

Ex/SC/GEOL/PG/CORE/TH/11/2025

M. SC. APPLIED GEOLOGY EXAMINATION, 2025

(2nd Year, 1st Semester)

GEOCHEMICAL AND GEOPHYSICAL EXPLORATION

PAPER : CORE/TH/11

Time : Two Hours

Full Marks : 40

(Use separate answer scripts for each Part)

Part-I (20 marks)

Answer **all** questions.

1. (a) Show that the Earth's gravity at a point, $g = g_o + g'_r$,
where $g_o = \frac{GM}{r^2}$ and g'_r is the radial component of
gravity due to the excess mass in the bulged region of
the distorted earth. All conventional symbols are used
in the above equation.
(b) Prove that the potential (U) in the gravity field containing
no attracting mass satisfies the following equation :
 $\nabla^2 U = 0$, where ∇^2 represents the Laplacian operator.
3+2=5 [CO4]
2. (a) Using the potential term U , find the first derivative of
Earth's gravity in the vertical direction in terms of
Cartesian coordinates.

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[Turn Over]

(2)

(b) Show that $A + B + C = 2 \int r'^2 dm$, where A , B and C denote Earth's moment of inertia along the equatorial coordinate axes, x and y and the polar coordinate axis, z , respectively. r' and m represent radial coordinate and mass, respectively. $2+3=5$ [CO4]

3. (a) A terrain contains a vertical cylindrical body of radius, R and axial length, L with a density anomaly ρ' . The body is located at a depth of D . Derive a general equation to show the gravity anomaly due to this body at a point (located along its axis) on the surface.

(b) Use the same equation to interpret the gravity anomaly when $R \gg L$. $4+1=5$ [CO4]

4. (a) A horizontal sill with a thickness of T occurs at a depth of Z . The sill terminates against an inclined surface dipping α . Explain the theoretical approach (full derivation not required) in finding the gravity anomaly on the surface due to the presence of this sill.

(b) Draw schematically a graphical plot to show the lateral variation of gravity anomaly above the sill.

$4+1=5$ [CO4]

5. (a) Describe the theoretical principle of the free-fall method used for gravity measurements.

(b) With a schematic diagram, illustrate the principle of operation of the vertical-motion seismometer. $3+2=5$

[CO5]

(5)

(iv) Which of the following underground mining methods is a 'supported method'? [CO5]

I. shrinkage stoping

II. cut and fill stoping

III. sublevel stoping

Choose the correct option from the following :

A. I

B. I and II

C. II and III

D. III

(v) For drilling in limestone, drill bit to be used should be

[CO5]

A. 8 to 10 SPC-WC

B. Impregnated - 30 to 60 SPC

C. Impregnated – WC

D. 80 - 110 SPC – WC

★ ★ ★

(3)

6. (a) Explain the difference in geometric attenuations between body waves and surface waves.
- (b) Using schematic drawings, explain the basic difference between split-spread and common-mid-point methods in reflection seismology. 3+2=5 [CO5]

Part-II (20 marks)

Answer *any four* questions from the following : 5×4=20

1. Draw a schematic labelled diagram to show the arrangement of different major components of a double-cylinder wire-line diamond rotary drill. What is the function of 'reaming shell'? Why is the 'pawl and ratchet' rotary motion important for reaming shell? 3+1+1=5 [CO5]
2. How are the operating costs of opencast mines, the cut-off grade of the mined ore material, the recovery of mineral per unit of ore and the unit weight of the ore material functionally related to the final saleable price of the mined mineral? Explain briefly with relevant equations. Represent a 2D graph to show how the economic limit of an opencast mine for inclined bedded deposits varies with its overburden ratio and time span of mining. 3+2=5 [CO3]
3. Present a tabular chart to show the different gross and specific techniques those are generally being deployed for underground mining. Mention major negative impacts of overall underground mining process. 3+2=5 [CO5]

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[Turn Over]

4)

4. What is an orientation survey? What are the relevant objectives it solves at the outset of a geochemical exploration constricted to a specific region? Mention the significance of the 'threshold' value and 'anomaly' related to mineral exploration. 1+2+2=5 [CO1]
5. Choose the correct option from the following : 1×5=5
(For MCQ, write the full question first, then mention your option with its full text)
- (i) The stages followed in mining of mineral resources are [CO2]
- A. Prospecting-Exploration-Development-Exploitation
B. Prospecting-Development-Exploration-Exploitation
C. Exploration-Prospecting-Development-Exploitation
D. Prospecting-Development-Exploitation-Exploration
- (ii) Long wall caving method is generally employed for [CO4]
- A. iron-ore mining
B. copper mining
C. Coal mining
D. Gypsum mining
- (iii) The main variables which are taken to estimate the drillability are [CO5]
- A. rock properties – drill rate – bit wear – method of drilling
B. rock properties – weathering status of rock – RPM of the bit – method of drilling
C. rock texture – RPM of the bit – bit wear – method of drilling
D. rock texture – drill rate – bit wear – method of drilling

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