IASIEM Education: Integrated Approach to Science, Engineering and Medicine, for Advanced Knowledge, Healthy Living and Society Building

by Prof. Dhanjoo Ghista
President, University 2020 Foundation, Northborough, MA, USA; Website: www.dhanjooghista.com ; Email: d.ghista@gmail.com

Contents:

I. Vision and Theme of IASIEM Education—for Advanced Knowledge Community Infrastructure, Healthy Living, and Society Building:

Science, Engineering and Medicine play a vital role in human comfort. Science and Engineering are all around us, and Medicine is working for us. For our living comfort, we are continually learning and utilizing (i) Science disciplines, such as physics of weather forecasting and medical imaging, chemistry of food digestion and drug action on the body, biology of our DNA and environmental protection for healthy living, mathematics analysis of physical-chemical-biological systems to develop precise solutions and outcomes; (ii) Engineering disciplines , such as building structures, electricity and water supply, rail and air services, solar panels for homes and electric cars; (iii) Medicine disciplines, such as knowing and regulating our blood pressure, cholesterol and glucose, understanding diagnosing and treating organ dysfunction and diseases at cellular and molecular level, as well as technical medicine of designing customized 3-d printed prosthetic limbs to provide mobility for the handicapped.

Integrating science and engineering into medicine has contributed to more intricate knowledge of disease processes, development of more precise diagnostic systems, personalized treatment and gene therapy, design of customized prosthetic devices, and even planning of patient-specific surgical procedures. In fact, we are now entering a new era of educating technical-medical

professionals, who can improve patient safety, provide more reliable diagnosis and treatment through the innovative use of medical technology in more direct patient care. This is what IASIEM Education is promoting.

Now we are also introducing three new fields, in (i) Science: Mindsci, science of mind development, (ii) Engineering: Govening, engineering of city and state governance administration, and (iii) Medicine: Regemed, regenerative medicine. Together, all these integrated disciplines constitute IASIEM, integrated approach to science, engineering and medicine learning.

In our University and College Education, we need to inculcate:

1. the concept of Thematic Education, by promoting a broad spectrum of Liberal Arts and Science Curriculum, to educate inspired and holistic students and build for them a mind-opening life-long foundation of learning and creativity;
2. a broad Vision on the roles of the various Disciplines (including Humanities) in educating the *whole student*;
3. IASIEM Education, to provide an interdisciplinary and transdisciplinary approach to learning across academic disciplines, wherein academic concepts are coupled with real-world problem-based learning.

II. Embarking on an Inspirational Education Odyssey:

We are embarking on an exciting odyssey in education, to teach students how to enjoy learning, be creative and want to learn more and more. It is in universities and colleges that we plant the seeds of the quest for life-long learning. Societal culture is shaped in universities and colleges, to influence the values and the norms of the society. Hence, University and College Education is the most important phase of one's life. In constituting the foundation of societal building, University and College Education programs can help to build the character and personality of the student. At the end of this education odyssey, students are to be ready to recognize where they want to work, and what can be their role in promoting a healthy and caring society for the common good.

To this end, universities and colleges need to promote a broad curriculum representing humanities & social sciences, physical & biological sciences, mathematical & computer sciences, engineering & technology, medical & health sciences, management science, and even sports science & engineering. Humanities and Social Sciences courses can help to build ideas and values of the society, and make students humanitarian. Physical and Biological Sciences courses develop insights into natural phenomena and life processes; physics, chemistry and biology are functioning all around us and also govern our body function processes; now our new 'Mindsci' field can be developed to learn about mind function and its development. Engineering and Technology courses provide knowledge of the community infrastructure for our daily living, and how engineering innovations have made our life comfortable. Physiology and Medical Sciences courses provide knowledge of body function, diagnosis and treatment for organ dysfunction and diseases, for maintaining good health; now the new 'Regemed' field can be developed to enable biological regeneration and disease curing through gene therapy and even meditation; 'technical medicine' can enable development of customized prosthetic limbs and artificial organs as well as surgical procedures. Economics and Political Sciences courses teach

us about governance and measures for economic sustainability. Management has a wide arena from hospital healthcare management to city budget management for economic sustainability; now our new 'Govening' discipline can be developed to incorporate systems engineering and operations research into city and state budget planning for sustainable economic development. Finally, Sports Physics enables us to understand and appreciate various sports and athletic performances, ranging from cricket reverse swing bowling and football curving kicks to tennis serve techniques and intricacies of pole vault. All of this constitutes our inspirational Education Odyssey.

III. IASIEM Education in the 2020 Era:

The Education Odyssey opens the student minds into a wide arena, and teaches them how to think divergently. Now the jobs and demands of the future will be dictated by the biggest problems that the world faces: health and wellbeing, food and water supply, urban and rural infrastructure development, climate change and renewable energy. No matter whether the technology or solutions exist today or must be developed, the skills that will be in most demand will be connected to finding the best solutions to the above problems. Scientists, Engineers and Doctors will be addressing a lot of these problems, and this brings us to the IASIEM field. In this 21st century, we need to offer our students education and learning in a wide range of the IASIEM field, involving (i) physical, biological and mind sciences, (ii) engineering and technology, (iii) medical sciences and clinical sciences as well as (iv) cosmology, universe & life origin, (v) city and hospital management, and (vi) sports physics and engineering.

Let us start with Calculus, but call it as the 'Calculus of Knowing'. The remarkable progress that has been made in science and technology during the last century (and especially in the last decades) is due in large part to the development of mathematics. In mathematics, calculus serves as a natural and powerful tool for attacking all problems that arise in physics, chemistry, biology, geology, astronomy, engineering, physiology, medicine, and even economics and administration of cities and states. Calculus enables us to quantitatively formulate physical and biological processes leading to technical & computational medicine, and has now even led us into the new Precision Medicine era, of being able to (i) more accurately diagnose disease and organ dysfunction, (ii) design 3-d printed prosthetic limbs, and (iii) even carry out patient-specific analysis of surgical procedures in order to achieve the beat outcomes.

IASIEM education encompasses learning about everything that is happening around and within us, what we are employing for daily living, and to even understand biological and physiological process for creating technical and mathematical medicine for more precise diagnosis and treatment. IASIEM Education Odyssey involves teaching students concepts involved in (i) formulations of physical, biological and mind processes, (ii) designing electric cars and aircrafts, and high-speed transportation systems, (iii) city infrastructure design, (iv) analysis of body structures and physiological processes, and regeneration of body tissues by stem cell therapy, (v) formulation of the physical universe from Consciousness, and entry of microvita into the mind and body cells, (vi) perfecting sports maneuvers, such as how kicking spin on the football enables the ball to curve into the corner of the net to score a goal.

IV. Sample Courses, emphasizing integrated approach to IASIEM learning:

1. Physics with Applications (in Engineering, Physiology, Sports and Medicine):

This Course involves concepts and formulations of Physics disciplines and their applications to engineering, physiology, sports and medicine. The physics topics of study include: (i) Statics and Motion analysis of jumping, walking and running, ball throwing and kicking; (ii) Work, Energy and Power, with application to energetics of pole vault; (iii) Mechanics of forces on structures, including musculo-skeletal structures; (iv) Linear and Angular Momentum, with applications to baseball batting and figure skating; (v) Simple and Compound Pendulum motion, with application to optimal frequency of jogging and running; (vi) Heat and Thermodynamics, with application to heat and body temperature regulation; (vii) Fluid Mechanics of inviscid and viscous fluid flow, flow through pipes and blood vessels; (viii) Waves Motion: sound waves and auditory mechanism, wave properties of light, X-Rays, (ix) Electricity: electric forces, fields and potentials, with applications to electrical fields in cell membranes; (x) Nerve conduction: ionic potential and resting potential, action potential propagation, axon analog circuits to determine response of an axon to stimulus; (xi) Atomic Physics: quantum mechanics, structure of matter and NMR imaging; (xii) Nuclear Physics: nuclear forces, nuclear fission and fusion, ionizing radiation, radiation detection and measurement in medicine.

2. Biochemistry:

This course involves the study of chemical processes within and relating to living organisms, involved in the flow of chemical energy through metabolism. The course deals with the following topics: (i) Functions and interactions of Biological molecules, such as proteins, nucleic acids, carbohydrates and lipids, which provide the structure of cells and perform many of the functions associated with life processes; (ii) DNA, genetics and reproduction, energy chemistry of living things, respiration processes, photosynthesis; (iii) Bioenergetics, enzymes, and metabolic pathways as interacting regulated systems; (iv) Enzymology, special properties of biological membranes, hormones, vitamins, and metabolic pathways; (v) Cellular processes in terms of protein structure and regulation of gene expression: transcriptional initiation, to RNA processing, and to the post-translational modification of a protein.

3. Quantitative Physiology (based on Physics and Engineering Principles):

This Course involves study of Human Physiology based on Physics and Engineering formulations of physiological processes: (i) Musculo-Skeletal System: body statics and motion, materials properties of the body, muscle function and forces in the musculo-skeletal structures; (ii) Body Metabolism: energy, heat, work and power of the body; (iii) Heart and Cardiovascular system: electrical conduction system in the heart myocardium, passive and active wall stresses in the heart wall, work done by the heart, blood pressure and flow in the circulatory system; (iv) Respiratory System: Lung ventilation, gas flow and exchange, work of breathing; (v) Renal System: countercurrent multiplier processes in the loop of Henle and urine concentration mechanism; (vi) Hearing System: physics of sound, speech production, hearing mechanism; (vii) Vision System: eye structure and image formation, vision correction by glasses; (viii) Nervous System: electrical properties of body cells and tissues, electrical conduction system in nerve axons.

4. Biomechanics (of Orthopedic and Cardiovascular systems):

This Course deals with the study of the disciplines of Solid Mechanics and Fluid Mechanics and their applications to study the Orthopedic musculo-skeletal system and the Cardiovascular system. Topics covered include (i) Orthopedic Mechanics of Body Limb and Spinal structures, to

determine muscle forces, joint forces, and forces in spinal structures; (ii) Cardiac Mechanics of the function of the heart chambers, determination of stresses in the LV wall and cardiac contractility index; (iii) Circulatory system modeling of flow in blood vessels.

5. Introductory Engineering (with Applications in Anatomy and Physiology):
Mechanical Engineering:
Statics and Dynamics, Simple machines, Forces on Structures, Structural Mechanics of bending and torsion, Musculo-Skeletal and Joint Structures analysis; Mechanical Energy, Work and Power, Newton's Laws of Motion and Equations of Motion; Solid Mechanics: Stresses in pressurized spherical and cylindrical bodies, stresses in heart wall; Fluid mechanics: Continuity equation, Bernoulli's equation, Poiseuille's law for viscous flow, Blood Flow in Arteries; Vibrations of undamped and damped single degree-of-freedom systems.
Electrical Engineering:
Basic Concepts: Charge, Current, Voltage, Power and Energy; Models for Resistors, Capacitors, Inductors; Measurements of voltage and current; Analysis of Circuits with resistor-inductor-capacitor, Kirchhoff's Laws, Network Theorems; Electrical Forces, Fields and Potentials, with applications to electrical charges in cell membranes; Nerve Cells and conduction: Resistance and Capacitance of an axon, Ionic and Resting potentials, Action potential and propagation; RC circuits to simulate response to nerve stimuli.

6. Science of Mind (Mindsci) and Meditation (for Good Health and Cognitive Development):
Yoga Meditation is a holistic practice which emphasizes mind-body connectedness. Meditation research has linked the practice to everything from improved cardiovascular health to cognitive benefits. MRI scans of meditators have shown increased brain gray-matter density, known to be important for learning and memory. Meditation on Consciousness draws microvita into the mind, to promote its development, and liberate it from its embedded impressions or samskaras. Meditation on cakras by means of mantras (having the ideation of consciousness), energizes them to help (i) overcome psychic propensities, and (ii) heal organ systems through the hormonal secretion of endocrine glands associated with the cakra-endocrine system pathways. This combined process leads to enlightenment of the mind, psychic elevation, and biological regeneration. Intensive research on the science of these mechanisms is now a top priority. This course provides introduction to the science of meditation, teaches the practice of meditation, and also gets students to themselves monitor the effects of meditation on their autonomic nervous system by monitoring their heart rate, breathing rate and blood pressure, and even having their EEG taken and analyzed, to see how meditation promotes relaxed state of mind and wellbeing.

7. Calculus, with Applications in Cardiology:
This Course covers (1) differential and integral calculus with applications to determining (i) the rate of change of left ventricular (LV) pressure as a measure of its contractility, volumes of heart chambers, rate of filling and emptying of LV, and cardiac output, from imaging data; (2) first-order differential equations for modeling (i) a patients' performance in treadmill test for cardiac assessment, in terms of heart-rate response to exercise, and employing it to formulate a cardiac fitness index, (ii) a patient's heart function in terms of left-ventricular pressure response to volume filling and LV volume response to pressure during LV ejection, to determine LV stiffness and contractility in health and heart failure.

8. Sports Physics and Engineering:
Sports Physics deals with the analyses and mechanisms of sports plays and maneuvers, such as soccer corner curving kicks, baseball pitching, football quarterback passing, hockey dribbling, tennis serves, high jump and pole vault. Sports Engineering deals with the design of sports equipment, such as design of cricket bats, hockey sticks, tennis racquets, and sports protection gear. Some of the topics that we can elaborate in our Teaching, are: 1. Football: Mechanics of the Spinning ball kick, based on the lateral force acting on the spinning ball; Computing the curved trajectory of a spinning football kick, into the corner of the net. 2. Cricket: physics mechanics of swing and reverse swing bowling—involving aerodynamic forces acting on the ball in flight, and flight trajectories; Biomechanics of batting: Bat-ball collision mechanics, maximum energy transfer area and batted-ball speed area. 3. Mechanics models to (i) study kinetic-to-potential energy conversion in maximizing pole-vaulting height, (ii) analyze discuss throw, in order to study the influence of disc spin-speed and moment of inertia on the performance, (iii) analyze javelin throw, in order to analyze the influence of javelin inclination and throw angle on the performance. 4. Determining the Optimal Long-distance Running Mode of an Athlete: This is based on the Double-Compound Pendulum model of the athlete's lower limb pivoted at the hip joint, involving the athlete's limb properties (mass and moment of inertia); analysis of the sinusoidal oscillations of the limbs yields the natural frequencies, from which we can determine the natural stride frequency of the athlete; this stride frequency is optimal for the athlete's performance. 5. Cricket Bats Design Analysis: The optimal design of cricket bats contribute to the maximum momentum transfer to the ball and minimal reaction forces on the arm joints; by modeling the limb-bat motion and simulating it with the monitored motion, we can optimize the bat's design parameters (mass, center-of-gravity, shape parameters, and sweet spot) to maximize the energy imparted to the ball and minimize the joint forces. This Program addresses the needs and interests of sports coaches and managers, and design of sports equipment.

9. Great Inventors and Inventions:
This Course is on some of the great Inventors who changed the world by their Inventions: Sushruta (who lived during 600 BCE) was an Indian surgeon and ophthalmologist who invented cataract surgery performed with a special tool called the jabamukhi salaka, a curved needle used to loosen the lens and push the cataract out of the field of vision. Aryabhata (476–550 CE) was an Indian mathematician and astronomer, famous for his works of Āryabhaṭīya and Arya-siddhanta, involving Mathematics (place value system and zero, approximation of π, trigonometry, algebra, Indeterminate Equations) and Astronomy (motions of the solar system, eclipses, sidereal periods, heliocentrism). Varāhamihira (505–587 CE) was an Indian astronomer, mathematician and astrologer, renowned for his works of Pancha-Siddhantika (on mathematical astronomical treatises), Brihat-Samhita (encyclopedia covering astrology, planetary movements, eclipses, rainfall, clouds, architecture, growth of crops, manufacture of perfume, matrimony, gems, pearls), and Astrology (covering the main branches of Jyotisha astrology). Leonardo da Vinci (1452-1519) was an Italian polymath and the epitome of a 'Renaissance man', who studied the laws of science and nature, which greatly registered his inventions, painting, sculpting, architecture, science, music and mathematics. Benjamin Franklin (1706-1790), one of the Founding Fathers of the United States, was a polymath renowned for his discoveries and theories regarding electricity, inventions of lightning rod, bifocal glasses and the

Franklin stove. George Stephenson (1781-1848) was an English civil engineer and mechanical engineer, who built the steam locomotive and the first public inter-city railway line in the world to use steam locomotives. Karl Friedrich Benz (1844-1929) was a German engineer, generally regarded as the inventor of the first automobile powered by an internal combustion engine and the first practical gasoline-powered automobile. Alexander Graham Bell (1847-1922) was a Scottish scientist, who invented the first practical telephone and did important work in communication for the deaf. Thomas Edison (1847-1931) was an American inventor, who developed many devices that greatly influenced life around the world, including the phonograph, the motion picture camera, and the electric light bulb. Jagadish Chandra Bose (1858 –1937) was an Indian Polymath, Physicist and Biologist, who (i) pioneered the investigation of radio and microwave optics, using semiconductor junctions to detect radio signals to demonstrate wireless communication for the first time, and (ii) also made a number of pioneering discoveries in plant physiology, using his own invented crescograph to measure plant response to various stimuli, and thereby scientifically proved parallelism between animal and plant tissues. The Wright brothers, Orville (1871 – 1948) and Wilbur (1867 –1912) were aviation pioneers, who are credited with inventing and building the world's first successful airplane and the first practical fixed-wing aircraft. Sir Alexander Fleming (1881 –1958) was a Scottish biologist, pharmacologist and botanist, who is best known for his discoveries of enzyme lysozyme in 1923 and the antibiotic substance benzylpenicillin (Penicillin G), for which he shared the Nobel Prize in Physiology or Medicine in 1945. Chandrasekhara Venkata Raman (1888 –1970) was an Indian Physicist, who won the Nobel Prize for Physics in 1930 for his pioneering work on scattering of light; he also worked on the acoustics of musical instruments, and was the first to investigate the harmonic nature of the sound of the Indian drums such as the tabla and the mridangam.

10. Hospital and Healthcare Management Program:

There is a big need for affordable and effective healthcare delivery by healthcare organizations and hospitals. This MBA Program is designed to educate and train healthcare and hospital administrators with the competency to (i) to develop cost-effective healthcare systems, and manage hospital operations in interaction with clinicians, and (ii) enhance the overall quality and efficiency of healthcare delivery. Graduates from this program can qualify for positions as hospital administrators in healthcare organizations and hospitals throughout the country.

The Program consists of Foundation courses in Management Science as well as Specialized courses in: (i) Hospital Services, (ii) Hospital Operations Management, (ii) Safe Patient Handling practices, (iii) Hospital Operational Efficiency for Patient-centered Care, (iv) Optimizing Hospital's Bed-occupancy and Patient Flow, (v) Hospital Departments' Performance Indices, (vi) Integrated Cost-Performance Indices of Hospital Departments, (vii) Hospital Budget Management: to formulate how a hospital budget can be optimally distributed, such that we can determine the Resource index for all the Departments to obtain acceptable values of their Performance indices and Cost-effective indices. This constitutes an in-demand Program for engineering and business students who want to work as hospital and healthcare administrators.

11. City and State Governance and Administration Program:

The Governance and Public Administration Program is designed to provide Post Graduate education and training programs in City and State Governance policies and administration, by means of knowledgeable budget planning to meet the needs of all the public sectors, towards sustainable economic development. The Master's and PhD Program in City and State

Governance and Administration can contribute to the development of a knowledgeable governance and infrastructure framework to provide economic stability and sustainability through efficient budget planning, by employing systems engineering and operations research methodologies to optimally distribute the budget allocations among the various public sectors, such as education, healthcare, infrastructure development, public transport and public security. This can lead to the design of economically sustainable urban-rural communities. The theme of this novel Program is to help cities and states to develop knowledgeable governance policies and administration in terms of budget planning methodology and technology, in order to provide economic stability and sustainability.

12. Mathematical Analysis of Physiological Non-dimensional Indices in Medical Assessment:

For Quantifying Physiological Systems and Analysing Medical Tests' Data, we have developed a new concept of Non-dimensional physiological indices (NDPIs) or Physiological numbers (PHYNs) for qualifying physiological dysfunction and diagnosing disease. In physiological medicine, the use of NDPIs can provide a systematic approach by which integration of a number of parameters can be combined into a NDPI, to characterize an abnormal pathological state associated with a particular organ or physiological system or an anatomical structure. For example, in Cardiovascular flow, the Reynold's number N_{re} is employed to characterize the conditions when laminar blood flow changes to turbulent flow, such as in the ascending aorta when the aortic valve is stenotic (giving rise to murmurs). In Medicine, NDPIs can be employed to (i) determine the functional performance of the heart by means of a novel Contractility Index, in terms of the normalised wall stress of the LV with respect to LV chamber pressure; (ii) reliably diagnose Diabetes by formulating the Oral-glucose tolerance test data in terms of a second-order differential equation (Deq) governing blood-glucose response to oral ingestion of glucose bolus, and combining the parameters of the Deq into a Diabetes Index, whose ranges of values can enable diagnosis of diabetes and even risk of diabetes; (iii) characterize arteriosclerosis by formulating a Deq of the aortic pressure response to aortic inflow-rate (or LV outflow-rate), in terms of the aortic volume elasticity and peripheral resistance, and combining these parameters into an Aortic Index (Aind), whose distribution in patient population enables diagnosis of vasoconstriction associated with low range values of Aind, arteriosclerosis corresponding to high range values of the index, with the middle range values representing normal healthy aorta; (iv) reliably detect heart dysfunction from Treadmill Test, by formulating a Deq of the subject's heart rate response to work load during exercise and after getting off the treadmill, and combining the Deq parameters into a Cardiac Fitness Index whose low range values are associated with heart dysfunction.

13. Biomedical Engineering:

Biomedical Engineering bridges engineering and medical disciplines to provide new insights in medicine and healthcare. The Curriculum consists of:

Fundamental Courses in Biological Physics, Quantitative Physiology, and Basic Engineering: Physics in Biology and Physiology, Quantitative Physiology I (Cells and Molecules); Transport Processes, Mechanics of Materials, Electrical Engineering and Circuits; Quantitative Physiology II (Organ Systems), Fluid Mechanics, Medical Electronics.

Biomedical Engineering Courses: Biomaterials, Cellular and Tissue Biomechanics, Biofluid Mechanics, Biotransport processes, Musculoskeletal Biomechanics; Cellular and Molecular

Engineering, Pharmaceutical Engineering: Drug designing, producing and delivery Systems; Bioelectrical Processes, Physiological Control Systems, Tissue Engineering and Regenerative Medicine; Physiological Signals and Processing, Medical Image Processing and Pattern Recognition, Medical Instrumentation; Orthopedic Biomechanics, Cardiac Bioelectro-Mechanical Engineering, Cardiovascular Hemodynamics.

14. Computational Orthopedics:

This course deals with biomechanics of skeletal & spinal structures and fractured bone-plate assemblies. It consists of the following modules: 1. Biomechanics: Elasticity theory, Mechanical loadings, Stresses in structures under axial-torsion-bending loading; Mechanical properties of bone, Bone stresses and fractures under physiological loading conditions; Enhanced bending and torsion capacities and strength of hollow bone structures; Determining ulna stiffness to detect osteoporosis. 2. Skeletal and Spinal Structures' Biomechanics: Structural analyses of foot, tibia, femur and arm under physiological loading, to determine the joint reactions and stresses in the bone; Spinal Vertebral Body's intrinsically optimal hyperboloid structure to bear the stresses due to applied axial-torsion-bending loading with maximum strength and minimal weight, Spinal Intervertebral Disc's intrinsically optimal structural design to bear spinal loading with minimal deformation; 3. Design of Bone-Plate Assemblies for Fractured Bones: Structural Analysis of Plate-Reinforced Fractured Bone under bending, to determine the stresses in the bone and plate (using composite beam theory) and the forces applied by the screws, and to determine the optimal number and placing of the screws, Hemihelical Plate design and screws placement to provide optimal osteosynthesis and strength to the spirally fractured bone (such as the tibia) under torsional loading (such as sustained in sports injuries).

15. Computational Cardiology:

This Course constitutes an exciting train ride through the Heart and into Blood Flows within its left ventricular chamber, the coronary tree, the aorta and finally into the coronary bypass grafting. The train starts from the Central station of the Heart, and we are treated to the fascinating scenery as it journeys through the stations of heart wall stress, cardiac contractility measures, active stress generation and setting up the systolic heart pressure for cardiac output, cardiomyopathic heart remodeling and decreased contractility, and into the theory of ECG and vector cardiogram derivation and medical applications. Finally we reach the Junction of Blood Flows into the Heart Chamber and the Coronary Tree.

At this Junction, we get down and take another train. We first travel into the left ventricle chamber to witness the amazing intricate intraventricular flow patterns which constitute the outcome of heart contractility. Then we see how the pressure pulse wave propagates into the aorta, and into its branches. We then climb into the mountainous coronary tree, and look at the fascinating scenery of coronary flows and myocardial perfusion which governs cardiac contractility. Finally we arrive at coronary bypass grafting, and can see how it has been modernized by the new sequential graft-artery anastomosis design. This is indeed a fascinating journey, and we can appreciate how it is transforming cardiology and taking it into the era of computational cardiology.

V. Global Education Academy, to promote global citizenship and harmony:

The Global relationships among world regions, (iii) international understanding, tolerance and empathy, and (iv) to appreciate that all nations have a stake in promoting happy living for their people. This is how we can prepare our students to develop concern for people in countries world-wide and grow up into global citizens, filled with noble ideals, compassion and cooperation, and supra-aestheticism. Education Academy in Colleges can will help to promote global awareness, towards ushering a new era of global understanding and peace. Global education involves teaching our students (i) knowledge of world cultures, (ii) the historical and cultural, economic and political

---

Announcement: Universities and Colleges (including IITs, NITs, AIIMSs, NITTTRs) interested in developing Programs in IASIEM Education, Biomedical Engineering and Computational Medicine are welcome to contact Prof. Dhanjoo Ghista at d.ghista@gmail.com .