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Universities as Agents for Innovation, Living Values, Sustainable Community Development and Progressive Society Building

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UNIVERSITIES AS AGENTS FOR INNOVATION, LIVING VALUES, SUSTAINABLE COMMUNITY DEVELOPMENT AND PROGRESSIVE SOCIETY BUILDING

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ABSTRACT

In this paper, we revisit Higher Education 4.0 and examine the power of universities as agents of new knowledge and innovations, for sustainable community development and progressive society building. With the benefit of retrospective economic analysis, we may posit that universities will continue to be central to socio-economic development. We can envision that in the face of a changing economic landscape, universities have the potential to serve as powerful agents of change toward a more equitable, just, and sustainable world. The power of universities in this modern era lies in their ability to create and disseminate knowledge, foster critical thinking, and promote social and economic development. Universities play a crucial role in (i) producing knowledge across academic fields, that is relevant to the needs of society, (ii) contributing to economic, industrial, and healthcare developments, to develop vibrant and functionally sustainable communities, and (iii) in training the next generation of leaders and innovators who can shape the future for a higher level of civilization. Specifically, this article presents the development of three significant composites of Higher Education 4.0: 1) Core Higher Education: Basic Education and Natural Sciences, Humanities and Law in Society; 2) STEM^2 Education in Technological development, Healthcare Delivery and Community Well-being, comprising: engineering and technology, agricultural engineering and technology, biomedical engineering in translational medicine; and 3) Universities to provide Integrated education at the Undergraduate level, and New knowledge at the Graduate level. Together, they describe how 21st century universities can contribute to (i) living values and living standards, new knowledge and innovations, for (ii) sustainable community development and progressive society building. The significant finding is that the innovative transformation Higher Education presents both challenges and opportunities for universities in this 21st century. While the integration of advanced technology and digitalization has the potential to transform teaching and learning, universities can also use their power to promote social and economic development and challenge dominant economic and political structures. By doing so, universities can play a crucial role in building a more equitable, just, and progressive society.

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INTRODUCTION

Since the time of Alexandria, Bologna, Nalanda, the Platonic Academy and Taixue, universities have served as seats of civilization, learning and growth of societies. They have been the cornerstones of the information economy even predating the agricultural, industrial, digital, and now the 4th industrial revolution. The Wikipedia entry on higher learning institutions states that they "were developed in many cultures to provide institutional frameworks for scholarly activities … (and these) ancient centres were sponsored and overseen by courts; by religious institutions, … scientific institutions, … and respective scholars." Higher Education 4.0, a term coined to describe the current phase of higher education, is characterized by the integration of academic fields: humanities, sciences, engineering, medicine, and law. In a post-capitalist society, universities can use their power to challenge dominant economic and political structures and promote alternative models of social organization and development. Universities can foster critical thinking and social consciousness among students, faculty, and staff, encouraging them to question the status quo and envision a more just and equitable future.Moreover, universities can contribute to the development of sustainable and resilient economies by promoting research across academic fields,

and especially in biomedical engineering, renewable energy, environmental conservation, sustainable agriculture, and a new STEM format of precision medicine. They can also support the development of social entrepreneurship and community-based enterprises that create employment and promote economic growth. Higher education plays a crucial role in promoting economic growth and global competitiveness by generating knowledge and developing a skilled and productive human capital (Jones, 2021; Marginson, 2016). According to the 1999 World Development Report on the Knowledge Economy, tertiary education is central to the four strategic dimensions of an appropriate economic and institutional framework, a strong human capital base, a dynamic information infrastructure, and an efficient state-level and national innovation system (World Bank, 1999).

The report emphasizes the complementary role of these dimensions in guiding countries towards a knowledge-based economy. Graduate research universities can play a vital role in the welfare and prosperity of their regions and nations. Today, the term "world-class university" has become a catchphrase for qualifying the quality of learning and research, as well as the acquisition and creation of advanced knowledge. The benchmarks for world rankings are academic and research performance, and the impact of faculty and doctoral students based on publications, citations, inventions, patents, and exclusive international awards. However, universities have a special role in promoting social mobility, industrial incubation, and sustainable development in underserved communities (Ghista, 2008; Narayan, 2007). Universities can cultivate a values-based society to foster agricultural, technological, and medical innovations to promote agro-industrial development, medical devices production, and employment for the people (Ghista, 2009; Ghista, 2008). In this modern era, the role of universities is paramount in promoting sustainable development by infusing neo-humanist ideals into the community's society and making scientific and technological advancements for industrial incubation. Sustainable development implies sustainability in all quality-of-life and happiness factors of human living, including cultural, environmental, social, and economic sustainability. A neo-concept of a sustainable community involves a progressive civilized state sustained in all realms of living, with the help of the university (Ghista, 2009; UNESCO, 2015). Functionally sustainable communities (FSC) comprise several cities with a large rural hinterland and provide economic sustainability to the community. Developing and emerging countries can focus on developing adequate standards of living, based on the provision of community services and environmental quality, maintenance of trade linkages with their rural hinterland, and measures of social justice to achieve sustainable development for cities and towns (Iyer, 2005). FSCs in the rural hinterland must generate revenue by supplying their produce to the cities and other neighboring FSCs, promoting agro-industrial development and manufacturing industry (Ghista, 2009). Universities can play a big role in promoting sustainable development by generating knowledge-based community economies (4). We can conclude this section with the statement from Abdullah Bin Ahmed Badawi, the then Prime Minister of Malaysia, in his Opening Speech of the 2006 Meeting of the Association of Commonwealth Universities which underscores the role of universities in growth and development: “I do believe that it is necessary to stress that for most countries today, human resource development and human capital formation are either extremely important, absolutely vital, or a matter of life and death. In the case of Malaysia, we think it is a matter of life or death.”

METHODOLOGY

Herein, we present three significant composites of Higher Education 4.0

- Core Higher Education: Basic Education and Natural Sciences, Humanities and Law in Society
- $STEM^2$ Education in Technological development, Healthcare Delivery and Community Well-being,
- comprising: Engineering and Technology, Agricultural Engineering and Technology, Biomedical Engineering in Translational Medicine.
- Universities to provideIntegrated education at the Undergraduate level and New knowledge at the Graduate level.

Core Higher Education: Basic Education and Natural Sciences, Humanities and Law in Society: The Natural Sciences Blocenables acquiring basic knowledge of natural phenomena and life processes, as well as the value of animal and plant life in the human habitat. The Humanities Blocenables students to develop a neohumanistoutlook contributing to fruitful human interactions for collective welfare. The Lawand Jurisprudence influences the way people behave and relate to each other, and it establishes a framework of order that is essential for the development and progress of any society.

$STEM^2$ Education in Technological Development, Healthcare Delivery and Community Well-being: Engineering includes **(i)**Biomedical engineeringas agents of translational medicine, **(ii)**Renewable energy, reducing emissions of harmful gases, with impact on climate change and human respiratory health, **(iii)**Pharmaceutical engineering, to treat specific ailments and enhance patient care, **(iv)**Agricultural engineering to provide food security and herbal medicines to the people, based on integrated farming combining agriculture, horticulture, floriculture, and sericulture.

Our innovation involves the development of STEM format of medicine: Leading to (i) Precision Medical Diagnostics based on nondimensional indices: Cardiac contractility index, Lung ventilation index, Diabetes index, Aortic stiffness index, Bone osteoporosis index, and (ii) Patient-tailored Surgical Procedures, such as for precision coronary bypass surgery involving pre-surgical analysis and design of the patient’s distal anastomosis.

Universities to provide Integrated education at the Undergraduate level, andNew knowledge at the Graduate level.
We are living in an era of Integrated Human knowledge and Education. Hence, at the undergraduate level, universities need to provide integrated education, involving humanities and social sciences, physical and life sciences, engineering of systems and devices for human use, basic medical sciences, mathematics and computer science. This Integrated Undergraduate Education can enable undergraduates to have more knowledgeable living, especially in understanding their health state and enabling better healthcare.

Then at the Graduate level, universities need to provide new knowledge in different fields, such as:

- Neohumanism, beyond narrow geo sentiments and socio sentiments, in Humanities
- People empowered Political Governance and Economic system,in Social Sciences.
- Cosmological Cycle, Universe development, and Life creation, in the Sciences.
- Organ Systems Engineering, in Biomedical Engineering.
- STEM Model of Medicine, in Medicine.
- Engineering Science of Sports and Athletic Events, a new field.
- Yogapathy, a new format of mind-body medicine, a new field.
- This new knowledge can contribute to better living standards and progressive society building.

These three concepts of Higher Education 4.0 are elaborated below:
To provide the framework of sustainable community development and progressive society building.

Core Higher Education: Basic Education and Natural Sciences, Humanities and Law in Society

Multidisciplinary Approaches to Core Higher Education: A university should aim to address the problems confronting society,

and cultivate the ideals required for its progress. To achieve this, a societal framework with a universal outlook should be developed, enabling individuals with diverse backgrounds to find fulfilling roles in society (Iyer, 2005; Sarkar, 1998). Balanced curricula in all fields must be developed to ensure that science and professional students can contribute to the technological and healthcare infrastructure of society, while humanities and social sciences students develop living ideals and values. Additionally, all students should be ecologically conscious and have a universal social outlook (Sarkar, 2012).

The following table lists the educational objectives and relevant academic disciplines required to address them: 1. Natural phenomena and Life processes, based on Physical and Life Sciences;2. Human habitation and Comfortable living, based on Engineering and Technology; 3. Human nature and Psychology, based on Ecological Sciences and Environmental Engineering. 4. Human physical and Mental health, based on Medical and Health Sciences; 5. Science and Methods of Food production, based on Agricultural Science and Food Technology; 6. Jurisprudence based on Cardinal values, based on Law and Jurisprudence; 7. Economic and Political framework for collective welfare, based on Economic and Political Sciences.

Basic Education: Basic education is the most critical phase of higher education, occurring during the initial two years before the student decides on a specialization. It provides students with a proper representation of the range of disciplines and helps them make informed choices. Basic education must provide a solid grounding and foundation for any field of specialization. It is crucial in building the character and personality of students, and they must be ready to recognize their role in society and interests in majoring in a discipline. The basic education program should impart a broad academic base enabling students to relate and interact with people of diverse educational backgrounds and specialties (Gandhi, 1949). Acquiring basic knowledge requires studying synergistic combinations of disciplines at a fundamental level. Physical sciences, life sciences, and ecology constitute a set of synergetic disciplines under the heading of the Natural Sciences Bloc (Figure 1) to acquire basic knowledge of natural phenomena and life processes, as well as the value of animal and plant life in the human habitat (Ghista, 2008).

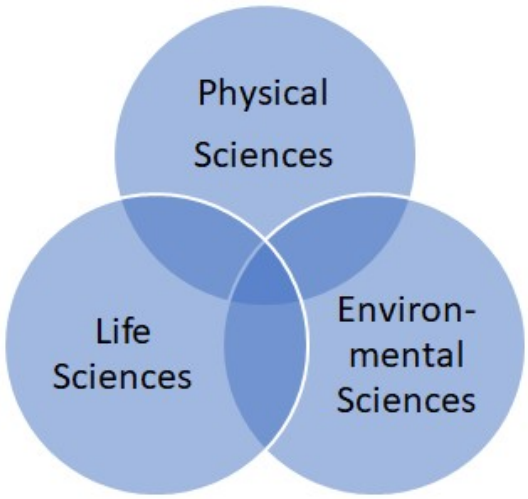

Figure 1. Natural Sciences Bloc of Studies

Communities today require the active involvement of universities in providing know-how for industrial development, while safeguarding ecology, developing art and literature for cultural development, channeling technological advancement for improvement in the quality-of-life, and ensuring requisite purchasing capacity for basic needs while providing scope for aesthetic expression.

In closing, a multidisciplinary approach to higher education is necessary to address the complex problems facing societies today: This approach requires a balance between scientific and professional education, humanities and social sciences education, and ecological consciousness, and a universal social outlook (Peters, 2019). Basic education is the foundation of higher education and must provide a broad academic base for enabling students to relate to and interact with people of diverse educational backgrounds and specialties.

Humanities in Society: An Academic Perspective: In addition to objective knowledge, subjective knowledge is also necessary to understand what it is that makes human beings happy. In this regard, philosophy enables people to understand themselves and cultivate humanistic values. The disciplines of literature, history, sociology, and philosophy are to be integrated and taught as a Humanities Bloc of Studies (Figure 2), to enable students to develop a neohumanistoutlook contributing to fruitful human interactions for collective welfare (Sarkar, 2012; Sarkar, 2011).

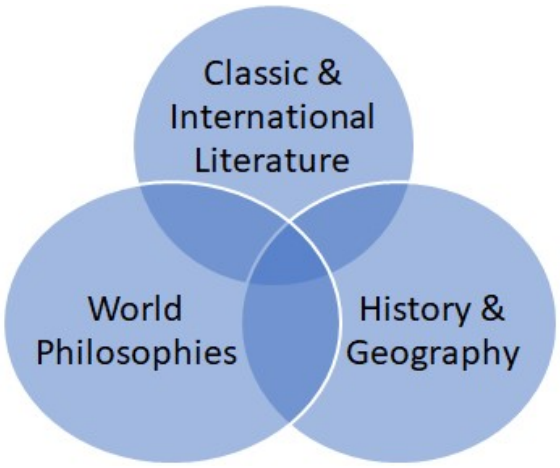

Figure 2. Humanities Bloc of Studies

The Humanities are crucial in society as they establish the principles of human thought and action (UNESCO, 2013). They can create models of human interaction, individual and collective psychologies, and socio-economic structures that facilitate individual growth and contribute to the advancement of society (Pawar, 2012; Sarkar, 2011). The examination of literature can be an influential way to express the hidden depths of the human heart. This allows society to move forward towards prosperity and fulfillment. Iconic works of literature can aid in educating students about the thoughts and emotions of people, providing them with insights into the collective psychology of society. Similarly, History can portray the sorrows and joys, the aspirations and accomplishments, and the trials and triumphs of the masses.

It can inspire students to comprehend how the various facets of spiritual and cultural expressions, social perspectives, and economic systems have influenced societal dynamics. The study of History can assist students in comprehending the elements of collective psychology and how the absence or alteration of these components can lead to the growth and decline of civilizations and societies. Moreover, the study of Humanities instills a set of neo-humanistic values, through epics and biographies infused with universalism and idealism. It aims to develop the ideals of a compassionate and fulfilling human society and how individuals can contribute to it. Neo-humanism promotes a higher level of living by encouraging individuals to rise above narrow-minded sentiments that have guided human thought and behavior throughout history, resulting in significant conflicts and sufferings. In this manner, neo-humanism raises humanism to universalism, allowing for freedom from complexes and promoting a superior level of human living (Sarkar, 2012).

Educational Objectives		Academic Disciplines
1. develop insights concerning natural phenomena and life processes		1. Physical and Life sciences,
2. require know-how for making life comfortable and reduce physical drudgeries and sufferings,		2. Engineering science and technology,
3. develop and understanding of natural environment and to maintain it conducive for human habitation,		3. Ecological sciences and Environmental engineering,
4. acquire knowledge of plant and animal life, and to cater to their existential as well as utility values,		4. Biology and Veterinary sciences,
5. learn about human nature, psychology and the faculties of mind, and aesthetic values,		5. Psychology and Philosophy, Behavioural science, Arts and Aesthetic sciences
6. learn about how people live, about their collective psychology and culture,		6. Anthropology, History and Social science,
7. acquire knowledge of the means to promote and maintain human physical and mental health, as well as psychological well-being and parapsychic development,		7. Medical and Health sciences,
8. learn about the science and methods of food production,		8. Agricultural science and Food technology,
9. develop understanding of jurisprudence based on cardinal values, human psychology, and collective welfare,		9. Law and Jurisprudence,
10. develop understanding of economic, and political frameworks that are compatible with human psychology, and facilitate all the above nine objectives.		10. Economic and Political sciences

Law and Society: A Humanist Perspective: Conflict is the primary cause of law-making, as individuals attempt to satisfy their respective physical and psychic aspects. Law becomes necessary as individuals become conscious of this conflict, which is, in fact, a disorder concerning the relationships between a dividing line between peaceful (and therefore ordered) relationships and conflicting (and therefore disordered) relationships. The primary law is thus prompted by social conflicts over incompatible psychic urges and values, and it is dedicated to addressing and resolving such conflicts. The function of law is to deal with existing or potential conflicts within society based on the prevailing social values, which may not always be the ideal basis of judicial codes (Patil, 2013). The law assumes this function through two basic roles, each corresponding to an aspect of human life. The first role is the establishment of institutions necessary for society's survival and progress; this role corresponds to the collective aspect of human life. Secondly, the stability of values prevailing in society does not prevent the succession of the processes of legal valuation of behavior aspects. This process remains essential, as it helps to confront and assess progress in human life and the resulting emergence of new forms of activities and transactions. Contemporary societies are witnessing a continuous development of the legal criteria of valuation in connection with all that is new in human living. Examples of such developments are laws relating to the protection of the environment, laws relating to the regulation of utilizing scientific discoveries in the fields of genetic engineering as well as transplants and artificial insemination, and laws relating to the protection of literary and artistic property.

Law and Values: Although the primary function of law is to resolve disputes in society, it is also closely related to the set of values in a society and how they balance each other to provide regulating norms for its function (Iyer, 2005; Sarkar, 1998).

The law plays a crucial role in striking a balance between various values that a society accumulates, deriving an ideal representation from it. Human existence is both individual and collective, and thus, has two sets of values: human values and social values. Human values are connected organically with human nature, and their realization contributes to the civilization of the world, as well as the realization of absolute truth. On the other hand, social values pertain to a given society and can be influenced by social prejudices and mental perversions (Sarkar, 2011). Social values remain relative, despite their apparent firmness and absoluteness in a society at a certain period, as they can be the cause of exploitation, suffering, and injustices for human beings (Iyer, 2005). For example, what is considered virtue in one part of the world may be considered a vice in another. On the other hand, human values are absolute in time and place and include justice, fraternity, equality, and freedom of thought to offer cosmological explanations and to find appropriate means and methods of developing the planet (Sarkar, 2011). Fundamental human values are the cardinal principles associated with the progression from the intellectual to the spiritual strata of human existence. These values are a product of human beings' intuitive contemplation of human nature and interpersonal relationships, leading to finer human feelings of mercy, sympathy, friendship, and love. Cardinal principles mark the differentiation between animality and humanity, while a high level of attainment of these values is associated with the confluence of a high level of humanity and the blossoming of divinity (Sarkar, 2012; Sarkar, 2011).

Importance of Humanities and Law in Society: To sum up, this section highlights the importance of Humanities and Law in Society. The study of Humanities offers students insight into the collective psychology of people, facilitating individual progress and contributing to societal progress.

Law, on the other hand, helps to deal with existing or potential conflicts within society, based on prevailing social values. Both are critical to the functioning of society, facilitating progress and capable of providing a level playing field for equitable and inclusive growth and development.

In this sense, the law is not only a product of society, but it also shapes it*:* The law influences the way people behave and the way they relate to each other, and it establishes a framework of order that is essential for the development and progress of any society. Moreover,law is not only a tool to maintain order and resolve conflicts, but it is also a reflection of the values and beliefs of a society. The legal system embodies the ideals and principles that are important to a particular culture, and it provides a means for the expression and preservation of those values over time. The legal system also serves as a mechanism for social change, as new values and beliefs emerge and are incorporated into the law. On the other hand, humanities play a crucial role in shaping society**,** by promoting the development of values, ideals, and cultural expressions that contribute to human progress and well-being. By studying literature and history, students can gain insight into the collective psychology of their society and understand how the past has shaped the present. The study of law also provides a means for understanding the values and beliefs of a society and how they are reflected in the legal system. Ultimately, humanities and law are essential components of a healthy and flourishing society, as they provide a framework for individual progress and collective social progress.

STEM^{2}Education in Technological Development, Healthcare Delivery and Community Well-being: STEM education, which stands for Science, Technology, Engineering, and Mathematics, should be an essential component of modern education. Particularly for political and business leaders and captains of society. STEM education focuses on the integration of science, technology, engineering, and mathematics, and provides students with an opportunity to develop their critical thinking, problem-solving, and decision-making skills. STEM education is crucial for the future of our world, as it is the driving force behind innovation, technology, and scientific discoveries. By encouraging students to pursue careers in STEM fields, we can help to ensure that we have a workforce that is equipped to meet the demands of a rapidly changing technological landscape. Now let us go even further, andrecognize that half of human knowledge is concerned with developments around us, and the other half of human knowledge is on developments within the human body. This brings us to the new concept of STEM^2 education, which stands for Science, Technology, Engineering, Mathematics, and Medicine. Hence STEM^2 education integrates total human knowledge, which is essential in today's world. This is verily the era of comprehensive universities to also include Medical Schools.

Engineering and Technology,for Community Well-being: The Engineering Faculty plays a significant role in community well-being by educating and training students in the state-of-the-art of engineering science and technology to meet national engineering professional qualifications and community industrial development needs. This section focuses on four new and needs-based engineering disciplines that could be introduced into engineering colleges: biomedical engineering, renewable energy, pharmaceutical engineering, agricultural and food engineering.

Biomedical engineering: Is designated as the agent for translational medicine, contributing to (i) precision medical diagnostics, by means of signal and image processing, artificial intelligence and machine learning, to make medical devices for automated diagnostics, (ii) precision patient-specific surgery, by carrying out pre-surgical analysis for optimal surgical procedures, and (iii) 3-d printing of patient's prosthetic limbs and artificial organs, to make perfect replacements (Ghista, 2008; Ghista, 2011). There is a substantial market for making medical equipment in hospitals and industry. So Biomedical Engineering departments can educate and train students to design medical monitoring, diagnostic, surgical, and prosthetic systems. Then, graduates from these programs can work in hospitals and in industry, and can contribute to a more advanced and benefitting healthcare delivery system.

Renewable Energy engineering: Involves developing systems that utilize energy generated from natural resources, such as wind, sunlight, rain, tides, and geothermal heat. The renewable energy industry involves designing energy-efficient green buildings, solar thermal systems, wind turbines, geothermal plants, and solar photovoltaic cells. There is a big demand for sustainable power, and this engineering discipline focuses on utilizing renewable resources to meet this demand. Renewable Energy reduces emissions of harmful gases and lowers the future risks of climate change, including the impact on food production and improved physical health with reduced symptoms of respiratory and cardiovascular conditions.

Pharmaceutical engineering: Involves developing and manufacturing medications. The curriculum includes courses in the kinetics of reactions, pharmaceutical processes, drug manufacturing processes and dosage formulation, pharmacokinetics and drug delivery, and pharmaceutical packaging technology. There is a big industrial demand for pharmaceutical engineers to develop and manufacture medications. Innovations in pharmaceutical engineering show promise, such as (i) 3D-printed drugsto regulate the number of active substances in the composition of the drug, and (ii) Digital pills containing an ingestible sensor generating an electrical signal picked up by a patch worn on the ribcage, forwarding information to a smartphone app.

Agricultural engineering: Is an essential discipline for universities in rural areas, oriented towards a controlled environment for enhancing plant life and agricultural products, and process control and automation involved in processed food production. This engineering discipline can contribute to food security and self-sufficiency, a topic that is discussed in the next section.

Agriculture Engineering and Technology, for Food Security and Self-Sufficiency: Food availability and accessibility have historically governed the patterns of population distributions in the regions of the world(1). Particularly, the Gulf Regions have the challenge of sustainability of agriculture on high-saline soil and irrigation water. The Gulf Regions face soil salinity because evapotranspiration exceeds precipitation, and deforestation contributes to desertification, leading to saline soil.

Agriculture in the Gulf Regions: The injudicious exploitation of subterranean water contributes to desertification. As the subterranean water recedes, the surface soil dries out and becomes saline. Deforestation also contributes to desertification. Deforestation hence also dries up the soil and contributes to salinity. The fibrous roots of plants absorb and hold a considerable amount of water, which is slowly released into the soil. Sandy soil can nevertheless be enriched by the use of compost and dried fish. The main problem concerns the sustainability of agriculture on high-saline soil and irrigation water. To address this issue, we need to develop plants and crops that can give high yield under these conditions. Salt-tolerant halophyte plant species have played a prominent role in fodder, food, and medicinal needs. Halophytes have special adaptive and resistance mechanisms to salinity in arid regions, involving succulence, salt-secretion, and shedding of salt-accumulating organelles. Propagation of high-biomass salt-tolerant halophytic species can be carried out by using biosaline technology, involving creating localized biotic changes in the rhizosphere, transplantation of acclimatized seedlings/saplings, good drainage for quick percolation of saline water, and application of chemical amendments such as sulfur to reduce salt accumulation at the root zone (Kassam,. 2019)

Integrated Farming Systems are an essential approach to food security, combining agriculture, horticulture, floriculture, and sericulture (Sarkar, 2014; Khan, 2019). Agriculture involves the production of pulses, cereals, oilseeds, vegetables, and medicinal plants. It is advisable to have adjacent fields for vegetables and crops such as barley and maize, and irrigate the vegetable field. Fruit trees

should be planted around cereal crop fields and along the irrigation channels because fruit trees can store a large amount of water in their roots. After the cereal crop is harvested, the controlled release of the water stored in the fruit trees can keep the soil moist and fertile. If paddy is cultivated, small fish can also be cultivated in the waterlogged fields during the rainy season, helping to conserve water (Prakash, 2019). It stands to reason that agriculture for food security and self-sufficiency, in combination with engineering and technology, can also promote sustainability by incorporating livestock production, such as poultry, sheep, and goats, to provide protein-rich foods and organic fertilizers for crops. This can also reduce waste by utilizing animal manure for fertilizer and energy production through biogas generation. The implementation of integrated farming systems requires careful planning and management to ensure optimal resource utilization and minimize negative impacts on the environment. This can be achieved through the adoption of precision agriculture technologies, such as remote sensing and GIS mapping, to optimize crop management and reduce waste. Furthermore, the use of renewable energy sources, such as solar and wind power, can reduce reliance on fossil fuels and promote sustainable agriculture.

Biotechnology in Agriculture: Biotechnology has the potential to revolutionize agriculture by improving crop yields, enhancing nutritional content, and increasing resistance to pests and diseases. This can be achieved through the development of genetically modified crops and the application of biotechnology tools in breeding and plant transformation (Mehmood, 2021). Recent advances in biotechnology have led to the development of CRISPR-Cas gene editing technology, which allows for precise and targeted modifications of plant genomes. This can be used to improve crop traits such as drought tolerance, disease resistance, and nutrient utilization. Furthermore, biotechnology tools such as RNA interference (RNAi) and epigenetic modification can be used to enhance crop yield and quality. However, the use of biotechnology in agriculture is a controversial topic, with concerns over the safety of genetically modified organisms (GMOs) and their potential impact on the environment and human health. It is therefore important to carefully evaluate the risks and benefits of biotechnology in agriculture and develop appropriate regulatory frameworks to ensure their safe and responsible use.

Biomedical Engineering in Translational Medicine (BETRAM): STEM format of Medicine, BETRAM Developments and Courses

STEM Format of Medicine: Biomedical Engineering Formulation of Anatomy, Physiology, Medicine, and Surgery: Through biomedical engineering analysis of anatomical structures, physiological and organ systems, medical tests and surgical procedures, we have developed new insights in:

Anatomy, in how anatomical structures are intrinsically optimally designed for their function. For example, the left ventricle is shaped as a truncated ellipsoid with helically wound fibers; hence when it is activated, the helical fibers enable it to twist thereby facilitating its contraction and blood ejection.

Physiology, in quantifying physiological systems and developing indices for their function and dysfunction, leading to medical diagnostics. By biomedical engineering modeling of physiological systems, we can characterize normal and dysfunctional physiological systems which can make it convenient for medical diagnostics. For example, a left ventricle with myocardial ischemia cannot contract effectively and hence has poor ejection fraction.

Medicine, by developing biomedical engineering formulation of medical diagnostic and assessment methods and indices (including a new concept of non-dimensional indices inmedical assessment). For example, we can characterize a poor contracting left ventricle by means of an non-dimensional contractility index (Ghista, 2011).

Surgery, involving customized biomedical engineering analysis of surgical procedures (such as coronary bypass surgery) and design of prosthetic devices (such as artificial heart valves). For example, coronary arterial stenosis leads to poor perfusion of the left ventricle's myocardium, hence requiring coronary bypass surgery (COBS). Now the location and angle of graft anastomosis with the stenosed coronary artery influences the fluid dynamics in the anastomotic region. Hence, for longer term patency of the coronary bypass surgical procedure, it is better to carry out presurgical analysis of COBS for a patient, to determine the optimal graft-artery anastomosis design. Together, these approaches can provide a more rigorous and precision formulation of STEM format of medicine, which can be incorporated into the medical curriculum, and also be implemented in clinical care.

BETRAM: Medical Engineering Developments and Courses (5)
Herein, we are providing developments (and courses) in the medical engineering analysis of organ systems: cardiovascular system, pulmonary system, pancreatic system, renal system, orthopedic and spinal systems.

Cardiovascular Medical Engineering: Left Ventricular Wall Stress and Contractility Index, Vector Cardiogram and ECG Signal Processing, Coronary Blood flow and Myocardial Perfusion, Myocardial Infarct detection and Heart Failure, Intra-Ventricular Blood Flow and Candidacy for bypass surgery, Pulse wave velocity and Detection of Arteriosclerosis, Aortic Pressure Profile and Aortic stiffness determination, Coronary Bypass surgery design for maximal patency, Prosthetic Aortic and Mitral Valve designs.

Pulmonary Medical Engineering*:* Lung Ventilation modeling for Lung disease detection, Lung Ventilatory Index, Lung Gas Transfer performance analysis, Determination of O2 and CO2 Diffusion coefficients, Non-dimensional Gas-transfer index, Indicators for Extubation of Mechanically ventilated COPD patients.

Pancreatic Medical Engineering*:* Glucose-Insulin Regulatory Control systems, Oral Glucose Tolerance Test modeling and model parameters determination, Non-dimensional indices for glucose and insulin responses, Non-dimensional Diabetic Index for Diabetes detection.

Renal Medical Engineering*:* Kidney Functional analysis, Countercurrent mechanisms and modelling of urine concentration, Osmolality in the descending and ascending limbs of the Loop of Henle, compartmental model of renal clearance kinetics, Physiological measurement of the Glomerular Filtration Rate (GFR), Relationship between blood creatinine levels and the renal clearance rate, Renal clearance convolution analysis; Renography modelling and determination of normalized urine flow rate index to differentiate between obstructed and normal kidneys.

Orthopedic Biomechanics and Surgery*:* Osteoporosis Index for osteoporosis detection; Structural analysis of plate-reinforced fractured bone and Optimal design of fixation plate; Osteosynthesis using hemihelical plates for fixation of oblique bone fractures, Finite Element analysis and design of Bone-Plate assemblies and Helical Fixation plate.

Spinal Biomechanics and Surgery: Biomechanical Simulation of Scoliotic Spinal deformity and Correction, Presurgical Finite-element Simulation of Scoliosis Correction, Structural analysis of the Spinal Vertebral body as an intrinsically optimal lightweight and high-strength structure, Fractured Vertebral body fixation techniques and design of a vertebral body cage, Clinical Biomechanics of Spinal Fixation: Anterior, Posterior Fixations; Structural analysis of Intervertebral Disc as an intrinsically optimal minimally deformed structure under spinal loading, Nucleotomized Disc model analysis and solution for disc herniation.

Non-dimensional Physiological Indices in Medical Assessment (6):
We have developed a new concept of Non-dimensional Physiological Indices (NDPIs) or Physiological Numbers (PHYNs) based on

analysis of physiological systems and medical Tests' data, to provide precision diagnostics of physiological systems and diseases:

Cardiac contractility index (based on wall stress analysis of the left ventricle) to characterize poorly contracting heart and risk of heart failure.

Lung ventilation index (based on lung volume and driving pressure) to detect lung disorders such as emphysema and asthma).

Diabetes index (based on glucose-insulin system modelling of glucose response to oral-glucose-tolerance test), for accurate detection of diabetes.

Aortic stiffness index (based on pulse pulse-wave velocity determined by ultrasound) to noninvasively determine the arterialconstitutive property, to diagnose arteriosclerosis.

Mitral Valve elasticity index (obtained from first heart sound and echocardiography data), to be employed diagnostically to track the deterioration due to calcification of the mitral valve.

Bone osteoporosis index (obtained by modeling the ulna bone as a simplysupported vibrating beam, and determining its resonance frequency), to measure its flexural stiffness for detection of osteoporosis.

Hospital management Index (based on hospital departments' performance-cost indices, and optimizing hospital budget allocation) for maximizing patient care with cost-effective hospital operation.

What is needed for Medicine: precision diagnostics, customized surgery,and patency of implants. It is our objective to (i) make medicine more precise in its diagnosis, (ii) improve the outcomes of surgical procedures (by customized surgical procedures), and (iii) patency of implants and prostheses.

For this purpose, we need to make Medical Sciences more quantitatively precise, so that they can be translated into more reliable medical and surgical procedures. Now medical sciences, such as anatomy, physiology, biochemistry, microbiology, molecular biology, pharmacology are undergoing transformation into more scientific and mathematically oriented disciplines. For example, physiology can be taught as physiological physics, anatomy can be taught as anatomical engineering, biology subjects can be taught as systems biology and mathematical biology. In other words, we need to incorporate the full scope of STEM subjects into Medicine, into both medical sciences and clinical sciences, constituting

STEM^2: Science, Technology, Engineering, Mathematics, and Medicine.

Universities to provide Integrated education at the Undergraduate level, and New knowledge at the Graduate level: For this new era, we are outlining a new role for universities to provide (i) Integrated education at the Undergraduate level, and (ii) New knowledge at the Graduate level.

We are living in an era of Integrated Human knowledge and Education: Hence at the undergraduate level, students can have integrated education, involving (i) humanities and social sciences, of living values and perspectives of equity and inclusion, (ii) physical and life sciences,to learn about natural phenomena and living organisms, (iii) engineering,of systems and devices for human use in daily living, (iv) basic medical sciences, of functions and dysfunctions of physiological systems, and (v) mathematics and computer science, for a deeper understanding of the mathematical foundations of their subjects (such as engineering), and application of software and hardware for use of technology in all fields (including medicine). This Integrated Undergraduate Education can enable undergraduates to have more knowledgeable living, especially in understanding their health state and enabling better healthcare. Then, specialization can be done at the graduate level. This is verily the role of the university in this era, to serve as repositories of knowledge in all aspects of human living, promoting cosmic thinking, and educating the 'wholestudent' (combining academics with personal and humanitarian development).

At the Graduate level, universities need to provide new knowledge in many fields

Neohumanism, promoting higher dimension living, beyond narrow geo sentiments and socio sentiments, based on the book:

Neo-Humanism: Principles and Cardinal Values, Sentimentality to Spirituality, Human Society https://drive.google.com/ file/d/136v CGvz303rMMlsZVKnlBLy3N4D2IwaD/view?usp=sharing

People empowered Political Governance and Economic system (devoid of political parties), based on the book: Socio-Economic Democracy and the World Government, World Scientific, 2004). (https://drive.google.com/open?id=0BzOPlHbjWLYtUl93UTNRLTZ IUkE)

Cosmological Cycle, Universe development, and Life creation, based on the article: Consciousness and Evolution: Unified Theory of Consciousness, Matter and Mind, International Conference on Science of Consciousness, Stockholm, 2011 (https://drive.google.com/ file/d/1jOi PzoNJNmnLkToTqe CBt9zFCe169rvT/view?usp=sharing)

Organ Systems Engineering: engineering formulations of organ functions and dysfunctions

The book,Applied Biomedical Engineering Mechanics (CRC Press, Taylor and Francis, 2009). (https://drive.google.com/ open?id= 0BzOPlHbjWLYta3djeFV0MkRaMXc) propounds cardiological engineering mechanics, pulmonary engineering mechanics, glucose-insulin regulatory mechanics, orthopedic engineering mechanics, and sports engineering mechanics.

***STEM Model of Medicine, involving physiological engineering, medical engineering, and surgical engineering*:** (https://drive.google.com/file/d/1PgLsgjKAm_BeIFl1gclYf0tMxvxI3 Wae/view?usp=sharing) New Era of Integrated Biomedical Engineering and Medicine: STEM Model of Medicine (STEM^2), Part 2. Gateway to new format of Medical Colleges, *Pacific Journal of Medical and Health Sciences*, ISSN: 2456-7450, Vol.4, No.1, 2022, pp-01-09. (https://driv e.google.com /file/d/1qsw WgjQPrY20QeB31oU5Urnxpv4LmDw6/view?usp=share_link)

Engineering Science of Sports and Athletic Events, to educate scientific sports coaches: Sports Science and Engineering Program, by DhanjooGhista Analysis of Spinning Ball Trajectories of Soccer Kicks and Basketball Throws, Chapter 15, Applied Biomedical Engineering Mechanics, CRC Press, 2009. https://drive.google.com/file/d/1G_SFDACx7enPAAnlMzxI-qbN-BNoCGM4/view?usp=sharing

Yogapathy, a new format of mind-body medicine (relative to Allopathy) for both preventive and curative care: We are proposing a unique MD-PhD (Yogapathy) Program, to educate doctors in yogapathy medicine, based on the paper:

Yogapathy: Psychosomatic Preventive and Curative Medicine —The need of the day, *Pacific Journal of Medical and Health Sciences*, ISSN: 2456-7450 | Vol.4, No.2, 2022, P. 21-42(https ://drive.google.com/file/d/1-zjx2wKqygbKryYv v9zlgRQ xf3 8 ZHT6/view?usp=share_link)

This new knowledge in seven fields can together contribute to living values, better living standards, and progressive society building.

Concluding Remarks: Universities contributing to Living Values and Living Standards

Humanities and Law have a big role in shaping a progressive society: The study of Humanities offers students insight into the collective psychology of people, facilitating individual progress and contributing to societal progress. Law, on the other hand, helps to deal with existing or potential conflicts within society, based on prevailing social values. Both are critical to the functioning of society, facilitating progress and capable of providing a level playing field for equitable and inclusive growth and development.

STEM fields contribute to enhanced living standards and sustainable community development: STEM education isthe driving force behind innovation, technology, and scientific discoveries. We need to recognize that half of human knowledge is concerned with developments around us, and the other half of human knowledge is on developments within the human body.

The development of new engineering disciplines such as biomedical engineering, renewable energy, pharmaceutical engineering, agricultural and food engineering can provide innovative solutions for sustainable community development. Agriculture plays a crucial role in ensuring global food security and enhanced living standards. The implementation of agricultural engineering, integrated farming systems, and biotechnology can improve crop yields, enhance nutritional content, and increase resistance to pests and diseases. Additionally, it is important to address issues such as soil salinity, water scarcity, and climate change to promote sustainable agriculture and ensure the availability and accessibility of food for future generations. The successful implementation of all these technologies and disciplines requires the collaboration of scientists, engineers, and policymakers to ensure their productive use for human living.

We have developed a new concept of STEM^2: STEM^{2}stands for Science, Technology, Engineering, Mathematics, and Medicine. Hence STEM^2 education integrates total human knowledge, which is essential in today's world. This is verily the era of comprehensive universities, including medical schools. In fact, some basic medical science and healthcare knowledge needs to be provided to all students as part of core undergraduate education.

CONCLUSION

Higher Education 4.0 presents both challenges and opportunities for universities in this 21st century. While the integration of advanced technology and digitalization has the potential to transform teaching and learning, universities can also use their power to promote social and economic development and challenge dominant economic and political structures. By doing so, universities can play a crucial role in building a more equitable, just, and progressive society. In parting, we want that everyone can live in peace and harmony, everyone can have unbarred opportunities for all-round development and for contributing to mutual welfare, everyone can move together in unison to the pinnacle of human existence and cosmic desideratum. We feel committed to ushering such anenlightened global order and era.

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