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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	TRANSPORTATION ENGINEERING
COURSE CODE	:	BFT 40303
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE/JULY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

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Q1 (a) State the **FIVE (5)** key areas in Transportation Engineering and describe briefly the scope of work for each key area.

(10 marks)

(b) Transport engineers are sometimes faced with the challenge of ensuring existing transportation facilities operate at their most productive and efficient levels. Consequently, they will have to apply Transportation Systems Management (TSM) strategies to improve the performance of transportation facilities.

One such strategy is by "Creating Efficient Use of Road Space". Discuss **FIVE (5)** engineering solutions that can help create road space that is used efficiently.

(15 marks)

Q2 (a) An existing freight and passenger railway track that is superelevated on a curve with a radius of 1500 m will be upgraded to accommodate a new design speed of 125 km/h.

(i) Check if the existing superelevation is adequate.

(7 marks)

(ii) Determine the minimum length of spiral curve that is required to connect a tangent to the horizontal curve on the upgraded track.

(5 marks)

(b) The distance between the Points of Vertical Intersection (PVIs) of two vertical curves, a crest curve followed by a sag curve, on a light rail transit main line track is 750 m. The grade of the approaching tangent of the crest curve is 4% and that of the departing tangent of the sag curve is 5%. Determine desired, preferred minimum and absolute minimum lengths of each of these curves if the design speed of the track is 90 km/h.

(13 marks)

Q3 (a) An airport will be built 915 m above sea level, where the normal maximum temperature is 26.7°C. The difference in centerline elevation between the high and low points of the runway is 6.0 m. The airport will serve 100% fleet and 60% useful load of a family of airplanes having a maximum certificated load of 272,000 N.

(i) Determine the unadjusted minimum primary runway length.

(2 marks)

(ii) Calculate the minimum primary runway length, considering wet and slippery conditions during aircraft landing, and difference in centerline elevation during aircraft take-off.

(8 marks)

(ii) Estimate the minimum required length for the crosswind runway.

(2 marks)

(b) An aircraft (design group V) with the following dimensions is moving between two parallel taxiways through a connecting taxiway that has a centerline perpendicular to the parallel taxiways.

Distance between undercarriage and cockpit (d)	=	20 m
Wheelbase (w)	=	16 m
Undercarriage width (u)	=	4 m

(i) Recommend appropriate values to be used for the taxiway width (W), edge safety margin (M) and centerline radius (R).

(3 marks)

(ii) Check the adequacy of the maximum nose wheel steering angle (B_{max}).

(6 marks)

(iii) Calculate the required lead-in (L) and radius of the fillet (F) to maintain the aircraft cockpit over the centerline.

(4 marks)

Q4 (a) Sketch and describe briefly the following facilities that can be commonly found at ferry terminals:

(i) Vehicle staging area.

(3 marks)

(ii) Passenger loading area.

(4 marks)

(b) A ferry docking at a berth in a ferry terminal has a 40-person capacity and one doorway. The berth has ticket machines located on-shore, a single channel gangway and a sloped walkway 10 m in length that ends in a pair of free-swinging gates. Tickets are collected manually at the gangway. The following were observed:

Capacity for ticket collection (C_f)	= 20 passengers/min
Capacity for walkway exit gate (C_x)	= 25 passengers/min/channel
Capacity for gangway (C_g)	= 35 passengers/min/channel
Passenger walking speed (v_e, v_d)	= 1.2 m/s
Clearance time (t_c)	= 5 min
Operating margin (t_{om})	= 3 min

Assuming that passenger volume is at maximum during peak hours,

(i) Calculate the embarking capacity (C_e) and disembarking capacity (C_d).

(10 marks)

(ii) Determine the total embarking and disembarking time (t_{ed}).

(4 marks)

(iii) Estimate the maximum number of ferries per hour (V_b) that the berth can accommodate during peak hours.

(4 marks)

- END OF QUESTIONS -

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Appendix A: Design Tables

I. Maximum grades for light rail main line railway tracks

Distance between points of vertical intersection	Maximum sustained grade (%)
More than 750 m	4
Up to 750 m	6
Up to 150 m	7

II. Taxiway dimensional standards (in meters)

Item	Airplane Design Group					
	I	II	III	IV	V	VI
Width	7.6	10.7	15.2	22.9	22.9	30.5
Edge safety margin	1.5	2.3	3.1	4.6	4.6	6.1
Shoulder width	3.1	3.1	6.1	7.6	10.7	12.2
Safety area width	14.9	24.1	36.0	52.1	65.2	79.9

III. Taxiway curvature dimensional standards (in meters)

Item	Airplane design group					
	I	II	III[b]	IV	V	VI
Radius of taxiway turn[a] (*R*)	22.9	22.9	30.5	45.7	45.7	51.8
Length of lead-in to fillet (*L*)	15.2	15.2	45.7	76.2	76.2	76.2
Fillet radius for tracking centerline (*F*)	18.3	16.8	16.8	25.9	25.9	25.9
Fillet radius for judgmental oversteering symmetrical widening (*F*)	19.1	17.5	20.7	32.0	32.0	33.5
Fillet radius for judgmental oversteering one side widening (*F*)	19.1	17.5	18.3	29.6	29.6	30.5

Notes:
a Dimensions for taxiway fillet designs relate to the radius of taxiway turns specified.
b Airplanes in airplane design group III with a wheelbase equal to or greater than 18.3 m should use a fillet radius of 15.2 m.

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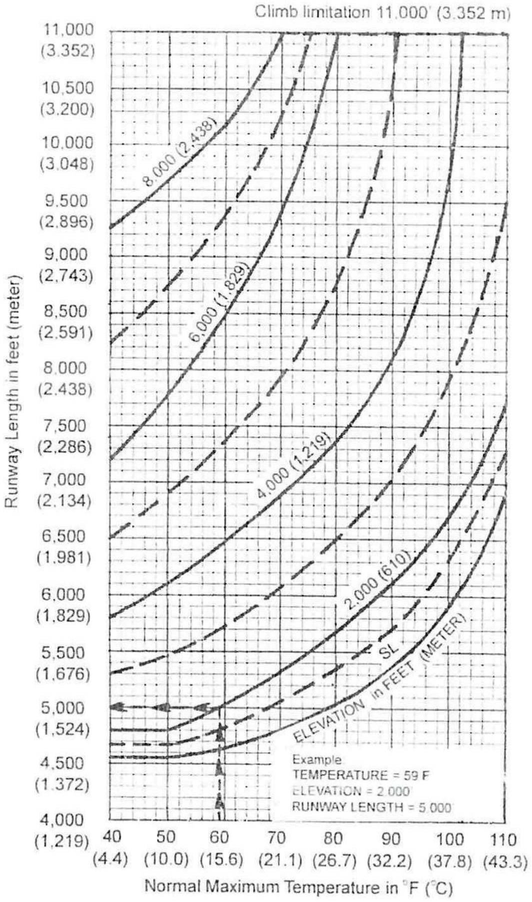
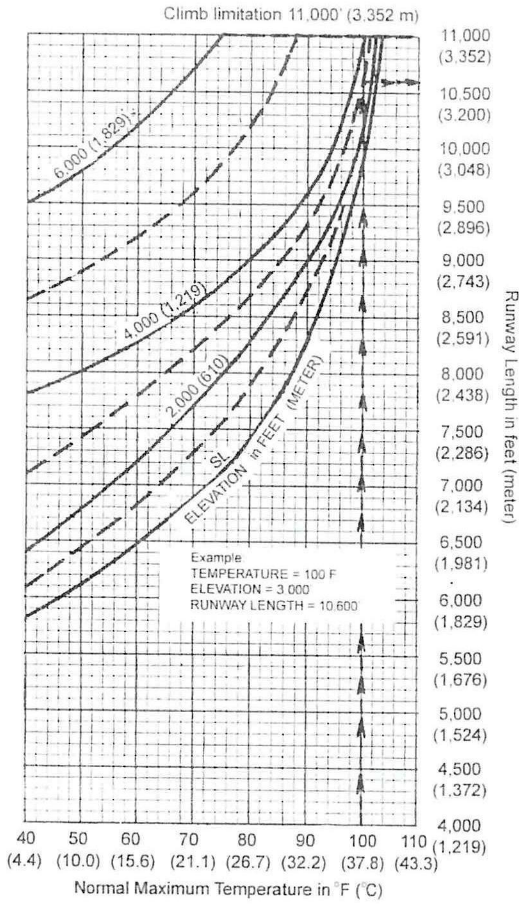
Appendix B: Design Charts

I. Runway length to serve 100% of large planes of 272,000 N or less



100% FLEET 60% USEFUL LOAD



100% FLEET 90% USEFUL LOAD

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Appendix C: Design Formulas

The following information may be useful. The symbols have their usual meaning.

$$LVC_{des} = 60A \qquad LVC_{min\,pref} = 30A \qquad LVC_{min\,abs(crest)} = \frac{Au^2}{212}$$

$$LVC_{min\,abs(sag)} = \frac{Au^2}{382} \qquad R = \frac{1718.89}{D_c} \qquad e_a = 0.79\left(\frac{u^2}{R}\right) - 1.68$$

$$e_q = e_a + e_u \qquad e_q = 0.00068u^2 D_c$$

$L_{min\,spiral} = 0.122e_u u$ to satisfy unbalanced acceleration

$L_{min\,spiral} = 7.44e_a$ to satisfy racking and torsional forces

$$A_{max} = sin^{-1}\left(\frac{d}{R}\right) \qquad L = d * ln\left[\frac{4d\,tan\left(\frac{A_{max}}{2}\right)}{W - u - 2M}\right] - d$$

$$B_{max} = tan^{-1}\left[\left(\frac{w}{d}\right)tan\,A_{max}\right] \qquad F = \left(R^2 + d^2 - 2Rd\,sin\,A_{max}\right)^{0.5} - 0.5u - M$$

$$C_d = min\begin{Bmatrix} C_g N_{cg} \\ C_x N_{ce} \end{Bmatrix} \qquad C_e = min\begin{Bmatrix} C_g N_{cg} \\ C_g N_f / t_f \\ C_x N_{ce} \end{Bmatrix} \qquad t_{ed} = 60\left(\frac{P_d}{C_d} + \frac{L_w}{v_d} + \frac{P_e}{C_e} + \frac{L_w}{v_e}\right)$$

$$t_v = t_{ed} + t_c + t_{om} \qquad V_b = \frac{3600}{t_v}$$