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Biotechnology teaching and career opportunities

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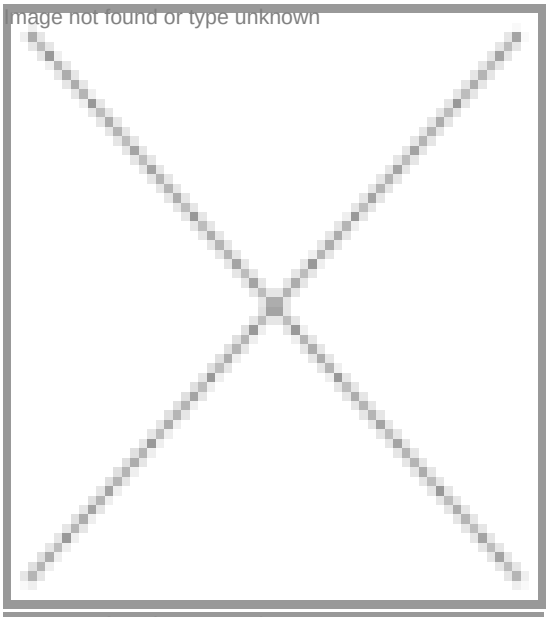
Biotechnology teaching and career opportunities

This article by Dr. Suman Govil and Shubhlata Sharma throws light on the various biotech courses, job openings and immense scope that this new sunrise industry has to offer.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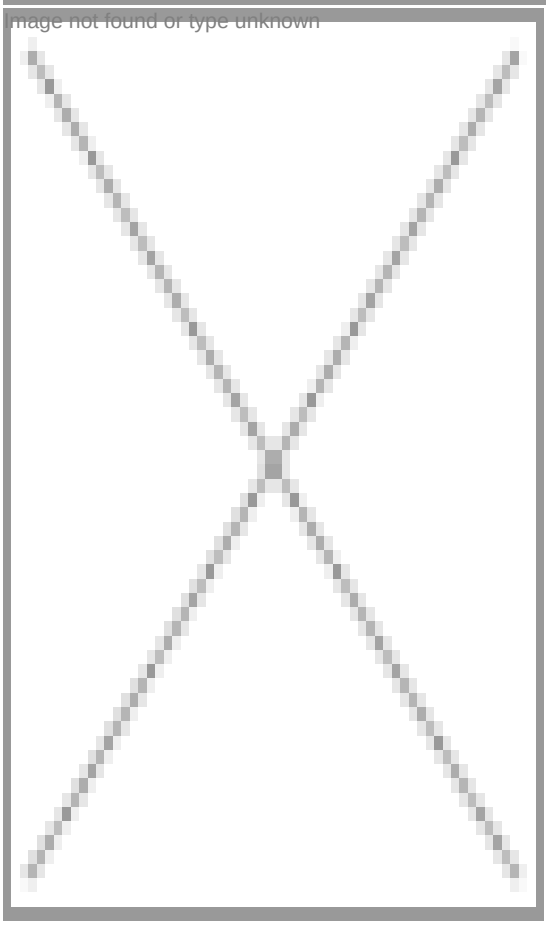
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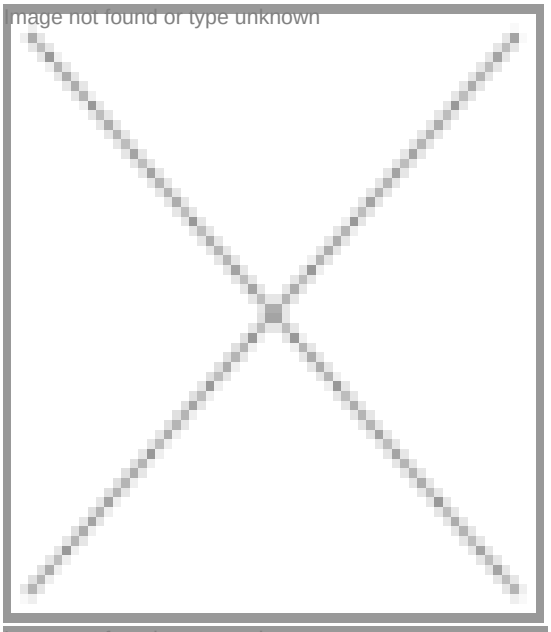

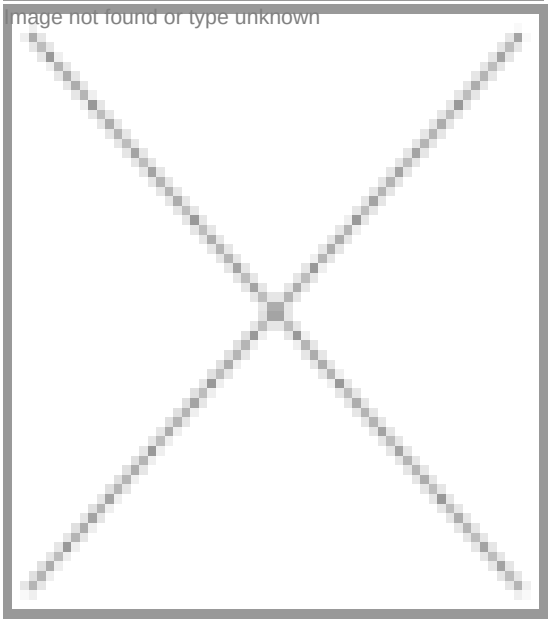

Biotechnology has tremendous potential in improving human and animal health, increasing agricultural productivity and providing a safe and clean environment. Realizing this, the Government of India started a multi-agency National Biotechnology Board comprising the UGC, ICMR, CSIR and DST in 1982, which was upgraded to a full-fledged department in 1986 to give the much-desired impetus to this area. Biotechnology is a multi-disciplinary and rapidly advancing area and well-trained manpower is a pre-requisite for meaningful R&D and production in biotechnology. India can take pride in being one of the first few countries in the world to initiate an integrated program of human resource development in biotechnology comprising post graduate teaching programs, short-term training courses for upgrading skills of mid-career scientists, faculty involved in undergraduate and post graduate teaching, training in leading overseas laboratories, in gap areas where expertise does not exist in the country.

The department took a well-informed decision not to start undergraduate teaching in biotechnology as it is a highly specialized, laboratory-intensive course. The post graduate courses were initiated in 1985 in six universities in close collaboration with the University Grants Commission, ICAR and the Department of Ocean Development. These programs were conceived as collaborative, inter-departmental and inter-institutional programs and initiated on the basis of core strength in the area of faculty, existing infrastructural facilities, R&D grants on competitive funding basis and nearby institutions engaged in biotechnology R&D. These programs served a catalytic role and many other institutes initiated these programs. The department provided liberal grants for the establishment of specialized laboratory infrastructure, equipment, recurring grants for consumables, studentship, books and journals, travel, visiting faculty, contingency etc. India is a vast country and keeping in mind, the demand for trained manpower in specific areas and regional aspirations, these programs have been

expanded in over 61 universities in general, medical, agricultural, marine, veterinary, industrial and pharmaceutical biotechnology. The department is considering initiating new programs in food and nutrition, clinical pharmacology and product development, bio-instruments and biomedical standards, bioenterprise management and financing and regulatory affairs.

Curricula

To maintain uniformity and minimum standards of education, model course curricula have been developed by organizing brainstorming sessions. These curricula are adopted by all teaching institutions with minor institutional variations based on in-house faculty strength in specific areas. The curricula revision exercise is undertaken periodically to keep pace with latest developments and to incorporate. To keep abreast with the latest developments in the rapidly advancing area of biotechnology, faculty upgradation programs in leading national laboratories with emphasis on hands-on training have been developed for college teachers involved in undergraduate education and faculty associated with postgraduate teaching. There is a provision for training in overseas laboratories also.

These teaching programs are continuously monitored by an in-house advisory committee with outside expert members from academia and industry and DBT representative, annual meeting of course coordinators and DBTâ€“UGC joint task force on HRD to ensure minimum and uniform teaching standards.

Admission criteria and procedure

To compete in the global market for jobs, it is important to select bright and meritorious candidates and impart best training. The selection of students is made on an all India basis through Common Entrance Test (CET), joint entrance test conducted by IIT or tests conducted by respective universities. The courses are very popular and admission procedure is highly stringent which is evident from the fact that approximately 21,000 students competed for 428 seats of MSc General Biotechnology in the JNU Common Entrance Test during 2006-07. The candidates with bachelor's degree under 10+2+3 pattern of education in physical, biological, agricultural, veterinary and fishery sciences, pharmacy, engineering/technology, four years BS (Physician Assistant course) or MBBS or BDS are eligible.

Curriculum outline

Intensive theoretical and practical training is offered to all MSc/MTech students. The details of courses in different streams are given below:

MSc (General) Biotechnology: Cell biology, bio-molecules, microbial physiology and genetics, computer applications and biostatistics, molecular biology, macromolecules and basic enzymology, biology of the immune system, biophysical chemistry, animal biotechnology, genetic engineering, plant biotechnology, bioprocess engineering and technology, genomics and functional genomics and project in third and fourth semester.

MSc (Agriculture) Biotechnology

Major courses: Molecular genetics and cell biology, techniques in cell biology, fundamentals of molecular biology, techniques in molecular biology, principles of genetic engineering, techniques in genetic engineering, techniques in plant tissue culture, biotechnology for crop improvement, biodiversity, IPR, biosafety and bioethics, plant metabolic engineering,

MSc (Animal) Biotechnology

Major courses: Molecular genetics and cell biology, techniques in cell biology, fundamentals of molecular biology, techniques in molecular biology, principles of genetic engineering, techniques in genetic engineering, techniques in animal tissue culture, biotechnology for animal improvement, biodiversity, IPR, biosafety and bioethics, Introduction to immunology and vaccinology. Minor courses viz. essentials in biochemistry, molecular biophysics, bioinformatics & statistics, microbiology are common to agriculture and animal biotechnology.

MSc (Medical) Biotechnology: Biochemistry and cell biology, human physiology, quantitative methods, molecular biology, genetics and developmental biology, medical microbiology, genetic engineering, genomics and proteomics, human genetics and human genome, immunology, vaccines and transplantation technology, somatic and germline engineering, social, ethical and legal issues in medical biotechnology, diagnostics and communication skills as well as optional courses.

In MTech courses, students from different background such as BTech biochemical engineering, chemical engineering and MSc Biotechnology are admitted. Students can opt for different courses in the first semester. Students with BTech biochemical engineering are offered courses in biochemistry, biophysics, enzyme catalyzed organic synthesis, analytical methods in biotechnology, carbohydrates and lipids in biotechnology, fluid solid systems, food science and engineering,

thermodynamics of biological systems, multistage separations, biosensor technology, advanced bioprocess control. Students with BTech chemical engineering are offered biosensor technology, microbial biochemistry, lab techniques in microbial biochemistry, enzyme and microbial technology, recovery and purification of products, biochemical engineering fundamentals while MSc students are offered courses in bioprocess engineering enzyme and microbial technology, recovery and purification of products, biochemical engineering fundamentals, applied mathematics, process engineering principles. Courses on protein engineering, advance bioprocess engineering, animal and plant cell technology, bioinformatics methods and application, pharma biotechnology, combinatorial biotechnology, modeling and simulation of bioprocess, bioprocess plant design are offered in second and third semester along with major project in third and fourth semester. (Please visit the DBT website http://www.dbtindia.nic.in for curriculum details).

Placement analysis

The success of a teaching program is primarily judged by the quality of education imparted and placement of students passing out. These programs have flourished as students coming out of these programs qualify in UGC-CSIR National Entrance Test (NET) for Junior Research Fellowship (JRF), DBT Biotechnology eligibility test (BET) for JRF and are pursuing research in leading laboratories in the country like the TIFR, BARC, IISc, NII, CCMB and JNU. A number of students find placement in leading industries such as Biocon, Dr Reddy's Laboratories, Shantha Biotech, Panacea, Advanced Enzyme Technology, Bharat Serum, Intas Pharmaceuticals, Serum Institute, US Vitamins, Wockhardt and Zydus Cadila Pharmaceuticals. The analysis of the first placement of approximately 1000 students produced during 1985 -1995 shows 54 percent students opt for PhD within the country, almost ¼th students opt for jobs in research, teaching and industry. The analysis of 2000 students produced during the last five years depicts almost similar trend. However, percentage of students working in industry has increased from 12 to 17. As expected, MSc general, agricultural, medical, marine biotechnology students prefer PhD while MTech students (almost half) join industries.

The Biotech Consortium India Ltd (BCIL) brings out a priced publication, "Directory of research institutions and industries in biotechnology in the country" with details of area of specialization and contact persons. Students willing to obtain a copy of the directory for details of industries may please contact:

Dr Purnima Sharma, CEO and Executive Director, Biotech Consortium India Ltd, Anuvrat Bhavan, Deen Dayal Upadhyay Marg, New Delhi-110002

Industrial training

Prominent industry leaders and HR experts feel that it is difficult to find the right candidates as the skillsets of manpower produced by academic institutions often do not match the requirements of the ever competitive biotechnology industry. This could be due to a big gap between the knowledge imparted vis a vis knowledge required by the industry. Finding the right people for the job is the immediate challenge faced by the industry, as the industry finds it difficult to invest in in-service training of hired candidates.

To bridge this gap, the Department of Biotechnology is facilitating practical exposure to biotechnology postgraduates for a period of six months in the industry. This program is mutually beneficial to the students and industry. Industrial exposure orients students to the needs of the industry increasing their acceptability and also provides an opportunity to the companies to assess their performance. This program has completed 15 years and has become increasingly popular among students and industries as is evident from increase in number of applicants and number of selected candidates. The number of industries offering this training has also steadily grown. Several leading biotechnology companies like Monsanto, Workhardt, Aurigene Discovery Technologies, Gangagen Biotech, Lifecare Innovations, Dabur, Dr Reddy's Lab, Panacea Biotech, JK Agrigenetics, Auroprobe Labs, Nicholas Piramal, Jubilant Biosys, Pepsi Foods, Pepsico Holdings, ABL Biotech Ltd and Mahyco have offered training to the students. This industrial training has facilitated in permanent placement of students in the industry with a success rate of approximately 25 percent. Some of the industries who have absorbed trainees are Lifecare Innovations, Unique Biotech Ltd, Century Seeds, Sangene Biotech and Shantha Biotechnics, Dabur, Jubilant Biosys, Gangagen Biotechnologies and Monsanto.

Career opportunities

The biotechnology industry has recorded 37 percent growth and has touched the $1.5-billion mark with biopharma accounting for 72 percent share, bioagri sector being the fastest growing sector with 80 percent growth and bioservices growing at 69.3 percent and occupying 11 percent of the market share (industry overview, Biospectrum, July 2006). India is becoming one of the most important destinations for clinical trials of new drugs, field trials of genetically modified plants, contract research and contact manufacturing. On the venture capital front, the funding activity has shown significant momentum in India during 2005-06 by registering a growth of 150 percent over the last year (BioSpectrum, November 2006).

Biotechnology has applications in all spheres of human and animal life such as food and nutritional sufficiency, health, crime investigation and forensic science, environmentally sustainable development. Predictions of IT-BT led boom in the coming years resulted in hype with hope for creation of a number of jobs in the coming years. This has led to mushrooming of a large number of private and public sector institutions conducting self financing degree courses in biotechnology both at undergraduate and postgraduate levels. This expansion has led to a general deterioration in quality of manpower which is a major concern with producers as well as employers of manpower. The need for accreditation of institutes offering teaching programs has never been felt so strongly before.

Opportunities for biotechnology students exist in agri-based industries involved in production of transgenic plants, seed industries, tissue culture units, agri chemicals such as biofertilisers and biopesticides, environmental amelioration, pharma industries for diagnostics, vaccines, new drug molecules, clinical research organizations and bioinformatics industry. Opportunities exist in research and development, production and manufacturing, quality control and analysis, technology transfer and management knowledge-based marketing, setting up of new enterprises, consultancy organizations for preparation of techno economic feasibility reports, regulatory affairs such as toxicology, environment health and safety, biosafety, patent attorneys and examiners for IPR. The jobs for marketing are 20 times more in number as compared to R&D as well as more monetarily rewarding. With India becoming a signatory to GATT, a sudden spurt in filing of patents as well as dispute settlement cases has been witnessed resulting in the creation of tremendous opportunities for patent attorneys and examiners. In addition to the industry, opportunities for science management, teaching and R&D jobs exist in public and private sector teaching and R&D institutions.

These teaching programs have improved teaching and research not only in biotechnology but also in allied life sciences areas such as botany, zoology, microbiology, biochemistry and genetics. This initiative has provided necessary skilled manpower resource vital for biotechnology manufacturing, production and services on a sustainable basis. According to Dr Kiran Mazumdar-Shaw, CMD, Biocon, biotechnology in India has the potential of generating revenues of about $5 billion and creating one million skilled jobs in the next five years through products and services. This is indeed good news for students and professionals in this area.

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Note: The views expressed in this article are those of the authors and not necessarily of the organization to which they belong.

Note: The complete list of DBT programs will be made available online.