4

- 7. (a) Answer (any five only)
  - (i) Why the Carbides of W, Ti, and Ta are so hard?

3

- (ii) Why Polythenes are transparent or translucent?
- (iii) Why Turbine Blades are investment cast, rather than forged?
- (iv) How does Epoxy-resin act as adhesive?
- (v) Why Boiler Plate steels are deoxidized by Silicon and not Aluminium?
- (vi) Why do arrhenius type relations occur during Creep?
- 8. (a) Write down the structural formulae of Nylon 6,6.
  - (ii) What is the importance of Chromium in Ni-hard?
  - (iii) Discuss the uses of Engineering Polymers.
  - (iv) How does Coble creep differ from Nabarro-Herring creep?
  - (v) Name two Super alloys and their special properties.
- 9. (i) A Magnesium-Aluminium alloy is used to make containers for fuel elements in nuclear reactors. The useful life of the containers can be considered to have ended, when a (tensile) creep strain (*e*) of 1% (0.01) is achieved. The life of the fuel elements is 3 years. Experiments show that at the stresses involved, the containers will last 5 years at 450°C.Show that the life of the containers will be less than the life of the fuel elements at 500°C. The activation energy (E) for creep of the alloy is 133.76 kJ. mole<sup>-1</sup> and Gas Constant, R is 8.36 J.mole<sup>-1</sup>K<sup>-1</sup> and L-M parameter relation can be expressed by, where, A=Arbitrary Constant, t=Time, Sec., (E/R)  $\sigma$  = T (In A + In t In  $\epsilon$ )

- (ii) Write down the structural formulas for Vinyl chloride and vinyl acetate. Determine the mole fractions of vinyl chloride and vinyl acetate in a copolymer having a molecular weight of 10,520 g/mol and a degree of polymerisation of 160. 2x5
- 10. (i) Andrade relation for Creep,  $\varepsilon = \varepsilon_0 + \alpha^{1/3} + \beta t$  can be expressed to represent the creep strain,  $\varepsilon$  In a Creep Test in which  $\varepsilon_0$  was 0.00222, the recorded creep strain was 0.00292 at t=10 sec and 0.00575 at 1000 sec. Determine the creep strain at 5=100 sec. 4
  - (ii) Draw the nature of engineering stress-strain curve of Rail Steels. Some times 1% Cr in rail and/or 1% Mo are added to axel steel–Justify.
  - (iii) Draw the force diagram of Relationship of fibre tension to force resisting Projectile. How can the modern material used in bullet-proof jackets, combat the ballistic threat to security personnel and VIPs from guns and bomb splinters?
- (i) Draw the typical temperature dependent variation of magnetic susceptibility (*c*) for ferromagnetic and ferrimagnetic materials.
  3
  - (ii) Explain how could you tallor make the saturation magnetization of  $NiFe_2O^4$  by forming solid solution with  $ZnFe_2O^4$ . 7
- 12. (i) Why BaTiO<sub>3</sub> is an important dielectric material– Explain. 4

— x —

(ii) Give two methods of Synthesis of BaTiO<sub>3</sub>. 6

### EX/MET/T/425/83/09

# **BACHELOR OF METALLURGICAL ENGG. EXAMINATION, 2009**

(4th year, 2nd semester)

### MATERIAL ENGINEERING

Time : Three hours

Full Marks : 100

Use separate asnwer script for each part.

## PART - I

#### Attempt at least two questions.

- (a) What are the applications of copper-beryllium alloys. Discuss the microstructural features of cast and wrought copper beryllium alloys.
  - (b) Give typical composition, properties and applications of the following copper alloys :

(i) gliding metal, (ii) naval brass, (iii) phosphor bronze & (iv) cupronickel. 10

- 2. (a) How are the different types of aluminium alloys designated. Give atleast one example of each grade. 10
  - (b) What do the following treatment nomenclatures stand for name atleast one alloy for each treatment :

(i) 0, (ii) H 38, (iii) T4, (iv) T61, (iv) T85 10

- 3. (a) What are the chief alloying elements of titanium and how do these affect the phase diagram.
  - (b) With the help of suitable diagram explain the basic principles of heat treatment of Ti-alloys. 5
  - (c) Discuss at least three important Ti-alloys.

(PTO)

9

- 4. (a) Answer any four :  $2^{1/2}x^{4}=10$ 
  - (i) Brass and not copper is used for cold rolled electrical contact springs–why?
  - (ii) How do you make copper-tungsten alloys? Where are they used?
  - (iii) Ni-steel is commonly used at cryogenic condition-justify.
  - (iv) FCC materials are preferred for use at low temperature why?
  - (v) Suggest with reasons one ferrous and one nonferrous material for use in pipeline to carry pressurised liquid at sub zero temp.
  - (vi) Suggest with justification a material for making sliding/ moving electrical contact.
- 5. Justify any five of the following additions. 2x5=10
  - (i) Mo in Ni-Cr-Mo steel (AISI 4340)
  - (ii) W in High speed steel
  - (iii) Cr in High carbon high chromium steel
  - (iv) Mo in Cr-Mo heat resisting steel
  - (v) Mo in Austenitic stainless steel (AISI 316)
  - (vi) V in Microalloyed steel
  - (vii) Mn in HSLA steel.

# PART - II

Answer any five questions.

6. Briefly explain (any five only)

- (i) Larson-Millar Parameter, (ii) Nicro-silal, (iii) PET,
- (iv) Creep Damage tolerance parameter, (v) WC-Roll,
- (vi) Y,-phase.