Proposed UG Thesis Topics – Fall 2021

Please review the list of topics provided below. In some instances, professors have identified specific thesis topics. In other instances, professors have indicated that they are willing to work with you to develop a topic that is related to one of the topic areas that is listed. You are encouraged to contact professors to learn more about the projects listed – and to secure the topic that most interests you as topics are typically assigned on a first-come basis.

At this stage, it is envisioned that the fall semester will take place by remote learning. Thus, the majority of thesis topics being suggested have been structured such that you will be able to complete them without having physical access to the campus.

Topic Sponsored by Industry
Contact: H. Buhler, Water Treatment Operations Support Engineer, City of Winnipeg
(204-986-2229) (hbuhler@winnipeg.ca)
1. Optimization of sludge settlement: polymer type & dose (using jar testing methodology)

Y. Chen (204-474-6292) **(Ying.Chen@umanitoba.ca)**
1. Farming in Mars using Martian soil - literature review or/and conceptual design
2. Mechanical weed control for crop production – literature review
3. Weed identification using image analysis
4. Simulation of material tensile tests using the Discrete Element Method (DEM)

N. Cicek (E2-376 EITC) (204-474-6208) (**Nazim.Cicek@umanitoba.ca**)
No specific topics suggested, but Dr. Cicek's research program is focused on utilization of waste products and waste treatment (anaerobic digestion of dairy manure, engineered wetlands for wastewater treatment, removal of antibiotics from wastewater, value-added uses of waste streams from industrial and agricultural applications, bioenergy and renewable energy technologies).

C. Erkinbaev (E1-344 EITC) (204-474-6977) (**Chyngyz.Erkinbaev@umanitoba.ca**)
No specific topics suggested, but Dr. Erkinbaev's research program is focused on smart sensing in agri-food industry.

F. Jian (E1-532 EITC) (204-474-7965) (**Fuji.Jian@umanitoba.ca**)
1. Mathematical modeling of grain drying.
2. Mathematical modeling of airflow resistance through grain bulks.
3. Mathematical modeling of fan velocity and static pressure.

D. Levin (E1-354 EITC) (204-474-7429) **(David.Levin@umanitoba.ca)**
1. Physical-mechanical-thermal properties, applications, and biodegradability of renewable biodegradable polymers, such as Polyhydroxyalkanoates (PHAs and PLA)
2. Physical-mechanical-thermal properties, applications, and biodegradability of petroleum-based, biodegradable polymers, such as Polyethylene succinate (PES), Polybutylene succinate (PBS), Polycaprolactone (PCL), and Polybutylene Adipate Terephthalate (PBAT)

S. Liu (W581 Duff Roblin Bldg) (204-474-9616) (**Song.Liu@umanitoba.ca**)
1. Antiviral coatings

D. Mann (E2-376 EITC) (204-474-7149) **(Danny.Mann@umanitoba.ca)**
1. Bearing wear monitoring
    a. Literature review to determine potential techniques to monitor bearings for indications of failure.

b. Conceptual design of a lab test apparatus for evaluation of a bearing wear monitoring system.

2. Electrically-powered gantry tractor
    a. Literature review to understand the agronomic benefits associated with controlled traffic farming.
    b. Conceptual design of an electrically-powered gantry tractor for prairie grain production, indicating the placement and distribution of electric engines between the gantry tractor and the various implements.
3. Harvesting of canola stalks for fibre production
    a. Conceptual design of a harvesting system that enables collection of both canola seeds and stalks.

J. Morrison (E1-356 EITC) (204-474-8496) **(Jason.Morrison@umanitoba.ca)**
Please contact Dr. Morrison for projects related to his research expertise listed below.

Biofibre collection, separation, and grading of all stages using imaging, spectroscopy and mechanical assessment. Material properties assessment of biologically sourced and/or bio-compatible materials.

J. Paliwal (E1-342 EITC) (204-474-8429) **(J.Paliwal@umanitoba.ca)**

- Simulation of background inconsistencies in micro-CT imaging using Matlab
- Identifying broken from sound corn kernels using Image Processing
- Proof of concept design of a floatation vest or wearable alerting device for grain entrapment
- Design of a data collection system for volume and moisture at the GSRL's grain elevator pit
- Quantifying the variations in canola's electrical permittivity as a function of oil content
- Evaluating the effect of magnetic field stimulation on germination of grains
- A comparative study on evaluating the movement of insects toward artificial pheromones in pulse flours.

Rahman, M. (W583 Duff Roblin Bldg) (204-474-8509) (**Mashiur.Rahman@umanitoba.ca**)

1. Microplastics release from the facemasks – a literature review.
2. Herzberg's two-factor theory for engineers (literature review).
3. Environmental effects of and CO_2 emission from textile processing (literature review)

J. Seniuk Cicek (333 Stanley Pauley) (204-474-9698) **(Jillian.SeniukCicek@umanitoba.ca)**
Research focus: Engineering Education
Engineering education research may be described as a field of study that focuses on the scholarship of teaching and learning in engineering. Researchers employ the theories, frameworks, research methodologies, and practices of the learning and social sciences, for the ultimate purpose of describing and improving the training and education of engineers.
Topics:

1. Indigenous approaches to engineering, and ways of being, doing and thinking
2. Impact of Indigenous initiatives on student learning
3. Sociotechnical thinking in engineering
4. Engineering competencies in engineering practice
5. Student culture, diversity, perspectives, identity, and learning
6. Program evaluation
7. Outcomes-based teaching and assessing
8. Instructor pedagogical practices and belief-systems
9. Epistemologies in engineering education

R. Sri Ranjan (E1-346 EITC) (204-474-9344) **(Sri.Ranjan@umanitoba.ca)**

1. Building and optimizing the operation of aeroponic systems for growing herbs/vegetables indoors

Q. Zhang (E1-399 EITC) (204-474-9819) **(Qiang.Zhang@umanitoba.ca)**

1. Literature review of aerosol transmission of animal diseases.

2. Literature review of bioaerosol sampling methods for airborne disease pathogens.
3. Literature review of precision livestock farming.
4. Effects of mechanical vibration/shocks on animals and humans.
5. Growth chambers for vegetable production in northern communities.

W. Zhong (W579 Duff Roblin Bldg) (204-474-9913) (**Wen.Zhong@umanitoba.ca**)
1. Development of conductive hydrogels for biosensors.
2. Functional nanofibers for biomedical applications.

J. Ackerman (Strawbale Building) (204-261-0930) (**Joe.Ackerman@umanitoba.ca**)
Note: Dr. Ackerman is the recently-appointed Manager & Research Associate for our new Sustainability-in-Action Facility (SiAF). He is willing to supervise theses related to the following topics:

1. **Burning waste fibre**: energy, ash nutrients and atmospheric pollution. Using crop residues, cattails, twig/branch tree trimmings, waste paper, furniture board, and biodegradable fast food packaging (PLA, food contact papers, paper cups), conduct analysis of: a) methods of compaction, b) tolerable moisture range for combustion c) kJ/kg produced d) ash quantity, quality, nutrient level, pollutants (e.g., heavy metals) e) airborne pollutants (e.g., condensed and volatile POPs, particulates, GHG, NOx, SOx)

2. **Alternatives to Plastic Recycling**. Instead of sending Blue Box plastic offshore for recycling, explore alternative methods of local re-manufacture with waste plastic (PET, PE, PVC, PP, Acrylic, Polycarbonate, PS, composite thermoplastics and thermosets). Starting with practical items that could be made from recycled plastic, explore optimum polymers, processes, equipment, hazards, quality control, and markets. On a pilot scale, what size of shredder, extruder, and press would be needed. Would age, wear, UV degradation, loss of plasticizers, antioxidants, stabilizers, etc., affect the final product? If so, could this be remedied by design, addition of virgin material, or addition of new plasticizers, etc

3. **Is there a better way to recycle plastic?** Looking at the differences between recycling practices, standards, legislation, infrastructure and ultimate fate of blue bin plastic collections in North America, Europe and other parts of the world. Separation and recycling processes are often manual but increasingly automated with Near Infra Red scanning and robotics a current feature. Neither is perfect and the final product is usually contaminated by non-plastic items and by mixed polymer types. How can this problem be solved? What are innovations (packaging design, sorting technology, policies) that may improve the process?

4. **Bioplastic and biodegradability**. Sometimes there are small distinctions in the description of a material: bio-based, bioplastic, biodegradable, compostable, oxo-degradable, and plant-based. What are examples of each? What are the technical definitions of these terms and what do they mean in the context of a recycling and composting stream? How do the differences impede or simplify the recycling process and the composting process?

5. **Regenerative agriculture and soil carbon sequestration.** There is current promotion of "regenerative agriculture", with the idea of storing atmospheric CO_2 in the soil via changes in agricultural practices. What are the assumptions that go along with this narrative, and are they correct? Is it possible to store carbon in the soil that is truly sequestered and will not break down via insect, microbial, and fungal activities? What are the methods currently used to measure this? Is there evidence to support the idea of increased soil carbon through agricultural practices?

6. **Wood chips as compost ingredient.** A common ingredient in an initial compost mix is wood chips. Wood is slower to break down than most other compost ingredients and are then transferred

to soil intact where they do not add any nutrient benefit to crops and are possibly a hindrance. However, wood chips offer structure for aeration during the composting process, and in this way offer benefit. Does the benefit of aeration offset the slow rate of decomposition of wood chips or should the practice be abandoned?

7. **Uses for post-consumer glass.** Despite a Blue Box program in Manitoba, the collected glass is used at the landfill as roadbed and is not re-used in the greater society. What are the physical features of post-consumer glass and what are possible uses for it that could displace virgin materials like sand or gravel? Why does Manitoba not have any avenues of re-use except landfill? Have other options been tried in the past?

8. **CO_2 and steel production**. It has been proposed that rather than sell off peak load electricity production at extremely low rates, this power should be used to split water via hydrolysis and produce O_2 and H_2. Steel smelting normally uses coke (derived from coal) for removal of oxygen from iron ore (FeO_3), producing CO_2 as a by-product, but emitting 1.4 tonnes of CO_2 for every tonne of steel. Using H_2 to remove the oxide creates water in the direct reduction process and producing 97% less CO_2. Could this technology be integrated into the rolling mills in Selkirk or could a companion steel smelter be installed?