Name and surname:
No:

Marmara University - Engineering Faculty
Department of Metallurgical and Materials Engineering
MSE 201-R - Materials Science (Final)

Q.1 a) Determine the indices for the directions shown in the cubic unit cell. b) Determine the Miller indices for the planes shown in the cubic unit cell.

Q.2 a) Derive linear density expression for FCC [111] direction in terms of the atomic radius R.
b) Derive planar density expression for BCC (110) plane in terms of the atomic radius R.

Q.3 Calculate the equilibrium number of vacancies per cubic meter for copper at 1000°C. The energy for vacancy formation is 0.9 eV/atom; the atomic weight and density for copper are 63.5 g/mol and 8.4 g/cm^3, respectively. k=8.62*10^{-5} eV/K.

Q.4 A cylindrical specimen of some alloy 8 mm in diameter is stressed elastically in tension. A force of 15700 N produces a reduction in specimen diameter of 5*10^{-3} mm. Compute Poisson's ratio for this material if its modulus of elasticity is 140 GPa.

Q.5 a) What is the driving force for recrystallization.? b) The average grain diameter for a brass material was measured as a function of time at 600°C, which is tabulated below at two different times:

Time (min)	Grain Diameter (mm)
30	2*10^{-2}
90	5*10^{-2}

What is the original grain diameter? What grain diameter would you predict after 200 min at 600°C?

Q.6

Q.7 Estimate carbon contents for steels having following microstructures
a) 38 % pearlite – 62 % primary ferrite
b) 93 % pearlite – 7 % primary cementite
c) 97 % total ferrite – 3 % total cementite

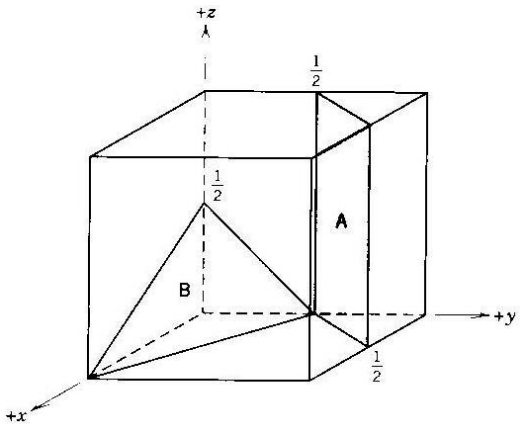
Q.8 Determine the carburizing time necessary to achieve a carbon concentration of 0.40 wt % at a position 1 mm into an iron-carbon alloy that initially contains 0.10 wt %C. The surface concentration is to be maintained at .8 wt % C, and the treatment is to be conducted at 900°C.

Do= 2.3*10^{-5}, Q=148 000 J/mol R=8.31 J/mol K

Q.9 Give the electron configurations for the following elements. (P (15), Sn(50), Fe(26), and Cu(29))

Q.10 The fraction recrystallized-time data for the recrystallization at 350°C of a previously deformed aluminum are tabulated here. Assuming that the kinetic of this process obey the Avrami relationship, determine the fraction recrystallized after a total time of 116,8 min.

Fraction Recrystallized	Time (min)
0.30	95.2
0.80	126.6



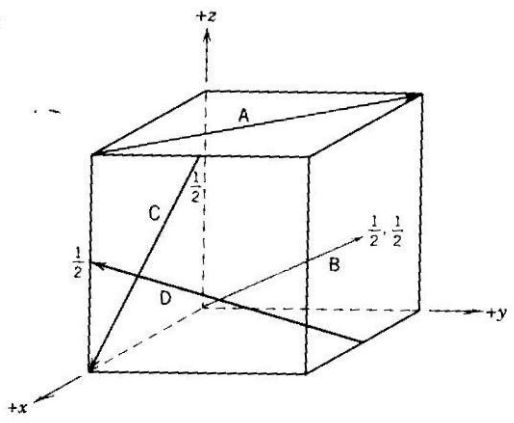


Table 5.1 Tabulation of Error Function Values

z	$erf(z)$	z	$erf(z)$	z	$erf(z)$
0	0	0.55	0.5633	1.3	0.9340
0.025	0.0282	0.60	0.6039	1.4	0.9523
0.05	0.0564	0.65	0.6420	1.5	0.9661
0.10	0.1125	0.70	0.6778	1.6	0.9763
0.15	0.1680	0.75	0.7112	1.7	0.9838
0.20	0.2227	0.80	0.7421	1.8	0.9891
0.25	0.2763	0.85	0.7707	1.9	0.9928
0.30	0.3286	0.90	0.7970	2.0	0.9953
0.35	0.3794	0.95	0.8209	2.2	0.9981
0.40	0.4284	1.0	0.8427	2.4	0.9993
0.45	0.4755	1.1	0.8802	2.6	0.9998
0.50	0.5205	1.2	0.9103	2.8	0.9999