

Major

Instructions:

- Answer **ALL** the questions, and
- Assume any data required suitably and draw neat sketches wherever necessary,

Question 1 (3×4=12 Marks)

- A calibrated utility function for travel to an airport is, $U = a - 0.01X_1 - 0.05X_2$, where X_1 is the travel cost (Rs) and X_2 is the travel time in minutes. Calculate the share of the modes for the given values (Table 1). Due to the hike in parking fee at the airport, each trip by car would cost Rs. 20 more. How does it affect the market share of bus?

Table 1

Mode	a	X_1	X_2
Car	-0.30	60	30
Bus	-0.35	40	40

- Discuss the effect of aircraft performance on runway length quantitatively.
- How do you design a taxiway fillet graphically?

Question 2 (10 Marks)

A runway is to service arrivals and departures. The common approach path is 11.2 km for all aircraft. During a particular time interval the runway is serving only two types of aircraft: type A with an approach speed of 192 km/h and type B with an approach speed of 144 km/h. Each arriving aircraft will be on the runway for 40 s before exiting the runway. The aircraft separation rules in effect are given in the Table 1 below. The aircrafts order of arrival on the runway is B,A,B,A,A. An identical ordered departure queue of aircraft is awaiting clearance to take off. Find the arrival only capacity and mixed operations capacity of the runway if there is a positional error of 20 s and probability of violating the minimum separation rule for arrival spacing is 5% ($q_v = 1.65$)

Table 1: Air Traffic Separation Rules

Operational Sequence	Air Traffic Rules		
Arrival-Departure	Clear Runway		
Departure-Arrival	Arrival at least 3.2 km from arrival threshold		
Departure-Departure	120 s		
Arrival-Arrival	km:	Leading	
		A	B
	Trailing	A	$\begin{bmatrix} 6.4 & 4.8 \end{bmatrix}$
		B	$\begin{bmatrix} 8.0 & 4.8 \end{bmatrix}$

Question 3 (10 Marks)

- Discuss in detail about the joints and spacings and dowel – tie reinforcement details of concrete pavements. (4)
- Explain in detail how the ACN and hence the ACN-PCN of a flexible pavement can be obtained (6)

Question 4 (08 Marks)

- Elaborate on various types of points and switches used in turnouts. (3)
- How a number of turnout is defined by different methods. A broad gauge track with a radius of turnout 228 m, has a heel divergence of 0.114 m, and the turnout angle is 6°42'35". Find the angle of switch and crossing lead, if the straight portion at the crossing is of length 0.85 m. (5)

Some Useful formulas:

$$\Delta T_{ij} = \delta_{ij} / V_j; \quad \Delta T_{ij} = \delta_{ij} / V_i + \gamma(1/V_j - 1/V_i) \quad \text{or} \quad \Delta T_{ij} = \delta_{ij} / V_j + \gamma(1/V_j - 1/V_i)$$

$$b_{ij} = q_v \sigma_0; \quad b_{ij} = q_v \sigma_0 - \delta_{ij}(1/V_j - 1/V_i); \quad E(\Delta T_{ij}) = \sum [p_{ij}][M_{ij} + B_{ij}]; \quad C_m = \frac{1}{E(\Delta T_{ij})}(1 + \sum n_d p_{nd})$$

$$R_0 = \frac{G - d - x \sin \alpha}{\cos \beta - \cos \alpha}; \quad L = x \cos \alpha + (G - d - x \sin \alpha) \cot \frac{\alpha + \beta}{2}$$