Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER– III • EXAMINATION – WINTER • 2014

Subject code: 734302 **Date: 27-11-2014**

Subject Name:Rock Opening & Tunnels

Time: 02:30 pm - 05:00 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)**	State and elaborate structural classification of massive rock for underground openings.	**07**
	(b)	Explain importance of rock class identification. Explain joint, fracture, parting and separation. What do you mean by elastic rock and inelastic rock while determining in-situ state of stress?	**07**
Q.2	**(a)**	State various index properties of rock. Explain their importance and application. Also summarize the tests carried out to determine each property.	**07**
	(b)	Enlist classification of tunnel as per purpose with neat sketch. Explain in detail purpose of geological exploration for tunnel construction	**07**
Q.3	**(a)**	Explain rock strength. Categorized modes of rock failure and explain each in detail. Enlist various failure criteria's and justify 'Mohr-Coulomb' failure criterion.	**07**
	(b)	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**
		OR	
Q.3	**(a)**	Explain with equations the stress distribution pattern adopted by Coulomb-Navier theory. How it differs from Mohr's theory. What were Griffith's observations and what was its final conclusion.	**07**
	(b)	Explain the importance of 'friction' on rock surfaces. Give various configurations used for measuring friction in triaxial testing machine. State 'Byerlee's' law.	**07**
Q.4	**(a)**	Describe with neat sketch 'triaxial compression test' on rock. State its limitations.	**07**
	(b)	Describe in detail with neat sketch 'rock bolting. Support your answer with one field application. State design criteria for rock bolting.	**07**
		OR	
Q.4	**(a)**	Define multiple opening. State criteria for single and multiple opening. Give and explain various boundary conditions for stress distribution in case of row of circular openings.	**07**
Q.4	**(b)**	State various methods to determine absolute stress in rock. Explain Borehole deformation method with deformation rosette.	**07**

Q.5 **(a)** Define rib pillars. Show the empirical equation to calculate maximum compressive stress concentration in pillars and explain plot of maximum stress concentration for various opening-to-pillar width ratios. What limitations are observed in case of row of ovaloidal openings? Explain areal extraction ratio. Explain vertical and horizontal stress distribution pattern in case of limestone pillar and lead ore pillar. What are your inferences for both cases? **07**

(b) State various principal conclusions useful in the design of multiple opening separated by rib pillars for 2-D case. Why aerial extraction ratio is kept less than 0.75? **07**

OR

Q.5 **(a)** Explain assumptions made for openings in massive rock for three-dimensional case. For a case of two circular openings explain the importance of ratio Wo/Wp when Sv=Sh and Sv≠Sh, Sh = 0. **07**

(b) Show the various inter-relations to calculate extraction ratio in case of 3-D array of pillars. Explain the importance of extraction ratio in case of 3-D array of pillars in both massive elastic rock and massive inelastic rock. **07**