Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH. (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, Nov/Dec 2017

SUBJECT: DRUG DELIVERY: ENGINEERING PRINCIPLES [BIO 4011]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

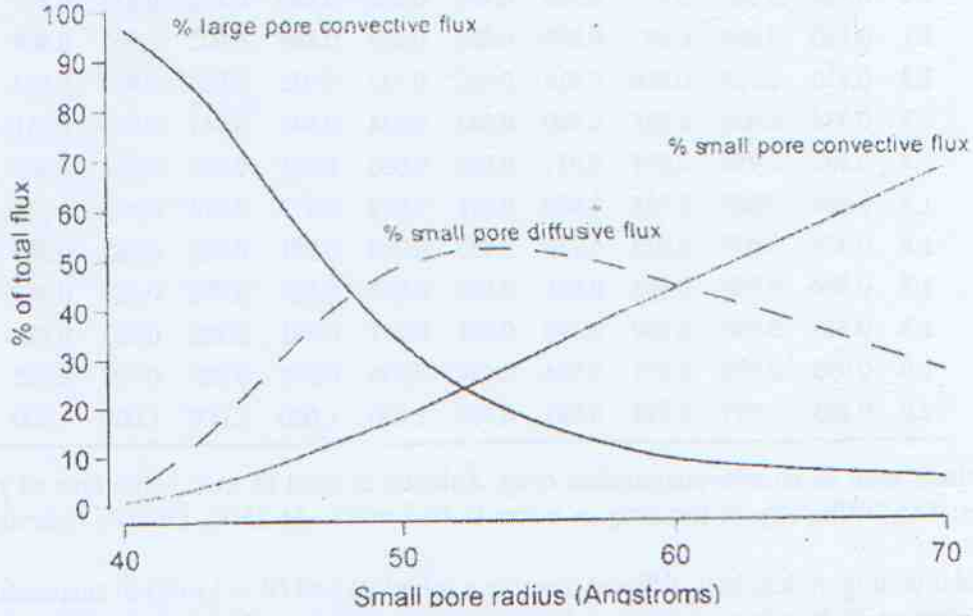
- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. Derive the mathematical expression to calculate the Permeability as a function of partition coefficient and molecular weight in lipid membranes. **4**

1B. Explain the mechanism of Na^+ transport through ion channel? **2**

1C. Briefly explain the mechanism and governing factors for solute transport in skin cells? **4**

2A. Permeation of solute transport through endothelium layers are studied and plotted. Briefly explain the trend and the reasons for it. **3**



2B. Develop the mathematical expression to calculate blood flow rate in a vessel and list out all the assumptions made? **4**

2C. Humans have always attempted to improve their health by ingesting or administering drugs. Give few examples that appear in written history from different continent and culture. **3**

3A. Explain the role of engineers in drug delivery **3**

3B. Give an example for a drug administered via Intrathecal injection mode. Also mention the advantage and disadvantage. 2

Zoladex (goserelin) is used to treat symptoms of prostate cancer. In a particular study Zoladex implants release 50 ppm at its surface. Assume that the drug molecule diffuses on one side of a planar surface, after injection into the site of action. The Diffusivity of the drug is 10^{-7} cm^2/s. The diffusing solute is also eliminated from the tissue, such that the volumetric rate of elimination is first order. The rate constant for elimination, k is 10^{-6} /s. Predict the concentration of the drug molecule at a distance of 2 cm after 1 hr.

$$\frac{c}{c_0} = \frac{1}{2}\exp\left\{-x\sqrt{k/D_A}\right\}\operatorname{erfc}\left\{\frac{x}{2\sqrt{D_A t}} - \sqrt{kt}\right\} + \frac{1}{2}\exp\left\{x\sqrt{k/D_A}\right\} + \operatorname{erfc}\left\{\frac{x}{2\sqrt{D_A t}} + \sqrt{kt}\right\}$$

3B. 5

TABLE 7.2-1. Values of erf(x)

x	0	1	2	3	4	5	6	7	8	9
0.0	0.000	0.011	0.023	0.034	0.045	0.056	0.068	0.079	0.090	0.101
0.1	0.112	0.124	0.135	0.146	0.157	0.168	0.179	0.190	0.201	0.212
0.2	0.223	0.234	0.244	0.255	0.266	0.276	0.287	0.297	0.308	0.318
0.3	0.329	0.340	0.349	0.359	0.369	0.379	0.389	0.399	0.409	0.419
0.4	0.428	0.438	0.447	0.457	0.446	0.475	0.485	0.494	0.503	0.512
0.5	0.521	0.529	0.538	0.546	0.555	0.563	0.572	0.580	0.588	0.596
0.6	0.604	0.611	0.619	0.627	0.634	0.642	0.649	0.657	0.664	0.671
0.7	0.678	0.685	0.691	0.698	0.705	0.711	0.717	0.724	0.730	0.736
0.8	0.742	0.748	0.754	0.759	0.765	0.771	0.776	0.781	0.787	0.792
0.9	0.797	0.802	0.807	0.812	0.816	0.821	0.825	0.830	0.834	0.839
1.0	0.843	0.847	0.851	0.855	0.859	0.862	0.866	0.870	0.873	0.877
1.1	0.880	0.884	0.887	0.890	0.893	0.896	0.899	0.902	0.905	0.908
1.2	0.910	0.913	0.916	0.918	0.921	0.923	0.925	0.928	0.930	0.932
1.3	0.934	0.936	0.938	0.940	0.942	0.944	0.946	0.947	0.949	0.951
1.4	0.952	0.954	0.955	0.957	0.958	0.960	0.961	0.962	0.964	0.965
1.5	0.966	0.967	0.968	0.970	0.971	0.972	0.973	0.974	0.975	0.975
1.6	0.976	0.977	0.978	0.979	0.980	0.980	0.981	0.982	0.982	0.983
1.7	0.984	0.984	0.985	0.986	0.986	0.987	0.987	0.988	0.988	0.989
1.8	0.989	0.990	0.990	0.990	0.991	0.991	0.991	0.992	0.992	0.992
1.9	0.993	0.993	0.993	0.994	0.994	0.994	0.994	0.995	0.995	0.995
2.0	0.995	0.997	0.998	0.999	0.999	1.000	1.000	1.000	1.000	1.000

4A. Heparin is used as an anti-coagulation drug. Zoladex is used to treat symptoms of prostate cancer. The Diffusivity of the drug in water is 10^{-7} cm^2/s. At 25°C, Find its hydrodynamic radius 2

4B. Consider ta drug molecule is diffused towards a spherical cell (R = 1 mm) in suspension. The concentration of drug in suspension is 50 ppm before diffusion. The drug is consumed at the surface of the cell, and the rate of consumption is rapid. The Diffusivity of the drug at the cell surface is 1.6×10^{-7} cm^2/s. Predict the concentration of drug at a distance of 0.6 mm from the cell surface after 2 hr 3

4C. Explain the difference in drug release from bulk eroding and surface eroding polymers with examples 5

5A. Explain the challenges of Insulin oral delivery. Is it possible in the future? explain 5

5B. Explain how nanoparticle delivery helps in cancer treatment with proper example 5