



BSC IN COMPUTING AND IT RELATED SUBJECTS WITH FLEXIBLE AND CHANGING ENTRY CRITERIA: INTERNATIONAL TRENDS AND ADOPTION IN INDIAN PRIVATE UNIVERSITIES—A KNOWLEDGE SURVEY

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Abstract

The world is changing rapidly empowered by the information, technology and research affairs. And for the promotion of these facets education play a great role. Developing country like India needs special support on educational promotion and development. Universities and Higher Educational Institutions (HEIs) have been changed rapidly in last few years in India. Thus many new subjects, interdisciplinary subjects have been started in recent years in Indian educational institutions. In this respect subjects in the areas of Computing and Information Technologies many newer subjects have been developed internationally and also in India. There are closely related fields within the Computing and Information Technologies and all having different characteristics and applications in respective cases. International Universities are moving towards new generation programs and areas within Computing and Information Technologies for the development and applications. Traditionally within the field of Computing and Information Technologies 'Computer Science' treated as the first one with a due focus on mathematics and theoretical sciences. Gradually many other subjects have originated in the areas include Information Technology, Information Systems, Software Systems, Computer Applications etc. In India, among these subjects, only Computer Applications and Information Technology are widely available and practiced. The study is restricted to private universities and the programs offered in Computing and Information Technologies areas with Bachelors degree with special reference to the BSc degree only. Paper highlighted the changing pattern of eligibility and flexibility in this regard as well.

Keywords: Information, Computing, India, Development, BSc, BSc-CS, Higher Education, Research and Development, Universities, BSc-IT.

Introduction

The world is changing and in respect of the development of educational affairs as well there has been a significant move noticed in recent past in a country like India as well [1], [3], [4]. As far as Indian Universities are concerned, private universities have developed newer models and methods in educational delivery. They are also responsible for the creation and development of new age programs, degrees, subjects and so on. The field of Computing and Information Technologies is vast and today consists of several subjects and areas ranging from Computer Science, Computer

Engineering, Computing, Computer Systems etc. Though additionally later-on information segment was introduced with different other areas and knowledge such as Informatics, Information Science, Information Systems, Information Management, Information Engineering and so on [2], [5], [8]. However in the Indian context, all these subjects are unavailable; here mainly Computer Science, Computer Engineering (available as merged CSE), Computer Application programs are offered in different types of universities including private one. Internationally Bachelors degrees are available with BS/BSc award. Though in few European and its follower countries additionally Technology and Engineering track is also available at Bachelors level with BE/BTech award. In India also both Science and Technology track is common in Computing and Information Technology fields mainly in the subject of CS/CSE and IT. Though apart from these, Computer Application subject is available with the degrees of BCA and MCA in Bachelors and Masters levels respectively [6], [9]. Initially, CS is considered only for the same or Mathematical Science background but the growing need of the manpower changed the syllabus of international universities and thus flexible eligibility has been adopted, beyond same subject/ Mathematical Science requirement.

Objective and Methods

The present paper is theoretical in nature and deals with the education of computer science and information technology. It mainly lies on following aim and objectives in brief—

- To learn about the higher education systems in India with reference to the universities in a brief manner and to learn the degrees and programs available in the field of information and computing not only in international universities but with emphasis on Indian context.
- To explore the nature and differences in computing and information related field in Indian and International context.
- To dig out the general criteria for the eligibility of Computing and IT programs with reference to BSc degrees in India.
- To find out the changing eligibility criteria of BSc program in the areas of Computing and Information Technologies specifically in the private universities in India.
- To learn about the need of changing eligibility criteria in BSc in the areas of Computing and Information Technology programs with its proper justification.
- To learn about the emerging programs of BSc in the Computing and Information Technologies offered by the private universities.

The present study entitled ‘BSc in Computing and IT related subjects with flexible and changing entry criteria: International Trends and adoption in Indian Private Universities—A *Knowledge Survey*’ has adopted a different kind of methods initially the review of literature and thus books and journals etc were reviewed to learn about the basics of Computing and Information Technologies; including its need, characteristics, nature, educational programs available etc. Moreover, web review was undertaken to reach the goal and hypothesis of the topic concerned and here core URL considered of UGC (<https://www.ugc.ac.in/privatuniversity.aspx>), due to the aimed hypothesis on private universities mapping in respect of Computing and Information Technologies programs with BSc degree in India.

Indian Education, Private Universities and Computing and IT related Programs

Indian Higher Education system is large enough with over 40,000+ institutions in its bag. Among the Higher Educational Institutes (HEIs) important and components are Colleges, Universities, Research and Autonomous Centres, Institute of National Importance etc. The degree awarding bodies are included 800+ universities and among these private universities are 279+ (as on October, 2017). All the universities have the power to confer all the degrees irrespective of their type/ funding. Among the private universities Rajasthan holds the first position, Gujarat got the second position whereas Uttar

Pradesh holds the third position with numbers 46, 30 and 29 respectively (*Table: 1 provides a detailed distribution*).

Computing and Information as a Field and BSc Degrees: Flexibility-Why and How?

Internationally initially the courses on Computer related nomenclatures were started which include Computer Science, Computer Engineering, Computing, Computer Systems etc. However, later-on due to the requirement in the industry and organizations several newer applied fields have been originated within information segment as well, and thus introduced different other areas and knowledge such as Informatics, Information Science, Information Systems, Information Management, and Information Engineering. The following are the availability of programs in World Vs. India—

- **Computer Science**-The field is highly mathematical and theoretical and mainly deals with the internal affairs of computers including architecture, systems, evaluation, and designing. It partially deals with the software technologies/ systems. It is available internationally mainly with BS/MS Degree whereas it is available in India as BSc/MSc and in few institutions with BTech/MTech (also called BE/ME) Degrees.
- **Computer Engineering**-The field is very close to the Computer Science but it is mainly focused on designing and development of newer computing systems etc. It is more hardware centric but also deals with Software Technology components. Internationally it is available with BS/MS Degree but in India, this program is not offered as BSc/MSc Degree. But merged Computer Science and Computer Engineering is offered as 'CSE' with BTech/MTech in a large number of Indian institutions especially in the Engineering Colleges.
- **Computing /Computer Systems**-The branch is available in International universities with a special focus on applications in different settings and due concentration on software technologies and components. In India, the branch is unavailable though, a similar program has started and still widely available in Indian Universities as 'Computer Application' program. The Computer Application is available with BCA and MCA Degrees except few universities have started with BSc/MSc degree.
- **IT/Information related Fields**-In India, IT/Information related programs mainly offered with the tag of Information Technology; which is a broad domain consists of different kind of technologies viz. Database Technology, Web Technology, Multimedia Technology, and Networking Technology in addition to Software Technology (the branch Computing/CA which covered and deals mainly).

Internationally several Information related fields are available like Informatics, Information Science, Information Systems, Information Management, Information Engineering whereas in India only Information Technology nomenclature is available with both Science and Technology track (BSc/MSc/BTech/MTech). Internationally IT is available as BS/MS degrees [6], [7], [10].

Thus, as far as Indian Universities are concerned BSc Degree is mainly offered in the following nomenclature and subjects viz. BSc-Computer Science/Information Technology/ Computer Application (very limited offer). No other nomenclature offered in the areas mentioned above with BSc tag. Moreover, Private Universities are mainly concentrated on only CS and IT (BSc) degree. The field of Computer Science is mathematical and the core of theories and designing and thus initially only the Mathematical Science or Computer Science permitted to pursue the program at MSc level whereas at BSc level it was open to 10+2 qualification with a pure Science background. However in

the case of Information Technology (BSc) due to its concentration on the application and lesser in Mathematics many international universities allow candidates as 10+2 with Computer/IT as a paper and even 10+2 qualification in any stream!

In recent past, many international universities have changed their curricula as per the market demand and were included several IT components and applied components, thus many universities accept the eligibility as 10+2 with Mathematics as a paper/course only. Even, more than that, many universities have started accepting eligibility as 10+2 with Computer as a paper/course. Another significant move is 10+2 eligibility in any discipline.

Thus in India also many BSc programs (in private universities) accept such criteria of 10+2 with Computer science as a paper or even 10+2 in any stream!

Surprisingly, the subjects are not only from the Information Technology but also from Computer Science. Table: 1 depicts the distribution of the private universities in India with reference to the flexible accepting BSc Computing and IT programs and universities.

Table: 1-Indian Private Universities with flexible entry to the BSc in IT and Computing fields (also number of programs).

Serial No.	States	No. of Universities	No. universities having Flexible entry in BSc in IT & Computing related fields/ programs	Flexible entry in BSc in IT & Computing related fields/ programs
1	Arunachal Pradesh	7	1	2
2	Assam	5	Nil	Nil
3	Bihar	2	Nil	Nil
4	Chhattisgarh	9	2	2
5	Gujarat	30	3	4
6	Haryana	20	4	4
7	Himachal Pradesh	17	1	1
8	Jharkhand	7	1	1
9	Karnataka	14	1	1
10	Meghalaya	8	1	1
11	Mizoram	1	Nil	Nil
12	Madhya Pradesh	24	7	10
13	Maharashtra	9	1	1
14	Manipur	1	Nil	Nil
15	Nagaland	3	Nil	Nil
16	Odisha	4	Nil	Nil
17	Punjab	15	8	9
18	Rajasthan	46	6	8
19	Sikkim	5	3	3
20	Tripura	1	Nil	Nil
21	Uttar Pradesh	29	3	4
22	Uttarakhand	13	3	3
23	West Bengal	9	Nil	Nil
Grand Total		279	45	54

According to the study it has noted that among the 279 private universities 45 universities (irrespective of the number of programs) offer various flexible BSc programs in the Computing and IT related subjects. Some of the universities even have more than one program with the flexible entry of 10+2 in any stream. Among the North East States, the universities in Arunachal Pradesh, Sikkim, and

Meghalaya, and in the North and South States, a large number of universities are offering such flexibilities. In the Western States, Gujarat and Punjab are the main stakeholders. The state wise list and the programs are depicted in the Table: 2 herewith.

Table: 2-Indian Private Universities with flexible entry to the BSc in IT and Computing-Detailed overview

Sl. No.	Universities with BSc-IT/CS Program at a Glance: Beyond Mathematics/ Computing requirement	
	Universities	Programs & Eligibility
Arunachal Pradesh		
1	North East Frontier Technical University	BSc-CS (Any 10+2) BSc-IT (Any 10+2)
Assam		
	Absent	
Chhattisgarh		
2	ISBM University	BSc-IT (Any 10+2)
3	Maharishi University of Management and Technology	BSc-IT (Any 10+2)
Gujarat		
4	AURO University of Hospitality and Management	BSc-IT (Any 10+2)
5	Calorx Teacher's University	BSc-CS (Any 10+2) BSc-IT (Any 10+2)
6	Charotar University of Science & Technology	BSc-IT (Any 10+2)
7	NIILM University	BSc-CS (Any 10+2)
Haryana		
8	Amity University	BSc-IT (Any 10+2)
9	G.D. Goenka University	BSc-IT (Any 10+2)
10	Starex University	BSc-CS (Hons) (Any 10+2)
Himachal Pradesh		
11	Indus International University	BSc-IT (10+2 Any)
Jharkhand		
12	Amity University	BSc-IT (10+2 Any)
Karnataka		
13	Garden City University	BSc-IT (10+2 Any)
Meghalaya		
14	Mahatma Gandhi University	BSc-IT (10+2 Any)
Madhya Pradesh		
15	A.K.S. University	BSc (H)-IT (10+2 Any) BSc-CS (H)- (10+2 Any)
16	Amity University	BSc-IT (10+2 Any)
17	G.H. Rasoni University	BSc-IT (10+2 Any)
18	Maharishi Mahesh Yogi Vedic Vishwavidyalaya	BSc-CS (10+2 Any)
19	P.K. University	BSc-CS (10+2 Any) BSc-IT (10+2 Any)
20	Sarvepalli Radhakrishnan University	BSc-CS (10+2 Any) BSc-IT (10+2 Any)
21	Swami Vivekananda University	BSc-IT (10+2 Any)
Maharashtra		
22	Amity University	BSc-IT (10+2 Any)
Manipur		
	Absent	
Nagaland		
	Absent	
Punjab		

23	Chandigarh University	BSc-CS (10+2 Any)
24	D.A.V. University	BSc-CS (10+2 Any)
25	Desh Bhagat University	BSc-IT (10+2 Any)
26	Guru Kashi University	BSc-IT (10+2 Any)
27	Lovely Professional University	BSc-CS (10+2 Any) BSc-IT (10+2 Any)
28	RIMT University	BSc-CS (10+2 Any)
29	Sant Baba Bhag Singh University	BSc-IT (10+2 Any)
30	GNA University	BSc-IT (10+2 Any)
Rajasthan		
31	Career Point University	BSc-IT (10+2 Any)
32	Mahatma Jyoti Rao Phoole University	BSc-IT (10+2 Any) BSc-CS (10+2 Any)
33	Mody University of Science and Technology	BSc-CS (10+2 Any) BSc-IT (10+2 Any)
34	Shri Jagdish Prasad Jhabarmal Tibrewala University	BSc-IT (10+2 Any)
35	Shridhar University	BSc-IT (10+2 Any)
36	Singhania University	BSc-IT (10+2 Any)
Sikkim		
37	SRM University	BSc-IT (10+2 Any)
38	Sikkim Manipal University	BSc-IT (10+2 Any)
39	Vinayaka Missions Sikkim University	BSc-IT (10+2 Any)
Uttar Pradesh		
40	Amity University	BSc-IT (10+2 Any)
41	J.S. University	BSc-CS (10+2 Any) BSc-IT (10+2 Any)
42	Rama University	BSc-IT (10+2 Any)
Uttarkhand		
43	Graphic Era Parvatiya Vishwavidyalaya	BSc-IT (10+2 Any)
44	Motherhood University	BSc-IT (10+2 Any)
45	Shri Guru Ram Rai University	BSc-IT (10+2 Any)
West Bengal		
Absent		

It is worthy to note that among the universities few universities offer two different nomenclatures with BSc Degree such as both ‘Computer Science’ and ‘Information Technology’ and thus the number of the program reached 54 (fifty four) against 45 university’s flexible criteria. State wise first rank in respect of the highest number of programs offered by the Madhya Pradesh whereas Punjab and Rajasthan hold second and third positions respectively (refer Fig:1 for more clarification including the number of programs).

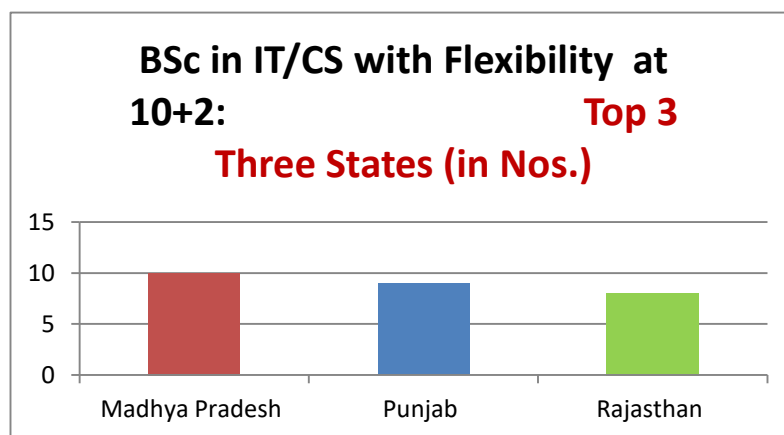


Fig: 1-Flexible Criteria in BSc in IT and Computing related fields from 10+2 candidates

It is worthy to note that few universities also accepted and offered two degrees and such are include (mainly BSc-Computer Science and BSc-Information Technology); among these universities few are—

- *North East Frontier Technical University*
- *Calorx Teacher's University*
- *A.K.S. University*
- *P.K. University*
- *Sarvepalli Radhakrishnan University*
- *Mahatma Jyoti Rao Phoole University*
- *Mody University of Science and Technology*
- *Lovely Professional University*

It is also studied as per the present work that the universities also offered another computer centered/ focus subject called 'Computer Application' with the Degree BCA. And the study shows that among the 279 private universities a large number of BCA programs are offered (i.e. 107 Programs). The table: 3 in this respect offers a detailed overview of State wise distribution of BCA program Vs. BSc-IT and Computing related fields. It is important to note that these are flexible programs only for 10+2 in any stream irrespective of Science or Math or even Computing as a paper requirement.

Table: 3-Indian Private Universities with flexible entry to the both BCA and BSc in IT and Computing programs

Serial No.	States	No. of Universities	Flexible entry in BCA programs
1	Arunachal Pradesh	7	3
2	Assam	5	2
3	Bihar	2	Nil
4	Chhattisgarh	9	4
5	Gujarat	30	9
6	Haryana	20	6
7	Himachal Pradesh	17	8
8	Jharkhand	7	2
9	Karnataka	14	5
10	Meghalaya	8	4
11	Mizoram	1	1
12	Madhya Pradesh	24	10
13	Maharashtra	9	4
14	Manipur	1	1
15	Nagaland	3	Nil
16	Odisha	4	1
17	Punjab	15	11
18	Rajasthan	46	20
19	Sikkim	5	Nil
20	Tripura	1	1
21	Uttar Pradesh	29	9
22	Uttarakhand	13	4
23	West Bengal	9	2
Grand Total		279	107

Hence Private Universities offers 107 BCA programs with flexible and changing eligibility criteria (10+2 Any Stream) whereas 54 programs are available with the following tag—

- BSc-Computer Science
- BSc-Information Technology

It is observed that few universities have also added the Honors tag within the BSc Degrees such as Amity University; Madhya Pradesh, AKS University; Madhya Pradesh, Starex University; Gujarat etc.

Suggestion and Result

- Many Universities have started BSc with flexible criteria as per the trend of international universities; no doubt it is a good move in respect of providing skilled and adequate manpower and also providing an opportunity to large number of the candidates who are interested the education in the concerned/ allied subject. It is important to note that the program may be offered to the Polytechnic Candidates with Lateral Entry option.
- The BSc degree is available with Computer Science; which is theoretical and internal affairs dealing of the university and instead of only BSc-IT from information circle but other emerging domains may be also be introduced like Informatics, Information Science, Information Systems, Information Management, and Information Engineering as per international trend.
- Candidates with relevant skill and experiences with any background may also be allowed enter into the programs in the universities where still 10+2 with Science is the pre-requisites.
- Within the BSc in Information Technology, several sub fields and components may be offered as a specialization such as BSc in Information Technology (Networking), BSc in Information Technology (Web Technology), BSc in Information Technology (Database Technology) etc.
- Similarly in Computer Science, the areas viz. Software Technology, Machine Learning, Artificial Intelligence etc may be offered in the BSc-Computer Science with the model such as BSc-Computer Science (AI and Machine Learning) etc.

Conclusion

The world is changing and in Information and Computing fields apart from the domains mentioned above many emerging and super specialties have been introduced. This also supported to the introduction of the education programs leading to the BSc in the areas such as Cloud Computing, Big Data Technologies, Human Centered Computer etc. The criteria adopted in large number of private universities may be also offered in other universities as well; because ultimately world is changing and universities around the world have to become more flexible and board-minded with accepting emerging concepts, educational planning, and policies. Hence the changes in the norms towards the flexibility not only help the candidates wish to study the IT and Computing field but also it may create a new arena in the jobs and adequate, skilled manpower. Ultimately development and progress including reaching a new age and Digital Society and Economy many ways may be the current and timely educational policies and in this regard flexibility is a good and best way as started in Indian educational systems in the line of western nations!

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