GATE 2022

Civil Engineering

Afternoon Session - 12.02.2022

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GATE 2022 [Afternoon Session]
Civil Engineering

General Aptitude

Question 1

A survey of 450 students about their subject of interest result in the following outcome.

- 150 students are interested in maths
- 200 students are interested in physics
- 175 students are interested in chemistry
- 50 students are interested in maths and physics
- 60 students are interested in physics and chemistry
- 40 students are interested in maths and chemistry
- 30 students are interested in maths physics and chemistry

Remaining students are interested in humanities based on the about information the number of students interested in humanities is.

(A) 10 (B) 45

(C) 30 (D) 40

Ans. B

Question 2

The movie was funny and I _____?

(A) Could helped laughed (B) Could help laughing

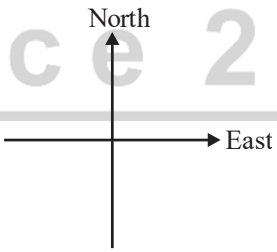
(C) Couldn't help laughing (D) Couldn't help laughed

Ans. C

Question 3

An ant walks in a straight line on a plane learning behind a trace of its movement. The initial position of the ant is at point P facing east. The ant first turns 72^0 anticlockwise at P, and then does the following two steps in sequence exactly five times before halting.

1. Moues forward for 10 cm
2. turns 144^0 clockwise



The pattern made by the trace left behind by the ant is.

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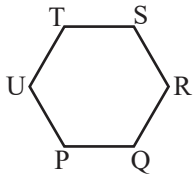
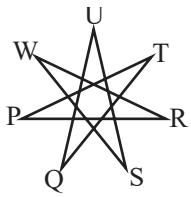
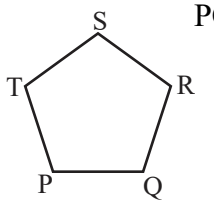
(A) 

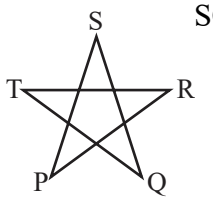
PQ = QR = RS = ST = TU = UP = 10 cm

(B) 

SW = WR = RP = PT = TQ = QU = US = 10 cm

(C) 

PQ = QR =RS = ST =TP = 10 cm

(D) 

SQ = QT = TR = RP = PS = 10 cm

Ans. D

Question 4

In a partnership business the monthly investment by three friends for the first six months is in the ratio 3:4:5 after six months, they had to increase their monthly investments by 10%, 15% and 20% respectively, of their initial monthly investment. The new investment ratio was kept constant for the next six months.

What is the ratio of their shares in the total profit (in the same order) at the end of the year such that the share is proportional to their individual total investment over the year?

(A) 22:23:24 (B) 63:86:110

(C) 22:33:50 (D) 33:46:60

Ans. B

Question 5

Given below are two statements and four conclusion drawn based on the statements?

Statement 1 : Some soaps are clean

Statement 2 : All clean objects are wet.

Conclusion I : Some clean objects are soaps.

Conclusion II : No clean objects is a soap

Conclusion III : Some wet object are soaps.

Conclusion IV : All wet object are soaps.

Which one of the following option can be logically inferred.

(A) Either conclusion III or conclusion IV is

(B) Either conclusion I or conclusion II is correct

(C) Only conclusion I is correct

(D) Only conclusion I and conclusion III are correct

Ans. D

Question 6

Consider the following equations of straight lines :

Line L1 : $2x-3y=5$

Line L2 : $3x+2y=8$

Line L3 : $4x-6y=5$

Line L4 : $6x-9y=6$

Which one among the following is the correct statement?

(A) L2 is parallel to L4 and L2 is perpendicular to L1

(B) L1 is parallel to L2 and L1 is perpendicular to L3

(C) L3 is parallel to L4 and L3 is perpendicular to L2

(D) L4 is parallel to L3 and L4 is perpendicular to L2

Ans. D

Question 7

$$x:y:z=\frac{1}{2}:\frac{1}{3}:\frac{1}{4}$$

What is the value of $\frac{x+z-y}{y}=?$

(A) 1.25 (B) 3.25

(C) 0.75 (D) 2.25

Ans. A

Question 8

In the last few years, several new shopping malls were opened in the city. The total number of visitors in malls is impressive. However the total revenue generated through sales in the shops in these malls is generally low.

Which one of the following is the correct logical inference based on the information in the about passage?

(A) Fewer people are visiting the malls but spending more.

(B) Fever people are visiting the malls and not spending enough.

(C) More people are visiting the malls and spending more.

(D) More people are visiting the malls but not spending enough.

Ans. D

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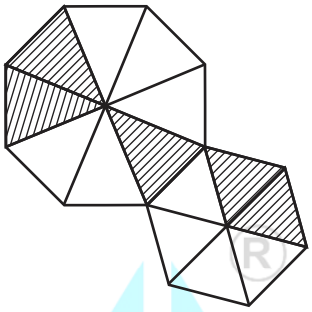
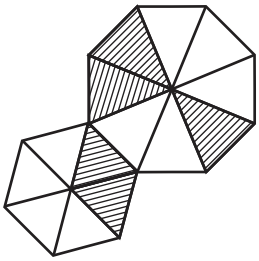
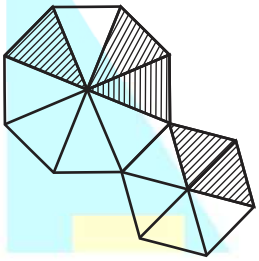
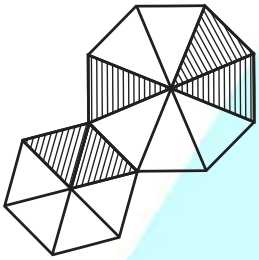
Question 9

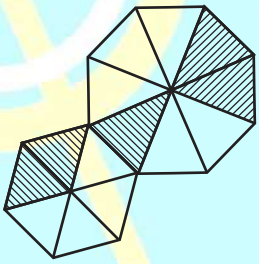
For the picture shown about which one of the following is the correct picture representing reflection with respect to the mirror shown as the dotted line?



(A) 

(B) 

(C) 

(D) 

Ans. D

Question 10

Both the numerator and the denominator of $\frac{3}{4}$ are increased by a positive integer x and those of $\frac{15}{17}$ are decreased by the same integer. This operation results in the same value for both the fractions.

What is the value of x?

(A) 3 (B) 4

(C) 1 (D) 2

Ans. A

Technical Section

Question 1

The dimension of dynamic viscosity

(A) ML^0T^{-1} (B) $ML^{-1}T^{-2}$

(C) $ML^{-2}T^{-2}$ (D) $ML^{-1}T^{-1}$

Ans. D

Question 2

Activities	Duration (Days)	Depend on
A	10	-
B	12	-
C	5	A
D	14	B
E	10	B, C

Total float of the activity E (in days) is.

Ans. 1

Question 3

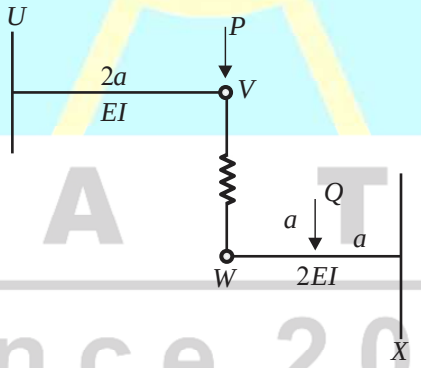
If the M.B of sun at a place at noon is 52^0 E the magnetic declination (in degree) at that place is.

(A) 2^0 W (B) 4^0 W

(C) 2^0 E (D) 4^0 E

Ans. C

Question 4



Linearly elastic planer structure UV and UX are connected with spring constant $k = 20$ kN/m. The flexural rigidity $EI = 10^5$ kN – m^2, $P = 100$ kN and $a = 5$ m. Force Q is applied at the centre of WX such that force in spring VW becomes zero. The magnitude of force Q (in kN).

Ans. 640

Question 5

Concentrically loaded isolated square footing 2m×2m. Concentrated vertical load 1000 kN consider Boussinesq's theory maximum depth (in m) of the pressure bulb, corresponding to 10% of vertical load intensity will be _____.

Ans. 2.185

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Question 6

Group of 16 piles in square grid centre to centre spacing (s) between piles is 3m. The diameter and length of embedment are 1m & 20m. The design capacity of each pile is 1000 kN is vertical down. The pile group efficiency.

$$\theta = \tan^{-1}\left(\frac{d}{s}\right) \quad \eta_B = 1 - \frac{\theta}{90}\left[\frac{(n-1)m + (m-1)n}{mn}\right]$$

m & *n* are number of rows and column. The design value of pile group capacity (in kN) is ____.

Ans. 11082

Question 7

Evapotranspiration = 6 mm/day

Crop coefficient = 1.2

Soil coefficient = 0.8

Actual evapotranspiration (mm/day) _____.

Ans. 7.2

Question 8

Insider diameter sampler tube = 50 mm

Insider clearance ratio = 1.0 %

The inside diameter of cutting edge is _____.

Ans. 49.5

Question 9

A single lane highway has a traffic density of 40 vehicle/km. If the time mean speed and space mean speed are 40 kmph and 30 kmph, respectively, the average headway (in sec) between the vehicle is

(A) 8.33×10^{-4} (B) 6.25×10^{-4}

(C) 2.25 (D) 3.00

Ans. D

Question 10

A sample of air 25^0C and 1 atm is reported to contain 0.04 ppm of SO_2. The equivalent SO_2 concentration (in $\mu g/m^3$)

Ans. 104.71

Question 11

Column X	Column
Horton's	Design of alluvial channel
Penman	Maximum flood discharge
Lacey's	Evapotranspiration
Chezy's	Infiltration
Dickens	Flow velocity

Question 12

(MSW) formula $C_{100}H_{250}O_{80}$. By force aeration composting process. Assume oxygen in air (by weight) 23 % and density of air 1.3 kg/m^3. Atomic mass C and H are oxidized completely and converted into NH_3 during oxidation for oxidative degradation of 1 tonne of waste the required theoretical volume of air.

(A) 1418 m^3/tonne
(B) 4749 m^3/tonne
(C) 1092 m^3/tonne
(D) 8025 m^3/tonne

Ans. B

Question 13

A flood control structure having life n year is designed by return period T years. When $T = n$ $n \to \infty$ the structure hydrologic risk in (%).

Ans. 63.2

Question 14

In a solid waste handling facility moisture content (MC) of food waste, paper waste and glass waste were found MC_f, MC_p, MC_g. Energy content (EC) of PW, FW, GW, EC_{pp}, EC_f, EC_g.

(A) $MC_f > MC_p > MC_g$
(B) $MC_f < MC_p < MC_g$
(C) $EC_{pp} > EC_f > EC_g$
(D) $EC_{pp} < EC_f < EC_g$

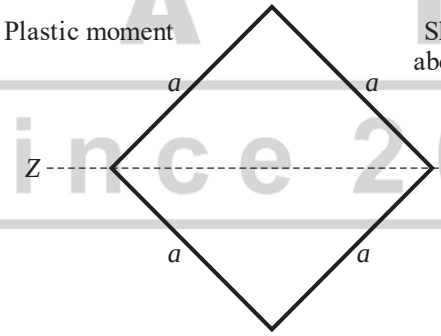
Ans. A, C

Question 15

A parabolic vertical west curve grade +1 % and -2 %. SSD = 200 m. Driver height 1.2, obstacle = 0.15 m, minimum curve length?

Ans. 272.72

Question 16



Consider yield a stress $f_y = 250$ MPa and $a = 100$ mm. The value of S and M_p

(A) $S = 1.5$, $M_p = 58.9$ kN-m
(B) $S = 2$, $M_p = 100.2$ kN-m
(C) $S = 1.5$, $M_p = 100.2$ kN-m
(D) $S = 2.0$, $M_p = 58.9$ kN-m

Ans. D

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Question 17

A post tension concrete member 15 m and cross-section 450 mm×450 mm (3 steel tendons) each of cross-section area 200 mm^2, The tendons are tensioned one after another to a stress of 1500 MPa. All tendons are straight located at 125 mm from bottom of the member Assume prestress to be same in all tendon, Modular ratio 6. The average loss of prestress due to elastic deformation of concrete considering all three tendons.

(A) 28.32 MPa
(B) 14.16 MPa
(C) 42.48 MPa
(D) 7.08 MPa

Ans. B

Question 18

Two discrete spherical particles (P & Q) of equal mars & S are independently released in water particle P and Q have dia of 0.5 mm & 1 mm respectively Assume stokes law is valid. The drag force on particle Q will be _____ times the drag force on P.

Ans. 8

Question 19

The base length of runway at mean sea wet (MSL) in 1500m. If the runway is located at all altitude of 300 m above the MSL. The actual length of runway?

Ans. 1605

Question 20

A sewage treatment plant sewage at flow rate 5000 m^3/day. The total suspended solid concentration in sewage at the inlet of primary clarifies is 200 mg/l. After primary treatment TSS concentration is reduced by 60%. The sludge from the primary clarifier contains 2% solid concentration. The sludge is subjected to gravity thickening process to achieve a solid concentration of 6%. Assume density before and after thickening is 1000 kg/m^3. The daily volume of thickened sludge (in m^3/day) is _____.

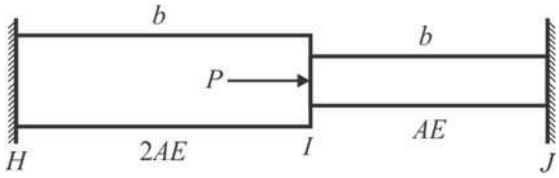
Ans. 10

Question 21

A hydraulic jump takes place in 6 m wide R.C. at point where upstream depth is 0.5 m (just before jump). If the discharge in the channel is 30 m^3s, the energy loss in the jump is 1.6 m. Froude number at the end of jump is. ($g = 10$ m/s^2)

Ans. 0.316

Question 22



2 linearly elastic rods *HI IJ*. The rods are colinear and confined between two fixed supports. Initially both are stress free. α- coefficient of L.E. The temperature of the road *IJ* is raised by ΔT. Where as temperature of rod *HI* remains unchanged. External horizontal force *P* is applied at *I*. $\alpha = 10^{-6}\,C^{-1}, \Delta T = 50^{0}C, b = 2\text{ m}, AE = 10^{6}$ N. The axial rigidities of rod *HI* and *IJ* are $2AE$ and AE.

To make the axial force in rod *HI* equal to zero, the value of external force *P* (in N).

Ans. 50

Question 23

In a tri-axial (UU) test on a saturated clay sample, the cell pressure was 100 kPa . If the deviation C. stress at failure was 150 kPa . The undrained shear strength of soil. (kPa)

Ans. 75

Question 24

A 100 mg of HNO_3 is added to water, bringing final volume to 1 litre. Atomic weight H, N, O as 1 1g/mol , 14 g/mol and 16 g/mol . The final pH. (Ignore dissociation of H_2O).

(A) 6.5 (B) 3.8

(C) 8.5 (D) 2.8

Ans. D

Question 25

A process equipment emits 5 kg/h of volatile organic compounds (vocs). If a hood is placed over the equipment captures 95% of the VOCs, then fugitive emission in kg/h is

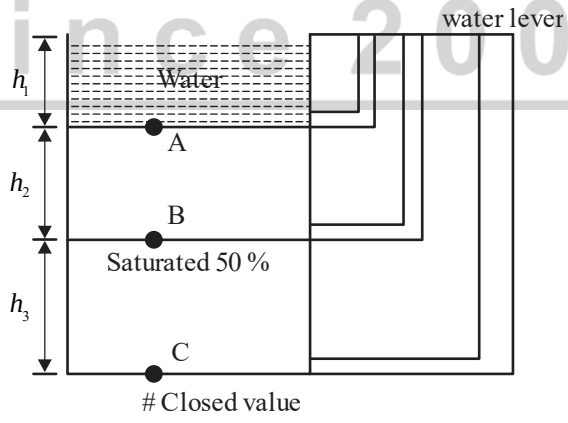
(A) 0.25 (B) 4.75

(C) 2.50 (D) 0.48

Ans. A

Question 26

A soil sample is underlying water column of height h. The vertical effective stress at points A, B, C are $\sigma'_A, \sigma'_B, \sigma'_C$ respectively. γ_{sat} & γ' be saturated and submerged unit weight. Which expression correctly represent. $(\sigma'_A + \sigma'_B + \sigma'_C)$?



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(A) $(h_1+h_2+h_3)\gamma^1$ (B) $(h_2+h_3)(\gamma_{sat}-\gamma_w)$

(C) $(h_1+h_2+h_3)\gamma_{sat}$ (D) $(2h_2+h_3)\gamma^1$

Ans. D

Question 27

For linear elastic and isotropic material, the correct relationship among (E) Poisson ratio (ν) and shear mode lulus.

(A) $E=\dfrac{G}{1+2\nu}$ (B) $G=\dfrac{E}{2(1+\nu)}$

(C) $G=\dfrac{E}{1+2\nu}$ (D) $E=\dfrac{G}{2(1+\nu)}$

Ans. B

Question 28

Match :

(i) C_3S

(ii) C_2S

(iii) C_3A

(P) Early age strength

(Q) Later age strength

(R) Flash setting

(S) highest heat of hydration

(T) Lowest heat of hydration

(A)

(i) Q & T

(ii) P & S

(iii) R

(B)

(i) P

(ii) Q & T

(iii) R & S

(C)

(i) T

(ii) S

(iii) P & Q

(D)

(i) P

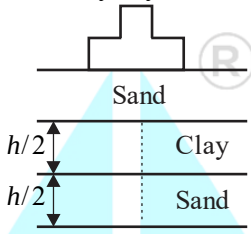
(ii) Q & R

(iii) T

Ans. B

Question 29

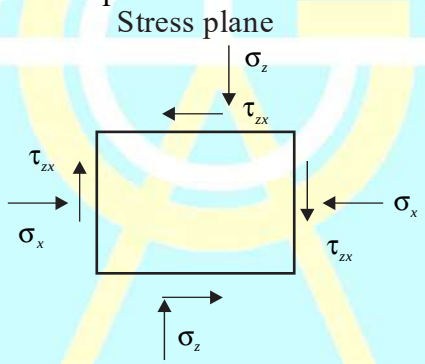
A saturated compacted clay of thickness h is sandwiched between two sand layer. Total vertical stress and pure water pressure at P located at mid depth of the clay layer 150 kpa and 25 kpa. Construction of building caused an additional total vertical stress 100 kpa at p. When the vertical effective stress at p is 175 kpa, the percentage of consolidation in clay layer.



Ans. 50

Question 30

Shear stress $(\sigma_z > \sigma_x)$, major and minor principal stresses σ_1 and σ_3. Compressive stress as $+ve$. Angle between major principal and horizontal plane



(A) $\tan^{-1}\left(\frac{\tau_{zx}}{\sigma_1-\sigma_x}\right)$

(B) $\tan^{-1}\left(\frac{\tau_{zx}}{\sigma_1+\sigma_3}\right)$

(C) $\tan^{-1}\left(\frac{\tau_{zx}}{\sigma_1+\sigma_x}\right)$

(D) $\tan^{-1}\left(\frac{\tau_{zx}}{\sigma_3-\sigma_x}\right)$

Question 31

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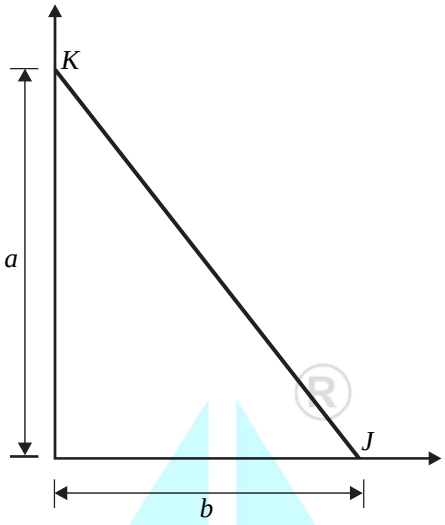

$W = 10\,\text{kN}, a = 4\,\text{m}, b = 3\text{m}$ frictionless vertical wall at μ. rough horizontal surface at J. minimum coefficient of static friction, that is required at point S to hold the rod in equilibrium.

Ans. 0.375

Question 32

Consider a beam PQ fixed at P hinged at Q and subjected to a load P as shown. The static and kinematic degree of indeterminacy

(A) 1 and 2
(B) 2 and 0
(C) 2 and 2
(D) 2 and 1

Ans. D

Question 33

For a traffic stream V is space mean speed, k is the density, q is the flow, V_f, k_j *Jam* density. Speed decreases linearly with flow. Which of following is correct.

(A) $q = V_f k - \left(\frac{V_f}{k_j}\right)k^2$
(B) $q = k_j k - \left(\frac{k_j}{V_f}\right)k^2$
(C) $q = V_f V - \left(\frac{V_f}{k_j}\right)V^2$
(D) $q = k_f V - \left(\frac{k_j}{V_f}\right)V^2$

Ans. A

Question 34

Water is flowing in a horizontal, frictionless rectangular channel. A smooth humped is built on channel floor at a section and its height in gradually increased to reach choked condition. The depth of water its section is y_2 and that at its U/S. Section is y_1. The correct statement for choked and unchoked condition in channel are.

(A) In unchoked condition y_1 remains unaffected when the flow is supercritical or subcritical.

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(B) In choked condition y_1 decreases if the flow is supercritical and increases if flow is subcritical.

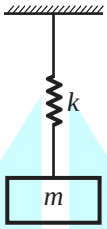
(C) In choked condition y_2 is equal to critical depth if flow is supercritical or subcritical.

(D) In choked condition y_1 increase if the flow is supercritical and decreases. If the flow is subcritical.

Ans. A

Question 35

An undamped spring mass system with mass m. Spring stiffness k.



Natural frequency and natural period are ωrad/s and T sec.

If stiffness is doubled and the mass is halved. The natural frequency and natural period of modified system are.

(A) 2ωrad/s and $T/2$ sec.

(B) $\omega/2$ rad/s and $2Ts$.

(C) $\omega/2$ rad/s and Ts.

(D) 4ω rad/s and $T/4s$.

Ans. A

Question 36

A pump with an efficiency 80% is used to draw ground water from a well for irrigating field area of 108 ha. The base period and delta for paddy cop on this field all 120 day and 144 cm. Water application $(\eta) = 80\%$. The lowest level of water in the well is 10 m below ground. The minimum horse power of pump. ($1\,\text{HP} = 746\,\text{W}$, unit weight of water is 9810 kg/m^3)

Ans. 30.82

Question 37

Let y be a non zero vector of size 2022×1. Which of the following statement(s) is/are true?

(A) $y^T y$ is an eigen value of yy^T

(B) yy^T has a rank of 2022

(C) yy^T is a symmetric matrix

(D) yy^T is invertible

Ans. A, C

Question 38

$\int\left(x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+.....\right)dx$ is equal to

(A) $-\frac{1}{1-x}+$ constant

(B) $-\frac{1}{1-x^2}+$ constant

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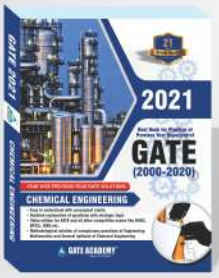

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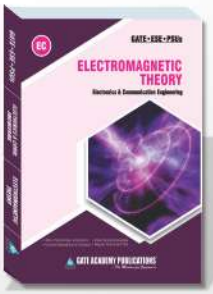

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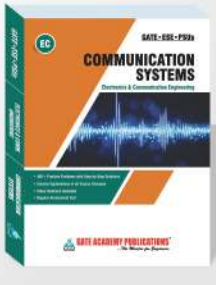

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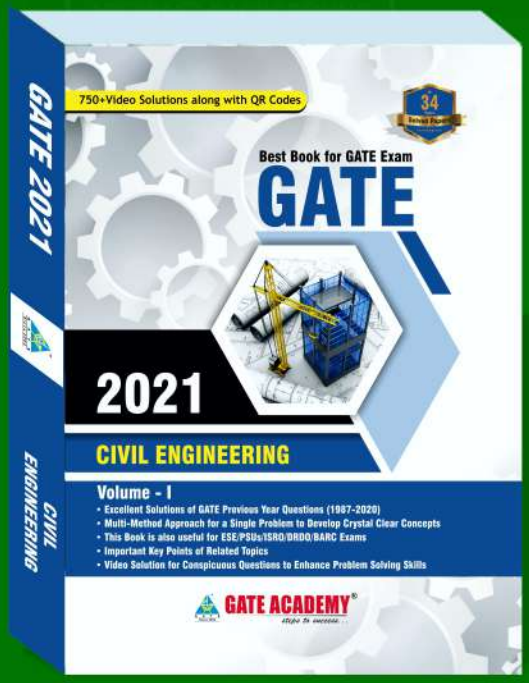

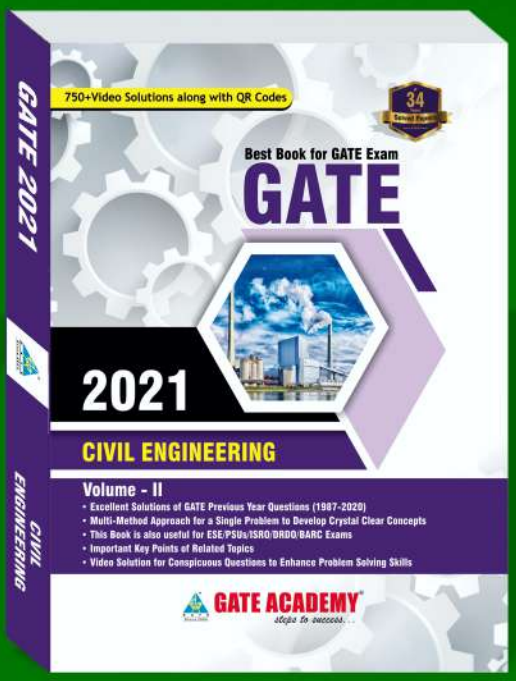

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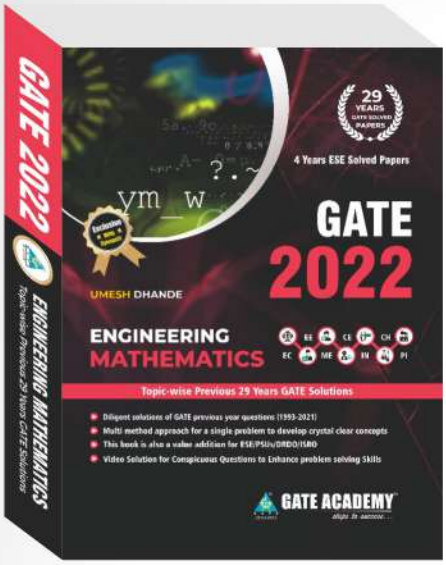

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(C) $\frac{1}{1+x^2}+$ constant (D) $\frac{1}{1+x}+$ constant

Ans. MTA

Question 39

The function $F(x,y)$ satisfies the Laplace equation,

$$\nabla^2 F(x,y)=0$$

on a circular domain of radius $r=1$ with its center at point P with coordinates $x=0, y=0$. The value of this function on the circular boundary of this domain is equal to 3. The numerical value of $f(0,0)$ is

(A) 1 (B) 0

(C) 2 (D) 3

Question 40

A pair of six-faced dice is rolled thrice. The probability that the sum of the outcomes in each roll equals 4 in exactly two of the three attempts is _____. (round off to three decimal places)

Ans. 0.019

Question 41

P and Q are two square matrices of the same order. Which of the following statement(s) is/are correct?

(A) If P and Q are not invertible, then $[PQ]^{-1}=Q^{-1}P^{-1}$

(B) If P and Q are invertible, then $[PQ]^{-1}=P^{-1}Q^{-1}$

(C) If P and Q are invertible, then $[PQ]^{-1}=Q^{-1}P^{-1}$

(D) If P and Q are invertible, then $[QP]^{-1}=P^{-1}Q^{-1}$

Ans. C, D

Question 42

Consider the polynomial $f(x)=x^3-6x^2+11x-6$ on the domain S given by $1\le x\le 3$. The first and second derivatives are $f'(x)$ and $f''(x)$. Consider the following statements :

I. The given polynomial is zero at the boundary points $x=1$ and $x=3$.

II. There exists one local maxima of $f(x)$ with in the domain S.

III. The second derivative $f''(x)>0$ throughout the domain S.

IV. There exists one local minima of $f(x)$ with in the domain S.

The correct option is :

(A) Only statement II and IV are correct

(B) Only statement I and IV are correct

(C) Only statement I, II and IV are correct

(D) Only statement I, II and III are correct

Ans. **C**

Question 43

The component of pure shear strain in a sheared material are given in the matrix

$$E=\begin{bmatrix}1 & 1\\ 1 & -1\end{bmatrix}$$

Here, trace $(E)=0$. Given $P=$ Trace (E^8) and $Q=$ Trace (E'').

Numerical value $(P+Q)$ is equal to _____.

Ans. **32**

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TOPPER'S SPEAK

GATE 2020

I am very grateful to whole GATE ACADEMY team for helping me to build my concepts in all the subjects. For my success of AIR-1 there is immense role of Gate Academy. It was great learning & experience with the top most faculties of India. A special thanks to respected Umesh Dhande sir for creating such a wonderful platform for all GATE aspirants and Gurupal Chawla sir for motivating me at the time of failure.

I also want to thank Sujay sir, Saket sir, Das sir and Saurabh Sir for guiding me to take success steps towards my career.

To all the future GATE aspirants I would like to say, never give up on your dreams. Because it is our dreams that keep us alive.

GATE 2019

Hello Everyone! I am Rajat Soni. I secured AIR 1 in GATE 2019 in Electronics & Communication Engineering. I have completed my B.Tech in 2018 from NIT Warangal. It was 2017 when I came to know about GATE ACADEMY's YouTube channel. It helped me a lot for my preparation for GATE. Umesh Dhande Sir's YouTube videos on Control Systems really helped me to get a deeper insights in the subjects. Jasuja sir's videos on Digital Electronics and Gurupal sir's videos on Engineering Mathematics were very helpful for the last minute preparation. Also I have enrolled in the GATE ACADEMY's Online Test Series which helped me in analysis of my mistakes before GATE Examination. I owe a lot to GATE ACADEMY for their quality content on YouTube channel and very well designed Online Test Series.

GATE 2018

I thank Dhande sir for giving a kickstart to my GATE preparation. I was primarily focused on my research work and was not interested in the exam. Just before 4 months of Gate Examination, I came to know about Gate Academy's YouTube channel and in this way I started my preparation. Umesh Sir's video on Control Theory (especially the one on GM and PM) and Analog Circuits (especially Topology Concept and Gain Calulation Shortcuts) were insightful and conceptually sound. Also a lot of tricky questions were asked in the test series offered by Gate Academy and it gave me the necessary confidence for the exam. So I owe a lot to the Gate Academy's YouTube Channel and Gate Academy's test Series for my performance.

GATE 2017

I am very thankful to Dhande sir, Vishal sir, Sujay sir, Gurupal sir, Das sir and entire Gate academy team which helped me in building concepts and getting the numerical approach for Gate exam when I started my preparation.

For my success (AIR-1), there are a lot of people who have immense role and Gate Academy is on of them. For the aspiring students, I want to say that like you only I used to think how a topper looks like and now I know that, meaning that everyone has a topper in them you just need to believe in yourself to understand the concept, try to solve new questions through test series and don't act ideal on examination day.

If I can, then YOU WILL!