INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad-500043

HIGH TEMPERATURE MATERIALS

TUTORIAL QUESTION BANK

Course Title	**HIGH TEMPERATURE MATERIALS**				
Course Code	AAE806				
Programme	B.Tech				
Semester	VII	AE			
Course Type	SKILL				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	-	-	-	-	-
Chief Coordinator	Dr. Prashant GK, Associate Professor				
Course Faculty	Dr. Prashant GK, Associate Professor				

COURSE OBJECTIVES:

The course should enable the students to:	
I	Explain the creep behavior, mechanisms and effect of different parameters like stress, temporary, strain rate on creep.
II	Learn laws that would be beneficial in determining the rupture life of a component.
III	Identify the various types of fracture and its occurrence.
IV	Understand the oxidation and corrosion, behavior of super alloys and other high temperature materials.

TUTORIAL QUESTION BANK

UNIT -I	
CREEP	
S.NO	**QUESTIONS (Part-A)**
1	Define creep?
2	Explain the factors influencing the creep at high temperatures
3	Define the properties of creep
4	Explain the procedure for creep test?
5	Define the stages of creep?
6	Name creep resistant materials?
7	Define creep strees?
8	Explain the effect of creep?
9	Distinguish between Diffusion creep & Dislocation creep
10	Explain factors influencing the creep?
S.NO	**QUESTIONS (Part-B)**
1	Why is the rate of creep more at elevated temperature?
2	What are the factors influencing functional life of components at elevated temp?
3	What are the deformation modes?
4	What are effects of stress and temperature on the creep curve?
5	Write any two high creep resistance materials.Name two metallurgical factors that affect creep rate.
6	What are Material aspects for creep resistance?Define rupture life of creep in detail?
7	Distinguish between Ductile material and brittle material.
8	What are the problems associated with materials used at elevated temperature?
9	Draw typical creep curve, mark the various stages and mention the factors influencing each stage.
10	Which types of materials are preferred for creep application?
11	What are the deformation modes?Define super plasticity
12	What are effects of stress and temperature on the creep curve?
13	Explain the term Creep Ductile Fracture and Brittle Fracture.
14	What is meant by diffusion process? What are the factors responsible for influencing the creep property of a material?
15	Define super plasticity. Which types of materials are preferred for creep application?
UNIT–II	
LAWS TO DETERMINE CREEP	
S.NO	**QUESTIONS (Part-A)**
1	Explain the laws of creep?
2	State Andrade's Law?
3	Explain Logarithemic law of creep?
4	Define hyperbolic law of transient creep?
5	Difference between transient creep and secondary creep?
6	Explain miller parameters that affect the creep?
7	Explain monkman grant relationship?
8	Explain the different laws of creep?
9	How to determine the rupture life of creep material?
10	Explain different types of hardening process of material?
S.NO	**QUESTIONS (Part-B)**
1	Define Monkmann-Grant formula.
2	Define Transient creep time.
3	What is meant by strain hardening?
4	What are the types of Hardening (Strengthening) mechanisms?

5	Define Monkman-Grant relationship and its significance as a Master curve.
6	What are Material aspects for creep resistance?
7	Define rupture life of creep?Distinguish between Ductile material and brittle material.
8	During a creep test on pure aluminium at 280oC under steady stress of 6.85 MPa, the following data were recorded. Time t (min) / Stain ε (mm'mm) / Time t (min) / Strain ε (mm/mm) 0 / 0 / 24 / 0.094 1 / 0.020 / 32 / 0.109 2 / 0.029 / 40 / 0.122 4 / 0.041 / 48 / 0.136 8 / 0.057 / 60 / 0.156 16 / 0.078 / 72 / 0.176 Plot strain-time curve, and show the extents of primary, secondary and tertiary stages on it. Determine (a) minimum creep rate, (b) the creep intercept, and (c) transient creep law.
9	What is the mechanism of creep? What are the properties of a creep resistant materials, and mention few examples of creep resistant materials?
10	What is purpose of hardening? Determine the law to determine rupture life of a component? Explain any one method in brief.
11	State one method of determining the rupture life of creep, and elaborate on the steps to derive the Arrhenius-type expression.
12	What do you understand by strain (work). Explain the creep law, along with hyperbolic law of transient creep for concrete creep strain.
13	Explain the law of Andrade's Law of transient creep.
14	Explain the logarithmic law of transient creep.
15	Draw a detailed figure explaining the typical heat treatment cycle for high speed steel. Why is preheating required?

UNIT –III

HIGH TEMPERATURE FRACTURE

S.NO	QUESTIONS (Part-A)
1	Explain the types of fracture?
2	Difference between ductile and brittle facture?
3	Name the factors affect fracture toughness?
4	Explain Griffith theory?
5	Write the equation for Griffith theory?

S.NO	QUESTIONS (Part-B)
1	Define Fracture? What are the types of fracture?
2	Explain the terms Chisel Edge fracture and Point Edge fracture.
3	What is meant by Equicohesive Tempe rature (ECT)?
4	Distinguish between ductile fracture and brittle fracture?
5	What do you understand by Bauchinger's effect?
6	What do you understand by fracture? Explain about Ideal fracture stress?
7	What are the different types of fracture? Why is ductile fracture preferred over brittle fracture?
8	Differentiate between ductile and brittle fracture? Brief about the Griffith theory?
9	Derive the equation for maximum the Griffith theory.

10	What do you understand by fracture toughness? State with an example?
11	Explain in brief the cleavage fracture & micro void coalescence.
12	Compare grain-boundary- and surface-diffusion-controlled void growth in the following way. For equal volumetric void growth in the following way. For equal volumetric void growth rates, determine the ratio of the damage accumulation rate (dfh/dt) for the two mechanism.
13	Write notes on 1. Blue Brittle Fracture 2. Orange Peel Effect 3. Dominant Void Growth Modes
14	Illustrate the effect of any one stress state on microvoid morphology, and elaborate on it.
15	Illustrate the effect of a one stress state on microvoid morphology.

UNIT -IV

OXIDATION & CORROSION

S.NO	QUESTIONS
1	What is oxidation? Explain the phenomenon of bed worth theory.
2	What are the different stages of hot corrosion? Also explain the kinetic laws of oxidation.
3	Define hot corrosion. What are the methods used for combat hot corrosion?
4	Name some oxidation resistance materials?Comment on the various kinetic laws of oxidation
5	Define basic fluxing in hot corrosion with an example.
6	What do you understand by acidic fluxing in hot corrosion?
7	What is the difference between n-type and p-type oxides?
8	Write any two methods to prevent corrosion. Also explain hot corrosion.
9	How are oxides formed on the metal surface? Explain in detail.
10	What do you understand by oxide films and scales?
11	What are the conditions required for internal oxidation?
12	Explain about the various techniques of corrosion control.
13	Why is protective surface coating needed? What are the importance of protective surface coating?
14	What are the various factors influencing corrosion? Explain about the various types of corrosion?
15	Explain about the corrosion of metal by a liquid galvanic cells.

UNIT -V

HIGH TEMPERATURE RESISTANT MATERIALS

S.NO	QUESTIONS
1	Define Super alloys. What are the properties of super alloys?
2	Why are super alloys preferred for high temperature application?
3	Write short notes on 1. Intermetallics 2. Ceramic materials
4	What are the strengthening mechanisms used for alloys? Name a few examples for super alloys applicable for high temperature applications.
5	What properties of ceramic compound offer high temperature applications? Mention the name of two high temperature ceramics?
6	What is grain boundary cracking? Give remedy for it. Also, what are the types of Ni-base alloys?
7	Define TCP phases and its significance in super alloys. What are Super alloys and their applications?
8	Define directional solidifications and its benefits.Name two chemical compositions of super alloys.
9	Explain why the single crystal turbine blades perform better than directionally solidified and coarse grained cast products.
10	Define and list various TCP phases and explain whether they are beneficial or detrimental for high temperature properties.

11	The presence of grain boundaries has an additional effect on the deformation behavior of a material by serving as an effective barrier to the movement of glide dislocations. Explain
12	Conrad has demonstrated clearly that σ_i may be separated into two components: σ_{ST} which is not temperature sensitive. Explain
13	Lead is the oldest of the commonly used metals and the softest of the heavy metals. What are the properties of Lead which make it such a usable material?
14	Lead is the oldest of the commonly used metals and the softest of the heavy metals. Explain its uses and application which make it such a usable material.
15	Write short notes on the following:- 1. Nickel-Iron alloys 2. Nickel-Copper alloys 3. Ni-Cu-Zn alloys 4. Nickel-Chromium alloys 5. Nickel-Molybdenum alloys

Prepared by:
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HOD, AE