries. Tongji University's School of Design and Innovation offers a Master's program in Human-Computer Interaction and Ergonomics. This program integrates design thinking and user-centred approaches with Human Factors principles.
- Technology Integration:
  The University of Tsukuba's Master's program in Human Interface Science places a significant focus on technology integration. Students learn how to design interfaces that seamlessly integrate with emerging technologies. This prepares them to address the challenges posed by rapidly evolving digital environments.
- Specialization Focus:
  Kyoto Institute of Technology offers a Master's program in Human Systems Science and Design that allows students to specialize in various areas within Human Factors and Ergonomics. Students can choose to focus on fields such as cognitive psychology, usability engineering, or biomechanics, tailoring their education to their specific interests. The University of Tokyo offers a Human Security Engineering program that includes Human Factors and Ergonomics as a crucial component. This program focuses on safety, comfort, and efficiency in systems design. Hiroshima University provides a Master's program in Human Science and Environment, where students can specialize in Ergonomics and Human Factors Engineering, gaining expertise in optimizing human interactions with technology and environments. Osaka University offers a Human Sciences program that encompasses Ergonomics. This interdisciplinary approach prepares students for diverse applications in designing user-centred systems.

These universities in Singapore, China, and Japan offer diverse master's programs in Human Factors and Ergonomics, each with its unique focus. Students have the opportunity to pursue interdisciplinary studies, engage in cutting-edge research, apply their knowledge in practical settings, collaborate with industry partners, integrate technology, specialize in their areas of interest, and gain valuable experiential learning. These programs equip graduates with the skills and expertise needed to excel in the dynamic field of Human Factors and Ergonomics.

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Prathamesh is a dedicated engineer with a profound passion for Health and Safety and research experience and interest in diverse domains including Physical and Cognitive ergonomics, Human Factors, Occupational Safety, Biomechanics, User-Centred Design, Neuroscience, and Human-Machine Interaction.

Building on a strong academic foundation, Prathamesh completed his Master of Science (MSc) in Technology, Work and Health from KTH Royal Institute of Technology, Stockholm,

Sweden, in 2023 and a Master of Science (MSc. Exchange) in Biomedical Engineering from Technical University of Delft, Netherlands in 2022. His diverse educational journey also includes a Bachelor of Technology (B.Tech.) in Agricultural Engineering from the College of Agricultural Engineering and Technology, Dapoli, India in 2020.

As a Research Assistant at IIT Kanpur, India, Prathamesh actively contributed to the formulation and co-authorship of a book on master's curriculum for Human Factors and Ergonomics, showcasing his dedication to academic excellence and collaboration with subject matter experts.

Prior to his academic pursuits, Prathamesh demonstrated leadership as a Health and Safety Supervisor at a marine products company in Ratnagiri, India in 2021 where he spearheading risk awareness, assessment and mitigation initiatives, ensured meticulous adherence to safety standards.

In terms of academic projects and research, Prathamesh has undertaken diverse initiatives, ranging from incident investigation and ergonomic design interventions to risk assessments in various work environments. Recognized for his achievements, Prathamesh received a fully funded graduate scholarship sponsored by DTE Maharashtra State and a university gold medal for exceptional performance in Farm Power and Machinery during his undergraduate studies. Prathamesh is poised to continue making significant contributions to the field, fostering safer and more efficient work environments.

Ram Maikala, Ph.D.

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Dr. Rammohan Maikala joined the National Safety Council, Itasca, Illinois, USA, in November 2021 as a Subject Matter Expert-Program Technical Consultant. Previously, he worked as an

Injury Prevention and Ergonomics Program Specialist at Providence Regional Medical Center in Everett, Washington, USA, for seven years. At Providence, Ram taught and trained hospital staff on safe patient handling and mobility. Ram also provided ergonomics and safety risk assessments and mitigation strategies to Providence staff in multiple hospitals and medical clinics in different counties in Washington. Before his work at Providence in October 2014, Ram was a Research Scientist for 12.9 years at the Center for Physical Ergonomics, Liberty Mutual Research Institute for Safety in Hopkinton, Massachusetts, USA. For almost two decades, Ram's research has focused on human performance, specifically through the lens of Work and Exercise Physiology, using various non-invasive physiological modalities, including Near-infrared spectroscopy.

Ram is the current Editor-in-Chief of Ergonomics in Design, a quarterly peer-reviewed Design periodical of the US Human Factors and Ergonomics Society (HFES), and a Scientific Editor for the International Journal of Industrial Ergonomics. Ram is also an Adjunct Professor at the Dept. of Industrial Engineering, Clemson University, Clemson, SC, USA. He served as a past president of the Puget Sound Chapter of the HFES (2016-2018) and The International Society for Occupational Ergonomics & Safety (2016-2017). Ram is an elected Fellow of the HFES and a 2022 Science Policy Fellow of the HFES.

Ram has a Doctoral degree in Rehabilitation Science from the University of Alberta, Edmonton, Canada, Masters in Industrial Engineering with special emphasis on Ergonomics and Safety Engineering from West Virginia University, Morgantown, West Virginia, USA. He earned a Bachelor's degree in Mechanical Engineering with first-class distinction from Osmania University, Telangana, India.

HUMAN FACTORS & ERGONOMICS

SYLLABUS FOR INDIAN UNIVERSITIES

M. Tech./ M. S./ M. Des./ M. Eng./ Ph. D.

As India moves towards the "Vision 2047" in a quest for a better future, there is a growing need for the design of technology and infrastructure to enable well-being, safety, and productivity for Indians. Human Factors and Ergonomics is one discipline that supports the well-being of people in terms of design, maintenance, management, regulation, and governance of technology. Due to the lack of disciplinary programs that address the totality of the discipline, there is a need for capacity building in the academic sector for training the next generation of practitioners. This sample syllabus, while covering the breadth of the discipline, also provides a foundation for Indian universities to fulfill the requirements of Human Factors and Ergonomics. This syllabus can be creatively adapted to suit specific master's programs in science, engineering, technology, and design. This syllabus provides a basis for a holistic academic program that supports the next generation of learners in India.