First Semester Examination
2021/2022 Academic Session

February/March 2022

EAL431 – Highway Design

Duration : 1 hour

Please ensure that this examination paper contains **SIX (6)** printed pages before you begin the examination.

Instructions : This paper contains **TWO (2)** questions. Answer **All** questions.

All questions **MUST BE** answered on a new page.

...2/-

1. (a). To harmonize variations in vehicle types plying on a highway, the concept of design vehicle was coined in road geometric design. The three design vehicle types used are designated as P, SU and WB-15. The designer must choose the correct design vehicle for a particular project.

(i). Identify the type of design vehicle that you would adopt to design a junction located in each of the following areas, justify your answer:

• ABC Industrial Estate

[5 marks]

• XYZ Residential Area

[5 marks]

(ii). Explain **TWO (2)** adverse effects on road geometrics if design vehicle P is adopted for design of at-grade junctions in the ABC Industrial Estate

[5 marks]

(b). The following data and information are considered to build and to maintain Federal Roads which are gazetted under the Ministry of Works, Malaysia. One of the packages involves the construction of a summit vertical curve that connects the grade lines. The following data and information are considered in the design stage.

- Road hierarchy R4 passing through flat terrain topography
- Uphill grade of 4% and downhill grade of 3.5%
- Design speed is 90 km/h
- Driver's eye height = 0.92 m
- Obstruction object height = 0.15 m
- Stopping sight distance (SSD) = 180 m

- Acceptable centrifugal force for driver comfort = 0.3 m/s^2
- K value for crest vertical curve (ATJ 8/86) = 59

State other assumptions used, if any.

(i). Calculate the length of the vertical curve based on the stopping sight distance (SSD) and comfort criteria.

[18 marks]

(ii). Based on these results, determine the minimum length of curve that you will adopt for design purposes. Justify your answer.

[5 marks]

(c). A road shoulder is part of the carriageway that is continuous with the travelling direction. This feature accommodates emergency-stopped vehicles, emergency use, and mainly confines and provides lateral support along the pavement.

(i). Explain **TWO (2)** main functions of road shoulder that are beneficial to daily commuter including motorcyclist.

[6 marks]

(ii). Based on your observation, sketch a shoulder edge drop-off condition that happened when resurfacing of the road was completed without sufficiently raising the shoulder height. Explain how this condition endangers motorcyclists and suggest **ONE (1)** solution to solve the problem.

[6 marks]

2. (a). Horizontal curves provide transitions between two tangent lines for a section of a new rural highway. To attain a smooth transition, a simple circular curve that the PI at station 20+50.20, with the intersecting angle equal to 35° has been designed. The degree of curvature is approximately 4°. Based on the given information, you are required to:

(i). Sketch an appropriate diagram and label it based on the given information

[5 marks]

(ii). Locate the station of the point of curvature (PC) and the point of tangent (PT)

[15 marks]

(b). **Figure 1** shows a three-legged intersection that connects a minor road to the major road network. The opposite traffic directions are divided by the double continuous lines only, without the presence of a median strip. Due to the escalating number of accidents happening at this intersection, you are required to reduce the traffic conflicts using the channelisation concept.

With the aid of a sketch, via the channelisation concept, suggest the improvements required to reduce the number of traffic conflict points. Label all improvements made in the sketch. Additionally, show **SIX** (6) traffic conflict points after the improvement using channelisation concept.

[15 marks]

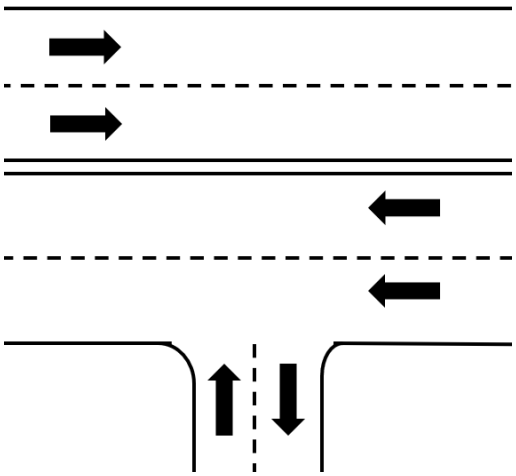

Figure 1: Three-legged intersection

(c). Road accident injuries are hidden global epidemic affecting millions of humans. The problem of road safety in Malaysia indicates shortcomings in the transportation planning process. As an auditor, you are assigned to conduct an audit of an existing road in the operational stage (**Figure 2)**. Based on the idea of providing safer roads, answer the following questions:

(i). Identify the stage of the Road Safety Audit (RSA) that you should perform. Justify your answer

[3 marks]

(ii). With the aid of relevant sketches, suggest **FOUR (4)** improvements required to enhance the safety level of the road. Label all improvements made in the sketch.

[12 marks]

Figure 2

-oooOOOooo-