GATE 2012 CIVIL ENGINEERING[1]

EE25BTECH11013 - Bhargav

Q.1 – Q.25 CARRY ONE MARK EACH.

1) The estimate of $\int_{0.5}^{1.5} \frac{dx}{x}$ obtained using Simpson rule with three-point function evaluation exceeds the exact value by (*GATE CE* 2012)

a) 0.235
b) 0.068
c) 0.024
d) 0.012

2) The annual precipitation data of a city is normally distributed with mean and standard deviation as 1000 mm and 200 mm, respectively. The probability that the annual precipitation will be more than 1200 mm is (*GATE CE* 2012)

a) $< 50\%$
b) 50%
c) 75%
d) 100%

3) The infinite series

$$1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots \tag{1}$$

corresponds to (*GATE CE* 2012)

a) $\sec x$
b) e^x
c) $\cos x$
d) $1 + \sin^2 x$

4) The Poisson ratio is defined as (*GATE CE* 2012)

a) $\frac{\text{axial stress}}{\text{lateral stress}}$
b) $\frac{\text{lateral strain}}{\text{axial strain}}$
c) $\frac{\text{lateral stress}}{\text{axial stress}}$
d) $\frac{\text{axial strain}}{\text{lateral strain}}$

5) The following statements are related to bending of beams: (*GATE CE* 2012)

a) The slope of the bending moment diagram is equal to the shear force.
b) The slope of the shear force diagram is equal to the load intensity.
c) The slope of the curvature is equal to the flexural rotation.
d) The second derivative of the deflection is equal to the curvature.

The only **FALSE** statement is

a) I
b) II
c) III
d) IV

6) If a small concrete cube is submerged deep in still water in such a way that the pressure exerted on all faces of the cube is p, then the maximum shear stress developed inside the cube is (*GATE CE* 2012)

a) 0
b) $\frac{p}{2}$
c) p
d) $2p$

7) As per IS 456 : 2000, in the Limit State Design of a flexural member, the strain in reinforcing bars under tension at ultimate state should not be less than (*GATE CE* 2012)

a) $\frac{f_y}{E_s}$
b) $\frac{f_y}{E_s} + 0.002$
c) $\frac{f_y}{1.15E_s}$
d) $\frac{f_y}{1.15E_s} + 0.002$

8) Which one of the following is categorised as a long-term loss of prestress in a prestressed concrete member? (*GATE CE* 2012)

a) Loss due to elastic shortening
b) Loss due to friction
c) Loss due to relaxation of strands
d) Loss due to anchorage slip

9) In a steel plate with bolted connections, the rupture of the net section is a mode of failure under (*GATE CE* 2012)

a) tension
b) compression
c) flexure
d) shear

10) The ratio of the theoretical critical buckling load for a column with fixed ends to that of another column with the same dimensions and material, but with pinned ends, is equal to (*GATE CE* 2012)

a) 0.5
b) 1.0
c) 2.0
d) 4.0

11) The effective stress friction angle of a saturated, cohesionless soil is 38°. The ratio of shear stress to normal effective stress on the failure plane is (*GATE CE* 2012)

a) 0.781
b) 0.616
c) 0.488
d) 0.438

12) Two series of compaction tests were performed in the laboratory on an inorganic clayey soil employing two different levels of compaction energy per unit volume of soil. With regard to the above tests, the following two statements are made: (*GATE CE* 2012)

a) The optimum moisture content is expected to be more for the tests with higher energy.
b) The maximum dry density is expected to be more for the tests with higher energy.

The CORRECT option evaluating the above statements is

a) Only I is TRUE
b) Only II is TRUE
c) Both I and II are TRUE
d) Neither I nor II is TRUE

13) As per the Indian Standard soil classification system, a sample of silty clay with liquid limit of 40% and plasticity index of 28% is classified as (*GATE CE* 2012)

a) CH
b) CI
c) CL
d) CL-ML

14) A smooth rigid retaining wall moves as shown. The backfill material is homogeneous, isotropic, and obeys the Mohr-Coulomb failure criterion. The major principal stress is (*GATE CE* 2012)

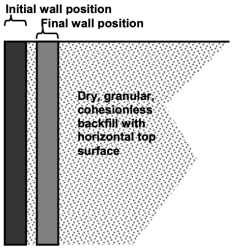

Fig. 14

a) parallel to the wall face and acting downwards
b) normal to the wall face
c) oblique to the wall face acting downwards
d) oblique to the wall face acting upwards

15) An embankment is to be constructed with a granular soil (bulk unit weight = 20 kN/m^3) on a saturated clayey silt deposit (undrained shear strength = 25 kPa). Assuming undrained general shear failure and bearing capacity factor of 5.7, the maximum height (in m) of the embankment at the point of failure is (*GATE CE* 2012)

a) 7.1
b) 5.0
c) 4.5
d) 2.5

16) A trapezoidal channel is 10.0 m wide at the base and has a side slope of 4 horizontal to 3 vertical. The bed slope is 0.002. The channel is lined with smooth concrete (Manning's n = 0.012). The hydraulic radius (*in m*) for a depth of flow of 3.0 m is (*GATE CE* 2012)

a) 20.0
b) 3.5
c) 3.0
d) 2.1

17) A rectangular open channel of width 5.0 m is carrying a discharge of 100 m^3/s. The Froude number of the flow is 0.8. The depth of flow (in m) in the channel is (*GATE CE* 2012)

a) 4
b) 5
c) 16
d) 20

18) The circular water pipes shown are flowing full. The velocity of flow (in m/s) in the branch pipe "R" is (*GATE CE* 2012)

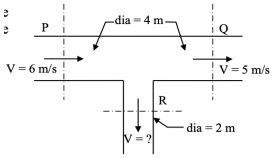

Fig. 18

a) 3
b) 4
c) 5
d) 6

19) The ratio of actual evapo-transpiration to potential evapo-transpiration is in the range (*GATE CE* 2012)

a) 0.0 to 0.4
b) 0.6 to 0.9
c) 0.0 to 1.0
d) 1.0 to 2.0

20) A sample of domestic sewage is digested with silver sulphate, sulphuric acid, potassium dichromate, and mercuric sulphate in chemical oxygen demand (*COD*) test. The digested sample is titrated with standard ferrous ammonium sulphate (*FAS*) to determine the un-reacted amount of (*GATE CE* 2012)

a) mercuric sulphate
b) potassium dichromate
c) silver sulphate
d) sulphuric acid

21) Assertion [a]: At a manhole, the crown of the outgoing sewer should not be higher than the crown of the incoming sewer.
Reason [r]: Transition from a larger diameter incoming sewer to a smaller diameter outgoing sewer at a manhole should not be made. (*GATE CE* 2012)

a) Both [a] and [r] are true and [r] is the correct reason for [a]
b) Both [a] and [r] are true but [r] is not a the correct reason for [a]
c) Both [a] and [r] are false is true but [r] is false

22) Two major roads with two lanes each are crossing in an urban area to form an uncontrolled intersection. The number of conflict points when both roads are one-way is 'X' and when both roads are two-way is 'Y'. The ratio of X to Y is (*GATE CE* 2012)

a) 0.25
b) 0.33
c) 0.50
d) 0.75

23) Two bitumen samples 'X' and 'Y' have softening points 45°C and 60°C, respectively. Consider: (*GATE CE* 2012)

a) Viscosity of 'X' will be higher than that of 'Y' at the same temperature.
b) Penetration value of 'X' will be less than that of 'Y' under standard conditions.

The CORRECT option evaluating the above statements is

a) Both I and II are TRUE
b) I is FALSE and II is TRUE
c) Both I and II are FALSE
d) I is TRUE and II is FALSE

24) Road roughness is measured using (*GATE CE* 2012)

a) Benkelman beam
b) Bump integrator
c) Dynamic cone penetrometer
d) Falling weight deflectometer

25) Which of the following errors can be eliminated by reciprocal measurements in differential leveling?
I Error due to earth's curvature
II Error due to atmospheric refraction (*GATE CE* 2012)

a) Both I and II
b) I only
c) II only
d) Neither I nor II

26) The error in

$$\left.\frac{d}{dx}f(x)\right|_{x=x_0} \tag{2}$$

for a continuous function estimated with $h = 0.03$ using the central difference formula

$$\left.\frac{d}{dx}f(x)\right|_{x=x_0} \approx \frac{f(x_0+h)-f(x_0-h)}{2h} \tag{3}$$

is 2×10^{-3}. The values of x_0 and $f(x_0)$ are 19.78 and 500.01, respectively. The corresponding error in the central difference estimate for $h = 0.02$ is approximately (*GATE CE* 2012)

a) 1.3×10^{-4}
b) 3.0×10^{-4}
c) 4.5×10^{-4}
d) 9.0×10^{-4}

27) In an experiment, positive and negative values are equally likely to occur. The probability of obtaining at most one negative value in five trials is (*GATE CE* 2012)

a) $\frac{1}{32}$
b) $\frac{2}{32}$
c) $\frac{3}{32}$
d) $\frac{6}{32}$

28) The eigenvalues of matrix $\begin{pmatrix} 9 & 5 \\ 5 & 8 \end{pmatrix}$ are (*GATE CE* 2012)

a) −2.42 and 6.86
b) 3.48 and 13.53
c) 4.70 and 6.86
d) 6.86 and 9.50

29) For the parallelogram OPQR shown in the sketch,

$$\overrightarrow{OP} = a\hat{i} + b\hat{j} and \overrightarrow{OR} = c\hat{i} + d\hat{j} \quad (4)$$

.The area of the parallelogram is (*GATE CE* 2012)

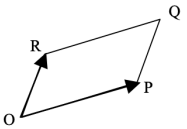

Fig. 29

a) $ad - bc$
b) $ac + bd$
c) $ad + bc$
d) $ab - cd$

30) The solution of the ordinary differential equation $\frac{dy}{dx} + 2y = 0$ for the boundary condition $y = 5$ at $x = 1$ is (*GATE CE* 2012)

a) $y = e^{-2x}$
b) $y = 2e^{-2x}$
c) $y = 10.95\, e^{-2x}$
d) $y = 36.95\, e^{-2x}$

31) A simply supported beam is subjected to a uniformly distributed load of intensity w per unit length, on half of the span from one end. The length of the span and the flexural stiffness are denoted as l and EI, respectively. The deflection at mid-span of the beam is (*GATE CE* 2012)

a) $\frac{5wl^4}{6144\ EI}$
b) $\frac{5wl^4}{768\ EI}$
c) $\frac{5wl^4}{384\ EI}$
d) $\frac{5wl^4}{192\ EI}$

32) The sketch shows a column with a pin at the base and rollers at the top. It is subjected to an axial force P and a moment M at mid-height. The reaction at R is/are (*GATE CE* 2012)

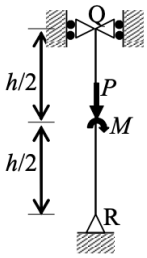

Fig. 32

a) a vertical force equal to P
b) a vertical force equal to $\frac{P}{2}$
c) a vertical force equal to P and a horizontal force equal to $\frac{M}{h}$
d) a vertical force equal to $\frac{P}{2}$ and a horizontal force equal to $\frac{M}{h}$

33) A concrete beam prestressed with a parabolic tendon is shown in the sketch. The eccentricity of the tendon is measured from the centroid of the cross-section. The applied prestressing force at service is 1620 kN. The uniformly distributed load of 45 (kN/m) includes the self-weight. The stress (in N/mm^2) in the bottom fibre at mid-span is (*GATE CE* 2012)

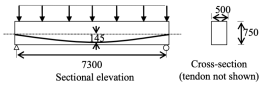

Fig. 33

a) tensile 2.90
b) compressive 2.90
c) tensile 4.32
d) compressive 4.32

34) A symmetric frame PQR consists of two inclined members PQ and QR, connected at 'Q' with a rigid joint, and hinged at 'P' and 'R'. The horizontal length PR is l. If a weight W is suspended at 'Q', the bending moment at 'Q' is (*GATE CE* 2012)

a) $\frac{Wl}{2}$ b) $\frac{Wl}{4}$ c) $\frac{Wl}{8}$ d) zero

35) Two plates are connected by fillet welds of size 10 mm and subjected to tension, as shown in the sketch. The thickness of each plate is 12 mm. The yield stress and the ultimate tensile stress of steel are 250 MPa and 410 MPa, respectively. The welding is done in the workshop (γ_{mw} = 1.25). As per IS 800:2007 (Limit State Method), the minimum length (rounded up to nearest higher multiple of 5 mm) of each weld to transmit P = 270 kN is (*GATE CE* 2012)

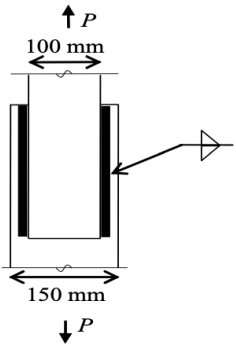

Fig. 35

a) 100 mm
b) 105 mm
c) 110 mm
d) 115 mm

36) Two soil specimens with identical geometric dimensions were subjected to falling head permeability tests under identical conditions. The ratio of initial to final water heads for the test involving the first specimen was 1.25. If the coefficient of permeability of the second specimen is five times that of the first, the ratio of initial to final water heads in the test involving the second specimen is (*GATE CE* 2012)

a) 3.05
b) 3.80
c) 4.00
d) 6.25

37) A layer of normally consolidated, saturated silty clay of 1 m thickness is subjected to one-dimensional consolidation under a pressure increment of 20 kPa. Properties: specific gravity = 2.7, natural moisture content = 45%, compression index = 0.45, recompression index = 0.05. Initial average effective stress within layer = 100 kPa. Assuming Terzaghi's theory, the primary consolidation settlement (*nearest mm*) is (*GATE CE* 2012)

a) 2 mm
b) 9 mm
c) 14 mm
d) 16 mm

38) Steady state seepage is taking place through a soil element at Q, 2 m below ground surface immediately downstream of the toe of an earthen dam (*see sketch*). The water level in a piezometer at P (500 *mm above* Q) is at ground surface. The water level in a piezometer at R (500 *mm below* Q) is 100 mm above ground surface. Bulk saturated unit weight = 18 kN/m^3, unit weight of water = 9.81 kN/m^3. The vertical effective stress (*in kPa*) at Q is (*GATE CE* 2012)

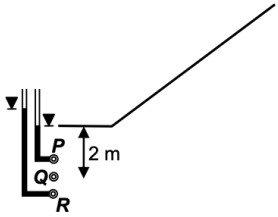

Fig. 38

a) 14.42
b) 15.89
c) 16.38
d) 18.34

39) The top width and the depth of flow in a triangular channel were measured as 4 m and 1 m, respectively. The measured velocities on the centre line at the water surface, 0.2 m and 0.8 m below the surface are 0.7 m/s, 0.6 m/s and 0.4 m/s respectively. Using two-point method of velocity measurement, the discharge (in m^3/s) in the channel is (*GATE CE* 2012)

a) 1.4
b) 1.2
c) 1.0
d) 0.8

40) Group I contains parameters and Group II lists methods/instruments.
Group I: P. Streamflow velocity Q. Evapo-transpiration rate R. Infiltration rate S. Wind velocity
Group II: 1. Anemometer 2. Penman's method 3. Horton's method 4. Current meter
The CORRECT match of Group I with Group II is (*GATE CE* 2012)

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

41) Wheat crop requires 55 cm of water during 120 days of base period. Total rainfall during this period is 100 mm. Assume irrigation efficiency = 60%. The area (in ha) of land that can be irrigated with canal flow 0.01 m^3/s is (*GATE CE* 2012)

a) 13.82
b) 18.85
c) 23.04
d) 230.40

42) A water sample has a pH of 9.25. The concentration of hydroxyl ions in the water sample is (*GATE CE* 2012)

a) $10^{-9.25}$ moles/L
b) $10^{-4.75}$ mmoles/L
c) 0.302 mg/L
d) 3.020 mg/L

43) A town is required to treat 4.2 m^3/min of raw water for daily domestic supply. Flocculating particles are to be produced by chemical coagulation. A column analysis indicated that an overflow rate of 0.2 mm/s will produce satisfactory particle removal in a settling basin at a depth of 3.5 m. The required surface area $\left(\text{in } m^2\right)$ for settling is (*GATE CE* 2012)

a) 210
b) 350
c) 1728
d) 21000

44) A pavement designer has arrived at a design traffic of 100 million standard axles for a newly developing national highway as per IRC:37 guidelines using the following data: design life = 15 years, commercial vehicle count before pavement construction = 4500 vehicles/day, annual traffic growth rate = 8%. The vehicle damage factor used in the calculation was (*GATE CE* 2012)

a) 1.53
b) 2.24
c) 3.66
d) 4.14

45) The following data are related to a horizontal curved portion of a two-lane highway: length of curve = 200 m, radius of curve = 300 m and width of pavement = 7.5 m. In order to provide a stopping sight distance (SSD) of 80 m, the set back distance (in m) required from the centre line of the inner lane of the pavement is (*GATE CE* 2012)

a) 2.54
b) 4.55
c) 7.10
d) 7.96

46) A two-lane urban road with one-way traffic has a maximum capacity of 1800 vehicles/hour. Under the jam condition, the average length occupied by the vehicles is 5.0 m. The speed versus density relationship is linear. For a traffic volume of 1000 vehicles/hour, the density ($invehicles/km$) is (*GATE CE* 2012)

a) 52
b) 58
c) 67
d) 75

47) The horizontal distance between two stations P and Q is 100 m. The vertical angles from P and Q to the top of a vertical tower at T are 3° and 5° above horizontal, respectively. The vertical angles from P and Q to the base of the tower are 0.1° and 0.5° below horizontal, respectively. Stations P, Q and the tower are in the same vertical plane with P and Q being on the same side of T. Neglecting earth's curvature and atmospheric refraction, the height ($in\ m$) of the tower is (*GATE CE* 2012)

a) 6.972
b) 12.387
c) 12.540
d) 128.745

Common Data for Questions 48 and 49

The flow net around a sheet pile wall is shown in the sketch. The properties of the soil are: permeability coefficient = 0.09 m/day (*isotropic*), specific gravity = 2.70 and void ratio = 0.85. The sheet pile wall and the bottom of the soil are impermeable.

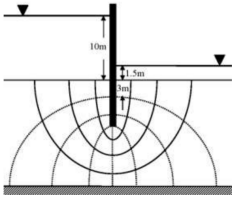

Fig. 47

48) The seepage loss $\left(\text{in } m^3 \text{ per day per unit length of the wall}\right)$ of water is (*GATE CE* 2012)

a) 0.33
b) 0.38
c) 0.43
d) 0.54

49) The factor of safety against the occurrence of piping failure is (*GATE CE* 2012)

a) 3.55
b) 2.93
c) 2.60
d) 0.39

Common Data for Questions 50 and 51

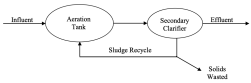

Fig. 49

An activated sludge system (*sketched below*) is operating at equilibrium with the following information. Wastewater related data: flow rate = 500 m^3 /hour, influent BOD = 150 mg/L, effluent BOD = 10 mg/L. Aeration tank related data: hydraulic retention time = 8 hours, mean cell-residence time = 240 hours, volume = 4000 m^3 , mixed liquor suspended solids = 2000 mg/L.

50) The food-to-biomass (F/M) ratio (*in kg BOD per kg biomass per day*) for the aeration tank is (*GATE CE* 2012)

a) 0.015
b) 0.210
c) 0.225
d) 0.240

51) The mass (*in kg/day*) of solids wasted from the system is (*GATE CE* 2012)

a) 24000
b) 1000
c) 800
d) 33

Linked Answer Questions
Statement for Linked Answer Questions 52 and 53

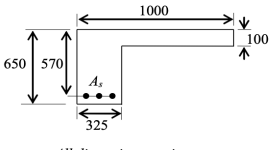

Fig. 51

The cross-section at mid-span of a beam at the edge of a slab is shown in the sketch. A portion of the slab is considered as the effective flange width for the beam. The grades of concrete and reinforcing steel are $M25$ and $Fe415$, respectively. The total area of reinforcing bars (As) is 4000 mm^2 . At the ultimate limit state, xu denotes the depth of the neutral axis from the top fibre. Treat the section as under-reinforced and flanged (xu > 100 mm).

52) The value of x_u (in mm) computed as per the Limit State Method of IS 456:2000 is (*GATE CE* 2012)

a) 200.0
b) 223.3
c) 236.3
d) 273.6

53) The ultimate moment capacity (*in kNm*) of the section, as per the Limit State Method of IS 456 : 2000 is (*GATE CE* 2012)

a) 475.2
b) 717.0
c) 756.4
d) 762.5

Statement for Linked Answer Questions 54 and 55
The drainage area of a watershed is 50 km^2. The ϕ index is 0.5 cm/hour and the base flow at the outlet is 10 m^3/s. One hour unit hydrograph (unit depth = 1 cm) of the watershed is triangular in shape with a time base of 15 hours. The peak ordinate occurs at 5 hours.

54) The peak ordinate (in m^3/s/cm) of the unit hydrograph is (*GATE CE* 2012)

a) 10.00
b) 18.52
c) 37.03
d) 185.20

55) For a storm of depth of 5.5 cm and duration of 1 hour, the peak ordinate (in m^3/s) of the hydrograph is (*GATE CE* 2012)

a) 55.00
b) 82.60
c) 92.60
d) 102.60

General Aptitude (GA) Questions

Q. 56 - Q. 60 CARRY ONE MARK EACH

56) Despite several _____ the mission succeeded in its attempt to resolve the conflict. (*GATE CE* 2012)

a) attempts
b) setbacks
c) meetings
d) delegations

57) The cost function for a product in a firm is given by $5q^2$, where q is the amount of production. The firm can sell the product at a market price of 50 per unit. The number of units to be produced by the firm such that the profit is maximized is (*GATE CE* 2012)

a) 5
b) 10
c) 15
d) 25

58) Suresh's dog is the one _____ was hurt in the stampede. (*GATE CE* 2012)

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

59) Choose the grammatically INCORRECT sentence: (*GATE CE* 2012)

a) They gave us the money back less the service charges of Three Hundred rupees.
b) This country's expenditure is not less than that of Bangladesh.
c) The committee initially asked for a funding of Fifty Lakh rupees, but later settled for a lesser sum.
d) This country's expenditure on educational reforms is very less.

60) Which one of the following options is the closest in meaning to the word given below?
Mitigate (*GATE CE* 2012)

a) Diminish
b) Divulge
c) Dedicate
d) Denote

Q. 61 - Q. 65 CARRY TWO MARKS EACH

61) A political party orders an arch for the entrance to the ground in which the annual convention is being held. The profile of the arch follows the equation $y = 2x - 0.1x^2$ where y is the height of the arch in meters. The maximum possible height of the arch is (*GATE CE* 2012)

a) 8
b) 10
c) 12
d) 14

62) Wanted Temporary, Part-time persons for the post of Field Interviewer to conduct personal interviews to collect and collate economic data. Requirements: High School-pass, must be available for Day, Evening and Saturday work. Transportation paid, expenses reimbursed. The best inference from the above advertisement is (*GATE CE* 2012)

a) Gender-discriminatory
b) Xenophobic
c) Not designed to make the post attractive
d) Not gender-discriminatory

63) Given the sequence of terms, AD CG FK JP, the next term is (*GATE CE* 2012)

a) OV
b) OW
c) PV
d) PW

64) Which of the following assertions are CORRECT?
P: Adding 7 to each entry in a list adds 7 to the mean of the list
Q: Adding 7 to each entry in a list adds 7 to the standard deviation of the list
R: Doubling each entry in a list doubles the mean of the list
S: Doubling each entry in a list leaves the standard deviation of the list unchanged
(*GATE CE* 2012)

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

65) An automobile plant contracted to buy shock absorbers from two suppliers X and Y. X supplies 60% and Y supplies 40% of the shock absorbers. All shock absorbers are subjected to a quality test. The ones that pass are considered reliable. Of X's shock absorbers, 96% are reliable. Of Y's shock absorbers, 72% are reliable. The probability that a randomly chosen shock absorber, which is found to be reliable, is made by Y is (*GATE CE* 2012)

a) 0.288
b) 0.334
c) 0.667
d) 0.720