GATE XE 2019

AI25BTECH11003 - Bhavesh Gaikwad

General Aptitude

1) Once the team of analysts identify the problem, we _____ in a better position to comment on the issue. Which one of the following choices CANNOT fill the given blank?
(GATE 2019 XE)

a) will be
b) were to be
c) are going to be
d) might be

2) A final examination is the _____ of a series of evaluations that a student has to go through.
(GATE 2019 XE)

a) culmination
b) consultation
c) desperation
d) insinuation

3) If `IMHO = JNIP`; `IDK = JEL`; and `SO = TP`, then `IDC` = _____
(GATE 2019 XE)

a) JDE
b) JED
c) JDC
d) JCD

4) The product of three integers X, Y and Z is 192. Z is equal to 4 and P is equal to the average of X and Y. What is the minimum possible value of P?
(GATE 2019 XE)

a) 6
b) 7
c) 8
d) 9.5

5) Are there enough seats here? There are ____ people here than I expected.
(GATE 2019 XE)

a) many
b) most
c) least
d) more

6) Fiscal deficit was 4% of the GDP in 2015 and that increased to 5% in 2016. If the GDP increased by 10% from 2015 to 2016, the percentage increase in the actual fiscal deficit is ____.

(GATE 2019 XE)

a) 37.50
b) 35.70
c) 25.00
d) 10.00

7) Two pipes P and Q can fill a tank in 6 hours and 9 hours respectively, while a third pipe R can empty the tank in 12 hours. Initially, P and R are open for 4 hours. Then P is closed and Q is opened. After 6 more hours R is closed. The total time taken to fill the tank (in hours) is _____.

(GATE 2019 XE)

a) 13.50
b) 14.50
c) 15.50
d) 16.50

8) While teaching a creative writing class in India, I was surprised at receiving stories from the students that were all set in distant places: in the American West with cowboys and in Manhattan penthouses with clinking ice cubes. This was, till an eminent Caribbean writer gave the writers in the once-colonised countries the confidence to see the shabby lives around them as worthy of being "told". The writer of this passage is surprised by the creative writing assignments of his students, because
(GATE 2019 XE)

a) Some of the students had written stories set in foreign places
b) None of the students had written stories set in India
c) None of the students had written about ice cubes and cowboys
d) Some of the students had written about ice cubes and cowboys

9) Mola is a digital platform for taxis in a city. It offers three types of rides – Pool, Mini and Prime. The Table below presents the number of rides for the past four months. The platform earns one US dollar per ride. What is the percentage share of revenue contributed by Prime to the total revenues of Mola, for the entire duration?

TABLE 9: Table-1

Type	January	February	March	April
Pool	170	320	215	190
Mini	110	220	180	70
Prime	75	180	120	90

(GATE 2019 XE)

a) 16.24
b) 23.97
c) 25.86
d) 38.74

10) X is an online media provider. By offering unlimited and exclusive online content at attractive prices for a loyalty membership, X is almost forcing its customers towards its loyalty membership. If its loyalty membership continues to grow at its current rate, within the next eight years more households will be watching X than cable television. Which one of the following statements can be inferred from the above paragraph?
(GATE 2019 XE)

a) Most households that subscribe to X's loyalty membership discontinue watching cable television
b) Non-members prefer to watch cable television
c) Cable television operators don't subscribe to X's loyalty membership
d) The X is canceling accounts of non-members

END OF SECTION- GA

ENGINEERING MATHEMATICS

1) Let X be the Poisson random variable with parameter $\lambda = 1$. Then, the probability $P(2 \leq X \leq 4)$ equals (GATE 2019 XE)

a) $\frac{19}{24e}$
b) $\frac{17}{24e}$
c) $\frac{13}{24e}$
d) $\frac{11}{24e}$

2) For the series $\sum_{n=1}^{\infty} \frac{(x+1)^n}{n, 2^n}$, $-\infty < x < \infty$, which of the following statements is NOT correct? (GATE 2019 XE)

a) The series converges at $x = -3$
b) The series converges at $x = -1$
c) The series converges at $x = 0$
d) The series converges at $x = 1$

3) Let $f(z) = \bar{z}, e^{-|z|^2}$, where $\bar{z}$ is the complex conjugate of z. Then, it is differentiable on (GATE 2019 XE)

a) $|z| > 1$
b) $|z| < 1$
c) $|z| = 1$
d) the entire complex plane $\mathbb{C}$

4) If the transformation $u(x,t) = e^{-x}, v(x,t)$ reduces the partial differential equation $\frac{\partial^2 u}{\partial x^2} - 2\frac{\partial u}{\partial x} + u = 9$ to the equation $\frac{\partial^2 v}{\partial x^2} = 9, f(x)$, then $f(x)$ equals (GATE 2019 XE)

a) $-e^{-x}$
b) e^{-x}
c) $-2e^{-x}$
d) $2e^{-x}$

5) The value of α for which the system of equations
$x - y - 3z = 3$
$2x + z = 0$
$-2y - 7z = \alpha$
has a solution is _____.
(GATE 2019 XE)

6) The value of the line integral $\oint_{\gamma}(-y^3dx + x^3dy)$, where γ is the circle $x^2 + y^2 = 1$ oriented counter clockwise, is _____.

7) Let $y_1(x)$ and $y_2(x)$ be two linearly independent solutions of the differential equation $x^2y'' + xy' - 4y = 0$, $x > 0$. If $y_1(x) = x^2$, then $\lim_{x\to\infty} y_2(x)$ is _____. (GATE 2019 XE)

8) If $Q = \begin{bmatrix} 3 & 2 & 4 \\ 2 & 0 & 2 \\ 4 & 2 & 3 \end{bmatrix}$ and $P = (\mathbf{v}_1\ \mathbf{v}_2\ \mathbf{v}_3)$ is the matrix where $\mathbf{v}_1, \mathbf{v}_2$ and $\mathbf{v}_3$ are linearly independent eigenvectors of the matrix Q, then the sum of the absolute values of all the elements of the matrix $P^{-1}QP$ is (GATE 2019 XE)

a) 6
b) 10
c) 14
d) 22

9) If $P(x) = ax^3 + bx^2 + cx + d$ is the polynomial obtained by Lagrange interpolation satisfying $P(0) = -8$, $P(1) = -7$, $P(2) = -6$ and $P(4) = 20$, then the value of $a - b + c$ is (GATE 2019 XE)

a) 1
b) 3
c) 5
d) 7

10) The number of critical points of the function $f(x, y) = x^3 + 3xy^2 - 15x - 12y$ at which there is neither maximum nor minimum is _____. (GATE 2019 XE)

11) Let $I = \dfrac{10^5 i}{2\pi} \oint_\gamma \dfrac{dz}{(z-4)(z^7-1)}$, where $i = \sqrt{-1}$ and γ is the circle $|z| = 2$ oriented counter clockwise. Then, the value of I rounded off to one decimal place is _____. (GATE 2019 XE)

END OF SECTION- A

FLUID MECHANICS

1) For stable equilibrium of a floating body, which one of the following statements is correct? (GATE 2019 XE)

a) Centre of gravity must be located below the centre of buoyancy.
b) Centre of buoyancy must be located below the centre of gravity.
c) Metacentre must be located below the centre of gravity.
d) Centre of gravity must be located below the metacentre.

2) If u and v are the velocity components in the x- and y-directions respectively, the z-component of vorticity ω_z at a point in a flow field is (GATE 2019 XE)

a) $\dfrac{\partial v}{\partial x} - \dfrac{\partial u}{\partial y}$
b) $\dfrac{\partial u}{\partial x} - \dfrac{\partial v}{\partial y}$
c) $\dfrac{\partial v}{\partial y} + \dfrac{\partial u}{\partial x}$
d) $\dfrac{\partial u}{\partial y} - \dfrac{\partial v}{\partial x}$

3) In which one of the following devices the difference between static and total pressure is used to determine the flow velocity? (GATE 2019 XE)

a) Piezometer
b) Pitot static tube
c) Orificemeter
d) Venturimeter

4) A golf ball is dimpled to make the flow turbulent and consequently to reduce the drag. Turbulent flow reduces the drag on the golf ball because (GATE 2019 XE)

a) skin friction coefficient is lower in a turbulent flow.
b) skin friction coefficient is higher in a turbulent flow.
c) turbulent flow has a lower tendency to separate.
d) turbulent flow has a higher tendency to separate.

5) For a steady laminar incompressible boundary layer flow over a sharp-edged flat plate at zero incidence, (GATE 2019 XE)

a) the edge of the boundary layer is a streamline.
b) the edge of the boundary layer is a pathline.
c) the skin friction coefficient decreases as the distance from the leading edge increases.
d) the skin friction coefficient remains constant all along the plate.

6) The power input P to a centrifugal pump is a function of the volume flow rate Q, impeller diameter D, rotational speed Ω, fluid density ρ, dynamic viscosity μ, and surface roughness ε. To carry out a dimensional analysis using Buckingham's π theorem, which one of the following sets can be taken as the set of repeating variables? (GATE 2019 XE)

a) $Q,\ \Omega,\ D$
b) $Q,\ \varepsilon,\ D$
c) $\varepsilon,\ D,\ \rho$
d) $D,\ \rho,\ \Omega$

7) Consider the two-dimensional laminar flow of water ($\mu = 0.001\ \mathrm{N \cdot s/m^2}$) between two infinitely long parallel plates $0.1\ \mathrm{m}$ apart as shown in the figure below. The velocity profile at any location is given by $u(y) = 100(0.1y - y^2)$ m/s where y is in m. The magnitude of shear stress (in N/m^2, rounded off to 2 decimal places) acting on the bottom plate is _____.

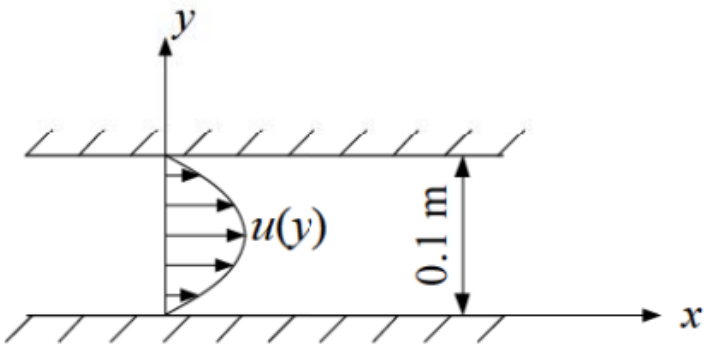

Fig. 7: Laminar flow of water

(GATE 2019 XE)

8) The maximum velocity in a fully developed laminar incompressible flow through a circular pipe of constant cross-sectional area is $6\ \mathrm{m/s}$. The average velocity (in m/s) of the flow is _____. (GATE 2019 XE)

9) The theoretical discharge for the flow through an orificemeter is $40\ \mathrm{m^3/s}$. If the measured discharge in an experiment is $32\ \mathrm{m^3/s}$, then the discharge coefficient (rounded off to one decimal place) is _____. (GATE 2019 XE)

10) Consider the flow between two infinitely long parallel plates of large width separated by a distance $2H$. The upper plate is moving with a constant velocity U while the lower plate is stationary. The volumetric flow rate per unit width of the plate is (GATE 2019 XE)

a) $0.25, UH$
b) $0.5, UH$
c) UH
d) $2, UH$

11) The velocity field in Cartesian coordinates in a two-dimensional steady incompressible flow of a fluid with density ρ is $\mathbf{V} = x, \hat{\imath} - y, \hat{\jmath}$. Assuming no body and line forces, the magnitude of pressure gradient ∇p at point $(1, 1)$ is (GATE 2019 XE)

a) $\sqrt{2}, \rho$
b) ρ
c) $\rho/\sqrt{2}$
d) $\rho/2$

12) A two-dimensional velocity field in Cartesian coordinates is defined by $\mathbf{V} = y, \hat{\imath} - x, \hat{\jmath}$. This flow is (GATE 2019 XE)

a) compressible and rotational
b) compressible and irrotational
c) incompressible and rotational
d) incompressible and irrotational

13) **Assertion [A]:** The streamlines in a free vortex flow are concentric circles.
Reasoning [R]: There exists only radial component for the velocity field in a free vortex flow.
(GATE 2019 XE)

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 the correct reason for [A]
A is true but [R] is false
A is false but [R] is true

14) The velocity components in Cartesian coordinates in a two-dimensional incompressible flow are $u = e^x \cos x$ and $v = e^x \sin x$. The magnitude of total acceleration at the point $(-1, 1)$ is (GATE 2019 XE)

a) 0
b) 1
c) e
d) e^2

15) For steady laminar flow at zero incidence over a flat plate, the component of velocity parallel to the plate in the boundary layer is given by $u(y) = a + by + cy^2$, where y is the distance measured normal to the flat plate. If μ is the coefficient of dynamic viscosity, U is the velocity parallel to the wall at the edge of the boundary layer and δ is the boundary layer thickness, the wall shear stress is given by (GATE 2019 XE)

a) $\mu, U/\delta$
b) $2\mu, U/\delta$
c) $2\mu, (U/\delta)^2$
d) $3\mu, U/\delta$

16) A fluid with constant density of $1\ \mathrm{kg/m^3}$ flows past a semi-cylindrical structure with a freestream velocity of $2\ \mathrm{m/s}$ as shown in the figure below. The difference in static pressure between points P and Q is $10\ \mathrm{N/m^2}$. If the gravitational acceleration g is $10\ \mathrm{m/s^2}$ and the flow is assumed to be potential, what is the radius r (in m) of the semi-cylindrical structure?

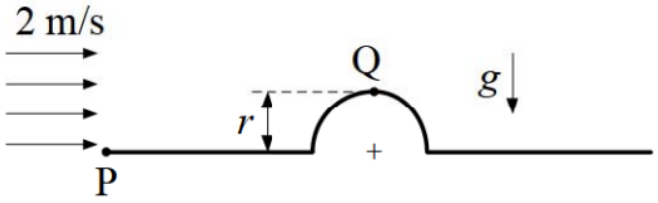

Fig. 16: Diagram

(GATE 2019 XE)

a) 1
b) 0.8
c) 0.6
d) 0.4

17) The mercury manometer shown in the figure below is connected to a water pipe at one end while the other end is open to the atmosphere. The density of water is $1000\ \mathrm{kg/m^3}$, the specific gravity of mercury is 13.6 and the gravitational acceleration g is $10\ \mathrm{m/s^2}$. The gauge pressure p_w (in kN/m^2, rounded off to 2 decimal places) in the water pipe is _____.

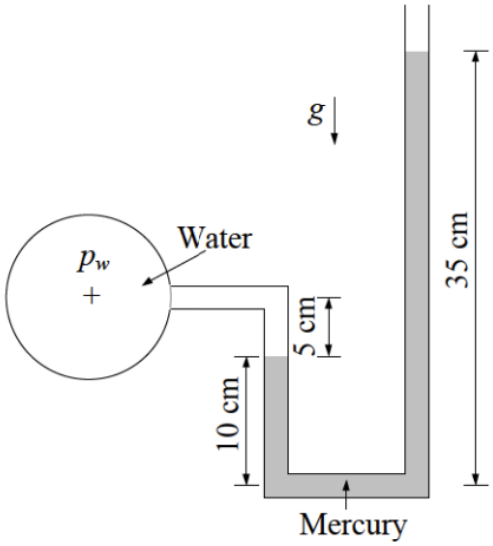

Fig. 17: Mercury Manometer

18) Water ($\rho = 1000\ \mathrm{kg/m^3}$, $\mu = 0.001\ \mathrm{N \cdot s/m^2}$) flows through a smooth circular pipe of radius $0.05\ \mathrm{m}$. If the flow Reynolds number is 1000, then the pressure drop (in N/m^2, rounded off to 2 decimals) over a length of $5\ \mathrm{m}$ will be ____. (GATE 2019 XE)

19) A uniform flow with a velocity of $2\ \mathrm{m/s}$ in the x-direction approaches a line source placed on the x-axis at a distance of $0.1\ \mathrm{m}$ from the origin. If the origin is the stagnation point in the resulting flow, the strength of the source (in m^2/s, rounded off to 2 decimals) is ____. (GATE 2019 XE)

20) In a steady incompressible flow of a fluid past a smooth stationary sphere, the drag force F depends on the flow velocity U, diameter D, and the dynamic viscosity μ and density ρ of the fluid. Experiments are conducted on the same sphere at the same flow velocity using two different fluids. The density of the second fluid is two times that of the first fluid. The dynamic viscosity of the second fluid is n times that of the first fluid. If the non-dimensional force $\dfrac{F}{\rho U^2 D^2}$ remains the same in both the experiments, the value of n is _____. (GATE 2019 XE)

21) An incompressible fluid flows past a flat plate as shown in the figure below with a uniform inlet velocity profile $u = U$ and a parabolic exit velocity profile $u = U(2\eta - \eta^2)$, where u is the component of velocity parallel to the wall, y is the normal distance from the plate and $\eta = y/\delta$. If the volume flow rate across the top surface of the control volume (CV) is $Q = p, U, \delta$ per unit width (perpendicular to the x-y plane) of the plate, the value of p (rounded off to 2 decimals) is _____.

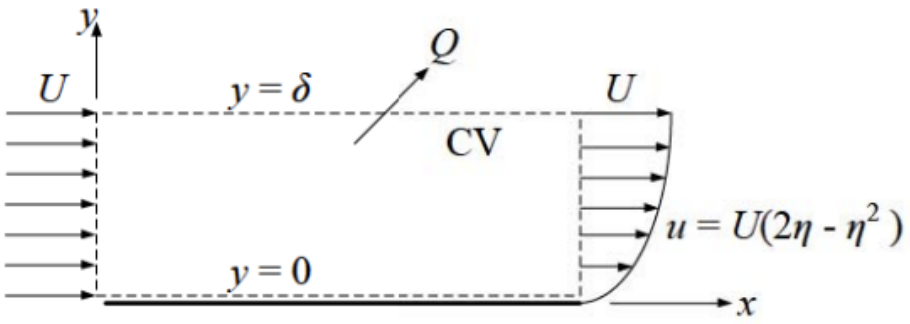

Fig. 21: Diagram

(GATE 2019 XE)

22) A jet engine is to be tested on a thrust stand as shown in the figure below. The conditions prevailing in a typical test are as follows: Axial intake air velocity $= 100$ m/s; axial exhaust gas velocity $= 250$ m/s; intake cross-sectional area $= 1$ m^2; intake static pressure $= -22$ kPa (gauge); exhaust static pressure $= 0$ kPa (gauge); mass flow rate through the engine $= 100$ kg/s. The anchoring force (in kN) in axial direction on the thrust stand is _____.

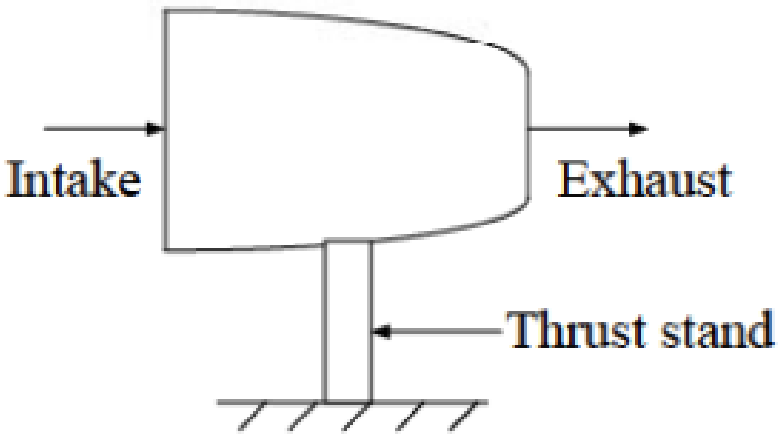

Fig. 22: Jet Engine

(GATE 2019 XE)

END OF SECTION- B

MATERIALS SCIENCE

1) On decreasing the objective aperture size in an optical microscope (GATE 2019 XE)

a) the spherical aberration increases
b) the depth of field increases
c) the diffraction-limited resolution increases
d) the astigmatism increases

2) Pilling-Bedworth ratios for oxides of some metals are given in the table.

TABLE 2: Table-2

Metal	Ratio
Li	0.57
Ce	1.16
Ta	2.33
W	3.40

Based on the criterion of Pilling-Bedworth ratio alone, which one of the following metals will be most protected from high temperature oxidation? (GATE 2019 XE)

a) Li
b) Ce
c) Ta
d) W

3) In NaCl, the substitution of a Na^+ ion by a Ca^{2+} ion would most probably lead to (GATE 2019 XE)

a) the formation of a Na^+ vacancy
b) the creation of a Cl^- interstitial
c) the formation of a Cl^- vacancy
d) the formation of a Na^+ and Cl^- vacancy pair

4) Which one of the following is time-independent? (GATE 2019 XE)

a) Elastic deformation
b) Anelastic deformation
c) Viscoelastic deformation
d) Creep deformation

5) Copper is diffused into aluminium at $400°C$ for 100 hours to obtain a certain concentration at a given depth. In another experiment conducted at $500°C$, to achieve the same concentration of copper at the same depth, the time required in hours is (Given: Diffusion coefficients of copper in aluminium at $400°C$ and $500°C$ are $5 \times 10^{-14}\ m^2s^{-1}$ and $6 \times 10^{-13}\ m^2s^{-1}$, respectively) (GATE 2019 XE)

6) If carbon (C) in iron (Fe) is 6 percent by weight, then its atomic percent is approximately (Given: atomic weight C=12, Fe=56) (GATE 2019 XE)

a) 13
b) 23
c) 30
d) 50

7) GaAs has advantage over silicon when used in integrated circuits at low power because it has (GATE 2019 XE)

a) larger band gap
b) more than one element
c) higher electron mobility
d) higher hole mobility

8) Glass transition temperature of a polymer can be determined by (GATE 2019 XE)

a) Thermo-gravimetric analysis
b) Raman spectroscopy
c) NMR spectroscopy
d) Differential scanning calorimetry

9) The maximum wavelength of radiation to which Germanium (Ge) is opaque will be (Given: energy gap of Ge=0.67 eV, Planck's constant $h = 6.63 \times 10^{-34}$ J·s, velocity of light $c = 3 \times 10^{8}$ m·s^{-1} and 1 eV$= 1.6 \times 10^{-19}$ J) (GATE 2019 XE)

a) 0.8 μm
b) 1.8 μm
c) 2.8 μm
d) 4.8 μm

10) An alternating copolymer has number-averaged molecular weight of 10^5 g·mol^{-1} and degree of polymerization of 2210. If one of the repeat units is ethylene, the other one is (Given: atomic weight of H=1, C=12, F=19 and Cl=35.5) (GATE 2019 XE)

a) –CH_2–$CH(CH_3)$–
b) –CH_2–CHCl–
c) –CF_2–CF_2–
d) –CH_2–$CH(C_6H_5)$–

11) Match the sintering processes in column I with the most suitable products in column II.

TABLE 11: Table-3

Column I	**Column II**
(P) Solid state sintering	(1) Carbon nanotube products
(Q) Liquid phase sintering	(2) Mixture of Cu and Zn powder
(R) Spark plasma sintering	(3) iron powder products
(S) Laser sintering	(4) 3D printed products

(GATE 2019 XE)

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

12) Which one of the following conditions will NOT favour the separation of impurities in zone refining process? (GATE 2019 XE)

a) Increase in the gap between solidus and liquidus lines
b) Increase in the solubility of impurities in solid as compared to that in liquid phase
c) Agitation of melt
d) Low cooling rate of melt

13) A monochromatic X-ray beam of wavelength 0.154 nm is incident on a cubic crystal having lattice parameter $a = 0.245$ nm. The diffraction angle (2θ) for the first order reflection from a set of planes represented by the schematic plane below is _____ degrees (round off to 1 decimal place).

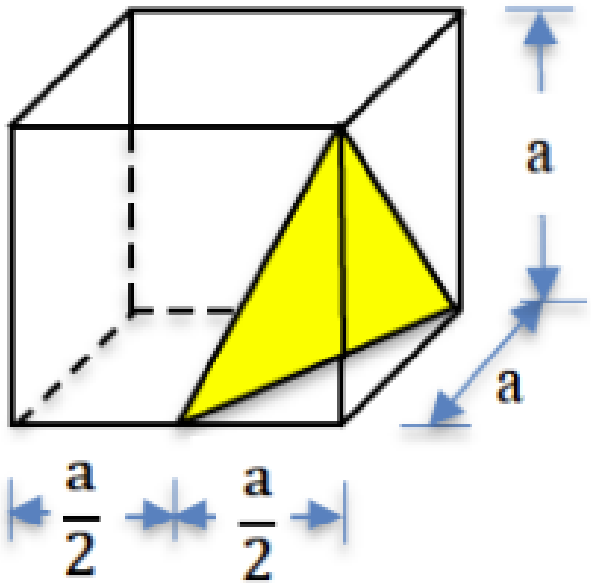

Fig. 13: Cubic Crystal Lattice

(GATE 2019 XE)

14) Nickel corrodes at 298 K in a solution of 0.06 M nickel chloride having pH 4. Assuming complete dissociation of nickel chloride, the partial pressure of hydrogen required to stop the corrosion of nickel is _____ atm (round off to the nearest integer) (GATE 2019 XE)

15) The potential energy, $U(r)$, of a pair of atoms spaced at a distance r in a solid is given by $U(r) = -A/r^3 + B/r^7$. The equilibrium distance between the atom pair is _____ nm (round off to 2 decimal places) (GATE 2019 XE)

16) Tensile true stress–true strain curve for plastic region of an alloy is given by $\sigma(\text{MPa}) = 600, \varepsilon^n$. When true strain is 0.05, the true stress is 350 MPa. For the same alloy, when engineering strain is 0.12 then the engineering stress is _____ MPa (round off to the nearest integer). (GATE 2019 XE)

17) Box-S has 2 white and 4 black balls and box-T has 5 white and 3 black balls. A ball is drawn at random, from the box-S and put in box-T. Subsequently, the probability of drawing a white ball from box-T is _____ (round off to 2 decimal places). (GATE 2019 XE)

18) The zero point energy of an electron in a box of 0.2 nm width is _____ eV (round off to 1 decimal place). (GATE 2019 XE)

19) The de Broglie wavelength of an electron accelerated across a 300 kV potential in an electron microscope is _____ $\times 10^{-12}$ m (round off to 2 decimal places). Ignore relativistic effects. (Given: Planck's constant=6.63×10^{-34} J·s, electron rest mass=9.11×10^{-31} kg, electron charge=1.6×10^{-19}) (GATE 2019 XE)

20) A stress of 17 MPa is applied to a polymer serving as a fastener in a complex assembly. At constant strain the stress drops to 16.6 MPa after 100 hours. The stress on the polymer must remain above 14.5 MPa in order for the assembly to function properly. The expected life of the assembly is _____ hours (round off to the nearest integer). (GATE 2019 XE)

21) A piezoelectric material has a Young's modulus of 72 GPa. The stress required to change the polarization from 640 to 645 $C \cdot mm^{-3}$ is _____ MPa (round off to the nearest integer). (GATE 2019 XE)

22) An iron bar magnet having coercivity of 7000 $A \cdot m^{-1}$ is to be demagnetized. The bar is introduced fully inside a 0.25 m long solenoid having 150 turns of wire. The electric current required to generate the necessary magnetic field is _____ A (round off to 1 decimal place). (GATE 2019 XE)

END OF SECTION- C

POLYMER SCIENCE

1) The functionality of allyl alcohol (CH_2=CH–CH_2OH) for condensation reaction with terephthalic acid is (GATE 2019 XE)

a) 0
b) 1
c) 2
d) 3

2) Which of the following polymers can be synthesized by ring opening polymerization? (GATE 2019 XE)

a) Poly(vinyl alcohol)
b) Nylon 66
c) Poly(ethylene terephthalate)
d) Poly(ε-caprolactone)

3) The weather resistant polymer among the following is (GATE 2019 XE)

a) natural rubber
b) styrene butadiene rubber
c) nitrile rubber
d) silicone rubber

4) If a combination of sodium and naphthalene is used to initiate polymerization of styrene, then the most likely mechanism of polymerization is (GATE 2019 XE)

a) free radical
b) cationic
c) anionic
d) olefin metathesis

5) Hypalon is the trade name for (GATE 2019 XE)

a) chlorosulfonated polyethylene
b) chlorinated polyethylene
c) ultra high molecular weight polyethylene
d) cross-linked polyethylene

6) The copolymer(s) among high density polyethylene (HDPE), low density polyethylene (LDPE) and linear low density polyethylene (LLDPE) is/are (GATE 2019 XE)

a) LDPE only
b) LLDPE only
c) LDPE and LLDPE
d) HDPE and LDPE

7) The polymer which lacks the ability to exhibit tacticity among the following is (GATE 2019 XE)

a) polypropylene
b) polystyrene
c) polyisobutylene
d) poly(methyl methacrylate)

8) The correct order of glass transition temperature (T_g) for the polymers listed below is (PC=polycarbonate; PET=poly(ethylene terephthalate); PE=polyethylene; PP=polypropylene) (GATE 2019 XE)

a) PC > PET > PP > PE
b) PC > PET > PE > PP
c) PET > PC > PE > PP
d) PET > PC >v PP > PE

9) Polystyrene coffee cup can be most economically manufactured by (GATE 2019 XE)

a) thermoforming
b) injection molding
c) compression molding
d) blow molding

10) Match the following rubber additives to their function:

TABLE 10: Table-4

Additives	**Fuctions**
P. Tetramethyl thiuram disulfide	1. Peptizer
Q. Xylyl mercaptan	2. Antiozonant
R. Sulfur	3. Accelerator
S. Microcrystalline wax	4. Cross-linking agent

(GATE 2019 XE)

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

11) Match the following polymers with their characteristic infrared (IR) stretching frequency:

TABLE 11: Table-5

Polymer	ν **(cm^{-1})**
P. Polystyrene	1. 2242
Q. Polyacrylonitrile	2. 1733
R. Poly(ethylene terephthalate)	3. 3392
S. Poly(vinyl alcohol)	4. 3100

(GATE 2019 XE)

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

12) Match the following products to the most suitable polymer for their manufacture:

TABLE 12: Table-6

Products	**Polymer**
P. Electrical cables	1. Polyurethane
Q. Electrical switches	2. Poly(methyl methacrylate)
R. Optical lenses	3. Cross-linked polyethylene
S. Shoe soles	4. Phenol formaldehyde resin

(GATE 2019 XE)

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

13) The order of limiting oxygen index for the following polymers is (PP=polypropylene; PTFE=polytetrafluoroethyl PVC=poly(vinyl chloride)) (GATE 2019 XE)

a) PP $<$ PTFE $<$ Nylon 6 $<$ PVC
b) PP $<$ PVC $<$ Nylon 6 $<$ PTFE
c) PP $<$ Nylon 6 $<$ PVC $<$ PTFE
d) PP $<$ Nylon 6 $<$ PTFE $<$ PVC

14) Match the following plastic additives to their function:

TABLE 14: Table-7

Additives	**Fuction**
P. Molybdenum disulphide	1. Heat stabilizer
Q. Glycerol monostearate	2. UV-absorber
R. Tribasic lead sulphate	3. Antistatic agent
S. 2-hydroxybenzophenone	4. Solid layer lubricant

(GATE 2019 XE)

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

15) Match the material classification in Column A with the appropriate one in Column B:
(PS=polystyrene, PPO=polyphenylene oxide, PDMS=poly(dimethyl siloxane), PP=polypropylene, PE=polyethyl
PP-g-MA=maleic anhydride grafted PP)

TABLE 15: Table-8

Column-A	**Column-B**
P. Miscible blend	1. PDMS + Fumed silica
Q. Immiscible blend	2. Nylon 6 + PP-g-MA + PP
R. Compatibilized blend	3. PS + PPO
S. Polymer composite	4. PE + PP

(GATE 2019 XE)

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

16) A linear amorphous polymer has a Tg of $+10°$C. At $28°$C, it has a melt viscosity of 4×10^8 poise. The viscosity of the polymer at its Tg is _____ $\times 10^{13}$ poise (round off to one decimal place). (GATE 2019 XE)

17) A polypropylene (PP) bar with a 10 mm$\times$10 mm square section is 225 mm long. The modulus of PP bar is 861 MN$\cdot$m^{-2}. It is pinned at both ends and an axial compressive load of 140 N is applied. The strain due to the applied load experienced by the PP bar is _____% (round off to two decimal places).
(GATE 2019 XE)

18) In a unidirectional carbon fibre/vinyl ester composite, the ratio of the moduli of the carbon fibre to that of vinyl ester is 35 and the fibres take up 50% of the cross-section. The percentage of applied force taken up by the fibres is _____% (round off to one decimal place).
(GATE 2019 XE)

19) A 3 mm thick layer of softened poly(methyl methacrylate) at $190°$C is sandwiched between two flat parallel plates. A shear stress of 100 kPa is applied to the softened polymer. Assuming the softened polymer as a Newtonian fluid with an apparent viscosity of 3.9×10^4 Pa$\cdot$s, the relative sliding velocity between the two plates is _____ mm$\cdot$s^{-1} (round off to one decimal place). (GATE 2019 XE)

20) For AIBN initiated polymerization of styrene, if both the monomer and initiator concentration are doubled, then the rate of polymerization increases by a factor of _____ (round off to two decimal places).
(GATE 2019 XE)

21) If 49 moles of hexamethylene diamine is reacted with 50 moles of adipic acid to prepare Nylon 66, then the number average molecular weight, M_n, of the resulting polymer at 99.5% conversion (ignoring contribution from end groups) is _____ g$\cdot$mol^{-1} (round off to 2 decimal places). (GATE 2019 XE)

22) A single screw extruder is to be used to manufacture a nylon rod of 0.5 cm diameter at a production rate of 2.5 $cm \cdot s^{-1}$. The density of solid nylon and nylon melt are 1.140 $g \cdot cm^{-3}$ and 0.790 $g \cdot cm^{-3}$, respectively. The melt flow rate through the die is _____ $cm^3 \cdot s^{-1}$ (round off to two decimal places). (GATE 2019 XE)

END OF SECTION- D

FOOD TECHNOLOGY

1) Colloidal stability of milk casein is because of the highly hydrated carbohydrate residues in (GATE 2019 XE)

a) α_{s1} casein
b) α_{s2} casein
c) β casein
d) κ casein

2) Rice bran is stabilized prior to oil extraction to protect it from the activity of ____. (GATE 2019 XE)

a) Polyphenol oxidase
b) Peroxidase
c) Lipase
d) Lipoxygenase

3) Sticking of powder to wall of the chamber during spray drying of fruit juice is due to _____. (GATE 2019 XE)

a) Low glass transition temperature of the compounds in juice
b) High glass transition temperature of the compounds in juice
c) Improper processing parameters of spray dryer
d) Presence of gums in feed material

4) Thearubigins and theaflavins in black tea are formed by the oxidation and dimerization of (GATE 2019 XE)

a) Quercetin
b) Catechins
c) Gallic acid
d) Kaempferol

5) Ratio of Schmidt number to Lewis number is _____. (GATE 2019 XE)

a) Prandtl number
b) Reynolds number
c) Nusselt number
d) Sherwood number

6) 'Red dog' is one of the byproducts during milling of _____. (GATE 2019 XE)

a) Corn
b) Rice
c) Ragi
d) Wheat

7) An ice cream mix of 870 g·L^{-1} has been used to prepare ice cream which yielded a finished product of 490 g·L^{-1}. The per cent over run is _____ (round off to 1 decimal place). (GATE 2019 XE)

8) Impeller in a fruit juice mixing tank is rotating at 200 rpm with a Reynolds number $> 10^4$. Density of juice is 1,045 kg·m^{-3}. If diameter of the impeller is doubled and other conditions remained constant, the power requirement of mixing will increase by a factor of _____. (GATE 2019 XE)

9) Paddy consisting of 20% husk has been milled to remove 6% bran during polishing. Assuming no other losses, yield (per cent) of polished rice from the paddy is _____ (round off to 1 decimal place). (GATE 2019 XE)

10) Match the following laws in Column I with corresponding phenomenon in Column II.

TABLE 10: Table-9

Column-I	**Column-II**
P. Newton's law	1. Size reduction
Q. Hertx constant stress theory	2. Substance cooling
R. Fick's law	3. Damage of fruits and vegetables
S. Bond's Law	4. Molecular diffusion

(GATE 2019 XE)

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

11) Match the mold in Column I with its asexual/sexual spore shown in Column II.

TABLE 11: Table-10

Column-I	**Column-II**
P. Aspergillus	1. Arthrospore
Q. Geotrichum	2. Oospores
R. Rhizopus	3. Conidia
S. Oomycetes	4. Sporangiospores

(GATE 2019 XE)

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

12) Match the foods given in Column I with their specific usage given in Column II.

TABLE 12: Table-11

Column-I	**Column-II**
P. Egg yolk	1. Ice cream
Q. Pregelatinised starch	2. Mayonnaise
R. Gum	3. Baking powder
S. Starch	4. Baby food

(GATE 2019 XE)

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

13) Match the bioactive compounds in Column I with their botanical source given in Column II.

(GATE 2019 XE)

TABLE 13: Table-12

Column-I	Column-II
P. Isoflavones	1. Corn
Q. Resistant starch	2. Grapes
R. Xanthophyll	3. Soyabean
S. Resveratrol	4. Platain (culinary banana)

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

14) Match the following microbial species in Column I with related disease caused by them as listed in Column II.

TABLE 14: Table-13

Column-I	Column-II
P. Vibrio	1. Gastroeneritis
Q. Shigella sp.	2. Typhoid
R. E. coli	3. Cholera
S. Salmoonella typhi	4. Bacillary dysentery

(GATE 2019 XE)

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

15) Buffalo milk having density of 1,030 kg·m^{-3} is homogenized with a pressure of 30 MPa. Given, acceleration due to gravity as 9.81 m·s^{-2} and assuming no pressure loss, the velocity (m·s^{-1}) of the milk flowing through the homogenizer valve will be _____ (round off to 2 decimal places). (GATE 2019 XE)

16) Potato slices have been dehydrated from an initial solid content of 12% to a final solid content of 94%. If the peeling and other losses are to the tune of 10%, final yield (per cent) of the dried chips per ton of fresh potato taken is _____ (round off to 2 decimal places). (GATE 2019 XE)

17) A mixed fruit beverage with 12 °Brix having specific heat of 4,298 J·kg^{-1}·K^{-1} is being heated from 30°C to 95°C for pasteurization at a flow rate of 1,000 L·h^{-1} in a tubular heat exchanger. Steam at 100°C is used as heating medium which is converted into condensate at 100°C. If the density of beverage is 1,075 kg·m^{-3} and the latent heat of steam at the given temperature is 2,257 kJ·kg^{-1}, the mass flow rate of steam (kg·min^{-1}) is _____ (round off to 2 decimal places). (GATE 2019 XE)

18) Fruit juice was cooled in a tubular heat exchanger from 50°C to 7°C using water at 2°C, which gets heated to 5°C. Assume, Pr=0.72, Re=20,000 and thermal conductivity=0.6 W·m^{-1} · °C^{-1} and no viscous effect. If pipe diameter was 10 cm, the convective heat transfer coefficient (W·m^{-2} · °C^{-1}) is _____ (round off to 1 decimal place). (GATE 2019 XE)

19) Room air is at 40°C with 60% relative humidity. Saturated vapour pressure of water at 40°C is 7.375 kPa. Volume of humid air (m^3 per kg of dry air) is _____ (round off to 3 decimal places). (GATE 2019 XE)

20) A shallow-bed horizontal belt type solvent extractor is operating on 0.3 mm thick soybean flakes with 0.5 m bed depth and a forward speed of 0.8 m·min^{-1} with miscella flux rate of 0.25 m·min^{-1}. If porosity of the flakes is 60%, the distance between washing nozzle and miscella collecting receptacle (cm) is _____ (round off to 1 decimal place). (GATE 2019 XE)

21) An extruded snack food is packed in a barrier film having water vapour transmission rate of 0.02 mL·m^{-2}·day^{-1}. Pack surface area is 0.0012 m^2 per gram of dry food solids, EMC of the food is 6% (d.b.), initial moisture content is 2% (d.b.), critical moisture content is 5% (d.b.) and slope of moisture sorption isotherm is 3.4% (d.b.) per unit water activity (a_w). Sealed pack is stored at 30°C. Assume that the vapor pressure of pure water at 30°C is 31.7 torr. Time required for the food to reach the critical moisture content (days) is _____ (round off to 1 decimal place). (GATE 2019 XE)

22) Freezing of 100 mm spherical meat ball with 60% moisture at 35°C is being done in an air blast freezer maintained at -45°C. Given, latent heat of fusion for water is 333.2 kJ·kg^{-1}, thermal conductivity of meat is 1.5 W·m$^{-1}\cdot{}^\circ$C^{-1}, convective heat transfer coefficient is 40 W·m$^{-2}\cdot{}^\circ$C^{-1}, density of frozen meat is 980 kg·m^{-3} and initial freezing temperature of meat ball is -10°C. Using Plank's equation, freezing time (h) is _____ (round off to 2 decimal places). (GATE 2019 XE)

END OF SECTION- E