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Computing & Information Related Degrees Worldwide & India—*An Analytical Policy Research*

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ABSTRACT

Education and its solid dissemination including Technologies are responsible for the development in different perspective. Technological Studies are important name for solid business solutions and development. There are many problems, obstacles facing by the institutions and systems within developing country. New academic innovation and research Information and knowledge dissemination lead valuable role for reaching Knowledge Economy. Industrial needs and right availability of human resources with proper manpower is the need of hour. Computing previously treated as most valuable name in knowledge world but the gradual development later created another nomenclature and fields with Information. It is an important fact that subfields of Information Sciences and Technology are emerging rapidly due to its need in different sectors. Universities and Educational institutions are around the world moving towards interdisciplinary research. Indian educational institutions and academics are also become dynamic and offering several areas of study which are applied, non-traditional and interdisciplinary. This paper is conceptual in nature and provided information on computing and informatics programs in the field with international look and emphasizing Indian context in brief manner. The paper also highlighted few emerging areas which developed in recent past.

Keywords: Computing, informatics engineering, information, India, digital economy, interdisciplinary Studies, development, ICT4D, educational policies

Developing countries are moving towards better knowledge cultivation and development *countries such as China, Colombia, Malaysia, Mauritius, India, Brazil, South Africa etc.* are moving towards better knowledge dissemination and solid manpower development for all-round development. India is developing its social, economical strategies for better a world and thus there is an urgent need for the development of such programs related to the computing which are much applied and helps to reach knowledge economy. Many programs are available worldwide in different level such as Bachelors, Masters, and Doctoral Degrees which deals nature of such kind. However, India is also slowly designing educational programs[6],[9]. In computing most common and available program is Engineering with Computing focus.

Engineering is encompasses a specific weight on particular facets of applied science (pure & bio), technology over and above various types of application. ABET has defined "engineering" as *"The creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination; or to construct or operate the same with full cognizance of their design; or to forecast their behavior under specific operating conditions; all as respects an intended function, economics of operation or safety to life and property"* (Source: Wikipedia). Engineering is a field and area since human development and devised elementary inventions counting the wedge, lever, wheel, pulley etc. Engineering is becomes today a common

and important domains as far as education and training is concerned. Among the most general and common Engineering Mechanical Engineering, Civil Engineering, Electrical Engineering, Electronics Engineering are popular. However in recent past several other interdisciplinary areas have been started to make applied social development. Interesting to note that later on many universities have been started newer fields viz. Computer Engineering, Nano Technology, Bio Technology and so on. Gradually some other fields have been started in Computing combined with other areas such as Quantum Mathematical Computing Sciences, Information Sciences and Computing[3],[6]. Most recent in the list is Data Engineering and also known as Data Analytics. In India, a large number of educational institutions are offering Engineering programs in different level and mainly in the subject of Computer Science and Engineering, Information Technology etc. Interestingly in different parts of the globe have started research in the following areas due to their increasing needs:

- ❒ Cloud Computing
- ❒ Green Computing
- ❒ Green Systems
- ❒ Big-Data Science
- ❒ Internet of Things
- ❒ Business Analytics & Intelligence and so on.

There are many universities and educational institutions of India in recent past (mainly from private sector) have started research work and programs in these areas. Even some are offering specializations to produce direct manpower.

Objective and Agenda

The present paper is conceptual in nature and deals with various affairs leading to objective of following (but not restricted to):

- ❒ To know the basics of Engineering Science and its related areas emphasizing engineering programs in the areas of Computing and similar Sciences.
- ❒ To learn about Computing and Allied Programs in general context and availabilities of the programs in Indian Context.
- ❒ To get a basic overview of Engineering Colleges and Universities in India where Computing related programs are offered.
- ❒ To learn about the Computing as a field and also related and allied areas in Computing including their nature, tools and objectives.
- ❒ To learn about some of the emerging programs started worldwide and in India in brief context.
- ❒ To learn and dig out core issues and challenges in relation to Computing and Information Technology as far as India is concerned.

Methodology

This is a research paper of conceptual nature and interdisciplinary in the sense as it deals with the educational affairs, technological affairs to solve managerial problems. The basic review work has been undertaken for the research work. Importantly, web review plays a vital. To learn about present thought regarding Engineering, Computing etc. concerned international bodies and council's websites have been studied such as ABET, ACM. To study Computing and related areas and programs in India sample have been considered as the URL of UGC (University Grants Commission), Govt. of India. Subsequently, the URL of AICTE also searched, analyzed and reported here in the context of scientific review and policy based paper. Moreover, search strategies have used with two different statements 'Computing & Information Technology Programs in India' and 'Emerging Computing related Degrees'. Result up to 15 pages was studied. The study was undertaken during the term/ period August-September, 2017. The valuable and related result was selected and incorporated in the literature.

Engineering & Computing: An Introduction

Engineering is most important and valuable these days. In generally, Engineering programs are available as a program of study, though in some cases authorized examinations are conducted for the degrees or authorized qualifications. Although for practicing, supervised training in some countries also organizes for licensing or registration. It is tough to express what exactly Engineering, as far as Fung *et al.* in his revised classic engineering text cited *Foundations of Solid Mechanics*, mention that,

"*Engineering is quite different from science. Scientists try to understand nature. Engineers try to make things that do not exist in nature. Engineers stress innovation and invention. To embody an invention the engineer must put his idea in concrete terms, and design something that people can use*".

In Engineering space many newer subjects have recently popularized viz. Manufacturing Engineering, Automotive Engineering, Computer Engineering, Petroleum Engineering, Agricultural Engineering, Bio-Systems Engineering Software Engineering, Corrosion Engineering, Aerospace Engineering, Biomedical Engineering, Geological Engineering, Textile Engineering, so on. In the domain of Engineering many other Computing areas have been started such as Computer Engineering, Information Technology, Bio Information Technology etc.

To become Computer Engineer in private sector there is no need to licensing. Though, in government space, it is become common. For example, the UK Engineering Council is responsible for the licensing and registration of the engineer profession. Licensing is an important concern for Engineering practice in many nations[1],[5],[6].

Important to note that Engineering also known as *Technological Sciences* (arrived from the term *Technik*). In German and European language it is pronounced as a *technik* and *technologie* respectively though it is popularized worldwide as "technology". Hence in Computing many areas have been developed. Apart from Information Technology few other areas are include—Networking Technologies, Communication Technologies, Database Technologies etc. are also offered as an Applied Science program.

Computing Degrees: The Perspective of the World and India

Computer Science education is growing in many developing countries as well apart from its popularity in developed countries. The term Computing is used widely to represent the context of computing activities as well as. It is difficult to define Computing though in ACM *Computing Curricula 2005* Computing has been defined as "In a general way, we can define computing to mean any goal-oriented activity requiring, benefiting from, or creating computers. Thus, computing includes designing and building hardware and software systems for a wide range of purposes; processing, structuring, and managing various kinds of information; doing scientific studies using computers; making computer systems behave intelligently; creating and using communications and entertainment media; finding and gathering information relevant to any particular purpose, and so on. The list is virtually endless, and the possibilities are vast." (Source: Wikipedia). Universities are offering various nomenclature of this field and some of the related fields of Computing are—Computer Technology, Computer Systems, Computer Software Systems etc.[2],[4],[7].

There are many merged related domains are available around the world due to the integration of the fields viz. Computer Science and Engineering, Computer and Electronics Engineering, Computer and Information Science, Computer Technology and Management Computer, and Communication Science etc.

In the area of Computing, Computer Science was most earlier and available worldwide apart from the related merged domains few other areas have been generated in Information Spectrum viz. Information Technology, Information Systems, Informatics, Information Science etc. Though these are related but sometimes also differs the areas and coursework. Some of the basic areas, nature etc. are listed as follows. The nature of Indian and international Computing related programs depicted in Table 1 & 2.

Computer science is a theoretical subject mainly dedicated to the computation and its applications. It is normally deals with the feasibility, structure, and appearance of the algorithms. Computer Science is nurture internal affairs of computing systems responsible for the collection, selection, organization, processing, storage, communication, and access of the information. Creation of computing systems study of hardware, operating systems, microprocessor etc. are the core of Computer Science.

Information Technology (IT) is responsible for information affairs viz storing, retrieving, transmitting, and manipulating data with the help of technologies. Here, among the technologies few important are include components viz. Database

Table 1: The Nature of common Computing & Information related fields (Global Context)

Computing & Information Related Domains: The Nature				
Computer Science	**Computer Science & Engineering**	**Information Technology**	**Information Science**	**Informatics**
+ Theoretical + Mathematical + Internal & Core Affairs + Hardware study as theory + Less Software Study	+ Theoretical + Mathematical + Internal & Core Affairs + Hardware study as practical + Development of Computer Systems	+ Applied + Business Focused + Applications of Various Components *(Viz. Network, Databases, Multimedia, Communication Technology)* +Less Mathematical	+ Applied + Social + Business Focused + All Components of IT and their focus/ issues in Social/ Business/ Health context.	Applied + Social + Business Focused + Information Systems Designing and Development

Table 2: Computing & Information related fields availabilities in India & curricula nature

Computing & Information Related Domains: Its availability in India & Abroad				
Computer Science	**Computer Science & Engineering**	**Information Technology**	**Information Science**	**Informatics**
+Most Popular in Colleges & Universities (A Large number of Universities and Colleges offered the programs as BSc/MSc Degree. + The focus same as offered in International Universities and depicted in Table 1	+ Available in about 3000+ Engineering colleges with BE/BTech/ ME/MTech program + Where rest of the world offers BS/ MS but in India BE/BTech/ ME/MTech program +Focus is same as depicted in Table 1	+ Available in about 3000+ Engineering colleges with BE/BTech/ ME/MTech program + Where rest of the world offers BS/ MS but in India BSc/BE/BTech/ MSc/ ME/ MTech program	+ Available a very limited institutes about 10 programs + It is available as MSc program. +No BSc yet offered though about 5000 institutes offered BSc-CS +Focus of the subject in India and world more or less similar as practicing in globe	+ The programs not offered in around 800 Universities, 3000+ Engineering Colleges & 40000+ HEIs + Only the subject offered in University of Delhi (MSc-Informatics) With focus differs from the globe, it is as like MSc-CS/IT

Technology, Multimedia Technology, Networking Technology, Communication Technology, Computing Technology etc. In some context Information Technology (IT) is also treated as applications and utilizations of computers and technologies in the context of a business and enterprises. It also deals with the skills and knowledge of managing information systems in organizational context. Some of the emerging areas viz. Cloud Computing, Internet of Things (IoT), Big Data, Human Computer Interaction (HCI), Data Analytics, Web Technologies, SEO have become popular areas of IT which are responsible for the development of many tangible and intangible facets[8],[10],[12].

Information Systems is similar to Information Technology and dedicated to the analysis, use, creation, as well as development of information based services, products and mostly Information Systems. Information Systems is treated as both theory and practice based domain. The technological phenomenon in Information systems is most common in the domain and it reflects and integrates its requirement in the organizations and society. Some times, the nomenclature varies its role little bit from country to country and overlaps its nature[8],[11],[13].

In other words, Information Systems is a field that deals with managerial, strategic, policy, operational facets of information. It is associated with technologies organizations. Information Systems Management, Policies related to the Information, Policies of Information Systems, Policies of IT Organization, Policies of Software Systems etc. are the core concern of Information Systems. Information Systems created some other emerging domains/ fields (i.e. merged with other related fields) viz. *'Information*

Systems and Technology' or *'Information Systems and Engineering'*. Though Information Systems itself deals with Management but in some context, it is in general applications in societal applications as well. Hence to distinguish such confusion many universities and bodies incorporated the term/ field 'Information Systems & Management'.

Informatics is similar to Information Science in many contexts but sometimes it may only deemed as computer information systems. Initially, academician of UK prefers the term Informatics and in US and its follower countries, the term Information Science become popular. It is responsible for the designing, development of information interfaces, organizations, technologies. It is closely associated with the term and area information science, information, technology. Informatics has very close relationship with the areas such as statistics, economics, and management sciences. Informatics deals with the following in broad context:

- Computational impact of information technologies
- Mathematical impact of information technologies
- Biological impact of information technologies
- Cognitive impact of information technologies
- Social aspects impact of information technologies

It is important to note that social impact of information technologies are treated as vital as far as Informatics is concerned. Informatics is treated as a branch of Applied Science with strong linkages with societal affairs similar to Information Science. The nature of curricula varies between India and other parts and such nature listed in Table 2.

Indian Computing Vs. World Computing Domain: Analysis of Nature

In India thus conventional programs are available these are *Computer Science* fields with programs viz. BSc/MSc/MPhil- Computer Science in most of the universities in thousands of affiliating universities. Moreover, interesting to note that while in around the world *Information Technology* programs were started for solving human resources in Computing fields and industries, India started *Computer Applications* program as skill based gradients for the industries. Though Information Technology program combines with technologies of Software, Networking & Communication, Databases & Information Management, Multimedia etc. but India's programs were gear up with focus of Software Technologies (mainly for software development etc.). Internationally IT started with dealing with all areas within many cases an option of concentration/ major.

In Computer Applications segment flagship programs is Masters one i.e. MCA (Master of Computer Applications). The program is governed by the All India Council for Technical Education (AICTE) with an annual intake of around 1 Lakh (about 100000). Refer Table 4 for more details. Though in many universities in their affiliating colleges BCA program started (this is not under the preview of AICTE). The Table 3 showing list of Computer Applications Colleges and Engineering College Institutes.

Table 3: Computing and Engineering Institutions in India (Source: AICTE)

Year	Engineering	MCA
2010–11	3222	1198
2011–12	3393	1228
2012–13	3495	1241
2013–14	3384	1241
2014–15	3392	1241
2015–16	3364	1241
2016–17	3288	1241

Though most popular programs in Computing segment in India is *Computer Science and Engineering* which is offered in thousands of Engineering Colleges with the Degrees of BE/BTech/ME/MTech. The programs are a combination of Computing theory and practice both. A detail on CSE is listed in the Table 1.

Though later on in mid of 1990's Information Technology programs also started in India but the focus of the subject still not at par with international context. It is just an extension of Computer Applications programs and in many contexts deals with same program structures[8],[14]. But many universities have started the programs just an alternative of MCA as it is not come under the jurisdiction of AICTE and differ from traditional Computer Science (BSc/MSc) fields. As Computer Science is a core of traditional subjects and deals

the nature of mathematical/ theoretical areas. In Information Technology segments the programs are also various in India namely BSc/BE/BTech-Information Technology and in Masters level MSc/ ME/ MTech/ MS/ MS (Research)-Information Technology. But already mentioned nature differs from India to International market.

Table 4: Engineering Institutions and Computer Applications Intake in India (Source: AICTE)

Year	Engineering and Technology	MCA
2007-08	653290	70513
2008-09	841018	73995
2009-10	1071896	78293
2010-11	1314594	87216
2011-12	1485894	92216
2012-13	1761976	100700
2013-14	1804353	119713
2014-15	1901501	109925
2015-16	1844642	103048
2016-17	1752296	94159

Around the world, few other interdisciplinary programs (broadly may be called as *Information Sciences*) and subjects have been started such as Information Science, Information Systems, and merged subjects like Information Science and Technology, Information Systems and Technology, Information Systems and Management, Information Science and Management. The popularities of such Information related areas in a broader sense called as Information Sciences and Technology or Information Science & Computing as well.

Table 5: Some premier University full-fledged on Information Science

Reputed Information Science University in International level
Tokyo University of Information Science and Technology, Japan.
Beijing University of Information Science and Technology, China.
University of Information Science and Technology, Ohrid-Macedonia.
Kyushu Institute of Information Sciences, Japan.
The University of Information Science, Cuba.
Nanjing University of Information Science and Technology.

Though in some universities Information Science & Technology Department, Colleges, and even full-fledged universities have started (please refer Table 5). However, a fewer programs in these areas in India have started (though very limited compared to other Computing/ IT programs available in India, please refer Table 7). The Table 7 showing a list of institutions and programs available in India. A typical overview of such programs curricula/ courses are listed in Table 6.

Table 6: Some of the sample areas and papers of Computing-Informatics (CIS & IST)

Computer and Information Sciences (CIS)
Theories of Information Sciences
Computer Architecture
Database Systems
Information Management
Advance Database
Information Technology for Medicine/ Business/Society/ Education
Knowledge Organization & Management
Knowledge Processing
Operating Systems
Data Structure
Fundamental of Programming
OOPS with C/ C++
Java with Emerging Applications
Web Systems and Internet Systems
Markup Languages with Information Designing/ Architecture
Style Sheets for Interaction Design/UI
Internet Engineering with PHP & MySQL
Routing and Switching-Implementation & Management
Basics of Cloud Computing
Cloud Computing Using Microsoft Technologies
Basics of Human Computer Interaction and Usability Engineering
Basics of Network and Corporate Information Security
E Business
E Commerce & E Governance
Applied Tools for Managing, Securing Information
Information Sources and Ethics
Project Management for Information Systems
Strategic Management
Advance Cloud Strategies
Green Systems

Emerging Business Process
Information Laws & Policies
Digital & Knowledge Economy
Research Issues in ICT
Research Methods for CIS/ Information Systems

It is important to note that apart from listed programs in the Table 7, another program in Engineering segment is run by a University (VTU) at Karnataka, India. The program called BE (Bachelor of Engineering) - Information Science & Engineering.

Computer Science and similar programs are available with subfields concentration in a very limited number of institutions and universities in India. Majority of the programs started in Engineering field. Few institutions and programs and universities listed in Table 8 below.

However, such specialization or concentration is absent in other Computing programs like BSc/ MSc-Computer Science/ MCA/ BSc-IT/MSc-IT. It is important to note that apart from this two flagship & higher degree based unique specialization program is offered by the Srinivas University called *MPhil-Data Analytics & Cloud Computing, MPhil-Big Data & Business Analytics*. Apart from this, private knowledge provider head-quartered at Bangalore started collaboration in offering new age honors/majored BCA programs in diverse areas like Cloud Technology and Information Security, Mobile Applications, IT Infrastructure Management Services etc. The Table 9 is showing some of the programs and universities.

Proposed Emerging Programs: Promoting solid Information Science and Technology

Hence, though in India several programs and subjects viz. Information Technology, Computer Science, Computer Science & Applications, Computer Engineering, Software Engineering, Information

Table 7: Information Sciences & similar programs in India

Information & Computing Programs	University/ Institutions	Duration of the Program	Nature of the program
B.Sc.-Information Science and Telecommunication	Ravensaw University, Odisha	3 years	Computing and Telecommunication Focused
BIM-Bachelor of Information and Management	Kurukhestra University	3 years	Management Information Systems based
M.Sc.-Information Science	IEM, Saltlake, Kolkata	2 Year	Mainly IT centric; few components on Information Systems included
M.Sc.-Information Science	Techno India, Saltlake, Kolkata	2 Year	Mainly IT centric; few components on Information Systems included
M.Sc.-Information Science	Techno India Hooghly, WB	2 Year	Mainly IT centric; few components on Information Systems included
M.Sc.-Information Science	Dr BC Roy Engineering College, Durgapur	2 Year	Mainly IT centric; few components on Information Systems included
M.Sc.-Information Science	KITM, Buniadpur, WB	2 Year	Mainly IT centric; few components on Information Systems included
M.Sc.-Information Science	MCIS, Manipal University	2 Year	Mainly IT centric; Basics of Information Science/Systems/ Management is missing
M.Sc.-Information Science	Periyar University	2 Year	Mainly IT centric; no gradients of basic of Information/ Information Management
M.Sc. [Tech] Information System	BITS Pilani	2 Year	Mainly IT and Computer Science focused with programming
M.Tech.-Information System	NSIT, Delhi University	2 Year	Mainly IT and Computing centric & Information Systems
M.Tech.-Information System and Management	ISIM, Mysore University	2 Year	Information System as practiced internationally

Table 8: Super Specialty programs of Computing: Engineering Platform

Universities	Programs
VIT University, Tamilnadu	MTech-CSE (Cloud Computing)
Bharat University, Himachal Pradesh	B. Tech. – IT (Information Security and Cloud Technology)
Teerthanker Mahaveer University, UP	B. Tech. – IT (Information Security and Cloud Technology)
Amity University, Uttarpradesh	MTech-Cloud Computing
Vel Tech University, TN	B. Tech. – IT (Information Security and Cloud Technology)
	MTech (IT Infrastructure and Cloud Computing)
Graphic Era University,	BTech-CSE (Cloud Computing)
University of Petroleum and Energy Studies, Uttarakhand	BTech-CSE (Cloud Computing)
Kaziranga University, Jorhat	B. Tech. – IT Information Security and Cloud Technology
Hindsthan University, TN	BTech IT (Cloud Computing)
	BTech CSE (Cloud Computing)
University of Technology and Management, Meghalaya	BTech-CSE (Cloud Computing)
Poornima University, Jaipur	B. Tech. – IT (Information Security and Cloud Technology)
SRM University, Tamilnadu	MTech- Cloud Computing
Assam Down town University, Guwahati	B. Tech. – IT (Information Security and Cloud Technology)
KL University, Andhrapradesh	MTech- Cloud Computing
Rayat Bhara University, Mohali, Punjab	B. Tech. – IT (Information Security and Cloud Technology)

Table 9: Super Specialty programs of Computing: BCA Track

Cloud Computing & Other emerging BCA Programs
BCA – Cloud Technology and Information Security, Jain University, Bangalore
BCA – Cloud Technology and Information Security, ADT University, Guwahati
BCA – Cloud Technology and Information Security, Ajeenkya D. Y. Patil University, Pune
BCA – Cloud Technology and Information Security, KL University, Andhra Pradesh
BCA – Mobile Applications and Cloud Technology, Ajeenkya D. Y. Patil University, Pune
BCA – Mobile Applications and Cloud Technology, Jain University, Bangalore
BCA-Cloud Computing and IT Infrastructure Management Services, Poornima University

Systems but for creating solid and interdisciplinary research environment, skilled manpower in diverse sectors the following programs may be started:

- ❒ Information Science
- ❒ Computer and Information Science
- ❒ Information Engineering
- ❒ Knowledge Management
- ❒ Knowledge Engineering
- ❒ Information Systems and Technology
- ❒ Information Systems and Management

These subjects may be started as BS/BSc, MS/MSc programs apart from Engineering and Technological platform (BE/BTech/ME/MTech). Domain based informatics and computing (like Health Informatics, Bio Informatics, Education Informatics, Environmental Informatics may also be started in different level (please refer Table 10).

However, initially, if it is become difficult to start full-fledged degree programs in the above mentioned areas due to the problem of audience, lack of infrastructure, qualified manpower, then specialization may be offered in computing and information related fields. However, to see the nature of interdisciplinary affairs and broadness Information Science or Information Systems would be better rather Computer Science (as it is mainly for

Table 10: Some of the possible emerging Informatics domains (full-fledged)

Science Platform	Technology/ Engineering Platform
BSc/MPhil- Health Informatics	BTech/MTech- Health Informatics
BSc/MSc-Education Informatics	BTech/MTech -Education Informatics
BSc/MSc-Urban Informatics	BTech/MTech -Urban Informatics
BSc/MSc-Chemo Informatics	BTech/MTech -Chemo Informatics
BSc/MSc- Quantum Informatics	BTech/MTech - Quantum Informatics
BSc/MSc-Social Informatics	BTech/MTech -Social Informatics

Table 11: Domain based informatics in Information Science specialization

Science Platform	Technology/ Engineering Platform
BSc/MPhil (IS)- Health Informatics	BTech/MTech(IS)- Health Informatics
BSc/MSc(IS)- Education Informatics	BTech/MTech(IS)- Education Informatics
BSc/MSc(IS)- Urban Informatics	BTech/MTech (IS)- Urban Informatics
BSc/MSc(IS)- Chemo Informatics	BTech/MTech (IS)- Chemo Informatics
BSc/MSc(IS)- Quantum Informatics	BTech/MTech (IS)- Quantum Informatics
BSc/MSc(IS)- Social Informatics	BTech/MTech (IS)- Social Informatics

Table 12: Proposed Cloud Computing Programs in Developing countries context

Science	Engineering
BSc/MSc- Network & Cloud Computing	BE/BTech/ME/MTech- Network & Cloud Computing
BSc/MSc-Cloud & Fog Computing	BE/BTech/ME/MTech-Cloud & Fog Computing
BSc/MSc-Cloud & Green System Management	BE/BTech/ME/MTech-Cloud System Management
BSc/MSc-Cloud & Environmental Informatics	BE/BTech/ME/MTech-Cloud & Environmental Informatics
BSc/MSc-Cloud & Green Systems	BE/BTech/ME/MTech-Cloud & Green Systems
BSc/MSc-Cloud and Scalable Computing	BE/BTech/ME/MTech-Cloud and Scalable Computing

designing and development of computer systems). Table 11 depicted specializations of emerging and possible domain focused Informatics/Computing areas.

Among the technologies, *Cloud Computing* is important one responsible for the virtualization of software, systems, hardware, operating systems etc. Cloud Computing also called as Cloud Technology depends on the internet and network technology. Many organizations these days adopting Cloud Computing services in different models and as per availability of skilled manpower, it is limited in many contexts. Cloud Computing is also responsible for energy consumption and management. It is important to note that a whole concept on energy management in respect of computing has been developed called *Green Computing* which is for recycling, reusing of computers with software and other Computing Systems, Technological products are the main concern of Green Computing[7]. Here, few proposed programs are illustrated in Table 12.

Internet of Things (IoT)

Internet of Things (IoT) is another emerging area of Computing and Information Technology responsible for the managing and deploying electronics and non-electronics devices, systems and services. The concept of IoT is based on remote based sensors and here cloud computing also plays a vital role. The growing internet and advent of similar technologies even led the development of IoT as a field in many countries. In Indian context, IoT may be offered in bellow mentioned degrees. In India, it is difficult to find five institutes offering the area. While, SRM University, Chennai has been started a complete degree on MTech in IoT. Here, Table 13 is proposed programs with full-fledged on IoT or Information Technology specializations.

Table 13: Proposed programs on Internet of Things (IoT) in Indian context

Full Fledged Context	Information Technology Context
BSc/MSc-IoT	BSc/MSc- IT (IoT)
BSc/MSc-IoT and Cloud Systems	BSc/MSc-IT (IoT and Cloud Systems)
BSc/MSc-Internet Science & IoT	BSc/MSc-IT (Internet Science & IoT)
BE/BTech/ ME/ MTech-IoT & Internet Technologies	BE/BTech/ ME/ MTech-IT (IoT & Internet Technologies)
BE/BTech/ ME/ MTech- Cloud & IoT	BE/BTech/ ME/ MTech- IT (Cloud & IoT)

Table 14: Proposed areas and specializations in the areas of Big Data and Data Sciences

Full Fledged Context	Information Technology Context
BSc/MSc-Big Data Management	BSc/MSc-IT (Big Data Management)
BSc/MSc-Big-Data Analytics	BSc/MSc-IT (Big-Data Analytics)
BSc/MSc-Data Science	BSc/MSc-IT (Data Science)
BSc/MSc-Data Science with Digital Curation	BSc/MSc-IT (Data Science with Digital Curation)
BSc/MSc-Business Analytics with Data Management	BSc/MSc-IT (Business Analytics with Data Management)
BE/BTech/ME/MTech-Big Data/ Data Science	BE/BTech/ME/MTech-IT (Big Data/ Data Science)

Data Science & Big Data—Data Science is responsible for managing complex data management. Day by day the amount of data is increasing and it is a key challenge data in respect of analysis, data-curation, sharing, storage, transfer. Hence, it is also known as Big Data Management. Many universities worldwide have started full-fledged programs in these areas. Even in India as well[8]. The Table 14 is proposed few programs in this segment as full-fledged programs and also as a specialization.

Suggestion

- Indian Higher education systems need reforms in educational policies, funding, and budgets for higher education and training.
- Creation of skilled manpower in the field of Information Technology is most important and valuable in many contexts hence finishing school may be introduced.
- New age subjects, programs, specializations and major may be started in emerging areas to cope up the job opportunities and better HR solutions.
- Industry and Academia collaboration and tie-ups are important for better and healthy HR solutions.
- Balanced seat/intake, institutions are essential to open for solid educational systems creation.

CONCLUSION

Higher Education is the key for all-round success in any country and India as a developing country emerging rapidly through innovations in higher education systems and models. India holds a record number of higher educational institutions (about 40000+), universities (about 800), Large number of Engineering Colleges (3500+), Management Colleges (5000+) and many other HEI and polytechnics etc. Indian Institutions are also offering many programs in Computing with huge intake etc. Though emerging programs such as Cloud Computing, Big Data technologies, Grid Computing and Technologies, Scalable Computing are the need of hour, today many organizations are much smarter and intelligent even e-governance system also changed Governance systems. Proper policy, regulation, framework, and initiative of availability of adequate manpower are very much important for the success of Indian education systems. Information Technology is important for the development of all kind solid Digital Economy is only possible with adequate educational systems and here Information Technology and Computing will play a great role.

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