ASSIGNMENT 2: GATE 2011 MN: MINING ENGINEERING

AI25BTECH11010 - Dhanush Kumar A

1) A scatter plot prepared using a set of values of lead and zinc from a lead-zinc deposit is shown in figure below. The value of correlation coefficient is

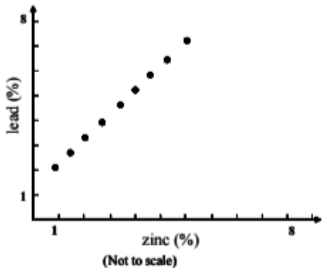


Fig. 1

(GATE MN 2011)

a) 1.0 b) 0.7 c) 0.5 d) 0

2) The two vectors are orthonormal, if

(GATE MN 2011)

a) vector product is zero and norm of each vector is also zero
b) vector product is one and norm of each vector is also one
c) cross product is zero and norm of each vector is one
d) cross product is one and norm of each vector is zero

3) The value of

$$\lim_{x\to 0} \frac{1}{x}\left(\sqrt{1+x} - \sqrt{1-x}\right) \text{ is}$$

(GATE MN 2011)

a) 0 b) 1 c) 2 d) 3

4) The infinite series $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \cdots$ is

(GATE MN 2011)

a) convergent b) divergent c) oscillatory d) semi-convergent

5) The largest area of a rectangular shaft for a given constant perimeter is obtained when length is

(GATE MN 2011)

a) 2.5 times of breadth
b) 1.5 times of breadth
c) 2 times of breadth
d) equal to breadth

6) A drive shaft of an engine develops torque of 500 N·m. It rotates at a constant speed of 50 rpm. The power transmitted by the shaft in kW is

(GATE MN 2011)

a) 1.46 b) 2.05 c) 2.62 d) 4.32

7) A mine winder cage traveling 450 m from pit bottom to pit top is following a three period duty cycle as shown in the figure below. The maximum velocity attained by the cage in m/s is

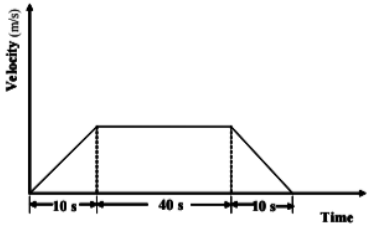


Fig. 7

(GATE MN 2011)

a) 7.5 b) 9.0 c) 11.0 d) 12.0

8) Stress concentration at a point on the wall of a vertical shaft results in a compressive stress of 59.66 MPa. The wall rock mass has an unconfined compressive strength of 89.49 MPa. The safety factor of the shaft wall at the point is

(GATE MN 2011)

a) 0.67 b) 0.86 c) 1.23 d) 1.50

9) A core sample of 54 mm diameter having Young's modulus of 68.97 GPa fails in uniaxial compression at 0.1% axial strain. The axial load at failure in kN is

(GATE MN 2011)

a) 158.00 b) 68.97 c) 58.00 d) 15.80

10) The maximum number of coal faces in an underground bord and pillar development district is 13. The number of headings in the district is

(GATE MN 2011)

a) 3 b) 5 c) 6 d) 7

11) The whole circle bearing of the line AB is 116°20′20″. If there exists an east declination of 20′, the true quadrantal bearing of line AB is

(GATE MN 2011)

a) S41°59′40″E b) S43°39′40″E c) S45°59′40″W d) S47°59′40″W

12) It is proposed to connect two straights of a road by a simple circular curve. If the maximum speed of the vehicle is 60 km/h and the centrifugal ratio for the road is 1/4, the minimum radius of the curve in m is

(GATE MN 2011)

a) 113.26 b) 98.18 c) 25.46 d) 15.50

13) A centrifugal fan rotating at 500 rpm delivers 70 m^3/s of air. If the speed is reduced to 200 rpm, the quantity of air delivered in m^3/s will be

(GATE MN 2011)

a) 175 b) 55 c) 28 d) 11

14) According to mine regulations, the value of the fleet angle α, in degree of a drum winder installation lies in the range of

(GATE MN 2011)

a) $1.5 < \alpha \leq 2.0$ b) $0 < \alpha \leq 1.5$ c) $2.0 < \alpha \leq 2.5$ d) $2.5 < \alpha \leq 3.0$

15) Water will not be delivered by a centrifugal pump due to

(GATE MN 2011)

a) lack of priming
b) too low discharge head
c) wrong direction of rotation
d) partial obstruction at discharge outlet

16) Match the following

Mine car type	**Mode of unloading**
P. Granby	1. Bottom opening
Q. Gable bottom	2. Both side tilting
R. Drop bottom	3. Single side opening
S. Rocker dump	4. Both side opening

TABLE 16

(GATE MN 2011)

a) P-2, Q-4, R-3, S-1
b) P-4, Q-1, R-3, S-2
c) P-3, Q-1, R-4, S-2
d) P-3, Q-4, R-1, S-2

17) Mean air temperature of a 450 m deep downcast shaft is 29°C and that of the upcast shaft is 37°C. The height of the motive column in m is

(GATE MN 2011)

a) 8.2 b) 9.5 c) 11.6 d) 12.8

18) The total pressure and the static pressure measured at a point in a ventilation duct are 20 mm and 10 mm of water gauge respectively. If density of air is 1.2 kg/m^3, the velocity of the air in m/s is

(GATE MN 2011)

a) 14.08 b) 12.78 c) 8.53 d) 6.24

19) The type of fire extinguisher that must **NOT** be used in case of fire in an electric substation located in an underground metal mine is

(GATE MN 2011)

a) multi-purpose dry chemical extinguisher
b) CO_2 snow extinguisher
c) dry chemical powder extinguisher
d) foam extinguisher

20) ISO 9000 Quality Systems **DO NOT** contain

(GATE MN 2011)

a) legal provisions b) measurement c) document control d) standardization

21) Air samples collected from the intake and the return gates of a retreating longwall face show methane concentration values of 0.1% and 0.8% respectively. The production from the longwall face is 2000 tonne/day and the air quantity circulating the face is 15 m^3/s. The rate of methane emission in m^3 per tonne of coal produced is

(GATE MN 2011)

a) 11.0 b) 9.5 c) 5.5 d) 4.5

22) The time study data of an equipment deployed in a mine during a calendar month is given below.
Total working hours = 400
Total maintenance hours = 100
Total hours of actual work = 240
The percentage of utilization of the equipment is

(GATE MN 2011)

a) 85 b) 80 c) 65 d) 60

23) 100 ml of waste water is allowed to evaporate in a dish weighing 48.6232 g. The weight of the dish with dry solids is 48.6432 g. The concentration of dry solids in waste water in mg/l is

(GATE MN 2011)

a) 200 b) 220 c) 260 d) 320

24) A longwall face cut by double back shuffle method can be only worked with

(GATE MN 2011)

a) fixed drum shearer
b) single ended ranging drum shearer
c) double ended ranging drum shearer
d) plough

25) Proximate analysis of 50 g of a coal sample shows the following:
Moisture = 0.80 g
Ash = 7.85 g
Volatile matter = 15.90 g
The fixed carbon in percentage on a dry, ash free basis is

(GATE MN 2011)

a) 83 b) 66 c) 55 d) 45

26) For an oil exploration drilling, chance of striking an oil reservoir is 1 out of 15. If an oil exploration company decides to explore 5 sites, the probability of striking at least one successful oil reservoir is

(GATE MN 2011)

a) 0.292 b) 0.250 c) 0.034 d) 0.0024

27) Product of the eigen values of the matrix A is

$$\mathbf{A} = \begin{pmatrix} 3 & 2 & 5 \\ 2 & 2 & 1 \\ 1 & 5 & 4 \end{pmatrix}$$

(GATE MN 2011)

a) 6 b) 8 c) 10 d) 35

28) For the equation $\frac{dy}{dx} = 2x+3y$, the value of y at $x = 0.1$ in one step using Runge-Kutta fourth order method for the condition $y = 1$ when $x = 0$, is

(GATE MN 2011)

a) 0.3608 b) 1.2508 c) 1.3608 d) 1.4625

29) Value of the integral $\int_0^1 \sqrt{\frac{1+x}{1-x}}\,dx$ is

(GATE MN 2011)

a) $\frac{\pi}{2} - 1$ b) $\frac{\pi}{2} + 1$ c) $\pi - 1$ d) $\pi + 1$

30) A 1 tonne mine car traveling at a constant speed o f 10 km/h collides with a stationary buffer and co mes to rest. If the buffer spring stiffness is 200 kN/m, the maximum compression in the spring in mm is

(GATE MN 2011)

a) 49 b) 98 c) 196 d) 247

31) In an iron ore handling port, a barge is pulled by ropes using two tugboats as shown in the figure. In equilibrium, the resultant of the forces T_1 and T_2 along the axis of the barge in the direction of its travel is 5000 N. The tensions T_1 and T_2 in N respectively are

(GATE MN 2011)

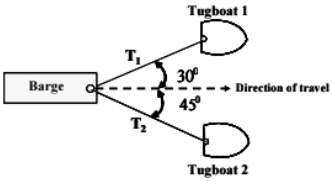


Fig. 31

a) 9700 and 6831
b) 6831 and 9700
c) 3660 and 2588
d) 2588 and 3660

32) A flat belt conveyor is carrying coal of bulk density 1 tonne/m^3 at a rate of 400 tonne/h. The belt speed is 3 m/s. Coal is spread over the belt covering 80% of the belt width in a shape of a triangle. If the pile height is 1/4 of the belt width, the width of the belt in mm is

(GATE MN 2011)

a) 1109 b) 909 c) 709 d) 609

33) Match the following

Hydraulic system components		Symbols
P Fixed displacement unidirectional flow pump	1	
Q Fixed displacement unidirectional flow motor	2	
R Accumulator	3	
S Filter	4	

Fig. 33

(GATE MN 2011)

a) P-4, Q-2, R-3, S-1
b) P-2, Q-4, R-3, S-1
c) P-3, Q-2, R-1, S-4
d) P-2, Q-3, R-1, S-4

34) Match the following

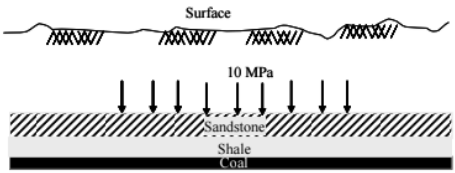
Method of mining	Stope support	Ore loading
P. Shrinkage stoping	1. Insitu pillar	a. Overhead mucker
Q. Blasthole stoping	2. Broken ore	b. Pneumatic autoloader
R. Top slicing	3. Timber mat	c. Load haul dumper

TABLE 34

(GATE MN 2011)

a) P-2-a, Q-1-c, R-3-b
b) P-2-a, Q-3-c, R-1-b
c) P-2-b, Q-3-c, R-1-a
d) P-3-c, Q-2-a, R-1-b

35) A typical case of gravity loading under complete lateral restraint in flat strata is shown in the figure below. The physico-mechanical parameters of the strata are given in the table. The in situ stresses (σ_Z, σ_H) on the top of the coal seam in MPa are:



Cross-section of the strata

Fig. 35

Strata	Thickness (m)	Specific Gravity	Young's Modulus (GPa)	Shear Modulus (GPa)
Sandstone	50	2.35	26.40	12.50
Shale	25	2.15	20.50	8.25
Coal	20	1.52	2.41	0.95

TABLE 35

(GATE MN 2011)

a) $(10.17, 2.54)$ b) $(10.17, 3.69)$ c) $(11.68, 3.69)$ d) $(11.68, 2.54)$

36) The sale value of chromite ore from an open pit mine is Rs. 6500 per tonne. Cost of mining, excluding stripping cost, is Rs. 2450 per tonne. If the cost of stripping is Rs. 1150 per m^3, the breakeven stripping ratio in m^3/tonne is

(GATE MN 2011)

a) 2.18 b) 3.52 c) 3.65 d) 4.25

37) An investment at 10% yearly interest rate, compounded quarterly, accumulates to a sum of Rs. 120,000 in 5 years. The present value of the sum in rupees is

(GATE MN 2011)

a) 72,233 b) 74,511 c) 88,232 d) 106,063

38) A toxic gas flows into a mine working place at the rate of 2.52 m^3/min. The concentration of the gas in the intake air is 0.25%. The minimum quantity of intake air in m^3/min required to dilute the gas to its threshold limit value of 1.0% is

(GATE MN 2011)

a) 123 b) 252 c) 295 d) 333

39) An exhaust fan attached to an evasee of 18 m^2 cross-sectional area at the outlet circulates 150 m^3/s of air at the pressure of 1000 Pa in a mine ventilation system. The ratio of the inlet to outlet area of the evasee is 1:4 and the density of air is 1.2 kg/m^3. The quantity of air circulated in the mine in absence of evasee is 120 m^3/s. The evasee efficiency in % is

(GATE MN 2011)

a) 57.6 b) 43.2 c) 39.06 d) 37.7

40) A fan circulates 24 m^3/s of air at a pressure of 1200 Pa in a ventilation district. It is intended to reduce the air quantity to 16 m^3/s by placing a regulator. Assuming the pressure remains unchanged, the size of the regulator in m^2 is

(GATE MN 2011)

a) 1.48 b) 0.74 c) 0.37 d) 0.18

41) An air sample taken from the return airway of a district contains the following gases. The Graham's ratio for the district is

Gas	Concentration (%)
CO_2	0.40
H_2	1.17
O_2	19.92
N_2	78.49
CO	0.02

TABLE 41

(GATE MN 2011)

a) 5.6 b) 4.8 c) 3.0 d) 2.3

42) An incandescent headlight of a mining vehicle is of spot beam type with a beam angle of 30°. The spherical surface in m^2 subtended by the lighted beam at a distance of 5 m from the headlight is

(GATE MN 2011)

a) 7.5 b) 15 c) 21 d) 25

43) The thickness of a coal deposit is represented by a spherical semi-variogram model with sill of 5 m^2. If the semi-variogram value at lag distance h is 3 m^2, the correlogram value at the same lag distance is

(GATE MN 2011)

a) 0.4 b) 2.0 c) 2.5 d) 5.0

44) The total cost C (lakh rupees) of a longwall face of length L in m is given by the equation

$$C = 0.1L + \frac{1562.5}{L} + 300$$

Length of the face in m for the minimum total cost is

(GATE MN 2011)

a) 40 b) 125 c) 156 d) 300

45) 20 plain detonators in series, each of 2Ω resistance, are fired by a DC exploder supplying a current of 1.25 A. If 250 mJ energy is spent to fire the detonators, the time required in millisecond after detonator initiation is

(GATE MN 2011)

a) 4 b) 8 c) 12 d) 16

46) A sudden increase of CO incidence has occurred in an underground mine section. A man at point A starts to run out to the main intake of the mine where he will be safe. Refer figure below for the mine section and the logic diagram. The probabilities that he will successfully cross the gallery sections A, B, C, D, E, and F are 0.9, 0.8, 0.7, 0.8, 0.7 and 0.9 respectively. The probability that he will successfully reach the main intake is

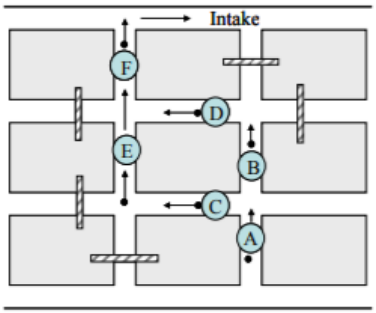


Fig. 46

Section of the mine

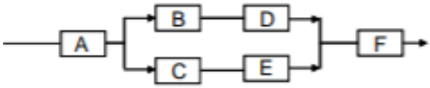


Fig. 46

Series-parallel logic diagram

(GATE MN 2011)

a) 0.40 b) 0.51 c) 0.66 d) 0.77

47) In an underground correlation survey by the Weisbach triangle (figure below) the following data are obtained:

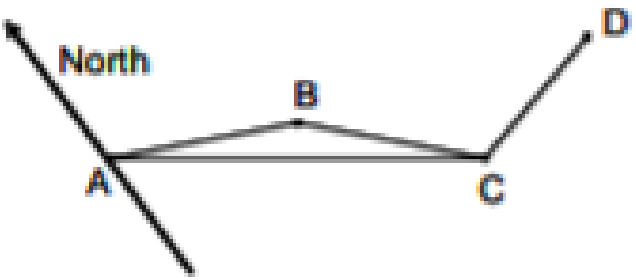


Fig. 47

(GATE MN 2011)

a) 102°27′16″ c) 115°27′16″
b) 114°41′49″ d) 179°14′16″

Common Data Questions

Common Data for Questions 48 and 49:

A concentrator pilot plant is fed with 1 tonne of copper ore at ROM grade of 1.5% Cu. Metal recovery in the concentrator pilot plant is 90% and the grade of copper in concentrate is 20%.

48) The amount of copper in concentrate in kg is:

(GATE MN 2011)

a) 13.5 b) 14.0 c) 14.5 d) 15.0

49) Amount of concentrate produced from 1 tonne of ore in kg is:

(GATE MN 2011)

a) 75.0 b) 72.0 c) 70.0 d) 67.5

Common Data for Questions 50 and 51: A mine ventilation system consists of two splits A and B with resistances of $0.8\,Ns^2/m^8$ respectively as shown in figure. Trunk airways have resistance of $0.2\,Ns^2/m^8$. The main fan generating pressure of 500 Pa.

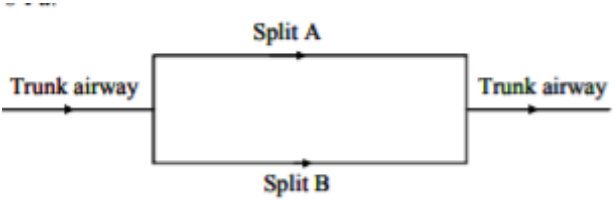


Fig. 49

50) The air quantities in m^3/s circulated in the splits A and B respectively are:

(GATE MN 2011)

a) 20 and 30 b) 30 and 20 c) 20 and 10 d) 40 and 10

51) The flows in the two splits are equalized by placing a booster fan in split B. Assume that the fan pressure does not change after installation of the booster fan. The size of the booster fan in Pa is:

(GATE MN 2011)

a) 749.05 b) 850.08 c) 950.02 d) 1000.50

Linked Answer Questions

Statement for Linked Answer Questions 52 and 53:

A 400 V, 3 phase, star connected induction motor takes a line current of 10 A with 0.86 p.f. lagging. Total stator losses are 5% of the input. Rotor copper losses are 4% of the input to the rotor, and mechanical losses are 3% of the input to the rotor.

52) The input power to the rotor in Watts is

(GATE MN 2011)

a) 5958 b) 5788 c) 5660 d) 5532

53) The shaft output power in Watts is

(GATE MN 2011)

a) 5562 b) 5490 c) 5434 d) 5264

Statement for Linked Answer Questions 54 and 55:

The bolts are spaced at 1.5 m centre-to-centre in a square pattern as shown in the figure below. The tensile stress in 22 mm diameter bolt rod is 193.35 MPa. The unit weight of the roof layer is 25 kN/m^3.

Plan view of rock bolting pattern (figure)

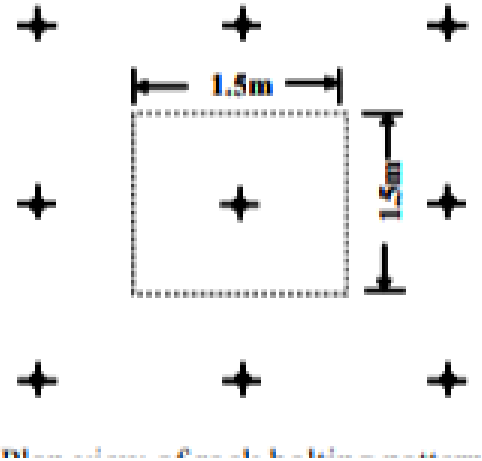


Fig. 53

54) The axial load in the bolt rod in kN is

(GATE MN 2011)

a) 294.0 b) 173.5 c) 147.0 d) 73.5

55) At equilibrium, the thickness of the roof layer supported by the bolt in m is
(GATE MN 2011)

a) 1.31 b) 2.4 c) 2.62 d) 3.08

General Aptitude (GA) Questions
Q.56 – Q.60 carry one mark each.

56) Choose the word from the options given below that is most nearly opposite in meaning to the given word:
Deference
(GATE MN 2011)

a) aversion
b) resignation
c) suspicion
d) contempt

57) Choose the most appropriate word(s) from the options given below to complete the sentence.
We lost confidence in him because he never _____ the grandiose promises he had made.
(GATE MN 2011)

a) delivered
b) deliberated on
c) forgot
d) reneged on

58) Choose the word or phrase that best completes the sentence below.
_____ in the frozen wastes of Arctic takes special equipment.
(GATE MN 2011)

a) To survive
b) Surviving
c) Survival
d) That survival

59) In how many ways 3 scholarships can be awarded to 4 applicants, when each applicant can receive any number of scholarships?
(GATE MN 2011)

a) 4 b) 12 c) 64 d) 81

60) Choose the most appropriate word from the options given below to complete the following sentence.
The _____ of evidence was on the side of the plaintiff since all but one witness testified that his story was correct.
(GATE MN 2011)

a) paucity
b) propensity
c) preponderance
d) accuracy

Q.61 to Q.65 carry two marks each.

61) If $(2y+1)(y+2) < 1$, then which of the following alternatives gives the **CORRECT** range of y?

(GATE MN 2011)

a) $-2 < y < 2$ b) $-2 < y < 1$ c) $-3 < y < 1$ d) $-4 < y < 1$

62) A student attempted to solve a quadratic equation in x twice. However, in the first attempt, he incorrectly wrote the constant term and ended up with the roots as (4,3). In the second attempt, he incorrectly wrote down the coefficient of x and got the roots as (3,2). Based on the above information, the roots of the correct quadratic equation are

(GATE MN 2011)

a) (3,4) b) (3,-4) c) (6,1) d) (4,2)

63) L, M and N are waiting in a queue meant for children to enter the zoo. There are 5 children between L and M, and 8 children between M and N. If there are 3 children ahead of N and 21 children behind L, then what is the minimum number of children in the queue?

(GATE MN 2011)

a) 28 b) 27 c) 41 d) 40

64) Four archers P, Q, R and S try to hit a bull's eye during a tournament consisting of seven rounds. As illustrated in the figure below, a player receives 10 points for hitting the bull's eye, 5 points for hitting within the inner circle and 1 point for hitting within the outer circle.

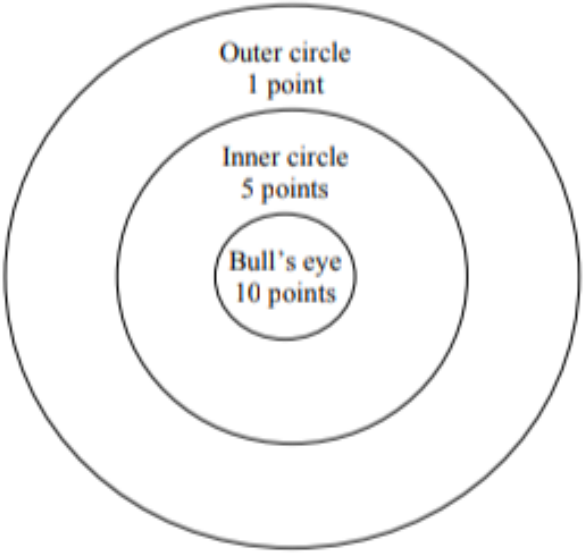


Fig. 64

The final scores received by the players during the tournament are listed in the table below.

Round	P	Q	R	S
1	1	5	1	10
2	10	10	5	1
3	1	10	1	5
4	10	1	5	1
5	1	10	1	5
6	10	5	1	1
7	5	10	5	1

TABLE 64

The most accurate and the most consistent players during the tournament are respectively

(GATE MN 2011)

a) P and S b) Q and R c) Q and Q d) R and Q

65) Nimbus clouds are dark and ragged, stratus clouds appear dull in colour and cover the entire sky. Cirrus clouds are thin and delicate, whereas cumulus clouds look like cotton balls.

It can be inferred from the passage that

(GATE MN 2011)

a) A cumulus cloud on the ground is called fog
b) It is easy to predict the weather by studying clouds
c) Clouds are generally of very different shapes, sizes and mass
d) There are four basic cloud types: stratus, nimbus, cumulus and cirrus

END OF THE QUESTION PAPER