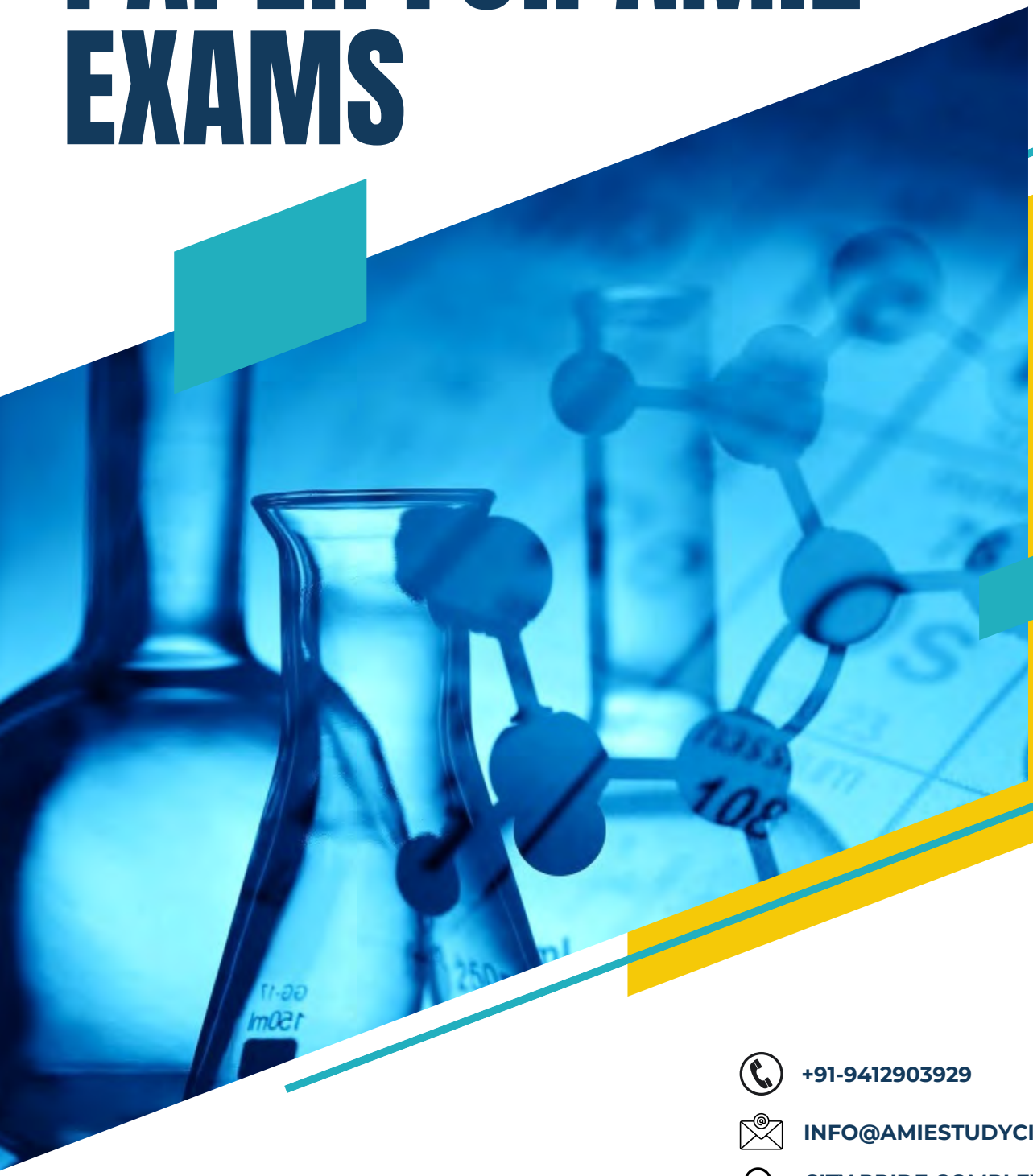
AMIE STUDY CIRCLE, ROORKEE

MODEL TEST PAPER FOR AMIE EXAMS



MATERIAL SCIENCE & ENGINEERING

TEST PAPER 1

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MATERIAL SCIENCE & ENGINEERING

***Time**: Three Hours*

***Maximum Marks**: 100*

Answer five questions, taking ANY TWO from Group A, any two from Group B and all from Group C.

All parts of a question (a, b, etc.) should be answered at one place.

Answer should be brief and to-the-point and be supplemented with neat sketches.

Unnecessary long answer may result in loss of marks.

Any missing or wrong data may be assumed suitably giving proper justification.

Figures on the right-hand side margin indicate full marks.

Group A

1.	(a)	What are major alloying elements in steels? Briefly discuss the effects of at least three alloying elements on the properties of steels.	8
	(b)	What are nano materials? Give two unique properties of Nanomaterials explaining the cause.	6
	(c)	What is composite materials? What are advantages of composite materials over other engineering alloys?	6
2.	(a)	Calculate and compare the atomic packing factors of the FCC and BCC unit cells.	8
	(b)	Differentiate between Frenkel and Schottky defects.	6
	(c)	Discuss major differences between edge and screw dislocation.	6
3.	(a)	What is Gibb's phase rule? Explain its application with reference to binary phase diagram.	
	(b)	Neatly sketch the Iron-Iron Carbide equilibrium phase diagram and label different phases on it.	
	(c)	Draw a typical TTT diagram and explain the term critical cooling rate with reference to the diagram.	

4. (a) What is true stress? Show that true stress is related to engineering stress (σ_s) by the relation 8

$$\sigma = \sigma_s(1+\sigma_e)$$

where σ_e is the engineering strain.

(b) What is Hook's law? Draw a typical stress strain curve for a mild steel specimen showing yield point, elastic limit, ultimate tensile strength and fracture points. 6

(c) What is the difference between the slip and twinning mechanisms of plastic deformation of metals? 6

Group B

5. (a) Differentiate between annealing and normalizing. Discuss the purposes for which these treatments are done. 8

(b) Discuss the tempering process. What are main aims of tempering? 6

(c) Define hardness and hardenability, explaining their difference. Mention the factors which affect hardenability. 6

6. (a) What is strain hardening (work hardening)? Name one application where it is advantageous and one example where it is problematic. 8

(b) Why are some polymers recyclable? What are elastomers and their special property? 6

(c) What is degree of polymerization? How are the rigidity and melting point of a polymer related to its degree of polymerization? Distinguish between atactic, isotactic and syndiotactic structures of polymers. 6

7. (a) Define thermal stress. Discuss stresses due to restrained thermal expansion and contraction. 8

(b) What are refractories? Discuss their industrial applications. 6

(c) What are cryogenic materials? 6

8. (a) Explain the terms (i) Magnetization, (ii) Diamagnetism, (iii) Paramagnetism, and (iv) Ferro-magnetism. 8

(b) Differentiate between soft and hard magnets. Give two examples of soft magnetic materials. 6

(c) What are semiconductors? Explain semiconductors, intrinsic and extrinsic semiconductors. 6

Group C

9. Answer the following in brief: 20

(i) Define Burger's vector.

(ii) Shear modulus, G (GPa), obeys proportionality with elastic modulus, E (GPa). If E = 18 GPa for a metal and Poisson's ratio = 0.33, calculate the value of G for the metal.

(iii) Two samples A and B of a brittle material have crack length in the ratio 3:1. What will be the ratio of tensile strengths of A and B ?

(iv) What are super alloys ? Give examples.

(v) What is the angle between [101] and [011] directions of a cubic crystal ?

(vi) What is a peritectic reaction ?

(vii) What is Bauschinger effect ?

(viii) Define the glass transition temperature (T_G).

(ix) Stainless steels (an alloy of iron, a = 0.2867 nm) always can contain huge amount of chromium. (a = 0.2885 nm) – Explain.

(x) What is TD nickel?

(Refer our course material for answers)