Madan Bhandari University of Science and Technology

Chitlang, Thaha Municipality Ward 9, Bagmati Province, Nepal

Curriculum

Graduate Programs in

Forest Biomaterials Science and Engineering

October 2023

1. Introduction

The Master of Applied Science and PhD in Forest Biomaterials Science and Engineering programs at MBUST are Science, Technology, Engineering and Mathematics (STEM) focused programs directed towards developing sustainable technologies for value-added utilization of forest resources. These programs will enable students in applying cutting-edge research and technologies for sustainable management of forest resources to generate environmental, economic, and social benefits, in particular meeting the future needs of Forest-Based Industrial Sector (locally and internationally). Some key features of these programs include:

- A distinctive focus that differentiates from, but complements the existing forestry related graduate programs in Nepal,
- A focus on the sustainable development of forest products, fulfilling ecological requirements and biological conservation of natural ecosystems in accordance with the specific needs of Nepal and beyond,
- Industrial applications of both timber and non-timber forest products (NTFPs),
- Development of systematic and specialized knowledge for efficient utilization, conservation of forest resources and building capacity to contribute to research and innovation to support requirements of industries based on forest biomaterials.

2. Academic Programs

The Graduate Programs are offered to the students from Nepal and overseas. After the completion of programs of Master of Applied Science in Forest Biomaterials or Ph.D. in Forest Biomaterials, the graduates will possess specialized knowledge and skills for research, innovation and product development from forest biomaterials and professional market potential analysis.

3. Program Aims

The program has been designed to provide graduates with:

- Specialist in-depth knowledge and understanding of forest biomaterials science (chemistry and physics), engineering and technology.
- Understanding of Nepal's forest conservation and management practices, and the importance of the forest sector to climate change, biodiversity, sustainable development, economic income, and social equity.

- The first-hand knowledge of the forest sector through field trips, internships, and collaborative projects for addressing real issues faced by industries. Students will work in the state-of-the art laboratory facilities available at the University.
- The latest research analysis and computer programming tools, such as Artificial Intelligence (AI) and data analytics and modeling.
- Entrepreneurship, communications, and leadership trainings to develop professional skills.
- Skills to build partnerships among industry, community, academia, and government for an enriched educational experience.
- Exposure to frontier science and technology developments through interactions with leading scientists from around the world and opportunities of collaboration and partnership with national and international institutes and industries.
- Expertise to strengthen the forest-based industries such as timber seasoning, grading, plywood and wood-based biomaterials design, utilization of rosin, turpentine, tannin, cellulose, hemicellulose, lignin and herbal materials and essential oil production and processing.

4. Learning Outcomes

The graduates specialized with cognitive and technical skills in forest biomaterials will independently demonstrate:

- The capacity for an independent research or experimentation on forest biomaterials using appropriate methods.
- The ability to communicate, critically use of the source material, experimental results and publish in relevant peer-reviewed academic journals.
- The ability to diversify the use of forest materials and optimize the management of forest products for livelihood improvement.
- The capacity for technological advancement and innovation in the use of forest biomaterials for the economic development in a sustainable and environmentally manner.
- The capacity to produce thesis and patent application meeting the international standards of science.

- The ability to contribute to the government strategies and policies for timber and non-timber forest products and their utilization.

5. Eligibility for Admission

A. Master of Applied Sciences

- 4-year Bachelor's degree in science/engineering/technology fields from recognized universities with CGPA of 2.75 out of 4.0 (or international equivalent)

B. Ph.D.

- Master's in Engineering/Technology/Science fields from recognized universities with CGPA of 3.0 out of 4.0 (or international equivalent)

6. Courses

A. Core Courses

S.N.	Course code	Course title	Credit
1	FB-CR-501	Fundamentals of Forest Biomaterials	4
2	FB-CR-502	Chemistry of Biomaterials	4
3	FB-CR-550	Advanced Topics in Sustainable Bio-products	4
4	GC-CR-501	Development Policy	4

B. Non-Credit Compulsory Courses

S.N.	Course code	Course title	Credit
1	GC-NC-502	Research Methodology and Data Mining	0
2	GC-NC-550	Entrepreneurship, Scientific Communication and Leadership	0
3	FB-NC-551	Forest Conservation and Management	0

C. Technical Elective Courses

S.N.	Course Code	Course Title	Credit
1	FB-EL-561	Mechanics of Biomaterials and Bio-composites	4
2	FB-EL-562	Bonding and Adhesion Sciences and Technology	4
3	FB-EL-563	Wood Drying, Grading, Finishing, Treatment, Seasoning and Protection	4
4	FB-EL-564	Non-timber Forest Products Processing and Value Addition	4
5	FB-EL-565	Extraction and Characterization of Essential Oils and Secondary Metabolites	4
6	FB-EL-566	Dendro-wood Anatomy and its Application	4
7	FB-EL-567	Bioenergy, Bio-carbon, and Biorefinery	4
8	FB-EL-568	Biological Treatment and Conversion of Biomass	4
9	FB-EL-569	Utilization of Forest Products (such as Bamboo etc.) and other Non-wood Natural Materials	4
10	FB-EL-570	Engineered Design and Construction	4
11	FB-EL-571	Conservation of Landscape and Biodiversity	4
12	FB-EL-572	Rainwater Discharge and Forest Management	4
13	FB-EL-573	Advanced Biomaterial Development and Protection	4
14	FB-EL-574	Environmental Life Cycle Assessment and Thinking	4
15	FB-EL-575	Bamboo engineering	4
16	FB-EL-576	Utilization of non-timber natural materials, advanced biomaterial development and protection	4

7. Course Structure

7.1. Master of Applied Science in Forest Biomaterials Science and Engineering

Duration of the Course: 2 years

Semester I				**Semester II**		
Course Code	**Course Title**	**Credit**		**Course Code**	**Course Title**	**Credit**
FB-CR-501	Fundamentals of Forest Biomaterials Science	4		FB-CR-550	Advanced Topics in Sustainable Bioproducts	4
FB-CR-502	Chemistry of Biomaterials	4		FB-TH-699	Thesis	
GC-CR-501	Development Policy	4		GC-NC-550	Entrepreneurship, Scientific Communication and Leadership	0
GC-NC-502	Research methodology and Data Mining	0		FB-NC-551	Forest Conservation and Management	0
				FB-EL-561~576	One course from the list related to thesis	4
Semester III				**Semester IV**		
Course Code	**Course Title**	**Credit**		**Course Code**	**Course Title**	**Credit**
FB-TH-699	Thesis			FB-TH-699	Thesis	
Total credit for Thesis = 30 credit Total credit for Master of Applied Science = 50 credit (16 credit core course + 4 credit Technical elective + 30 credit Thesis)						

7.2. Ph.D. in Forest Biomaterials Science and Engineering

Duration of the Course: 3 years

Semester I				**Semester II**		
Course Code	**Course Title**	**Credit**		**Course Code**	**Course Title**	**Credit**
FB-CR-501	Fundamentals of Forest Biomaterials Science	4		FB-CR-550	Advanced Topics in Sustainable Bioproducts	4
FB-CR-502	Chemistry of Biomaterials	4		FB-TH-999	Thesis	
GC-CR-501	Development Policy	4		GC-NC-550	Entrepreneurship, Scientific Communication and Leadership	0
GC-NC-502	Research methodology and Data Mining	0		FB-NC-551	Forest Conservation and Management	0
				FB-EL-561~576	One course from the list related to thesis	4
Semester III				**Semester IV**		
Course Code	**Course Title**	**Credit**		**Course Code**	**Course Title**	**Credit**
FB-EL-561~576	One course from the list related to thesis	4		FB-TH-999	Thesis	
FB-TH-999	Thesis					

Semester V				**Semester VI**		
Course Code	**Course Title**	**Credit**		**Course Code**	**Course Title**	**Credit**
FB-TH-999	Thesis			FB-TH-999	Thesis	
Total credit for Thesis = 51 credit Total credit for Ph.D. = 75 credit (16 credit core course + 8 credit Technical elective + 51 credit Thesis)						

If someone enrolls into Ph.D. program after completing Master of Applied Science, courses taken at the Master's level will be exempted. However, he/she may have to take additional technical elective courses.

8. Course Description

8.1. Core Courses

Course Code	Course Title	Description
FB-CR-501	Fundamentals of Forest Biomaterials Science (incl. Labs on design Fabrication and testing)	Wood anatomy, wood interaction with the environment, wood grading and mechanics, wood chemistry, wood treatment, wood processing, wood-based products (lumber, plywood, wood panel and composites, wood parquets, mass timbers), 3D fabrication, materials testing and characterization using advanced techniques
FB-CR - 502	Chemistry of Biomaterials	Chemical conversion, thermal-chemical conversion, biological conversion, nanomaterials and nanotechnology, bioenergy, biofuel, natural products-based chemicals (Characterization of structure, function of cellulose, hemicellulose, lignin, separation and spectroscopic analysis of compounds of medicinal and aromatic plants), and advanced bio-based materials

FB-CR - 550	Advanced Topics in Sustainable Bioproducts (invited seminars)	Guest lectures on the latest developments related to sustainable bioproducts from around the world
GC-CR-501	Development Policy	Public policies in developing countries, cases of education, health, trade, industry, energy, water, natural resource, sanitation, agriculture, labor, and social protection, policies related to market failures, government failures; and possible remedies

8.2. Non-Credit Courses

Course Code	**Course Title**	**Description**
GC-NC-502	Research Methods and Data Mining	• Research methodology (critical literature review, formulation of research proposal, and develop research questions/hypothesis, etc.) • Statistical methods and tools for data analysis (Design of experiments, analysis of variance, data regression, correlation analysis, etc.) • AI and data analytics (Computer coding and deep learning basics, clustering analysis, etc.)
GC-NC-550	Entrepreneurship, Scientific Communications, and Leadership	• Entrepreneurship (business case and startup) • Leadership skills • Communications (technical writings and presentation skills) • Academic Writing
FB-NC-551	Forest Conservation and Management	Forest conservation and management systems and practices • Forest and climate change • Forest timber extraction and tenure systems • Environmental management, circular economy, and carbon policy

		• Medicinal and aromatic plants conservation and management

8.3. Technical Elective Courses

Course Code	Course Title	Description
FB-EL-561	Mechanics of Biomaterials and Bio-composites	Structure, properties and application of biomaterials for biomedical applications, and fiber reinforced composites including composites based on renewable resources. Processing methods and testing and characterization techniques.
FB-EL-562	Bonding and Adhesion Sciences and Technology	Mechanics of the adhesive bond, chemistry of adhesives and surface science.
FB-EL-563	Wood Drying, Grading, Finishing, Treatment, Seasoning and Protection	Technologies of wood processing, nondestructive evaluation of wood property, degradation of wood and recognition of wood and its processing
FB-EL-564	Non-timber Forest Products Processing and Value Addition	Diversity of NTFPs, use value and trade of NTFPs in Ayurveda, ethnobotany, herbal formulations and conservation strategies. Storage, grading, processing, packaging and marketing, buyer-driven and producer driven value chain.
FB-EL-565	Extraction and Characterization of Essential Oils and Secondary Metabolites	Sources of essential oils, properties and trade value. Essential oil extraction, isolation of principal components, and purification from raw materials for the cosmetic, pharmaceutical, and food industries.
FB-EL-566	Dendro Wood Anatomy and its Application	Principles and practices of agro-forestry, forest utilization: wood and wood products. Micro- and macro-structure of wood cells and their features from a biological and physical point of view, wood anatomical features of coniferous and deciduous species, such as cell size, lumen area and diameter, and cell-wall

Course Code	Course Title	Description
		thickness to establish inter-annual chronologies and investigation of different environmental signals.
FB-EL-567	Bioenergy, Bio-carbon, and Biorefinery	Bioconversion technologies to convert biomass containing carbon, use of chemical catalysis for economic and sustainable production of biofuels and chemicals from renewable biomass.
FB-EL-568	Biological Treatment and Conversion of Biomass	Basics of biomass, physio-chemical, biological, and thermal conversion pathways.
FB-EL-569	Utilization of Bamboo and Other Non-wood Natural Materials	Treatment of non-wood materials like bamboo, rattan, oil palm, and bagasse for durability and applications in construction and automotive industries.
FB-EL-570	Engineered Design and Construction	Mechanical characterization of bio-materials (i.e. bamboo and timber) for structural applications, development of design methods for bamboo and timber connections, classification/grading through non-destructive evaluation (non-destructive/AI)
FB-EL-571	Conservation of Landscape and Biodiversity	Planning and design of urban afforestation, natural restoration, assessment and mitigation of natural environments
FB-EL-572	Rainwater Discharge and Forest Management	Sediment discharge, forest debris flow, management of slope and landslides
FB-EL-573	Advanced Biomaterials Development and Protection	Treatment and durability of bamboo and timber, fire-resistance evaluation of biomaterials, development of advanced timber/bamboo materials, development of advanced/sustainable bamboo and timber cultivation methods, bamboo and wood processing technology
FB-EL-574	Environmental Life Cycle Assessment and Thinking	Formulation of life cycle assessment of forest biomaterials: 4 phases: goal and scope, inventory analysis, impact assessment and interpretation;

Course Code	Course Title	Description
		5 stages: resource extraction, processing, transportation/distribution, use and end of life disposal/recovery
FB-EL-575	Bamboo Engineering	Identification of bamboo; harvesting, treatment and grading for production of construction grade poles; mechanical testing and characterization; structural analysis and design
FB-EL-576	Utilization of Non-timber Natural Materials, Advanced Biomaterials Development and Protection	Treatment and seasoning of non-timber materials (e.g. rattan, oil palm, and bagasse); durability and fire-resistance evaluation; classification and grading; development of advanced/sustainable materials; development of advanced/sustainable cultivation methods; processing technology