



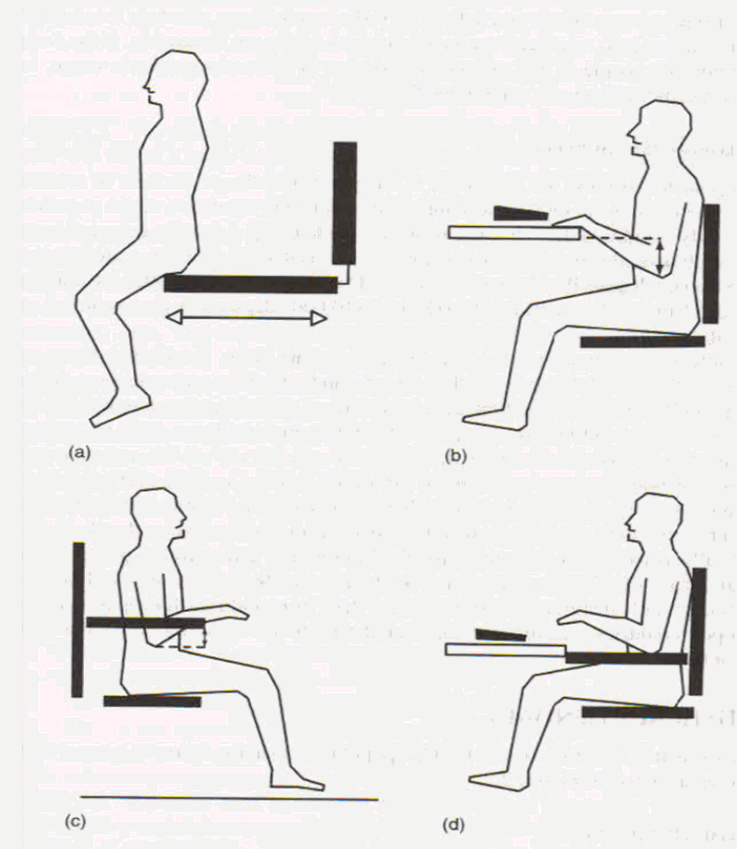
# **APPLIED ERGONOMICS**

# DESIGN OF A CHAIR: A COMMON EXAMPLE

Design mismatches :

- (a) Seat too deep
- (b) Seat too low
- (c) Elbow rest too high
- (d) Elbow rest touches front of desk, task distance too far

- These mismatches may cause chronic problems like lower-back pain etc







# **INTRODUCTION AND OVERVIEW OF ERGONOMICS**

**LECTURE I  
DR. ANKUR GUPTA**

A decorative graphic on the left side of the slide consisting of two parallel, wavy lines. The inner line is a light blue color, and the outer line is white. They start from the top left and curve downwards towards the bottom left.

# **INTRODUCTORY NOTE**

# WHAT IS ERGONOMICS ?

- Ergonomics comes from the Greek word : “Ergo” which means “work” and “nomos” which means “law”.
- **Definition:** Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies, theory, principles, data, and methods to design in order to optimize human well being and overall system performance.
- Its purpose is to improve the performance of system by improving human- machine interaction.
- Practitioners of ergonomics and ergonomists contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people



# PROBLEMS AND CORRESPONDING KNOWLEDGE ARISING FROM THE INTRODUCTION OF COMPUTERS IN THE WORKPLACE

## Problem

Work posture and keying

Size of screen characters, contrast, colors

Environmental factors

Layout of screen information

Design of new systems

Problem solving at work

## Knowledge Required to Solve Problem

Biomechanics

Vision research, perception

Noise, environmental stress

Cognitive psychology, cognitive engineering

Systems design

Cognitive work analysis, task analysis



Implementation of ergonomics in system design should make the system work better by eliminating undesirable, uncontrolled aspects such as :

- Fatigue
- Inefficiency
- Accidents, injuries
- User difficulty

Human factors is synonymous with ergonomics

Ergonomics emphasizes work physiology and anthropometry

Europe – industrial work systems

Human factors emphasizes experimental psychology and systems engineering

U.S. – military work systems

# LACK OF ERGONOMICS

Since 1979, following human related disasters have contributed to public awareness about the importance of ergonomics and human factors

- Three Mile island nuclear power plant accident (near Harrisburg, Pennsylvania, March 1979)
- Bhopal Pesticide plant, Union Carbide Company (Bhopal, India, December, 1984)
- Challenger space Shuttle (above Cape Kennedy, Florida, January 1986)
- Chernobyl nuclear plant explosion (Kiev, Ukraine, April 1986)
- Exxon valdez oil split (Prince William Sound, Alaska, March 1989)
- Columbia space shuttle (over Texas, February 2003)
- *These disasters were the results of human errors, mostly caused by inadequate attention to ergonomics and human factors in system design and related management, and obviously, caused by flaws in decisions by human being.*

# COURSE OUTLINE

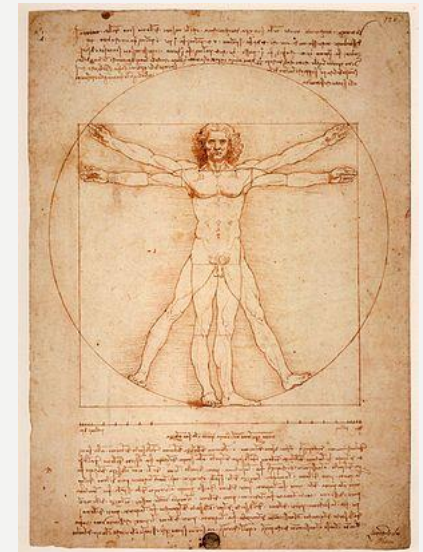
- Introduction & H-M system
- Physical Ergonomics
- Cognitive Ergonomics
- Biomechanics
- Work Environment
- Research Methods
- Occupational Safety & Health

A stylized, light blue outline of a human figure, showing the head, torso, and limbs, positioned on the left side of the image. The outline is composed of two parallel lines, with the space between them filled with a light blue color.

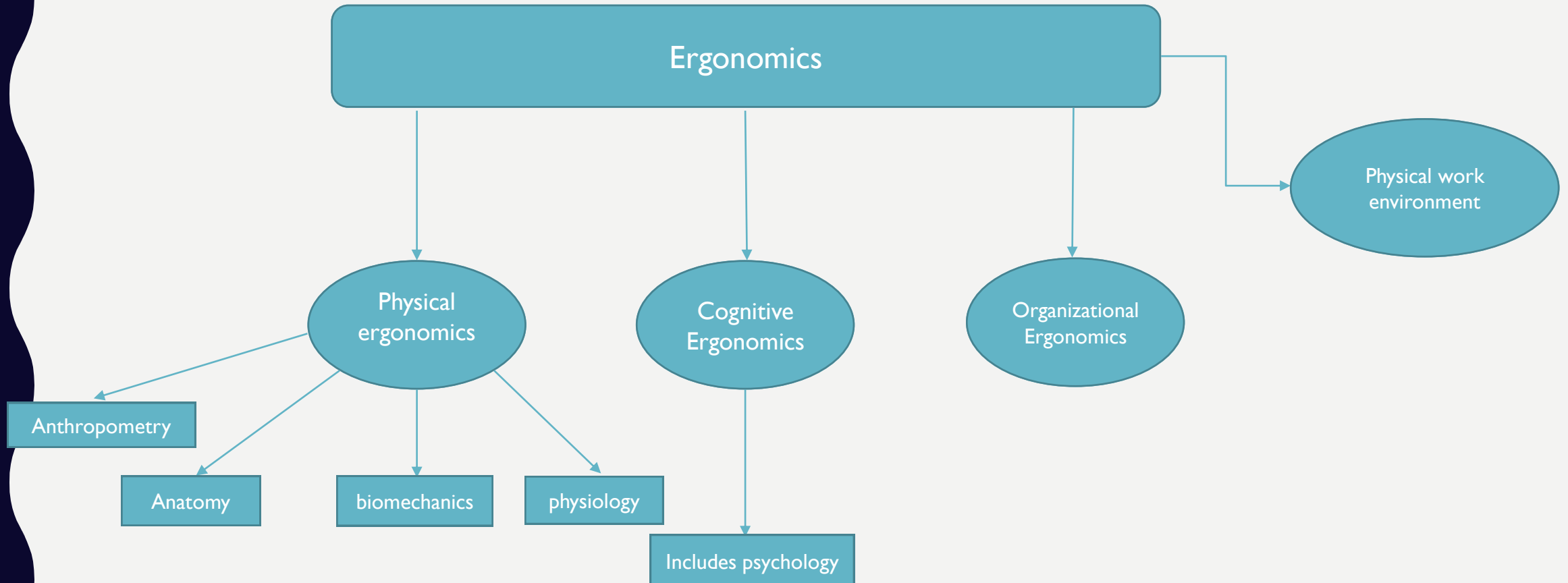
# **OVERVIEW OF ERGONOMICS**

# A BRIEF HISTORY OF ERGONOMICS

- Father of word “ergonomics”: **Wojciech Jastrzębowski** in 1857.
- The word ergonomics was coined by British scientist K. F. H. Murrell and entered the English language in 1949
- Statues and paintings indicate that the ancient Greeks had a good knowledge of anthropometry.
- the father of medical science Hippocrates (370 BC) develops concrete recommendations for the surgeon's workplace.
- Hippocrates, Aristotle, Leonardo Da Vinci ..... and many more... 😊



# ERGONOMICS CAN BE SUBDIVIDED IN FOLLOWING KEY AREAS



# PHYSICAL ERGONOMICS

Physical ergonomics is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity.

(Relevant topics include working postures, materials handling, repetitive movements, work related musculoskeletal disorders, workplace layout, safety and health, temperature, vibration etc.)



<http://stridestrong.com/office-ergonomics/>

# FEW IMPORTANT TERMS

Name	Definition	Relation to ergonomics
Anthropometry	It is scientific study of the measurement and proportions of the body.	It involves collecting statistics or measurements relevant to the human body, called Anthropometric Data. The data is usually displayed as a table of results, diagram or graph. Anthropometric data is used by designers and architects.
Physiology	It is a branch of biology concerned with the vital processes of living organisms and how their constituent tissues and cells function .	Physiological problems occur when the body is required to do too much work, to work awkwardly or to work under bad environmental conditions. So design of a system should consider avoiding them.
Biomechanics	It is a study of the mechanical laws relating to the movement or structure of living organisms.	In this module, we can just model muscles with forces and calculate ways to minimize work done
Anatomy	It is the branch of science concerned with the bodily structure of humans, animals, and other living organisms, especially as revealed by dissection and the separation of parts.	Physical work of a person involves various body parts. In order to improve the efficiency of the work, study of anatomy is needed

- These topics will be explained in detail in the coming lectures



# WHY PHYSICAL ERGONOMICS?

- Example:
  - A large number of occupations require workers to expend physical energy to perform their jobs. Manual labor is a primary work activity in industries such as construction, agriculture, mining, manufacturing and logistics. These work situations include a significant amount of lifting, carrying, and other manual handling tasks.



# COGNITIVE ERGONOMICS

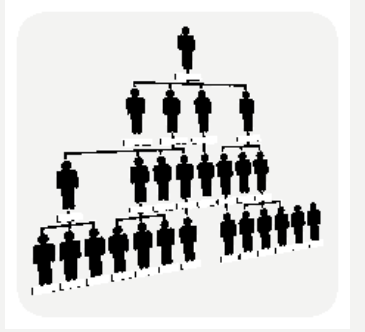
- Cognitive ergonomics is concerned with the capabilities and limitations of the human brain and sensory system while performing activities that have a significant information processing content.
- Cognitive ergonomics considers how the human mind perceives its environment and processes information.
- Cognitive activities include reading, writing, listening, speaking, thinking, learning, planning, designing, calculating, problem solving, diagnosing, decision making and interaction with a computer.

(Relevant topics include mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as these may relate to human-system design.)

# COGNITIVE ERGONOMICS > PHYSICAL ERGONOMICS

- Cognitive Ergonomics has become increasingly important relative to physical ergonomics because of several trends in industry and technology:
- Growth in the service industry sector of the economy relative to the manufacturing sector.
- Increased use of mechanization and automation in physical tasks, requiring workers to monitor and control processes that were previously performed manually.
- Increased use of technologically sophisticated equipment that is cognitively more challenging to operate, maintain, and repair.

# ORGANIZATIONAL ERGONOMICS



- Organizational ergonomics is concerned with the optimization of sociotechnical systems, including their organizational structures, policies, and processes.
- (Relevant topics include communication, crew resource management, work design, design of working times, teamwork, participatory design, community ergonomics, cooperative work, new work paradigms, virtual organizations, telework, and quality management.)

# PHYSICAL WORK ENVIRONMENT

- Whether work is physical or cognitive, it is performed in an environment.
- By making the physical components of the work as comfortable and undistracting as possible, better job satisfaction and greater productivity are encouraged



<http://amicusinteriors.com.au>

# WORK ENVIRONMENT

- Visual environment
  - Physics of light
  - Visibility & visual performance
  - Lighting system
- Auditory environment
  - Effect noise & permissible noise
  - Noise control
- Climate control
  - Thermoregulation
  - Heat stress & cold stress

# OCCUPATIONAL SAFETY AND HEALTH

- Occupational safety – concerned with the avoidance of industrial accidents
  - One-time events that cause injury or fatality
- Occupational Health – concerned with avoiding diseases and disorders caused by exposure to hazardous materials or conditions
  - Develop after prolonged periods of exposure
  - May take years before symptoms reveal the onset of the malady

# MATTER TO READ

- “Introduction to Ergonomics” by R. S. Bridger
- “Engineering psychology and human performance” by Christopher and Justin
- “The measure of man & woman: Human factors in Design”
- “An Introduction to Human Factors Engineering” by Christopher D. Wickens
- “The practice and management of Industrial Ergonomics” by David C. A.
- “Engineering Psychology and Cognitive Ergonomics” (Ed. Don harris)
- Matter from various research papers and other searches.
- Special thanks to “Google”.





**THANK YOU**

