Innovative Approaches in Engineering Education – An Indian Perspective

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ABSTRACT

Education is aimed at imparting or acquisition of knowledge i.e. awareness and understanding of factual (qualitative or quantitative) information about matters of relevance, over a period of time through logical stages. Engineering education is distinctly different in its scope, philosophy and execution than that for subjects related to science, commerce or humanities. However, engineering is founded on scientific principles devoid of emotive, parochial or historical issues. Yet engineering has distinctive flavor. If science is driven by pure curiosity 'why', engineering emerges from an urge to replicate an object, phenomenon or process, and technology takes engineering to the level of successful commercial exploitation for the benefit of mankind. Therefore, engineering education must build on relevant scientific theories and principles to address the issues of 'need' of the society; e.g. high strength material, greater thermal/electrical conductivity, affordable health care, sustainable energy resources, remedial measures for carbon footprint, efficient devices/machines, etc. The need can often be complex (lab-on-chip), conflicting (hard yet tough), centuries old (cancer drug), and even stretching the limit of imagination (mystery of the universe). It is for this reason, challenge in engineering and technology is inexhaustible, particularly when translation of science to engineering and eventually to viable technology is keenly awaited.

Engineering education is seldom successful in conventional pedagogic style – lecture, monologue, text books, notes, examination, and degree. The best innovative minds are often attracted to engineering tempted by challenges that can make them rich, famous, even immortal. Engineering education must do justice to this canon. Fortunately in India, the most talented youth throng engineering or medicine. Although this trend is primarily related to the urge for securing better livelihood (high paying jobs) than pure love for engineering, the ones who join engineering, particularly in the IITs (Indian Institutes of Technology) are certainly better performers at the high school level as they come through possibly the toughest entrance examination in the world at this level (success rate is 1 in 100). It is not easy to do justice to a given curriculum within the stipulated time and yet be enough innovative to satisfy their intellectual demands.

In the present talk, the author wishes to introduce some of the innovative approaches designed and practiced by him or his colleagues at IIT Kharagpur and Kanpur for teaching primarily Materials Engineering related courses. These approaches are based on: (i) project based learning (individual/group), (ii) learning through real time problem solving (individual/group), (ii)

why does the alternative solution fail (explain why age old solutions or models cannot be easily replaced), (iv) history of material/component evolution and its impact on society (motivation to successful design), (v) group discussion and term paper. Besides these, supplementary innovative approaches, which are bound to make engineering education more effective and universally appealing, are: (a) animation and videos, (b) simulation and modeling, (c) reverse engineering, and (d) tinkering to explore new engineering designs and processes. The talk will also include data and statistics about Indian Engineering Institutions and their current status.

About the speaker:

Professor Manna, currently the Director of IIT Kanpur, is an educationist and materials engineer with wide ranging research interests covering structure-property correlation and modeling in nanometric metals and ceramics, laser/plasma assisted surface engineering, nano-fluid and bainitic steel. Before moving to IIT Kanpur, he headed Central Glass and Ceramic Research Institute, a CSIR laboratory in Kolkata. Earlier, he taught subjects related to Physical Metallurgy at IIT Kharagpur for 25 years (1985-2010) including one year at Nanyang Technological University in Singapore. He received his bachelor's degree from Calcutta University (1983), master's degree from IIT Kanpur (1984) and Ph.D from IIT Kharagpur (1990). While serving at IIT Kharagpur, he worked as a guest scientist in different renowned Institutions/Universities abroad like Max Planck Institute at Stuttgart, Technical University of Clausthal, Liverpool University, and University of Ulm. Prof Manna has over 250 journal publications, supervised 16 PhD thesis, completed over Rs 16 crore worth sponsored research at IIT-Kharagpur and received several awards including Humboldt and DAAD Fellowship, GD Birla Gold Medal of IIM, Platinum Jubilee Medal of ISCA, INSA Young Scientist Award, Young Metallurgist and Metallurgist of the Year. He was an INAE Distinguished Industry Professor (2007-09), President of the Materials Science Section of Indian Science Congress (2009-10) and INAE Visvesvarya Chair Professor (2009-11). He is a Fellow of INSA-New Delhi (FNA) INAE-New Delhi (FNAE), IAS-Bangalore (FASc), NASI-Allahabad (FNASc), and IIM, IE(I), EMSI, WAST. Currently, he is a J C Bose Fellow of DST (2012-17).