DEPARTMENT OF MINING ENGINEERING

INDIAN INSTITUTE OF TECHNOLOGY (INDIAN SCHOOL OF MINES), DHANBAD

End-Semester Examination

Examination: VII B. Tech.

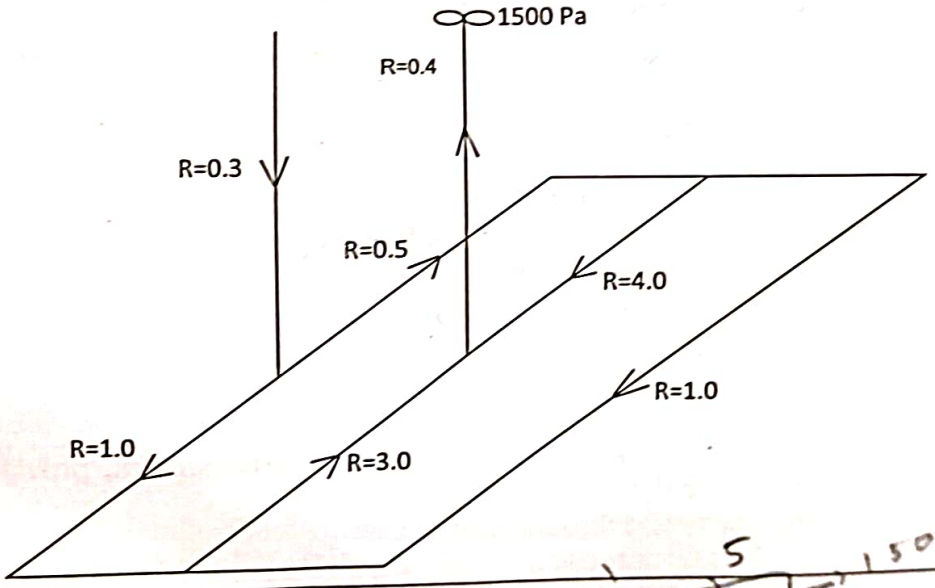
Semester: Monsoon **Session: 2024-2025**

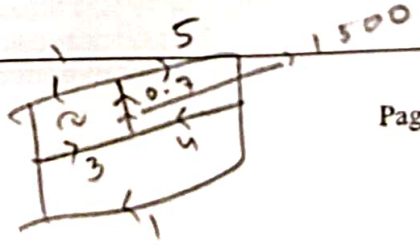
Subject: Advanced Mine Ventilation (MND 401)

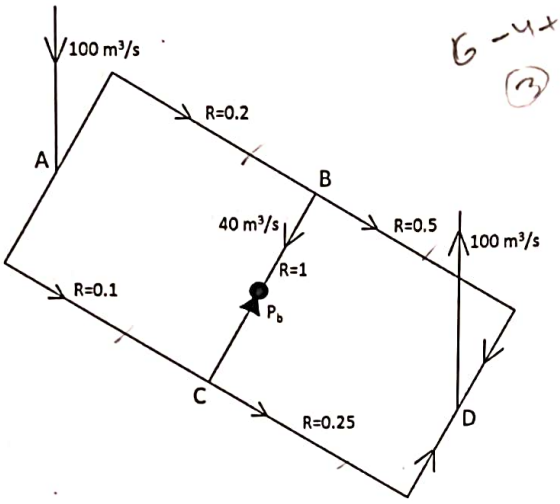
Time: 3 Hours Total Marks: 100

Instruction: Answer any FIVE questions

Q. No.	Question	Marks
1.	a) With neat sketches discuss the mine ventilation thermodynamics.	12
	b) Discuss the various important sources of heat in a longwall coal mine panel.	8
2.	a) Derive the formula for calculating the mesh correction factor in a mine ventilation network by Hardy Cross iteration technique.	14
	b) Discuss the steps for computation of airflow in a mine ventilation network by Hardy Cross iteration technique.	6
3.	The ventilation network of a mine shown in figure consists of a downcast and an upcast shaft. The resistance values of the branches in Ns^2m^{-8} are shown in figure. If the main mine fan installed at the upcast shaft produces 1500 Pa pressure, and that there is no natural ventilation, determine the distribution of airflow in the network using the Hardy Cross iteration technique up to 5 iterations.	20





4.	a) With a neat sketch discuss the tube-bundle technique used for environmental monitoring in underground coal mines.	8
	b) The ventilation network of an underground mine served by a downcast and upcast shaft circulating 100 m^3/s of air is shown in the figure. The resistance values of each branch in Ns^2/m^8 are indicated in the network. A booster fan boosts the airflow in the central branch to 40 m^3/s. Calculate the airflow distribution in the network and the total pressure developed by the booster fan.	12
	 c)	
5.	A steel pipe of 150 mm inside diameter and 160 mm outside diameter carries cold water at 10°C along a mine airway. The outer surface of the pipe is at a temperature of 11°C when the temperature of the water inside the pipe is 10°C. The wet-bulb and dry-bulb temperatures of air in the airway are 24°C and 27°C respectively and the barometric pressure of air is 100 kPa. Determine the rate of heat pickup by the water, given the convective heat transfer coefficient = 20.5 $W/m^2°C$, emissivity and view factor = 0.95, saturated vapour pressure at 11°C = 1.312 kPa and actual vapour pressure = 2.79 kPa.	20
6.	a) With a neat sketch discuss the application, constructional features and working of a counterflow cooling tower used in mine air-conditioning system.	8
	b) A mine refrigeration system with a single stage compressor using Refrigerant 11 operates at the following conditions: • Evaporator pressure: 50 kPa (Absolute) • Condenser pressure: 230 kPa (Absolute) • Compressor inlet temperature: 3.5°C • Compressor outlet temperature: 70°C Using the pressure-enthalpy diagram of the refrigerant, provided in a separate page, calculate the following: a) Heat removed through condenser b) Work of compression c) Coefficient of performance (COP) of the refrigeration system	12

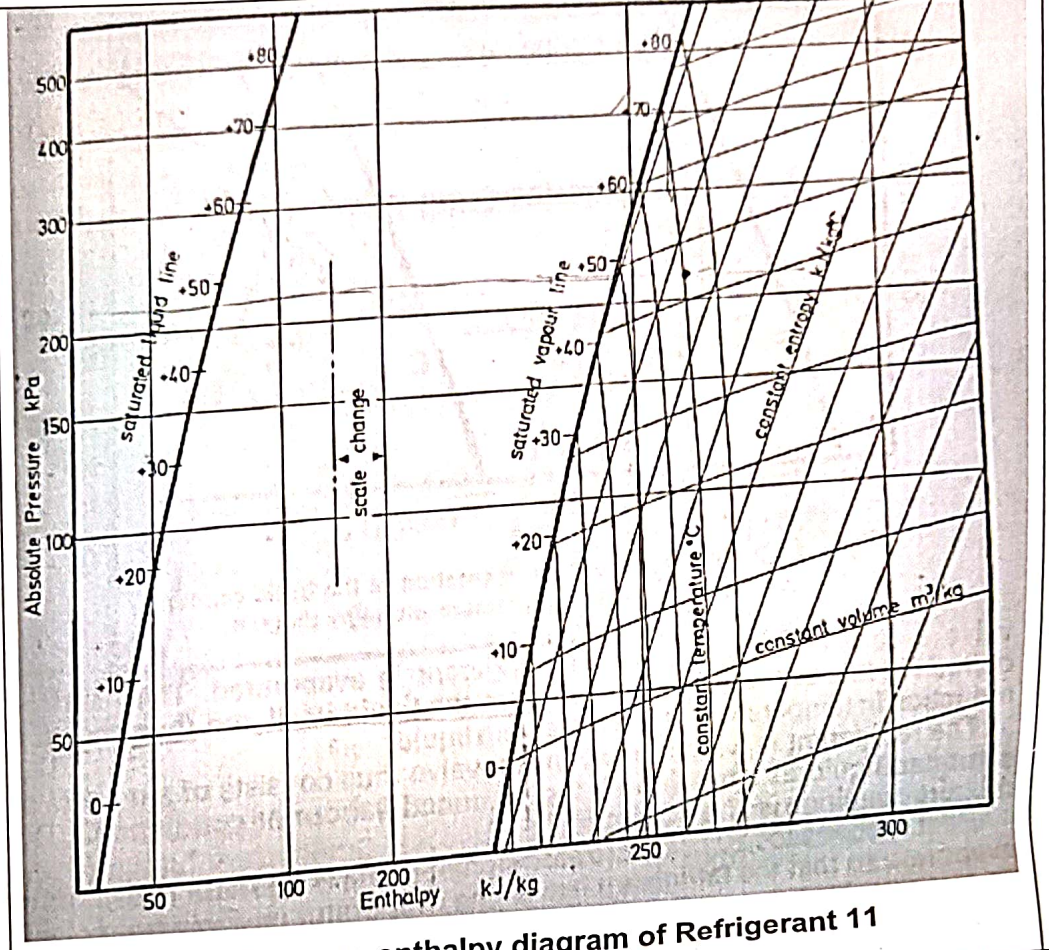


Fig. Pressure-enthalpy diagram of Refrigerant 11

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Important formulae:

$e = e'_{wb} - 0.000644B(t_{db}-t_{wb})$, $e'_{wb} = 0.6105 \exp [17.27t_{wb}/(t_{wb}+237.3)]$

$q = 2\pi K.T.L\ (t_{vr} - t_s)$, $q_R = h_r.A_1\ (t_{db}-t_s).F_{ev}$

$q_c = h_c.A\ (t_s-t_{db})$, $q_L = hc.A.\lambda\ [0.7\ (\phi e'_{db}-e'_s)/B]$, $hc = Nu.Ka/D$

$Nu = 0.35.f.Re/[1+1.592(15.217.f.Re^{0.2}-1)/Re^{0.125}]$

$T = 0.685/Fo^{0.146}$

$q_R = 5.67 \times 10^{-8}\ (T_1^4-T_2^4) \times A_1 \times F_{ev}$

END-SEMESTER EXAMINATION

Course: 7th Sem B.Tech. (MNE, MME, EE, ECE, CSE, M&C, MLMTE, & PE) & JRF

Session: 2024-2025 **Semester:** Monsoon

Subject: Mine Environmental Engineering (MND – 406)

Time: 3 hrs **Max. Mark:** 100

Instructions: *Answer any FIVE questions.*

Q.No.	Question	Marks
1.	a) How does analysis of air samples help in early detection of heating? Given below the analysis result of a sample taken from inside a sealed off fire area: $N_2 = 79.79\%$, $CO_2 = 8.44\%$, $CH_4 = 3.86\%$, $O_2 = 4.97\%$, $CO = 2.00\%$, $H_2 = 0.94\%$. What does it indicate regarding (i) the condition of fire, and (ii) air-tightness of the stoppings?	2+8+2
	b) A panel developed on bord and pillar in mine has been sealed off due to a fire. What are the regular checks to be made to determine the conditions inside the sealed off area? When can the conditions be considered safe to reopen the panel?	5+3
2.	a) It is required to build a brick dam with a crushing strength of 17.5 kg/cm^2 against rise workings in an underground mine. The head of water is expected to be 120 m. A stream of water of about 2000 GPM is flowing through the gallery of 4 m width and 3 m height. Describe how you will construct the dam with special reference to (i) Selection of site, (ii) Thickness of dam.	4+4
	b) A coal seam is being worked adjoining an old colliery which is full of water. Give an account of all matters which should be followed to ensure safety while approaching the waterlogged area.	8
	c) What precautions would you take to guard against the danger of inundation from surface water in underground coal mines?	4
3.	a) What is self-contained breathing apparatus? With the help of a diagram, describe one such apparatus used in Indian mines.	2+6
	b) What are the functions of the rescue station? Describe in brief the different types of rescue stations.	2+6
	c) In an underground mine, a miner inhales the normal air and exhales the air containing 15.5% O_2 and 3.5% CO_2. What is the respiratory quotient of breathing for the worker?	4
4.	a) Explain with examples the difference between intrinsically safe and flame proof electrical equipment.	3+3
	b) Define 'Lux'. What standards of lighting have been recommended for underground mines? Floor illumination at a point directly below a light source in an underground garage of height 4 m is 40 lux. What is the floor illumination at a point 8 m away from the light source?	2+4+4
	c) An incandescent headlight of a mining vehicle is of spot beam type with a beam angle of 30°. What is the spherical surface in m^2 subtended by the lighted beam at a distance of 5 m from the headlight?	4

5.	a) What are the major sources of dust underground coal mines? What steps will you take to minimise generation of dust?	2+6
	b) Describe briefly the procedure of airborne dust survey.	6
	c) A miner works at a grizzly for 4.5 hours on an average per shift wearing a dust mask which is 90% efficient for -5 μm dust. He spends one hour on the average per shift in travelling inside the mine. Calculate his cumulative dust dosage in a 10-year working span taking 280 working shifts in a year on the average. Also calculate the average dust concentration he is exposed to and estimate his exposure to dust hazard if the respirable dust contains < 5% free silica. The average respirable dust concentration at the grizzly and in the general body of the mine air is 21 mg/m^3 and 0.2 mg/m^3.	6
6.	a) What does coal dust explosion occur in an underground mine?	6
	b) What are the factors affecting inflammability of coal dust?	4
	c) What measures are taken to prevent coal dust explosion?	4
	d) With the help of a diagram, explain how the explosion proof isolation stopping is constructed in degree III coal seam.	6
7	a) What is water danger plan? What features are shown in it?	2+4
	b) What is the purpose of whitewashing the workings belowground? Which places are required to be whitewashed?	2+4
	c) What is spontaneous combustion? What are the different stages of spontaneous combustion of coal? How are underground mine fires classified?	2+4+2

End of the Question Paper

END-SEMESTER EXAMINATION, Monsoon Semester, SESSION: 2024-25

Subject: Geospatial Technology in Mining (MND403), OE, VII Semester BTMNE & others

Answer any five Questions

Maximum marks: 100 **Time: 3:00hrs**

Q. NO.	Description of Question	Marks
1	a) Briefly discuss the Geospatial Technologies.	10
	b) As we know that Geographical Information System (GIS) is being applied in different application fields, explain briefly its application in Mining Life Cycle.	10
2	a) Briefly discuss the interaction of EMR with earth's atmosphere.	5
	b) Show through figure (i) the spectral distribution of energy radiated from black bodies of various temperatures (ii) spectral characteristics of energy source (sun), atmospheric transmittance and common remote sensing systems.	5
	c) Briefly discuss the concept of signature in remote sensing.	5
	d) Briefly describe the Indian Remote Sensing (IRS) Programme.	5
3	a) Enumerate and describe the different components of remote sensing system.	10
	b) As we know that Remote Sensing Technology is being applied in different application fields, explain briefly its application in Mining Life Cycle.	10
4	a) Explain in brief different basic types of measurements for computing GNSS receiver position.	10
	b) Explain the procedure for pseudo-range-based positioning of GNSS receiver.	10
5	a) Explain the generalised modelled GNSS observation equations for pseudo-range and carrier phase.	10
	b) As we know that Global Navigation Satellite System (GNSS) is being applied in different application fields, explain briefly its application in Mining Life Cycle.	10
6	a) Enumerate different modes of GNSS positioning.	05
	b) Explain in detail the different modes of GNSS positioning along with mentioning the level of accuracy obtained in different modes.	15
7	a) Characterise the current and developing global and regional satellite-based navigation systems.	12
	b) Characterise the current and developing satellite-based augmentation systems	8

Indian Institute of Technology (Indian School of Mines) Dhanbad

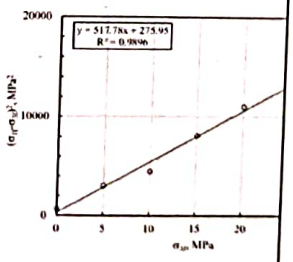
Department of Mining Engineering

End-Semester Examination (Monsoon Session) 2024-25 for B.Tech. Students (97 nos.)

Subject: Open-Pit Slope Analysis and Design (MND 402) **Venue: NLHC LH 01-03**

Time: 180 Minutes (02.00 PM-05.00 PM) **Date: 23.11.2024** **Maximum Marks: 96**

Answer questions of all the sections

Question No.	Section A Answer any three questions [3×8=24 Marks]	Marks
1.	Briefly describe the factors affecting the hydraulic conductivity.	[8]
2.	Draw the Mohr circle for the following test conditions: a. i. Uniaxial Compression ii. Uniaxial tension iii. Brazillian Tensile Test b. Discuss the limitations of the Mohr-Coulomb Failure Criterion for its application in geotechnical engineering.	[3+5]
3.	a. Draw the flow chart utilizing the parameters of the Hoek-Brown Failure Criterion for the overall design process of the geotechnical structures. b. Tri-axial tests were carried out on 50mm diameter rock cores, and the following data were obtained for the principal stress at failure. Estimate the tensile strength (in MPa) of this rock using the Hoek-Brown Failure Criterion. σ_3 (MPa): 0, 5, 10, 15, 20, 25 σ_1 (MPa): 25, 60, 77, 105, 125, 140 Generalized $\sigma'_{1f} = \sigma'_{3f} + \sigma_{ci}\left(m_b \frac{\sigma'_{3f}}{\sigma_{ci}} + s\right)^{\alpha}$ For intact rocks $\left(\sigma'_{1f} - \sigma'_{3f}\right)^2 = m_i \sigma_{ci} \sigma'_{3f} + \sigma_{ci}^2$  $\left[\frac{\sigma_n}{\sigma_{ci}}\right] = -\frac{\left(\sqrt{m_i^2 + 4s}\right) - m_i}{2}$	[4+4]
4.	Briefly enumerate the numerical modeling application in rock slope engineering.	[8]

Section B

Answer all the questions [24+16+16+16 =72 Marks]

5.

a. Referring to the figure given below, if a slope of height 'H' is excavated in the rock and a sliding plane A2-A3 cuts the slope at the surface at a distance 'B' from the crest of the slope, derive the expression for: **10+4+10**

i. Top Width, B
ii. Contact area A2-A3 of sliding block A1-A2-A3, A
iii. Weight of the sliding block, W
iv. Factor of Safety

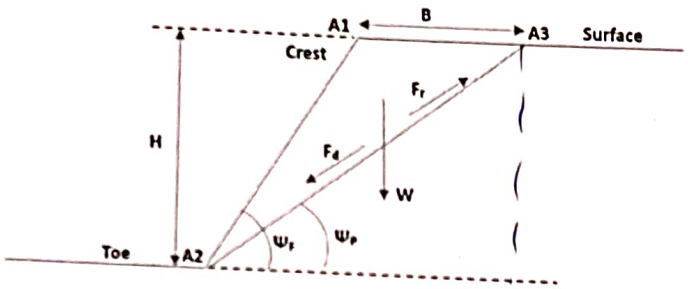


Fig. 1

b. State the rock mechanics setup that leads to the formation of the tension crack in the rock slope. Why is the bottom portion generally found stable in comparison to the other parts of the slope (a conceptual diagram is required for explanation)?

c. If the critical tension crack of 'Z_c' is formed at 'B_c' distance away from the crest (Fig.2). Derive the expression for 'Z_c' and 'B_c'.

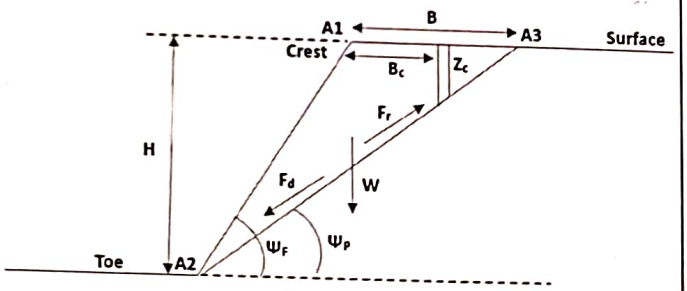
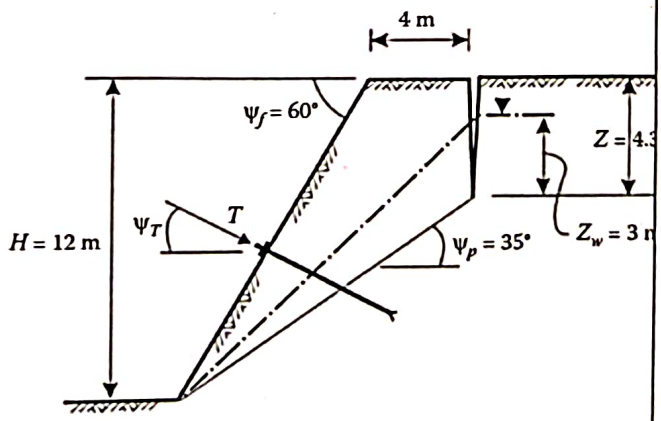


Fig. 2

OR,

A 12m high rock slope has been excavated at a face angle of 60^0. The rock in which this cut has been made contains persistent bedding planes that dip at an angle of 35^0 into the excavation. The 4.35m deep tension crack is 4m behind the crest and is filled with water to a height of 3m above the sliding surface. The strength parameters of the sliding surface are as follows: **16+8**

	Cohesion = 35 KPa Unit weight of the rock = 30 KN/m^3 Friction = 35^0 Unit weight of water = 9.81 KN/m^3 Assuming that a plane slope failure is the most likely type of instability, analyze the following stability conditions. **a. Factor of Safety Calculations:** i. Calculate the factor of safety of the slope for the conditions given in Fig.3. ii. Determine the factor of safety if the tension crack was completely filled with water due to run-off collecting on the crest of the slope. iii. Determine the factor of safety if the slope was completely drained. iv. Determine the factor of safety if the cohesion were to be reduced to zero due to excessive vibrations from nearby blasting operations, assuming that the slope was still completely drained. **b. Slope Reinforcement using Rock Bolts:** v. It is proposed that the drained slope with zero cohesion be reinforced by installing tensioned rock bolts anchored into sound rock beneath the sliding plane. If the rock bolts are installed at right angles to the sliding plane, that is, $\psi_T = 55°$, and the total load on the anchors per lineal metre of slope is 400 kN, calculate the factor of safety. vi. Calculate the factor of safety if the bolts are installed at a flatter angle so that the ψ_T is decreased from 55° to 20°.  **Fig. 3**	
6.	For the slope shown in Fig. 4, find the factor of safety of the slope with a unit weight of 22 KN/m^3; width of the slice is about 2.5m; cohesion of the material is about 25 KN/m^2; angle of friction is about	16

23^0, using the ordinary method of slices. The average height (h_n), length (ΔL_n), and angle of each slice are given in the table below:

Slice No	h_n (m)	ΔL_n (m)	α_n (^{0})
1st	5	2.95	65
2nd	7	6.80	55
3rd	9	5.10	45
4th	9	4.60	35
5th	5	4.10	28
6th	3	3.80	22
7th	2	3.20	15

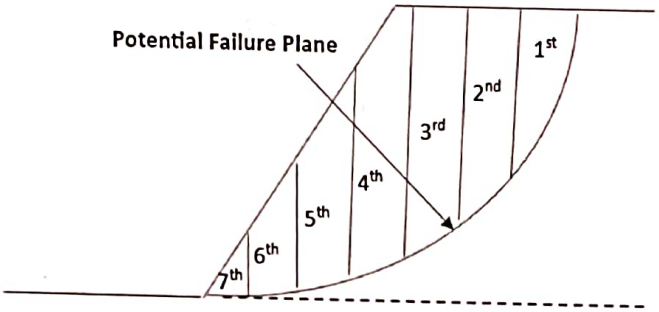
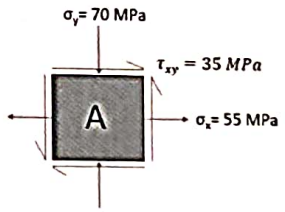


Fig. 4

7. Utilizing the Mohr Circle's stress transformation concept and stress condition of the element 'A', graphically plot and evaluate the following parameters: **16**

i. Average Normal Stress
ii. Principal Stresses
iii. Maximum Shear Stress
iv. Angle ɵ to reach the principal stress



8. **6+5+5**

a. A constant head permeability test was conducted on a soil specimen under a hydraulic gradient of 2.2. The soil specimen has a specific gravity of 2.75 and a saturated water content of 22%. If the coefficient of permeability of the soil is 0.15 cm/s, what would be the seepage velocity through the soil specimen?

b. The following data are for a falling head permeability test:

Length of the soil sample	175 mm
Area of the soil sample	2000 mm^2
Area of the standpipe	25 mm^2
At time t = 0	head difference = 450mm
At time t = 9 min	head difference = 150 mm

i. Determine the hydraulic conductivity of the soil (cm/sec).

ii. What was the head difference at t =7 min?

c. Fig. 5 shows three layers of soil in a tube that is 120 mm×120 mm in cross-section. Water is supplied to maintain a constant head difference of 300 mm across the sample. The hydraulic conductivities of the soils in the direction of flow through them are as follow:

Soil	K (cm/sec)
A	10^{-2}
B	4×10^{-3}
C	5.9×10^{-4}

Find the rate of water supply in cm^3/hr.

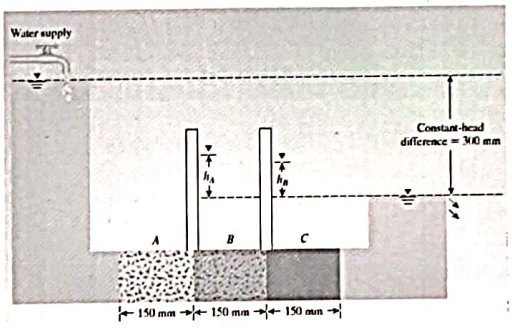


Fig. 5