

# **Division of Biomedical Engineering: Overview and Self-Assessment**

**W.J. (Chris) Zhang, Ph.D., P.Eng**

**Professor and Acting Chair  
Division of Biomedical Engineering**

**Date: December 20, 2011**

## **Executive Summary**

Biomedical Engineering links the Physical Sciences and Engineering with Clinical Medicine and the Life Sciences in many interdisciplinary activities. This multi-disciplinary field plays a vital role in bringing advances of the natural sciences and technology to improvement of our life and healthcare. Contemporary medicine, both diagnostic and therapeutic, relies increasingly upon highly sophisticated technical methods, devices, and equipment. This trend has continued for the past three decades and continues to increase. These achievements represent only a sample of what can be obtained through synergic cooperation and collaboration. The cooperation and collaboration indeed represents a two-way street of benefits. Not only do medicine and healthcare benefit, but also new developments in natural science and engineering may benefit from the problems brought to engineering from the medical and life sciences.

The Division of Biomedical Engineering at the University of Saskatchewan was launched in 1962 and is one of the oldest biomedical engineering units in North America. Since its inauguration, there have been in total 9 colleges across the campus participating, together with Canadian Light Source (CLS), Vaccine and Infectious Disease Organization (VIDO) and Plant Biotechnology Institute (PBI). The Division currently has 53 members and 56 students. The Division is financially supported by CGSR and administrated by the College of Engineering. The Division has graduated 8 students, secured the research grant of \$7.5 million and produced 109 refereed journal articles in the academic year of 2010 - 2011.

This report presents an overview of Division of Biomedical Engineering in the areas of its organizational structure, governance, and operation. There are six sections within this report: Section 1: Introduction; Section 2: Mission, goal and visions; Section 3: Organizational structure; Section 4: Operation; Section 5: Self-assessment; Section 6: Closing remarks. The purpose of the report is therefore to facilitate the division review process to identify the strengths, weaknesses, opportunities, and threats facing the Division and to advance the Division to the next level of excellence.



## **Acronym**

CLS	: Canadian Light Source
VIDO	: Vaccine and Infectious Disease Organization
PBI	: Plant Biology Institute
CGSR	: College of Graduate Studies and Research
GSC	: Graduate Study Committee
PGD	: Post Graduate Diploma
SHRF	: Saskatchewan Health Research Foundation
CIHR	: Canadian Institute of Health Research
NSERC	: Natural Science and Engineering Research Council
MRI	: Magnetic Resource Imaging

## **Acknowledgements**

The creation of this report is perhaps impossible without various supports the author has received from the members of the Division and the Secretary (J. Compain) of the Division. Herewith, the author wants to acknowledge these supports. Thanks shall also go to Jialei (Gary) Huang (graduate research assistant of Mechanical Engineering) and Phani Adapa (Manager of the division review project) for their quick response to requests of information. Gary has also been in a great help in compiling information and editing the report.

## Table of Contents

<b>Executive Summary</b> .....	i
<b>Acronym</b> .....	iii
<b>Acknowledgements</b> .....	iv
<b>1. Introduction</b> .....	1
<b>2. Mission, goal, visions</b> .....	1
<b>2.1 Mission</b> .....	1
<b>2.2 Goal</b> .....	1
<b>2.3 Visions</b> .....	2
<b>3. Organizational structure</b> .....	2
<b>3.1 Infrastructure and facility</b> .....	2
<b>3.2 People</b> .....	4
<b>3.3 Finance</b> .....	4
<b>3.4 Student</b> .....	5
<b>4. Operation</b> .....	7
<b>4.1 Governance</b> .....	7
<b>4.2 Program</b> .....	7
<b>4.3 Teaching</b> .....	7
<b>4.4 Research</b> .....	8
<b>4.5 Service</b> .....	9
<b>4.6 Administration</b> .....	9
<b>5. Self-assessment</b> .....	11

<b>6. Closing remarks .....</b>	<b>14</b>
<b>Bibliographies.....</b>	<b>16</b>
<b>Appendix A. Division review charter .....</b>	<b>17</b>
<b>Appendix B. Member list .....</b>	<b>23</b>
<b>Appendix C. Budget sheet .....</b>	<b>30</b>
<b>Appendix D. List of current students.....</b>	<b>31</b>
<b>Appendix E. List of graduated students .....</b>	<b>34</b>
<b>Appendix F. Term and Condition .....</b>	<b>39</b>
<b>Appendix G. List of courses .....</b>	<b>42</b>
<b>Appendix H. Recommendation of a new student.....</b>	<b>43</b>
<b>Appendix I. Proposal of School of Biomedical Engineering .....</b>	<b>44</b>

## **1. Introduction**

This report presents a general overview of the Division of Biomedical Engineering in various aspects. The Division was launched in 1962. The motivation of this report is to facilitate the division review process (see Appendix A). This report does not include the programs delivered by the Division in detail but focuses on the structure of the Division, its governance, operation, and impact to the whole university. The report includes six sections including the introduction section and several appendices. Section 2 presents the mission, goal, visions of the Division. Section 3 presents the information of the structure of the Division, followed by the description of the operation of the Division in Section 4. In Section 5, the response to the specific questions is presented, as form of self-assessment. Finally, in Section 6, there is description of some thoughts for the future of the Division.

## **2. Mission, goal, visions**

### **2.1 Mission**

The Division strives to be an excellent place to promote interdisciplinary research across engineering, medicine and life science on the campus of the University of Saskatchewan. In Saskatchewan, animals are also paid great attention for the province's unique geography. Therefore, veterinary medicine is included in medicine.

### **2.2 Goal**

The Division delivers a graduate program in the broad area of biomedical engineering, including: biomechanics, nuclear magnetic resonance spectroscopy and magnetic resonance imaging, ultrasonography, biomedical signal and image processing, applications of artificial neural networks, fuzzy logic and expert systems to medical and life science problems, physiological system modeling, tissue engineering, biosensor and bioactuator, healthcare engineering, and medical instrumentation. In particular, the Division offers the following

graduate degree programs: (1) Master of (Clinical) Engineering, (2) Master of Engineering, (3) Master of Science, and (4) Doctor of Philosophy degrees. The Division also offers a post-graduate diploma program as a tool to accommodate students with different backgrounds and experiences.

## **2.3 Vision**

- (1) Advance the knowledge of human life and health especially to the healthcare system by applying engineering principles to medicine and life science.
- (2) Advance the knowledge of engineering by bringing new challenges and problems derived from medicine and life science.
- (3) Develop tools and technologies for medicine and life science to improve our understanding of medical and life phenomenon and our capability in diagnosis and treatment of diseases.
- (4) Establish the center of excellence for interdisciplinary and multidisciplinary research and education.

## **3. Organizational Structure**

### **3.1 Infrastructure and facility**

The Division is located at the College of Engineering. The Division can be accessed in the cyber-space through two portals: U of S -> University center -> Biomedical Engineering with web-link ([http://www.usask.ca/university\\_secretary/centers/](http://www.usask.ca/university_secretary/centers/)); U of S -> College of Engineering -> Division -> Biomedical Engineering with web-link ([www.engr.usask.ca](http://www.engr.usask.ca)). The main office of the Division is headquartered in the Engineering Building (1B95) which is shared with the Division of Environmental Engineering and Engineering Workshop. The Division has no faculty office space, as faculty have their own home departments or units. The Division has no independent laboratory space. The Division has the graduate student desk space, which is located partly in Animal Science Building (see Fig. 1a) and partly in Engineering Building (see Fig. 1b). The total

student desk space is 750 square feet (Animal Science Building 550 square feet plus Engineering Building 200 square feet). The capacity of the student desk space is for 20 students.

The Division is strongly affiliated with the Synchrotron Radiation facility on the University of Saskatchewan campus in particular Biomedical Beamline. The Division is also strongly affiliated with the Medical Imaging Department in particular MRI facility. These facilities are readily accessible to faculty and students of the Division.



**Fig. 1a** Graduate student desk space in Animal Science Building.



**Fig. 1b** Graduate student desk space in Engineering Building.

### **3.2 People**

The Division does not have standing faculty members. All the members of the Division are from other departments or units across the campus of the University. The members have their home departments or units. Colleges and units involved include College of Medicine, College of Veterinary Medicine, College of Arts & Science, College of Engineering, College of Kinesiology, School of Physical Therapy, Saskatoon Cancer Center, Saskatoon City Hospital, VIDO (Vaccine and Infectious Disease Organization), CLS (Canadian Light Source), and Plant Biology Institute (PBI). There is no extra financial resource to faculty of the Division. The Division has a standing (1/4) time secretary. The salary of the secretary is provided by CGSR (College of Graduate Studies and Research). Appendix B lists all the members in the Division at present.

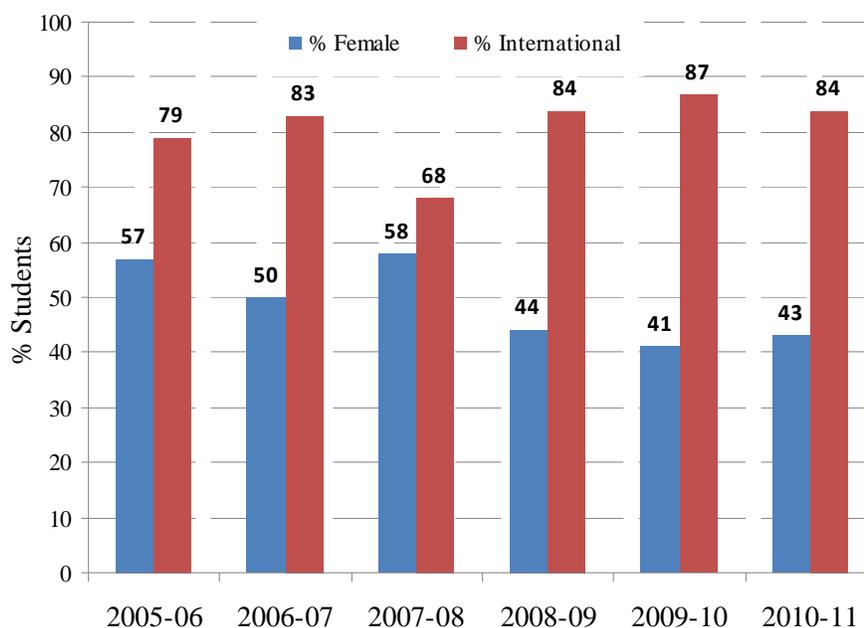
### **3.3 Finance**

The Division is funded by CGSR for the 1/4 secretarial support as mentioned before. The Division has an operating budget of \$711 on average every year (see Appendix C). The operating

budget is mainly used to cover the expenses of the Division's annual graduate seminar, Division Annual General Assembly, and stationery for office use. The Division receives \$47K on average every year for scholarships since 2010. Scholarships are offered to graduate students of the Division each year. Before 2010, the Division belonged to the non-devolved scholarship unit at CGSR. As a non-devolved scholarship unit, students in the Division participated scholarship competition among all non-devolved scholarship units across the campus. Typically, the Division would receive 2-4 scholarship awards every year, which corresponded to \$35K – 80K every year.

### **3.4 Students**

Students in the Division represent a variety of backgrounds, including Engineering, Medicine, Life Sciences, Economics, Mathematics, Administration and Management. There has been a wide interest in the Division from international students (close to 80% of the total student number), see Fig. 2 and Table 1. As well, there is a relatively large population of female students in the Division (close to 40% of the total student number), see Fig. 2 and Table 1. In the recent years, on average, 5 students graduated and received their degrees (see Table 1). Appendix D lists all the students currently registered in the Division. Appendix E lists all the students graduated from the Division from the year of 1980 to 2011.



**Fig. 2** Population of female and international students in the Division  
(Source: College research report, from 2005 to 2011 inclusive)

**Table 1** Student population and degrees awarded in the Division  
(Source: College research report, from 2005 to 2011 inclusive)

Year	Graduate Students					Degrees Awarded
	PhD	MSc	Total	%Female	%International	
2005-06	4	8	14	57	79	1
2006-07	6	10	18	50	83	3
2007-08	7	11	19	58	68	5
2008-09	10	15	25	44	84	5
2009-10	14	23	39	41	87	2
2010-11	22	29	56	43	84	8

## **4. Operation**

### **4.1 Governance**

The Term and Condition of establishing the Division is seen in Appendix F. The Division has a chair and an executive committee, see Appendix B. The executive committee must be comprised of members from different colleges across the campus. The chair is appointed by the Dean of Engineering after consultation with members of the Division and the Dean of Graduate Studies and Research. The Division has a graduate chair or a vice chair and a Graduate Study Committee (GSC). The GSC is responsible for scholarship competition and graduate student admission. Chair of the Division is automatically a member of the GSC of the Division.

The Division holds an annual general assembly to discuss important issues affecting the Division. The Executive Committee of the Division holds meetings as issues arise. The GSC meets annually to discuss and select scholarship awardees, and it may also hold meetings when other graduate study issues arise.

### **4.2 Program**

The Division offers a graduate program including PhD, MSc, Master of Engineering, Master of Clinical Engineering and PGD (Post Graduate Diploma). The Division has its own courses (see Appendix G). These courses are instructed by members of the Division. Some members' home units may take the account of involvement of the members in the Division in the assignment of duties, while others may not. There is no unified policy available across different units in the campus to taking the account of member involvement in the Division.

### **4.3 Teaching**

The Division follows the general concept of CGSR that students in the Division can take courses from other units at the University. The Division has its own courses as well, see Appendix G. The Division has no requirement on the number of Division's own courses that a student

registered in the Division's programs must take. Such is delegated to the judgement and decision of advisory committees of students, as a part of their study programs.

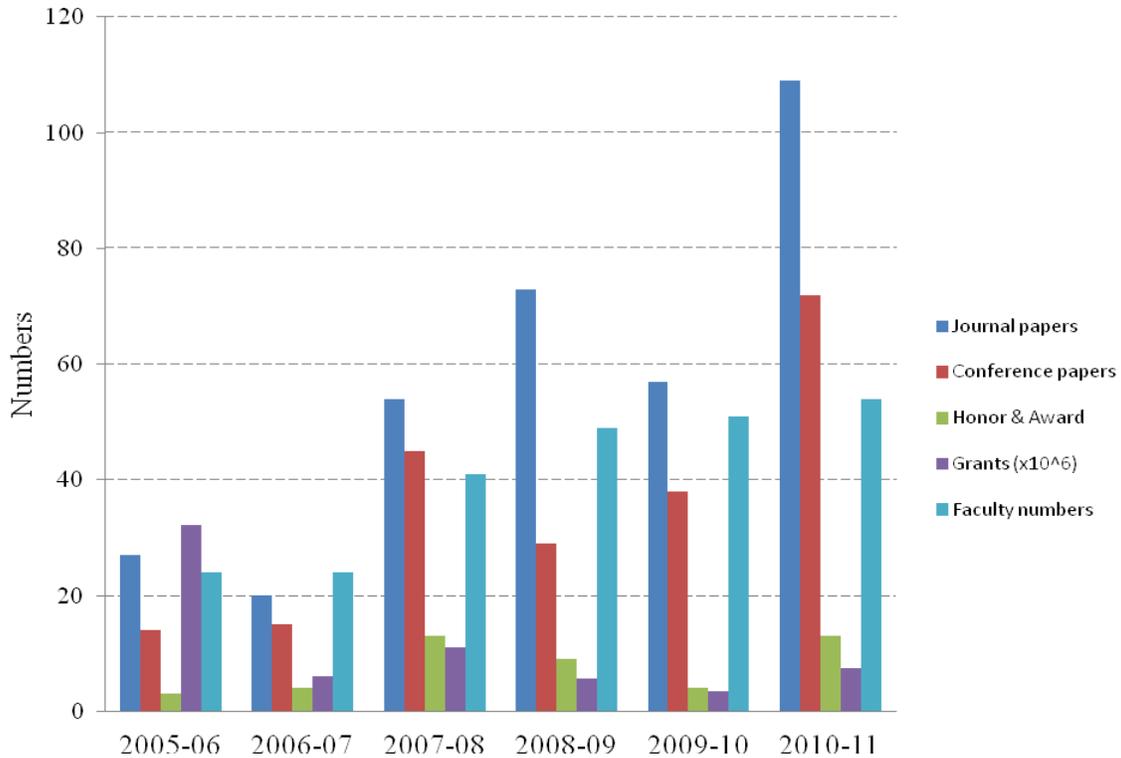
#### **4.4 Research**

Members of the Division have conducted research in a broad area of biomedical engineering. At present, there are 7 active areas of research focus in the Division. They include:

- (1) Tissue engineering,
- (2) BioMEMS/BioNEMS,
- (3) Medical imaging including synchrotron radiation technology,
- (4) Rehabilitation and assistive robots,
- (5) Bioinformatics and systems biology,
- (6) Biosensor, bio-actuator, biomaterial, bio-artefact, bio-instrumentation, and
- (7) Healthcare systems.

Research in (1) has been supported by SHRF (Saskatchewan Health Research Foundation) and CIHR (Canadian Institute of Health Research). Research in (2) has been supported by SHRF. Research in (3) has been supported by NSERC (Natural Science and Engineering Research Council) and CIHR, SHRF. Research in (5) has been supported by NSERC. Research in (6) has been supported by NSERC and industries, and research in (7) has been supported by the University through a faculty start-up grant.

The Division has produced 109 refereed journal papers and 72 refereed conference papers in the year of 2010 - 2011 and has secured research grant of \$7.5M in the year of 2010 - 2011. The Division graduated 8 students (7 MSc and 1 PhD) in the year of 2010-2011. The overview of research outputs of the Division in the recent six years can be found in Fig. 3.



**Fig. 3** Research outputs of the Division in the recent six years.

#### 4.5 Service

Consultation Services of the Division are provided by individual members. For example, in the year of 2010 - 2011, two members participated in the Saskatchewan Education Board Outreach Activities Program to host high school students to their research labs. Through this program, high school students are exposed to real-world research.

#### 4.6 Administration

Chair of the Division oversees the day-to-day operations of the Division, and he or she chairs the Executive Committee of the Division, the general assembly of the Division, and sits in the GSC of the Division. The Graduate Chair of the Division makes decisions on all graduate student issues. In the absence of the Graduate Chair, the Division Chair assumes this responsibility. In

the absence of the Division Chair, the Graduate Chair assumes the responsibilities of the Division Chair.

Regular day-to-day responsibilities of the Division include: (1) appointment of a new members including associate members and adjunct members into the Division, (2) admission of new graduate students, and (3) dealing with other university business as it arises.

To appoint new members (1), the procedure is:

- (a) potential applicants submit their expression of interest in the Division by submitting, including their CV and plan of involvement in the Division
- (b) the Division Chair reviews the application, performs a preliminary screening of the suitability of the applicant
- (c) the Division Chair will call for a meeting of the executive committee to discuss the application if the preliminary screening is passed
- (d) the Executive Committee discusses the application and votes on the application. A simple majority of vote approves the application
- (e) if the executive committee approves the application, the applicant will be appointed as a member of the Division, and a letter confirming the appointment is sent to the new member.

To admit a new graduate student (2), the procedure is as follows:

- (a) an applicant submits his or her application based on the CGSR's procedure
- (b) the secretary of the Division reviews the applicant's information package to ensure its completeness
- (c) the secretary will then distribute this information to members who have interest in the applicant, otherwise circulate among faculty members whose areas match the applicant's area
- (d) if an agreement between the applicant and a member or members is reached, the secretary will generate a letter of the recommendation to CGSR. The letter will be signed by Graduate Chair of the Division; a sample of the letter can be found in Appendix H.

## 5. Self-assessment

We believe the Division has well fulfilled its goal and advanced its vision. The Division is essentially a research center with a graduate program. The Division has grown quite large, size in terms of the number of faculty members, graduate students, and areas where research has been undertaken. The Division has successfully attracted interest from faculty and scientists from nine separate colleges of the University of Saskatchewan plus three organizations (CLS, VIDO, PBI). With such demonstrated inclusivity and diversity, this Division is perhaps at the top of all biomedical engineering programs in Canada.

While it is obvious that the application of engineering to medicine and life science has generated many benefits to medicine and life science, the endeavour to solve problems in medicine and life science reciprocally leading to new discoveries in engineering. One example is a study conducted in the Division [1] on real-time measurement of minutes of hydrogen sulphide in sera and blood. The study further reveals that pristine carbon nanotube can bind with some proteins and inorganic elements [2]. The initiative to explore and realize mutual benefits from the synergy of engineering and medicine has been largely taken by the Division, which is perhaps a very unique feature of the Division.

The Division's research activity has aligned with two of the six signature areas of the University of Saskatchewan, namely Area I: One Health: Solutions at the Animal-Human-Environment Interface; Area II: Synchrotron Sciences: Innovation in Health, Environment and Advanced Technologies. Research in the thrust of medical imaging makes use of synchrotron radiation techniques for cutting edge research (e.g., Bystander effect in cancer treatments using radiology, X-ray diffraction technique [3] etc.). Research in the thrust of healthcare system and BioMEMS / BioNEMS has been developing technologies to address healthcare problems from a systems perspective.

Research in the Division covers the broad area of biomedical engineering including the seven areas of focuses as described in Section 4.4. The quality of the work is high in terms of the reputation of journals and conferences where members of the Division have published their

research results. In terms of quantity, the Division has produced 1.3 refereed journal papers and 0.8 refereed conference papers per member on average each year for the past six years. The detailed information of this can be seen from Table 2.

Research in the Division involves traditional topics in biomedical engineering such as biomechanics at the whole human body level and sensors and instruments for measuring physiological signals to the emerging topics such as biomechanics at the cellular level, nanobioscience and technology, and healthcare systems (a systems perspective in designing and managing healthcare delivery), and systems biology. Researches in these emerging areas very well represent the current view and trend in medicine and healthcare, i.e., achieving personalized and individualized Medical approaches and solutions. It must be noted that the students' knowledge background in the Division is very diverse, including the Life Science, Medicine, Engineering, Biotechnology, Mathematics, and Management. We believe this level of diversity among our graduate students demonstrates their confidence in the Division and its vision. The Division's research activity pattern (i.e., diversity and emerging) is perhaps responsible for the rapid growth of the Division over the past six years in terms of faculty members (from 20 to 53) and in graduate students (from 14 to 56).

Table 2 Quantity of publication from the Division

Year	Numbers			Refereed Journal papers per person	Refereed Conference papers per person
	Refereed Journal papers	Refereed Conference papers	Faculty numbers		
2005-06	27	14	24	1.1	0.6
2006-07	20	15	24	0.8	0.6
2007-08	54	45	41	1.3	1.1
2008-09	73	29	49	1.5	0.6
2009-10	57	38	51	1.1	0.7
2010-11	104	65	53	2.0	1.2
Average of six years	56	34	40	1.3	0.8

The Division is perhaps quite unique in Canada in its close ties with CLS and VIDO. Quite a large number of research projects conducted by the Division are relevant to improvement and innovative use of synchrotron radiation facilities [3]. There have been a few research projects aimed towards the provision of more effective tools for drug delivery of virus vaccine, e.g., hepatitis C virus vaccine [4]. The Division has recently been developing the research thrust of healthcare systems (see the discussion in Section 4.4). The fundamental idea of this research thrust is to have a systems view of healthcare. Based on this view, healthcare problems can be tackled more scientifically and more systematically (for example using systems dynamics techniques). A recent joint appointment of a faculty member between the Department of Medical Imaging and the Department of Mechanical Engineering on system dynamics approach to medical imaging has provided an important milestone to this new research thrust. These areas represent an emerging focus of the Division and should be promoted and enhanced.

The Division has greatly contributed to the University in terms of training of graduate students. Currently, both the size of student population and the number of students graduated per year are 4<sup>th</sup> in the College of Engineering (before the merge of the department of chemical engineering and the department of agriculture and bioresource engineering). The Division has become very popular in the campus of the University and attracts a lot of interest amongst highly qualified graduate students. An initiative to move the Division of Biomedical Engineering into a School of Biomedical Engineering was advanced by the members of the Division, in the University's Second Phase Integrated Planning Project; see Appendix I.

The Chair of the Division has been very active in continuously improving existing research thrusts and developing new research thrusts. Often, the Chair of the Division actively approaches suitable Faculties or scientists on the campus of the University and introduces to them the research and graduate program of the Division. This active approach has been extremely effective as the Division has grown from 20 members six years ago to 53 members at present. With the growing number of members, and increasing student numbers, it is anticipated that the scope of the Division's research activities will also expand further increasing interest in the Division.

The growth and expansion of the Division has generated concerns about the limited infrastructure and resources (in particular student space and secretarial support) currently available to the Division. The student space of the Division is about 50% below what is required. Additionally, the Division does not have dedicated laboratory space which has restricted to some extent the ability of the Division to operate effectively. For instance, laboratory components in courses have to be missed thereby diminishing the educational experience of the students. The secretarial support is greatly below what is required by a Division with so many students and faculty. Compensation for teaching and administration activities in the Division is not available, which at times compromises the effective delivery of courses and administration activities. While the members within the College of Engineering may well be taken care of for their activities in the Division through the assignment of duties in their home departments, outside the College of Engineering, cases may vary. The Division has no authority to appoint adjunct members, which may compromise the effective delivery of the program of the Division. In general, the challenge of how to attract more medical doctors and other healthcare specialists to the Division activities is a priority issue to be addressed. Some existing policies in the University, including the appointment of adjunct professors and the appointment of medical doctors to Ph.D advisory committees are strongly relevant to this issue.

## **6. Closing remarks**

The Division of Biomedical Engineering is a robust and thriving unit at the University of Saskatchewan. It has a 50 year history of participation in University research related activity and is a virtual unit in the sense that the Division does not have its standing faculty members. All the members are based in “home” departments and units. The Division offers graduate programs in the broad area of biomedical engineering. It is a popular unit across the campus of the University, attracting interest and participation from nine separate colleges. Apart from engaging in University research projects, the Division is connected to the Provinces research mission with its active involvement in synchrotron-based research, in particular via the biomedical beamline.

The primary mandate of the Division is the provision of a “virtual” place to facilitate multi-disciplinary research in the campus of the University. The Division has met this mandate. Both the structure and operation of the Division are quite across the boarder of different departments or units in the campus of the University. Clearly, a strong belief exists in the minds of Faculty on the campus of the University that the Division of Biomedical Engineering is a home of inter-disciplinary activities.

While the initial design of the Division both in its structure and governance has been shown to be very successful, some changes are perhaps necessary to advance its vision further. The Division is poised to adopt the “School of Biomedical Engineering” model suggested in the University of Saskatchewan’s 2<sup>nd</sup> integrated plan. One specialized feature of having a School of Biomedical Engineering is the potential for collaboration with the College of Medicine. This would contribute to training of medical doctors and other healthcare specialists thereby further establishing the University of Saskatchewan as a leader in Biomedical Engineering.

## **Bibliographies**

1. Xiaochu Wu. Measurement of low concentration and nano quantity hydrogen sulphide by carbon nanotube, PhD thesis, University of Saskatchewan, 2008. Supervised by C. Zhang and Rui Wang.
2. Eric Zhang. Fundamental study of measurement of low concentration hydrogen sulphide in sera using carbon nanotube, University of Saskatchewan, 2010. Supervised by C. Zhang and R. Sammynaiken.
3. Honglin Zhang. Imaging dilute contrast materials in small animals using synchrotron light, University of Saskatchewan, 2009. Supervised by Dean Chapman and M.M. Gupta.
4. Wenting Chen. Investigation of functionalized carbon nanotubes as a delivery system for enhanced gene expression with implications in developing DNA vaccines for hepatitis C virus, MSc thesis, University of Saskatchewan. Supervised by C. Zhang and Q. Liu.

## Appendix A. Division review charter

### College of Engineering Project Charter

1.0 Project Identification	
<b>Name</b>	Review of the Division of Biomedical Engineering – Type B Centre
<b>Description</b>	To review of the Division's mandate, governance, infrastructure and long-term vision to maximize its success across the spectrum of research, teaching, outreach, and service to support the goals of the University of Saskatchewan.
<b>Sponsor</b>	Ernie Barber, Dean
<b>Project Manager</b>	Phani Adapa, Director, Research and International Relations
<b>Charter Version</b>	V1

2.0 reasons for project
<ul style="list-style-type: none"><li>▪ The mandate and policy of the division of biomedical engineering has not been reviewed since its inception in 1962. According to the University policy on management of centers, the review of division should occur once every 5 years</li><li>▪ There is a need to ensure that the Division's mandate is well understood within the college and university, and may not be optimal in the current environment given the length of time since the last review</li><li>▪ A clear mandate for the division and clear accountabilities for the chair will ensure the division's success is fully supported by its leadership</li><li>▪ The relationship of the Division with other Colleges at UofS, and their role needs to be defined since the Division is considered to be a Type-B centre</li></ul>

3.0 PROJECT SCOPE
<p>The self-assessment document and the review team will be asked to consider the following questions:</p> <ol style="list-style-type: none"><li>1. <b>Mandate</b><ol style="list-style-type: none"><li>a. How well is the Division fulfilling its goals and objectives?</li><li>b. How well does the Division's mandate align with the strategic priorities of the University of Saskatchewan?</li><li>c. What kind of research and scholarly activity occurs within the Division and what is its quality and quantity?</li><li>d. Is the Division's commitment to research and scholarly activities consistent with trends and expectations? Do they serve the needs of students?</li><li>e. Are there important areas of concentration, strength or innovation that the Division should be pursuing?</li><li>f. Does the Division add value to research and training at the University?</li><li>g. Does the Division have meaningful impact:<ol style="list-style-type: none"><li>a. with regard to community-university relations, and/or</li><li>b. in and for the various stakeholders and communities it serves?</li></ol></li><li>h. Do faculty members of the Division have an appropriate sense of their place within the University community?</li></ol></li></ol>

### 3.0 PROJECT SCOPE

#### 2. Governance

- a. Does the administrative structure of the Division provide the support necessary for Division to meet its mandate?
- b. Are the accountabilities, expectations and role of the Division and the Division chair defined and understood?
- c. How does the division interact with Engineering's faculty council, CGSR's faculty council, and other college's faculty councils to ensure its programs reflect the perspective of its member faculties?
- d. What is the relationship of the Division to Research Services and to the Office of the Vice-President – Research?
- e. Is communication within the College and between the College and other parts of the University adequate?
- f. Is the leadership from other Colleges have been involved in evolution of the Division? What is the existing relationship of the division with other Colleges?

#### 3. Infrastructure

- a. Are the College's human resources appropriate to meet its mandate and are they effectively and efficiently utilized? Does the Division have the right mix of faculty, staff and HQP?
- b. Is the Division effectively and efficiently utilizing its resources?
- c. What are the strengths? What/where are the gaps (short, medium and long term)?

#### 4. Long Term Vision

- a. Does the Division have a long-term vision that is consistent with the university's integrated plan?
- b. Is the vision for the future significantly different from today?
- c. Is the Division sustainable?

**Note: The purpose of this exercise is to review the mandate, governance, and vision of the Division and not to review the graduate program or curriculum.**

### 4.0 PROJECT PARTICIPANTS

Name/Position	Primary Responsibilities
Phani Adapa	<p><b>Project Leader:</b> Provide operational oversight to the review including:</p> <ul style="list-style-type: none"> <li>▪ ensuring the terms of reference are developed and fulfilled</li> <li>▪ overseeing the project to ensure it is completed in accordance with the terms of reference</li> <li>▪ engaging interested faculty and staff from the university community including:               <ul style="list-style-type: none"> <li>• Research Services</li> <li>• Faculty involved in the divisions</li> <li>• Staff involved in the divisions</li> <li>• Engineering's Faculty Council</li> <li>• Deans/senior leadership of all other colleges involved in the Division</li> </ul> </li> <li>▪ overseeing engagement with external reviewers</li> </ul>
Ernie Barber	<p><b>Executive Sponsor:</b> Provide senior leadership including:</p> <ul style="list-style-type: none"> <li>▪ requesting the review &amp; approving project charter</li> <li>▪ approving the requests to be sent to the external reviewers</li> <li>▪ provide input to external reviewers</li> <li>▪ accepting the final report from external reviewers</li> </ul>
Elissa Aitken	<ul style="list-style-type: none"> <li>▪ Advise on structure and scope of project, including communications plan</li> <li>▪ provide input to external reviewers</li> </ul>

<b>4.0 PROJECT PARTICIPANTS</b>	
Ajay Dalai	<ul style="list-style-type: none"> <li>▪ Advise on structure and scope of project</li> <li>▪ Input to self-assessment document</li> <li>▪ Assist with liaison to the Office of the Vice-President – Research</li> <li>▪ Provide input to external reviewers</li> </ul>
Chris Zhang, Acting Chair, Division of Biomedical Engineering	<ul style="list-style-type: none"> <li>▪ Develop self-assessment document that provides information to support the key questions to be addressed in this external review</li> <li>▪ facilitate appropriate engagement of faculty and staff in division</li> <li>▪ assist in identifying potential external/internal reviewers</li> <li>▪ provide input to external reviewers</li> </ul>
David Harris, Senior Advisor, Research Services	<ul style="list-style-type: none"> <li>▪ provide information and guidance on the review process to ensure consistency with other type B centers reviews</li> <li>▪ provide input to external reviewers</li> </ul>
Lawrence Martz, Dean, CGSR	<ul style="list-style-type: none"> <li>▪ provide information on the current administrative process for the division; resources available from CGSR to support the division; strength and weaknesses of current reporting structure</li> <li>▪ provide input to external reviewers</li> </ul>
Review Team	<ul style="list-style-type: none"> <li>▪ Review the Division based on the terms above project scope</li> <li>▪ Provide review report including recommendations</li> </ul>

<b>5.0 KEY PROJECT DELIVERABLES</b>	
<b>Item</b>	<b>Description</b>
Project Charter	<ul style="list-style-type: none"> <li>▪ Outline key expectations, deliverables, participants of the project</li> </ul>
Letter to Reviewers	<ul style="list-style-type: none"> <li>▪ Outlines task for external reviewers</li> </ul>
Self-Assessment Document	<ul style="list-style-type: none"> <li>▪ Provides information and analysis to support the key questions to be addressed in the review</li> </ul>
Review Report	<ul style="list-style-type: none"> <li>▪ The three member review team will provide a report to the Dean, College of Engineering based on the terms of reference (review questions) provided by the Project Steering Committee.</li> </ul>

<b>6.0 REQUIRED RESOURCES</b>	
<b>Resource</b>	<b>Status (in place, requested or who is responsible for requesting)</b>
Roxanne Cossette: Administrative support for setting-up meetings	Available
Site visit by an external reviewer (optional): If required, a cost-shared model (shared between university central administration and college) to support division review will be used to finance the external review process	To be decided at a later stage of the review process

<b>7.0 MILESTONE DATES</b>	
<b>Major Events / Milestones</b>	<b>Dates</b>
Finalize Terms of Reference	October 31, 2011
Identify Review Team	November 15, 2011
<i>Itinerary for the Review Team</i>	November 30, 2011
Self-assessment Document	December 20, 2011
<i>Dispatch Review Package (memo from Dean, project charter, review questions, self-assessment document, and itinerary)</i>	January 3, 2012
<i>Review Team Site Visit</i>	Week of February 21, 2012
<i>Review Report</i>	March 31, 2012
<i>Project Steering Committee to Review the Review Report</i>	April 15, 2012

<b>8.0 KEY STAKEHOLDERS</b>
<b>STAKEHOLDER</b>
Faculty members associated with the Division of Biomedical Engineering from the College of Engineering, Arts and Science, Medicine, Kinesiology, School of Physical Therapy, Royal University Hospital, Saskatoon Cancer Centre, Saskatoon City Hospital, and Western College of Veterinary Medicine
Graduate Students
College of Graduate Studies and Research
Engineering Faculty Council
Research Services
College Executive Committee

<b>9.0 RISKS</b>	
<b>Severity*</b>	<b>Description</b>
1	<i>Short time-lines (refer to section 7)</i>
1	<i>Participation of faculty members during the self-assessment process</i>
1	<i>Availability of reviewers and stakeholders (refer to section 8 above) is critical to meet the milestones</i>

\* number from 1-5 with 1 very severe and 5 a minor concern.

<b>10.0 CRITICAL SUCCESS FACTORS</b>	
1.	Senior leadership in the College of Engineering, Research Services and all other involved colleges will see the review as appropriate and fairly conducted
2.	All faculty and staff in the College of Engineering will have had an opportunity to be involved
3.	At the end of the review process, there is: <ul style="list-style-type: none"> <li>▪ a mandate for the division that is:               <ul style="list-style-type: none"> <li>• clearly understood and seen as appropriate by the people in the college, division and related units on campus</li> <li>• aligned with the College's strategic plan and the University's integrated plan</li> <li>• supports continuous improve the quality by bringing performance and agreed upon goals into closer alignment (A Framework for Assessment: Beyond Systematic Program Review, UofS)</li> </ul> </li> <li>▪ an administrative and governance structure that effectively supports the division's mandate</li> <li>▪ clear accountabilities and expectations of the division chair</li> <li>▪ mechanisms or procedures that ensure regular communication about outcomes, desired outcomes, successes and failures (A Framework for Assessment: Beyond Systematic Program Review, UofS)</li> </ul>

<b>11.0 COMMUNICATIONS PLAN</b>	
Division Chair	<ul style="list-style-type: none"> <li>▪ Project manager to meet and discuss with division chair; chair to be kept up to date on progress by project manager</li> </ul>
College Faculty and Staff	<ul style="list-style-type: none"> <li>▪ Project manager to:               <ul style="list-style-type: none"> <li>• prepare email to be sent from Dean to College faculty and staff informing them of the review</li> <li>• provide the self-assessment document and final report for information</li> </ul> </li> </ul>
Faculty, Staff and Students of the Biomedical Division	<ul style="list-style-type: none"> <li>▪ In collaboration with the Division chair, update the faculty and staff on the review process</li> </ul>
Deans affiliated with the review	<ul style="list-style-type: none"> <li>▪ Inform the faculty council of the review process</li> <li>▪ Share outcomes of the review process</li> </ul>
Engineering Faculty Council	<ul style="list-style-type: none"> <li>▪ Inform the faculty council of the review process</li> <li>▪ Share outcomes of the review process for feedback to the Dean</li> </ul>
College Executive	<ul style="list-style-type: none"> <li>▪ Update them of the review process</li> </ul>
Research Services, OVPR	<ul style="list-style-type: none"> <li>▪ Inform the research services of the review process and provide them with the project charter</li> <li>▪ Provide them with the self-assessment document</li> <li>▪ Share the outcome of the review process</li> </ul>

**11.0 CHARTER APPROVAL**

Project Sponsor:

Date:

## **Appendix B. Member list**

### **Acting Chair**

Chris Zhang (Mechanical Engineering)

### **Executive Committee**

Bill Dust (Medicine)

Daniel Chen (Engineering)

Joel Lanovaz (Kinesiology)

J. Singh (Vet Medicine)

Chris Zhang (Engineering)

J.D. Johnston (Engineering)

Gordon Sarty (Arts and Science)

Gary A. Linassi (Medicine)

### **Faculty and Staff**

G.P. Adams

Professor

Veterinary Biomedical Sciences

Research area and interest: Reproductive physiology/endocrinology, ultrasonography, medical imaging

Web link: [http://www.usask.ca/wcvm/wcvm\\_people/profiles/Adams\\_Gregg.php](http://www.usask.ca/wcvm/wcvm_people/profiles/Adams_Gregg.php)

Baik, Oon-Doo

Associate Professor

Department of Chemical and Biological Engineering

Research area and interest: Energy Efficient Extraction of Medicinal and Nutraeutical components with Radio Frequency and Pulsed Electric Field combination

Web link: [http://www.engr.usask.ca/faculty/Baik\\_Oon-Doo.php](http://www.engr.usask.ca/faculty/Baik_Oon-Doo.php)

D. Chen

Professor

Department of Mechanical Engineering

Research area and interest: Tissue Engineering, Mechatronics and Biomechatronics, Dynamics System and Control, Precision Fluid manipulation.

Web link: [homepage.usask.ca/~xbc719/](http://homepage.usask.ca/~xbc719/)

L. Chen

Assistant Professor

Department of Electrical & Computer Engineering

Research area and interest: A reconfigurable fault-tolerant 32-bit Forth Engine Low-power, fault-tolerant memories and systems; Ultra low-power digital systems Near-fall and fall detecting system Impulse UWB radar sensors for medical applications; Chip Design for Biomedical Instruments.

Web link: [http://www.engr.usask.ca/nodeonly.php?cmd=tree\\_nodeID569&personID=737.php?li.chen](http://www.engr.usask.ca/nodeonly.php?cmd=tree_nodeID569&personID=737.php?li.chen)

L. Dean Chapman

Professor

Department of Anatomy & Cell Biology

Research area and interest: Physics of contrast mechanisms such as diffraction enhanced imaging (DEI), soft tissue contrast characterization, x-ray optics research, synchrotron and conventional imaging systems research.

Web link: <http://www.medicine.usask.ca/acb/people/faculty/Faculty%20web%20pages%20folder/chapman/index.html>

P. Chilibeck

Associate Professor

College of Kinesiology

Research area and interest: Adaptation of muscle and bone to exercise and nutritional interventions; Spinal cord injury and conditions that affect bone and mineral status.

Web link: <http://kinesiology.usask.ca/academics/find-people-phil-chilibeck/>

A.T. Dolovich

Associate Professor

Department of Mechanical Engineering

Research area and interest: Biomechanics, Tomography, Ultrasound imaging, Inverse Problems

Web link: [http://www.engr.usask.ca/nodeonly.php?cmd=tree\\_nodeID569&personID=94.php?allan.dolovich](http://www.engr.usask.ca/nodeonly.php?cmd=tree_nodeID569&personID=94.php?allan.dolovich)

W.N. Dust

Professor

FRCSC, FACS (Orthopaedic Program Director)

Department of Orthopaedic Surgery

Research area and interest: Orthopedic trauma, Adult joint reconstruction, Arthroplasty, Joint dislocations, fractures, and breaks

Web link: <http://www.medicine.usask.ca/surgery/divisions/orthopedic/faculty.html>

M. Eramian

Associate Professor

Department of Computer Science

Research area and interest: Computer Vision, Image Processing, Medical Image Analysis, Computer Assisted Diagnosis.

Web link: [http://www.cs.usask.ca/faculty/eramian/Mark\\_Eramians\\_Home\\_Page/Welcome.html](http://www.cs.usask.ca/faculty/eramian/Mark_Eramians_Home_Page/Welcome.html)

G. George

Associate Faculty Members

Department of Anatomy & Cell Biology

Research area and interest: Use of synchrotron radiation to solve structural and chemical problems in biology and chemistry.

Web link: <http://www.medicine.usask.ca/acb/people/faculty/index.html>

J.R. Gray

Associate Professor

Department of Biology

Research area and interest: Neuroethology and Kinematics of Insect flight.

Web link: <http://www.usask.ca/biology/gray/>

J.E. Greer

Professor

Department of Computer Science

Research area and interest: Artificial Intelligence, expert systems

Web link: <http://www.cs.usask.ca/faculty/greer/>

J.D. Johnston

Assistant Professor

Department of Mechanical Engineering

Research area and interest: Biomechanics - Medical Imaging

Web link: [http://www.engr.usask.ca/nodeonly.php?cmd=tree\\_nodeID569&personID=1039.php?jd.johnston](http://www.engr.usask.ca/nodeonly.php?cmd=tree_nodeID569&personID=1039.php?jd.johnston)

S.O. Kasap

Professor

Department of Electrical & Computer Engineering

Research area and interest: Photovoltaic materials, Xeroradiography

Weblink: [http://www.engr.usask.ca/nodeonly.php?cmd=tree\\_nodeID569&personID=24.php?safa.kasap](http://www.engr.usask.ca/nodeonly.php?cmd=tree_nodeID569&personID=24.php?safa.kasap)

Venkatesh Meda

Associate Professor

Department of Chemical and Biological Engineering

Research area and interest: Post-harvest processing - Food / BioProcess Engineering.

Weblink: [http://www.engr.usask.ca/nodeonly.php?cmd=tree\\_nodeID569&personID=12.php?Venkatesh.Meda](http://www.engr.usask.ca/nodeonly.php?cmd=tree_nodeID569&personID=12.php?Venkatesh.Meda)

Ko, Seok-Bum

Associate Professor

Department of Electrical & Computer Engineering

Research area and interest: Wireless medical sensing technology, Fall/Near-Fall detection system, information security for biomedical application

Web link: [homepage.usask.ca/~sek867](http://homepage.usask.ca/~sek867)

A. Kusalik

Faculty Member

Department of Computer Science

Research area and interest: Bioinformatics, Computational biology, Machine learning, Constraint logic programming

Web link: <http://www.cs.usask.ca/faculty/kusalik/>

J. Lanovaz

Assistant Professor

College of Kinesiology

Research area and interest: Biomechanics, musculoskeletal modelling and simulation, orthopaedics, motion analysis.

Web link: <http://kinesiology.usask.ca/academics/find-people-joel-lanovaz/>

Y.-H. Lin

Professor

Department of Chemical and Biological Engineering

Research area and interest: Systems biology, Global gene expression and whole-cell protein profiling, Applied Bioinformatics and Protein-Protein Interaction Network, Fuel Alcohol and Yeast Physiology

Web link: [homepage.usask.ca/~yel360/](http://homepage.usask.ca/~yel360/)

Qiang Liu

Research Scientist

Vaccine and Infectious Disease Organization, VIDO

Research area and interest: Viral Pathogenesis, Vaccine Development, Vaccine Delivery by Nanotechnology

Web link: [http://www.vido.org/about\\_vido\\_intervac/directory/profiles/Qiang-Liu.php](http://www.vido.org/about_vido_intervac/directory/profiles/Qiang-Liu.php)

Gillian Muir

Professor

Veterinary Biomedical Sciences

Research area and interest: Immunochemistry, retrograde tract-tracing and neuroanatomical measurement and dendritic arborization

Web link: <http://www.medicine.usask.ca/research/health-research-groups/neural-systems-and-plasticity-research-group-1/group-members/gillian-muir/>

I. McQuillan

Associate Professor

Department of Computer Science

Research area and interest: Bioinformatics, Natural Computing, and Theoretical Computer Science

Web link: [http://www.cs.usask.ca/faculty/mcquillan/Work/About\\_Me.html](http://www.cs.usask.ca/faculty/mcquillan/Work/About_Me.html)

E. Neufeld

Professor  
Department of Computer Science  
Research area and interest: Graphics and Artificial Intelligence  
Web link: [http://www.cs.usask.ca/faculty/eric/Site/About\\_me.html](http://www.cs.usask.ca/faculty/eric/Site/About_me.html)

Helen Nichol  
Associate Professor  
Department of Anatomy and Cell Biology  
Research area and interest: Applications of synchrotron technology to mitochondrial and neurodegenerative diseases of metal metabolism.  
Weblink: <http://www.medicine.usask.ca/acb/people/faculty/Faculty%20web%20pages%20folder/nichol/index.html>

Catherine, Niu  
Associate Professor  
Department of Chemical and Biological Engineering  
Research area and interest: Biosorption, Bioseparation and Bioethanol Purification  
Weblink: [http://www.engr.usask.ca/nodeonly.php?cmd=tree\\_nodeID569&personID=117/Niu\\_Catherine.php](http://www.engr.usask.ca/nodeonly.php?cmd=tree_nodeID569&personID=117/Niu_Catherine.php)

Nathaniel Osgood  
Associate Professor  
Department of Computer Science  
Research area and interest: System dynamics modelling and simulation for decision making using differential equation and agent-based modelling; Project dynamics and management in software development and construction  
Web link: <http://www.cs.usask.ca/~osgood/>

David Schreyer  
Associate Professor  
Department of Anatomy & Cell Biology  
Research area and interest: Neuro Scientist  
Web link: <http://www.usask.ca/healthsci/cmsnrc/d-schreyer.html>

Ingrid J. Pickering  
Associate Professor  
Department of Geological Science  
Research area and interest: Synchrotron radiation studies of environmental and biological systems.  
Web link: <http://www.usask.ca/geology/nfaculty/ip/index.htm>

R.A. Pierson  
Professor  
Department of Obstetrics, Gynecology & Reproductive Sciences  
Research area and interest: Reproductive physiology  
Web link: <http://www.medicine.usask.ca/obgyn/people/faculty/roger-pierson/index.html>

Saadat Mehr, Aryan  
Assistant Professor  
Department of Electrical & Computer Engineering  
Research area and interest: Signal Processing for Biomedical Instruments  
Web link: [www.ece.usask.ca/eceresearch/faculty/ars628/](http://www.ece.usask.ca/eceresearch/faculty/ars628/)

G.E. Sarty  
Professor  
Psychology and Associate in Medical Imaging, Physics and Obstetrics and Gynecology  
Research area and interest: MRI Hardware and image reconstruction, FMRI data analysis, Physiological Math Models of the Brain and Ovary, Observational and theoretical astrophysics.  
Web link: <http://homepage.usask.ca/~ges125/>

B. Singh  
Professor

Veterinary Biomedical Sciences

Research area and interest: Cell and molecular biology of lung inflammation. Focused on mechanisms of neutrophil and monocyte migration into inflamed lungs. biology of pulmonary intravascular macrophages and environmental pulmonary toxicology.

Web link: [http://www.usask.ca/wcvm/wcvm\\_people/profiles/Singh\\_Baljit.php](http://www.usask.ca/wcvm/wcvm_people/profiles/Singh_Baljit.php)

J. Singh  
Professor

Veterinary Biomedical Sciences

Research area and interest: Ultrasonographic, morphologic and biochemical kinetics of ovarian follicles to refine the bovine model.

Web link: [http://www.usask.ca/wcvm/wcvm\\_people/profiles/Singh\\_Jaswant.php](http://www.usask.ca/wcvm/wcvm_people/profiles/Singh_Jaswant.php)

W. Szyszkowski  
Professor

Department of Mechanical Engineering

Research area and interest: Flexible Structures, Optimization, Computational Mechanics, Time-Dependent Materials, Holographic Interferometry

Web link: [homepage.usask.ca/~was675](http://homepage.usask.ca/~was675)

Khan A. Wahid  
Associate Professor

Department of Electrical and Computing Engineering

Research area and interest: Bio-medical Imaging application using wavelet transform: low power image and video processors for wireless endoscopy: telemedicine: arithmetic techniques and number theory.

Web link: [www.ece.usask.ca/eceresearch/faculty/kaw171/](http://www.ece.usask.ca/eceresearch/faculty/kaw171/)

N.H. West  
Professor  
Physiology

Research area and interest: Cardiopulmonary physiology

Web link: <http://www.medicine.usask.ca/physiology/people/faculty-members/nigel-west/index.html>

T. Wysokinski  
Beamline scientist

Canadian Light Source, BMIT

Research area and interest: Medical Physics, Cryogenics, Applied Superconductivity

Web link: [http://www.lightsource.ca/experimental/bmit\\_2.php](http://www.lightsource.ca/experimental/bmit_2.php)

FangXiang Wu  
Associate Professor

Department of Mechanical Engineering

Research area and interest: Bioengineering , Systems biology, Gene regulatory networks, Protein interaction networks, Bioinformatics and proteomics, Real time control of mass spectrometers, Control theory with applications to biology and medicine

Web link: [homepage.usask.ca/~faw341](http://homepage.usask.ca/~faw341)

Qiaoqin Yang  
Professor

Department of Mechanical Engineering

Research area and interest: Physical and Chemical vapor deposition, nanoengineered thin films and coatings, Friction and wear, Carbon and its related nanostructures, Biomedical tools and implants, Nano - drug and antibody delivery.

Web link: [http://www.engr.usask.ca/nodeonly.php?cmd=tree\\_nodeID569&personID=103/Yang\\_Qiaoqin.php](http://www.engr.usask.ca/nodeonly.php?cmd=tree_nodeID569&personID=103/Yang_Qiaoqin.php)

Ken Yong-Hing  
Professor  
Department of Orthopaedic Surgery  
Research area and interest: Internal fixation devices, modeling  
Web link: <http://www.medicine.usask.ca/surgery/divisions/orthopedic/faculty.html>

Chris Zhang  
Professor  
Department of Mechanical Engineering  
Research area and interest: Nano-robotics, Biosensor, Nano-drug delivery system, Human Behavior Modeling, Bioinformatics, Human Centered Mechatronics, Biologically Inspired System  
Web link: [homepage.usask.ca/~wjz485](http://homepage.usask.ca/~wjz485)

Dinh, Anh van  
Professor  
Department of Electrical and Computer Engineering  
Research area and interest: Wireless communications, fall and near fall detection device.  
Web link: [http://www.engr.usask.ca/nodeonly.php?cmd=tree\\_nodeID569&personID=76.php?anh.dinh](http://www.engr.usask.ca/nodeonly.php?cmd=tree_nodeID569&personID=76.php?anh.dinh)

Gary A. Linassi  
Associate Professor  
Physical Medicine and Rehabilitation  
Assistant Dean Undergraduate Medical Education  
Web link: <http://www.medicine.usask.ca/pmr/dr-a-g-linassi.html>

Paul S. Babyn, MD, FRCPC  
Department of Medical Imaging, Royal University Hospital  
Web link: <http://www.usask.ca/medicine/imaging/People/people.html>

Brian Bewer, PhD  
Science Associate (BioXAS), Canadian Light Source  
Web link: <http://www.lightsource.ca/contacts/details.php?id=294>

Saija Kontulainen, PhD  
Assistant Professor  
College of Kinesiology  
Research area and interest: Effective fracture prevention strategies for children and older adults  
Web link: <http://kinesiology.usask.ca/academics/find-people-saija-kontulainen/>

## **Adjunct Professors**

Gopalan Selvaraj  
Adjunct professor  
Department of Plant Sciences  
Web link: <http://www.nrc-cnrc.gc.ca/eng/ibp/pbi/about/gopalan-selvaraj.html>

Rob Lewis  
Professor  
X-ray and Synchrotron Physics  
Research area and interest: Measurement of mass attenuation coefficients of various breast tissues; Dose-energy image quality assessment of slot scanning mammography; Tissue specific X-ray imaging, Breast cancer diagnosis utilising scattered x-rays, X-ray Detection  
Web link: <http://www.physics.monash.edu.au/people/academic/lewis.html>

Assem Hedayat

Assistant professor

Biomaterials

Research area and interest: Biomaterials, nano-fabrication, and orthodontic coatings.

Web link: [http://www.usask.ca/dentistry/faculty\\_staff/details.php?heading=menuFacultyStaff&id=85](http://www.usask.ca/dentistry/faculty_staff/details.php?heading=menuFacultyStaff&id=85)

B. Juurlink

Professor

Department of Anatomy & Cell Biology

Research area and interest: The principal research interests are in the area of how neural and vascular cells respond to perturbations that lead to oxidative stress and inflammation.

Web link: [http://www.alfaisal.edu/faculty\\_staff/cv/bernhard%20juurlink.htm](http://www.alfaisal.edu/faculty_staff/cv/bernhard%20juurlink.htm)

## Professor Emeritus

Kushwaha, Lal

Professor

Department of Chemical and Biological Engineering

Research area and interest: Biomaterials and Biotribology

Web link: [http://www.engr.usask.ca/nodeonly.php?cmd=tree\\_nodeID569&personID=8.php?lal.kushwaha](http://www.engr.usask.ca/nodeonly.php?cmd=tree_nodeID569&personID=8.php?lal.kushwaha)

M.M. Gupta

Professor

Department of Mechanical Engineering

Research area and interest: Adaptive control Systems, Neural Networks, Cardiac Signal Processing and Robotics

Web link: [http://www.engr.usask.ca/faculty/Gupta\\_Madan.php](http://www.engr.usask.ca/faculty/Gupta_Madan.php)

R.E. Gander

Professor

Department of Electrical & Computer Engineering

Research area and interest: Biological signal processing, medical instrumentation, artificial neural networks

Web

[http://www.engr.usask.ca/nodeonly.php?cmd=tree\\_nodeID569&personID=33.php?bob.gander](http://www.engr.usask.ca/nodeonly.php?cmd=tree_nodeID569&personID=33.php?bob.gander)

link:

## Secretary

Jan Compain

## Appendix C. Budget sheet

### Biomedical Engineering Operating Statement For the Fiscal Years 2007 through October 2011

	October 2011 YTD	April 2011 Year End	April 2010 Year End	April 2009 Year End	April 2008 Year End	April 2007 Year End
<b>Revenue</b>						
Student Service Fees - Applications	100	2,831	1,929	1,373	400	579
<b>Total Revenue</b>	<b>100</b>	<b>2,831</b>	<b>1,929</b>	<b>1,373</b>	<b>400</b>	<b>579</b>
<b>Expenses</b>						
Salary & Benefits Support Staff	10,425	24,516	23,009	21,910	19,881	19,550
Office Supplies	52	293	367	2,034	380	171
Equipment & Computers	-	-	-	-	289	-
Registration Fees	800	-	-	-	-	-
Working Lunches/Staff Appreciation	261	500	365	399	151	61
Travel	-	-	-	29	350	-
Other Expenses	145	-	-	-	-	-
Transfers	223	(47,525)	-	(22,003)	(19,880)	(19,550)
<b>Total Expenses</b>	<b>11,906</b>	<b>(22,216)</b>	<b>23,740</b>	<b>2,368</b>	<b>1,170</b>	<b>232</b>
<b>Revenues less Expenses</b>	<b>(11,806)</b>	<b>25,047</b>	<b>(21,811)</b>	<b>(995)</b>	<b>(770)</b>	<b>347</b>
<i>Opening Balance</i>	11,371	(13,676)	8,135	9,130	9,900	9,552
<i>Closing Balance</i>	(435)	11,371	(13,676)	8,135	9,130	9,900

**Notes:**

Transfer amounts represent the College of Engineering contribution.

The opening balance for the 2006/07 fiscal year is a result of the College of Engineering Contribution.

The salary component is a portion of the annual salary expense for J. Compain.

This fund also covers expenses for Environmental Engineering graduate program.

There is a specific Biomedical Fund (102595) that has been inactive over this time frame; it has a current balance of \$3,248.96

## Appendix D. List of current students

### BIOMEDICAL ENGINEERING – LIST HIGHLY QUALIFIED PERSONNEL

**Table 3** Current graduate student (Source: College research report)

Name	Degree	Supervisor(s)	Support	Area
Burnett, W.	M.Sc.	Johnston	Supervisor	Bone density is linked to osteoarthritis-related knee pain
Cao, N.	M.Sc.	Chen / Schreyer*		Experimental Study on Tissue Engineered Nerve Constructed by Schwann Cells and Biodegradable Materials
Cheema, I.	Ph.D.	Zhang		Rehabilitation
Chen, B.	Ph.D.	Wu	CSC	Bioinformatics
Chen, J.	PGD	Eramian*	Self	Medical imaging
Cheng, W.	Ph.D.	Zhang		Colonoscopy
Gao, T.	M.Sc.		Supervisor	TBA
Ghorpade, A.	Ph.D.	Zhang	Supervisor	Memory
Gopalan, S.	M.Sc.	Kushwaha	AAFC-ABIP	Development and Characterization of Hemp nanocomposite using PLA and nanoclay for various biomedical applications.
Guan, Y.	M.Sc.	Chen / Chapman	Supervisor	Characterization of Alginate Scaffolds Using X-ray Imaging Techniques
Hou, H.	M.Sc.	Chen / Schreyer*	Supervisor	Tissue engineering
Izadifar, M.	M.Sc.	Baik	Supervisor	A POROUS MEDIA APPROACH TOWARDS A DYNAMIC MECHANISTIC MODEL OF DRUG ELIMINATION BY THE LIVER
Izadifar, Z.	M.Sc.	Baik	Supervisor	Ultrasound assisted extraction of phenolic compounds from dried distilled grains
Izadifar, Z.	Ph.D.	Chen		Articular Cartilage Repair Using Hybrid Scaffold Tissue Engineering
Kannan, B.	M.Sc.	Chapman*		TBA
Kaur, R.	M.Eng.	Niu / Dalai		TBA
Khan, M.	M.Eng.	Chen	Self	TBA
Khan, S.K.	M.Sc.	Chen / Schreyer*		Fabrication of Bovine Serum Albumin (BSA) Encapsulating Chitosan Microspheres.
Kumarai, S.	M.Eng.	Kushwaha*	Supervisor	TBA
Li, J.	PGD	Zhang	Self	Healthcare systems
Li, J.	Ph.D.	Zhang/Chen		Study and Control of Vibrations on Beamlines at the Canadian Light Source
Lin, W.	Ph.D.	Wu / Zhang	NSERC	Tandem mass spectra data analysis

Little, C.	M.Sc.	Chen / Kulyk*	Dean's Scholarship	Fabrication of Composite Scaffolds Impregnated with an Optimized Fibrin-Alginate Hydrogel for Cartilage Tissue Engineering
Lu, H.	M.Sc.	Zhang		Healthcare systems
Maley, J.	Ph.D.	Zhang / Hirose*	Self	TBA
Mandal, A.	Ph.D.	Meda / Zhang	AAFC-ABIP	Development of nano-magnetic and antimicrobial functionalized biocompatible collagen scaffold for biomedical applications
Mani, A.	Ph.D.	Gray*		TBA
Morrell, B.	M.Sc.	Kasap		TBA
Muzar, E.	M.Sc.	Kasap / Chapman*	Supervisor	TBA
Napa, A.K.	M.Sc.	Chapman	Self	High Level Data Link Controller Protocol
Rajaram, A.	Ph.D.	Chen / Schreyer*		Bioengineered scaffolds with incorporated Schwann cells for peripheral nerve regeneration
Rhoades, G.	M.Sc.	A. Rosenberg* / Chapman*	Supervisor	TBA
Saha, S.	M.Sc.	Chen / Schreyer*	AAFC-ABIP	Data Analysis of Chemosensor Bead Array for Olfactory Model
Shah, W.	M.Sc.	Wahid		Data Analysis of Chemosensor Bead Array for Olfactory Model
Shi, J.	Ph.D.	Wu	NSERC	Inference of proteins from tandem mass spectra
Song, K.	Ph.D.	Zhang/Gupta	NSERC	Formation of Controlled Uniform Microspheres by MEMS for Effective Drug Delivery
Sun, J.	M.Sc.	Wu	NSERC	Parallelizing RT-PSM
Tian, X.	Ph.D.	Chen		Development of Cell Damage Laws for Bio-Manufacturing Processes
Vahedi, S.	Ph.D.	Kasap		TBA
Wang, L.	M.Sc.	Chen	Supervisor	TBA
Wang, M.	M.Sc.	Chen / Schreyer*		Synergistic Effects of Crosslinked HA-based 3D Porous Scaffolds, Schwann Cells and Growth Factors for SCI Repair
Wellens, V.	M.Sc.	Lanovaz	Self	Heel Compliance and Walking Mechanics Using the Niagara Foot Prosthetic
Xu, H.	M.Sc.	Zhang		Worker injury
Yan, Y.	Ph.D.	Wu	State Scholarship Fund (CSC)	Bioinformatics
Yang, C.	M.Sc.	Zhang		Rehabilitation
Yuan, Z.	M.Sc.	Wu	NSERC	Deisotoping of tandem mass spectra
Zhai, P.	M.Sc.	Chen / Schreyer*		Hyaluronic Acid Scaffolds Modified with Nogo-66 Receptor Antagonist for Repair of Spinal Cord Injury in vitro
Zhang, C.	Ph.D.	Yang	Chinese Scholarship Council and NSERC	DLC for biomedical applications

Zhang, Q.	M.Sc.	Shi / Ko	CGSR Scholarship / TBA NSERC Strategic Project Grant	
Zhang, T.	Ph.D.	Zhang	Scholarship	Robotics
Zhu, N.	Ph.D.	Chapman / Chen		3-Dimensional Designed and Funcional Poly (L-lactic acid)/Chitosan Scaffolds for Peripheral Nerve Tissue Engineering
Zhu, Y.	Ph.D.	Chapman		
Zhu, Y.	Ph.D.	Zhang / Sammynaiken*		Bystander effect

**Table 4** Post-Doctoral Fellows and Visiting Scholars

<b>Name</b>	<b>Country</b>	<b>Collaborator(s)</b>
Niwas, I. (VS)	India	Zhang

- RE - Research Engineer
- PDF - Post-doctoral Fellow
- VS - Visiting Scholar
- RA - Research Associate
- SS - Summer Student

## Appendix E. List of graduated students

**Table 5** List of students graduated from Division of Biomedical Engineering

YEAR	M.SC	PhD	M.ENG	PGD	NAME	SUPERVISOR
1980 S	X				James Jiann Lih Yu	M.M. Gupta
1981 S	X				Urs Peter Wyss	V. Pollak
1981 F				X	Kenneth Paul Magee	K. Takaya
1982 S	X				Bertram Nworah Ezenwa	M.M. Gupta
1982 S	X				Roger Robert Michel Martin-Clouaire	M.M. Gupta
1982 F				X	Dean Herbert Correll	K. Takaya
1982 F			X		Joseph Rosaire Lavoie	K. Takaya
1982 F			X		Kenneth Paul Magee	K. Takaya
1983 F	X				Robert James Firby	K. Takaya
1983 F	X				Norman Jed Schroeder	K. Takaya
1984 F		X			Urs Peter Wyss	V. Pollak
1984 F	X				Mushtaq Syed	K. Takaya
1986 S		X			Luis Carlos Carvalho	K. Takaya/J.F. Lopez
1986 S	X				Ming-Song Chung	V. Pollak/B.R. Brandell
1986 S		X			Bertram Nworah Ezenwa	M.M. Gupta/K. Prasad
1986 S	X				Douglas Leigh Hall	V. Pollak
1986 S	X				Karthik Krishnan	M.M. Gupta/K. Prasad
1986 F	X				Ming Tak Lee	M.M. Gupta/K. Prasad
1987 S	X				Andrew John Pratt	R.E. Gander/B.R. Brandell
1987 S	X				Robert Malcolm Sabiston	L.G. Watson/J.F. Lopez
1987 S	X				Eric Wing Cheung Tam	K. Takaya/J.F. Lopez

1988 S	X				Brian Gallagher	V. Pollack/J. Leszczynski
1988 S			X		Ramesh Kumar Kushwaha	M.M. Gupta/K. Prasad
1988 S	X				Srinivasan Shankar	R.E. Gander/B.R. Brandell
1988 F	X				Joseph Arthur Luc Berneche	B.L. Graham
1988 F	X				Hungenahally Krishnaswamy Suresh	R.E. Gander/J.F. Lopez
1989 S	X				Paul Man-Yui Lee	K. Prasad/M. Gupta
1989 S			X		Robert Dale Petrosenko	K. Yong-Hing
1989 S	X				Badri Narayana Prasad	H.C. Wood/R. Swanson
1989 F	X				Venkateswara Subramania Venkatesan	H.C. Wood/S. Sokhansanj
1990 F	X				Viswanath Aiyah	R.E. Gander/S.O. Kasap
1991 S	X				Robert Donald Cram	R.J. Bolton
1991 S	X				Bryce Lynden Jones	R.E. Gander/E.C. Crichlow
1991 F	X				Christian Falkenberg-Andersen	R.E. Gander/E.C. Crichlow
1992 S	X				Bharath Subbiah Krishnan	C. Gallagher/B.L. Graham
1992 S		X			Shankar Srinivasan	R.E. Gander/H.C. Wood
1992 S	X				Atul Sharad Varde	K.L. Massey/H.C. Wood
1992 S	X				Naiquan Zheng	K. Yong-Hing/L.G. Watson
1993 S	X				Chungying Chu	K. Takaya
1993 F	X				Veldanda Anantha Lakshmi Rao	K. Takaya/J.F. Lopez
1995 S	X				Degang Gu	R.E. Gander/E.C. Crichlow
1995 S		X			Naiquan Zheng	L.G. Watson/K.

						Yong-Hing
1995 F	X				John David Costa	R.E. Gander
1995 F		X			Viswanath Aiyah	S.O. Kasap/A. Baillie
1996 S	X				Xiaobo Li	K. Takaya
1996 F		X			Farzad Towhidkhah	R.E. Gander/H.C. Wood
1997 S			X		Mark Douglas Hewko	R.E. Gander/Y. Zhu (RUH)
1997 S			X		David Edward Potkins	R.E. Gander/Y. Zhu (RUH)
1997 S	X				Joseph William Tom	G. Adams (Vet.Anatomy)/A. Dolovich
1997 F		X			Paul Man-Yiu Lee	M.M. Gupta/K. Prasad (Physiology)
1998 S			X		Jennifer Ann Galloway	R.E. Gander/Y. Zhu (RUH)
1998 S	X				Lauria Elaine Blackwell	R.E. Gander/R. Pierson (RUH)
1998 S	X				Anand Elango	R.E. Gander/G.P. Adams (WCVM)
1998 S	X				Yimin Tang	A.T. Dolovich/G.P. Adams (WCVM)
1998 F	X				Ram Balakrishnan	A. Shuaib (R.U.H) /R.E. Gander
2000 S	X				Sheela Rani Behl	R. Pierson/R. Gander
2000 F			X		Jennifer Carolyn McGill	R.E. Gander
2000 F	X				Michele Marie Cowan	R.E. Gander/R. Colborne
2000 F	X				Manivannan Poyvasi	E. Kendall
2000 F	X				Donghui Yin	E. Kendall
2001 S	X				Tiaoyu Wang	L.G. Watson
2001 F	X				Yusuf Abu Tayeb Bhagat	E. Kendall
2001 F	X				Shawnee Rose Eidt	G. Guttman

2001 F	X				Zhao Gong	E.Kendall
2001 F	X				Saravanan Subramanian	R.E. Gander/J. McClements
2002 S	X				Jie Cui	E. Kendall
2002 S	X				Kefa Dallé Hayek	R.E. Gander
2002 S	X				Nan Li	G. Sarty
2004S			X		Elaine Bee Ching Ong	L. Glen Watson
2004F		X			Fangxiang Wu	Chris Zhang / Tony Kusalik
2005F	X				Yi Zou	Ron Geyer / Chris Zhang
2005F	X				Carissa Erickson	Edward Kendall
2005F			X		Jyothi Kolluri	Chris Zhang
2007S	x				Wu, Dongqing	Chris Zhang
2007F	X				Alagarsamy Nagarajan	D. Chapman / W. Szyszkowski
2007F	X				C. Denise Miller	Tony Kusalik
2007F		X			Vakorin Vasily	Gord Sarty
2008S		X			Xiao Chu Wu	Chris Zhang / Rui Wang
2008F			X		Qiang Huang	Chris Zhang
2008F	X				Lu Qian	Mark Eramian / J. Singh
2008F	X				Mary Ruth Pradeepa Raghavan	Mark Eramina / Roger Pierson
2009S	X				Chen, Wenting	Chris Zhang/Q Liu
2009S	X				Lin Li	Chris Zhang

2009S	X				Popoola, Aminat	Gregg Adams / Dean Chapman
2009F	X				Butala, Jaydrath	Jack Gray / Bob Gander
2009F		X			Zhang, Honglin	Dean Chapman / M. Gupta
2010S						
2010F	X				Guan, Yijing	Daniel Chen / Dean Chapman
2010F					Zhang, Qiao	Daniel Chen
2011S	X				Suparna Saha	Satya Panigrahi
2011S			X		Shaza Khan	Daniel Chen / David Schryer
2011S			X		Shah Waqas	Khan Wahid
2011F	X				Valerie Wellens	Joel Lanovaz
2011F	X				Chun Yang	Dr. Chris Zhang
2011F	X				Ning Cao	Daniel Chen / David Schreyer
2012S		X			Ki-Young Song	Dr. Chris Zhang / Dr. Gupta
2012S	X				Izadifar, Mohammad	Dr. Oon-Doo Baik

## **Appendix F. Term and Condition**

### **TERMS OF REFERENCE**

#### **DIVISION OF BIOMEDICAL ENGINEERING**

1. The Division of Biomedical Engineering shall be an administrative and research organization within the College of Graduate Studies and Research. Operational control is delegated to the Dean of Engineering.
2. Membership in the Division is open, upon application, to all faculty members actively working in the area of Biomedical Engineering, and the membership of an individual will continue for as long as she or he maintains active involvement.
  - a) Non-faculty personnel engaged in Biomedical Engineering work can apply for associate membership status. Associate members do not have voting privileges.
  - b) Applications for full or associate membership have to be approved by a simple majority of the votes by the executive.
  - c) The Executive has the right to review the membership status of any person belonging to the Division and after a period of inactivity of at least two years may ask the member or associate member, whether or not, he or she wishes their membership to continue. According to the reply the Executive may delete that particular individual from the membership roster.
3. The Dean of Engineering shall appoint a Chair for a three-year term after consultation with members of the Division and the Dean of Graduate Studies and Research.
  - a) The Executive shall recommend a Deputy Chair, not necessarily a member of the Executive. Upon approval by a simple majority of votes of the membership at large, the name of the Deputy Chair shall be submitted to the Dean of Engineering for confirmation.
  - b) The Deputy Chair shall take over the duties of the Chair during periods the Chair is unable to carry out his/her obligations.
4. The Division shall:
  - a) Review class offerings suitable for students of Biomedical Engineering, make recommendations to avoid unnecessary duplication, and recommend the development of new classes as considered desirable;
  - b) Act as a consultative organization concerning the employment of new staff which would promote training and research in this field; and
  - c) Promote cooperation between members of different disciplines, encourage team work,

and take appropriate steps to foster research in the area of Biomedical Engineering.

- d) Administer, under the rules and regulations of the College of Graduate Studies and Research, an autonomous graduate program in Biomedical Engineering
5. There shall be an Executive of the Division consisting of the Chair of the Division and at least four but no more than seven other members who are elected annually by the membership: at least two from Life Sciences and at least two from the area of the Physical and Applied Sciences.
- a) The members of the Executive shall be elected for a three-year period. The terms of the individual members shall be staggered, so that each year at least one member of the Executive would come up for re-election. Replacements for a member resigning from the Executive shall be elected for the remainder of the term of the original member.
6. The Executive shall be responsible for:
- a) Considering applications from students for admission to postgraduate work in Biomedical Engineering and, after acceptance by a prospective supervisor in the Division, submit recommendations to the College of Graduate Studies and Research.
  - b) Preparing and submitting course requirements, research programs, and composition of advisory committee for students in Biomedical Engineering to the College of Graduate Studies and Research for approval.
  - c) Recommending, for the Division, evaluating procedures for student progress, including exams.
  - d) Co-ordinating the research activities of the Division and encouraging the acquisition of necessary funds, laboratory space and facilities.
  - e) The Chair of the Division (on the advice of the Executive of the Division) shall make the necessary recommendation to the College of Graduate Studies and Research for the award of each postgraduate degree in Biomedical Engineering.
  - f) The Executive is empowered to co-opt a member of the Division not belonging to the Executive for the solution of a particular problem or for a limited period of time not exceeding six months.
7. The Chair of the Division shall request the Deans of involved Colleges or in special cases the Head of a particular Department to appoint a liaison person for the Division if this appears necessary. The appointee does not have to be a member of the Division. The appointment may be for the solution of a particular problem or for a term not exceeding the remainder of the term of office of the Chair.

8. The Dean of the College of Graduate Studies and Research shall be an ex-officio member of the Division.

## Appendix G. List of courses

BIOE 802	02	SK	3.0	Fundamentals of Signals Theory For Life Scientists
BIOE 800	01	SK	3.0	Advanced Biomedical Instrumentation
BIOE 806	01	SK	3.0	Biomaterials
BIOE 850	01	SK	3.0	Synchrotron XRay Imaging
BIOE 898	03	SK	3.0	Intro Magnetic Resonance Imaging
BIOE 898	2	SK	3.0	Intro Computational Systems Biology
BIOE 898	02	SK	3.0	Physical Methods in Biomedical Engineering
BIOE 898	01	SK	3.0	Human Factors and Ergonomics
BIOE 898	01	SK	3.0	Introduction to Computational Protein Mass Spectra
BIOE 990		SK	3.0	Seminar
BIOE 994		SK	3.0	Research
BIOE 996		SK	3.0	Research

## Appendix H. Recommendation of a new student

May 2, 2008

Name:

Dear :

This letter is to inform you that the Division is recommending that you be accepted into the College of Graduate Studies and Research as a candidate for the Ph.D. Degree in Biomedical Engineering. You should be receiving a letter from the College of Graduate Studies and Research concerning your application. You are not eligible to register without this letter.

Professor C. Zhang (Department of Mechanical Engineering) and Professor D. Chen (Department of Mechanical Engineering) will be acting as your research supervisors. I would suggest that you communicate directly with them in order to learn more about the research topic that they might have in mind.

Your supervisors, Professor Zhang and Professor Chen, have informed me that they will be providing you with a financial support of \$1,500/month in the form of a Graduate Research Assistantship. This support would continue for the duration of your Ph.D. program, to a maximum of 48 months, and is contingent on acceptable academic performance in your graduate course work and satisfactory progress in your research.

If you have any questions about this information or other related matters, please email or phone me at your convenience. In order to begin your graduate studies you should arrive here no later than September 2, 2008.

Yours Sincerely,

---

Fangxiang Wu  
Graduate Chair

cc College of Graduate Studies & Research  
Professor D. Chen, Department of Mechanical Engineering,  
Professor D. Chapman, Department of Anatomy and Cell Biology

## Appendix I. Proposal of School of Biomedical Engineering

### **School of Biomedical Engineering**

#### ***Mission Statement***

Broaden the technical capability of biomedical sciences for the betterment of human and animal health.

#### ***Vision***

Create a seamless environment between the technical sciences and the life sciences with a common goal of advancing tools for research, diagnostic and therapeutic purposes. In addition, a deeper understanding of living systems will lead to advances and solutions for current engineering problems.

We will have achieved our goal when there is a reciprocal understanding of the issues involved in the respective disciplines and how they bear on a given problem.

#### ***Why Here, Why Us, Why Now***

The University of Saskatchewan has and is located in a dynamic “biomedical rich” environment. The University of Saskatchewan’s College of Medicine is now taking bold steps to become a leader in medical research; the Western College of Veterinary Medicine, is greatly expanding its research facilities and scientist complement; the Saskatoon Cancer Center delivers excellence in patient care and cancer control; and the Vaccine and Infectious Disease Organization (VIDO), has secured funding for a multi-million dollar International Vaccine Centre. The Canadian Light Source has a number of facilities which directly address biomedical research issues, most prominently the BioMedical Imaging and Therapy (BMIT) beamlines project. This \$17+M complex is being built specifically to bring advanced synchrotron light imaging and therapy methods to bear on some of the most vexing problems in human, animal and plant research. Additionally, the Phase III complement of beamlines will include a \$20+M BioXAS beamline specifically directed to understanding the role of metals in biological and medical systems.

The present Biomedical Engineering Division has 31 faculty members from the College of Engineering, the Western College of Veterinary Medicine, the College of Medicine, the College of Arts and Sciences, the College of Kinesiology, and the Canadian Light Source. The division supports a robust graduate program with 18 students. There are now 61 graduate level courses are offered by 11 different departments in the 5 different colleges.

The goal is to develop an undergraduate program in biomedical engineering. We feel there is an unmet need in Saskatchewan with the absence of an undergraduate biomedical engineering program. Presently, in North America there are 121 institutions (5 in Canada) who have biomedical engineering programs\* (Masters, PhD and undergraduate) with 49 institutions who grant B.Sc. degrees in biomedical engineering.

None of the institutions are as ideally suited for such a program as the University of Saskatchewan, having both a veterinary college and medical college. No university in the world has these colleges AND a synchrotron co-located on the same campus. We will have no peers in this regard.

The undergraduate students from this school will go on to become candidates for medical schools (highly sought after due to the technical expertise they possess), to become candidates for advanced degrees in biomedical areas, or become employed by the rapidly expanding world-wide biotechnology sector.

Collectively, the University of Saskatchewan research community is already considered a world leader in Life Sciences R&D. The creation of a school will enhance this leadership standing, will serve as a locus for scholarly activities, and will promote spin-off technologies and commercialization opportunities.

### ***Tools for Cutting Edge Research***

One must keep in mind that the research is only as good as the tools used, and that continual work must be done to develop new instrumentation and methods to stay at the forefront of advancing technology. For that to happen, those who know how to develop instrumentation must be closely involved with those who need and use those tools. Also, we need scientists who recognize opportunities to translate technology into reality.

Saskatoon has become a place that is heavily committed to health research. To become a world player, we must also become a place for developing the tools for that research and to translating those tools to the real world where economic benefits occur.

We can be the place that integrates the most advanced research tools imaginable with cutting-edge research along with a drive to commercialize that research for the benefit of society.

### ***The Plan***

The step to support an undergraduate program will require strategic hiring of faculty in engineering (beginning with a chaired position to head the effort) and interdisciplinary faculty in other colleges who can help with the development of the undergraduate program.

\*as listed by the Whitaker Foundation