INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Extra

End-Autumn Semester 2018-19

Date of Examination: **15-11-2018** Session: **[A/N] 02:00 PM-05:00 PM** **Full Marks: 100**

Subject No.: **MI31003** Subject: **UNDERGROUND METAL MINING**

Note: (a) Answer any five questions (b) Figures in the margin indicate marks

(This question paper has two pages)

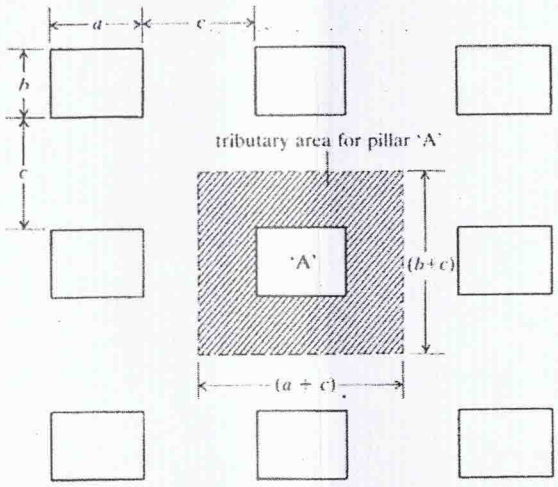
Q1. Use the layout of a Room & Pillar stope shown in the figure below and derive the expressions for the followings: **[5+10 +2+3]**

a) Area extraction ratio (r) in terms of pillar size and room span.

b) Relation between average axial pillar stress (σ_p), vertical normal component of the pre-mining stress field (p_{zz}) and extraction ratio (r) using tributary area analysis.

c) Rewrite the equation from (b) for square pillars (w_p x w_p) and uniform room dimension w_o.

d) Explain with a graph (not to scale) why area extraction ratios usually does not exceed 0.75.



Q2. A 2.5 m thick horizontal ore body is located at a depth of 100 m, with the rock cover having a unit weight of 25 kNm^{-3}. An initial mining layout is based on 6.0 m room spans and 5.0 m square pillars, with the full ore body thickness of 2.5 m being mined. The pillar strength (S) has been empirically determined as $S = 7.18h^{-0.66}w_p^{0.46}$. Find out the average axial pillar stress σ_p, Pillar strength and Factor of safety (F). Offer your comments about the adequacy of the design.(S is in MPa, h and w_p are height and width of pillars in m) **[20]**

Q3. (a) What are the different modes of pillar failures in underground metal mines? Explain the probable causes for each mode with simple sketches. **[10+10]**

(b) A copper ore deposit is lying 150 m below ground with a strike length of 1200 m extending north-south and dipping west to east at an angle of 40^0. The ore body is 25 m thick. Both the ore body and host rock are moderately strong. Propose and describe a mining method with section floor plan and transverse section. Discuss the extent of mechanization that can be adopted and the process of backfilling if required. Assume your own conditions.

Q4. a) What are the different materials used for back filling a stope? Which are the most important characteristics of mill tailings for judging its suitability for stowing? **[10+10]**

b) Calculate the monthly requirement of stowing materials (in metric tons) if daily production from a Lead-Zinc mine using cut and fill method is 1500 ton. (Given that the density of stowing material and the ore are 1.8 t/m^3 and 3 t/m^3 respectively. Factor of stowing is 82%)

Q5. (a) Describe the Vertical Crater Retreat (VCR) method of mining including its applicability, stope development, drilling, blasting and ore transportation. Why the productivity and percentage of recovery are high in case of mines using VCR method? **[12+8]**

(b) Define spherical charge in the context of large diameter vertical blast holes. For a stope using VCR method of mining, calculate the length of the charge, critical charge depth and optimum charge

depth for 165 mm dia blast-holes using a strain energy factor (S) of 1.5 .

Q6. a) For a Big-hole burn-cut parallel hole design of shaft sinking, determine the furthest distance a primary blast hole can be placed from a central relief hole for achieving good propagation. (Given that the diameters of primary blast-hole and central relief hole are 33 mm and 165 mm respectively. Assume a crater angle of 35 degrees) **[10+10]**

b) Design the cut area in a hard rock drive round up to third square using closely spaced two reaming holes of 57mm diameter in the centre along with drawings (not to scale).