8. MME 4304 Printable Materials

9. 3 credits and 3 contact hours per week

10. Namsoo Peter Kim

4. N.P. Kim, “21 papers on Additive Manufacturing and Printable Materials”
   K.N. Han, “Fundamentals of Aqueous Metallurgy,” SME/AIME, 2002.
   D. R. Poirier and G. H. Geiger, "Transport Phenomena in Materials Processing," TMS (1994)
   Contemp. Journal Papers

8. Specific course information
   a. This course deals with various aspects of nano size particles in conjuction with printing processes to form layered materials for flexible electronics, sensors, RFIDs, and medical devices. Major issues that arise in direct writing processes: ink-jet, micro dispensing deposition write; R2R systems, printable components and processes, emphasizing the fundamental physical chemistry, colloidal stability; general modeling and mathematical concepts, and analysis and simulation tools required for existing or future printable applications.
   b. CHEM1306 and PHYS2421 with a grade of “C” or better.
   c. Required

9. Specific goals for the course
   a. Specific Learning Outcomes of instruction:
      - Apply basic mathematical, chemical, physical and thermodynamic engineering theories on printing materials (Exam. I)
      - Describe the concepts of the 3D printable materials related 3D printing technology to construct 2D, 2.5D and 3D structures (Exam I, II)
      - Describe the measurements of the mechanical, chemical, physical, and biological properties of printed materials and apply them to the solving of engineering problems (Exam I,II)
      - Identify the advantages and disadvantages of 3D printing or Additive Manufacturing Process (Exam II)
      - Report results in the form of an oral presentation based on the 3D design and final products including Arduino board and Raspberry Pi’s control, the 2D, 2.5D or 3D design tool and convert to G-code simulation. (Exam II and Presentation)
   b. Student Outcomes addressed by the course: Student Outcomes 1,2, and 6 are emphasized at a high level.

10. Brief list of topics to be covered

Introduction of Physical Chemistry of Surfaces, and Thermodynamics of interfaces; surface free energy; surface tension, Wetting phenomena; contact angle; spreading coefficient, surface charge and its applications

- Electrical properties of charged surfaces; chemical and physical adsorption phenomena
- Colloidal stability; electrostatic repulsion and Van der Waals force
- Introduction: Post-treatment, corrosion, CV, Electrochemical treatment and analysis
- Adhesion and cohesion, and particle agglomeration
- Introduction of Direct writing technologies, packing simulation, probability theory
- Synthesis of printable particles using micelle and inverse micelle
- FDM, MDDW (micro dispensing depositing write), Ink-Jet
- Packing theory and simulation
- STE and PTE Printing Technology for non-Newtonian fluid
- IoT control of Monkey-bar Printer
- Creation of 3D structures using Single Line design