W'11 : 4 AN : MN 404 (1533)

EXPLOITATION OF MINERAL DEPOSITS

Time : Three hours

Maximum Marks : 100

Answer FIVE *questions, taking* ANY TWO *from* **Group A,**
ANY TWO *from* **Group B** *and* ALL *from* **Group C.**

*All parts of a question (a,b,etc.) should
be answered at one place.*

*Answer should be brief and to-the-point and be supplemented
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result in loss of marks.*

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Figures on the right-hand side margin indicate full marks.

Group A

1. (*a*) Discuss salient differences between the underground coal and underground metal mines only for the following characteristics, viz., hardness, uniformity in value/gangue, mining geometry, gas hazards.   4 x 2

    (*b*) Explain, in brief, how the following factors influence the choice of coal mining methods : (*i*) Depth of the seam; (*ii*) thickness of the seam; (*iii*) characteristics of roof and floor; and (*iv*) hydrological conditions of the coal measures.   4 x 3

2. (*a*) Explain briefly the advancing and retreating systems of longwall mining layouts with the help of sketches.   6 + 6

    (*b*) Draw the line diagrams and label the parts of the following longwall mining equipment :   2 x 4
    (*i*)   Double ended ranging drum shearer
    (*ii*)   Shield support.

(Turn Over)

3. (*a*) A 2.5 m thick coal seam, dipping at 1 in 10, located at a depth of 100 m from the surface, is to be worked by 'Bord and Pillar' method of working. Give the district layout, support system, ventilation arrangements and manpower requirement for a production of 300 ton/day from the district. 3 + 3 + 3 + 3

(*b*) Explain briefly *any two* methods of extraction of pillars with the help of neat diagrams. 2 × 4

4. Explain the following in brief with neat sketches : 4 × 5

(*i*) Horizon mining method

(*ii*) Shortwall mining method

(*iii*) Pillar extraction by hydraulic stowing

(*iv*) Critical area, sub-critical area and supercritical area of subsidence.

Group B

5. (*a*) Give a complete categorization of stoping methods as to support on 'main-class' and their 'sub-class' (as suggested by the USBM). How are the excavated parts of each of the sub-class of stopes kept stable during mining ? 6 + 4

(*b*) Calculate the 'stripping allowance' at zero profit and the maximum allowable stripping ratio (SR_{max}) from the following data given for a mineral deposit : 2 + 2

Value of ore = Rs. 120,000/ton
Cost (excluding stripping) = Rs. 82, 500/t
Stripping cost = Rs. 6500/m³.

(*c*) What is a box cut ? Explain briefly, using sketches the box cut layout, to cut open a surface coal mine. 2 + 4

6. (*a*) Give the layout of an opencast coal mine to be worked out employing shovel dumper combination with annual production of 3 million tonne. The salient geo-mining conditions of the coal seam are given below :

Number of coal seam = 1
Seam thickness = 12 m
Average stripping ratio = 1·4
Dip of the seam = 1 in 16

Determine the capacity of major heavy earth moving machines (HEMM), indicating monthly as well as daily coal production and overburden removal. Give the drilling patterns for both coal and overburden benches, indicating the type and capacity of the drilling machine. 16

(*b*) Describe, with neat sketches, the 'glory hole' mining method. 4

7. (*a*) Explain the significance of the following parameters in the context of underground metal mining : 4 × 3

(*i*) 'Pull factor' in respect of developmental headings.

(*ii*) 'Powder factor' in respect of blasting.

(*iii*) 'Tonnage factor' in respect of stoping.

(*iv*) 'Swell factor' in respect of loading of rock.

(*b*) Calculate the 'drilling factor' (in t/m) for one blast in a bench block being mined by underhand stoping, having dimensions of 2 m × 3 m × 2 m (width × length × height of the bench). The bench is excavated by drilling-blasting. The drill hole diameter is 28 mm – drilled at a constant 'burden × speeing' of 0·5 m × 0·6 m. Assume in-situ density of the bench block to be 3 tonne/m³. 3

(*c*) Explain, with neat sketches, mining of bench placer-sand deposit by dredging technique. 5

8. Write short notes, supplemented by neat sketches, wherever necessary : 4 × 5

(a) Shrinkage stoping method

(b) Rescuing stoping method

(c) Inclined *vs*. vertical drilling in open pit mining

(d) Mechanization at draw point for sub-level stoping by trackless mining.

Group C

9. (A) Choose the *correct* answer for the following : 10 × 1

(i) Direct overburden casting in opencast mine is done with the help of

(a) bucket wheel excavator.

(b) dragline.

(c) wheel scraper.

(d) backboe excavator.

(ii) Which one of the following methods is *not* employed to mine placer deposits ?

(a) Panning and sluicing

(b) Hydraulicking

(c) Cut and fill mining

(d) Dredging

(iii) The spacing between drawpoints in sub-level caving method depends on

(a) diameter of the long hole.

(b) bucket capacity of loader.

(c) ellipsoid of draw.

(d) broken ore fragmentation.

(iv) Crown pillar breakes the

(a) up and down dip continuity of a stope.

(b) strike continuity of a stope.

(c) across-the-strike continuity of a stope.

(d) both dip and strike continuity of a stope.

(v) In hydraulicking, coal face is broken by

(a) air blasting.

(b) blasting with cardox.

(c) wedging and sloting.

(d) water monitor jet.

(vi) 'Soutirage' mining in coal is

(a) sub-level caving.

(b) integrated sub-level caving.

(c) horizon mining.

(d) in-seam mining.

(vii) Which one of the following angle hole drilling patterns is generally used for solid blasting in coal gallery ?

(a) Draw cut.

(b) Drag cut.

(c) Cone cut.

(d) Wedge cut.

(viii) All other conditions remaining the same, the costliest method of stoping is

(a) timbered square set stoping.

(b) sub-level caving.

(c) sub-level open stoping.

(d) block caving.

(ix) In open pit mining, amount of overburden removed in terms of m^3 per tonne of ore produced is called

(a) swell factor.

(b) bulking factor.

(c) stripping ratio.

(d) coupling ratio.

(x) Which one of the following machines is not used to construct haulroad in open pit mines ?

(a) Motor grader

(b) Bulldozer

(c) Vibratory compactor

(d) Clamshell

(B) Select the *correct* answer for the following :   5 × 2

(i) In order of the chronological development, the longwall support systems are arranged as (P : Powered support Q : Link bar and friction support R : Frame support S : Hydraulic support)

(a) $R > Q > S > P$

(b) $P > Q > R > S$

(c) $Q > S > R > P$

(d) $S > R > P > Q$

(ii) Which one of the following entry system is *not* a primary access and egrees to an underground mine?

(a) Vertical shaft

(b) Staple shaft

(c) Inclined shaft

(d) Compound shaft

(iii) Match the following :

P. Cut and fill stoping		a. Natural pillar
Q. Square set stoping		b. Unsupported
R. Sub-level stoping		c. Mill failing
S. Sub-level caving		d. Timber frame

(a) *P-a, Q-b, R-c, S-d*

(b) *P-c, Q-a, R-b, S-d*

(c) *P-c, Q-a, R-d, S-b*

(d) *P-c, Q-d, R-a, S-b*

(iv) Given the bench height = 12 m; spacing = 5 m; burden = 4 m; explosive per hole : 120 kg; tonnage factor = 2·6 t/m^3; powder factor in (tonnes/kg) is

(a) 2·0

(b) 4·6

(c) 5·2

(d) 7·3

(v) Match the following :

Mining method	Operation
P. Bord and pillar	1. Longhole radial drilling
Q. Sub-level caving	2. Splitting & slicing
R. Longwall retreating	3. Loosening under strata pressure
S. Integrated caving	4. Mechanical cutting

(a) *P-2, Q-1, R-4, S-3*

(b) *P-4, Q-2, R-3, S-1*

(c) *P-1, Q-4, R-3, S-2*

(d) *P-2, Q-3, R-1, S-4*

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EXPLOITATION OF MINERAL DEPOSITS

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Maximum Marks : 100

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Group A

1. (*a*) Describe various factors affecting the length of longwall
    face.   8

    (*b*) Draw a layout of a longwall retreating face being worked
    with DERD shearer for a seam having 1·8 m thickness
    and lying at a depth of 350 m. Describe its salient
    features and list the face equipment.   ·   12

2. (*a*) Explain the sequence of pillar extraction in the board
    and pillar system of mining for a seam 3 m thick
    and lying at a depth of 250 m with suitable sketches.
    Assume relevant data wherever necessary. ·   12

    (*b*) Compare board and pillar system with shortwall system
    of coal mining.   8

(Turn Over)

(a) What are the applicability conditions for stowing ? Discuss and draw a schematic diagram of surface arrangement of hydraulic stowing practiced in India. 4 + 8

(b) Explain working of power support used in longwall system.   8

4. (a) Describe blasting gallery method with neat sketches to extract thick coal seam having thickness 6 m.   10

(b) Explain the factors affecting subsidence in coal mining.   10

Group B

5. (a) A lead-zinc deposit is to be worked by underground method. Suggest and describe suitable method with sketches in the following situations :   12

Ore body dipping at 60°-70°
Width of ore body = 25 m
Country rock is hard and competent
Ore body is competent
Height of ore block = 60 m

(b) Explain, with neat sketches, the method of raising by raise borer to develop a raise of 3 m dia.   8

6. (a) Explain recent developments taking place for stope mechanisation.   10

(b) Write short notes on following :   2 × 5

(i) Shrinkage stoping method

(ii) VCR method

7. (a) Design a mechanised opencast mine for producing limestone 2·0 million tonne per annum. Assume that 15% waste to be handled in addition to limestone. Also, give machinery requirement for extraction of limestone and overburden.   15

(b) Explain in brief the factors to be considered for selecting pit layout for a mechanised opencast mine.   5

8. (a) Describe the factors to be considered for optimum blast design.   10

(b) Explain computerised truck dispatch system used in well mechanised opencast mines.   10

Group C

9. (A) Choose the *correct* answer for the following :   8 × 1

(i) Equipment not used in hard rock metal mining drivage is

(a) road header.

(b) drill jumbo.

(c) jack hammer.

(d) dint header.

(ii) Continuous miner and shuttle car combination is not applicable in mining with

(a) longwall method.

(b) Wangawilli system.

(c) board and pillar method.

(d) room and pillar method.

(iii) Blasting technique used for controlled throw of overburden is known as

(a) pop shooting.

(b) cast blasting.

(c) coyote blasting.

(d) plaster shooting.

(*iv*) Stoping method, where a large part of blasted ore is allowed to accumulate in the stope to serve the purpose of providing working platform for stoping as well as to support the wall-rock, is known as

(*a*) cut and fill stoping.

(*b*) sub-level stoping.

(*c*) shrinkage stoping.

(*d*) square-set stoping.

(*v*) Face support used with mechanised longwall in flat seam is

(*a*) cable bolting.

(*b*) shield support.

(*c*) alpine breaker line support.

(*d*) troika shield support.

(*vi*) The maximum number of coal faces in an underground board and pillar development district is 11. The number of headings in the district is

(*a*) 5

(*b*) 6

(*c*) 7

(*d*) 3

(*vii*) Angle of draw in a trough subsidence help in determining the

(*a*) maximum subsidence.

(*b*) plane of fracture.

(*c*) extent of surface subsidence.

(*d*) critical width of opening.

(*viii*) Equipment used in mining of placer deposit is

(*a*) rope saw.

(*b*) wagon drill.

(*c*) auger.

(*d*) riffle box.

(B) Explain the following in brief :   6 × 2

(*i*)   Angle of break

(*ii*) Rocker shovel

(*iii*) Block caving

(*iv*) Box cut

(*v*)   Cable bolting

(*vi*) Shortwall mining.

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EXPLOITATION OF MINERAL DEPOSITS

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Group A

1.   (*a*) Discuss the factors affecting choice of underground
coal mining methods.   **8**

     (*b*) Draw a layout of a longwall advancing face being
worked with DERD shearer for a seam having 2·4 m
thickness and lying at a depth of 360 m. Describe its
salient features and list the face equipment.   **12**

2.   (*a*) Give a layout of depillaring panel producing 600 ton
per day. The coal seam is 3.2 m thick lying at a depth
of 300 m and developed by Board and Panel method
of mining. Explain cycle of operation for this panel in
detail. Assume relevant data wherever necessary.   **12**

     (*b*) Explain shortwall system of coal mining practiced in
India.   **8**

(Turn Over)

3.   (*a*) What are the applicability conditions of stowing ? Give advantages and disadvantages of hydraulic stowing in an underground coal mine.   4 + 8

     (*b*) Explain factors affecting choice of support system in roadways and face in coal mining.   8

4.   (*a*) Describe horizontal slicing method to extract thick coal seam having thickness 20 m and dipping at $28°$.   10

     (*b*) Explain mechanics of subsidence in coal mining. How is surface subsidence measured ?   5 + 5

Group B

5.   (*a*) Suggest and explain a suitable stoping method to work an ore body having (*i*) width 25 m, (*ii*) lying at depth 300 m, (*iii*) nature of ore body—medium hard, (*iv*) hanging wall—not competent, (*v*) footwall—competent. You may touch upon following points : Development, method of work with cycle of operation, layout, manpower, machinery and limitation of methods.   12

     (*b*) Explain, with neat sketches, the method of raising by long hole to develop a raise of size 2·5 m × 2·5 m.   8

6.   (*a*) Explain the factors affecting the selection of stoping method. Also, give examples.   10

     (*b*) Write short notes on the following :   2 × 5

       (*i*) Block caving

       (*ii*) Square set stoping method.

7.   (*a*) Design a mechanised opencast mine for producing iron ore 10 million ton per annum. The iron ore deposit is overlain by 5 m thick lateritic overburden in hilly terrain. Also, give number of equipment required for extraction of iron ore and overburden.   15

     (*b*) What are the advantages and limitations of surface mining ?   5

8.   (*a*) Explain the working of surface miner used to extract limestone deposit of having strength 50 MPa.   10

     (*b*) Discuss the factors for selection of suitable drill in mechanised opencast mines.   10

Group C

9.   (A) Choose the *correct* answer for the following :   8 × 1

       (*i*) Terrace cut is made in an open pit mine using

         (*a*) front end loader.

         (*b*) bucket wheel excavator.

         (*c*) wheel tractor scraper.

         (*d*) clamshell.

       (*ii*) The line joining the pillars under actual extraction is known as

         (*a*) knife edge.

         (*b*) diagonal line.

         (*c*) straight line.

         (*d*) line of extraction.

       (*iii*) A drum shearer is mounted on

         (*a*) A.F.C.

         (*b*) separate rail.

         (*c*) its own skid.

         (*d*) support frame.

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(*iv*) In VCR method of mining, the charge length to diameter ratio is restricted to

(*a*) 2 : 1

(*b*) 4 : 1

(*c*) 6 : 1

(*d*) 8 : 1

(*v*) The parting between any two sections of a thick seam or between two contiguous seam should be

(*a*) not more than 3 m thick.

(*b*) not less than 3 m thick.

(*c*) not less than 1 m thick.

(*d*) not more than 1 m thick.

(*vi*) The width of headings in Board and Pillar method of working depends upon

(*a*) depth of working.

(*b*) ventilation requirement.

(*c*) size of pillars.

(*d*) face machinery used.

(*vii*) High production rates coupled with large scale and extensive subsidence results from the method of

(*a*) top slicing.

(*b*) block caving.

(*c*) sublevel caving.

(*d*) VCR mining.

(*viii*) The machine best suited for digging below the level on which it stands and loads the dumper is

(*a*) tractor shovel.

(*b*) stripper shovel.

(*c*) back hoe.

(*d*) dipper shovel.

(B) Explain the following in brief :   **6 × 2**

(*i*) Angle of draw

(*ii*) Electronic detonator

(*iii*) Hydraulicking

(*iv*) Overall pit slope

(*v*) Shield support

(*vi*) DERD

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Group A

1. Explain the following briefly :   4 × 5

   (*a*) Shortwall mining

   (*b*) Horizon mining

   (*c*) Loading characteristics of powered support

   (*d*) Hydraulic monitor

2. (*a*) State the engineering parameters of subsidence and
       show them diagramatically.   12

   (*b*) Explain briefly the factors influencing angle of draw.   8

3. (*a*) Explain the principle of continuous mining method for
       extracting coal.   6

(Turn Over)

(b) Describe the schemes of pillar development and depillaring by using continuous miners with the help of suitable layouts.   7 + 7

4. (a) State the principle of longwall method of working.   4

(b) What are the basic elements of a longwall face ?   4

(c) Compare advantages and retreating longwall method.   6

(d) Draw a neat sketch of a longwall retreating powered support face.   6

Group B

5. (a) Explain the principle of working of a surface miner with a suitable diagram.   10

(b) Under what conditions you would deploy a surface miner and what are its advantages and limitations ?   5 + 5

6. A raise 2 m × 2 m in cross-section is to be driven at a rate of 4 m per day to correct two levels with 100 m vertical interval. Suggest a mechanised method raising and list the equipment and machinery required for this purpose.   20

7. (a) What are the conditions under which overcasting method of overburden disposal can be successfully used ?   10

(b) State and discuss factors governing rock slope stability.   10

8. (a) Explain, with neat sketches, the method of exploitation by post-pillar method. How does it differs from horizontal cut and fill method ?   12

(b) What is deslimed mill tailing and how is it obtained ?   8

Group C

9. (A) Explain the following in brief :   8 × 2

(i) Draw point

(ii) Loading pocket

(iii) Sill pillar

(iv) Creep and heave

(v) Sink holes

(vi) Dredging

(vii) Dilution

(viii) Spreader

(B) Choose the *correct* answer for the following :   4 × 1

(i) Compressibility of hydraulically placed fill is

(a) 5 - 10 %
(b) 10 - 15 %
(c) 15 - 20 %
(d) 20 % and above

(ii) Shrinkage stoping is generally unsuitable for pyratic ore bodies because of

(a) poor fragmentation of ore.
(b) chances of spontaneous heating.
(c) poor ore drawing characteristics.
(d) None of the three above

(iii) Narrow vertical opening excavated in a deposit at the end of a stope to provide free face is known as

(*a*) portal.

(*b*) bleeder.

(*c*) slot.

(*d*) lateral.

(*iv*) Spud is one of the basic parts of

(*a*) drill machine.

(*b*) shield support.

(*c*) L.H.D.

(*d*) dredge.

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