Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. SEMESTER III–EXAMINATION (Remedial)– WINTER 2015

Subject code: 734302 **Date: 07/12/2015**

Subject Name: Rock Opening & Tunnels

Time: 2:30 PM to 5:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Define tunnel. Distinguish between tunnel and mining. Explain in detail with neat sketch the complete classification of Traffic tunnels on the basis of position or alignment.	**07**
	(b)	Enlist the various classification systems for rock mass. Explain Deere's engineering classification of in-situ rock on the basis of joint spacing, Watkins classification, Franklin point load index and NGI classification in detail.	**07**
Q.2	**(a)**	What is allowable bearing pressure on footings on rock? For sand stone give Raphael and Goodman bearing capacity analysis. What guidelines are observed while placing footing on rock with open joints and on layered rock?	**07**
	(b)	State modes of rock failure and explain each in detail. Define 'rock strength' and explain 'Mohr-Coulomb' failure criterion.	**07**
		OR	
	(b)	Justify in detail Coulomb-Navier theory of failure with necessary equations.	
Q.3	**(a)**	Enlist the various rock failure theories. Explain Griffith's theory of brittle fracture with necessary equations. Is there any similarity between Mohr's theory and Griffith's theory?	**07**
	(b)	Elaborate allowable bearing pressure on footing s on rock. Explain with plot Raphael and Goodman bearing capacity analysis for sandstone. Explain criteria for placing footing on layered rock and rock with open joints.	**07**
		OR	
Q.3	**(a)**	Explain the importance of 'friction' on rock surfaces. Give various configurations used for measuring friction in triaxial testing machine. State 'Byerlee's' law.	**07**
	(b)	Define tensile strength, compressive strength and flexural strength of rock. Describe with neat sketch 'Brazilian test' of rock mass.	**07**
Q.4	**(a)**	State various methods to determine absolute stress in rock. Explain the principle of Borehole deformation method. Draw neat sketch of flat jack method.	**07**
	(b)	A roof layer is subjected to a uniformly distribution gas pressure. The thickness of the roof is 25cm and E= 1.1 x 10^4 kg/cm^2, γ = 2.78g/cc. Calculate modulus of rupture of rock assuming span 4m and factor of safety equal to 2.5.	**07**
		OR	
Q.4	**(a)**	In a two layer roof, layers have a thickness of 15cm and 20cm respectively for upper and lower layer. The observed E values are 1.2 x 10^4 kg/cm^2 and 1.5 x 10^4 kg/cm^2. If unit weight of lower layer is 15% higher than upper layer of rock, calculate % variation in max tensile stress, shear stress and deflection w.r.t gravity loaded roof.	**07**

Q.4 **(b)** Define single opening. Describe in detail uniaxial stress field with stress concentration for circular and elliptical opening. **07**

Q.5 **(a)** Define areal extraction ratio. Explain in detail various factors affecting compressive strength of rib pillar with necessary equations. Explain only the major conclusions drawn in design of multiple openings separated by rib pillars. **07**

(b) Explain in detail **<u>any one</u>** of the following: **07**

(i) The deterioration and repair of tunnels.

(ii) Rock bolting and rock grouting

OR

Q.5 Attempt **<u>any two</u>** of the following: **14**

(i) Following values are obtained for coulomb material:
Inherent shear strength = 120 kg/cm^2, angle of internal friction = 34°, poissons ratio = 0.18, modulus of elasticity = 1.2 x 10^3 kg/cm^2. Estimate hydrostatic stress for unstable failure and stable failure. Take G = E/2(1+μ) and B = 1.25 x 10^4.

(ii) Explain reinforcement of laminated roof by each by suspension effect and friction effect separately.

(iii) The compressive strength of rib pillars having overburden of rock equal to 400m height is 1500 kg/cm^2. Estimate room width in 2D and 3D array of pillars. The height of rib pillar is 4m thick bedded rock having width to height ratio equal to 2.5. Take unit weight of rock as 28.5 KN/m3 and factor of safety as 3. Assume length of pillar as 1.5 times width of pillar.

(iv) The ratio of room width in 3D and 2D array of pillars is 1:3. The extraction ratio obtained is 0.8 in 3D array of pillars. For 4m thick pillar of rock, the effective width to height ratio obtained is 2.5. Estimate room width for both array of pillars and extraction ratio of 2D opening. Take length of pillar as 2.0 times width of pillar.