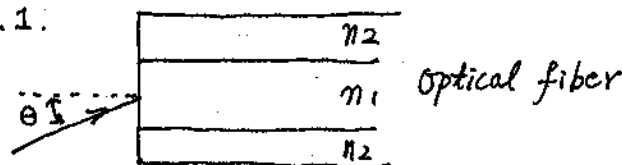


# 國立中央大學九十一年度碩士班研究生入學試題卷

所別： 光電科學研究所 不分組 科目： 普通物理 共 / 頁 第 / 頁

1. (20%) A particular optical fiber consists of a nongraded glass core (the refractive index is  $n_1$ ) surrounded by a cladding (the refractive index is  $n_2$ ). Suppose a beam of light enters the fiber from the air at an angle  $\theta$  with the fiber axis as shown in Fig.1. (1) express  $\sin \theta_{\max}$  as a function of  $n_1$  and  $n_2$ , where  $\theta_{\max}$  is the greatest possible value of  $\theta$  for which a ray can be propagated down the fiber. (2) Does this value depend on the wavelength of the incident beam? Why?
2. (20%) A rocket at rest in space, where there is virtually no gravity, has a mass of  $2 \times 10^5$  kg, of which  $1.51 \times 10^5$  is fuel. The engine consumes fuel at the rate of 400 kg/s, and the exhaust speed is 3 km/s. The engine is fired for 300 s. (a) Find the thrust of the rocket engine. (in [Newton]) (5%) (b) What is the mass of the rocket after the engine burn? (after 300 s)(in [kg]) (5%) (c) What is the final speed attained? (in [m/s]) (10%)
3. (15%) A 200-g body, connected to a spring whose force constant  $k=2$  N/m, is oscillating with an amplitude  $A$  of 20 cm. Treat this system as a quantum oscillator and find (a) The energy interval between the adjacent energy levels. (10%) (b) The quantum number that describes this oscillations. (5%)
4. (15%) For a moment in an oscillating LC circuit, the energy stored in the inductor is  $3/4$  of the total energy. (a) Express the charge amount in the capacitor as a function of the maximum charge ( $q_{\max}$ ). (b) Express the current in the inductor as a function of the maximum current ( $i_{\max}$ ). (c) What fraction of a period must elapse following the time the capacitor is fully charged for this condition to arise?
5. 簡答題 (請敘述其物理機制) (30%)
  - (1) 二極體為何具有整流的作用? (6%)
  - (2) 舉出二種利用界面反射或穿透來使光束線性偏極(linearly polarized)的方法? (6%)
  - (3) 某人發現一台老舊脫水機高速脫水時,在馬達旋轉的聲音中聽到一個約 1Hz 的音量起伏,可能的原因為何? (6%)
  - (4) 一輛機車其油箱置於引擎上方以利用重力供給汽油,當油箱蓋因久未清理而使得通氣孔被完全阻塞,會發生什麼狀況,為什麼? (6%)
  - (5) 若一架傳統直昇機尾部的垂直旋轉翼在空中運動時失效,會造成該直昇機運動上的何種效應,為什麼? (6%)

Fig. 1.



參考用