



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023**

- COURSE NAME : RAILWAY MODELLING AND DESIGN
- COURSE CODE : BNT 30703
- PROGRAMME : BNT
- TEST DATE : JULY/AUGUST 2023
- DURATION : 2 HOUR AND 30 MINUTES
- INSTRUCTION : 1. ANSWER **ALL** QUESTIONS.
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSE BOOK.

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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- Q1** (a) Provide a detailed explanation of the four fundamental principles of design, commonly referred to as the 4 C's, and analyze how these principles have shaped the advancement of rolling stock engineering and technology. Give an example.
(10 marks)
- (b) As a consultant responsible for advising on the design and procurement of rolling stock for a new railway system, what guiding principles would you utilize to determine the appropriate type of rolling stock required. Furthermore, create an assessment of each design principle, supported by suitable examples.
(12 marks)
- (c) Elaborate and discuss only **THREE (3)** energy reduction techniques utilised in modern railway vehicles.
(3 marks)
- Q2** (a) In the design of railway coaches and locomotives, car body optimization has become a crucial consideration.
- (i) Describe **FOUR (4)** main techniques that rail vehicle manufacturers typically use to achieve this optimization and
(4 marks)
- (ii) Explain how each technique impacts the performance and efficiency of railway vehicles. Provide specific examples to support your answer.
(4 marks)
- (b) Explain the **FOUR (4)** fundamental functions of a bogie.
(8 marks)
- (c) In the context of railway engineering, describe and explain in detail the basic suspension uses in car body.
(9 marks)

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- Q3** (a) A train travels around a 2100 m radius curve at 180 km/h. The track is canted at 6° and the body roll is 2.5° . Calculate the lateral acceleration experienced by a passenger on the train.

Assume $g = 10 \text{ m/s}^2$, $V = 180 \text{ km/h} = 50 \text{ m/s}$, $R = 2100 \text{ m}$

(5 marks)

- (b) The mass of new rolling stock is something that rail vehicle designers are constantly working to lower. Although the complexity of rail vehicles is increasing, the total mass seems to be staying constant.

(i) Discuss the factors that limit the total mass of a rail vehicle, those that may allow the mass to be lowered.

(4 marks)

(ii) Explain the factors that tend to increase the mass of a vehicle.

(4 marks)

(iii) Discuss methods that may limit vehicle mass.

(4 marks)

- (c) There are currently only a few applications where active suspensions are used.

(i) Outlines **THREE (3)** areas where active suspensions would have the greatest benefits.

(3 marks)

(ii) Describe how they might be implemented.

(5 marks)

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Q4 (a) You are the manager of Company A and have been assigned the task of developing railway standards. You have presented the standard to the Board of Directors (BOD) of the company. By using an appropriate flow chart, explain the process of the development of railway standard, and assess how the conflicts are resolved within the process.

(8 marks)

(b) Over the past century, the development of bogie design has undergone transformations to accommodate higher loading and higher speeds of trains. It means that the latest bogie designs have seen numerous improvements compared to older bogie designs. Formulate **FOUR (4)** new bogie design development focusing on higher loading and higher speeds of trains.

(8 marks)

(c) The Production Engineer has identified design failures in high-speed trains, resulting in a 20% decrease in speed and vibrations occurring in the train body. After conducting an analysis, it was determined that the issues were caused by slight deviations in the design, which lacked aerodynamic characteristics and did not adhere to the specifications. To overcome this problem, recommend **THREE (3)** methods can be implemented to reduce drag based on body shape, components, and safety considerations.

(9 marks)

END OF QUESTIONS