METALLURGY ENGINEERING (MT)

GATE 2025
EE25BTECH11027-INDHIRESH S

General Aptitude

Q.1 - Q.5 Carry ONE mark Each

1) Despite his initial hesitation, Rehman's _____ to contribute to the success of the project never wavered. (GATE MT 2025)
Select the most appropriate option to complete the above sentence.

a) ambivalence b) satisfaction c) resolve d) revolve

2) Bird : Nest :: Bee : _____ (GATE MT 2025)
Select the correct option to complete the analogy.

a) Kennel b) Hammock c) Hive d) Lair

3) If $Pe^{x} = Qe^{-x}$ for all real values of x, which one of the following statements is true? (GATE MT 2025)

a) $P = Q = 0$
b) $P = Q = 1$
c) $P = 1; Q = -1$
d) $\frac{P}{Q} = 0$

4) The paper as shown in the figure is folded to make a cube where each square corresponds to a particular face of the cube. Which one of the following options correctly represents the cube? (GATE MT 2025)
Note: The figures shown are representative.

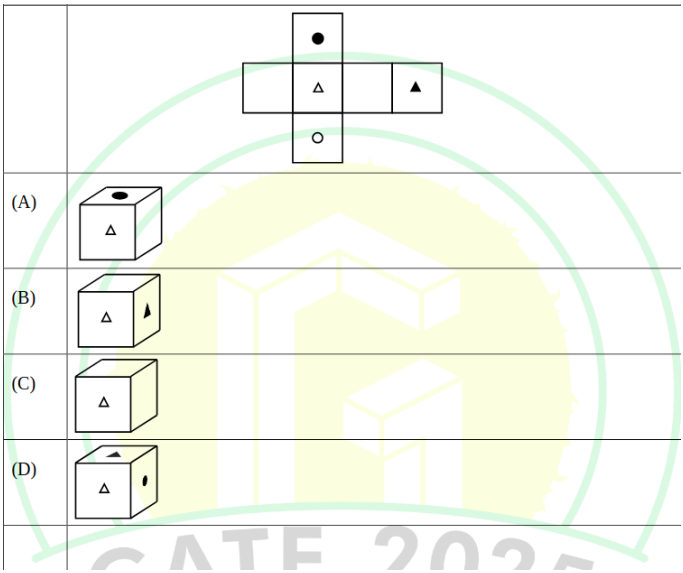

Fig. 4.

FIGURE

5) Let p_1 and p_2 denote two arbitrary prime numbers. Which one of the following statements is correct for all values of p_1 and p_2? (GATE MT 2025)

a) $p_1 + p_2$ is not a prime number.
b) $p_1 p_2$ is not a prime number.
c) $p_1 + p_2 + 1$ is a prime number.
d) $p_1 p_2 + 1$ is a prime number.

Q.6 - Q.10 Carry TWO marks Each

6) Based only on the conversation below, identify the logically correct inference: (GATE MT 2025)
"Even if I had known that you were in the hospital, I would not have gone there to see you", Ramya told Josephine.
a) Ramya knew that Josephine was in the hospital.
b) Ramya did not know that Josephine was in the hospital.
c) Ramya and Josephine were once close friends; but now, they are not.
d) Josephine was in the hospital due to an injury to her leg.

7) If IMAGE and FIELD are coded as FHBNJ and EMFJG respectively then, which one among the given options is the most appropriate code for BEACH? (GATE MT 2025)

a) CEADP b) IDBFC c) JGIBC d) IBCEC

8) Which one of the following options is correct for the given data in the table? (GATE MT 2025)

Iteration (i)	Input (I)	Output (X)	Output (Y)
0	20	20	20
1	-4	16	-80
2	10	26	-800
3	15	41	-12000

a) $X(i) = X(i-1) + I(i);\ Y(i) = Y(i-1)I(i);\ i > 0$
b) $X(i) = X(i-1)I(i);\ Y(i) = Y(i-1) + I(i);\ i > 0$
c) $X(i) = X(i-1)I(i);\ Y(i) = Y(i-1)I(i);\ i > 0$
d) $X(i) = X(i-1) + I(i);\ Y(i) = Y(i-1)I(i-1);\ i > 0$

9) In the given figure, PQRS is a square of side 2 cm and PLMN is a rectangle. The corner L of the rectangle is on the side QR. Side MN of the rectangle passes through the corner S of the square. (GATE MT 2025)
What is the area (in cm^2) of the rectangle PLMN?
Note: The figure shown is representative.

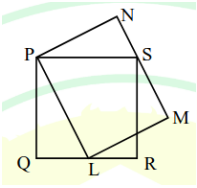

Fig. 9.

FIGURE

a) $2\sqrt{2}$ b) 2 c) 8 d) 4

10) The diagram below shows a river system consisting of 7 segments, marked P, Q, R, S, T, U, and V. It splits the land into 5 zones, marked Z1, Z2, Z3, Z4, and Z5. We need to connect these zones using the least number of bridges. Out of the following options, which one is correct? (GATE MT 2025)
Note: The figure shown is representative.

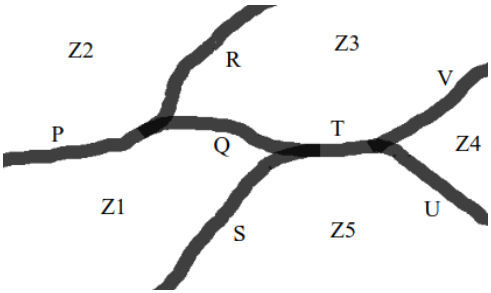

Fig. 10.

RIVER SYSTEM

a) Bridges on P, Q, and T
b) Bridges on P, Q, S, and T
c) Bridges on Q, R, T, and V
d) Bridges on P, Q, S, U, and V

Metallurgical Engineering

Q.11 - Q.35 Carry ONE mark Each

11) Which one of the following matrices has eigenvalues 1 and 6? (GATE MT 2025)

a) $\begin{pmatrix} 5 & -2 \\ -2 & 2 \end{pmatrix}$
b) $\begin{pmatrix} 3 & -1 \\ -2 & 2 \end{pmatrix}$
c) $\begin{pmatrix} 3 & -1 \\ -1 & 2 \end{pmatrix}$
d) $\begin{pmatrix} 2 & -1 \\ -1 & 3 \end{pmatrix}$

12) For an isobaric process, the heat transferred is equal to the change in _____ of the system. (GATE MT 2025)

a) enthalpy
b) entropy
c) Helmholtz free energy
d) Gibbs free energy

13) Match each crystal defect in Column I with the corresponding type in Column II. (GATE MT 2025)

Column I	**Column II**
P. Edge dislocation	1. Zero-dimensional defect
Q. Stacking fault	2. One-dimensional defect
R. Frenkel defect	3. Two-dimensional defect
S. Porosity	4. Three-dimensional defect

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

14) At high temperatures, which one of the following empirical expressions correctly describes the variation of dynamic viscosity μ of a Newtonian liquid with absolute temperature T? (GATE MT 2025)
Given: A and B are positive constants.

a) $\mu = A + BT$
b) $\mu = A\exp(-BT)$
c) $\mu = A\exp(B/T)$
d) $\mu = A\exp(BT)$

15) Which one of the following is an intensive property? (GATE MT 2025)

a) Chemical potential
b) Volume
c) Mass
d) Entropy

16) Hot metal from a blast furnace is treated with mill scale prior to oxygen steelmaking for _____ (GATE MT 2025)

a) dephosphorization
b) decarburization
c) desulphurization
d) desiliconization

17) In optical microscopy, which one of the following combinations of wavelength (λ) and numerical aperture (NA) provides the best spatial resolution? (GATE MT 2025)

a) λ = 400 nm and NA = 1.0
b) λ = 600 nm and NA = 1.2
c) λ = 400 nm and NA = 1.2
d) λ = 600 nm and NA = 1.0

18) The coordination number for an octahedral site in pure copper is _____. (GATE MT 2025)

a) 4 b) 6 c) 8 d) 12

19) Consider the following gas-phase reaction: (GATE MT 2025)

$$2SO_2 + O_2 \rightleftharpoons 2SO_3 \quad (1)$$

If the enthalpy of reaction is negative, which one of the following conditions promotes a higher equilibrium concentration of SO_3?

a) Higher pressure and higher temperature
b) Higher pressure and lower temperature
c) Lower pressure and higher temperature
d) Lower pressure and lower temperature

20) Which one of the following slag components is responsible for the oxidizing power of steelmaking slags? (GATE MT 2025)

a) SiO_2 b) CaO c) MgO d) FeO

21) Two randomly oriented polycrystalline copper samples with average grain sizes of 10μm (Sample A) and 100μm (Sample B) were tested at room temperature. (GATE MT 2025)
Given:
E_A = Young's modulus of Sample A
E_B = Young's modulus of Sample B
YS_A = Yield strength of Sample A
YS_B = Yield strength of Sample B
Which one of the following statements is CORRECT?

a) $E_A > E_B$ and $YS_A > YS_B$
b) $E_A = E_B$ and $YS_A < YS_B$
c) $E_A > E_B$ and $YS_A = YS_B$
d) $E_A = E_B$ and $YS_A > YS_B$

22) In metal casting, which one of the following gating ratios (sprue-runner-gate area ratio) represents a non-pressurized gating system? (GATE MT 2025)

a) 1 : 2 : 3 b) 3 : 2 : 1 c) 4 : 3 : 1 d) 5 : 4 : 1

23) In the Fe-C system, the invariant reaction Liquid + $\delta \rightleftharpoons \gamma$ takes place at 1493 °C. This type of reaction is called _____. (GATE MT 2025)

a) eutectic b) eutectoid c) peritectic d) monotectic

24) Match the following elements in Column I with their respective ores in Column II. (GATE MT 2025)

Column I	**Column II**
P. Al	1. Rutile
Q. Fe	2. Hematite
R. Ti	3. Chalcopyrite
S. Cu	4. Bauxite

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

25) Which of the following functions is/are expandable using Maclaurin series? (GATE MT 2025)

a) $\ln(1+z)$ b) $\ln z$ c) $\frac{1}{z^2}$ d) $\exp(z)$

26) With reference to edge and screw dislocations, which of the following statements is/are CORRECT? (GATE MT 2025)

a) Both edge and screw dislocations can leave the slip plane by climb.
b) Burgers vector of a screw dislocation is parallel to its line vector.
c) Both edge and screw dislocations can leave the slip plane by cross-slip.
d) Strain energy per unit length of an edge dislocation is higher than that of a screw dislocation.

27) Which of the following conditions is/are favorable for producing low-silicon hot metal in blast furnace ironmaking? (GATE MT 2025)

a) Reduced raceway adiabatic flame temperature
b) Oxygen-enriched blast
c) Lime injection through tuyeres
d) Increased hearth temperature

28) Which of the following statements is/are CORRECT with respect to the initial stage of GP zone formation in a precipitation hardenable $Al - 4.5wt.\%$ Cu alloy? (GATE MT 2025)

a) GP zones are Cu-rich clusters.
b) GP zones are $CuAl_2$ precipitates.
c) GP zones are incoherent with the matrix.
d) GP zones are coherent with the matrix.

29) Which of the following techniques can be used to detect an internal defect in a metal casting? (GATE MT 2025)

a) Ultrasonic inspection
b) Liquid (or dye) penetrant inspection
c) Gamma-ray radiography
d) X-ray radiography

30) Standard Gibbs free energies of formation of some solid oxides per mole of O_2 at 1000 K are given below. (GATE MT 2025)
$SiO_2 : -728kJ$, $TiO_2 : -737kJ$, $VO : -712kJ$, $MnO : -624kJ$
Regarding thermodynamic feasibility of oxide reduction, which of the following statements is/are CORRECT under standard conditions at 1000 K?

a) Si can reduce TiO_2.
b) Mn can reduce VO.
c) Ti can reduce MnO.
d) V can reduce SiO_2.

31) Consider a fully developed, steady, one-dimensional, laminar flow of a Newtonian liquid through a pipe. The maximum velocity in the pipe is proportional to which of the following quantities? (GATE MT 2025)
Given: ΔP is the difference between the outlet and inlet pressure, μ is the dynamic viscosity of the liquid, and R and L are radius and length of the pipe, respectively.

a) ΔP b) $1/R^2$ c) $1/\mu$ d) $1/L$

32) The hydrostatic stress for the stress tensor provided below is _____ MPa (in integer). (GATE MT 2025)

$$\begin{pmatrix} 150 & 0 & 0 \\ 0 & -100 & 100 \\ 0 & 100 & 250 \end{pmatrix} \tag{2}$$

33) For an application where the Reynolds number is to be kept constant, a liquid with a density of 1 g cm^{-3} and viscosity 0.01 Poise results in a characteristic speed of 1 cm s^{-1}. If this liquid is replaced by another with a density of 1.25 g cm^{-3} and viscosity of 0.015 Poise, the characteristic velocity will be _____ cm s^{-1} (rounded off to one decimal place). (GATE MT 2025)
Assume the characteristic length of the flow to be the same in both cases.

34) Consider the gas phase reaction: (GATE MT 2025)

$$CO + \frac{1}{2}O_2 \rightleftharpoons CO_2 \tag{3}$$

At equilibrium for a particular temperature, the partial pressures of CO, O_2, and CO_2 are found to be 10^{-6} atm, 10^{-6} atm, and 16 atm, respectively. The equilibrium constant for the reaction is _____ $\times 10^{10}$ (rounded off to one decimal place).

35) A linear regression model was fitted to a set of (x, y) data. The total sum of squares and sum of squares of error are 1200 and 120, respectively. The coefficient of determination (R^2) of the fit is _____ (rounded off to one decimal place). (GATE MT 2025)

Q.36 - Q.65 Carry TWO marks Each

36) For two continuous functions $M(x, y)$ and $N(x, y)$, the relation $Mdx + Ndy = 0$ describes an exact differential equation if (GATE MT 2025)

a) $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$ b) $\frac{\partial M}{\partial x} = -\frac{\partial N}{\partial y}$ c) $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$ d) $\frac{\partial M}{\partial y} = -\frac{\partial N}{\partial x}$

37) Consider the phase diagram of a one component system given below. (GATE MT 2025)
V_α, V_β, and V_{Liquid} are the molar volumes of α, β, and liquid phases, respectively. Which one of the following statements is TRUE?
Given: The change in molar enthalpies, $\Delta H_{\alpha \to \beta}$ and $\Delta H_{\beta \to \text{Liquid}}$, are positive.

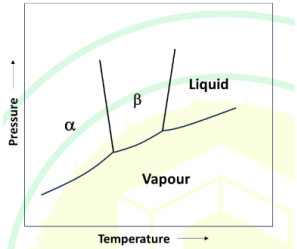

Fig. 37.

PHASE DIAGRAM

a) $V_\alpha < V_\beta$ and $V_\beta < V_{\text{Liquid}}$
b) $V_\alpha > V_\beta$ and $V_\beta < V_{\text{Liquid}}$
c) $V_\alpha < V_\beta$ and $V_\beta > V_{\text{Liquid}}$
d) $V_\alpha > V_\beta$ and $V_\beta > V_{\text{Liquid}}$

38) Match the steel plant related processes in Column I with the associated information in Column II. (GATE MT 2025)

Column I	**Column II**
P. Corex	1. Melter-gasifier
Q. Electric Arc Furnace	2. Natural gas reformer
R. Midrex	3. Electromagnetic stirrer
S. Continuous Casting	4. Hot heel

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

39) Radiative heat flux $\dot{q}$ at a hot surface at a temperature T_s can be expressed as (GATE MT 2025)

$$\dot{q} = A f(T_s, T_\infty)(T_s - T_\infty) \tag{4}$$

where A is a constant and T_∞ is the temperature of the surroundings (temperatures are expressed in K). The function $f(T_s, T_\infty)$ is given by _____.

a) $(T_s + T_\infty)^2(T_s - T_\infty)$
b) $(T_s^2 + T_\infty^2)(T_s + T_\infty)$
c) $(T_s^2 - T_\infty^2)(T_s + T_\infty)$
d) $(T_s - T_\infty)^2(T_s + T_\infty)$

40) Match the phenomena in Column I with the typical observations in Column II. (GATE MT 2025)

Column I	**Column II**
P. Dynamic strain aging	1. Grain boundary sliding
Q. Recrystallization	2. Decrease in yield stress with a reversal of loading direction
R. Bauschinger effect	3. Decrease in dislocation density
S. Superplasticity	4. Serrations in stress-strain curve

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

41) Which one of the following matrices is orthogonal? (GATE MT 2025)

a) $\begin{pmatrix} 1/2 & -\sqrt{3}/2 \\ -\sqrt{3}/2 & 1/2 \end{pmatrix}$
b) $\begin{pmatrix} 1/2 & -\sqrt{3}/2 \\ \sqrt{3}/2 & 1/2 \end{pmatrix}$
c) $\begin{pmatrix} 1/\sqrt{2} & -\sqrt{3}/2 \\ -\sqrt{3}/2 & 1/2 \end{pmatrix}$
d) $\begin{pmatrix} 1/\sqrt{2} & -\sqrt{3}/2 \\ \sqrt{3}/2 & -1/\sqrt{2} \end{pmatrix}$

42) Match the casting defects in Column I with the characteristic features in Column II. (GATE MT 2025)

Column I	**Column II**
P. Misrun	1. Penetration of liquid metal behind surface layer of sand moulds
Q. Expansion scab	2. Metal solidifies prematurely in the mould and some sections of the casting are not filled
R. Pin holes	3. Cracking because of restraint to contraction in certain areas of the casting during solidification and cooling to room temperature
S. Hot tearing	4. Evolution of gases during solidification resulting in porosity

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

43) The following are the activation energies for diffusion of carbon and iron at 773 K in polycrystalline BCC iron: (GATE MT 2025)
P = Activation energy for diffusion of carbon in BCC iron through the lattice
Q = Activation energy for diffusion of iron in BCC iron through the lattice

R = Activation energy for diffusion of iron in BCC iron along the grain boundary
Which one of the following statements is CORRECT?

a) $R < P < Q$ b) $R < Q < P$ c) $Q < P < R$ d) $P < R < Q$

44) Front tension is applied during cold rolling of a thin metal sheet. Which of the following statements is/are TRUE? (GATE MT 2025)
a) The neutral point shifts towards the roll entrance.
b) The rolling load is decreased.
c) The neutral point shifts towards the roll exit.
d) The rolling load is increased.

45) Which of the following statements is/are CORRECT when Ni is added as an alloying element to a low alloy steel? (GATE MT 2025)
a) Hardenability is increased AND the Ms temperature is lowered.
b) Hardenability is decreased AND the Ms temperature is lowered.
c) Hardenability is increased AND the Ms temperature is raised.
d) Hardenability is decreased AND the Ms temperature is raised.

46) Which of the following statements is/are CORRECT with respect to fusion welding and solid-state welding of metals and alloys? (GATE MT 2025)
a) Thermomechanically affected zone is found in the fusion welding of pure metals.
b) Partially melted zone is NOT found in the fusion welding of pure metal.
c) Diffusion bonding is one type of solid-state welding process.
d) Partially melted zone is found in the fusion welding of alloys with a large freezing range.

47) Which of the following welding processes does NOT / do NOT utilize consumable electrode? (GATE MT 2025)

a) Plasma arc welding
b) Gas metal arc welding
c) Shielded metal arc welding
d) Electron beam welding

48) For a two-dimensional field described by $T(x, y) = \frac{1}{3}xy(x + y)$, the magnitude of its gradient at the point (1,1) is _____ (rounded off to two decimal places). (GATE MT 2025)

49) X-ray diffraction using a monochromatic radiation of wavelength 0.154 nm is performed on powder samples of metal A (with FCC crystal structure) and metal B (with BCC crystal structure). If the first peak in both the cases occurs at a Bragg angle $\theta = 20°$, then the value of $\frac{\text{lattice parameter of metal A}}{\text{lattice parameter of metal B}}$ = _____ (rounded off to two decimal places). (GATE MT 2025)

50) The excess molar Gibbs free energy of a solution of element A and B at 1000 K is given by $G^{XS} = -3000X_AX_B$ J mol^{-1}, where X_A and X_B are mole fractions of A and B, respectively. The activity of B in a solution of A and B containing 40 mol% of B at 1000 K is _____ (rounded off to two decimal places). (GATE MT 2025)
Given: Ideal gas constant R = 8.314 J mol^{-1} K^{-1}.

51) Molten steel at 1900 K having dissolved hydrogen needs to be vacuum degassed. The equilibrium partial pressure of hydrogen to be maintained to achieve 1 ppm (mass basis) of dissolved hydrogen is _____ Torr (rounded off to two decimal places). (GATE MT 2025)
Given: For the hydrogen dissolution reaction in molten steel (½ $H_2(g)$ = [H]), the equilibrium constant (expressed in terms of ppm of dissolved H) is:
$\log_{10} K_{eq} = -\frac{1900}{T} + 2.4$
1 atm = 760 Torr

52) The value of $\lim_{x\to 0} \frac{6(x-\sin x)}{x^3}$ is _____ (in integer). (GATE MT 2025)

53) Consider the following reactions and their standard Gibbs free energies (in J): (GATE MT 2025)

$$Fe(s) + \frac{1}{2}O_2(g) \rightleftharpoons FeO(s) \quad \Delta G^\circ = -264900 + 65T \tag{5}$$

$$2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(g) \quad \Delta G^\circ = -492900 + 109T \tag{6}$$

Assuming Fe and FeO to be pure and no solubility of gases in the solids, the value of $\frac{p_{H_2O}}{p_{H_2}}$ required to reduce solid FeO to solid Fe at 1000 K is _____ (rounded off to two decimal places).
Given: Ideal gas constant R = 8.314 J mol^{-1} K^{-1}.

54) The diameter of spherical galena particles that have the same settling velocity as spherical quartz particles of diameter 25μm (both settling in water) is _____ μm (rounded off to one decimal place). (GATE MT 2025)
Assume Stokes law of settling to be valid.
Given: Density of galena = 7400 kg m^{-3}, density of quartz = 2600 kg m^{-3}, density of water = 1000 kg m^{-3}.

55) Consider the following cell reaction: (GATE MT 2025)

$$Mg + Cd^{2+} \rightleftharpoons Mg^{2+} + Cd \tag{7}$$

The standard Gibbs free energy change for the reaction is _____ kJ (rounded off to an integer).
Given: Standard oxidation potentials for the reactions with respect to standard hydrogen electrode are:
$Mg \rightleftharpoons Mg^{2+} + 2e^-$ $E^\circ = 2.37$ V
$Cd \rightleftharpoons Cd^{2+} + 2e^-$ $E^\circ = 0.403$ V
Faraday's constant = 96500 C mol^{-1}.

56) Copper is being electrodeposited from a $CuSO_4$ bath onto a stainless steel cathode of total surface area of 2 m^2 in an electrolytic cell operated at a current density of 200 A m^{-2} with a current efficiency of 90%. The mass of copper deposited in 24 h is _____ kg (rounded off to two decimal places). (GATE MT 2025)
Given: Faraday's constant = 96500 C mol^{-1}, atomic mass of copper = 63.5 g mol^{-1}.

57) An intrinsic semiconductor has conductivity of 100 Ω^{-1} m^{-1} at 300 K and 300 Ω^{-1} m^{-1} at 500 K. The band gap of the semiconductor is _____ eV (rounded off to two decimal places). (GATE MT 2025)
Given: Boltzmann constant $k_B = 8.6 \times 10^{-5}$ eV K^{-1}.

58) For a component fabricated from an alloy A with plane strain fracture toughness, K_{IC} = 50 MPa $m^{1/2}$, fracture was observed to take place at a crack length of 0.4 mm at a tensile service stress of σ. If the same component is instead fabricated from alloy B with K_{IC} = 75 MPa $m^{1/2}$, the crack length at which a similar crack geometry will result in fracture (under identical tensile service stress of σ) is _____ mm (rounded off to one decimal place). (GATE MT 2025)

59) Temperatures at two sides of a 0.4 m thick copper plate are 1000 and 500°C. Assuming steady state, one-dimensional conductive heat transfer through the wall and ignoring end-effects, the magnitude of the heat flux through the wall is _____ $\times 10^5$ W m^{-2} (in integer). (GATE MT 2025)
Given: Thermal conductivity of copper is 400 W m^{-1} K^{-1}.

60) In polycrystalline Ni, Nabarro-Herring diffusion creep was found to be the rate controlling creep mechanism at a certain temperature. At that temperature, if the steady state strain rate is 10^{-8} s^{-1} at a stress of 10 MPa, the steady state strain rate of 10^{-9} s^{-1} will be obtained at a stress value of _____ MPa (in integer). (GATE MT 2025)
Assume that the same creep mechanism is rate controlling during the creep deformation.

61) A single crystal BCC metal with a lattice parameter a = 0.4 nm is subjected to deformation at a shear strain rate of 0.001 s^{-1}. If the average mobile dislocation density in the single crystal is 10^{10} m^{-2}, the average dislocation velocity is _____ $\times 10^{-3}$ m s^{-1} (rounded off to two decimal places). (GATE MT 2025)
Given: Burgers vector $\mathbf{b} = \frac{a}{2}\langle 111 \rangle$.

62) A cylindrical specimen is subjected to plastic deformation in tension up to a uniform elongation of 10%. The final cross-sectional area of the gage section is found to be 20 mm^2. The initial cross-sectional area of the gage section is _____ mm^2 (rounded off to an integer). (GATE MT 2025)

63) The reaction represented by $A \longrightarrow B$ follows first order kinetics. At a given temperature, 20% of the reaction is completed in 223 s. The time taken to complete 50% of the reaction at the same temperature is _____ s (rounded off to the nearest integer). (GATE MT 2025)

64) A cylindrical Al alloy billet of 300 mm diameter is hot extruded to produce a cylindrical rod of 75 mm diameter at a constant true strain rate ($\dot{\epsilon}$) of 10 s^{-1}. The flow stress (σ) of the alloy at the extrusion temperature is given by $\sigma = 10(\dot{\epsilon})^{0.3}$ MPa. Assume the alloy is perfectly plastic and there is no temperature rise during the extrusion process. The ideal plastic work of deformation per unit volume is _____ $\times 10^6$ J m^{-3} (rounded off to one decimal place). (GATE MT 2025)

65) Two consecutive estimates of the root of a function $f(x)$ obtained using the Newton-Raphson method are x_i = 8.5 and x_{i+1} = 13.5, and the value of the function at x_i is 15. The numerical value of first derivative of the function evaluated at x_i is _____ (in integer). (GATE MT 2025)

END OF THE QUESTION PAPER