RGPVNOTES.IN

Program : **B.Tech**

Subject Name: **Industrial Engineering & Ergonomics**

Subject Code: **ME-504**

Semester: **5th**

Unit IV: Human factor engineering

Definition and history of development of human factors engineering, types & characteristics of man-machine-system, relative capabilities of human being and machines; development and use of human factor data; information input and processing: Introduction to information theory; factors effecting information reception and processing; coding and selecting of sensory inputs.

Q What do you understand by Human Factors? What is its Scope?

Human factors and ergonomics (**HF&E**) is a multidisciplinary field incorporating contributions from psychology, engineering, biomechanics, mechanobiology, industrial design, graphic design, statistics, operations research and anthropometry. In essence it is the study of designing equipment and devices that fit the human body and its cognitive abilities. The two terms "human factors" and "ergonomics" are essentially synonymous.

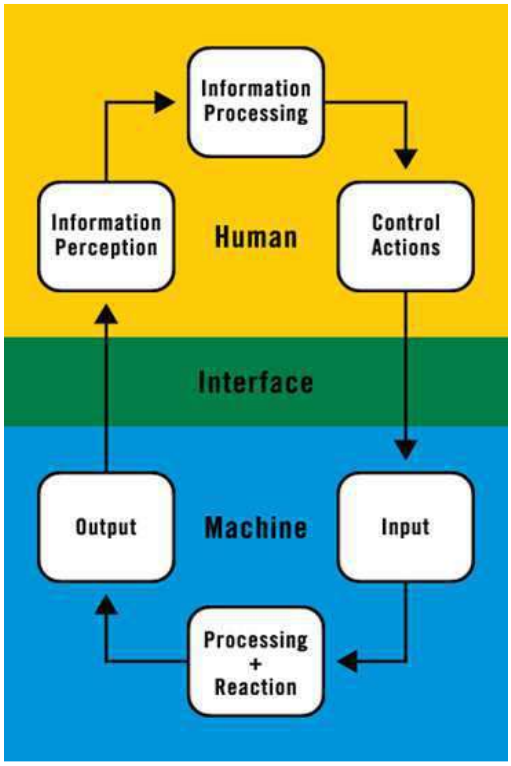
Human Factors is a body of science that incorporates the physical and cognitivecapabilities and limitations of populations of people into the design and operation of asystem, process, or equipment. Appropriate inclusion of human factors during thedesign process, also known as human engineering, results in improved operability,maintainability, and manufacturability of equipment, processes, and systems.

To understand the human-machine system, it's important to understand the ways that people:

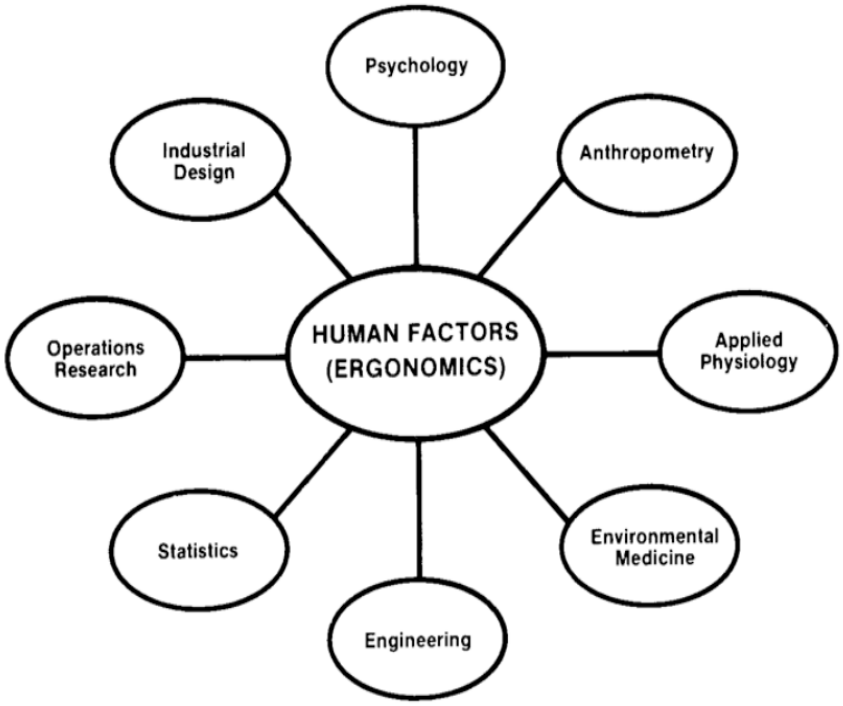
- Perceive information from the device,
- Interpret the information and make decisions about what to do, and
- Manipulate the device, its components, and/or its controls.

It's also important to understand the ways that devices:

- React to input from the user, and then
- Provide feedback to the user about the effects of their actions



- **The Scope of Human Factors**



Q Why is HFE is important to medical devices?

For medical devices, the most important goal of the human factors/usability engineering process is to minimize use-related hazards and risks and then confirm that these efforts were successful and users can use the device safely and effectively.

Specific beneficial outcomes of applying human factors/usability engineering to medical devices include:

- Easier-to-use devices,
- Safer connections between device components and accessories (e.g., power cords, leads, tubing, cartridges),
- Easier-to-read controls and displays,
- Better user understanding of the device's status and operation,
- Better user understanding of a patient's current medical condition,
- More effective alarm signals,
- Easier device maintenance and repair,
- Reduced user reliance on user manuals,
- Reduced need for user training and retraining,
- Reduced risk of use error,
- Reduced risk of adverse events, and
- Reduced risk of product recalls.

Q. Write a short note on relative capabilities of human being and machines?

MAN EXCELS IN	MACHINES EXCEL IN
Detection of certain forms of very low energy levels	Monitoring (both men and machines)
Sensitivity to an extremely wide variety of stimuli.	Performing routine, repetitive, or very precise operations.
Perceiving patterns and making generalizations about them.	Responding very quickly to control signal.
Detecting signals in high noise levels.	Exerting great force, smoothly and with precision.
Ability to store large amounts of information for long periods and recalling relevant facts at appropriate moments.	Storing and recalling large amounts of in-formation in short time-periods.
Ability to exercise judgment where events cannot be completely defined.	Performing complex and rapid computation with high, accuracy.
Improvising and adopting flexible procedures.	Sensitivity to stimuli beyond the range of human sensitivity (infrared, radio waves, etc.
Improvising and adopting flexible procedures.	Sensitivity to stimuli beyond the range of human sensitivity (infrared, radio waves, etc.
Ability to react to unexpected low-probability events.	Doing many different things at one time.
Applying originality in solving problems, i.e., alternate solutions.	Deductive processes.
Ability to profit from experience and alter course of action.	Insensitivity to extraneous factors.
Ability to perform fine manipulation, especially where misalignment appears un-expectedly.	Ability to repeat operations very rapidly, continuously, and precisely the same way over a long period.
Ability to continue to perform even when overloaded.	Operating in environments which are hostile to man or beyond human tolerance.
Ability to reason inductively.	Not possible

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Q. What is Anthropometry? What are the principles in application of anthropometric data?

Ans

Anthropometry is Study of Body Dimensions. It includes-

- Measurement of the Dimensions
- Physical Characteristics
- Static Measurement
- Dynamic Measurement

Two Primary Types of Body Measurements are-

- Static
- Dynamic (Functional)

Anthropometric Design Principles

- Determine body dimensions important in design (sit height as basic factor in seat-to-roof in automobiles)
- Define population to use the equipment/facilities
- Determine what principle should be applied (extremes, average or adjustable ranges)
- When relevant, select % of users served (90%, 95%) whatever is relevant to the problem
- Use anthropometric tables appropriate for the population, & use data
- Special clothing, add appropriate allowances
- Build full-scale mock-up of equipment/facility & use it w/user population
- All the anthropometric data in world cannot substitute for a full-scale mock-up.

(Please read the attached article **Anthropometric Data** by Selwyn Goldsmith)

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Q How Human beings receive Sensory information?

Ans- Human sensory systems are the way in which we perceive the external world, remain alert, form a body image, and regulate our movements. Sensations occur when external stimuli interact with receptors. Sensory information is conveyed to the brain as trains of action potentials traveling along individual sensory neurons and by populations of such neurons acting together. All sensory systems respond to four elementary features of stimuli—modality, location, intensity, and duration. The diverse sensations we experience, the sensory modalities, reflect different forms of energy that are transduced by receptors into depolarizing or hyperpolarizing electrical signals called receptor potentials. Receptors specialized for particular forms of energy, and sensitive to particular ranges of the energy bandwidth, allow humans to sense many kinds of mechanical, thermal, chemical, and electromagnetic events. To maintain the specificity of each modality within the nervous system, receptor axons are segregated into discrete anatomical pathways and processing areas.

The location and spatial dimensions of a stimulus are conveyed topographically, through each activated receptor's position in the sensory epithelium, called its receptive field. The identity of the active sensory neurons therefore signals not only the modality of a stimulus, but also the place where it occurs. The intensity and duration of stimulation, meanwhile, are reflected by the amplitude and time course of the receptor potential and by the total number of receptors activated. In the brain, intensity is conveyed by an action potential code in which the frequency of firing is proportional to the strength of the stimulus. The temporal features of a stimulus, such as duration and changes in magnitude, are signaled by the dynamics of the spike train.

The complex qualities of sounds, visual images, shapes, textures, tastes, and odors require the activation of large ensembles of receptors acting in parallel, each one signaling a particular stimulus attribute. For us to savor the richness and diversity of perception, the central nervous system must integrate the activity of an entire sensory population.

Sensory information in the central nervous system is processed in stages, in the sequential relay nuclei of the spinal cord, brain stem, thalamus, and cerebral cortex.

Each of these processing stations brings together sensory inputs from adjacent receptors and—using networks of inhibitory neurons—transforms the information to emphasize the strongest signals.

Q. Explain in brief -

a. Factors effecting information reception and processing

There are six factors that influence the effectiveness of a learner's information processing.

- The quality of sensory input information reaching the performer's senses
- The quality and effectiveness of sensory receptors in relaying information to the CNS
- The speed of processing stimulus information, known as reaction time
- The ability to anticipate
- The capacity to concentrate and attend to stimuli
- The level of arousal and psychological readiness

b. Coding and selecting of sensory inputs

A **code** is a rule for converting a piece of information (for example, a letter, word, phrase, or gesture) into another - usually shortened or covert - form or representation (one sign into another sign), not necessarily of the same type.

In communications and information processing, **encoding** is the process by which information from a source is converted into symbols to be communicated.

Cognition is the key. A sample of our cognitive abilities includes –

- Memory
- Process orientation
- Comparison/contrast
- Concept formation
- Symbol decoding
- Deductive reasoning
- Rule following
- Context comprehension
- Inferencing

These are not 'all or nothing' abilities.

Human information input and processing operations depend, of course, on the sensory reception of relevant external stimuli. It is these stimuli that contain the information we process.

Information from these original sources may come to us directly or indirectly through some intervening mechanism or device (such as radar, telescope, etc.).

In either case, the distal stimuli are sensed by the individual only through the energy that they generate through proximal stimuli (e.g. light, sound, mechanical energy, etc.).

In the case of indirect sensing, the new distal stimuli may be of two types:

1)-Coded stimuli (e.g. visual or auditory displays).

2)- Reproduced stimuli (e.g. TV, radio, photographs, hearing aids).

In such cases the reproduction may be intentionally modified in some way, as by enlargement, miniaturization, amplification, filtering, etc.

With either coded or reproduced stimuli, the new or converted stimuli become the actual distal stimuli to the human sensory receptors.

The human factors aspect of design enters into this process in these circumstances in which indirect sensing applies. It is in these circumstances that the designer can design displays for presenting information to people.

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Q. Explain the man-machine system & types of man-machine systems.

Ans

Human–machine system is a system in which the functions of a human operator (or a group of operators) and a machine are integrated.

There are five basic classes of man-machine systems.

In the **first**, **the human operator is included in the technological process, to which he must constantly attend**. He is guided in his work by instructions, which cover virtually all possible situations and solutions. Operators at transfer lines and operators who receive and transfer information are part of this type of man-machine system.

In systems of the **second** class, **operators monitor and control a process**. Operators in radar systems and traffic controllers in transportation systems are part of these systems.

The third class of man-machine systems requires **the operator to issue commands to robots, manipulators, and machines that amplify human muscular energy**.

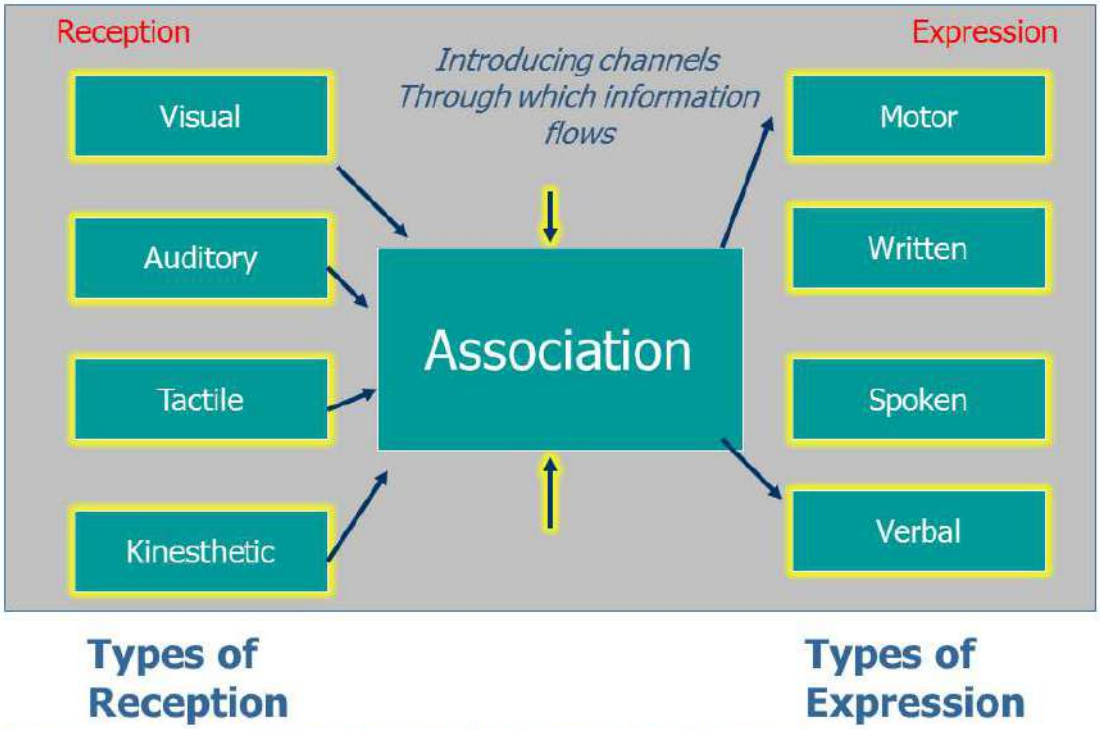
In systems of the fourth class, **the operator acts as an investigator**. Decipher clerks and computer operators are examples of operators in this class.

In systems of the fifth class, **the operator is called upon to make management decisions**. Organizers, planners, and executives work with systems in this class.

In the second, fourth, and fifth classes of systems, the operator can set up a dialogue with the machine. Here, the operator and machine alternate in performance of the task.

Q. Draw a model diagram to explain Human Information Processing .

Ans



Tactile : pronunciation and example sentences. Of or connected with the sense of touch
Kinesthetic : The sense that detects bodily position, weight, or movement of the muscles, tendons, and joints.
Motor : The physical activity of an individual..

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