Status Study and Need for Effective Masters Degree Programme in Embedded Systems Technologies in South India

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***Abstract*—The growth in India's embedded industry is not just a dream - A ten-fold increase in talent is expected to facilitate the embedded systems industry-from a current 60,000 professionals to over 6 lakhs people by 2015. Hence, it's a challenge for universities to fill the gap between education and industry. As more engineers are required by industry, more students should be taught the embedded system development skills whereas with the fast progress of the industry, the embedded system curriculum should being updated in order to catch up with the industry. This paper elaborates the status of PG programme on M.E-Embedded Systems Technologies in South Indian Universities by analyzing the relationship between courses and curriculum and the growing impact of embedded industries in Indian semiconductor hub.**

***Index Terms*— Embedded, curriculum, PG programme.**

I. Introduction

Post Graduate Engineering Education is a prime aspect to be concentrated in the technical programmes offered by universities. Effective curriculum evaluation is to be done for the PG programme on M.E–Embedded system Technologies, thus establishing industry specific curriculum contents, effective instructional methods and suggestive ways to plan a flexible study programme as a proposed model for curriculum.

II. Forecast of Embedded Industry in Indian Market

A. Introduction

India's strengths in software services, design, research and development put it at an advantage to design and develop more devices for the growing domestic and overseas markets. Consequently, the $3.25 billion semi conductor design services market in India is expected to reach $14.4 billion by 2012 according to a report by the Indian Semiconductor Association [1].

B. Verticals of Growth

India is emerging as the chip design center for most global companies. There are three types of embedded activities currently happening in India. These are:

- Embedded products designed, developed and manufactured by Indian companies for local markets or for exports—such as local product companies.
- Design projects executed by Indian design services companies for global companies—such as Wipro, KPIT, etc.
- Transnational R&D companies functional in India, who are doing captive design projects for parent companies from India—Delphi, Cisco, Intel, etc.

C. Leading Embedded Companies in India

TABLE I: Forecast of India's Electronic Industry by Segment up to 2020. [Source: ISA, India [2]]

ELECTRONICS INDUSTRY-PROJECTION BY SEGMENT		
	TARGET(*US $ BILLION*)	
	2014	2020
Semiconductor Design	20.0	58.2
High Tech Manufacturing	4.0	22.8
Electronic Components	2.8	3.4
Electronic Manufacturing Services	1.4	2.3
Electronic systems		
IT services and Hardware	16.7	54.4
Telecom products and equipments	29.8	153.5
Consumer electronics	8.1	17.8
Others(Industrial, Automotive and others)	2.7	7.0
Exports	15.0	80.0
TOTAL OF ALL SEGMENTS	100.0	400.0

TATA Elxsi, Ittiam Systems, Infosys, TATA Consultancy Services, HCL Technologies, Wipro Technologies, KPIT Cummins Info systems, Mphasis/BFL, Symphony, Sonata Software, Mistral/eInfochips, Dexcel Designs, Robosoft/Yindusoft, Intel, Sasken, Texas Instruments, Freescale, Philips, Samsung, LG Electronics, Ample Communications, Ibex, EmLabs [3].

III. Synthesis of Desired Core Competencies Needed in Embedded Systems

A. Programming Skills

- Experience with real-time multi-threaded programming
- Embedded C application programming.
- Experience with Matlab and Simulink and real time algorithm development
- Proficient with C/ C++/ C#/OOPS/ VC++/EVC++ and .NET Platform
- Knowledge of port programming in C microcontroller/Microprocessor is required

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B. Architecture/Design Skills

- Knowledge of basic electronic devices and Digital electronics
- Experience with Embedded processor development environments - RTOS driver design and kernel optimization
- Experience with embedded processor implementation -TI 2812, ARM, Microblaze and 8051.
- Write specifications, flow charts, Technical design decisions at both architecture and low level designs
- Excellent problem solving and debugging skills and integration abilities on complex systems
- Strong design & development skills for C/C++, STL, DS, Algos on Linux/Unix and Embedded & Firmware Systems
- Experience with Texas Instruments C2000 family
- Knowledge and ability to test own software components for design suitability.

C. Networking Skills

- Knowledge of communications interfaces -ARINC429, CAN, RS232, SPI
- Knowledge of field bus protocols (Modbus, Profibus, Ethernet IP, CCLink, CAN-Open, Device NET) will be an added advantage,
- Hands on experience of developing device level drivers, solid understanding of the principles of Ethernet protocols
- Experience with Socket and lower level network programming and troubleshooting

D. Inter Personal Skills

- Strong problem solving abilities
- Ability to meet frequent deadlines in a pressured environment
- Ability to work both independently and within a team environment
- Self starter with the initiative to work with little supervision
- Excellent written, verbal and communication skills.

IV. Curriculum Evaluation

The Curriculum of post graduate programme in Embedded System Technologies of following Universities is taken for study:

- Anna University-Chennai, Tamil Nadu (AUC)
- SRM University-Kattankalathur, Tamil Nadu(SRM)
- Kalasalingam University-Virudhu Nagar, Tamil Nadu(KU)
- Manipal University, Karnataka(MU)
- DOEACC, Calicut University, Kerala(CU)
- Jawaharlal Nehru Technological University, Hyderabad-Andhra Pradesh(JNTU)

A. Inference-Broad Categorization of Courses

TABLE II(A): Credit Comparison of South Indian Universities Based on Theory Courses

University	Credits for Theory courses
AUC [4]	44
SRM [5]	53.2
KU [6]	49
CU [7]	22.8
MU[8]	29.5
JNTU [9]	46.1

TABLE II(B): Credit Comparison of South Indian Universities Based on Practical Courses

University	Credits for Practical courses
AUC [4]	3
SRM [5]	2.1
KU [6]	6
CU [7]	15.2
MU[8]	6.8
JNTU [9]	7.7

TABLE II(C): Credit Comparison of South Indian Universities Based on Electives Courses

University	Credits for Elective courses
AUC [4]	26.5
SRM [5]	19.2
KU [6]	18
CU [7]	11.4
MU[8]	9.1
JNTU [9]	23.1

TABLE II(D): Credit Comparison of South Indian Universities Based on Project Courses

University	Credits for Project courses
AUC [4]	26.5
SRM [5]	25.5
KU [6]	27
CU [7]	50.6
MU[8]	54.6
JNTU [9]	23.1

The curriculum evaluation reveals the following:

1) Theory Courses: Curriculum of SRM University leads with 53.2 % weight age for credits followed by JNTU with 46.1% and Anna University with 44%, the least being Calicut University with22.8%
   **Calicut University and University could offer more theoretical courses to an average of 41%.
2) Practical Courses: Curriculum of Calicut university leads with 15.2 % weight age for credits followed by JNTU with 7.7% and Manipal University with 7.7%,the least being SRM University with 2.1% and Anna University with 3%.
   ** Anna University. SRM University, Kalasalingam University and Manipal University could strengthen their curriculum by offering practical courses more than an average of 7%

3) Elective Courses: Curriculum of Anna university leads with 26.5 % weight age for credits followed by JNTU with 23.1% the least being Manipal University with 9.1%
** Calicut University and Manipal University could offer increased choice of elective courses more than an average of 18%
4) Project Courses : Curriculum of Manipal university leads with 54.6 % weight age for credits followed by Calicut university with 50.6% ,the least being JNTU with 23.1%
** Anna University. SRM University, Kalasalingam University and JNTU could definitely increase their credits towards project courses more than average of 35% thus enabling the students towards more real time hands on experience.

B. *Inference-Specification of Courses*

TABLE III(A): CREDIT COMPARISON OF SOUTH INDIAN UNIVERSITIES BASED ON BASIC COURSES

University	Credits for Basic Courses
AUC	3.7
SRM	2.6
KU	2.9
CU	0
MU	0
JNTU	0

TABLE III(B): CREDIT COMPARISON OF SOUTH INDIAN UNIVERSITIES BASED ON CORE COURSES

University	Credits for Core courses
AUC	20.2
SRM	24.8
KU	20.3
CU	11
MU	10.3
JNTU	15.8

TABLE III(C): CREDIT COMPARISON OF SOUTH INDIAN UNIVERSITIES BASED ON APPLIED COURSES

University	Credits for Applied Courses
AUC	28.4
SRM	24.8
KU	26.2
CU	24.6
MU	25
JNTU	31.6

TABLE III(D): CREDIT COMPARISON OF SOUTH INDIAN UNIVERSITIES BASED ON PROJECT COURSES

University	Credits for Programming /Design Courses
AUC	11
SRM	10.1
KU	9.9
CU	13.7
MU	12.5
JNTU	25

TABLE III(E): CREDIT COMPARISON OF SOUTH INDIAN UNIVERSITIES BASED ON ADVANCED COURSES

University	Credits for Advanced Courses
AUC	20.2
SRM	17.1
KU	23.3
CU	13.7
MU	16.9
JNTU	11.8

TABLE III(F): CREDIT COMPARISON OF SOUTH INDIAN UNIVERSITIES BASED ON ADVANCED COURSES

University	Credits for Project work
AUC	16.5
SRM	20.6
KU	17.4
CU	37
MU	35.3
JNTU	15.8

The curriculum evaluation reveals the following:

1) Basic Courses: Curriculum of Anna university gives more weight age for basic courses-3.7% followed by Kalasalingam University with 2.9% whereas Calicut University, Manipal University and JNTU do not offer any basic courses.
**All universities excluding Anna University could include basic courses such as Applied Mathematics which would provide useful in communication and computer applications.
2) Core Courses: Curriculum of SRM University focuses more on core courses with248% weight age followed by Kalasalingam University with 20.3% and Anna University with 20.2% where as Calicut University and Manipal university offer only 10.5% towards core courses.
** Calicut university, Manipal University and JNTU could contribute towards more core courses greater than average of 17% which would help the graduates to develop strong technical concepts in embedded systems.
3) Applied Courses: JNTU leads with 31.6% whereas all the other universities are more or less equal on an average of 24%.
**Almost all universities contribute equally towards applied courses and this would be helpful to work on various application oriented fields related to embedded systems.
4) Programming/design Courses: Curriculum of JNTU proves beneficial as it offers 25% weight age for programming /design Courses followed by Calicut University with 13.7 % and the least being Kalasalingam University with 9.9%.
**All universities excluding JNTU could increase programming and design courses to more than average 14% as it is very important to develop the programming skills of graduates.
5) Advanced Courses: Kalasalingam university offers more of advanced level courses with 23.3% followed by Anna university with 20.2% whereas JNTU offers 11.*% only.

**Calicut University and JNTU could offer wide variety of advanced courses more than average of 17% in order to equip the graduates with latest technical developments.

6) Project Courses: Curriculum of Calicut University tops the list with 37% weight age for credits followed by Manipal University with 35.3% and least is JNTU which offers 15.8% only.
**An average of 24% and above weight age for project courses is desirable since it would be the best evaluation technique for students and added advantage towards employment. Anna University, SRM University, Kalasalingam University and JNTU could work towards this.

C. Elective Courses Based on Core Embedded Systems

Curriculum of Anna University gives more weight age for embedded related subjects with 44.4% followed by SRM University with 33.3%, JNTU and Kalasalingam University with 25% and the least being Calicut University with no embedded related elective courses.
**Calicut University and Manipal University could offer more weight age towards embedded related electives which would help in better exposure towards embedded systems.

V. Suggestions

The study reveals that the effectiveness of PG programme in embedded systems could be enhanced by implementing the latest technology tools for design of embedded systems in the curriculum, including mandatory in plant training programs, increasing the number of project work courses in the curriculum. addition of latest and advanced electives related to embedded systems .These are the suggestions for the necessary changes to be implemented in the curriculum design of the post graduate program.
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VI. Conclusion

Embedded system is one of the latest disciplines to be added to the academic map worldwide. Effective curriculum evaluation is done for the PG programme M.E – Embedded system Technologies of south Indian Universities. The desired competencies required by the embedded industries is also analysed, thus identifying the gaps in order to establish industry specific curriculum contents and effective instructional methods to make the graduates adequate to the skill set requirement which in turn will boost up the economic growth of semiconductor industry.

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