

Course Title: Work System Design and Ergonomics

Hosting Faculty: Dr. Goutam Sen, Associate Professor, Industrial and Systems Engineering, IIT Kharagpur

Co-Instructor: Dr. Sol Lim, Associate Professor, Industrial and Systems Engineering, Virginia Tech, USA

Host Institution: IIT Kharagpur | Duration: 12 contact hours (6 sessions × 2 hours) | Dates: October 26 – November 6, 2026

1. Course Objective

This Short Term Course (STC) aims to provide graduate students, occupational health professionals, and industry practitioners with an integrated understanding of human physical capabilities—including musculoskeletal function, anthropometric variability, and biomechanical loading—and the methods used to measure, quantify, and model these capabilities. The course will emphasize the direct application of this knowledge to the design and evaluation of physically demanding work systems. Participants will learn to quantify physical work demands using validated bioinstrumentation and biomechanical modeling techniques and, importantly, translate these assessments into actionable work-system design recommendations that can reduce work-related musculoskeletal disorder (WMSD) risk and improve human-system performance.

Human physical capability assessment and work-system design are closely interconnected, yet these topics are often taught as separate areas of study. Biomechanics and human-factors programs typically emphasize measurement and modeling of the human body, whereas industrial and systems engineering programs often focus on work-system analysis, process improvement, and design methods. As a result, learners may have limited opportunities to develop an end-to-end understanding of how quantitative assessments of human physical capabilities can inform practical work-system design decisions. This STC is specifically designed to bridge this gap.

The course brings together the complementary expertise of Dr. Sol Lim (Virginia Tech, USA) and Dr. Goutam Sen (IIT Kharagpur). Dr. Lim's graduate course, "Human Physical Capabilities," focuses on occupational biomechanics, bioinstrumentation, anthropometry, and physical capacity assessment, providing the scientific and methodological foundation for understanding and quantifying physical demands. Dr. Sen's course, "Work System Design and Ergonomics," focuses on applying ergonomics principles to the analysis and design of industrial work systems. Co-teaching these complementary topics within a single STC will allow participants to follow a coherent progression from understanding human physical capabilities, to measuring and modeling physical demands, to interpreting the results, and ultimately to making evidence-based work-system design decisions—an integrated perspective that neither instructor's home course provides independently.

Beyond the academic content, the collaboration will expose participants to complementary perspectives from the United States and India on occupational ergonomics, human-centered work-system design, and industrial practice. The course will also provide an opportunity for faculty and students at the host institution to engage with different research approaches, measurement practices, and applications in occupational ergonomics. More broadly, the co-teaching model demonstrates the value of cross-institutional and interdisciplinary collaboration in addressing complex human-work-system challenges that cannot be fully addressed from a single disciplinary perspective.

2. Course Outcome

On successful completion of this STC, participants will be able to:

- Describe and quantify key dimensions of human physical capability, including musculoskeletal structure, anthropometric variation, and strength/endurance.
- Apply bioinstrumentation methods (surface EMG, motion capture, physiological monitoring) to measure physical work demands.
- Use biomechanical models to estimate joint loading and injury risk during manual material handling tasks.
- Evaluate localized muscle fatigue and work-related musculoskeletal disorder (WMSD) risk factors in real work tasks.

- Integrate physical-capability assessment data into work-system design decisions to improve safety, productivity, and human-centered design outcomes.

3. Target Organisations / Institutions for STC

- Academic institutions: IITs, NITs, and affiliated engineering colleges offering programs in Industrial/Production/Mechanical/Biomedical Engineering, Ergonomics/Human Factors, or Occupational Health, and their graduate students and faculty.
- Industry: manufacturing, automotive, textile, electronics assembly, logistics/warehousing, and healthcare organisations, ergonomics, or occupational-health functions.
- Government / public sector: state and central occupational health and safety directorates, and labour welfare departments.
- Professional bodies: members of Indian ergonomics/human-factors professional societies and certified occupational-health and safety professionals.

4. Pre-requisites for External Applicants

- A Bachelor's degree (completed or in progress) in Engineering (Industrial/Production/Mechanical/Biomedical), Physiotherapy/Occupational Therapy, Kinesiology, Ergonomics/Human Factors, or a related discipline; OR equivalent professional experience in occupational health, safety, or ergonomics.
- Basic familiarity with mechanics (forces and moments) and elementary statistics is helpful but not mandatory.
- A personal laptop capable of running spreadsheet software
- Industry and government professionals working in ergonomics roles are welcome to apply irrespective of formal academic background, subject to approval by the course coordinators.

5. Syllabus and Lecture Schedule (12 hours)

The STC is a focused, 12-hour selection drawn from the two co-instructors' home graduate courses, delivered as six 2-hour sessions over two weeks. Each session combines a lecture with a short applied exercise or demonstration.

Ses s.	Date	Day / Time	Duration	Topic
1	Oct 26, 2026	Mon, 6:30-8:30 PM	2 hrs	Introduction to Human Physical Capabilities & the Musculoskeletal System
2	Oct 28, 2026	Wed, 6:30-8:30 PM	2 hrs	Anthropometry
3	Oct 30, 2026	Fri, 6:30-8:30 PM	2 hrs	Range of Motion / Strength Assessment
4	Nov 2, 2026	Mon, 6:30-8:30 PM	2 hrs	Bioinstrumentation Methods: EMG, Motion Capture & Physiological Monitoring
5	Nov 4, 2026	Wed, 6:30-8:30 PM	2 hrs	Occupational Biomechanics & Biomechanical Modeling of Work Tasks
6	Nov 6, 2026	Fri, 6:30-8:30 PM	2 hrs	Manual Material Handling & WMSD Risk Factors

6. Estimated Dates of the Co-teaching Module

The module will run over two weeks, Monday, Wednesday, and Friday, 6:30-8:30 PM (IST), from October 26 to November 6, 2026 (six sessions, 12 contact hours), in **ONLINE** mode hosted at IIT Kharagpur.

7. Plan of Assessment for External Participants and Internal Students

External (non-credit) STC participants:

- Minimum 80% session attendance required to be eligible for a Certificate of Completion.
- Short, graded formative quizzes / problem sets after the module for self-assessment.

Internal IIT Kharagpur students (registered for credit through Work System Design and Ergonomics):

- The STC content is delivered as an integrated 12-hour module within the existing credit-bearing course, so internal students are graded per the host course's regular scheme.
- Suggested grading: two module quizzes/problem sets ($\approx 10\%$ each).