# ASSIGNMENT 2: GATE 2017
# AG : Agricultural Engineering

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1) Matrix is a

$$\begin{pmatrix} 0 & 0.5 & 1.5 \\ -0.5 & 0 & 2.5 \\ -1.5 & -2.5 & 0 \end{pmatrix}$$

(GATE EE 2025)

a) Diagonal matrix
b) Orthogonal matrix
c) Symmetric matrix
d) Skew-symmetric matrix

2) Direction cosines of the vector $3\mathbf{i} - 2\mathbf{j} + 6\mathbf{k}$ are

(GATE EE 2025)

a) $[3/7, -2/7, 6/7]$ b) $[-3/7, 2/7, -6/7]$ c) $[-7/3, 7/2, -7/6]$ d) $[7/3, -7/2, 7/6]$

3) Characteristic equation of the matrix with Eigen value $\lambda$ is

$$\begin{pmatrix} 2 & \sqrt{2} \\ \sqrt{2} & 1 \end{pmatrix}$$

(GATE EE 2025)

a) $\lambda^2 + 3\lambda + 4 = 0$ b) $\lambda^2 + 3\lambda - 2 = 0$ c) $\lambda^2 - 3\lambda = 0$ d) $\lambda^2 + 3\lambda = 0$

4) A box contains three white and four red balls. Two balls are drawn randomly in sequence. If the first draw resulted in a red ball, the probability of getting a second red ball in the next draw is

(GATE EE 2025)

a) 0.33 b) 0.50 c) 0.67 d) 0.75

5) The probability of getting two heads and two tails from four tosses of the same coin is _____.

(GATE EE 2025)

6) The purchase price of a tractor is Rs. 5.0 lakh. Considering the constant rate of depreciation as 0.2 in declining balance method, the value of the tractor at the end of $4^{th}$ year in lakh will be _____.

(GATE EE 2025)

7) The pump used in high pressure orchard sprayer is

(GATE EE 2025)

a) Centrifugal pump
b) Rotary pump
c) Plunger type positive displacement pump
d) Turbine pump

8) If the Reel Speed Index of a grain combine is more than 1.5, it will increase
(GATE EE 2025)

a) Cutter bar loss
b) Shatter loss
c) Cylinder loss
d) Straw walker loss

9) A diesel fuel has same ignition delay as that of blend of two reference fuels namely 56% n-cetane and 44% hepta-methylnonane. The cetane number of the diesel fuel is _____.
(GATE EE 2025)

10) Air temperature at the beginning of adiabatic compression in an IC engine is 27°C and the engine compression ratio is 16:1. The temperature of air at the end of the compression in °C will be _____.
(GATE EE 2025)

11) In fuel property determination, Reid vapour pressure test is used for measuring
(GATE EE 2025)

a) Volatility
b) Viscosity
c) Sulphur content
d) Carbon residue

12) A tractor pulls 8 kN drawbar load against 4 kN rolling resistance. If the tractor develops 57% tractive efficiency, the slip experienced by the tractor in percentage will be_____.
(GATE EE 2025)

13) Antecedent Moisture Conditions (AMC) for a soil are defined on the basis of total rainfall occurred during previous _____ days.
(GATE EE 2025)

14) The seepage analysis in earthen dams is carried out by drawing flownet which consists of equipotential and stream lines. For a homogeneous and isotropic earthen dam, these two lines are always
(GATE EE 2025)

a) orthogonal to each other
b) parallel to each other
c) divergent to each other
d) convergent to each other

15) Remedial measure generally adopted for controlling stream-bank erosion is
(GATE EE 2025)

a) Shelter belts
b) Spurs
c) Brushwood dams
d) Drop spillways

16) Thickness of capillary zone above the water table varies
(GATE EE 2025)

a) linearly with the pore-size of soil
b) inversely with the height of water table
c) linearly with the height of water table
d) inversely with the pore-size of soil

17) A cavity well is a tubewell which has
(GATE EE 2025)

a) gravel pack and a strainer
b) a PVC strainer
c) no strainer
d) a bamboo strainer

18) Modified Hooghoudt's equation for the computation of drain spacing is applicable to
(GATE EE 2025)

a) homogeneous soils
b) anisotropic soils
c) heavy clay soils only
d) layered soils

19) The sum of 'specific yield' and 'specific retention' for an unconsolidated geologic formation is equal to its
(GATE EE 2025)

a) effective porosity b) total porosity c) micro-porosity d) macro-porosity

20) Sphericity of a cube with each side as L is _____
(GATE EE 2025)

21) A cylindrical shallow bin is filled with grains having angle of repose of 33°. The limiting height to diameter ratio of the bin is _____
(GATE EE 2025)

22) Length of the husking zone in a rubber roll paddy dehusker, having $d$ as roll diameter, $c$ as clearance between the rolls, and $b$ as grain thickness, is
(GATE EE 2025)

a) $\frac{\pi d}{360}\cos^{-1}\left(\frac{d+c}{d+b}\right)$
b) $\frac{\pi d}{180}\cos^{-1}\left(\frac{d+c}{d+b}\right)$
c) $\frac{\pi d}{360}\sin^{-1}\left(\frac{d+c}{d+b}\right)$
d) $\frac{\pi d}{180}\sin^{-1}\left(\frac{d+c}{d+b}\right)$

23) For a psychrometric ratio of 1003 J $kg^{-1}K^{-1}$, the latent heat of vaporization at the wet bulb temperature of 35°C is 2418.9 kJ $kg^{-1}$. The saturation vapour pressure is 19.7 kPa corresponding to the dry bulb temperature of 60°C.If the relative humidity of air is 20%, the saturation vapor pressure of the air at the wet bulb temperature in kPa will be _____
(GATE EE 2025)

24) A sphere (3.5 cm diameter) made of copper ($\rho$ = 8954 kg $m^{-3}$, $C_p$ = 0.4 kJ $kg^{-1}K^{-1}$, $k$ = 375 W $m^{-1}K^{-1}$) is initially at uniform temperature of 200°C. It is suddenly placed in an environment of 35°C having convective film coefficient of 12 W $m^{-2}K^{-1}$.After 18 minutes of exposure, the temperature of the sphere in °C will be _____
(GATE EE 2025)

25) The reaction rate for destruction of *Clostridium botulinum* increases 11 times for temperature rise of 10°C from 121.1°C. The decimal reduction time of this organism is 5.7 s at 121.1°C. The minimum sterilization time in seconds at 135°C, for eight log cycle reduction of the organism, is
(GATE EE 2025)

a) 0.20 b) 0.31 c) 1.63 d) 2.49

26) The areas of seven horizontal cross-sections of a water reservoir at intervals of 9 m are 210, 250, 320, 350, 290, 230 and 170 $m^2$. The estimated volume of the reservoir in $m^3$ using Simpson's rule is_____
(GATE EE 2025)

27) Divergence value of a function $(x^2y)\mathbf{i} - (z^2 \cdot 3x)\mathbf{j} + (4y^2)\mathbf{k}$ at $x = 1, y = 2, z = 3$ is _____

(GATE EE 2025)

28) Differentiation of $\sqrt{1+x^2}$ gives

(GATE EE 2025)

a) $\dfrac{1}{(1+x^2)}$

b) $\dfrac{1}{\sqrt{1+x^2}}$

c) $\dfrac{\sqrt{1+x^2}}{x}$

d) $\dfrac{x}{\sqrt{1+x^2}}$

29)

$$I = \int \sqrt{(a^2 - x^2)}\, dx$$

(GATE EE 2025)

a) $0.5\left[x\sqrt{a^2-x^2} + \sin^{-1}\left(\frac{x}{a}\right)\right]$

b) $0.5\left[x\sqrt{a^2-x^2} + a^2\sin^{-1}\left(\frac{x}{a}\right)\right]$

c) $0.5\left[\sqrt{a^2-x^2} + \sin^{-1}\left(\frac{x}{a}\right)\right]$

d) $0.5\left[\sqrt{a^2-x^2} + a^2\sin^{-1}\left(\frac{x}{a}\right)\right]$

30) A subsoiler operating at 400 mm depth requires 15 kW peak drawbar power at 3 km $h^{-1}$ speed. The standard is rigidly fixed vertically on the main frame. The resultant soil resistance acts horizontally at a vertical distance of 450 mm from the main frame. The standard has rectangular cross-section with width to thickness ratio of 4:1, and it fails due to bending. If the allowable bending stress is 90 N $mm^{-2}$, the width of the standard in mm will be _____.

(GATE EE 2025)

31) A 9-row fluted roller type seed drill with 400 mm ground wheel diameter is used for sowing wheat at 200 mm row spacing. Each fluted roller discharges 6500 $mm^3$ volume of seeds per revolution. The ratio of ground wheel rpm to fluted roller shaft rpm is 2:1. If the bulk density of wheat is 850 kg $m^{-3}$, the seed rate in kg $ha^{-1}$ will be _____.

(GATE EE 2025)

32) The diameter of feed rollers of a conveyor type power chaff cutter is 100 mm and they are rotating at 90 rpm for cutting the dry fodder. The effective length of each feed roller is 250 mm and the average clearance between them is 15 mm. The compressed density of the material while passing through the feed rollers is 250 kg $m^{-3}$. The throughput capacity of the chaff cutter in ton $h^{-1}$ is _____.

(GATE EE 2025)

33) The horizontal component of resultant soil thrust ($T$) acting on each gang of a single acting disc harrow is 1650 N. The resultant downward load ($W$) acting on each gang is 2500 N. The perpendicular distance of $T$ from the gang axis is 200 mm. In order to get a uniform depth of cut, the distance between the line of action of $W$ and the centre of gang in mm will be _____.

(GATE EE 2025)

34) A cylindrical parabolic solar collector is designed to heat a fluid that enters the absorber at 140°C at a flow rate of 5 kg $min^{-1}$. The specific heat capacity of the fluid is 1.5 kJ $kg^{-1}$ $°C^{-1}$ and its outlet temperature is 180°C. If the incident beam radiation on the plane of aperture is 3000 kJ $h^{-1}$ $m^{-2}$ and useful projected area of the reflector is 2 m × 10 m, the efficiency of the collector in percentage will be _____.

(GATE EE 2025)

35) A load of 3 kN is acting on a tyre having 150 mm nominal width. The effective friction coefficient of tyre and ground interaction is 0.6 and the kingpin offset is 10 mm. Assuming the tyre impression on ground as circle of diameter same as the tyre nominal width, the kingpin torque of the tyre in N m will be _____.

(GATE EE 2025)

36) In a tractor power transmission, the input pinion (24 teeth) is in mesh with a gear (46 teeth) on counter shaft and another gear (20 teeth) of counter shaft is in mesh with main shaft gear (50 teeth). The engine is running at 1800 rpm, differential gear ratio is 3.5:1 and final drive ratio is 4:1. If the tractor is fitted with 1.2 m diameter rear wheels, the forward speed of the tractor in km $h^{-1}$ is _____.

(GATE EE 2025)

37) A hydraulic system comprising of a pump and a single acting cylinder lifts 11 kN load. The pump flow rate is 25 L $min^{-1}$ and its overall efficiency is 80%. The cylinder diameter is 80 mm and its efficiency is 90%. If the pressure drop in the hydraulic circuit is 500 kPa, the power required to drive the pump in kW will be _____.

(GATE EE 2025)

38) A tractor of 19.5 kN weight and 1.8 m wheel base has 70% static weight on the rear axle. It pulls 8 kN drawbar load parallel to the ground through a hitch point located 450 mm above the ground. The dynamic weight on the rear axle of the tractor under operating condition in kN will be _____.

(GATE EE 2025)

39) A six-stage centrifugal pump delivers 120 L $s^{-1}$ against a total head of 510 m. If the design speed of this pump is 1450 rpm, the specific speed of the pump will be _____.

(GATE EE 2025)

40) A watershed of 100 $km^2$ is underlain by an unconfined aquifer having hydraulic conductivity of 15 m $day^{-1}$ and specific yield of 0.20. If 30 million $m^3$ of water is pumped from this aquifer through uniformly distributed wells, the average drop of water table over the watershed in meter will be

(GATE EE 2025)

a) 1.50 b) 0.75 c) 0.06 d) 6.00

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

| **Column-I** | **Column-II** |
|---|---|
| 1) Neutron Probe | P) Open channel flow |
| 2) Pressure Plate Apparatus | Q) Deep percolation |
| 3) Tipping Bucket | R) Aquifer parameters |
| 4) Current Meter | S) Soil moisture |
| 5) Pumping Test | T) Rainfall intensity |
| 6) Lysimeter | U) Soil-moisture characteristic curve |

(GATE EE 2025)

a) 1-Q, 2-P, 3-T, 4-S, 5-R, 6-U
b) 1-S, 2-U, 3-T, 4-P, 5-R, 6-Q
c) 1-S, 2-R, 3-T, 4-P, 5-Q, 6-U
d) 1-P, 2-U, 3-S, 4-T, 5-R, 6-Q

42) Graded furrows of 80 m length and 0.75 m spacing are used for irrigating a field with an initial furrow stream of 100 L $min^{-1}$. The initial furrow stream flow reaches the lower end of the field in 40 min. Thereafter, the furrow stream flow is reduced to 30 L $min^{-1}$ and the cutback stream flow is continued for 1 hour. The average depth of irrigation over the field in cm will be _____.

(GATE EE 2025)

43) The soil of a cropped field has field capacity of 25% and wilting point of 13% on weight basis. The effective root-zone depth of the crop is 0.70 m and the consumptive use of water by the crop is 5 mm $day^{-1}$. Apparent specific gravity of the soil is 1.50. If the allowable soil moisture depletion is 40%, the permissible moisture depletion between irrigations and the frequency of irrigation are
(GATE EE 2025)

a) 5 cm; 10 days b) 10 cm; 7 days c) 8 cm; 12 days d) 4 cm; 8 days

44) A watershed of 4.8 $km^2$ generates 4.3 cm runoff from a rain storm of 4-hour duration. The measured rainfall intensities for this storm in successive 30-minute durations are given below:

| Time interval (minutes) | Rainfall intensity (cm $h^{-1}$) |
|---|---|
| 0–30 | 1.6 |
| 30–60 | 4.8 |
| 60–90 | 3.2 |
| 90–120 | 3.4 |
| 120–150 | 2.2 |
| 150–180 | 5.0 |
| 180–210 | 4.2 |
| 210–240 | 1.2 |

The value of Φ-index for the watershed in cm $h^{-1}$ will be
(GATE EE 2025)

a) 6.5 b) 5.3 c) 2.4 d) 2.1

45) Bunds are to be constructed to conserve rainwater in a farm having 6% slope. If the horizontal interval between two bunds is 30 m and there is no loss of water, the required height of the bund to store rainwater from an 18 cm rainfall event with 10 years of return period in cm will be _____.
(GATE EE 2025)

46) A rectangular channel having bed slope of 0.05% and Manning's roughness coefficient of 0.01 carries a discharge of 5 $m^3$ $s^{-1}$. If the channel is designed as the most economical section, the width of the channel in meter will be _____.
(GATE EE 2025)

47) A trapezoidal notch, placed over an emergency spillway, has the following details:
Top width = 2 m
Bottom width = 1 m
Height = 0.5 m
Coefficient of discharge for the triangular portion = 0.65
Coefficient of discharge for the rectangular portion = 0.68
For a flow head of 0.4 m over the notch, the discharge in L/s will be about
(GATE EE 2025)

a) 155 b) 352 c) 508 d) 663

48) In a vertical tube single effect evaporator, the boiling film coefficient inside the tubes is 1350 W/$m^2$K. Steam condensation film coefficient outside is 7500 W/$m^2$K. Thermal conductivity of 2 mm tube made of SS 304 is 16 W/mK. The vertical tubes are 4.8 m long and are of 25 mm ID and 27 mm OD, maintaining a design $\Delta T$ of 15°C. Temperature difference across tube wall is negligible. Assume no boiling point rise, no heat losses, the feed enters the evaporator at the boiling point and the latent heat of vaporization of water is 2346.5 kJ/kg. Total water evaporation rate from the evaporator bundle of tubes in kg/h is _____
(GATE EE 2025)

49) Hot water at 95°C is sent through a countercurrent tube-in-tube heat exchanger with cold water entering at 25°C. Hot/cold water specific heat capacity is 4.2 kJ/kg°C. Flow rates of hot and cold water are 27 and 41 kg/min, respectively. Overall heat transfer coefficient is 850 W/m$^2$°C and area of heat transfer is 5 m$^2$. Cold water outlet temperature from the heat exchanger in °C will be_____

(GATE EE 2025)

50) In a cold storage, 10 metric ton of potato is to be brought down from 30 to 8°C storage temperature in 6 hours of air blast at the evaporator temperature of -10°C. Specific heat capacity of potato is 3.2 kJ/kg°C. COP of the refrigeration cycle deployed is 4.2 with evaporator load extraction capacity of 210 kJ/kg. Neglecting the respiration load of potato, the refrigerant flow rate and compressor power requirement will be

(GATE EE 2025)

a) 3.9 kg/min; 7.76 kW
b) 9.3 kg/min; 8.50 kW
c) 9.3 kg/min; 7.76 kW
d) 3.9 kg/min; 8.50 kW

51) Steam ($h_g$ = 632.2, $h_f$ = 211.3, $h_{fg}$ = 2745.4 kJ/kg) at 150°C is used to sterilize milk by direct steam injection. Milk is initially at 90°C and after sterilization, the blend of resultant milk and water is accelerated using $G$ = 6.7, $C_p$ = 219.5, $h_2$ = 2746.7, $h_f$ = 211.3, $h_{fg}$ = 2535.4 kJ/kg at 150°C. Total water content of milk is 88.3 % (by mass). Assuming no energy loss, the amount of milk (kg) sterilized per kg steam supplied is

(GATE EE 2025)

a) 21.57
b) 12.74
c) 9.73
d) 4.48

52) A batch of 1000 kg of apples containing 6.2% bruised apples is sorted by an electronic colour sorter. Performance analysis showed 327.3 kg of good apples rejected as bad apples. Remaining of red and bruised apples are delivered at the rejection outlet as sorter defect. Overall effectiveness of the sorter is_____

(GATE EE 2025)

53) Spherical dust particles of 50 $\mu$m are settling under gravity in air at 21°C and normal atmospheric pressure. Particle density is 1200 kg/m$^3$ and air density of air is 1.2 kg/m$^3$. Considering viscosity of air as $1.81\times10^{-5}$ PaÂ·s, the settling velocity of dust in mm/s will be _____

(GATE EE 2025)

54) India's annual paddy production is 160 million ton (clean paddy basis). Average husk content of paddy is 22.4% and milled rice yield is 70%. Considering 18% oil content in bran fraction and calorific value of 12 MJ/kg of husk, the oil potential of bran and energy potential of husk will respectively be

(GATE EE 2025)

a) $2.19\times10^6$ ton; $4.803\times10^{12}$ J
b) $2.19\times10^6$ ton; $2.104\times10^{13}$ J
c) $4.76\times10^6$ ton; $2.104\times10^{13}$ J
d) $4.76\times10^6$ ton; $4.803\times10^{12}$ J

55) A cylindrical silo, 3 m in diameter and 20 m high, is filled with barley having bulk density of 625 kg/m$^3$. Coefficient of friction between grain and the wall is 0.45 and the ratio of lateral pressure to vertical pressure is 0.4. The lateral pressure at the base of the bin in kPa will be _____

(GATE EE 2025)

56) The ways in which this game can be played _____ potentially infinite.
(GATE EE 2025)

a) is b) is being c) are d) are being

57) If you choose plan P, you will have to _____ plan Q, as these two are mutually _____
(GATE EE 2025)

a) forgo, exclusive
b) forget, inclusive
c) accept, extensive
d) adopt, intrusive

58) If $a$ and $b$ are integers and $a - b$ is even, which of the following must always be even?
(GATE EE 2025)

a) $ab$ b) $a^2 + b^2 + 1$ c) $a^2 + b + 1$ d) $ab - b$

59) A couple has 2 children. The probability that both children are boys if the older one is a boy is
(GATE EE 2025)

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

60) P looks at Q while Q looks at R. P is married, R is not. The number of pairs of people in which a married person is looking at an unmarried person is
(GATE EE 2025)

a) 0
b) 1
c) 2
d) Cannot be determined

61) "If you are looking for a history of India, or for an account of the rise and fall of the British Raj, or for the reason of the cleaving of the subcontinent into two mutually antagonistic parts and the effects this mutilation will have in the respective sections, and ultimately on Asia, you will not find it in these pages; for though I have spent a lifetime in the country, I lived too near the seat of events, and was too intimately associated with the actors, to get the perspective needed for the impartial recording of these matters."
Which of the following is closest in meaning to "cleaving"?
(GATE EE 2025)

a) deteriorating b) arguing c) departing d) splitting

62) X bullocks and Y tractors take 8 days to plough a field. If we halve the number of bullocks and double the number of tractors, it takes 5 days to plough the same field. How many days will it take X bullocks alone to plough the field? (GATE EE 2025)

a) 30 b) 35 c) 40 d) 45

63) There are 4 women P, Q, R, S, and 5 men V, W, X, Y, Z in a group. We are required to form pairs each consisting of one woman and one man. P is not to be paired with Z, and Y must necessarily be paired with someone. In how many ways can 4 such pairs be formed? (GATE EE 2025)

a) 74 b) 76 c) 78 d) 80

64) All people in a certain island are either 'Knights' or 'Knaves' and each person knows every other person's identity. Knights NEVER lie, and knaves ALWAYS lie.

P says "Both of us are knights". Q says "None of us are knaves".

Which one of the following can be logically inferred from the above?

(GATE EE 2025)

a) Both P and Q are knights
b) P is a knight; Q is a knave
c) Both P and Q are knaves
d) The identities of P and Q cannot be determined

65) In the graph below, the concentration of a particular pollutant in a lake is plotted over alternate days of a month in winter (average temperature 10°C) and a month in summer (average temperature 30°C).

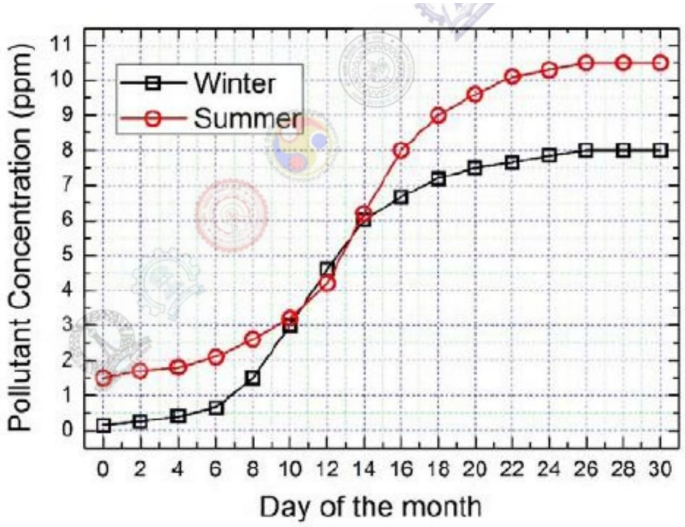


Fig. 65

Consider the following statements based on the data shown above:

i. Over the given months, the difference between the maximum and the minimum pollutant concentrations is the same in both winter and summer.
ii. There are at least four days in the summer month such that the pollutant concentrations on those days are within 1 ppm of the pollutant concentrations on the corresponding days in the winter month.

Which one of the following options is correct?

(GATE EE 2025)

a) Only i
b) Only ii
c) Both i and ii
d) Neither i nor ii