

ASSIGNMENT 3: GATE 2009

AG : Agricultural Engineering

EE25BTECH11047 - Ravula Shashank Reddy

1) Inverse of the matrix $\begin{pmatrix} 2 & 3 \\ 2 & 1 \end{pmatrix}$ is

(GATE EE 2025)

a) $\begin{pmatrix} -0.5 & 0.75 \\ 0.5 & -0.25 \end{pmatrix}$

c) $\begin{pmatrix} -0.25 & 0.75 \\ 0.5 & -0.5 \end{pmatrix}$

b) $\begin{pmatrix} -0.25 & 0.5 \\ -0.5 & 0.75 \end{pmatrix}$

d) $\begin{pmatrix} -0.25 & -0.5 \\ 0.75 & 0.5 \end{pmatrix}$

2) The probability function value $f(x)$ at $x = 3$ for Poisson distribution with mean of 2 is

(GATE EE 2025)

a) 0.12

b) 0.18

c) 0.24

d) 0.30

3)

$$I = \int_0^{\pi/2} \frac{\cos x \, dx}{(1 + \sin x)^2}$$

is

(GATE EE 2025)

a) -0.5

b) 0

c) 0.5

d) 1

4) A curve is having the equation

$$a(1 - \cos \theta)$$

. The perimeter of the curve between $\theta = 0$ to 2π is

(GATE EE 2025)

a) $2a$

b) $4a$

c) $6a$

d) $8a$

5) $\frac{1}{s^2 - a^2}$ is the Laplace Transform of

(GATE EE 2025)

a) $\sin(at)$

b) $t \sin(at)$

c) $\sinh(at)$

d) $a^{-1} \sinh(at)$

- 6) In a diesel engine with variable compression ratio, the initial compression ratio is 16:1. The ratio of specific heats is 1.4. For the same cut-off ratio of 4.0, if the compression ratio is increased by 25%, the air standard thermal efficiency of the engine will be

(GATE EE 2025)

- a) increased by 1.0%
b) increased by 2.8%
- c) increased by 3.5%
d) increased by 4.0%

- 7) The type of gasifier which produces nearly tar free producer gas is

(GATE EE 2025)

- a) Counter current gasifier
b) Co-current gasifier
c) Cross-draught gasifier
d) Fluidized bed gasifier

- 8) As per BIS standard, the power tests for tractor PTO includes

(GATE EE 2025)

- Maximum power, varying load and varying speed tests
- Varying speed and maximum power tests
- Varying load and varying speed tests
- Varying load and maximum power tests

- 9) The annual cost of a tractor is Rs. 4,00,000. The annual rate of depreciation is 15%. Following declining balance method, the value of the tractor at the end of 6th year is

(GATE EE 2025)

- a) Rs. 40,000 b) Rs. 1,51,000 c) Rs. 1,76,000 d) Rs. 2,01,000

- 10) The diameter of an undeflected tractor wheel fitted with 13.6 - 28, 12 PR tyre with an aspect ratio of 0.75 is

(GATE EE 2025)

- a) 0.99 m b) 1.05 m c) 1.23 m d) 1.40 m

- 11) Line of sight through the leveling instrument is called

(GATE EE 2025)

- a) Backsight b) Foresight c) Line of collimation d) Sight of collimation

- 12) In a reciprocal leveling, the level set up close to point P gave readings of 1.6 m and 0.8 m at stations P and Q respectively. The readings obtained by setting up the level close to point Q were 1.4 m and 0.5 m on stations P and Q respectively. Total error of collimation, curvature and refraction in m is

(GATE EE 2025)

- a) 0.10 b) 0.55 c) 0.65 d) 0.85

- 13) The empirical method for computing the consumptive use of a crop using the mean monthly temperature and day light hours is

(GATE EE 2025)

- a) Thornthwaite b) Blaney Criddle c) Hargreaves d) Lowry Johnson

- 14) The nature of Hooghoudt's equation for drain spacing is (GATE EE 2025)
- a) Parabolic b) Hyperbolic c) Elliptic d) Circular
- 15) For construction of a tubewell, the following formations were obtained from drilling: an unconfined aquifer between 12 m and 16 m and a confined aquifer between 30 m and 40 m below ground level. A horizontal centrifugal pump installed on the ground level can pump water from the constructed tubewell. Probable static water level from the ground surface in m is (GATE EE 2025)
- a) 5 b) 12 c) 16 d) 30
- 16) If the length, breadth and thickness of a rice grain are 7 mm, 3 mm and 2 mm respectively, the sphericity of the grain is (GATE EE 2025)
- a) 0.33 b) 0.50 c) 0.67 d) 0.75
- 17) Wheat weighing 4900 N at moisture content of 25% on wet basis is to be dried to moisture content of 10% on dry basis. The amount of moisture evaporated from the wheat in kg (GATE EE 2025)
- a) 87 b) 103 c) 116 d) 156
- 18) If bulk density of a particulate material is 600 kg m^{-3} and true density is 1000 kg m^{-3} , the porosity of the material is (GATE EE 2025)
- a) 20% b) 40% c) 60% d) 80%
- 19) An insulating material has a thermal conductivity of $0.03 \text{ W m}^{-1} \text{ K}^{-1}$. If 60 mm of this material is applied as insulation on a heat transfer surface, the R-value of the insulation in $\text{m}^2 \text{ K W}^{-1}$ is (GATE EE 2025)
- a) 1 b) 2 c) 3 d) 4
- 20) Convective heat transfer coefficient outside an ice cream block is $10 \text{ W m}^{-2} \text{ K}^{-1}$. Thermal conductivity of frozen ice cream is $0.3 \text{ W m}^{-1} \text{ K}^{-1}$. Convection takes place across a layer of 10 mm of air for 5 minutes. If the density and the specific heat capacity of ice cream are respectively 600 kg m^{-3} and $2.5 \text{ kJ kg}^{-1} \text{ K}^{-1}$, then 0.33 is (GATE EE 2025)
- a) Biot Number b) Nusselt Number c) Fourier Number d) Prandtl Number
- 21) A two-wheel drive tractor is pulling a load of 12 kN horizontally on a leveled surface at a forward speed of 5.0 km h^{-1} . The rolling radius of the traction wheel and wheel slip are 0.65 m and 20% respectively. If the rear axle torque is 9 kN m, the tractive efficiency is (GATE EE 2025)
- a) 56.7% b) 62.1% c) 69.3% d) 78.5%

- 29) The high idle speed of an engine is 2240 rpm and the governor regulation is 11.5%. The peak torque of 180 N m occurs at 1450 engine rpm. If lugging ability is 28 Nm, the engine power in kW at governor's maximum position will be
(GATE EE 2025)
- a) 31.8 b) 35.7 c) 37.6 d) 42.2
- 30) A tractor seat suspension system with a seat and operator mass of 90 kg has a seat suspension damping rate of 350 N s m^{-1} . If the spring rate of the system is 5 N mm^{-1} , the damping ratio of the system is
(GATE EE 2025)
- a) 0.13 b) 0.26 c) 0.39 d) 0.52
- 31) A venturimeter of 75 mm diameter is fitted to a horizontal pipe of 150 mm diameter. Gauge pressure in the venturimeter in case of no flow is 2 m of water. Taking atmospheric pressure as 10 m of water, theoretical flow through the pipeline in litres per second, when the throat point pressure is 2.60 m of water (absolute), is
(GATE EE 2025)
- a) 15 b) 30 c) 60 d) 75
- 32) The intensity of active earth pressure in kPa at a depth of 10 m in dry cohesionless sand with an angle of internal friction of 25° and specific weight of 15 kN m^{-3} is
(GATE EE 2025)
- a) 39 b) 61 c) 79 d) 129
- 33) If the probability of occurrence of rainfall on any day during June to September is 0.15, the probability that 4 out of 20 days in the month of August to remain dry will be
(GATE EE 2025)
- a) 0.162 b) 0.182 c) 0.192 d) 0.228
- 34) A 10 ha watershed received 100 mm uniformly distributed rainfall. Land use pattern consists of 25% residential area with soil group C and curve number 82, good meadow condition in 50% of the area with soil group D and curve number 78. There is also good open space condition in 25% of the area with soil group D and curve number 80. Assuming AMC-II condition, the volume of runoff in m^3 from the watershed will be
(GATE EE 2025)
- a) 4955 b) 5705 c) 5755 d) 6555
- 35) The peak runoff volume from the catchment between two contour bunds constructed on a 2.5% slope is 972.5 m^3 . The contour bunds have top width of 500 mm, height 600 mm, side slope 2:1, vertical interval 1.0 m and length 250 m. If the crest of the overflow weir is at a height of 300 mm from the ground and time available for the excess water to flow through the weir is 20 minutes, discharge in m^3 per minute through the weir is
(GATE EE 2025)

- a) 15.0 b) 20.0 c) 25.0 d) 48.6

36) An earthen embankment with a pipe spillway is constructed to create temporary storage in a gully. The pipe of 10 m length has to carry a peak discharge of $1 \text{ m}^3 \text{ s}^{-1}$ at an available head of 4 m. Entrance loss coefficient for the square entrance is 0.50 and the friction loss coefficient is 0.15. Required diameter of the pipe in m is

(GATE EE 2025)

- a) 0.50 b) 0.60 c) 0.75 d) 1.00

37) Contour bund is constructed on a land with S per cent slope. If the length of each contour bund is L and vertical interval is D , then the number of contour bunds per hectare of land area is

(GATE EE 2025)

- a) $\frac{S}{LD}$ b) $\frac{LD}{S}$ c) $\frac{100S}{LD}$ d) $\frac{10^4 S}{LD}$

38) A hydraulically efficient trapezoidal drainage channel with a side slope of 2:1 has been designed in a sandy loam soil for a catchment of 600 ha. Taking a drainage coefficient of 16 mm, the flow velocity in mm s^{-1} in the drainage channel with a flow depth of 1 m is

(GATE EE 2025)

- a) 427 b) 450 c) 497 d) 527

39) A three stage centrifugal pump discharges water at a rate of 2400 litre per minute at a total head of 36 m. If the pump is directly connected to an electric motor operating at 1440 revolutions per minute, its specific speed will be

(GATE EE 2025)

- a) 41.92 b) 44.67 c) 51.16 d) 54.65

40) The inside diameter and stroke length of a single acting reciprocating pump are 120 mm and 400 mm respectively. The speed of the piston is 50 strokes per minute. The suction and delivery heads are 5 m and 10 m respectively. If the efficiency of both suction and delivery strokes is 60%, the actual power required in kW by the pump is

(GATE EE 2025)

- a) 0.55 b) 0.65 c) 0.94 d) 1.12

41) Bulk density of paddy with 28% moisture content on wet basis is 650 kg m^{-3} . The dry solid bulk density of paddy in kg m^{-3} is

(GATE EE 2025)

- a) 468 b) 508 c) 832 d) 904

42) If absolute humidity at saturation and percentage humidity of air are 0.075 kg water vapour (kg dry air) $^{-1}$ and 60% respectively, the relative humidity of air is

(GATE EE 2025)

- a) 57.4% b) 60.0% c) 62.7% d) 74.5%

43) Milk weighing 98000 N having specific heat capacity $3.8 \text{ kJ kg}^{-1} \text{ K}^{-1}$ is to be chilled from 40°C to 5°C in one hour in a chilling plant using a refrigerant whose coefficient of performance is 4.7. The total compressor power consumption assuming 100% efficiency is

(GATE EE 2025)

- a) 79 kW b) 105 kW c) 79 hp d) 105 hp

- 44) In a tray drying experiment of mango pulp, the constant rate of drying was found to be 6.18×10^{-5} kg water $\text{m}^{-2} \text{s}^{-1}$. The humidity ratio and saturation humidity ratio of the air were 0.02 kg water vapour (kg dry air) $^{-1}$ and 0.075 kg water vapour (kg dry air) $^{-1}$ respectively at 1 atm pressure and 65°C temperature. Assuming the distance of travel for water vapour in drying air to be 10 mm, the mass diffusivity of water in $\text{m}^2 \text{s}^{-1}$ is
(GATE EE 2025)
- a) 10^{-4} b) 10^{-5} c) 10^{-6} d) 10^{-7}
- 45) Fruit juice flowing at the rate of 600 kg h^{-1} is to be heated using same flow rate of hot fruit juice in a countercurrent regenerator. The specific heat capacity of the fruit juice is 3.9 kJ $\text{kg}^{-1} \text{K}^{-1}$. The overall heat transfer coefficient of the regenerator is 512 W $\text{m}^{-2} \text{K}^{-1}$ and the area of the regenerator is 3.5 m^2 . The effectiveness of the regenerator is
(GATE EE 2025)
- a) 0.547 b) 0.734 c) 0.837 d) 0.943
- 46) The diameter of a grain storage bin is 4 m and the depth is 16 m. It is completely filled with wheat having bulk density of 800 kg m^{-3} . The angle of friction between wheat and wall is 24°. The ratio of lateral and vertical pressure intensity is 0.4. The lateral pressure intensity of wheat in kPa on the bin wall at 2 m depth is
(GATE EE 2025)
- a) 2.85 b) 5.28 c) 8.25 d) 8.52
- 47) Particles having average diameter of 20 μm and particle density of 1000 kg m^{-3} enter a cyclone of 500 mm diameter at a linear velocity of 20 m s^{-1} . The separation factor of the cyclone is
(GATE EE 2025)
- a) 136 b) 163 c) 316 d) 613
- 48) Vegetable seeds are stored at absolute temperature of 320 K and relative humidity of 20%. If Henderson equation for equilibrium relationship is valid for this case where the values of constants C and n are 6.5×10^{-6} and 1.8 respectively, the equilibrium moisture content of the seeds will be
(GATE EE 2025)
- a) 5.6% b) 10.2% c) 13.4% d) 20.5%
- 49) The theoretical volumetric flow rate of a horizontal screw conveyor is 1500 $\text{m}^3 \text{h}^{-1}$. The conveyor screw diameter is 1.2 m and the shaft diameter is 0.6 m. The rotational speed of the screw conveyor is 50 rpm. The pitch of the screw in mm is
(GATE EE 2025)
- a) 150 b) 340 c) 590 d) 950
- 50) A ball mill of 1.8 m diameter is charged with balls each having diameter of 40 mm for grinding solid material. The rotational speed of the balls is 80% of the critical speed. The operating speed of rotation in revolution per minute is
(GATE EE 2025)

- a) 18 b) 22 c) 26 d) 30

A vertical conveyor reaper is to be used for harvesting wheat crop at a height of 30 mm above the ground. The ultimate tensile strength and diameter of the crop stem are 35 N mm^{-2} and 3 mm respectively. The friction coefficient of knife edge for wheat crop is 0.346 and the maximum oblique angle of the counter shear is 17° . The crop stem is of homogeneous solid with a uniform circular section.

- 51) The horizontal force in N that would cause bending failure of the crop stem is
(GATE EE 2025)

- a) 1.55 b) 3.09 c) 4.64 d) 6.19

- 52) The maximum clip angle in degrees between the knife and the counter shear is
(GATE EE 2025)

- a) 2 b) 17 c) 19 d) 36

Water is recharged to an aquifer through a well of 200 mm diameter penetrating up to the base of the aquifer. The hydraulic conductivity of the aquifer is 19 m d^{-1} . During recharge, the water level in the well is 32 m from the base of the aquifer. A constant height of 27 m above the same base is obtained at a distance of 200 m from the well.

- 53) If the aquifer is confined with a thickness of 20 m, the theoretical recharge rate in litre per second is
(GATE EE 2025)

- a) 18.2 b) 25.2 c) 28.8 d) 30.5

- 54) If the aquifer is unconfined, the theoretical recharge rate in litre per second is
(GATE EE 2025)

- a) 10.5 b) 17.7 c) 26.8 d) 30.5

Apple is to be stored at 30°C in modified atmosphere package of laminated films made of $150 \mu\text{m}$ thick polyethylene and $100 \mu\text{m}$ thick nylon. The partial pressures of oxygen outside and inside of the package are 0.21 atm and 0.01 atm respectively. The permeability values of polyethylene and nylon in $\text{m}^3 \text{ solute (STP) m}^{-2} \text{ s}^{-1} \text{ atm}^{-1}$ per m thickness are 4.17×10^{-12} and 1.52×10^{-14} respectively.

- 55) Ratio of resistance to permeation between Nylon and Polyethylene films is
(GATE EE 2025)

- a) 138 b) 183 c) 381 d) 813

- 56) The molar flux of oxygen across the laminate in $\text{kg mole m}^{-2} \text{ s}^{-1}$ at steady state will be
(GATE EE 2025)

- a) 1.35×10^{-12} b) 2.47×10^{-12} c) 3.59×10^{-12} d) 5.41×10^{-12}

A tractor drawn vertical rotor planter is operated in the field at a forward speed of 5 km h^{-1} . The effective diameter of the ground wheel of the planter is 0.5 m and the transmission ratio between the ground wheel and the rotor shaft is 1:1.

