NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FOR CHEMISTRY STUDENTS ONLY

SPH 1209 ENGINEERING MATERIALS

SUPPLEMENTARY EXAMIANTIONS

BSc HONOURS PART IV: JULY 2001 DURATION: 3 HOURS

ANSWER ALL PARTS OF QUESTION 1 IN SECTION A AND ANY THREE QUESTIONS FROM SECTION B. SECTION A CARRIES 40 MARKS AND SECTION B CARRIES 60 MARKS

SECTION A

1. (a) Draw the following directions and planes in a unit cell

(i) [110] (ii) $[1\bar{1}1]$

(iii) [110] (iv) $[10\bar{1}]$ [8]

(b) Show that the packing factor for a FCC unit cell is 0.74. [4]

(c) Define the following terms

(i) glass transition temperature, Tg
(ii) Frenkel defect
(iii) Endurance ratio [6]

(d) BCC Lithium has a lattice parameter of 3.5089×10^{-10} m and contains one vacancy per 200 unit cells. Calculate

(i) the number of vacancies per cubic metre [4]
(ii) the density of Lithium. [4]

(e) Calculate the maximum force that a 5 mm diameter rod of $A1_2\,0_3$ with a yield strength of 240 MPa can withstand with no plastic deformation. [4]

(f) Calculate the density of cemented carbide based on a titanium matrix if the composite contains 50 wt % WC ; 22 wt % Ta C, 14 wt % TiC. $\rho_{wc} = 15.77\ gcm^3$; $\rho_{Ta} = 14.5\ gcm^{-3}$; $P_{Wc} = 4.94g\ cm^{-3}$; $\rho_{Ti} = 4.05g\ cm^{-3}$. [6]

(g) Distinguish, with examples between thermosetting and thermoplastic polymers. [4]