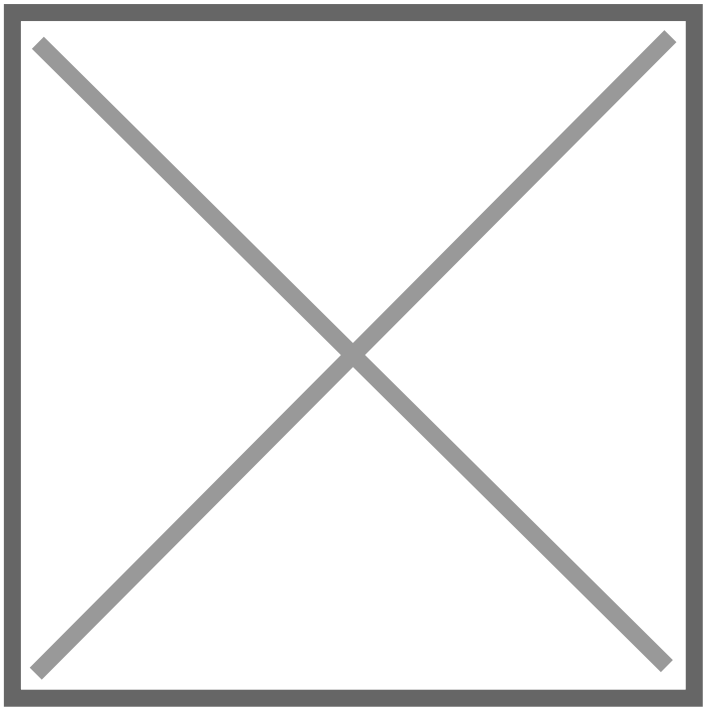
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## Entry Points

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For structured formal training in the subject today, one can choose biotechnology as the area of specialization at the graduation, post graduation or research level. Being an interdisciplinary field, higher education in biotechnology does not necessarily call for a prior degree in the same subject. For instance, if someone wants to do MSc (Biotechnology), then it is not essential for him to have a bachelors degree in biotechnology. Earlier, the biotech stream was offered only at the postgraduate level. But today due to the increasing popularity and awareness of biotech, some universities/private colleges have introduced biotech at undergraduate level (BSc Biotechnology).

## Bachelors Degree Program

A few of the universities like Bangalore University (Karnataka); Chaudhary Charan Singh University, Meerut, (Uttar Pradesh); Kakatiya University, Warangal (Andhra Pradesh); Madras University, Chennai (Tamil Nadu); Osmania University, Hyderabad (Andhra Pradesh); and Patna University, (Bihar) have BSc (Biotechnology) course. Several others are likely to introduce these courses.

The eligibility criterion is essentially 40 percent (the minimum percentage may vary from state to state) in PUC/10+2/Intermediate/equivalent with science subjects. The duration of the course is three years and admissions are either through an entrance exam or percentage based.

BSc Biotech is a new concept, but many prestigious institutes have been offering a four-year BTech course in Biotechnology for quite some time. For example, IIT Kharagpur offers a BTech degree program in Biotechnology and Biochemical Engineering while IIT Chennai and Gawahati give a BTech degree in Biotechnology. Similarly IIT Delhi and Kharagpur offer a five-year dual degree MTech course (After completion of 10+2) in Biochemical Engineering & Biotechnology where as IIT Chennai offers a similar MTech course in Biotechnology. Admission to these IIT undergraduate programs is through an all India competitive examÃ¢â?¬â?•the Joint Entrance Examination (JEE). The minimum qualification for admission through JEE is a pass grade in the final examination of 10+2 system or its equivalent.

Besides the IITs, several other institutes and universities offer a BE/BTech Biotechnology course. The Anna University in Chennai has been offering a BTech program in Industrial Biotechnology since 1992. Some other universities offering BTech (Biotechnology) courses include Bharathidasan Institute of Engineering and Technology, Tiruchirappalli; Guru Gobind Singh University, Delhi; Guru Nanak Dev University, Amritsar (BTech Chemistry and BioEngineering); UP Technical University, Lucknow; Vellore Institute of Technology, Vellore (Tamil Nadu). This is just a representative list. Students who have completed 10+2 with a science background are eligible. Students are selected either through the All India Engineering Entrance Examination (AIEEE), or the common entrance exam conducted by the state governments.

## Masters Degree Program

A major thrust in the area of biotech education has come from the government. The Indian government set up a separate Department of Biotechnology (DBT) under the Ministry of Science & Technology in 1986 to give impetus to the development of modern biology and biotechnology in India. In the last 18 years of its existence, DBT has promoted and accelerated the pace of development of biotechnology in the country. As part of that mandate, it encourages and supports postgraduate teaching programmes in the country. This to create trained human resource at the post-graduate level in general biotechnology and different specialized branches like agriculture biotechnology, medical biotechnology, marine biotechnology, neurosciences, biochemical engineering and biotechnology. Currently, through several universities spread all across the country, it supports 27 MSc courses in general biotechnology, seven in agriculture biotechnology, one in medical biotechnology, two in marine biotechnology, and six MTech courses in biochemical engineering, bio-process technology and biotechnology. In total, it supports about 60 courses.

The total intake of students through all the postgraduate courses is around 840 per year. Students are admitted to different universities through an All India combined entrance examination, conducted by Jawaharlal Nehru University (JNU), New Delhi (on behalf of Department of Biotechnology) in May.

DBT offers MTech Biotechnology program (2 year/4 semester) through Anna University, Chennai (Tamil Nadu) and University of Technology, Kolkata (West Bengal). Candidates who have done B Pharma or BTech/BE course (biotechnology or related disciplines) or MSc life sciences are eligible for this program. Admissions are either through the joint entrance exam conducted by JNU or through GATE. The Birla Institute of Technology (BITS), Pilani, also offers a ME degree in biotechnology.

In addition to the DBT supported postgraduate courses, many universities, private colleges and institutes are also offering masters program in biotechnology. Anyone wanting to opt for this course should have a BSc degree with a minimum of 50 percent aggregate marks (this percentage may vary from state to state) with chemistry or biochemistry as a compulsory subject and any one optional subject like botany, applied botany, zoology, environmental science, sericulture, biotechnology, and genetics. The admissions are either percentage based or through an entrance exam conducted by the university.

There have been other initiatives too. For instance, The University of Pune launched a unique two-year fulltime MBA program in biotechnology. This is the first such program by an Indian university or institute and probably the first in Asia too. The program admits 60 students each year. The syllabus is based on the requirements of the industry. 60 percent of the syllabus covers the managerial aspect and about 40 percent biotechnology.

## Bioinformatics Courses

Bioinformatics, which is an offshoot of biotechnology, has been lately attracting a lot of attention. This has led to specialized BSc/MSc and BTech courses in this branch. Like the Guru Gobind Singh Indraprastha University has been offering a BTech course in bioinformatics since 1999. Bharathiar University and Pune University offer a two-year MSc courses in bioinformatics.

DBT offers Advanced Diploma in Bioinformatics (1-year course) in five Indian universitiesÃ¢â?¬â?¢Calcutta University, Jawaharlal Nehru University (New Delhi), Madurai Kamaraj University, Pondicherry University and Pune University. The intake for these courses is based on All India Entrance Exams that are conducted by the respective centers. Apart from the DBT conducted courses, Bangalore-based Institute of Bioinformatics and Applied Biotechnology offers a 16-month postgraduate diploma course in bioinformatics.

The Bioinformatics Centre (BIC) at Jawaharlal University, New Delhi, offers a PhD program in bioinformatics. In the past few years, many private institutes have also started offering BSc/MSc Bioinformatics courses like Noida based Bioinformatics Institute of India, Delhi-based Amity Institute of Biotechnology, and The Jay Pee Institute.

## PhD Programs

Basic research is of significance to all aspects of modern biology. India has a large network of research institutes spread around the country established both by government and private sector. These have a thrust on biotechnology too. Students wanting to pursue an active career in biotech research can enter any CSIR, ICAR or ICMR lab depending on their qualification and area of specialization. The basic qualification required is a post graduation degree with a CSIR/ICAR fellowship and/or a good GATE score.

## CSIR

The Council for Scientific and Industrial Research (CSIR), the government body to promote scientific research has a network of 40 laboratories and 81 field stations/extension centers/regional centers all over India to undertake R&D in several disciplines including biotechnology. It currently employs more than 22,000 highly qualified multidisciplinary professionals.

CSIR holds the national level joint CSIR-UGC Examination (NET) normally twice every year, one in June and another in December. This examination determines the eligibility of Indian nationals for the award of Junior Research Fellowships (JRF) and for appointment of lecturers.

## ICAR

ICAR promotes science and technology programs in agricultural research and education and carries out research directly through ICAR institutes and national research centers, project directorates and also in association with the State Agricultural Universities (SAUs) through the all India coordinated research project systems. This vast network of ICAR has manpower of about 30,000 personnel out of which nearly 7,000 are engaged in active research and its management. 30 SAUs employ about 26,000 scientists for teaching, research and extension education; of these over 6,000 scientists are employed in the ICAR supported coordinated projects.

The Agricultural Research Services (ARS)/National Eligibility Test (NET) examination is conducted by Agricultural Scientists Recruitment Board (ASRB) (Krishi Anusandhan Bhavan, Pusa, New Delhi) for filling up vacancies of scientists of the ARS institutes, the ICAR institutes and for recruitment of lecturers and assistant professors by the State Agricultural Universities (SAU).

## ICMR

The Indian Council for Medical Research (ICMR) formulates, coordinates and promotes biomedical research in India. Its network consists of 21 permanent research institutes/centers (national institutes) located in different parts of India and six regional medical centers. The ICMR national institutes offer opportunities for research in the area of medical biotechnology.

Apart from the labs falling under CSIR/ICAR, almost all the IITs, institutes and universities having a life/biological sciences department offer scope for research in biotechnology. Admission to these PhD programs is made on the basis of written test/interview conducted by the department/centre concerned.

In order to train scientists in frontier areas of research in biotechnology, DBT introduced a Postdoctoral Fellowship Program in 2000. The Bangalore based Indian Institute of Science (IISc) engaged in major biotech research activities coordinates and implements this program. This fellowship is for two years and aspirants holding a PhD degree in Science, Engineering or MD degree in medicine with research interests in Biotechnology and Life Sciences are eligible. The program has recently been restructured and expanded to cover more universities and R&D institutions. IISc conducts both PhD and integrated PhD programs (directly after BSc) in biological sciences, which includes research in biotechnology also.

The Indian educational system offers a multi route channel for students to enter the biotechnology arena. There is no dearth of training opportunities and all that a student requires is hard work, dedicated outlook and an analytical approach to make a mark in this field.

(Log on to www.amity.edu/aib for detailed list of the universities/institutes/colleges offering biotechnology and related courses).