



Second Semester Examination
2020/2021 Academic Session

July/August 2021

EPM 322 – INDUSTRIAL ENGINEERING

Duration : 2 hours (2+2 hour for Asynchronous)

Please check that this examination paper consists of FOUR (4) pages pages including appendixes before you begin the examination.

Instructions : Answer ALL **FOUR (4)** questions.

Answer to each question must begin from a new page.

1. [a] A worker-machine system produces one work unit per cycle. The normal cycle time of the system is computed as 5.39 minutes where the manual work takes 0.84 minutes. In normal workday, a worker can complete 85 units during a standard 8-hour shift.
- (i) Using a personal time, fatigue and delay (PFD) allowance factor of 16% and the machine allowance factor of 30% for setup and maintenance, determine worker's efficiency and the standard time for the work cycle.
- (ii) If a total of 42 min was lost during the 8-hour clock time due to personal time and delays, determine the worker's performance.

[60 marks]

- [b] Future production requirements in the milling department must be satisfied through the acquisition of several new milling machines and the hiring of new operators. There are three new parts that will be produced in the planning. Part A has annual quantities of 20,000 units; part B, 32,000 units; and part C, 47,000 units. Corresponding standard times for these parts are 7.3 min, 4.9 min, and 8.4 min, respectively. The department will operate one 8-hour shift for 250 days/yr. The machines are expected to be 98% reliable, and the anticipated scrap rate is 4%. Worker efficiency is expected to be 100%.

As an industrial engineer, determine the exact number of the machines and new hires.

[40 marks]

2. A fundamental assumption in economics is that human behaviour is guided by self-interest based on financial gain. Even people who already possess significant wealth are almost always motivated to seek greater wealth, sometimes with drives that far exceed those of the average worker.

[a] How far do you agree to the above statement? Justify your opinion with appropriate motivational theory(ies).

[b] Suggest at least TWO (2) methods based on appropriate motivational theory(ies) to motivate an average worker in achieving an outstanding performance.

[100 marks]

3. Salman reached for the small part a short distance away in the workplace, picked up the part, and placed it in a vise. He then rotated the screw handle of the vise three turns to hold the part between the vise jaws. In rotating the screw handle, he had to grasp and regrasp the handle six times due to the limited rotation ability of his own wrist. On the seventh turn, Salman used both hands to apply additional torque to tighten the vise.
- [a] Write a list of the therbligs that comprise the motion sequence performed by Salman.
- [b] Label each therbligs in these motions with a brief description.
- [c] Identify at least TWO (2) areas for possible study that might improve the method, indicating the nature of the improvement that might result.

[100 marks]

4. [a] A time study was conducted on an assembly job consisting of three elements in a cycle in a normal 8-hour shift. For every eight cycles, the operator must exchange parts containers which took 1.60 minutes, rated at 95%. The study was conducted using cumulative timing method along with the performance rating. Stopwatch readings in hundredth of a minute and the rating factors are given in Table 4[a].

Table 4[a]

Element	Stopwatch readings (hundredth of a minute)					Rating (%)
	1	2	3	4	5	
1	10	73	139	203	266	80
2	25	88	155	218	280	100
3	64	128	193	257	320	110

- (i) If the operator is given 30 minutes lunch break and 20 minutes breaks for personal time and fatigue, compute the PFD allowance factor, A_{pfd} that should be added into the standard time computation.
- (ii) Calculate the standard time in second using the PFD allowance factor obtained in (i).
- (iii) Determine the worker's efficiency if the operator completes 600 parts in a normal 8-hour shift.

[50 marks]

[b] A work sampling study was conducted on a worker-machine system to establish the standard time for an automotive brake module assembly. The study took 3 standard 8-hour shifts to complete. The machine allowance factor is assumed to be zero. A total of 160 observations had been made and the summary of the study is listed below.

Manual operation	= 14 minutes
Machine controlled operation	= 106 minutes
Machine idle time	= 40 minutes
Average performance rating	= 80%
Number of modules produced	= 36 units
Allowance for personal needs and fatigue	= 10%

- (i) Determine the average task time to produce a brake module in machine-controlled operation and in manual operation.
- (ii) Determine the normal time to produce a brake module for the assembly operation.
- (iii) Determine the standard time to produce a brake module for the assembly operation.

[50 marks]

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