**CEL 341: TRANSPORTATION ENGINEERING-II**

**Major** | **Maximum Marks: 40; Time: 2 hrs** | **03rd May 2008**

*Instructions:*

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

**Question 1 (10 Marks)**

a) Show the difference in growth rates for the Logistic and Gompertz curves used in trend extrapolation. (2)

b) Find the minimum turning radius of an aircraft having a dual tandem wheels as main gear. The aircraft has straight wing span of 36.00 m. The main gear wheels are located at a tread distance of 6.00 m. The wheelbase is 16.00 m and the maximum angle of rotation of the nose gear is 60°. (2)

c) The visual range of a runway is 1000 m when the aircraft is flying at 150 m height. The angle between visual range with horizontal is 18° and the pitch angle is 0.5°, the cockpit cut off angle is 12°. Find the horizontal segment of the visual range. (2)

d) Explain in detail on how the runway occupancy time, $R_t$ is computed. Given that this procedure has some limitations/restricting assumptions, how do you propose to correct/modify it? (4)

**Question 2 (10 Marks)**

A runway is to service arrivals and departures. The common approach path is 9.6 km long for all aircraft. During a particular interval the runway is serving three type of aircraft with the mix and operating characteristics as shown in Table 1. The air traffic separation rules in effect are given in Table 2. Assume a standard deviation of the position of airborne aircraft and the error in the gaps between arrivals are known to be 20 s. Assume that the standard deviation of the position of the airborne aircraft and error in gaps between arrivals are known to be 20 s. And assume that the minimum separation rules may be violated 10% of the time. Determine the capacity of the airport under mixed mode of operations. ($q_v$ = 1.28 for 10% violation of time)

**Table 1: Aircraft Mix and Operating Characteristics**

| Aircraft Type | Approach speed, km/h | Runway Occupancy Time, s | Mix, %ge | |
|---|---|---|---|---|
| | | | Arrival | Departure |
| A | 216 | 50 | 30 | 20 |
| B | 176 | 40 | 35 | 50 |
| C | 144 | 30 | 35 | 30 |

**Table 2: Air Traffic Separation Rules**

| Operational Sequence | Air Traffic Rules |
|---|---|
| Arrival-Departure | Clear Runway |
| Departure-Departure | Seconds Leading<br>A B C<br>A [90 90 60]<br>Trailing B [90 90 60]<br>C [120 60 60] |
| Arrival-Arrival | km: Leading<br>A B C<br>A [6.4 4.8 4.8]<br>Trailing B [8.0 6.4 4.6]<br>C [9.6 6.4 4.8] |

**Question 3 (10 Marks)**

a) Explain in detail the Asphalt Institute design method of flexible airfield pavements. (3)

b) Discuss in detail about the asphalt overlay on concrete and concrete overlay on concrete pavements. (4)

c) Explain in detail how the ACN and hence the ACN-PCN of a flexible pavement can be obtained. (3)

**Question 4 (10 Marks)**

a) A broad gauge turnout with crossing lead of 35 m has a heel divergence of 0.133 m, the angle of switch is 1°28′43″. Find the number and radius of the crossing. What would be the crossing lead if a straight portion of length 0.85 m is introduced at the crossing?. (6)

b) If a cross-over occurs between two metre gauge parallel tracks of same crossing number 1 in 8.5 with reverse-curves of equal radii of 450 m and distance between the tracks is 4.5 m, find out the overall length of the crossing and intermediate length of the cross-over. (4)

**Some Useful formulas:**

$$H = VR\sin\theta - h\cot(\alpha - \beta)$$

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

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

$$R_0 = \frac{G - d - x\sin\alpha}{\cos\beta - \cos\alpha}; \quad L = x\cos\alpha + (G - d - x\sin\alpha)\cot\frac{\alpha + \beta}{2}; \ell = \sqrt{D(4R - 2G - D)}$$