Roll No. | | | | | | | | | | |

No. of Printed Pages—4 **ME-301**

B. TECH.

THIRD SEMESTER EXAMINATION, 2003-2004

MATERIAL SCIENCE

Time : 3 Hours *Total Marks : 100*

Note : (1) Attempt **All** six questions. There may be internal choices within questions.
(2) Q.1 carries 20 marks and other questions carry 16 marks each. Marks are also indicated therein.
(3) Answer briefly and neatly. No negative marking.
(4) Symbols have their usual meaning. Assume missing data, if any.

1. Answer ALL parts as directed :— **(2×10=20)**

(a) Name as asked for

(i) The source energy of atom-bomb is a nuclear-process called nuclear-'fission'. The source of solar energy in Sun is also a nuclear-process; name this process.

(ii) Einstein in 1905 gave a theory of relativity called 'special theory of relativity', which talks about mass increase, length contraction and time dilation and $E = mc^2$ etc. He in 1913 gave another theory of relativity which talks about that gravity is there because of curvature of space; what (name) this new theory of relativity is called ?

(b) Write material for

(i) Engine cylinder block

(ii) Fire-proof clothings.

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(c) Write application / use of —

(i) Zn (chemical element)

(ii) PVC (plastic).

(d) Write typical composition of

(i) Stainless Steel

(ii) Gun Metal.

(e) Write full form of

(i) LASER (beam)

(ii) HSS (tool material).

(f) Find the shortest wavelength produced in radiation for X-ray machine whose accelerating potential is 5 kilovolts.

(g) Find the kinetic energy ($KE = mc^2 - m_0c^2$) of an electron (in eV) moving with half the velocity of light. Rest mass (energy) of electron in electron volts is 0·51 eV.

(h) Copper (FCC) has atomic weight 63·5 and atomic radius 1·78Å. Find its density in gram/cc.

(i) X-ray with wavelength 0·58Å is used for evaluating interplanar spacing between certain planes. First order diffraction is obtained at glancing angle 9·5°. Find the interplanar spacing d. Also find angle for 3rd order diffraction.

(j) A bolt has to take up 1 ton (1000 kgf) tensile load. The yield strength of bolt-material is 400 N/mm^2. Design the diameter of bolt, taking a factor of safety as 2 i.e., permissible stress is limited to only half the yield stress.

2. Answer any *TWO* of the following :— (8×2=16)

(a) Briefly describe Radioactivity and properties of α, β and γ rays. Also derive $t_{1/2} = 0{\cdot}69 / \lambda$.

(b) Describe (enlist / classify) various types of Bravais lattices for crystals.

(c) Enlist and briefly describe various types of imperfections (defects and dislocations) in solids.

3. Answer any *TWO* of the following :— (8×2=16)

(a) Briefly explain (*i*) Fatigue and (*ii*) Creep and its testings. Also mention situations where these are important.

(b) Draw $\sigma - \in$ diagrams and microstructure of (*i*) mild steel and (*ii*) gray cast-iron, and also mention % C in these.

(c) Draw neat sketch of Fe–C equilibrium diagram and briefly describe cooling of 0·3 % carbon steel from molten stage to room temperature.

4. Answer any *TWO* of the following :— (8×2=16)

(a) Briefly describe any 2 steel making furnaces. Also name the furnace used for making wrought-iron and cast-iron. Differentiate between Carbon-steels and Alloy-steels.

(b) Briefly describe Annealing, Normalising, Quenching and Tempering heat-treatment processes and show these processes on T T T diagram.

(c) Differentiate between Brass and Bronze. Also differentiate between Soft-brass and Hard-brass and mention their applications.

5. Answer any *TWO* of the following :— (8×2=16)

(a) Differentiate between Soft and Hard magnetic materials. Also briefly describe the principle of magnetic-storage.

(b) Briefly describe solid-diffusion and factors affecting it. Write applications of solid-diffusion, specially in reference to doping of semi-conductors and its devices.

(c) Differentiate between Type I and Type II superconductors. Mention the applications of superconductors. Write the full form of : BCS (theory), JJ, SQUIDs related to superconductors.

6. Answer any *TWO* of the following :— (8×2=16)

(a) Briefly describe types and applications of Ceramics. Also show that cation to anion radius ratio is 0·155 for co-ordination number 3 (i.e., a small cation is compactly surrounded by 3 big anions).

(b) Enlist five Plastics and its chemistry (formula) and applications. Also briefly describe injection-moulding of plastic.

(c) Briefly describe types of Corrosion and Methods for corrosion-prevention.