B.E. MetallurgicalEngineering Examination, 2017
Third year (2nd Semester)

FOUNDRY METALLURGY

Time: Three Hours   Full Marks: 100

Answer any Five Questions

Q.1. (a) Answer (Any ten only)   10

1. Name two alloys where modifications of cast eutectic structure are possible.
2. Name two alloys which are notorious for long freezing.
3. Suggest an alloy other than Grey C.I. which can be easily produced in Induction furnace.
4. Suggest an alloy in which two eutectic reactions simultaneously occur within close range.
5. Name which free energy acts as inhibiting factor during solidification.
6. Suggest a product item where metal castings become amorphous.
7. Suggest an industrial casting product where a high amount of super-cooling can be maintained.
8. Name a casting process in which almost globular grains are manufactured in alloys.
9. Name a casting alloy which is notorious as section sensitive.
10. Name a casting alloy which produces consistent and reliable cast properties in service.
11. Name a cast iron microstructure which resembles steel microstructure.
12. Why does Grey iron production need little Risering?

(b)   Answer (Any ten only)   10

1. What is the value of Critical radius, r^* during solidification of liquid metals?
2. How super-cooling, ΔT does get related with the amount of change in volume freeenergy, ΔF_v?
3. What is Constitutional Super-cooling in alloys?
4. Draw at least two types of heterogeneous nucleating sites possible in solidification.
5. Is it possible to produce White iron or Ductile iron in Cupola by using basic lining?
6. What is Nodule count? If higher Nodule count is beneficial for increasing corrosion resistant to S.G.Iron?
7. A grey iron has been reported to be brittle. Can the melting coke be the cause?
8. Note howmicro-analyzed report would be within and outside the dendrite in different points from the center to the periphery.
9. For thin section Grey Iron castings what will be the chemistry of elements with sand molds?
10. For efficient modularization why higher temperature is preferred during S.G. iron production?
11. State the classical mathematical relationship in Plane front solidification.
12. What is Mold Dilation during Grey iron solidification in sand molds?

Q.2 (a) Answer (Any five only- 3 mark each)   15

1. Explain nature of the nucleation rate and the Growth rate with super-cooling during solidification.
2. Draw a schematic sketch of a Cupola and label its parts.
3. A pig iron (%) charge in Cupola assays C-3.6, Si- 1.8, Mn- 0.8, S-0.1, and P-0.9.State finalcomposition.
4. If the surface energy of Zinc is 60 erg/cm^2 and ΔH_v is 170 Cal/cm^3 with the estimated transformation
   Temperature of 419°C, calculate the minimum size of the nucleus @ $\Delta T=100^\circ C$.
5. Describe production principle of White Iron.
6. What is Chilled casting? How it is utilized in production of Cast Iron rolls for grinding powders?
7. State the basic conditions of Random Dendritic solidification. Why it is so common in ingots?

(a) Explain:[Any ten- each 1/2 mark]   5

(i) Bernoulli's Theorem (ii) Chvorinov Rule (iii) Aspiration(iv) Hot Tearing (vi) Metal Penetration (vii) Cupola, (viii) Cores (ix) Follow Board Pattern, (x) Venting (xi) Furnace (xii) Draft Allowance

Q.3. (a) Differentiate: [Any five- 2 mark each]   10
   (i)   Continuous Castings and Ingot castings,
   (ii)   Free Moisture and Bonded Moisture
   (iii)   Core Print and Core Box

[Turn over

(iv)   Contraction operated by Riser and contraction operated byPattern
(v)   Choke Area and Cup Area
(vi)   Machine Allowance and Contraction Allowance

(b) Justify indicating first the right answers: [Any ten -1 mark each] 10

1.   Tata foundry in Telco Jamshedpur produces Engine body casting regularly.
     (i) Captive foundry (ii) Sand Casting foundry
2.   In Hyderabad few foundry produce two-wheeler cast wheels and top handles.
     (i) Die Casting foundry (iii) Cast Iron foundry
3.   A foundry cannot function without a furnace. (i) True (ii) False
4.   All Silica sands can be fit for casting irons or steels. (i) True (ii) False
5.   Cast steel produces more difficulty in casting than Cast irons. (i) True (ii)) False
6.   Automobile pistons are not Die cast. (i) True (ii) Optional.
7.   Modern bathroom taps uses simple brass. (i) True (ii)) False
8.   Wagon bodies rest on support of steel castings (i) True (ii) False
9.   H. C. Copper castingsare not used in electrode clamps of arc furnace. (i) True (ii) False
10. Jewelers use pure goldnot gold alloys to cast ornaments. (i) True (ii) False
11. Zinc and lead alloys find excessive use in modern life. (i) True (ii) False
12. By Centrifugal castingmunicipal water pipes cannot be made. (i) True (ii) False

Q. 4. (a) Deduce the following: [Any Five –3 marks each]   15

1.   Determination of GFN of a Foundry Sand by Sieve analysis.
2.   Time of filling the mold by Bottom Gating system.
3.   Determination of Riser Size of a Cylinder & a Cylindrical Bush item by Modulus Method
4.   Gradient of Solidification time of castings vs. Modulus curve.When it fails?
5.   Permeability No. of $\frac{3007}{t}$ per min. for standard permeability test of molding sand.
6.   Aspiration correction for a standard Vertical Sprue.

(b) Explain: (Any Five) 1 mark each   5

(i) Jolting (ii) Hydraulic Bond, (iii) Squeezing, (iv)Flaskless Molding, (v) Drops (vi) Shift.

Q. 5. (a) Describe industrial method for the following, (Any five only)   15

(i) Turbine Blades (ii) Scooter Handle castings (iii) ScooterWheel castings (iv) Auto Gear Casting
     (v) Idlers for Belt Conveyor (vi) Large Bell Casting

(a) Describe(Any five only) 1 mark each   5

(i)Molasses, (ii) No-bake Binder (iii) Zircon sand (iv) Zinc flaring, (v) Silumin alloy (vi)Si-Bronze

Q. 6. (a) Describe: (Any Four only)   12

(i) Electrostatic Bonding,(ii) Radiographic Testing(iii) Means of Directional Solidification
(iv) Properties of Core Sand, (v) Copper alloy melting

(b) Solve the problems: 8

(i)   A gating design shows a velocity of liquid metal 400mm/sec through a channel of 10mm x 25mm in a sand mold of liquidAluminum having density 2500 kg/m^3 with viscosity of 2.7 cP. Calculate the Reynolds number.
(ii) A plate of 1000mm x 600mm x 40mm steel casting has been up for Risering. Calculate the requirement of possiblerisers, if cast flat horizontally.
(iii) A Sprue consists of Cup height as 100mm, Sprue height as 1000mm, and the Cup area as 200mm^2, what will be the Sprue diameter after aspiration correction?
(iv) A sieve analysis shows retained percentage of sand in each as following: Sieve No 10 -1.5%, 20- 9.8%, 30-24.2%, 40 -37.7%, 50 -13.8%, 60- 6.1%, 80 -2.1%, 100 – 0.8%, 150 -0.3% Pan - 1.9%. What is the GFN? Which metal could be cast by this sand?