B. E. Metallurgical Third year (2nd Semester) Examination, 2019
Foundry Metallurgy

Time: Three Hours Full Marks: 100

Answer Question No.10 and any FIVE from the rest

1. What is the importance of Coke Bed height? What is a Divided Blast? Why is it advantageous? Is it possible to produce White iron or SG iron in Cupola? Why Grey Iron is called Section sensitive but cheap engineering alloy?
   What is Carbon Equivalent and its importance? What is Chilled Iron and why Chilled irons are very important in modern time? How Chilled iron chemistry is decided and achieved during production?

2. What is ADI? State one composition and TTT diagram for producing the structure. Draw stress-strain curve for an ADI. Name three Cast irons where Flake Graphite is absent. Name three elements which increases graphitization in C.I. What is the importance of Si in graphitization?
   Name Two NDT methods where recordings can be made for defects. State I/I_o relationship for radiography. Why gamma ray radiography is popular over X-ray radiography? State the formula for Ultrasonography. Describe MPI method for detection of cracks in railway engines.

3. Deduce the condition for ΔT vs. r^* for solidification. Why plane front solidification is so much wanted for alloy solidification? How it can be achieved during CC?
   What is constitutional super cooling? How it produces Mushy zone? How can it be identified from Phase diagram? Which alloy suffers from Inverse segregation?

4. What is Divorced Eutectics? Where it is so common? Name a Divorced eutectics in non-ferrous system. What is modification in Silumin alloys and how it is done? What is Liquid forging? How it improves mechanical properties in auto mobile wheels.
   Describe any two modern Sand casting methods where high tolerance and good surface finish can be obtained. How Investing casting method can produce single crystal Turbine blades?

5. A cylindrical disc of diameter 350mm and thickness 20mm is sandwiched with another smaller disc of diameter 250mm of thickness 10mm. If a concentric bore of the jointed flange be 100mm, estimate the Modulus of Casting and size of the cylindrical riser (H=D). Calculate also the time of filling if bottom gated [50 mm^2] with 100 mm cope height.
   A steel pipe casting (B.P) measures 200mm O.D. and 100mm I.D with 800mm in length. If casting is done (i) horizontally (ii) vertically, with central axis normal to the ground, calculate its pattern dimensions.

6. (a) A Permeability tester clocked 25 sec for one testing when he identified the AFS sand sample actually measured 55mm height (H) and gauge pressure tested was found to be 11.6 gm.-wt. Calculate the percentage error in Permeability Number measurement.
   (b)If the surface energy of Copper is 177×10^{-7} J/cm^2 and the heat of transformation, ΔH_v is 1826 J/cm^3 with the estimated transformation temperature of 1083°C, calculate the minimum sizes of the nucleus in a mould @ΔT=10°C and 1000°C. Which is beneficial for mechanical properties?

© Determine the solidification time of a 50 mm thick very large Aluminium (661°C M.P) plate casting in a sand mould (30°C). Given Specific heat of Al – 980 J/k gm/K, Heat of Solidification – 389 kJ/k gm, Specific heat of Sand -900 J/k gm/K, Density of Sand 1350 k gm/m^3,Thermal conductivity– 0.88 w/m/K. Assume 50°C super heat and $H_f' = \Delta H_f + (Superheat\ x\ C_P^{Al})$.

7. Describe shortest method for acceptance of foundry sand for molding purpose. How can you measure Permeability Number of a given sand aggregate? How Bonding strength of a sand aggregate is measured?
Describe the design of Modulus method of Risering. Calculate Moduli of a Solid sphere and a Plate. Describe casting defects – Hot Tearing and Pipes.

8. Differentiate between (Any eight only) 2 x 8
(i) Core Sand and Molding Sand,
(ii) Free Moisture and Bonded Moisture,
(iii) Core Print and Core Box,
(iv) Hot Die Casting and Cold Die Casting,
(v) Choke Area and Sprue Area,
(vi) AFS Clay and Foundry Clay,
(vii) Pattern Dimension and Core Dimension,
(viii) Pressurized Gating System and Unpressurized Gating System,
(ix) Pattern's liability and Riser's liability,
(x) Pipe Sprue and Tapered Sprue

9. Explain: *(i) Jolting & Squeezing, (ii) Chemical Bond, (iii) Follow Board pattern, (iv)* Chvorinov Rule. (v) Hot Sleeves, (vi) Centrifugal Casting, (vii) Flaskless Molding, (viii) Whirl gate (ix) Zn- equivalent (x) Phos-copper. 2 x 8

10. Explain/discuss (any Twenty) only: 1 x 20

(i) Name two types of clay used in sand mould.
(ii) Express the condition for Un-pressurized Gating.
(iii) What is the condition for Aspiration correction?
(iv) State the formula for time of filling for bottom gating of a plate casting.
(v) In molding sand aggregate which property you cannot change?
(vi) How can you change Permeability of a sand mould in steel castings?
(vii) For risering a large or a small plate of same thickness whether the riser size is same?
(viii) For casting of Aluminum alloys why dry sand mould is essential?
(ix) How can you equalize flow rates in multiple gating in plate castings?
(x) What is the difference between clay and sand if those are of same micron size?
(xi) Draw a melting unit for Copper alloys.
(xii) Chunky/Bulky shape castings are (a) easy (b) difficult to cast.
(xiii) Modification of Silumin alloy should be applied @ (a) lower (b) higher temperature.
(xiv) What is the requirement of free moisture in sand moulding?
(xv) What type of castings do you suggest for Sweep patterns?
(xvi) Which sand among Olivine, Zircon and Silica – has the highest refractoriness?
(xvii) Why strength of Hydraulic bond is so much high?
(xviii) Why core making generally use Chemical bond?
(xix) Why Taper Allowance is essential for patterns used in sand molding?
(xx) Why do green sand mould require optimum moisture?
(xxi) Why alcohol base dressings are favored over water base in sand molding?
(xxii) Why for machine allowance in core, dimensions get decreased?
(xxiii) Can you name a riser which follow ideal shape? Why then it is uncommon?
(xxiv) Why Sea Coal is essential for molding sand of C.I. castings?
(xxv) How Zinc flaring improves Brass castings?