Kurdistan Regional Government- Iraq	**Final Exam (2022 - 2023)**
Salahaddin University – Erbil	**Date: 09 / 01 / 2023**
College of Engineering	**Time: 2 Hours**
Civil Engineering Department	**Subject: Airport and Railway Engineering**
Bologna System – Fall Semester	**Lecturer:** *Dr. Aso Faiz Talabany*

Q.1: (25 Marks: 9 + 16)

A- Draw suitable sketches for the following:

1- The runway markings.
2- Taxiway lighting
3- The conventional railway track.

B- Determine the total hourly delay using a single **11,000** ft runway with hourly demand = **40** operations per hour, peak 15-minute demand = **14** operations, hourly capacity = **40** operations per hour, arrivals and departures are equal and the mix index = **60**.

Q.2: (25 Marks)

The length of a common approach path γ = **6** nautical mi and the minimum separation = **3** nautical miles for an airport having the following aircraft landing population on a single runway:

Percentage of aircraft	**30**	**30**	**40**
Approach speed knots)	**95**	**100**	**110**

Calculate the ultimate runway capacity assuming that the runway occupancy times are smaller than the time separations during approach and have no effect on the capacity and allowing a buffer zone with standard deviation = **15** sec. Use **20%** probability of violation.

Q.3 : (25 Marks)

For a design traffic of **25,000** departures, determine the thickness requirements for a flexible pavement with subgrade CBR = **10** and subbase CBR = **20**. The design aircraft has dual-tandem landing gear and a maximum weight of **300,000** lb.

Q.4: (25 Marks: 10+15)

A- Design a **2.00** m long wood tie (sleeper) for axle load of **16,000** kg for Meter gauge railway track. The allowable stress of the tie material = **8,300,000** Pa.

B- Find the maximum pressure between a wheel with cylindrical rim of radius = **30** cm and rail with the radius of head = **30** cm. The design wheel load = **2000** kg, poisons ratio = **0.25**, and the modulus of elasticity = **206.8 * 10^9** Pa.

Useful Formulas and Tables

$$m(v_2, v_1) = \frac{\delta}{v_2} \text{ for } v_2 \geq v_1$$

$$m(v_2, v_1) = \frac{\delta}{v_2} + \gamma\left(\frac{1}{v_2} - \frac{1}{v_1}\right) \text{ for } v_2 < v_1$$

$$b(v_2, v_1) = \sigma_0 q(p_v)$$

$$b(v_2, v_1) = \sigma_0 q(p_v) - \delta\left(\frac{1}{v_2} - \frac{1}{v_1}\right)$$

$$C_w = \frac{\sum_{i=1}^{n} C_i W_i P_i}{\sum_{i=1}^{n} W_i P_i}$$

$$C = \min_{\text{all } i}\left[\frac{G_i}{T_i M_i}\right]$$

$$ADF = ADI \times [D/C]$$

$$DDF = DDI \times [D/C]$$

$$DTH = HD\{[PA \times DAHA] + [(1 - PA) \times DAHD]\}$$

$$\sigma_z = p(A + B)$$

$$\sigma_r = p[2\mu A + C + (1 - 2\mu)F]$$

$$\Delta_z = \frac{p(1+\mu)\,a}{E}\left[\frac{z}{a}A + (1-\mu)H\right]$$

Percentage of Predominant Capacity	Weight: Mix Index in VFR 0–180	Weight: Mix Index in IFR 0–20	21–50	51–180
91 or more	1	1	1	1
80–90	5	1	3	5
66–80	15	2	8	15
51–65	20	3	12	20
0–50	25	4	16	25

$$Z_w = Z - \frac{\Delta h}{30}\left[w + 0.53(h - \Delta h)\right] \quad \textit{imperical formula}$$

$$m = \frac{4}{\frac{1}{r_1} + \frac{1}{r_2}}$$

$$n = \frac{4E}{3(1-\mu)}$$

$$A = \frac{2}{m}$$

$$B = \frac{1}{2}\left|\left(\frac{1}{r_1} - \frac{1}{r_2}\right)\right|$$

$$\cos\theta = \frac{B}{A}$$

$$a = \alpha\sqrt[3]{\frac{P_m}{n}}$$

$$b = \beta\sqrt[3]{\frac{P_m}{n}}$$

$$\tau_{max} = \frac{23500 * P^{1/3}}{2 * \left(\frac{R_1}{R_2}\right)^{0.271} * R_2^{2/3}}$$

θ	20	30	35	40	45	50	55	60	65	70	75	80	85	90
α	3.772	2.731	2.397	2.136	1.926	1.754	1.611	1.486	1.398	1.284	1.202	1.128	1.061	1
β	0.408	0.493	0.53	0.567	0.504	0.641	0.688	0.717	0.759	0.802	0.846	0.893	0.944	1