International Journal on Recent Researches in Science, Engineering & Technology (IJRRSET)
A Journal Established in early 2000 as National journal and upgraded to International journal in 2013 and is in existence for the last 10 years. It is run by Retired Professors from NIT, Trichy. Journal Indexed in JIR, DIIF and SJIF.
Research Paper
Available online at: www.jrrset.com
UGC Approved Journal No: 45483
Received on: 07.02.2018 Published on: 28.02.2018 Pages : 24-33

ISSN (Print) : 2347-6729
ISSN (Online) : 2348-3105
Volume 6, Issue 3, March 2018.
JIR IF : 2.54
DIIF IF : 1.46
SJIF IF : 4.334

COMPUTING & INFORMATION SCIENCE DEGREES WITH EMERGING FLEXIBILITIES AND ENTRY LEVEL CRITERIA: STUDY OF MSC PROGRAMS IN IT AND COMPUTING FIELDS IN INDIAN PRIVATE UNIVERSITIES

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Abstract
The world is changing and purely depends on Information rather computer. And for information affairs Computing and similar devices and technologies are very much important in current time. The domain initially started with Computer Science but these days the concept of applied science and interdisciplinary sciences lead various other domains and nomenclatures. The popular programs in the field available with BSc and MSc degree, while in India and few other countries the Computing and Information Sciences related programs also offered as Engineering Degree and thus BTech and MTech programs are also offered. In some countries and universities instead of BE (Bachelor of Engineering) and ME (Master of Engineering) nomenclature are also being offered. In India, the field is available with Science and Engineering in general, however here another discipline is popular with BCA and MCA tag for the candidates of diverse background. In India, Higher Educational Institutes have risen in recent past and among the universities, the categories of Private funded institutions have been increased enormously. The worldwide changes in the academic model, platform, curricula, and eligibility criteria also affect and change the Indian Education System with special reference to Private Universities. Initially, Science programs were open only for science background (except BCA and MCA) but recently non-science candidates are allowed to pursue science based courses. In case of MSc degree in the field of Computing and IT or simply Information Sciences the tradition of science backgrounds become changed; this paper in this respect explores a lot with reference to the initiatives of the private universities in India.

Keywords
Information, IT, Computing, MSc, Masters Degree, Any Degree, Interdisciplinary, India, HEIs, Private Universities, Information Sciences in India.

Introduction

Computing is the core of today's digitalization, modernization as well as automation. Information Technology changes the entire systems of living style and civilization at large. The business, organizations, healthcare settings, educational institutions, government and administration, transportation etc are truly technology depended. Among the technologies, Computing and Information Technology play a lead role for the development of the society [1], [4], [5]. The subjects

and fields in this regard play a great role for the promotion of technologies in respect of societies. Educational institutes including universities are in this regard doing well by producing qualified manpower leading to degrees in Bachelors, Masters, and Doctoral in the field of Computing and Information Sciences. Initially, Computer Science was the main domain in this respect but the development and need of a subject and knowledge in this context created various parallel domains and fields.

The subjects in this category include Computer Engineering, Computer Application, Computing etc. In Information space, few other domains got birth in recent past viz. Information Science, Informatics, Information Systems, Information and Knowledge Management etc. The combination of these information related subjects also called as Information Sciences. In India the Computing related subjects are common and widely available whereas, in Information related subjects most useful and widely available one is Information Technology. As the branch, whether Computing or Information Sciences fall under the category of Science so that the entry criteria for the fields remain science stream until 1990s. But the development of interdisciplinary research and changing educational requirement allows students other than Computing and IT field for the education and study in this field (i.e. IT and Computing etc), in recent past (mainly after 2000) [2], [7], [12]. After viewing a global trend Indian Universities are also doing well to fix such criteria in India in recent time.

Objective and Agenda

The work is a conceptual and theoretical policy based and aimed with educational-technologies for the betterment of society. The study mainly deals with the following aim and agendas viz.-

- To learn about the traditional areas of Computing and emerging areas including the newer nomenclatures.
- To dig out the main strategies and characteristics in the field of Computing and Information Sciences.
- To know about the degrees in Computing and Information Sciences offered internationally and in India.
- To depict the changing eligibility criteria in an educational program in the field of Computing and Information Sciences to prepare professional manpower in IT field.
- To see the transformation of flexible eligibility criteria in advance Computing and Information Sciences programs leading to Bachelors and Masters in India in the line of western countries.
- To learn about the higher education systems in India with reference to Indian Private Universities.
- To see adoption of flexible eligibility criteria in advance Computing and Information Sciences programs leading to Masters (MSc only) in Indian Private Universities in the line of western countries.

Methods Adopted

The present work ‘Computing & Information Science Degrees with emerging flexibilities and entry level criteria: *Study of MSc Programs in IT and Computing Fields in Indian Private Universities’* is conceptual in nature with a focus on theoretical overview on Computing and Information Science domains including changing nomenclature, nature, and eligibility criteria. Thus initially the review of literature used to do the task and later on web reviews undertaken to reach the aim, agenda, and hypothesis. Moreover as the study concerned in the territory of India so that official URL of bodies such as MHRD, AICTE and specifically UGC (https://www.ugc.ac.in/privatuniversity.aspx) used and analyzed the result of such task later on included in the research work.

Computing and Information Sciences: The Emerging World

Computing and Information Technology related field is now gained and is a big science and technology field. Internationally in Computing segment and areas some of the popular and emerging subjects include—

- ***Computer Science***: It is a field of theoretical nature and purely mathematical for dealing internal and core of computers; mainly hardware systems. Study, analysis, evaluation and designing and development of computer is the core concern of Computer Science. It has a partial focus on software and programming languages.

- ***Computer Engineering***: It is similar to the Computer Science and apart from this it is widely responsible for the affairs of designing, manufacturing, and development of computer systems. It has a partial focus on software and programming languages.

- ***Computer Systems***: The field Computer Systems is large and applied in nature with due weight in software systems and computer in diverse fields. The similar role based domain also called as '*Computing'* and in India as '*Computer Applications*'.

- ***Merged Computing Fields***: The advancement of education systems and newer educational methodologies brought several newer merged nomenclatures and fields' viz. Computer Science and Engineering, Computer Science and Application etc.

Whereas in Information and allied fields many subjects and fields have emerged for the role of collection, selection, organization, processing, management, and dissemination of information with the help of technologies; some of the subjects for doing these role are include—

- ***Information Technology***: Information Technology deals with information affairs and dealing with the help of several technologies viz. Network Technologies, Database Technologies, Web Technologies, Communication Technologies and Multimedia Technologies in addition to the existing Software Technologies (that deals with the Computer Application / Computing / Computer Systems).

- ***Information and Communication Technology***: It is similar to Information Technology but core concentration of the field is Communication and Network Technologies. It is widely available due to its role.

- ***Informatics***: A field of study and practice for the information affairs with a due concentration of Information Technologies and Management. It also takes care about fundamentals of Information.

- ***Information Science***: This field is truly interdisciplinary and broad it is responsible for the collection, selection, organization, processing, management and dissemination of information with the help of technologies in addition to the Management and Social Issues.

- ***Information Systems***: Information Systems is similar to Information Science but it has a core concentration and integration with Business and Organizational context and issues (whereas Information Science also concerns with Societies and issues).

- ***Merged Information related domains (Information Sciences)***: Apart from the fields and nomenclatures mention above there are many merged and interdisciplinary domains started internationally and among these few important are 'Information System and Technology', 'Information Science and Technology', 'Computer and Information Science' etc.

India and World: Computing and Information Sciences Degrees and General Norms

Internationally all the nomenclatures with the category of Computing are mentioned with degrees of Bachelor of Science (BS/BSc), Master of Science (MS/MSc) whereas in few universities and specific European and its follower countries the degrees are also available in Engineering track (BEngg./ MEngg.). But in India nomenclatures of Computing, Computer Systems not available but another nomenclature called 'Computer Application' started and widely available apart from CS/ CSE. Hence in India, all the subjects are available under both Science and Technology branches [4], [8], [13]. The duration to reach Science-Masters is five years whereas to reach Engineering-Masters normally six years post 10+2 study required. However, the field Computer Application only available with Science track with BCA and MCA degrees or traditional Science track (BSc-CA/ MSc-CA).

As far as Information Spectrum among the subjects only Information Technology is widely available in a number of universities, colleges and mainly engineering colleges with both Science and Engineering track (BSc-IT/MSc-IT/ BTech-IT/MTech-IT). Among other area and field Information Science is available only in some institutes with MSc Degree only (no universities yet started BSc/ BTech/MTech in Information Science).

Flexible Eligibility in MSc Programs in Indian Private Universities

India holds a significant move in Higher Education System, today country holds more than 40000+ higher educational institutes (HEIs); which is highest ever in the world. Moreover, Indian Universities are categorized with the following—

- Central Universities
- State Universities
- Private Universities
- Deemed Universities (to be)

Though apart from these many Institutes of National Importance (INI) such as IITs, NITs, IIITs, IIEST are important and significant part of Indian HEIs [6], [11], [14].

In a significant move Private Universities developed rapidly in last few years and today the number touches 279 (as on October, 2017) during the study. Among the state wise distribution, Rajasthan holds first position (46 Universities), Gujarat second (30 Universities) and Uttar Pradesh (29 universities) holds the third position.

In a significant move, private universities are not only introducing newer nomenclatures and subjects but also new educational methodologies and degrees. Hence as far as Computing and Information Technology field is concerned changing criteria in the entry to the MSc program is adopting in many Private Universities. Many international universities are allowed candidates from diverse background to keep the entry to the IT jobs and thus for the creation of ready, skilled and adequate manpower. And this trend is rising in reputed international universities as well.

As already mentioned that in IT and Computing field there are two concentrations: one is Theoretical and another is on Applied. Internationally initially only in Applied programs this type of move is started and gradually in other programs i.e. theoretical and mathematical programs (such as Computer Track) flexible eligibility criteria has been started in leading international universities. In Indian Private Universities, this move has been noticed in a large number of universities. Table: 1 provides details on this flexibility in MSc programs in IT and Computing fields.

Table: 1-Private Universities in India and No. of Universities (& Programs) offering Flexible entry to MSc in IT and Computing Field

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

As far as this study is concerned it has been selected only with MSc Degree and irrespective of the subjects within IT and Computing *(viz. Computer Engineering, Computer Application, Computing etc. In Information space among the fields of Information Science, Informatics, Information Systems, Information and Knowledge Management)*; and it has observed only the nomenclature of ***Computer Science*** from Computing track and ***Information Technology*** from the Information related track available.

Importantly among the IT and Computing subjects apart from applied and information centric study and fields, the core and mathematical also been started in recent past by the private universities (i.e. MSc Computer Science). Table: 2 depicted a detailed list of universities in this regard offering in both Computing and Information Sciences (mainly MSc-Information Technology/ Computer Science).

Table: 2-Private Universities in India and No. of Universities (& Programs) offering Flexible entry to MSc in IT and Computing Field

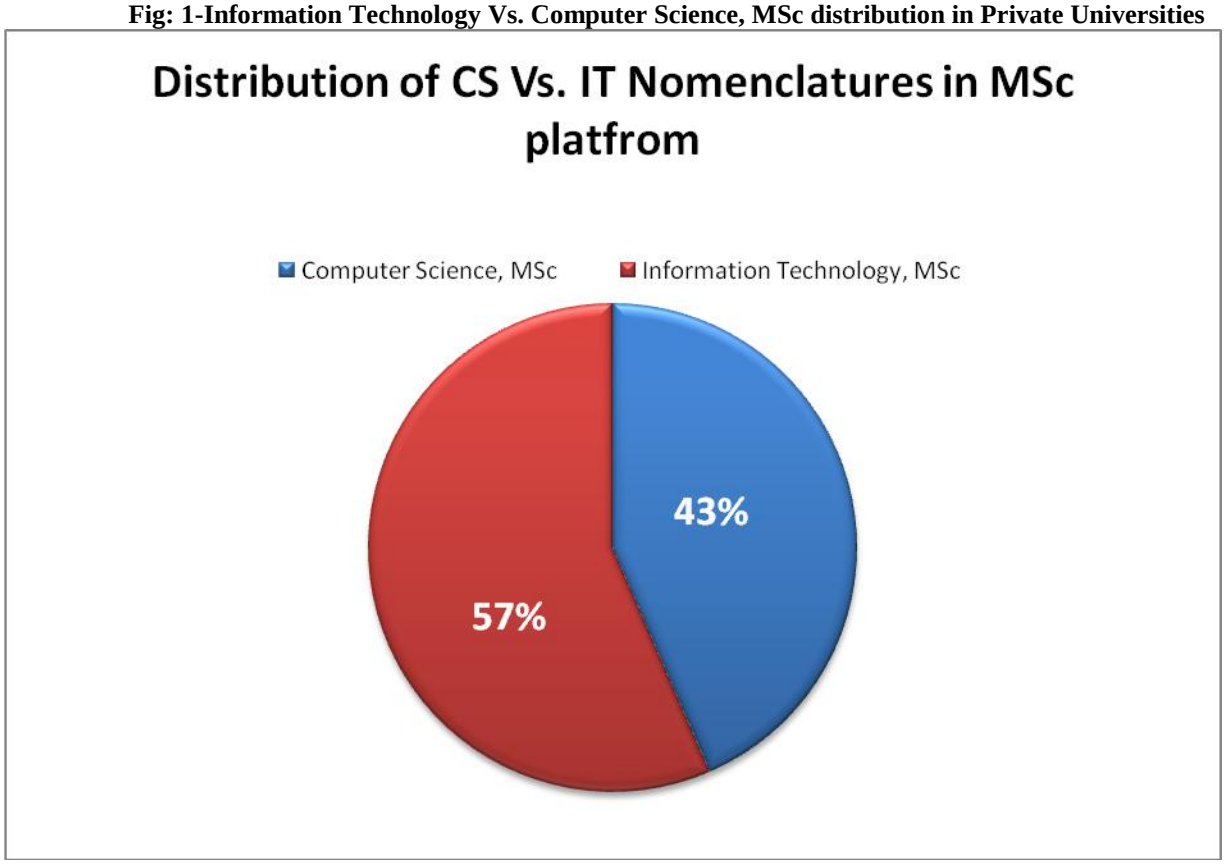
Sl. No.	Universities with Flexible Entry in MSc-IT/CS Program at a Glance: Beyond Mathematics/ Computing requirement	
	Universities	**Programs & Eligibility**
Arunachal Pradesh		
1	North East Frontier Technical University	MSc-CS (Any Degree)/ MSc-IT (Any Degree)
Assam		
	Absent	
Bihar		
	Absent	
Chhattisgarh		
2	ISBM University	MSc-IT (Any Degree)
3	Kalinga University	MSc-CS (Any Degree)
Gujarat		
4	AURO University of Hospitality and Management	MSc-IT (Any Degree)
5	Calorx Teacher's University	MSc-CS (Any Degree) MSc-IT (Any Degree)
6	C.U. Shah University	MSc-IT (Any Degree)
7	Dhirubhai Ambani Institute of Information and Communication Technology	MSc-IT (Any Degree)
	Navrachana University	MSc-IT (Any Degree)
Haryana		
8	Starex University	MSc-CS (Any Degree)
Himachal Pradesh		
Absent		
Jharkhand		
Absent		
	Karnataka	
Absent		
Meghalaya		
9	Mahatma Gandhi University	MSc-IT (Any Degree)
10	Martin Luther Christian University	MSc-IT (Any Degree)
Mizoram		
Absent		
Madhya Pradesh		
Absent		
	Maharashtra	
	Absent	
Manipur		
11	Sangai International University	MSc-CS (Any Degree)
Nagaland		
Absent		
Odisha		
Absent		
Punjab		
12	Desh Bhagat University	MSc-IT (Any Degree)
13	Lovely Professional University	MSc-CS (Any Degree)/ MSc-IT (Any Degree)
Rajasthan		

14	PAHER University	MSc-IT (Any Degree) MSc-CS (Any Degree)
15	Mahatma Jyoti Rao Phoole University	MSc-IT (Any Degree)
16	Mody University of Science and Technology	MSc-IT (Any Degree)
17	OPJS University	MSc-CS (Any Degree)
18	Shri Jagdish Prasad Jhabarmal Tibrewala University	MSc-IT (Any Degree)
Sikkim		
Absent		
Tripura		
Absent		
Uttar Pradesh		
19	J.S. University	MSc-IT (Any Degree) MSc-CS (Any Degree)
Uttarkhand		
20	Himalayan Garhwal University	MSc-CS (Any Degree)
West Bengal		
	Absent	

Among the Private Universities Rajasthan holds first position with total 5 (five) universities, similarly, Gujarat also holds five (5) universities in this category of offering flexible entry to the MSc-IT and Computing field. However, the states of Chhattisgarh, Meghalaya, and Uttarkhand also holds second position with two (2) universities offering flexibility in MSc entry to the diverse background. Among the well-known universities in this category are include—

- Dhirubhai Ambani Institute of Information and Communication Technology
- Lovely Professional University
- Navrachana University etc.

Fig: 1-Information Technology Vs. Computer Science, MSc distribution in Private Universities



Importantly among the universities, a large number of them have started the expected field (i.e. applied) in this category i.e. Information Technology. 57% of these universities allows Any Degree entry to the MSc-Information Technology program whereas rest 43% are also offered the core and theoretically focused MSc-Computer Science. The fig: 1 shows the distribution in this regard herewith. Total 23 Universities observed Flexible entry to the MSc in Computing and IT track and among these 13 are offered MSc-IT whereas 10 comes with MSc-CS program (refer Table: 2 and 3).

Findings and Direction

It is important to note that some of the international universities allow candidates from diverse background i.e. Bachelors in any stream with additional (second) Bachelor Degree in the related subjects. Such programs are available one more year for two Bachelors Degree. Hence such additional double degree students are eligible for the MSc in the concerned/ related fields.

In India double degree (second degree is rarely available) hence many universities allow candidates with Bachelors in any stream with Post Graduate Diploma (PGD) in the subjects. Similar to Double degree (second Bachelors with additional one year) such PGD also offered in International Universities with the similar term (i.e. one year post Bachelor). But the present study only has undertaken more flexibility in entry i.e. only Bachelors Degree in any stream without any Major/Minor/General/ Double Degree/ Post Graduate Diploma and noted that apart from IT few have also started Computer Science to all the Degree holders. Importantly such criteria in many Indian Private universities only available in IT and Computing fields even in same universities a specific Masters in Humanities asked for Bachelors in the same subject or at-least Minor/ General. Hence in the industry as well, this kind of move already appreciated for the creation of ready, skilled, and adequate manpower. Previously in case of MCA also such norms accepted in the industry and during in last 20+ Years, MCA Graduates are well established, nationally and internationally. But the present move is good enough as the degree MSc well established and known internationally whereas MCA is still available in India.

Another important reason for MSc tag that Computer Application (MCA) is dedicated only software whereas IT and similar Technologies and Information Sciences deal with other less touched but widely useful technologies viz. Network Technologies, Database Technologies, Web Technologies, Communication Technologies and Multimedia Technologies etc. Hence MSc tag is undoubted better in the creation of ready, skilled and adequate manpower delivery not only in IT Industry but also in general organizations and institutions (A list of such MSc-CS offered in Private universities listed in Table: 3.

Table: 3-Private Universities in India offering MSc-CS to diverse Bachelors Holders as per international trend

Sl. No.	MSc-Computer Science at Private Universities in India with Flexible Entry	
	Universities	**Programs**
1	North East Frontier Technical University, AP	MSc (Computer Science) for Bachelors in Any Stream/ Subjects
2	Kalinga University	MSc (Computer Science) for Bachelors in Any Stream/ Subjects
3	Calorx Teacher's University	MSc (Computer Science) for Bachelors in Any Stream/ Subjects
4	Starex University	MSc (Computer Science) for Bachelors in Any Stream/ Subjects
5	Sangai International University	MSc (Computer Science) for Bachelors in Any Stream/ Subjects
6	Lovely Professional University	MSc (Computer Science) for Bachelors in Any Stream/ Subjects
7	PAHER University	MSc (Computer Science) for Bachelors in Any Stream/ Subjects

8	OPJS University	MSc (Computer Science) for Bachelors in Any Stream/ Subjects
9	J.S. University	MSc (Computer Science) for Bachelors in Any Stream/ Subjects
10	Himalayan Garhwal University	MSc (Computer Science) for Bachelors in Any Stream/ Subjects

Table: 3 is depicted details list of universities offer Computer Science subject/field with the MSc award. It is worthy to note that though Computer Science is theoretical and mathematical in nature but few universities added few applied (restricted to the software technologies only) gradients in the MSc-CS curricula viz. Lovely Professional University, J.S. University. Hence for the betterment of future Information Technology Industry and organizations at large MSc degrees need to start in different subjects concentrated in Information Specific domain with due weight to emerging subjects and fields [2], [3], [10]—

- Cloud Computing
- Visualization Technologies
- Big Data and Data Science
- Usability Engineering
- User Experience Designing
- Internet Technology and IoT
- Data Management and Analytics

Though within Computer Science track the emerging focus may be on Artificial Intelligence, Robotics etc to the candidates with strong interest and logical skill sets.

Conclusion

The world is changing and educational systems also. Previously universities were much more conservative and traditional in nature. In a country like India, privatization becomes tough due to its several goodness and badness. Though in respect of advantages of private universities several new things already have been planned, initiated and developed such as industry integrated programs, emerging majors, up-to-date curricula and focus. Internationally acclaimed universities are moving joint degrees with other universities and other organizations and industries and in this respect, except for few government funded universities (as per placements and research funding, interdisciplinary culture initiation, NIRF Ranking etc) a majority are from Private Universities and Deemed to be Universities. Indian private universities (except few) are doing well not only for the educational promotions but also human resource developments which are required and useful. The flexible eligibility criteria may have few drawback candidates without knowledge or skill in the areas and thus it is better to allow candidates having additional diploma etc in the areas and obviously with skill and experiences. International reputed universities already have taken this measure and this becomes successful in a different context. In India also big players such as Dhirubhai Ambani Institute of Information and Communication Technology, Lovely Professional University etc already initiated such flexible model and it is better to accept such model in other universities with proper, planned curricula for not only development but also because of the creation of a true Digital Society and Economy!

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