# PRINCE OF SONGKLA UNIVERSITY
# FACULTY OF ENGINEERING

Final Examination: Semester I                    Academic Year: 2006

Date: October 2, 2006                            Time: 9:00 – 12:00

Subject: 226-341 Maintenance Engineering         Room: A400

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## Instructions

- Write your name and student ID on the answer book and exam paper.
- Write your answer in the answer book only, show your work clearly and legibly.
- This is an opened-book examination.
- There are 12 problems and total score is 120.
- Carefully read the problems and answer all questions in each problem.

ทุจริตในการสอบ โทษขั้นต่ำ คือ พักการเรียน 1 ภาคการศึกษา และปรับตกในรายวิชาที่ทุจริต

| Problem (Full score) | Score |
|---|---|
| 1    (15) | |
| 2    (5) | |
| 3    (5) | |
| 4    (5) | |
| 5    (5) | |
| 6    (5) | |
| 7    (5) | |
| 8    (20) | |
| 9    (5) | |
| 10   (10) | |
| 11   (15) | |
| 12   (20) | |
| **Total (120)** | |

Do your best and good luck

Thanate Ratanawilai

1. Explain the following items: (15 marks)

   a. OEE

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   b. Predictive Maintenance

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   c. Proactive Maintenance

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   d. MTTR

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   e. MTBF

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2. What are the six big losses of the production line at Haad Thip Co., Ltd? (5 marks)

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3. What is the relationship between 5S activities and maintenance system? (5 marks)

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4. Explain the concept of "Lean Maintenance". (5 marks)

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5. What is the purpose of "Inspection" and what should be included in the standard of "Inspection"? (5 marks)

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6. Describes the meaning of "the bathub curb" as shown in the figure below. (5 marks)



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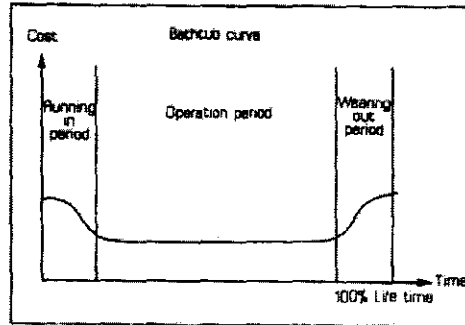
7. Describes "the life cycle profit" as shown in the figure below. (5 marks)



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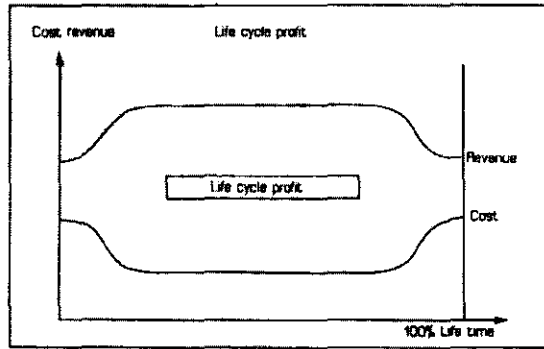
8. In the furniture industry, a CNC machine is operating at loading time of 8 hours per shift whereas breakdown and set ups time of each day are 0.5 hour and 1.5 hour, respectively. The factory operates 2 shifts a day and produces 600 parts each shift. The capacity of CNC machine is to produce 90 parts per hour. However, the amount defective is 25 parts and the amount re-processes is 20 parts. What is the overall effectiveness for this machine? (20 marks)

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9.  What is different between "Periodical Inspection" and Precision Inspection"? (5 marks)

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10. Please construct flow process chart to establish preventive maintenance for production line of Haad Thip Co., Ltd.  (10 marks)

11. If you are a member of the team to establish TPM system for the rubberwood product company. Please answer the following questions. All data can be assumed if necessary. (15 marks)

   a. How should you recommend the company for starting period?

   b. Define a TPM policy.

   c. Design training program for people involved.

   d. Haw can we measure results of these programs?

   e. What type of work should they do contract maintenance?

12. A small production line is established at IE macine shop in order to make a "gear" as a keychain. Three main operations are performed respectively on the following machines;

```
┌─────────────────────┐
│  Turning Machine    │
└─────────────────────┘
          │
          ▼
┌─────────────────────┐
│  Milling Machine    │
└─────────────────────┘
          │
          ▼
┌─────────────────────┐
│  Drilling Machine   │
└─────────────────────┘
```
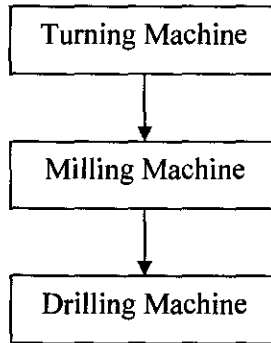
Construct the preventive maintenance in the given tables by selecting 2 out of the 3 machines above and choosing 3 parts from each selected machine. (20 marks)

## Machine / Equipment Analysis

| Machine / Equipment list | Machine charaterization and how to operate | Priority | working continuously / automatically / periodically | Work condition<br>1. time to operate<br>2. hour/day<br>day/week<br>week/year | Main part |
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# (MAINTENANCE ANALXSIS-NTBF)
## Frequeacy and Planning

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|---|---|---|
| (1) ©  : Clean | (4) Ⓐ  : Adjustment | |
| (2) $\Delta_L$  : Lubrication - Top up | (5) ⊕  : Repair | |
| ◯$_L$  : Lubrication - Replacement | ◯  : Replacement | |
| (3) ⊘  : Inspection | (6) ⊕  : Overhaul | |
| ●  : Functional Check | | |

| | Machine/Equipment | MIBF-Frequency | | | | Last Maintenance Date | Next Maintenance Date |
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# WEEKLY MAINTENANCE SCHEDULE

**Planning and Record**          Year                    Week No.                    Engding:  /    /

Location...................................

| Machine | SAT | | | | | | SUN | | | | | | MON | | | | | | TUE | | | | | | WED | | | | | | THU | | | | | | FRI | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | MORN | | AFT | | NIGHT | | M | | A | | N | | M | | A | | N | | M | | A | | N | | M | | A | | N | | M | | A | | N | | M | | A | | N | |
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| MONTHLY MAINTENANCE SCHEDULE | (Planning and Record) |
|---|---|
| | Month............................. Year................................. |

| Job | Job scheduling | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Number of main job | | |
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# ANNUALLY MAINTENANCE SCHEDULE

| (1) | ©  : Clean | (4) | Ⓐ  : Adjustment |
|---|---|---|---|
| (2) | △ L : Lubrication - Top up | (5) | ⊕  : Repair |
| (3) | ○ L : Lubrication - Replacement | | ○  : Replacement |
| | ⊘  : Inspection | (6) | ⊕  : Overhaul |
| | ●  : Functional Check | | |

PLANT : ...............................

DEPARTMANT : .........................

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | MACHINE AND EQUIPMENT | MTBF. MECH | ELEC | INST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT | OCT | NOV | DEC |
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Remark :

Lubrication follow the lubrication schedule

⊕ Overhaul

○ Replacement

● Functional Check

▲ Inspection

○ Clean

○ Cleaning

⊕ Repair

- 13 -

| **5 - Years Master Plan** | (1) | ⓒ : Clean | (4) Ⓐ : Adjustment |
| | (2) | △L : Lubrication - Top up | (5) ⊕ : Repair |
| | (3) | ○L : Lubrication - Replacement | ○ : Replacement |
| Planning and Record | | ⊘ : Inspection | (6) ⊕ : Overhaul |
| Location..........................Machine............................. | | ● : Functional Check | |

| ที่ | Description | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
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