SET A

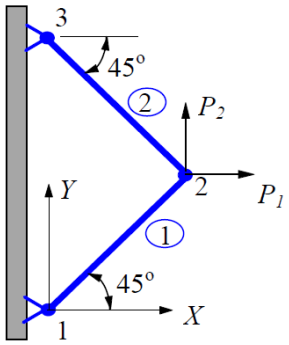
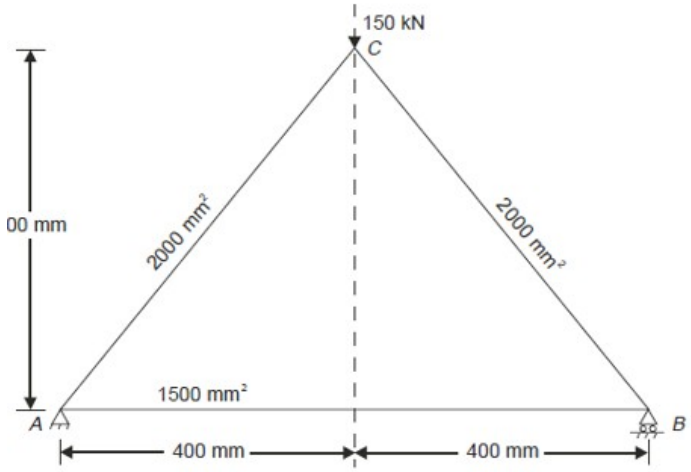
Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Programme: B. Tech (Mining Engineering) — **Semester: VI**
Course: Applied Rock Mechanics and Numerical Modeling — **Time: 03 hrs**
Course Code: GSEG 329 — **Max. Marks: 100**
Instructions: All questions are compulsory

SECTION A

S. No.		Marks	CO
Q 1	Define the following: (i) Rock Material (ii) Rock Mass (iii) Rock Quality Designation (RQD) (iv) Rock Mass Rating (RMR)	1+1+1+1	CO1
Q 2	Write a short note on the different coal pillar design approaches used in the mining sectors?	4	CO2
Q 3	Write a short note on the different subsidence prediction methods used in mining?	4	CO4
Q 4	Write a short note on the following (i) Block Caving (ii) Sub-level Caving	2+2	CO5
Q 5	Write a short note on the purposes and nature of monitoring rock mass performance?	4	CO6
	SECTION B		
Q 6	A Gold-bearing quartz vein of 2 m thick has dipping 90º. The mining stope is 800 m deep, $\Upsilon = 29$ kN/m^3, strike parallel to σ_2, $\sigma_1 = 37.0$ MPa and, σ_{UCS} (vein) = 218 MPa, T_o (host rock) = -5 MPa. Determine the following: (i) The maximum permissible stope height before failure occurs. (ii) The stress ratio (K)	5+5	CO1
Q 7	(a) A circular concrete liner in a vertical shaft is subject to an external pressure of 0.65 MPa. Concrete strength is 34.5 MPa. If the inside diameter of the liner must be 6 m, determine the liner thickness necessary to achieve a liner safety factor of 3.5. (b) A 1 m thick circular concrete shaft liner designed for an allowable stress of 25 MPa in compression. Outside diameter is 8 m. Determine the thickness of a steel (A36) liner with a safety factor of 1.5 and allowable stress of 248 MPa in compression that would support the same load but allow for a greater inside diameter and therefore a greater useful cross-sectional area of the shaft.	4+6	CO2
Q 8	Consider a vertical shaft excavated in a stress field where $S_v = 9.5$ MPa, S_h (north) = 2 MPa and S_H (east) = 8.5 MPa and a joint set that strikes due north and dips 60° with cohesion $c_j = 0.95$ MPa and friction angle $\varphi_j = 35°$. For convenience, fix the x-axis due east parallel with S_H. Determine joint safety factors before excavation, after	10	CO4

	excavation and the improvement that a bolting plan could achieve. Assume bolts are installed horizontally on a square pattern of 1 m centers and tensioned to 82.3 kN force.		
Q 9	Describe in details the design of sublevel caving layouts in mining? **OR** (a) Caving rock is estimated to have zero cohesion and a friction angle of 35°. If draw points are spaced on 20 m centers and are 3.5 m wide, determine the height of the dead zone between draw points. (b) A chimney cave forms over a square excavation of side length L and height h. The caved zone above the chimney is a cylinder of height H and forms an inscribed circular cross section. If the bulking porosity is B, determine the height of caved zone extend above the excavation? Assume B = 0.01 and h = 5 m.	**10** **5+5**	**CO5**
	SECTION-C		
Q 10	A simple plane truss is made up of the identical bars with young's modulus (E), Area (A) and Length (L) and loaded as shown in the figure. Determine the following (i) Displacement of node 2 (ii) Stress in each bar  **OR** For the three bar truss shown in the figure determine the nodal displacements and the stress in each member. Take modulus of elasticity as 200 GPa.  	**10+10** **20**	**CO3**
Q 11	Explain in detail the following monitoring systems of rock mass performance with neat sketch (i) Hydraulic pressure cells (ii) Multiple-point borehole extensometers	**10+10**	**CO6**

SET B

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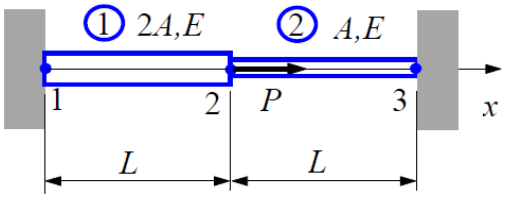
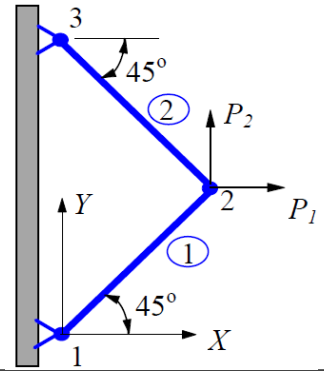
SECTION A

S. No.		Marks	CO
Q 1	Write the parameters used for the determination of Rock Mass Rating (RMR) of the rock.	**4**	**CO1**
Q 2	Write any four-pillar strength equations used for the design of the coal pillars?	**4**	**CO2**
Q 3	Define the following: (i) Angle of draw (ii) Angle of full subsidence	**2+2**	**CO4**
Q 4	Define the following caving in mining (i) Sub-level Caving (ii) Block Caving	**4**	**CO5**
Q 5	Discuss in brief the monitoring system of rock mass performance in mining?	**4**	**CO6**
	SECTION B		
Q 6	Write a detailed note on rock mass quality (Q) system of rock mass classifications?	**10**	**CO1**
Q 7	A 2.5 m thick horizontal orebody is located at a depth of 80 m, with the rock cover having the unit weight of 25 kN/m3. An initial mining layout is based on 6.0 m room span and 5.0 m square pillars, determine the following: (i) Pre-mining Stress (ii) Average axial pillar stress (iii) Pillar Strength (iv) Factor of safety	**2.5+2.5+2.5 +2.5**	**CO2**
Q 8	Write a detailed note on the following subsidence monitoring methods (i) Surface Instrumentations (ii) Spacing of Monuments	**5+5**	**CO4**
Q 9	Describe in details the design of block caving layouts in mining? **OR** (a) Caving rock is estimated to have zero cohesion and a friction angle of 35°. If draw points are spaced on 25 m centers and are 4 m wide, determine the height of the dead zone between draw points. (b) A chimney cave forms over a square excavation of side length L and height h. The caved zone above the chimney is a cylinder of height H and forms an inscribed circular cross section. If the bulking porosity is B, determine the	**10** **5+5**	**CO5**

	height of caved zone extend above the excavation? Assume B = 0.02 and h = 7 m.		
	SECTION-C		
Q 10	(a)Write down the formula of the stiffness matrix for the following: (i) Bar Element (ii) Truss Element (b) Find the stress in the two bars assembly, which is loaded with force P, and constrained at the two ends, as shown in the figure.  **OR** A simple plane truss is made up of the identical bars with young's modulus (E), Area (A) and Length (L) and loaded as shown in the figure. Determine the following (iii) Displacement of node 2 (iv) Stress in each bar  	**4+16** **20**	**CO3**
Q 11	Explain in detail the following monitoring systems of rock mass performance with neat sketch (i) Hydraulic pressure cells (ii) Multiple-point borehole extensometers	**10+10**	**CO6**