

**GUJARAT TECHNOLOGICAL UNIVERSITY****M. E. - SEMESTER – I • EXAMINATION – WINTER 2012****Subject code: 714602****Date: 09-01-2013****Subject Name: Work System Design and Human Factors Engineering****Time: 02.30 pm – 05.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain with suitable example how industrial engineering techniques will help improve productivity of any business. **07**
- (b) Define “Ergonomics” and explain its contribution in effective work system design. **07**

- Q.2** (a) Explain the factors affecting productivity with suitable examples. **07**
- (b) What is PMTS? List different PMTS. Explain merits and demerits of PMTS over stop watch time study. **07**

**OR**

- (b) Explain the objectives of “Method Study” with suitable examples. **07**

- Q.3** (a) Following are the particulars of milling a job by Mr. X... **07**
- i) Loading the job: 2 min.
- ii) Milling on auto feed: 4 min.
- iii) Unloading the job: 2 min.

Draw man-machine chart (*with conventional notations taking appropriate scale on your answer book only*) for above activities. Mr. X is then asked to operate two milling machines simultaneously for the same job. Draw man – machine chart for this case also and find out what will be the increase in his % utilization? What will be the increase in productivity in this case considering 8 hrs. shift with total rest period of 90 minutes? (*Distance between the machines is very negligible*).

- (b) Explain different elements to be considered during time-study with at least one example each. **07**

**OR**

- Q.3** (a) What is the importance of “Principles of Motion Economy” in designing efficient and effective workplace? – Explain the sub principles related with “Design of tools and equipments” with at least one example each. **07**
- (b) A work sampling study was conducted on a machine to ascertain the proportion of idle time of the same. The preliminary study revealed that the machine was found idle for 25% of the time. This study was carried out with 95% confidence level and +/- 5% accuracy. What should be the actual size of the sample required for this study? Find out revised sample size at the middle of the study where the proportion of machine idleness was found as 35%. Also find out accuracy of the study after making 5000 observations wherein the machine was found working during 3000 observations. If accuracy level is set at +/- 2.5% do we need to increase or decrease the sample size? By approximately how much? **07**

- Q.4 (a)** Explain the 7-steps approach, with suitable examples, to apply Anthropometric Data for effective product and work system design. **07**
- (b)** Define Aerobic and Anaerobic Processes. Explain the process of metabolism at work with the help of oxygen debt and repayment phenomena. **07**

**OR**

- Q.4 (a)** What are the options available for measuring work by physiological methods? Explain any one method in details. **07**
- (b)** What do you mean by human motor skill? What is the importance of the same in human factors engineering? Classify different motor movements with examples. **07**

- Q.5 (a)** What are the criteria that must be satisfied by ergonomically designed displays and controls? **07**
- (b)** Explain the terms “Thermoregulation, Acclimation and Acclimatization” with respect to heat stress to human. What are the health hazards due to prolonged or extreme heat stress? **07**

**OR**

- Q.5 (a)** Design of suitable environment for workplace will improve productivity. – Justify the statement with appropriate examples. **07**
- (b)** In a manufacturing plant, sitting workstations is designed for light assembly work for female operator as shown in Figure 1. The design is such that operator’s hand is held at 5 cm below elbow height as shown in the figure. The product height is H and it is being handled at H/2 as shown in the figure. The table is 3 cm thick. Comment whether this design is suitable for 5<sup>th</sup> percentile, 95<sup>th</sup> percentile or both the populations. (Refer Figure 1 and Table 1 for relevant data). **07**

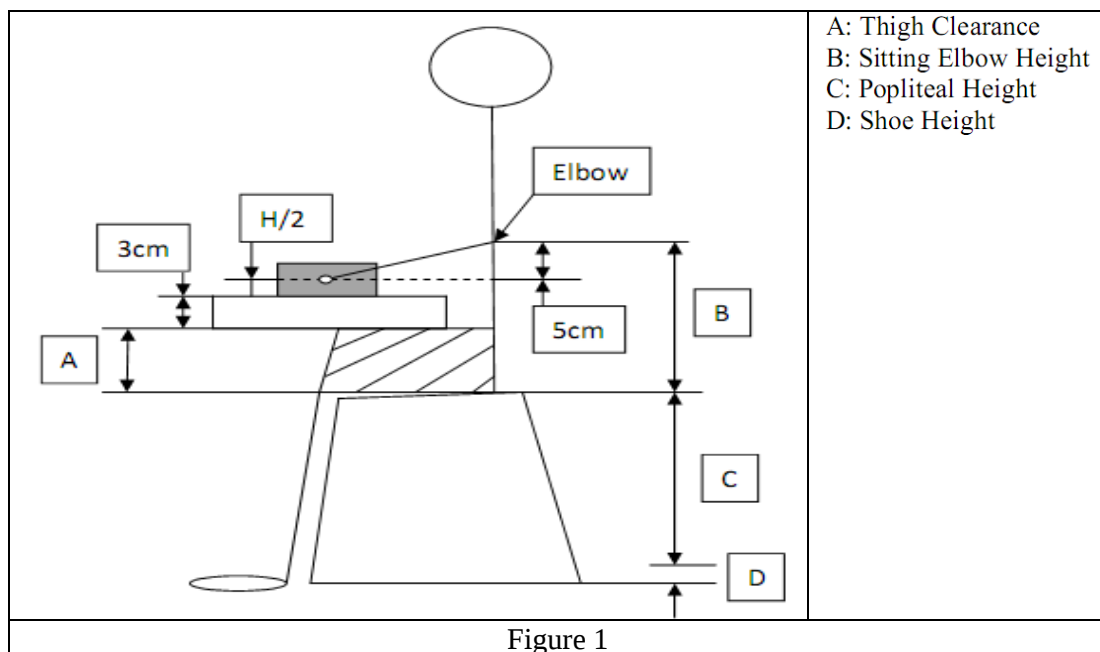


Table 1 Anthropometric Data

| Sr. No. | Particular           | 5 <sup>th</sup> Percentile Female (cm) | 95 <sup>th</sup> Percentile Female (cm) |
|---------|----------------------|----------------------------------------|-----------------------------------------|
| 1       | Thigh Clearance      | 10.6                                   | 17.5                                    |
| 2       | Sitting Elbow Height | 18.1                                   | 28.1                                    |
| 3       | Popliteal Height     | 35.5                                   | 48.5                                    |

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