Q. No. MMC - 401 078

ND/B.Tech./Even

Reg/2022-23

2022-23

TRANSPORT PHENOMENA IN METALLURGICAL PROCESS

MMC - 401

Full Marks : 25 Time : Ninety Minutes

The figures in the margin indicate full marks.

Answer *all* the questions.

Graph paper shall be supplied, if required.

Part - A

1. The temperature distribution profile across the thickness from one side of a wall is given by $T = 5x^2 - 24x$, where T is in °C and x is in meter. Calculate the heat flux across the wall at $x = 10$ cm. The thermal conductivity (K) of the wall is 50 W/m.°C. 2 [CO2]

2. Determine the steady state temperature distribution and heat flux through a slab of width b, which is extended to infinity in the other two directions. The two faces of the slab are maintained at temperatures T_1 and T_2. The material of the slab has a thermal conductivity of K. 2 [CO2]

P.T.O.

3. Derive an expression for steady state temperature distribution in an infinitely long rectangular bar, as shown in figure 1. The thermal conductivity (K) of the infinitely long rectangular bar is constant. 4 [CO2]

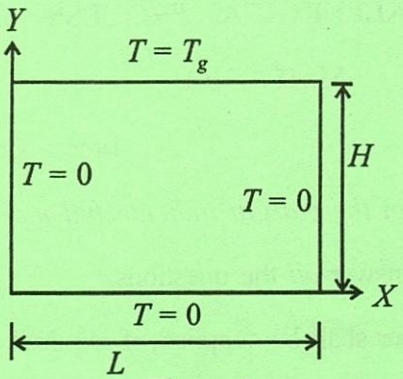

Figure 1

4. What is the difference between force and free convection? What is the unit of thermal resistance? 2 [CO2]

5. A wire 1 mm in diameter and 10 cm long is submerged in water at atmospheric pressure. An electric current is passed through the wire and the current is increased until the water boils at 100°C. Under this condition, the convection heat transfer coefficient is 5000 W/m^2.°C. How much electric power must be supplied to the wire to maintain the wire surface at 114°C? 3 [CO3]

6. Explain and derive Newton's Law of Viscosity. Find the dimensional analysis of the equation of Newton's law of viscosity. 2+2 [CO1]

7. Derive the equation of continuity in rectangular coordinates for (a) steady state and (b) incompressible fluid. 2+2 [CO1]

8. Find the viscosity of molten aluminium whose density is 2.7g/cc. 2 [CO3]

9. A very thin glass walled, 0.3 cm diameter mercury thermometer is placed in a steam of air where the heat transfer coefficient (h) is 57 $Wm^{-2}K^{-1}$ for measuring the unsteady temperature of the air. Consider cylindrical thermometer bulbs to consists of mercury only for which K = 8.9 $Wm^{-1}K^{-1}$ and a = 0.0166 m^2/h. Calculate the time required for the temperature change to reach half its final value. 2 [CO3]

Course Outcomes :

CO1 : Understand the fundamentals of fluid flow and momentum transfer.

CO2 : Understand different modes of heat transfer and mass transfer.

CO3 : Ability to solve metallurgical industry oriented problems involving heat, mass, and momentum transfer.

Q. No. MMC - 402 0076

ND/B.Tech./Even

Reg/2022-23

2022-23

MMC - 402

Full Marks : 25 Time : Ninety Minutes

The figures in the margin indicate full marks.

Answer any *five* questions.

Graph paper shall be supplied, if required.

1. Discuss the basic formulation of the phenomenological equation to represent duffusion flux. 5 [CO2]

2. In view of thermodynamic perspective, show that the true driving factor for diffusion in a purely chemical system is 'chemical potential gradient'. 5 [CO2]

3. Conceptually correlate: diffusion, chemical potential gradient, concentration gradient, activity coefficient, solution with high positive deviation and spinodal decomposition. 5 [CO2]

4. For a single phase homogeneous solution of two components prove $G = n_A \times \bar{G}_A + n_B \times \bar{G}_B$. Mention all notation used and assumptions clearly. 5 [CO1]

5. Which basic experiment do you need to carry out to plot free energy of a phase (of two components) as a function of composition at different temperatures? Draw a similar experimental plot for white tin. 2+3 [CO1]

P.T.O.

6. For a single phase two components system draw the plot of N_A and a_A as a function of composition. Discuss the significance if a_A has higher values than N_A (in terms of attraction between two types of atoms). 3+2 [CO1]

Course Outcomes :

- CO1 : To understand and interpret Free energy-composition diagram, origin of phase diagrams and phase transformation.
- CO2 : A detailed understanding on diffusion in solid and solid state phase transformations in steel.
- CO3 : To understand the fundamentals of solidification in order to apply it in Foundry industry.

Q. No. MMC - 403 0075

ND/B.Tech./Even

Reg/2022-23

2022-23

MATERIALS CHARACTERIZATION

MMC - 403

Full Marks : 25 Time : Ninety Minutes

The figures in the margin indicate full marks.

Answer *all* the questions.

Graph paper shall be supplied, if required.

1. Wavelength of K_β is shorter than K_α but having lower intensity than K_α — Justify. 2.5 [CO1]

2. With the help of a schematic plot of X-ray intensity vs. wavelength as a function of applied voltage, explain the origin of continuous spectrum and characteristic spectrum. 5 [CO1]

3. Derive Bragg's law.

   Construct 'Ewald Sphere' for graphical representation of diffraction condition. 5 [CO1]

OR

Describe diffraction under non-ideal condition and derive Scherrer's formula to measure the particle size of very small crystals from the measured width of their diffraction curves.

P.T.O.

4. Depth of field is directly proportional to illumination source wavelength. However SEM has much higher depth of field than optical microscope, why? 2.5 [CO1]

5. Draw a schematic diagram to show image formation (in reflection illumination) in a light microscope. 5 [CO1]

OR

Draw a schematic diagram to show image formation (in transmission illumination) in a light microscope.

6. Show the disc of least confusion in chromatic aberration. Why does the image screen is placed in a compromised position to form a disc of least confusion not before or not after that position. 3+2 [CO1]

Course Outcomes :

- CO1 : Learn fundamentals of X-ray diffraction, electron microscopy and other characterization techniques.
- CO2 : Identify the crystal structure and index the diffraction patterns of different phases to meet contemporary needs (including tutorials).
- CO3 : Learn different applications and developments in characterization techniques.

Q. No. MMC 601/ 61

B.TECH/EVEN
REG/(22-23)

Even Semester Mid-term Examination, 2022-23

STEEL MAKING

MMC 601

Full Marks : 25 *Time* : 90 Minutes

The figures in the margin indicate full marks.

Answer *all* the questions.

Question No.	Body of the Question	Marks	Mapped CO
1.	With a neat sketch explain the layout of a BOF plant?	5	CO2
2.	Why a multi nozzle lance is used in LD steel making explain in detail.	2.5	CO3
3.	Explain the construction of EAF?	5	COl
4.	Whnt is continuous casting? Explain with a neat sketch.	4	CO3
5	What is the principle of continuous casting? How does it help in the consolidation of structure?	2+2	CO3
6.	What are the different slag regimes in steel making? Which regime is preferred for alloy steel making and mild steel?	2+2.5	CO1

COURSE OUTCOMES

CO1: Understand fundamentals of physicochemical principles of steel making

CO2: Understand the design & operational aspects of steel making technology.

CO3: Understand the design & operational aspects of Continuous Casting

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Q. No. MMC 602/ 63

B.TECH/EVEN
REG/(22-23)

Even Semester Mid-term Examination, 2022-23

MECHANICAL WORKING OF MATERIALS

MMC 602

Full Marks : 25 *Time* : 90 Minutes

The figures in the margin indicate full marks.

Graph paper shall be supplied, if required.

Answer *all* the questions.

Question No.	Body of the Question	Marks	Mapped CO

1. Derive the correlation between Young's modulus and bulk modulus of a material considering 3D state of stress. 3 CO1

2. (a) What do you mean by strain energy of distortion?

   (b) Prove that $U_0' = \frac{J_2}{2G}$

   where, U_0' is strain energy of distortion, J_2 is second invariant of stress deviator and G is the shear modulus. 2+8 CO1

3. Differentiate between hot working and cold working 2 CO1

4. Determine the engineering strain, true strain and reduction for

   (a) a bar which is doubled in length;

(b) a bar which is halved in length. 4 CO1

5. Derive the expression for the axial stress at the die exit needed two cause deformation during drawing under ideal frictionless condition through slab analysis. 6 CO1

COURSE OUTCOMES

CO1: To understand the mechanics of metal forming processes

CO2: To know about tools and techniques of different metal forming processes

CO3: To understand the parameters which are needed to be controlled for increasing quality and productivity of different metal forming operations.

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Q. No. CYE 611/ 15

B.TECH/EVEN
REG/(22-23)

Even Semester Mid-term Examination, 2022-23

ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

CYE 611

Full Marks : 25 *Time* : 90 Minutes

The figures in the margin indicate full marks.

Answer the following questions.

[5 × 5 = 25]

1. Write down the principle of colorimetric analysis. What are the essential criteria for the choice of a colorimetric method of analysis?

2. Briefly describe the TLC procedure and mention the significance of it in the area of organic synthesis research.

3. Mention the essential criteria are that must be fulfill in titrimetric method with proper justification. How will you measure Hardness in water by titrimetric method?

4. What do mean by Gravimetric of analysis and explain with suitable example. How will you interpret the experimental data with precision and accuracy?

5. Write down the principle and application of Flame photometric technique. Why Tin (Sn) is able to measure in AAS but not in Flame Photometer?

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