

**National Exams May 2014**  
**98-Ind-A2-Analysis and Design of Work**  
**3 hours duration**

**Notes:**

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a Closed Book exam. Candidates may use one of two calculators, the Casio or Sharp approved models.
3. Any five questions constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.
4. All questions are of equal value.
5. Write your answers in point-form whenever possible, but fully. Show all the calculations.

**Marking Scheme (marks)**

- |    |        |         |         |
|----|--------|---------|---------|
| 1. | (i) 6, | (ii) 8, | (iii) 6 |
| 2. | (i) 7, | (ii) 7, | (iii) 6 |
| 3. | (i) 5, | (ii) 5, | (ii) 10 |
| 4. | (i) 9, | (ii) 6, | (iii) 5 |
| 5. | (i) 8, | (ii) 6, | (iii) 6 |
| 6. | (i) 6, | (ii) 7, | (iii) 7 |
| 7. | (i) 7, | (ii) 7, | (iii) 6 |

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1. (i) State the broad areas of opportunities for savings through the application of methods engineering and work measurement.  
(ii) Show the basic features of a flow process chart, including the summary form of such a chart. What are the main uses of such a chart?  
(iii) As an industrial engineer, you are asked to make methods improvement in a metal cutting manufacturing plant. State the various areas of the operation you would investigate to achieve your objective.
  
2. (i) State the basis principles of motion economy for the “use of the human body”.  
(ii) State the body members involved in the five classifications of movements. Explain the concept that all motions should be made at the lowest classification of movements.  
(iii) State briefly the macroscopic approaches to making improvements in the workplace.
  
3. (i) What are the major factors affecting fatigue of the operator?  
(ii) State the factors for which fatigue allowance is given in a stopwatch time study?  
(iii) Determine the optimum number of machines that should be assigned to an operator when:
 

Loading and unloading time per machine	= 2.00 min.
Walking time to next machine	= 0.12 min.
Machine time (power feed)	= 6.00 min.
Machine rate	= \$24.00 per hr.
Operator rate	= \$8.00 per hr.
  
4. (i) For a drill press operations, the following data are known:

Work Elements	Observed time (min.)	Rating %
1. Load drill press	0.25	110
2. Drill hole with automatic power feed	0.15	100
3. Check tolerance of the last piece produced during machine cycle (#2) with go/no-go gauge	0.08	115
4. Unload drill press	0.20	120

The company allows: 5% for personal, 5% for unavoidable delays and 5% for fatigue. Calculate the normal time and the standard time for the operation in min./pc.

- (ii) What are the uses of time standards?
- (iii) State the steps that are followed in a stopwatch time study.
  
5. (i) What are the advantages and disadvantages of predetermined motion times compared to stopwatch time study?  
(ii) How would you explain to a worker in your company who knows nothing about MTM (Methods-Time Measurement), what it is and how it is applied?  
(iii) Explain the factors that influence the reach and the move times in the MTM system.

6. (i) What is the basic purpose of employing work sampling techniques? What are the applications or uses of work sampling?
- (ii) The following data were obtained during the course of the day to establish standard time for a lathe machine operation by means of work sampling: total number of observations = 150, number of observations operator idle = 50, average performance rating = 150%, total time worked per day = 480 min., number of pieces produced per day = 250 pcs. The company allows 5% for personal, 5% for unavoidable delays and 5% for fatigue in establishing time standards. Determine the standard time in min./pc.
- (iii) Assume that the work sampling study was continued for the second day and a total of 300 observations were obtained, of these observations, the operator was found idle 75 times. Determine the relative and absolute accuracies of operator idle time at a confidence level of 99%.
7. (i) State the factors that are generally selected in point-system method of job evaluation plan.
- (ii) Why is the point-system method preferred over other methods of job evaluation plan?
- (iii) Why standard hour plan is most commonly used in direct financial plan, compared to piecework and measured day work?