INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM 695 547

B.Tech Quiz II Examination - March 2015

MA121 - Vector Calculus and Differential Equations

Time: 9.00 am - 10.00 am **Date: 12/03/2015** **Max. Marks: 15**

Attempt ALL questions

1. Prove or disprove the following: [5]

   (i) Between any two positive zeros of $J_0(x)$ there is a zero of $J_1(x)$.

   (ii) Between any two positive zeros of $J_1(x)$ there is a zero of $J_0(x)$.

2. (a) Find the eigen values and eigen functions of the following differential equations:

$$\frac{d}{dx}\left[x\,\frac{dy}{dx}\right] + \frac{\lambda}{x}\,y = 0, \quad y(1) = 0, \quad y(e^{\pi}) = 0.$$

   [3]

   (b) Let m be a positive integer. Show that

$$J_{-m}(x) = (-1)^m J_m(x)$$

   [2]

3. (a) Let $f_n(x) = \dfrac{1}{(nx+1)}$, $0 < x < 1$. Show that $\{f_n\}$ converges pointwise but not uniformly on $(0,1)$ by verifying the definition of uniform convergence. [2]

   (b) Let $\{f_n\}$ be a sequence defined for $n \geq 2$ by [3]

$$f_n(x) = \begin{cases} nx, & 0 \leq x \leq \frac{1}{n} \\ n(\frac{2}{n} - x), & \frac{1}{n} \leq x \leq \frac{2}{n} \\ 0, & x \geq \frac{2}{n} \text{ and } x < 0. \end{cases}$$

   Find the pointwise limit f of f_n. Check whether $\lim_{n\to\infty} \int f_n(x)dx$ and $\int \lim_{n\to\infty} f_n(x)dx$ are equal.

END

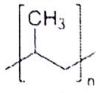
Indian Institute of Space Science and Technology
Thiruvananthapuram
Quiz II

Materials Science and Metallurgy (CH121),

9/03/2015

Time : 1 hr **Maximum Marks: 25**

Answer all questions

1. You have prepared a polyester from the monomers, $HO(CH_2)_6OH$ and $HOOC(CH_2)_4COOH$. The analysis of the whole reaction product showed 6.4×10^{-4} mols of carboxylic acid groups and the molar mass of the product was found to be 28,500 (Mn). [Hint: Contribution from the end groups is neglected for calculation of Mn)
   (i) Write the structure of the polyester
   (ii) Calculate the quantity of the monomers in grams that you would have taken for the reaction.
   (iii) Calculate the extent of polymerization (1+4 +1marks)
2. Describe a polymerization technique by which you can get the final product which can be directly used in paint formulations. (4 marks)
3. Arrange the following polymers in increasing order of T_g and give reasons for the order.
   (i) polyethylene (ii) nylon 6,6 (iii) polystyrene (iv) polypropylene  (4 marks)
4. (i) What is polymorphism? What are the polymorphic transformations in Zirconia?
   (ii) Calculate the planar density and planar packing fraction in (110) plane of BCC iron. The lattice parameter of BCC iron is 0.2866 nm. (2+3 marks)
5. (i) Describe HCP and CCP arrangement of atoms in crystals
   (ii) An element with an atomic mass of 114.82g/mole and a density of 7.286g/cc has a tetragonal structure with a=0.3257nm and c= 0.49459 nm. Does the element have the simple tetragonal or body centered tetragonal structure? (3+3 marks)