

**CHEMICAL ENGINEERING 4T3**  
**January – April 2016**

**APPLICATIONS OF CHEMICAL ENGINEERING IN MEDICINE**

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**LECTURE HOURS:** Monday, Wednesday, Thursday 10:30-11:20 PSY155

**COURSE OBJECTIVE:**

To impart some detailed knowledge and an overall appreciation of the contributions, actual and potential, of chemical engineering to medicine and biotechnology

**TOPICAL OUTLINE:**

Controlled release drug delivery

Materials; Transport aspects, Degradable systems, Commercially available drug delivery systems

Basic Biochemistry, Anatomy and Physiology – self study/ group project

Biomaterials

Definitions, potential applications, desired properties

Biomaterials in blood contacting applications

Blood vessels, cardiac valves, intra-aortic balloons, stents, left ventricular assist devices, total artificial heart

Biomaterials in non-blood contacting applications

Ophthalmic, orthopedic, dental applications

Tissue engineering

Regulatory

**FORMAT:**

Full class sessions, smaller groups for discussion sessions, design projects

**ASSESSMENT:**

Class participation and discussion sessions	15%
Final Examination Question and Solution (due March 29)	5%

Design projects (5)	30%
Research paper (due March 15)	20%
Pitch	5%
Final exam	25%

- In order not to replicate material that some of the students know well, there will be no general lectures of Biochemistry and Anatomy and Physiology. Should additional material be required, please see me and I will prepare something.
- The paper will be written on a cutting edge topic of your choice. This topic must be approved by the instructor. The paper will be in the form of a pitch to an investor group in order to obtain funding for prototype development.
- A series of 2-3 sets of journal articles on various topics will be handed out throughout the term. One week later, in class discussion sessions will be held on these papers. Participation in these sessions will be graded as will as short synopsis of the papers.
- Assignments (approximately 3) will be handed out periodically throughout the term (not marked).
- A final examination question worth 10 marks with a full solution must be developed and handed in (March 29) based on the material covered in class (hard copy and electronic copy). All questions and solutions will be distributed and one question will be selected and included on the final examination.
- Many of the sections that we cover will culminate in a design project which will require you to develop a new device or system to solve an existing biomedical engineering problem.
- Any calculator may be used on the final examination. One page (8.5x11) of cheat notes may be used in the final examination. The final percentage grades will be converted to letter grades using the Registrar's recommended procedure. Adjustments to the final grades may be done at the discretion of the instructor.

The Faculty of Engineering is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant as soon as possible.

Students are reminded that they should comply with the *Statement on Academic Ethics* and the *Senate Resolutions on Academic Dishonesty* as found in the Senate Policy Statements distributed at registration and available at the Senate Office. Any papers found to contain improperly referenced material will receive a grade of zero.

**RESOURCES:**

There is no single textbook is available to cover all aspects of the course. It is my intention to prepare a course pack for future classes which will include appropriate book chapters and lecture notes. These will be made available to you for assessment. In addition, the sources in the accompanying list may be found generally useful.

### READING RESOURCES FOR CHE 4T3/6T3

J. Enderle, S. Blanchard, J. Bronzino "Introduction to Biomedical Engineering" (2005). This is the recommended text for the course. Approximately 1/3 of the topics covered are in this book.

J.D. Bronzino (ed.), "The Biomedical Engineering Handbook" (1995)

R. Baker, "Controlled Release of Biologically Active Agents" (1987)

D.A. Lauffenburger and J.J. Linderman, "Receptors: Models for Binding, Trafficking and Signaling" (1993).

D.O. Cooney, "Biomedical Engineering Principles" (1976)

A.C. Burton, "Physiology and Biophysics of the Circulation" (1972)

T.E. Creighton, "Proteins: Structure and Function" (1992)

F. Eirich (ed.), "Rheology" vol 4 (Chapter by Goldsmith and Mason) (1967)

G. Cokelet, H.J. Meiselman, D.E. Brooks (eds.), "Erythrocyte Mechanics and Blood Flow" (1980)

L. Dintenfass, "Blood Viscosity" (1985)

J.O. Rowan, "Physics and the Circulation" (1981)

S. Middleman, "Transport Phenomena and the Cardiovascular System" (1972)

R.L. Whitmore, "Rheology of the Circulation" (1968)

D.N. Ghista *et al* (eds.), "Theoretical Foundation of Cardiovascular Processes" (1979)

D.H. Bergel (ed.) "Cardiovascular Fluid Dynamics" (1972)

D.J. Schneck (ed.), "Biofluid Mechanics 2" (1980)

A.C. Guyton, "Textbook of Medical Physiology" latest edition

A.L. Shrier and T.G. Kaufmann (eds.), "Mass Transfer in Biological Systems" CEP Symposium Series No. 99 (1970)

D. Hershey (ed.), "Blood Oxygenation" (1978)

J.B. Park, "Biomaterials Science and Engineering" (1984)

Shitzer and R.C. Eberhart, "Heat Transfer in Medicine" (1987).

R.C. Seagrave, "Biomedical Applications of Heat and Mass Transfer" (1971)

M.S. Lih, "Transport Phenomena in Medicine and Surgery" (1975)

A.L. Lehninger, "Biochemistry", numerous editions or other biochemistry text

C.W. Patrick, A.G. Mikos, L.V. McIntire (eds) "Frontiers in Tissue Engineering" (1998)

R.P. Lanza, R. Langer and W.L. Chick (eds) "Principles of Tissue Engineering" (1997)