DEPARTMENT OF SCIENCE

COURSE OUTLINE – WINTER 2011-12

BC 3200 – STRUCTURE & CATALYSIS

INSTRUCTOR:	Philip Johnson	**PHONE:**	780-539-2863
OFFICE:	J224	**E-MAIL:**	PJohnson@gprc.ab.ca

OFFICE HOURS: Mondays 1300-1420
Tuesdays 1130-1420
Thursdays 1130-1250

PREREQUISITE(S)/COREQUISITE: BC 2000, CH 1020 and CH 2630

REQUIRED TEXT/RESOURCE MATERIALS:

Chapters 3-7, 10-12
Lehninger Principles of Biochemistry (5th Edition)
David Nelson & Michael Cox
W.H. Freeman and Company 2008
(The 4th Edition (2005) of this text is also acceptable)

Handouts containing copies of the Powerpoint slides used in class will be available for download from the course page on Blackboard.
Students will also be able to access resources available on the textbook web page.

CALENDAR DESCRIPTION: Designed to illustrate, in detail, the relationships between structure and function in biological molecules. It covers the structure of proteins; techniques used to study proteins; contractile proteins and immunoglobulins as examples of protein function; enzyme catalysis kinetics and regulation; structural carbohydrates and glycobiology; the structure of lipids; biological membranes and mechanisms of transport; molecular mechanisms of biosignalling.

CREDIT/CONTACT HOURS: 3 credits (3-0-0)

DELIVERY MODE(S): Classes - Monday 1130-1250 (J227)
Friday 1000-1120 (J227)

TRANSFERABILITY: Biochemistry 320 (University of Alberta)

Notes: 1. Students with grades of less than B- in pre-requisite courses require consent of the instructor to enroll in BC 3200.
2. BC 3200 may not be taken for credit if credit has already been obtained in BC 2030 or BC 2050.

**** Grade of D or D+ may not be acceptable for transfer to other post-secondary institutions. Students are cautioned that it is their responsibility to contact the receiving institutions to ensure transferability**

EVALUATIONS:

Mid-term Exam I	30%
Mid-term Exam II	30%
Final Exam	40%

Mid-term Exam I will test knowledge of material covered in the first third of the course and will be completed during regular class time.
Mid-term II will test knowledge of material covered since the first mid-term and will also take place in regular class time.
The Final Exam will be cumulative and test knowledge of the entire course with approximately 40% of marks assigned to questions from the first two-thirds of the course, and approximately 60% of marks assigned to questions from the last third of the course.

All exams will consist of a combination of both multiple-choice and written questions.

GRADING CRITERIA:

GRANDE PRAIRIE REGIONAL COLLEGE			
GRADING CONVERSION CHART			
Alpha Grade	**4-point Equivalent**	**Percentage Guidelines**	**Designation**
A^+	**4.0**	**90 – 100**	**EXCELLENT**
A	**4.0**	**85 – 89**	
A^-	**3.7**	**80 – 84**	**FIRST CLASS STANDING**
B^+	**3.3**	**77 – 79**	
B	**3.0**	**73 – 76**	**GOOD**
B^-	**2.7**	**70 – 72**	
C^+	**2.3**	**67 – 69**	**SATISFACTORY**
C	**2.0**	**63 – 66**	
C^-	**1.7**	**60 – 62**	
D^+	**1.3**	**55 – 59**	**MINIMAL PASS**
D	**1.0**	**50 – 54**	
F	**0.0**	**0 – 49**	**FAIL**
WF	**0.0**	**0**	**FAIL, withdrawal after the deadline**

STUDENT RESPONSIBILITIES:

Since participation in lectures and completion of assignments are essential to achieving success in this course, regular attendance at classes is highly recommended. Students who chose not to attend classes must assume whatever risks are involved.

Students should avoid any disruptive behaviour during class.

All cell phones must be switched off during class.

Students should refer to pages 49-52 of the 2011-2012 G.P.R.C. Admissions Guide, especially in regards to policies on plagiarism, cheating and the resulting penalties. These are serious issues and will be dealt with severely. The Guide is available at

www.gprc.ab.ca/programs/calendar/admissions-guide-2011-2012/index.html

*Note: all Academic and Administrative policies are available on the same page.

BC 3200 – Topic Outline 2011-2012

hours	topic	Text readings 4th edition	Text readings 5th edition
5	Amino acids, peptides and proteins		
	Amino acids		
	Common structural features	76-77	72-74
	Classification by R-group	78-80	74-77
	Uncommon amino acids	80-81	77-78
	Functions as acids and bases	81-85	78-81
	Peptides and proteins		
	Composition of peptides	85-86	82
	Sizes of active peptides and polypeptides	86-87	83-84
	Composition and additional chemical groups	87-88	84
	Levels of protein structure	88	92
	Working with proteins		
	Separation, purification and column chromatography	7-8, 89-92	7-8, 85-88
	Electrophoresis	92-95	88-91
	Activity and Specific Activity	94-95	91-92
	Covalent Structure of proteins		
	Primary structure determines function	96-97	93
	Sequence determination	97-104	93-100
	Chemical synthesis of peptides	104-106	100-102
	Biochemical information from primary sequence	106	}102-106
	Primary sequence and evolution	106-110	
5	Three-dimensional structure of proteins		
	Overview		
	Stabilization of protein conformation	116-118	113-115
	Peptide bonds and Ramachandran Plots	118-120	115-117
	Protein Secondary structure		
	Structure and stability of the α-helix	120-122	117-120
	β-sheets and β-turns	123-124	120-121
	Bond angles and amino acid content	124	121-123
	Tertiary and Quarternary structure		
	Fibrous proteins (inc. Boxes 4-2 & 4-3)	125-129	123-129
	Globular proteins	129-135	129-131

	Determination of 3-D structure	Box 4-4	Box 4-5
	Structural patterns in globular proteins	138-141	131-136
	Structural classification	141-144	136-138
	Quarternary structure	144-146	138-140
	Denaturation and folding		
	Denaturation and renaturation	147-148	140-142
	Polypeptide folding	148-151	142-143
	Chaperones and assisted folding	151-153	143-145
2	Protein functions, interactions, molecular motors		
	Ligands and binding	157-158	153-154
	Myosin and actin	182-184	175-176
	Thin and thick filaments	184-185	176-177
	Sliding filaments and muscle contraction	185-186	178-179
6	Enzymes		
	Introduction		
	Importance of enzymes	190-191	183
	Enzymes, cofactors and classification	191-193	183-185
	How enzymes work		
	Active sites, reaction coordinate diagrams	193-195	186-188
	Definitions – reaction equilibria and rates	195-196	188
	Catalytic power and enzyme specificity	196-200	188-192
	Types of catalysis	200-202	192-194
	Enzyme kinetics and mechanisms		
	Substrate concentration and reaction rates	202-205, Box 6-1	194-197, Box 6-1
	Kinetic parameters for comparing activity	205-207	197-200
	Bisubstrate enzyme-catalyzed reactions	207-208	200
	Enzyme inhibitors	208-212, Box 6.2	201-204, Box 6-2
	Activity and pH	212	204
	Examples		
	Chymotrypsin	213-218	205-211
	Hexokinase	218-219	212
	Enolase	219 & 222	213
	Regulatory enzymes		
	Allosteric enzymes and pathway regulation	225-227	220-222

	Kinetic properties of allosteric enzymes	227-228	222
	Regulation by covalent modification	228-232	223-227
4	Carbohydrates and glycobiology		
	Monosaccharides and disaccharides		
	Aldoses, ketoses and stereoisomers	238-240	235-238
	Cyclic structures	240-243	238-239
	Hexose derivatives	243-244	240-241
	Glycosidic bonds	245-246	243-244
	Polysaccharides		
	Homopolysaccharides	247-250	244-247
	Homopolysaccharide folding	250-252	247-248
	Heteropolysaccharides	252-255	249-252
	Glycoconjugates		
	Proteoglycans, glycoproteins, glycolipids	255-261	252-257
	Carbohydrates as informational molecules		
	Lectins and the “sugar code”	262-267	258-263
	Working with carbohydrates	267-268	263-265
	Glycosylation and protein targetting	1068-1071	1100-1104
3	Lipids		
	Storage lipids		
	Fatty acids	343-345	343-345
	Triacylglycerols	345-348	346-348
	Waxes	348	349
	Membrane lipids		
	Glycerophospholipids	348-350	349-352
	Galactolipids	351	352
	Sphingolipids	352-354	352-355
	Sterols (cholesterol)	354-355	355-357
	Lipids as signals, cofactors and pigments	357	357
6	Biological membranes and transport		
	Composition and architecture of membranes		
	Characteristic lipids and proteins	369-371	371-373
	Lipid bilayer	371-373	373-374
	Integral and peripheral proteins	373-375	375-377

	Topology of integral proteins	376-378	378-379
	Covalent attachment of proteins to lipids	379	379-380
	Membrane dynamics		
	Ordering of acyl groups in a bilayer	380-381	381
	Transbilayer movement of lipids	381-382	381-383
	Lateral diffusion of lipids and proteins	382-383	383-384
	Membrane rafts	383-385	384-386
	Cell-to-cell interactions and adhesion	385-386	388
	Membrane fusion	387-389	387-388
	Solute transport across membranes		
	Types of transport	389-393	389-391
	Facilitated diffusion	393-395	391-393
	Primary active transport	397-400	395-399
	Secondary active transport	402-406	400-404
	Ionophores (valinomycin)	406	404
	Aquaporins	406-408	404-406
5	Biosignalling		
	Mechanisms of signal transduction		
	Biological signals	421	419
	Overview of mechanisms	422-424	419-420
	Fundamental signaling systems	424	420-424
	Lipids as signals, cofactors and pigments		
	Phosphatidylinositol and sphingosine derivatives	357-358, 442	357-358, 432-433
	Eicosanoids – paracrine hormones	358-359	358-359
	Steroid hormones	359-360, 465-466	359, 456-457
	Vitamins A & D – hormone precursors	360-362	360-361
	Vitamins E & K	362-363	361-362
	Gated ion channels		
	Electrical signaling	425-426	449-451
	Acetylcholine receptor (ligand-gated)	426-427	453
	Receptor enzymes		
	Insuline receptor (tyrosine kinase)	429-430	439
	G-protein receptors and second messengers		
	β-adrenergic receptor and cAMP	435-439	423-430