Sub-theme 1: Information Technology and Computing

Developments in science and technology are fundamentally altering the way people live, work, connect and communicate, with profound effects on socio-economic advances, improvements in health systems, education and infrastructure. In this regard, statistical science, information and communication technology (ICT), as a key component and enabler in science and technology, are increasingly simplifying the accessibility of information, financial service, and others to change people's lives in unprecedented ways. ICT is also changing the way how companies do business, transform public service delivery, and foster nations to move toward good governance. In education sectors, statistical science and ICT play an integration role. To address the problem of societies through well-developed statistical models and managed ICT application and services; the following focus areas of research are identified:

- **Computational Intelligence and Machine Learning:** Artificial Intelligence for Social Good, Health intelligence, Education and Agriculture, Machine Learning; Reinforcement Learning, Natural Language Processing, Human-Centric Digital Transformation, Cloud Computing, Deep Learning, Data Mining, Image processing, and Speech Processing.

- **Natural Data Science and Analytics:** Big Data Analytics; Network analysis; Time Series Data Analysis; Adaptive Data Analytics; Data science platforms tools, Databases and Information Retrieval, models and techniques; Application of data science.

- **Indigenous Knowledge Modelling and Geographic Information Processing: (**Health, Farming and Climate), Smart Business, and Society. Blockchain Technologies, Smart Health and Health Informatics. Land use planning, urbanization and urban and regional planning.

- **Computer Systems Engineering and Internet of Things (IoT):** Smart Agriculture, Yield Prediction, Environmental Protection, Smart Cities, Right Crop to Grow Guidance and Soil Monitoring. Cyber-security and Cryptography; Networks, Distributed Systems, Innovative teaching and learning technologies; Reconfigurable computing systems, Software Engineering and Programming Languages, Architectures, Compiler Optimization, Embedded Systems, Mobile Systems, Theory and Algorithms, Bioinformatics, Graphics and Immersive Computing, Human-Computer Interaction (HCI), and Graphics and Immersive Computing.

- **Applied statistics in agriculture, environmental sciences, biomedical sciences, education and social welfare.** Disease, economics, agricultural, education and environmental modelling, spatial modelling, biostatistics and bioinformatics. Emerging areas of application include clinical trials research, observational studies, physiology, imaging, and genomics.

Sub-theme 2: Advanced Materials Research and Development

The major challenge we face as a nation is a poor productivity due to the traditional mode of agricultural systems that are being practiced hitherto. Haramaya University, as one of the leading agricultural and one of the research University in Ethiopia, is expected to lead the research in modernizing our agriculture commensurate to its position via the involvement of emerging technologies such as nanotechnology. In this regard, research related to increased plant and animal production and productivity is important, with particular emphasis on delivery, sensing, diagnosis, nutrition, fertility and quality. Energy is also scarce, and the community depends mostly on firewoods and fossil fuels for cooking, heating, lighting and cottage industry. Hence, energy problem has contributed to food shortage and curtailed economic development. Environmental pollution is another formidable challenge that hampers the socio-economic development of our country. This is attributed mainly to population growth, lack of proper waste management systems and poor urban planning and other anthropogenic factors. To address these challenges, Ethiopia needs to build institutional excellence in the area of nanotechnology. Accordingly, we suggest the following topics on the fabrication of advanced materials (Metal oxides/Chalcogenides, Reduced gaphenes oxides rGO, Perovskites, Polyoxometalates, Metal Organic Frame works, Conducting Polymers, Nanocomposites/Organic-Inorganic hybrids) and Nanomaterials Immobilization. The major areas of applications are the following:

- **Health Applications**: Development and production of medical oxygen; breathing machines;

- **Agricultural Applications:** Plant production and productivity (Delivery, Sensing and Diagnosis); Animal Production and Productivity (Nutrition, Diagnosis, Sensing, Fertility, Quality); Postharvest technology (Bio-insecticidal formulations); Nanobiotechnology, Food processing and packaging.

- **Application to Energy:** Renewable energy production (Solar cells; Fuel cells; Bio- energy such as bio-fuels, bio-diesel, bio-oil, bio-gas); Energy storage (improved materials for super capacitors, batteries).

- **Application to Environment and Monitoring:** Photocatalysis; Sorption/desorption; Ion exchange; Photo-disinfection; Antimicrobials; Bio/Chemo-Sensors; Conversion of agricultural biomass wastes.

Sub-theme 3: Energy Resources Development and Utilization

Energy is the main input to the technological, industrial, social and economic development of a nation, which stimulates the economic development of a country. The Ethiopian energy sector is faced with the double challenge of limited access to modern energy and the heavy dependence on traditional biomass energy sources to meet growing demand. In this new era, renewable energy sources are an extremely attractive and desirable option in the energy sector due to the rising price of oil, natural gas and coal, as well as environmental concerns in terms of greenhouse gas emissions and global warming. Besides, the lack of alternative energy, which has brought deforestation, land degradation and food insecurity in Ethiopia, has led to the search for a new technological way of energy utilization. There is a general acceptance of the need to diversify energy supply for confronting these challenges by developing advanced, cleaner, more efficient, and cost-effective renewable energy technologies, including superior and cleaner fossil fuel technologies. Thus researches shall focus on the following areas:

- **Internet of Energy (IoE):** upgrading and automating electricity infrastructures for energy producers and manufacturers that allow energy production to move forward more efficiently and cleanly with the least amount of waste.

- **Alternate energy sources: solar & wind energy** system design and development, solar photovoltaic system development; b**io-energy:** biomass gasification; biogas generation from agricultural wastes; biodiesel production and utilization, stability of biodiesel and its blends. **Wind and geothermal energy**: wind energy explorations and power generation systems; design and generation geothermal renewable energy.

- **Small-scale hydro power development**: small hydropower planning, investigations, designs, development, optimization of generation, cost optimization.

- **Energy conservation**: conservation of energy in electrical network, energy auditing, energy, clean energy, saving and development, rural electrification for sustainable development, etc.

Sub-theme 4: Postharvest Technology, Processing and Food Analysis

In Ethiopia, the postharvest management system is in dire conditions characterized by poor quality products and large losses. As a result, the local market is inundated with poor quality products. Thus, the research in postharvest management must focus on minimization of losses, quality improvement, product development, and processing technologies of industrially and economically important crops. In addition, researches in food science, engineering and technology must focus on safeguarding the quality of food from production to consumption. Besides, the development of food quality standards, improvement of quality of fresh produce, as well as the development of new food products from wild, indigenous and traditional food resources is crucial. Furthermore, food and nutrition security problems in developing countries like Ethiopia must be addressed through different approaches. Therefore, priority shall be given to introduction, adoption, and utilization and creating awareness of technologies, nutritionally rich foods, and food safety practices to improve the food system. Moreover, improving and scale-up indigenous/traditional foods and processing techniques are also vital to increase their role in the national economy. Thus, researchers shall focus on the following lines:

- Agro-food processing technologies for sustainable food and nutrition security;
- Postharvest technology development and adoption;
- Development and promotion of nutritionally rich food products;
- Proper food development and promotion for maternal and child health improvement;
- Food quality and safety management and monitoring;
- Food processing firms' technology gap assessment and provisions of solutions;
- Training and awareness creation for the community for the alleviation of chronic malnutrition;
- Utilization of unexploited and new food sources to alleviate food and nutrition insecurity; and
- Improving and promoting the traditional/indigenous foods and processing practices.

Sub-theme 5: Civil Infrastructure, Manufacturing and Industrial Technology

Production and quality management has been recognized as an important factor in a country's economic growth. Rapid changes in technology have posed numerous opportunities and challenges, which have resulted in the enhancement of manufacturing capabilities through new materials, facilities, techniques and procedures. Hence, managing a service/production system has become a major challenge in the global competitive environment. Production and quality management leads the way for organizations to achieve their goals with minimum effort. Equally, computer-aided manufacturing and control system (automation) or robotics is a current global trend as it is capable of reducing cost of production, waste, hazard and increase accuracy, productivity as well as process capability in different industries. Attention shall also be given to small and medium manufacturing enterprises (SMME) as they contribute a lot to job creation and support the national economy of a country. Currently, SMME are organized and expanding in Ethiopia on the basis of agricultural-economy to industrial-economy transformation. Hence, the design and renovation of modified, cost competent and demand-driven technologies in areas of crop harvesting and after harvest processing as well as construction equipment are highly required in these manufacturing enterprises and markets to gear up the economy. Accordingly, the following prioritized research areas are included:

- **Manufacturing**: Agricultural mechanization: agricultural machine development, sensor development, automation, and irrigation development.
- **Civil Infrastructure**: cost-effective and alternative construction materials, low-cost housing; assessing seismic hazard potential, analysis of traffic congestion, accident and mitigation measure, road safety analysis, and transportation accessibility.
- **Industrial management**: Different aspects of quality & production management of different industries in eastern Ethiopia: logistics, total quality management, production operation management, continuous improvement (KAIZEN).
- **Reverse Engineering**: focusing on biomedical engineering, communication engineering, mechatronics and/or robotics (automation of systems & mechanisms).
- **Adaptive Technology**: focusing on agricultural machinery, construction equipment, and appropriate technologies to address local community problem.