UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	PACKAGING INDUSTRIAL MAINTENANCE
COURSE CODE	:	BNK 30103
PROGRAM ME	:	BNK
EXAMINATION DATE	:	JUNE 2015 / JULY 2015
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTION ONLY

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

Q1 (a) As the maintenance strategy generally evolves in any industrial plant, explain why the time based maintenance or preventive maintenance is no longer economical and the industrial packaging maintenance shall shift to the predictive maintenance strategy.

(6 marks)

(b) Appraise what are the benefits for successfully managing the quality and the training for the maintenance personnel in industrial plant to the plant manager, production manager and maintenance manager.

(4 marks)

(c) While doing routine checking on one of the belt at a packaging machine. A maintenance engineer found the belt with the damage as shown in **FIGURE Q1 (c)**. Diagnose the defect and predict the probable causes and propose the recommended solutions to avoid the defect from reappearing.

(6 marks)

(d) It is required to drive a shaft in **FIGURE Q1(d)** at 720 revolutions per minute (RPM), by means of a belt from a parallel shaft, having a pulley A 300 mm diameter on it and running at 240 revolutions per minute (RPM). What size pulley is required for the shaft B.

(5 marks)

(e) An engineer has to train his technician on the shaft and sprockets alignment. Sketch diagrams showing the methods to conduct shaft and sprocket alignment.

(4 marks)

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2014/2015 PROGRAMME : 3 BNK
COURSE : PACKAGING INDUSTRIAL MAINTENANCE COURSE CODE : BNK30103

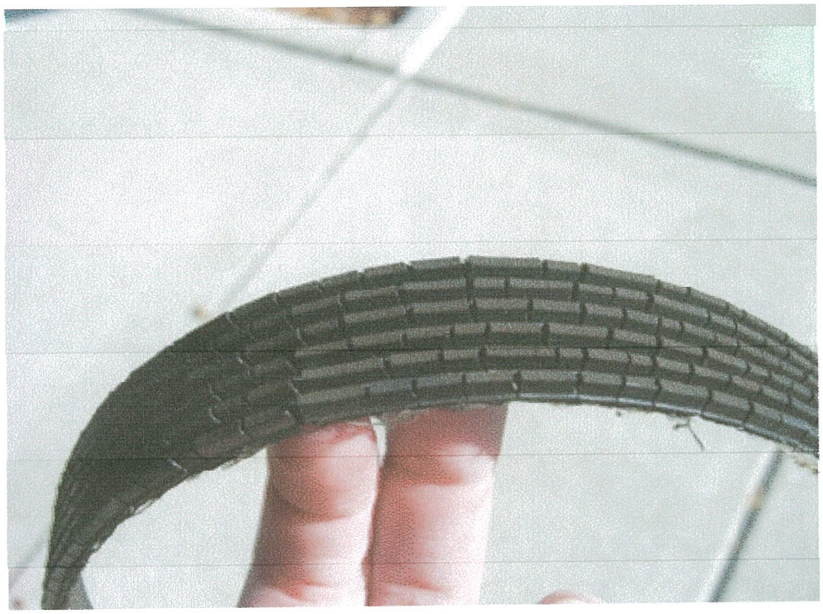

FIGURE Q1(c)

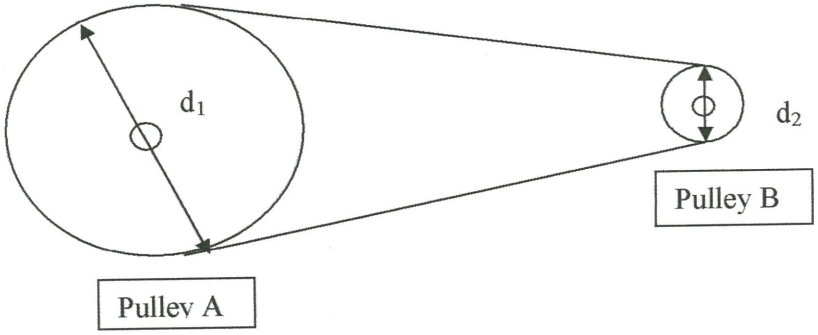

FIGURE Q1(d)

Q2 (a) In ensuring the gears at the packaging machine function as they are intended to, develop a maintenance strategy in detail for all the gears. The strategy shall take into account the time based and the condition based techniques.

(5 marks)

(b) Give your justifications why poor fitting is the common cause of premature bearing failure.

(4 marks)

(c) Calculate the basic life rating (L_{10}) of the following R830ZZ bearing with the following parameters.

Table Q2(c): Specification of R830ZZ bearing

Basic dynamic load rating (Cr)	553 N
Ball diameter (Dw)	1.587 mm
Number of balls (Z)	6
Speed in RPM (n)	3600 min^{-1}
Radial load (Fr)	6 N
Axial Load (Fa)	8 N
E	0.24
X	0.56
Y	1.84

(5 marks)

(d) Diagnose what failure's type of bearing in the **FIGURE Q2(d)** by giving the probable causes to the defect and recommend the appropriate solutions.

(6 marks)

(e) Rust is another enemy to a good bearing function. Propose a strategy on how to avoid rust attacked on the bearing whether while it is in the storage or after installation at the packaging machinery.

(5 marks)

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2014/2015 PROGRAMME : 3 BNK
COURSE : PACKAGING INDUSTRIAL MAINTENANCE COURSE CODE : BNK30103

FIGURE Q2(d)

Q3 (a) Soft foot is one of the reasons for failing to get a good alignment for shaft coupling. Describe soft foot and recommend what are the solutions for the problem.

(6 marks)

(b) Power consumption of rotating equipment in a plant is 30 Megawatts. By doing proper alignment of all these equipment to a smaller tolerance, it is expected to reduce the power consumption by 0.75%. Calculate the savings that might be gained by the plant through the plant wide shaft alignment exercise. Assume the electricity price is RM 0.45/kWh.

(4 marks)

(c) List down shaft alignment techniques and compare their strength and weaknesses.

(5 marks)

(d) Cavitations are one of the major problems in pumps operations. Explain how the cavitations build up and elaborate how cavitations affect the performance of the pump.

(5 marks)

(e) Pump priming is a very important procedure in the start up of centrifugal pump. Justify why there is a need to prime the pump before running the pump continuously.

(5 marks)

Q4 (a) An engineer has found that the plant electricity bills had increased by twenty percent in the last two months. Upon investigation, it was found that one of the compressors was the high consumer. Diagnose the problem by giving probable causes and propose corrective actions.

(6 marks)

(b) While inspecting the packaging machinery, Jesse found that the pneumatic air supply to run parts of the packing machinery contains abnormally extra liquid. Investigate what would be the causes for this problem.

(4 marks)

(c) After slinging onto a load has been secured, identify other things that need to be checked before the lifting process begins.

(5 marks)

(d) A signaler is the one who gives the signals to crane operator on the lifting operation. Describe the responsibilities of the signaler in order to avoid any injury or accident?

(4 marks)

(e) An engineer has to determine which lifting sling has the required safety weight limit (SWL). He has to examine the SWL for grade 80 Lifting sling with 10 mm diameter, grade 60 lifting chain with 10 mm diameter, and Flexible Steer Wire Roper (FSWR) with 10 mm diameter. If the load that needs to be lifted is 3 tones, which lifting sling is safe to lift the load?

(6 marks)

Q5 (a) Total Based Number (TBN) is one of the parameters measured for the engine oil specification. Explain why the TBN is such a useful parameter in engine oil.

(4 marks)

(b) Water content in the lubricant is also another important parameter that needs to be monitored periodically. What harm can the water content in lubrications do with the lubricated equipment if it surpasses the permissible limit?

(4 marks)

(c) As a maintenance engineer, you are assigned to develop a lubrication program in a plant. Prepare an outline that needs to be considered in developing the program.

(8 marks)

(d) List down and explain at least **FIVE (5)** methods of applying lubrication to the rotating equipment.

(4 marks)

(e) Determine the next time the lubrication of ball bearing need to be done if the bearing is working under temperature between 175 F to 200 F and surrounded with light contamination non-abrasive dust at humidity condition between 80 to 90 %. In addition, it vibrates at less than 2.0 ips velocity peak at and is positioned at 45 degree bore centerline. The bore diameter of the bearing is 50 mm.

(5 marks)

Q6 (a) By inspecting the following **FIGURE Q6 (a),** diagnose the failure of the mechanical seals by proposing the type of failures and the probable causes for the failure.

(5 marks)

(b) Explain how installation failures could also become the sources of mechanical seal failures.

(5 marks)

(c) A gearbox has an input speed of 1500 RPM clockwise and an output speed of 300 RPM anticlockwise. The input power is 20 kW and the efficiency is 70%. Determine the following.

(i) The gear ratio

(ii) The input torque

(iii) The output power

(iv) The output torque

(8 marks)

(d) In order to ensure a pump is functioning smoothly, propose what are the inspections that need to be done regularly.

(7 marks)

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2014/2015 PROGRAMME : 3 BNK
COURSE : PACKAGING INDUSTRIAL MAINTENANCE COURSE CODE : BNK30103

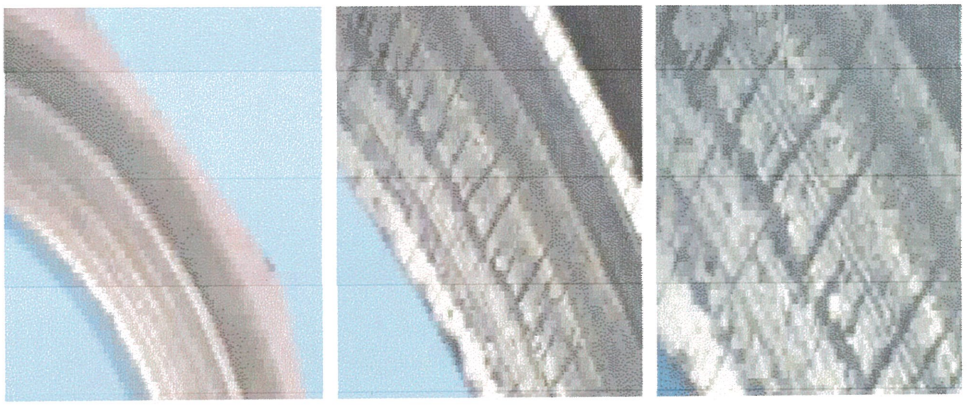

FIGURE Q6 (a)

-END OF QUESTION-

FORMULA and TABLES

$$T = K \times \left[\left(\frac{14{,}000{,}000}{n \times (d^{0.5})} \right) - 4 \times d \right]$$

Where:

T = Time until next relubrication (hours)

K = Product of all correction factors
Ft x Fc x Fm x Fv x Fp x Fd
(see table)

n = Speed (RPM)

d = Bore diameter (mm)

Note:
ips = inches / second
0.2 inches / second = 5 mm / sec.

Grease Interval Correction Factors

Condition	Average Operating Range	Correction Factor
Temperature Ft	Housing below 150°F	1.0
	150 to 175°F	0.5
	175 to 200°F	0.2
	Above 200°F	0.1
Contamination Fc	Light, non-abrasive dust	1.0
	Heavy, nonabrasive dust	0.7
	Light, abrasive dust	0.4
	Heavy, abrasive dust	0.2
Moisture Fm	Humidity mostly below 80%	1.0
	Humidity between 80 and 90%	0.7
	Occasional condensation	0.4
	Occasional water on housing	0.1
Vibration Fv	Less than 0.2 ips velocity, peak	1.0
	0.2 to 0.4 ips	0.6
	Above 0.4 (see note)	0.3
Position Fp	Horizontal bore centerline	1.0
	45 degree bore centerline	0.5
	Vertical centerline	0.3
Bearing Design Fd	Ball bearings	10
	Cylindrical and needle roller bearings	5.0
	Tapered and spherical roller bearings	1.0

Bearing load

1. **Dynamic equivalent radial load**

   $Pr = XFr + YFa$

2. Life 90%

   a. $L10 = (C/Pr)^3$

   b. $L_{10h} = (10^6 / 60n)L_{10}$