GATE 2019 AG

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Q.1 – Q.5 carry one mark each

1) The fishermen, _____ the flood victims owed their lives, were rewarded by the government.

a) whom b) to which c) to whom d) that

(GATE AG 2019)

2) Some students were not involved in the strike.

If the above statement is true, which of the following conclusions is/are logically necessary?

1. Some who were involved in the strike were students.
2. No student was involved in the strike.
3. At least one student was involved in the strike.
4. Some who were not involved in the strike were students.

a) 1 and 2 b) 3 c) 4 d) 2 and 3

(GATE AG 2019)

3) The radius as well as the height of a circular cone increases by 10%. The percentage increase in its volume is _____.

a) 17.1 b) 21.0 c) 33.1 d) 72.8

(GATE AG 2019)

4) Five numbers 10, 7, 5, 4 and 2 are to be arranged in a sequence from left to right following the directions given below:

1. No two odd or even numbers are next to each other.
2. The second number from the left is exactly half of the left-most number.
3. The middle number is exactly twice the right-most number.

Which is the second number from the right?

a) 2 b) 4 c) 7 d) 10

(GATE AG 2019)

5) Until Iran came along, India had never been _____ in kabaddi.

a) defeated b) defeating c) defeat d) defeatist

(GATE AG 2019)

Q.6-Q.10 carry two marks each.

6) Since the last one year, after a 125 basis point reduction in repo rate by the Reserve Bank of India, banking institutions have been making a demand to reduce interest rates on small saving schemes. Finally, the government announced yesterday a reduction in interest rates on small saving schemes to bring them on par with fixed deposit interest rates.

Which one of the following statements can be inferred from the given passage?

a) Whenever the Reserve Bank of India reduces the repo rate, the interest rates on small saving schemes are also reduced

b) Interest rates on small saving schemes are always maintained on par with fixed deposit interest rates

c) The government sometimes takes into consideration the demands of banking institutions before reducing the interest rates on small saving schemes

d) A reduction in interest rates on small saving schemes follow only after a reduction in repo rate by the Reserve Bank of India

(GATE AG 2019)

7) In a country of 1400 million population, 70% own mobile phones. Among the mobile phone owners, only 294 million access the Internet. Among these Internet users, only half buy goods from e-commerce portals. What is the percentage of these buyers in the country?

a) 10.50 b) 14.70 c) 15.00 d) 50.00

(GATE AG 2019)

8) The nomenclature of Hindustani music has changed over the centuries. Since the medieval period *dhrupad* styles were identified as *baani*s. Terms like *gayaki* and *baaj* were used to refer to vocal and instrumental styles, respectively. With the institutionalization of music education the term *gharana* became acceptable. *Gharana* originally referred to hereditary musicians from a particular lineage, including disciples and grand disciples.

Which one of the following pairings is NOT correct?

a) *dhrupad*, *baani*

b) *gayaki*, vocal

c) *baaj*, institution

d) *gharana*, lineage

(GATE AG 2019)

9) Two trains started at 7AM from the same point. The first train travelled north at a speed of 80 km/h and the second train travelled south at a speed of 100 km/h. The time at which they were 540 km apart is _____ AM.

a) 9

b) 10

c) 11

d) 11.30

(GATE AG 2019)

10) "I read somewhere that in ancient times the prestige of a kingdom depended upon the number of taxes that it was able to levy on its people. It was very much like the prestige of a head-hunter in his own community."

Based on the paragraph above, the prestige of a head-hunter depended upon _____

a) the prestige of the kingdom

b) the prestige of the heads

c) the number of taxes he could levy

d) the number of heads he could gather (GATE AG 2019)

END OF THE QUESTION PAPER

Q.1 – Q.25 CARRY ONE MARK EACH

1)

$$I = \int_0^{\infty} \frac{dx}{(x^2+1)^2}$$

has the value

a) 0.785 b) 0.915 c) 1.000 d) 1.245

(GATE AG 2019)

2) The determinant of the matrix

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

is

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

(GATE AG 2019)

3) In a relay race there are five teams A, B, C, D and E. Assuming that each team has an equal chance of securing any position (first, second, third, fourth or fifth) in the race, the probability that A, B and C finish first, second and third, respectively, is

a) $\frac{1}{60}$ b) $\frac{1}{20}$ c) $\frac{1}{10}$ d) $\frac{3}{10}$

(GATE AG 2019)

4) The path traced by the material threshed between the cylinder and the concave of an axial flow thresher is

a) straight single pass and perpendicular to the cylinder shaft

b) curved and perpendicular to the cylinder shaft

c) helical and several times

d) straight and parallel to the cylinder shaft

(GATE AG 2019)

5) The farm machine/implement used only for preparing wetland is

a) rotavator b) disk harrow c) hydro-tiller d) cultivator

(GATE AG 2019)

6) The type of typical spray distribution profile of a hollow cone nozzle is

a) steep sided slopes b) narrow topped with gradual slopes c) gradual sloping sides d) narrow topped with steep sides

(GATE AG 2019)

7) The amount of biogas required to run a diesel engine is 0.65 m^3 $kW^{-1}h^{-1}$. The minimum size of the Deenbandhu model biogas plant in m^3 required to run a 1 kW (brake power) diesel engine daily for one hour is

a) 1 b) 2 c) 3 d) 4

(GATE AG 2019)

8) A soil sample has a porosity of 40%. Void ratio of the soil sample is

a) 0.367 b) 0.467 c) 0.567 d) 0.667

(GATE AG 2019)

9) In the Muskingum method of channel routing, the routing equation is written as $Q_2 = C_0I_2 + C_1I_1 + C_2Q_1$. If the storage-time constant K = 12 h, weighting factor x = 0.15 and the time step for routing Δt = 4 h, the coefficient C_0 is

a) 0.016 b) 0.048 c) 0.328 d) 0.656

(GATE AG 2019)

10) Match the following items between Column-I and Column-II with the most appropriate combinations:

Column-I	**Column-II**
1) Uniformly spaced contour lines	P) Flat ground
2) Widely spaced contour lines	Q) Steep ground
3) Closely spaced contour lines	R) Hill
4) A series of close contours with high value inside	S) Uniform slope

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

(GATE AG 2019)

11) Tensiometer installed in the soil measures

a) osmotic suction of soil moisture

b) soil permeability

c) soil moisture content

d) capillary potential of the soil

(GATE AG 2019)

12) Head pulley of a bucket elevator has an effective radius of 150 mm. In order to obtain the most satisfactory discharge from this elevator, the speed of the head pulley in rpm is

a) 36 b) 44 c) 50 d) 77

(GATE AG 2019)

13) The clean paddy production per annum is 160 million tonnes. Average milling quality analysis indicates the husk content, total yield and degree of polish as 22%, 73.32% and 6%, respectively. For an average bran oil yield of 20%, the annual rice bran oil potential in million tonnes is

a) 1.268 b) 1.498 c) 1.617 d) 1.945

(GATE AG 2019)

14) A batch of 10000 L milk is to be sterilized and thereafter packed in 20000 packets of 500 ml each. The mean Standard Plate Count (SPC) of *Bacillus subtilis* in 100 samples of fresh milk was found to be 50 ml^{-1}. The milk is to be sterilized such that each 500 ml packet is completely devoid of the same organism. Minimum number of log cycle reduction for sterilization of this batch is

a) 8 b) 9 c) 10 d) 12

(GATE AG 2019)

15) A tube-in-tube counter-flow heat exchanger is heating oil from 35Â°C to 77Â°C by circulating hot water at 100Â°C. The outlet temperature of water is 70Â°C. The log-mean-temperature difference (LMTD) is

a) exactly equal to the mean arithmetic temperature difference

b) significantly greater than the mean arithmetic temperature difference

c) significantly smaller than the mean arithmetic temperature difference

d) very nearly equal to the mean arithmetic temperature difference

(GATE AG 2019)

16) Using trapezoidal rule, the value of

$$I = \int_{4.0}^{5.2} \ln(x)\, dx$$

(*rounded off to three decimal places*) is _____.

x	4.0	4.2	4.4	4.6	4.8	5.0	5.2
$Y = \ln(x)$	1.386	1.435	1.482	1.526	1.569	1.609	1.648

(GATE AG 2019)

17) Two cards are drawn at random and without replacement from a pack of 52 playing cards. The probability that both the cards are black (*rounded off to three decimal places*) is _____. (GATE AG 2019)

18) The total width between the two extreme furrow openers in a tractor drawn 9-row wheat seed drill is 1.6 m. The average mass of wheat seeds dropped per meter of row length in each furrow opener is 2.15 g. Seed rate obtained with the seed drill in kg ha^{-1} (*rounded off to one decimal place*) is _____. (GATE AG 2019)

19) The purchase price of a tractor is Rs. 5,50,000. Useful life of the tractor is 10 years and its salvage value is 10% of the purchase price. Following the *sum of the years digit method*, the depreciation in 3rd year in Rs. is _____. (GATE AG 2019)

20) A pair of straight teeth spur gears is transmitting power at 500 rpm. The pinion has 16 standard full depth involute teeth of module 8 mm. The pitch line velocity of the pinion in m s^{-1} (*rounded off to two decimal places*) is _____. (GATE AG 2019)

21) A soil conservation structure has an expected life of 10 years and is designed for a flood magnitude of return period 50 years. The risk of this hydrologic design in percentage (*rounded off to two decimal places*) is _____. (GATE AG 2019)

22) A watershed of area 80 ha has a runoff coefficient of 0.3. A storm of intensity 5 cm h^{-1} occurs for a duration more than the time of concentration of the watershed. The peak discharge in m^3 s^{-1} (*rounded off to two decimal places*) is _____. (GATE AG 2019)

23) A lateral has 12 sprinklers spaced 14 m apart in a sprinkler irrigation system. The laterals are spaced 20 m apart on the main line. If the recommended fertilizer dose is 80 kg ha^{-1}, the amount of fertilizer to be applied at each setting in kg (*rounded off to two decimal places*) is _____. (GATE AG 2019)

24) In a rubber roll sheller, 250 mm diameter rolls are set at a clearance of 1 mm. If the mean thickness of paddy grains being shelled is 2 mm, the length of husking zone in mm (*rounded off to two decimal places*) is _____. (GATE AG 2019)

25) Air-water vapour mixture at 1 atmosphere pressure has 0.035 kg water vapour (kg dry air)$^{-1}$ and dry bulb temperature of 37 °C. The value of Universal gas constant is 8.314 kJ (kg mole K)$^{-1}$. The humid volume of this air-water vapour mixture in m^3 (kg dry air)$^{-1}$ (*rounded off to three decimal places*) is _____. (GATE AG 2019)

A. Q.26 – Q.55 carry two marks each.

26) General solution to the differential equation $y'' + 4y' + 5y = 0 is$

a) $e^{2x}(a\cos x + b\sin x)$

b) $e^{x}(a\cos 2x + b\sin 2x)$

c) $e^{-2x}(a\cos x + b\sin x)$

d) $e^{-x}(a\cos 2x + b\sin 2x)$

(GATE AG 2019)

27) For vectors $\mathbf{F} = 3xy\hat{i} - y^2\hat{j}$ and $\mathbf{R} = x\hat{i} + y\hat{j}$, the value of $\int_C \mathbf{F} \cdot d\mathbf{R}$ on the curve C ($y = 2x^2$) in the x-y plane from (0, 0) to (1, 2) is

a) -1.17 b) 1.50 c) -2.67 d) 2.67

(GATE AG 2019)

28) A 3-cylinder 4-stroke CI engine coupled with a turbocharger has a bore and stroke length of 120 mm and 130 mm, respectively. The engine is running at 1600 rpm with a volumetric efficiency of 150%. The air to fuel ratio for complete combustion on weight basis is 14.9:1 and the density of air entering the cylinder is 1.2 kg m^{-3}. The fuel consumption in kg h^{-1} is

a) 17.05 b) 25.57 c) 33.33 d) 51.14

(GATE AG 2019)

29) A level field of 1.2 ha (120 m $\times$ 100 m) is ploughed using a reversible mould board plough with a total effective cutting width of 0.64 m. The average field overlap is 80 mm between two consecutive laps. The average time taken for each turn is 30 seconds and the mean operating speed is 5.0 km h^{-1}. The maximum effective field capacity in ha h^{-1} is

a) 0.207 b) 0.236 c) 0.283 d) 0.318

(GATE AG 2019)

30) The thresher 'A' has output capacity of 170 kg h^{-1} while threshing paddy crop at 14% moisture content (m.c.) with a grain to straw ratio 45:55. The thresher 'B' has output capacity of 160 kg h^{-1} while threshing paddy crop at 13% m.c. with a grain to straw ratio 40:60. Both the threshers have threshing efficiency of 97%. If a farmer has to carry out threshing of paddy crop at 12% m.c. with a grain to straw ratio 40:60 in the least time, the selected thresher and its output in kg when operated for 5 hours will be

a) A and 738 b) A and 850 c) B and 791 d) B and 800

(GATE AG 2019)

31) A horizontal axis drag type wind rotor, fitted with 4 thin rectangular blades having drag coefficient 1.29, is used to extract power when the average wind velocity in the rotor plane is 10 km h^{-1}. The maximum power coefficient is

a) 0.148 b) 0.191 c) 0.393 d) 0.593

(GATE AG 2019)

32) A two-wheel drive tractor while operating a plough at a forward speed of 5 km h^{-1} experiences a wheel slip of 15%. If the angular speed of the rear axle is 2.4 rad s^{-1}, the rolling radius of the traction wheel in meter will be

a) 0.49 b) 0.58 c) 0.68 d) 0.75

(GATE AG 2019)

33) The combined mass of a tractor seat and operator is 75 kg and the undamped natural frequency of the operator seat is 10 rad s^{-1}. If the seat suspension damping rate is 600 N m^{-1} s^{-1}, the damping ratio is

a) 0.2 b) 0.4 c) 0.6 d) 0.8

(GATE AG 2019)

34) A catchment has eight raingauge stations. In a year, the annual rainfall recorded by the gauges (in cm) are 93.8, 106.5, 170.6, 138.7, 87.8, 156.2, 180.9 and 110.3. For a 10% error in the estimation of the mean rainfall, the optimum number of stations in the catchment is

a) 4 b) 6 c) 8 d) 10

(GATE AG 2019)

35) On a 4% land slope in a medium rainfall zone, the horizontal spacing of bunds in meter and the length of bunds per hectare in meter, respectively are

a) 25 and 300 b) 25 and 400 c) 30 and 300 d) 30 and 400

(GATE AG 2019)

36) In a drainage area of 15 ha, the slope and drainage coefficient are 0.4% and 11 mm/day, respectively. The value of Manning's roughness coefficient is 0.016. The inside diameter (in mm) of the corrugated plastic tubing used for drainage is

a) 200.51 b) 205.52 c) 209.51 d) 215.23

(GATE AG 2019)

37) A 20 cm diameter well fully penetrates a confined aquifer of thickness 20 m. After a long period of pumping at the rate of 1500 L min^{-1}, the steady drawdowns in the wells at 30 m and 50 m from the pumping well are found to be 2.0 m and 1.5 m, respectively. Assuming $\pi = 3.14$, the transmissivity of the aquifer in m^2 s^{-1} is

a) 0.244 b) 14.676 c) 352.224 d) 880.560

(GATE AG 2019)

38) Water is flowing at a velocity of 1.6 m s^{-1} in a pipe of diameter 8 cm and length 100 m. Assuming the value of coefficient of friction for pipe, f = 0.005 and acceleration due to gravity, g = 9.81 m s^{-2}, the head loss (in meter) due to friction in the pipe is

a) 1.28 b) 2.28 c) 2.78 d) 3.26

(GATE AG 2019)

39) A cream separator has discharge radii of 6 cm and 9 cm and the density of cream and skim milk are 860 and 1035 kg m^{-3}, respectively. The ideal radius (in meter) for placing the feed inlet is

a) 0.085 b) 0.098 c) 0.113 d) 0.174

(GATE AG 2019)

40) Head rice contents in the samples collected at feed inlet, head rice outlet and broken rice outlet of an indented cylinder grader are 82%, 94% and 15%, respectively. If the grader receives the feed at 1200 kg h^{-1}, the flow rate (in kg h^{-1}) of head rice in the broken rice stream is

a) 20.17 b) 27.34 c) 182.28 d) 1017.72

(GATE AG 2019)

41) A batch of 100 kg grain at 32% moisture content (wet basis) is being dried using hot air at 70 °C and 30% RH. The values of Henderson equation's constants c and n for the grain are 8.5×10^{-6} and 2.07, respectively. Considering the maximum possible drying of the batch, the quantity of moisture removed in kg is

a) 10.20 b) 17.05 c) 21.98 d) 25.07

(GATE AG 2019)

42) A chiller working on mechanical vapour compression refrigeration system (COP = 4.5) is used for cooling 12500 kg of fresh cow milk (c_p = 3.8 kJ kg^{-1} K^{-1}) from 30 °C to 4 °C in 3 hours. Assuming ideal compression process, the power consumed by the electric motor in kW and the tonnage of refrigeration (TR), respectively are

a) 25.4 and 32.5 b) 32.5 and 25.4 c) 25.4 and 114.3 d) 114.3 and 25.4

(GATE AG 2019)

43) Two streams of air with the following conditions are adiabatically mixed:

Stream	Flow rate, kg dry air h^{-1}	Dry bulb temperature, °C	Absolute humidity, g water vapour (kg
Fresh air	727	35	27
Recycled air	1020	55	40

Latent heat of vaporization of water at 0 °C = 2501 kJ kg^{-1} Specific heat capacity of dry air = 1.005 kJ kg^{-1} K^{-1} Specific heat capacity of water vapour = 1.880 kJ kg^{-1} K^{-1}

Using above values, the dry bulb temperature and the absolute humidity of the mixed air in °C and g water vapour (kg dry air)$^{-1}$, respectively are

a) 43 and 30 b) 44 and 31 c) 45 and 33 d) 46 and 35

(GATE AG 2019)

44) Directional derivative of $f(x, y, z) = xy^2 + yz^3$ at the point $(2, -1, 1)$ in the direction of vector $\hat{i} + 2\hat{j} + 2\hat{k}$ (rounded off to two decimal places) is _____. (GATE AG 2019)

45) The mean absolute deviation about the median for the data 3, 9, 5, 3, 12, 10, 18, 4, 7, 19, 21 (rounded off to two decimal places) is _____. (GATE AG 2019)

46) The application rate of an 18-nozzle hydraulic sprayer is 1120 L ha^{-1}. The nozzle spacing and forward speed are 400 mm and 3.4 km h^{-1}, respectively. The operating pressure is 2.1 MPa and the pump efficiency is 60%. If 10% of the pump output power is used for agitating the liquid, the power needed to operate the sprayer in kW (rounded off to three decimal places) is _____. (GATE AG 2019)

47) A two-wheeled drive tractor is taking a turn with a radius of curvature 5.0 m. The minimum horizontal distance between the tipping axis and line of action of the CG is 800 mm. The angle between the line of action of centrifugal force and perpendicular direction to the tipping plane is 15°. If the vertical distance of the CG from the ground level is 900 mm, the limiting speed (in km h^{-1}) of the tractor to prevent overturning (rounded off to two decimal places) is _____. (GATE AG 2019)

48) During operation, a two-wheel drive tractor with a total weight of 2000 kg has a weight distribution of 35% and 65% in front and rear axles, respectively. The width and diameter of the tyres fitted to the front axle are 0.18 m and 0.56 m, and those of the rear axle are 0.34 m and 1.10 m, respectively. If tyre deflection is 20%, then rolling resistance (in kN) of the tractor in a soil with average cone index 1000 kPa at a wheel slip of 15% (rounded off to two decimal places) will be _____. (GATE AG 2019)

49) The peak of a flood hydrograph due to a 5-hour storm is 670 m^3 s^{-1}. The total depth of rainfall is 9 cm. Assuming an average infiltration loss of 0.2 cm h^{-1} and a constant baseflow of 30 m^3 s^{-1}, the peak discharge of the 5-hour unit hydrograph for this catchment in m^3 s^{-1} is _____. (GATE AG 2019)

50) A parabolic grassed water channel 8 m wide at the top and 60 cm deep is laid on a slope of 3%. Assuming the value of 'n' in Manning's formula as 0.04 $m^{-1/3}$s, the discharge capacity (in m^3 s^{-1}) of the channel (rounded off to two decimal places) is _____. (GATE AG 2019)

51) Undisturbed soil sample is collected from a field when the soil moisture is at field capacity. The inside diameter of the core sampler is 7.5 cm with a height of 15 cm. Weight of the core sampling cylinder with moist soil is 2.81 kg and that with oven dry soil is 2.61 kg. The weight of the core sampling cylinder is 1.56 kg. Assuming π = 3.14, the water depth in centimeter per meter depth of soil (rounded off to two decimal places) is _____. (GATE AG 2019)

52) An irrigation stream of 27 L s^{-1} is diverted to a check basin of size 12 m × 12 m. The water holding capacity of the soil is 15% and the average soil moisture content in the crop root zone prior to applying water is 7.5%. The depth of crop root zone is 1.2 m and apparent specific gravity of the soil is 1.5. Assuming no loss due to deep percolation, irrigation time (in minute) required to replenish the root zone moisture to its field capacity is _____. (GATE AG 2019)

53) Angle of internal friction of a certain grain (bulk density = 650 kg m^{-3}) is 30°. A bin filled with this grain experiences a pressure of 60 kPa at its base. Ignoring the factor of safety, the safe height (in meter) to which water (density = 1000 kg m^{-3}) can be filled in this bin (rounded off to two decimal places) is _____. (GATE AG 2019)

54) The steady-state mass transfer coefficient (k_g) based on water vapour pressure differential (VPD) operating across stagnant, non-diffusing air was estimated to be 0.05 g mole s^{-1} m^{-2} kPa^{-1}. If VPD varies from 12 kPa to 7 kPa over a distance of 2 mm, then the mass transfer coefficient (k'_y) based on equimolar counter-diffusion in g mole s^{-1} m^{-2} (mole fraction)$^{-1}$ (rounded off to one decimal place) is _____. (GATE AG 2019)

55) In an air blast freezing operation, a flat tray of 1.0 m×1.0 m×0.02 m dimensions is used to freeze filled depodded peas. Bulk density and moisture content of peas are 550 kg m^{-3} and 85% (w.b.), respectively. Latent heat of freezing from water to ice at -1 °C is 335 kJ kg^{-1} and heat transfer occurs

identically to the top and the bottom surfaces of the tray. Convective film heat transfer coefficient on the heat transfer surfaces of the tray is 30 W m^{-2} K^{-1} and the thermal conductivity of frozen peas is 0.54 W m^{-1} K^{-1}. Assuming the tray to be a semi-infinite slab, the freezing time (in minutes) to completely freeze the product (rounded off to one decimal place) is _____. (GATE AG 2019)

END OF THE QUESTION PAPER