

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (INDUSTRIAL ENGINEERING) (46) WORK SYSTEM DESIGN AND HUMAN FACTORS ENGINEERING SUBJECT CODE: 2714602 SEMESTER: I

Type of course: Core II

Prerequisite: NA

Rationale: The aim of the course is to familiarize students with the basic approaches of work system design and human factor engineering. Application of different concept for work system and human factor engineering as per industry requirement is considered. This subject helps student to design work system for human performance improvement.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to Work Study: Productivity, Scope of methods, motion and time study.	2	5
2	Work Methods Design: Operation Process Chart, Flow Process Chart, Flow Diagram, String Diagram, Man and machine chart, Two handed process chart, Travel Chart, Micro motion and memo motion study.	6	10
3	Work Measurement: Tools and Techniques	5	10
4	Work Sampling: Determining time standards from standard data and formulas, Predetermined motion time standards, Work factor system, Methods time measurement, Analytical Estimation, Measuring work by physiological methods – heart rate measurement – measuring oxygen consumption– establishing time standards by physiology methods.	7	15
5	Human Factors Engineering: Introduction to ergonomics, Man/machine/environment systems concept, Human Anthropometry and its use in work place layout.	4	10
6	Human Performance: Information input and processing, factors affecting human performance, physical work load and energy expenditure, heat stress, manual lifting. Static and dynamic muscular load, human motor activity, metabolism, physical work load, repetitive and inspection work, measurement of physical work load, mental work load and its measurement, work duration and work pauses, principles of motion economy.	7	15
7	Design of Work Space & Equipment: Work-space design for standing and seated workers, arrangement of components with in a physical space, Interpersonal aspect of work place design, Ergonomic Factors to be	6	15

	considered, design of displays and controls, design for maintainability.		
8	Design of Environment: Illumination and its effect, Climate - Heat Humidity – Body heat balance, effective temperature scales, zones of discomfort, effect of heat on body and work performance, Vibrations - Response of body to low frequency vibrations, vibrations and discomfort, effect on health of worker, high frequency vibrations, effect of high frequency vibrations, methods of reducing vibrations, Noise - Physiological effects of noise, annoyance of noise, speed interference, hearing loss, temporary and permanent threshold shift, effect of noise on performance, reduction of noise, personal noise protection.	8	20

Reference Books:

1. Introduction to Work Study, I.L.O., 3rd Revised Edn.
2. Motion and Time Study – Design and Measurement of Work, Barnes, Raeph.m., John Wiley & sons, New York, 1990.
3. Human Factors in Engineering and Design, Macormick, E.J., Tata McGraw-Hill
4. A Guide to Ergonomics of Manufacturing, Martin Helander, TMH, 1996.
5. Human Factor Engineering, Sanders & McCormick, McGrawhill Publications.
6. Sound, Noise and Vibration Control, Lyle, F. Yerges, Van Nostrand, 1978
7. Methods, Standards and Work Design, Benjamin W. Niebel and AndrisFreivalds, WCB McGraw Hill(1999)
8. Improving Productivity and Effectiveness, Mundel, Marvin, E., Prentice Hall, 1983.
9. Human Factors Engineering & Design, Sounders, M.S. and McCornic, E.J., McGraw Hill, 1983.
10. Motion and time study, Benjamin .W. Neibel,, Richard .D .Irwin Inc., Seventh Edition, 1982.
11. Work design Stephen Konz., Publishing Horizon Inc.,Second Edition,1979.
12. Introduction to Ergonomics, Bridger R.S.,McGraw Hill,1995.
13. Applied Ergonomics, Hand Book: Brien Shakel (Edited) Butterworth Scientific, London 1988.
14. Work Study and Ergonomics, Shan, H.S, DhanpatRai& Sons, 1992.

Course Outcome:

After learning the course the students should be able to:

- 1) Demonstrate application of work study
- 2) Demonstrate work method design by different charts and apply it for improvement
- 3) Demonstrate work measurement
- 4) Apply work sampling techniques
- 5) Demonstrate human factor engineering and human performance
- 6) Prepare and solve case problem related to work space design
- 7) Demonstrate concept of design of environment

List of Experiments:

- 1) Study of work study and productivity concepts
- 2) Exercises on work method design (different charts/diagrams, such as, OPC, FPC, TPC, MMC etc.)
- 3) Exercise on work measurement
- 4) Exercise on performance rating
- 5) Exercise on principles of motion economy
- 6) Case problems on ergonomics considerations (workshop/office).

Open Ended Problems:

1. Students can prepare OPC, FPC, two handed chart, travel chart on concern industry problem
2. Students can apply ergonomics concept in different product and identify possibility of improvement in existing product.
3. Student can visit industry and apply work space design and prepare report.

Major Equipments:

Workshop and office environment to carry out above experiments.