Research Article Impact Factor: 0.621 ISSN: 2319-507X
Indrajit Sangole, IJPRET, 2014; Volume 2 (9): 65-71 IJPRET

INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

A PATH FOR HORIZING YOUR INNOVATIVE WORK

THE EVOLUTION, THE NEEDS AND THE CHALLENGES

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Accepted Date: 27/02/2014 ; Published Date: 01/05/2014

Abstract: Mechatronics is a rapidly developing discipline. Despite its short period of existence it has created a substantial contribution on our everyday life. However, Mechatronics Engineering course did not achieve its uniqueness. It needs more and more research, and a lot of efforts to draw the skeleton of its course structure. Mechatronics engineering courses at undergraduate and graduate levels, as well as vocational training courses are rapidly increasing across the world. Philosophy and structure, of such courses divert from the classical single-discipline engineering programs and induce a challenge for the higher education institutions. Different institutions in various countries are reacting differently to this challenge but, all are aiming at educating mechatronics engineers. Mechatronics should be seen to represent a synergy and fusion of technologies, and should be regarded as a philosophy supporting new way of thinking and innovation. Thus, Mechatronics engineer identifies with systems thinking, and the philosophy that lies behind it. Mechatronics represents a unifying paradigm that integrates, permeates, and comprehends fundamental and modern engineering. It concentrates on achieving the necessary synergy right through from the conceptual stages of the design process. The growth of interest in Mechatronics has identified a need for the provision of engineers whose education and training enables them to operate in an interdisciplinary manner.

Keywords: Mechatronics, Vocational Training

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Access Online On:

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How to Cite This Article:

Indrajit Sangole, IJPRET, 2014; Volume 2 (9): 65-71

PAPER-QR CODE

INTRODUCTION

Most engineered products or processes have moving parts and require manipulation and control of their dynamic constructions to a required accuracy. This may involve a combination of the enabling technologies such as sensors, actuators, structural mechanics, electronics, microcontrollers, software and control engineering, neural networks, fuzzy logic, and active materials. A key factor in the mechatronics philosophy is the integration of microelectronics, computing, and control into mechanical systems, so as to obtain the best possible design solution and a product with a degree of intelligence and flexibility. Design of such products and processes, therefore, has to be the outcome of multidisciplinary activity rather than an interdisciplinary one and must address other factors such as appropriateness. In all cases it is of paramount importance that the adoption of a mechatronics design approach should have some added value. This may either be in terms of added functionality for the same price or a reduced price for similar functionality when compared with a product produced by a more conventional approach. Mechatronic design philosophies and concurrent practices for achieving the physical embodiment of those designs are seen as an appropriate response to the challenge. The adoption of such philosophies begin nigh at conceptual design level requires engineers with a new range of skills and attitudes and with a concomitant stimulus to the providers of training and education. Universities and colleges are currently reacting to the challenge in their own different ways. Some higher education institutions in various counties are reachting to the challenge of educating mechatronics engineers of the future [1]. Nevertheless, The author suggests that a sound mechatronics engineering program should have the following features. 1) The program suggests duration should be longer than a typical single disciple engineering program to enable the coverage of both breadth and depth of the essential mechanical, electrical/electronic and computing subjects. 2) An integrating thread of practical analysis and synthesis projects should run at every level throughout the program. A combination, without integration, of suitable mechanical and electronics engineering and computing course would not be suitable. 3) Mechatronics philosophy should be continuously taught throughout the program. There should be structured and open ended practical laboratory work to develop the necessary practical skills. 4) Effective communication skills and ability to work in teams are essential skills and should be developed to a professional level. 5) Input from industry in the form of real life design and development projects and supervision of such projects by experienced engineers is highly desirable. [2]

MECHATRONICS AS DISCLIPNE

The term "Mechationics" first introduced by a Yasakawa Electric engineer in 1969 soon became popular in industry. A technical committee on mechatronics, The International Federation for the Theory of Machines and Mechanism (IFTMM), provides a good definition of mechatronics: "Mechatronics is the synergistic combination of precision mechanical engineering, electronic control, and systems thinking in design of products and manufacturing processes." This definition helps to steer the philosophies of mechatronics technology, including. development, design, and manufacturing. With increasingly liberal use of the term, mechatronics, three is a need to encompass mechatronics products excluded from the above IFTMM definition. Some critical characteristics of IFTMM definition, such as the synergistic combination of mechanical and electronic engineering seem lacking in numerous mechatronics products the range from digital watches to electronic robots. A classification based on product configuration concept may extend the IFTMM definition. [2]

MECHANICAL DESIGN IN MECHATRONICS

Nearly everyone who has taught, or taken an engineering course on the subject of mechatronics quickly comes to the same conclusion: The design and implementation of Mechartonic systems is a highly satisfying process in which practitioners balance analytical skills with craftsmanship and creativity. There is undeniable fascination with the process of having computer control of physical system. There is also a 'snowballing' effect the takes place over the course of a typical semester as students realize that they can understand much of the textbooks and popular books written in this area and therefore teach themselves. A mechatronics course with little or no mechanical design component can be highly rewarding, effective and appropriate. If this is the case however, the true potential of mechatronics is being missed [4] While no one can argue that the creative process known as design is not an important part of nearly all mechatronics courses, there is very little of the traditional mechanical design experience incorporated into most of these courses. This is usually obvious by inspecting the resulting Mechatronic projects. While some students are capable of designing and constructing aesthetically pleasing and reliable mechanical designs, these aspects usually take a back seat to the time intensive processes of circuit design, program organization and the mechanical system being controlled is considered a sideline electronics and the control program and the mechanical system being controlled is considered a sideline something on which to hand the electronics and microcontroller. Often, this is considered a reasonable tradeoff due to the large amount of material that can be covered in a mechatronics course. The issue is further complicated by the fact that the faculty members who usually engage in development and teaching the mechatronics courses are rarely those involved in mechanical design courses. Further, many lack formal training in mechanical engineering at all, coming instead from and Electrical or Systems Engineering background. The problem is a formidable one, but ripe for innovative solutions [5]

THE MECHATRONICS CURRICULUM

The term "Mechatronics" has been well received by high tech industry and academic community in the world since late 1980 s. A comprehensive definition and the scope of mechatronics, however, are far from being a reality. There are several radically different definitions proposed for Mechatronics by academicians and researchers. The authors perceive mechatronics to be "an integration of Mechanical and Electronics engineering. This definition also includes the well-known electromechanical systems. The primary motivation to implement a new curriculum on Mechatronics technology at its undergraduate level is to prepare the program for the inevitable trend of inter-disciplinary engineering education for the next century." The under-graduate course in Mechatronics is clearly a multi-engineering discipline. The introduction of this course at the undergraduate level will supply the high tech industry in the nation with much needed human resource with desired knowledge and experience. The strategy used in developing the unprecedented curriculum of the mechatronics engineering should involve combination of new course in theory and laboratory work. Many efforts are necessary prior to this development in fact finding, information collections, and faculty development, experimentation with non-traditional UG courses, and developing the strategies and funding proposals to external soures [6]

CURRICULUM STRUCTURE

There are many institutions around the world offering courses or degrees in mechatronics. However, no degree program in mechtronics at any level is offered by any institution in the country. Most mechatronical courses are offered sporadically at the graduate level as on elective subjects for final year Mechanical, Electrical or electronics engineering students. It was of the opinion of many senior executives of the high tech industry in the country that an undergraduate branch in engineering is far more effective for mechatronics education than ad-hoc approaches with isolated courses, as is the case of most of the institutions. The principal reason for this is because of the integrated nature of key subjects involved in mechatronics. Only a carefully designed curriculum can offer the students a complete education in mechatronics [7] Students are expected to acquire basic knowledge in design and manufacture of mechatronics products in macro, meson and micro scales. The mechatronmics curriculum should be uniquely built on three pillars viz. Pillar 1: The fundamentals, Pillar2: the hands on experience and Pillar 3: the application of mechatronics in a specific local industry. Pillar I courses can include subjects from which students are expected to learn the basic elements that constitute mechatronics systems and products. Pillar 2 includes students hands-on experience which can gained from a newly set up Mechatronics Engineering laboratory which can educate students in design, construction and measurements of hybrid mechanical and electrical systems. The laboratory work may include, in addition to, requiring students developing projects for specific system, to learn the basics of mechatronics through a set of specially designed experiments. The third pillar for the curriculum can comprise of the microelectronics and computer industry. The currently available Automatic Control Laboratory with a variety of work stations for design and implementing process controls in temperature, pressure, air flow, etc., and the Flexible Manufacturing Laboratory consisting of robots, material and parts handling equipment and CNC machinery can provide the necessary backup for mechatronics experimentation. Pillar 3 courses may be related to application of mechatronics to a specific industry. The proximity of any institute with industrial area like NOIDA, Bangalore, Navy-Mumbai, can cater the needs of microelectronics and Microsystems industry. [8]

CURRICULUM DELIVERY

The curriculum of Mechatronics engineering can include basic engineering subjects at First year level. This is normally common for all the engineering branches in most of the Universities and Institution in India. The second year can include the basic subjects of mechatronics engineering such as, basic analog and digital electronics, sensors and transducers, power drive devices, micro controllers and thermodynamics etc. Instruction on the fundamental course Fundamentals of Mechatronics Engineering can be included at this level. The objective of this course can be to help the students gaining a solid grasp on the fundamental aspects of the mechatronics technology. The third year subjects can be of applied mechatronics in nature and the final year subjects should be diversified in nature. The laboratory experiments can be developed to support the content presented in the lecture part of the course. The sequence of experiments should be designed such that it begins with basic electronics and ends with microprocessor control of an electromechanical part. A team smart product design project which integrates what the students have learned in this class is also required. Specific descriptions of the laboratory assignments may designed according to the need of industry [6] The most important course Mechatronics Systems Engineering can be offered to the mechanical engineering students for the last many years under the title Measurement and Control. This new lab can emphasizes the application of microcontroller (microprocessor) for real-time automatic controls, like developing smart products with feedback-controlled algorithm and circuitry. Groups of two to three students can work collaboratively on some control experiments, and the final group project can related to smart product design and implementation. The identified models can then used to design analog and digital control algorithms using MATLAB and Semolina software. The course activity can be conducted in three mechanical engineering laboratories: the Mechatronics Engineering Laboratory, the Automatic Control Laboratory and the Flexible Manufacturing Laboratory and two Electronics engineering laboratories: The Digital electronics laboratory and Microcontroller laboratory [7] Mechanical design of micro-systems requires the input of intrinsic effects, such as residual stresses and strains inherent from ,micro fabrication processes, which involve primarily chemical and materials engineering principles. Coupling of mechanical engineering and electrical engineering is another major factor in the design and packaging of micro-systems. While students may found it hard with the many different disciplinary subjects involved in this branch, they can be encouraged upon learning the ways how these engineering disciplines can be integrated in the design and manufacture of many micro devices that they had been fascinating. Students enrolled in this branch are expected to satisfy prerequisites in college physics and chemistry, introduction of circuit analysis, mechanics of materials and a fundamental course on material science. Mechanical engineering design is a desired prerequisite. The coupling of electromechanical principles in micro-systems design analysis appears to be a challenge to the UG students. Such coupling effect can be illustrated by a simple physical phenomenon that a reduction of the gap between the electrode plates. due to mechanical deflection of the driving arms can significantly increase the electrostatic force that cause the deflection. According to the electrostatic theory, a 50% reduction of the gap can result in a 400% increase of electrostatic force with constant voltage supply. This coupling effect has thus become a major consideration in the design of micro gripper. [9]

CONCLUSIONS

It is now becoming widely recognized that mechatronics skills are needed in many advanced technological applications, typically in the areas of automated production systems including robotics, space systems and satellites, hydraulic, pneumatic and electrical control and drives, food processing and the petrochemical industry. Mechatronics reflects the nature of subjects which combines the modem fields of precision mechanical engineering, electronics, control, information systems. A new under graduate course in consultation with the local industries can be run in the institutes in the industrial town like NOEDA, Pune, Bangalore etc. Graduates who follow a traditional mechanical or electronic program of study find they are disadvantaged when placed in a mechatronics environment, hence a new interdisciplinary program of study should be introduced to bridge this gap by focusing on the key elements from both of these traditional engineering disciplines.

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