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IS INDIAN COMPUTING ACADEMIC UNITS ARE INTERESTED IN THE AREAS OF IT? A CASE OF CLOUD COMPUTING & VIRTUALIZATION

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Abstract
Computing is one of the emerging and rapidly changing fields. The field is responsible for the development of diverse areas. Initially within Computing, *Computer Science* was core and main subject and gradually many other subjects have been originated viz. Computer Engineering, Computing, Computer Applications, Information Technology, Information Systems, Informatics, Information Management etc. Though there is a difference in between Computing related fields and Information related fields. *Computer Science* is theoretical in nature and mainly deals with the mathematical affairs for the study, evaluation, design and development of *computer systems*. Though *Computer Engineering* is mainly focuses on design and development and partially software systems. As far as Computer Application is concerned it is purely concentrated on software technologies. *Information Technology* whereas concentrated on the information related affairs and allied technologies viz. Networking Technologies, Database Technologies, Communication Technology, Multimedia Technology, Web Technology etc. In India, common academic programs of Computing and IT mainly concentrated on the nomenclature Computer Science, Computer Application, and Information Technology. Among the emerging subjects, few important are Big Data Technologies, Cloud Computing etc and these are rising as an academic program as well in different universities internationally. Though the areas of Information Technology in Indian academics have several disparities compared to international universities. However, in recent past Indian academics, mainly private bodies are moving towards some of the applied areas of IT within the department, programs of Computing. This paper deals with the basics of computing and IT related subjects especially the trend of applied computing emphasizing cloud computing in Indian private universities.

Keywords
Computing, Indian Universities, Higher Education, India, Development, Cloud Computing, Emerging Degree, New Age Program, Private Universities

Introduction
Cloud Computing is an important branch within Information Technology. It is the virtualization of resources. Among the other emerging Information Technology components, few important are Big Data Technologies, Human Computer Interaction, User Experience Designing, Internet of Things

(IoT) etc. Though, in Indian context Information Technology is about the extension of Computing/ Computer Application. Internationally universities not only added the components of Networking Technologies, Database Technologies, Communication Technology, Multimedia Technology, Web Technology etc in the Information Technology but also these emerging and super specialty programs [1], [5]. Cloud Computing hence an Applied Science field of Information Technology but in recent past, it has noted that many universities have started the Cloud Computing program as a major/ specialization / concentration in academia. Though Computer Science is core and deals with the following areas—

- Theory of Computation
- Compilers and Operating Systems
- Computer Architecture & Parallel Processing
- Embedded System
- VLSI Technology
- Theory of Computation
- Numerical Methods
- Automata Theory
- Algorithms and Data Structure
- Computer Graphics and Image Processing
- Integrated Circuit and Signal Processing
- Machine Learning with AI
- High Level Languages
- Software Engineering
- Internet Technology
- Visualization
- Cryptography
- Distributed Computing

Though it is important to note that within the Information Technology (IT) the following are emerging subjects viz.

- Fundamental of Information Technology
- Information Systems
- Database Technologies
- Relational and Object Databases for Industries and Applications
- IT for Society
- IT for Business Process
- Computer & Information Networking
- Multimedia Technology
- Human Centered Computing
- Web Systems and Technology
- Programming Languages
- Advance Routing and Switching
- Data Mining
- Data Warehousing
- Big Data Management
- Cloud Computing & IT

- Green ICT

The field of Computer Application/ CSE additionally just includes the areas of Software technologies such as programming languages, systems application, simulations etc [2], [3]. Hence it is a great matter that the Indian universities are moving towards new age subjects and areas within Information Technology in the line of international universities. Private Universities have started the program in different level viz. Bachelors, Masters, Doctoral etc [4], [7].

Objective and Agenda

The paper is conceptual in nature emphasizing new policies and moreover mainly deals with the following aim and agenda viz.

- To learn about the basics of Computing and Information Technology in general and features.
- To know about the components of Computing and Information related fields viz. Computer Science, Computer Application, Information Technology etc.
- To learn about the Indian Higher Education Systems with reference to the private universities in brief.
- To know about the emerging and super specialty areas of Computing and Information Sciences.
- To learn about the basics of Cloud and emerging allied technologies in brief with available educational programs in Indian Universities.

Computing & Academics: An Overview of Super Specialty Age

Computing and Information Sciences is emerging rapidly and now there are many subjects have been developed and generated internationally among these few important are Big Data Science, Big Data Technologies, Human Computer Interaction, Usability Engineering, User Experience Designing, Cloud Computing, Virtualization, Internet of Things (IoT) etc. These are part of several sub fields of Networking Technologies, Database Technologies, Communication Technology, Multimedia Technology, Web Technology etc [6], [8].

Cloud Computing and Virtualization: An Overview emphasizing Need

Cloud Computing is a virtualization tool and a significant pool of resource sharing depending upon requirement and uses. Cloud Computing helps in making centralized storage, virtual memory, high speed processing, high bandwidth etc. Cloud Computing is required for the dynamic allocation, scaling, movement of various affairs and objects applications, massive, web scale abstracted infrastructure and for this no further software packages and hardware utilization are required. Among the areas Cloud Computing and assurance is an important and popular sub domain of computer security, Cloud Computing may be mainly three types private cloud, public cloud, hybrid cloud. Based on the platform this may be Software as a Service, Infrastructure as a Service, Security as a Service, Platform as a Service etc [9] [11].

Indian HEIs and Cloud Computing as a Program

Indian Higher Education is changing rapidly, this is the most largest knowledge provider with more than 40000+ Higher Educational Institutes [10], [12]. As far as the degree awarding body is concerned there are about 800+ universities pan India basis with different types viz. Central Universities, Private Universities, Deemed Universities, State Universities etc. In India, Information Technology basically concentrated on the area of software and programming technologies and few on Data and Networking Technologies whereas internationally there is a healthy focus on the allied technologies viz. Networking Technologies, Database Technologies, Communication Technology, Multimedia Technology, Web Technology [8], [13], [14].

Hence in the latest of Cloud Computing and allied fields is the part of Networking Technology in many contexts. In recent past, many universities have been started the Cloud Computing programs in a different way. In the present study Cloud Computing and allied areas (Networking, Virtualization) have been mapped in the private universities. And it has been studied that the areas are being offered in Engineering, Technology, Science, Management, Computer Application etc with the focus viz.—

- Full-fledged Degree
- Major/ Honors
- Specializations

The following table (Table: 1) depicted the list of private universities and Cloud Computing and allied programs.

Table: 1-List of Private Universities and the programs on Cloud and Allied Subjects

Sl. No.	Private Universities with Cloud & Allied Technologies (UG & Above)	
	Universities	**Programs**
Arunachal Pradesh		
1	Himalayan University	BSc-Networking/ Telecommunication/ MSc-Tele Communication) (Relevant)/ MSc- Networking
Assam		
2	Assam Down Town University	BCA/MCA Integrated- Cloud Technology & Information Security (Science) / BCA-Cloud Technology & Information Security (Science) BTech-CS (Cloud Technology & Information Security)
3	The Assam Kaziranga University	BCA-MCA Integrated (Cloud Technology & Information Security)/ MCA (Cloud Technology) with Math/ MCA (Cloud Technology) Lateral
Bihar		
Absent		
Chhattisgarh		
Absent		
Gujarat		
4	Ganpat University	BSc-MSc (Tech)- IT IMS (Relevant Paper)/ BTech /MTech CSE-(Cloud Based Applications)/ MSc (Tech)- IT Infrastructure Management Services
5	Nirma University	BTech-CE (Minor: IoT with Cloud) BTech-IT (Minor: IoT with Cloud) MSc eligible MTech-IT (Networking- with Minor IoT & Cloud) MTech-CE (Information & Network Security with Minor IoT & Cloud)
6	Navrachana University	MSc-IT (Network Administration)- Any Degree
7	R.K.University	MSc-IT (Cloud Technology) MSc-IT (Infrastructure Managed Service)
8	Team Lease Skills University	BSc-IT Infrastructure Management Service
Haryana		
9	Amity University	BTech (Network & Cyber Security) MSc-Network Technology & Management): Related Degree
10	Ansal University	MTech-CSE (Network & Information Security) MTech-CSE (Tele-commutation & Mobile Technology)
11	Apeejay Stya University	BTech-CSE (Cloud Computing) PGD in Cloud Computing
12	Jagan Nath University	BTech-CSE (Cloud Computing & Virtualization)-IBM
13	PDM University	BTech-CSE (Cloud Computing)-IBM

14	Shree Guru Gobind Singh Tricentenary University	BTech-CSE (Network & Cyber Security) MTech-CSE (Networking)
15	The Northcap University	BTech-CSE (Network & Cyber Security) MTech-CSE (Networking)
Himachal Pradesh		
16	Shoolini University of Biotechnology and Management Sciences	BTech-IT (Cloud & Information Security)
Jharkhand		
Absent		
Karnataka		
17	Dayanand Sagar University	MTech- CSE (Cloud Computing)
18	Institute of Trans-Disciplinary Health Sciences and Technology University	MSc-CS CS (Data Analytics) Integrated MSc-CS (Data Analytics)
19	JSS Science & Technology University	MTech- Network & Internet Engineering
20	PES University	MTech-CSE (Cloud Computing)
21	Reva University	BS-CS (Cloud Computing & Big Data) MTech- Data Engineering & Cloud Computing MTech-Computer Network Engineering
22	Srinivas University	BCA (Data Analytics & Cloud Computing) Integrated MCA (4 Year) & Trimester Based (10+2 Any)- (*With Specialization Networking & Cloud Computing with 2nd Big Data*) 2 Year MCA (Related Degree)- *With Specialization Networking & Cloud Computing with 2nd Specialization Big Data/* MPhil (Data Analytics & Cloud Computing/ MPhil (Business Analytics & Cloud Computing)
Meghalaya		
Absent		
Mizoram		
Absent		
Madhya Pradesh		
23	Avantika University	BTech-CSE (Networking) BTech- Cloud Computing
24	Jagran Lakecity University	BTech-CSE (Cloud Technology & Information Security)
25	People's University	BTech-CSE Cloud Computing & Virtualization) BTech-IT (Cloud Computing & Virtualization)
26	Shri Vaishnav Vidyapeeth Vishwavidyalaya	BTech-CSE (Cloud & Mobile Computing)-IBM
27	Mandsaur University	BCA (Cloud Computing)
28	PK University	BTech-CSE/IT (Cloud Computing & Virtualization)
29	RKDF University	BTech-CSE/IT (Cloud Computing & Virtualization)
30	Sarvepalli Radhakrishnan University	BTech-CSE/IT (Cloud Computing & Virtualization)
Maharashtra		
31	Ajeenkya D.Y. Patil University	BTech-(Cloud Technology & Information Security) BTech-Mobile Application & Cloud Technology) BCA (Cloud Technology & Information Security) BCA (Mobile Application & Cloud Technology)
32	MIT Art Design & Technology University	BTech-CSE (Network & Security) MTech-CSE (Network Security)
33	Sandip University	BTech- Cloud Technology & Information Security MTech-Cloud Technology & Information Security BCA- Cloud Technology & Information Security (10+2 with Math)
Manipur		

Absent		
Nagaland		
Absent		
Odisha		
34	Centurion University of Technology and Management	BTech-CS (Cloud Technology & Information Security)-iNurture BSc-IT (Cloud Technology & Information Security)
Punjab		
35	Chandigarh University	BCA (Information Security & Cloud Computing BE(Hons) CSE (Cloud Computing)-IBM BE/ME (Hons) CSE (Cloud Computing)-IBM
36	Guru Kashi University	MTech- Cloud Computing (MSc eligible)
37	GNA University	BTech-Cloud Computing (all BTech 10+2 Any)
38	Lovely Professional University	MBA (Business Analytics)
39	Rayat Bahra University	MCA- Networking (Any Degree)
Rajasthan		
40	J.E.C.R.C University	MTech- CSE (Computer Network & Security)
41	J.K. Lakshmipat University	BTech-CSE (Cloud Computing)-IBM BTech-CSE (Enterprise IT)-IBM
42	Manipal University	MTech- / Information & Network Security-with CDAC
43	Mody University of Science and Technology	BTech-CSE (Cloud Computing)—IBM
44	Poornima University	BTech-CSE (Cloud Technology & Information Security) BCA (Mobile Application & Information Security-10+2 with Science/ BCA (IT Infrastructure Management & Cloud Technology-10+2 Any)
45	Sir Padmapat Singhania University	BTech-CSE (Cloud Technology & Information Security)-iNurture
Sikkim		
46	Sikkim Manipal University	BCA (Cloud Technology & Information Security)
Tripura		
Absent		
Uttar Pradesh		
47	Amity University	MTech- Computer Network & Information Security MSc-Network Technology and Management PGD in Network Configuration & Management
48	GLA University	BTech-CSE (Cloud Computing/ Virtualization)
49	Galgotias University	BTech (H)-CSE (Computer Network & Cyber Security) BTech (H)-CSE (Cloud Computing) BTech (H)-CSE (Telecom Informatics) BTech (H)-CSE (Cloud Technology & Cyber Security BTech (H)-CSE (IT Infrastructure)
50	Invertis University	BTech-CSE (Cloud Technology)
51	Rama University	BTech-CS (Cyber & Network Security)
52	Sharda University	BTech-CSE (Cloud Computing & Virtualization)-IBM BTech-CSE (Information Security & Cloud Technology)-iNurture MTech-CSE (Networking)
53	Shobhit University	MCA (Networking)- Any Degree

54	Teerthanker Mahaveer University	BTech-CSE (Cloud Technology & Information Security) -iNurture BTech-CSE (Cloud & Mobile Based Applications/ Big Data Analytics)-IBM
55	The Glocal University	BTech-CSE (Cloud Computing & Cyber Security)
Uttarkhand		
56	DIT University	BTech-CSE (Cloud Computing-IBM)
57	University of Petroleum and Energy Studies	BTech-CSE (Cloud Computing & Virtualization) BTech-CSE (IT Infrastructure) BTech-CSE Telecom Informatics (all with IBM)
58	Graphic Era Parvatiya Vishwavidyalaya	BTech-CSE (Cloud Computing)
West Bengal		
Absent		

According to the study, it has been noticed that a large number of private universities are now offering degrees leading to the Cloud Computing concentration (58 universities) and among these universities, maximum are from Madhya Pradesh (total 8), Haryana (total 7), Karnataka & Rajasthan (6 each). Another field is Computer Application which is concentrated on Software Technologies and programming viz. programming with C, C++, Java Programming, PHP, VB.NET etc. Though the traditional concept of Computer Application become change and now several other technologies (mainly IT components) also been added such as—

- Database Technologies
- Web Technologies
- Networking Technologies
- Multimedia Technologies etc

Hence among the super specialty areas within Networking Technologies Cloud Computing is important and vital one.

Table: 2- Depicted Cloud Computing specialization in Computer Applications

Sl. No.	Private Universities in India offering Cloud and Allied Technologies Programs (Computer Application Track)	
	Universities	**Programs**
1	Assam Down Town University	BCA/MCA Integrated- Cloud Technology & Information Security / BCA-Cloud Technology & Information Security
2	The Assam Kaziranga University	BCA-MCA Integrated (Cloud Technology & Information Security)/ MCA (Cloud Technology)
3	Srinivas University	BCA (Data Analytics & Cloud Computing) Integrated MCA (4 Year) & Trimester Based (10+2 Any)- (*With Specialization Networking & Cloud Computing with 2nd Big Data*) 2 Year MCA (Related Degree)- *With Specialization Networking & Cloud Computing with 2nd Specialization Big Data*
4	Mandsaur University	BCA (Cloud Computing)
5	Ajeenkya D.Y. Patil University	BCA (Cloud Technology & Information Security) BCA (Mobile Application & Cloud Technology)
6	Sandip University	BCA- (Cloud Technology & Information Security)
7	Chandigarh University	BCA (Information Security & Cloud Computing)

8	Rayat Bahra University	MCA- Networking (Any Degree)
9	Poornima University	BCA (Mobile Application & Information Security-10+2 with Science/ BCA (IT Infrastructure Management & Cloud Technology-10+2 Any)
10	Sikkim Manipal University	BCA (Cloud Technology & Information Security)
11	Shobhit University	MCA (Networking)- Any Degree

Findings

- Information Technology is most emerging fields and study areas which are concentrated on various broad technologies viz. Networking Technologies, Database Technologies, Communication Technology, Multimedia Technology, Web Technology.
- Among the emerging areas of technologies of few important are include Big Data Technologies, Human Computer Interaction, User Experience Designing, Internet of Things (IoT).
- Cloud Computing today not only treated as a virtualization and tools it is now a day becomes a subject and field of Information Technology.
- Cloud Computing and related areas are now available as a degree program with Major/ Hons./ Specializations in major Indian private universities.
- Total 58 private universities are offering Cloud Computing and allied subjects (including Networking) as a degree leading to BSc, MSc, BCA, MCA, BTech, MTech.
- Total 11 private universities have started Cloud Computing and allied areas within the degree of Computer Application (BCA & MCA).

Table: 3- Depicted Cloud Computing specialization in Engineering track

Sl. No.	Private Universities in India offering Cloud and Allied Technologies Programs (Engineering Track/Masters)	
	Universities	**Programs**
1	Nirma University	MTech-IT (Networking- with Minor IoT & Cloud) MTech-CE (Information & Network Security with Minor IoT & Cloud)
2	Ansal University	MTech-CSE (Network & Information Security) MTech-CSE (Tele-commutation & Mobile Technology)
3	The Northcap University	MTech-CSE (Networking)
4	Dayanand Sagar University	MTech- CSE (Cloud Computing)
5	JSS Science & Technology University	MTech- Network & Internet Engineering
6	PES University	MTech-CSE (Cloud Computing)
7	Reva University	MTech- Data Engineering & Cloud Computing MTech-Computer Network Engineering
8	Sandip University	MTech-Cloud Technology & Information Security
9	Chandigarh University	ME (Hons) CSE (Cloud Computing)-IBM
10	Guru Kashi University	MTech- Cloud Computing (MSc eligible)

11	J.E.C.R.C University	MTech- CSE (Computer Network & Security)
12	Manipal University	MTech- / Information & Network Security-with CDAC
13	Amity University	MTech- Computer Network & Information Security
14	Sharda University	MTech-CSE (Networking)

Conclusion

The universities are moving towards the new age subjects and courses in todays age and thus many IT programs have been started internationally. In Computer Science field also many academic units are moving towards the new age papers within the curricula and most of these are part of Information Technology field. Cloud Computing and allied technologies become the new age technologies these days and universities are moving towards new age educational programs and specializations. Based on the concept of international universities in recent past Indian universities have also started new age programs emphasizing Cloud Computing, Virtualization, Big Data Technologies and so on. Private Universities of Madhya Pradesh, Haryana, and Karnataka play a leading role in this development phase. Similarly in future State and Central Universities also need to start these programs for solid and healthy manpower development in these areas. Though starting these programs means doing the affairs with challenges and thus universities need to take right decisions in this regard.

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