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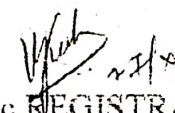
UNIVERSITY OF MUMBAI

No.UG/ 460 of 2004

CIRCULAR :

Attention of Principals of the affiliated colleges in the faculty of Science is hereby invited to the Ordinances, Regulations and syllabi relating to the Diploma/Advanced Diploma in Vocational Biotechnology vide Pamphlet No.360 and to this office Circular No.UG/587 of 2003, dated 22nd December, 2003 and they are hereby informed that the recommendation made by the Dean, faculty of Science at its meeting held on 23rd February, 2004 has been accepted by the Academic Council at its meeting held on 18th June, 2004 vide item No.4.16 and that in accordance therewith the syllabus for the Diploma/Advanced Diploma course in Vocational Biotechnology is as per Appendix and that the same has been brought into force with effect from the academic year 2004-2005.

Mumbai 400 032,
26th October, 2004.
To,


for I/c REGISTRAR.

Principals of the affiliated colleges in the faculty of Science.

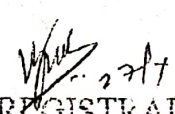
A.C 4.16-18.06.2004

No. UG/460-A of 2004

26th October, 2004.

Copy forwarded with Compliments for information to :-

- 1) the Dean, Faculty of Science.
- 2) The Chairman, Board of Studies in Microbiology.


for I/c REGISTRAR.

Copy to :-

The Director, Board of College and University Development, the Controller of Examinations/the Deputy Registrar (Eligibility & Migration Section), the Director of Students Welfare, the Personal Assistants to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-centre, Ratnagiri, for informations.

The Controller of Examinations (10 copies), F. & A. O. (Accounts Section) Fort, (2 copies), Record Section (5 copies), Publication Section (5 copies), D.R., (Enrolment, Eligibility & Migration Section - 3 copies), D.R. (P.R.O.) (2 copies), D.R. (Statistical Unit) (2 copies), D. R., (Accounts Section), Vidyasagar, (2 copies), D. R. (Affiliation Section) (2 copies), The Director, U.C.C., I.D.E. Bldg., Vidyasagar, D.R. Executive Authorities Unit, (2 copies) A. R., A. A. Unit (2 copies) He is requested to treat this as Action taken report on the concerned resolution adopted by the Academic Council/Management Council, referred to in the above Circular; and that no separate A.T.R. will be sent in this connection. A. R. CONCOL (2 copies), BUCTU (1 copy) Dy. Acct. (Unit V) (1 copy), In-charge, Central Computing Facility (1 copy), Receptionist (1 copy), Telephone Operator (1 copy), Secretary, MUCASA (1 copy), Superintendent, P.G. Section (2 copies).

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UNIVERSITY OF MUMBAI



Syllabus for Diploma / Advanced Diploma in Vocational Biotechnology

(with effect from the academic year 2004-2005)

Syllabus for
Add-On Diploma course in Vocational Biotechnology

No of lectures	60 / year
No of practicals	60 /year
Duration	3 Years

Note:

- 1) The course is designed as a three-year integrated course and the syllabus of the course expects continuity from first year to second year and to third year.
- 2) On the successful completion of first year, student will be awarded a certificate, on the successful completion of second year, Diploma and after successful completion of third year, Advance Diploma, as per the directive.
- 3) Since the number of lectures of the course is reduced by 50%, the level of original course could not be maintained. As a result the emphasis is now kept on core Biotechnology and it is expected that basics of Biology and chemistry / biochemistry etc, will be covered in regular B.Sc. course. This will also avoid overlapping syllabi.

Second Year: Add-On Diploma course in Vocational Biotechnology (60 Lectures)

Theory Syllabus

I. Introduction to Mathematical and Statistical Techniques [10]

- i. Importance of mathematical and statistical tools in solving biological problems, role in modeling biotechnological processes and quantitative analysis tool in Biotechnology,
- ii. Illustration of techniques in analysis of experimental and process data as well as their modeling - from Calculus, probability, regression analysis
- iii. Worked out examples – Kinetic analysis

II. Bioprocess Technology – Microbial Biotechnology [Total - 48]

- i. Scope of fermentation technology /Industrial Microbiology – types of products produced and their applications [1]
- ii. Novel product development and improvements in comparison with traditional fermentations.-
 - a. Role of molecular biological and bioinformatics techniques in product development [14]
 - 1) Review of basic molecular biological techniques and recombinant DNA techniques used in development and improvement of strains, recombinant microorganisms. Comparison of these techniques with traditional screening techniques.
 - 2) Discussion of examples of products /strains produced successfully by conventional screening techniques and recombinant products

- b. Large scale production of proteins using recombinant microorganisms, Antimicrobial drugs and agents, Enzymes, Biocontrol agents (microbial insecticides), Fine chemical products, Organic transformations with enzymes and whole cells, Vaccines [3]

- iii. Process development fundamentals - Development and working of industrial microbiological operations, [10]
 Steps involved –
 a. Product selection based on various criteria like market survey [1]
 b. Screening programs for selection and improvement of microbial strains – steps of primary and secondary screening techniques, [2]
 c. Product recovery method development - Downstream processing [2]
 d. Process monitoring, optimization and improvement as an on-going iterative steps [2]
 e. Scale up from Lab scale, pilot plant scale to Production scale [2]
 f. QC methods and waste treatment [1]
- iv. Fermentation Processes [2]
 1. Overview of a typical fermentation industry –
 a. Typical plant layout
 b. Supporting services required
 c. General steps in a typical process - flow sheet [1]
 2. Inoculums development and maintenance [1]
 3. Media Formulation and sterilization
 4. Fermentation proper
 a. Bioreactors and support Equipments - Types of reactors, criteria used for their classification and characterization, typical construction of a fermentation vessel, various components and their role [4]
 b. Process parameters - methods of their monitoring, control and importance – aeration, agitation and mixing, pH, foam and temperature control, monitoring metabolites – substrates, intermediates and products, power consumption [4]
 5. Product recovery - down stream processing [4]
 a. General principles involved
 b. Types of equipments used – centrifuges, filters, dryers, concentrators, solvent extractors, chromatographic systems
 c. Aseptic handling systems
 d. Packaging and storage
 6. Waste treatment [2]
 a. Nature of industrial waste
 b. Obligation of industry to treat waste
 c. General principles and methods used
- v. Illustrative examples of conventional and novel production processes with flow sheets [2]
- III. Intellectual property rights & Bioethics with special reference to Modern Biotechnology [2]

Second Year: Add-On Diploma course in Vocational Biotechnology
List of Textbooks and Reference Books

1. Casida L. E., "Industrial Microbiology "(1999), New Age International (P) Ltd, New Delhi
2. Purohit S. S., (2001), "Biotechnology Fundamentals and Applications", 3rd Edition, Agrobios, Jodhpur
3. Glick B.R. & Pasternak J. J., (2003), "Molecular Biotechnology, Principles and applications of recombinant DNA", 3rd Edition, ASM Press, Washington, USA
4. Stanbury P. F., Whitaker A. & Hall S. J., (1997), "Principles of Fermentation Technology", 2nd Edition, Aditya Books Pvt. Ltd, New Delhi.
5. Crueger W. and Crueger A. (2000) "Biotechnology – "A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing Corporation, New Delhi.
6. El-Mansi E. M. T. & Bryce C. F. A. (2000), "Fermentation Microbiology and Biotechnology", Taylor and Francis Ltd., New Delhi
7. Schmauder H. & Schweizer M.(2002), "Methods in Biotechnology", Taylor and Francis Ltd., New Delhi
8. Torres N.V. & Voit E.O., (2002), "Pathway Analysis and optimization in metabolic engineering", Cambridge University Press
9. Rajaram, "Fundamental of Computers", Printice Hall (India)
10. Boylan M & Brown K. E.; (2001), "Genetic Engineering, Science and ethics on new frontier", Pearson Education, Delhi, India
11. Nicholl D. S. ;(2002)"An Introduction to Genetic Engineering"2nd Edition, Cambridge University Press
12. Walker, J. M. & Rapley, R. (2003), "Molecular Biology and Biotechnology", 4th Edition, Panima Publishing Corporation, New Delhi, India.
13. Ratledge, C. & Kristiansen, B. (2001), " Basic Biotechnology", 2nd Edition, Cambridge University Press
14. Primrose, S. B., Twyman, R. M. & Old, R. W.(2001), "Principles of Gene Manipulation", 6th Edition, Blackwell Science Ltd.
15. Various Internet Sites dealing with such topics – computational biology, system biology, Pathway analysis

Second Year: Add-On Diploma course in Vocational Biotechnology

Practical syllabus (60 hrs equivalents)

(No in [] brackets indicate hours of practical)

I. Mathematics and Statistics Mathematics and Statistics

[Total – 18]

1. Use of computer programs for undertaking mathematical and statistical analysis like MS Excel or equivalent – [9]
 - a) Data plotting – XY, line, bar, pie, 3D charts, proper presentation
 - b) Linear regression analysis, regression line on plots
 - c) Calculation of Standard deviation,
 - d) Student t test,
 - e) ANOVA
2. Demonstration and use of dedicated mathematical and statistical software packages like Mathematica, Sigma plot, curve expert etc. and search of suitable freeware / shareware packages for various types of analysis on web. [3]
3. Demonstration of modeling software like PLAS (Power Law Based metabolic pathway analysis), Flux Balance analysis (FBA), E-cell etc [6]

[Total – 42]

II. Bioprocess technology

1. Visit to Biotechnology industry and discussion with the entrepreneur reporting the steps, difficulties and problems faced and solved while establishing such industry. Groups of students can cover as many industries as possible under the supervision of teaching staff. Diagrammatic representation of plant layout, organization of various services with comment on its advantages and disadvantages and suggestions for improvements [Equivalent of 6]
2. Overview of Molecular biological techniques as applied to industrial strain development
 - i. DNA extraction – Genomic / Plasmid – (mini and midi)
 - ii. Restriction digestion, electrophoretic analysis and integration of fragments of interest in to carrier plasmid
 - iii. Transformation to demonstrate acquisition of new characters
 - iv. Demonstration of genomic library preparation and screening [Equivalent of 16]
3. Consolidated exercise of process development and production, taking any one suitable product; starting from product selection, strain isolation and screening, strain improvement, lab scale production, purification (down stream processing), waste disposal, packaging. Suggested examples – amino acid producers, antibiotic producers, recombinant enzyme production, Biocontrol agents, Biofertilizers etc. Students can be divided in to several groups for undertaking multiple problems for complete coverage. [Equivalent of 20]

All students should report all projects of all groups in the class in their journal and must have full knowledge of work carried out by each group.

Practical Examination can be of 3 hrs each on two consecutive days, since it will involve certain culture work. Examination can be based on various techniques used for such projects (section 3) and various molecular biological techniques and mathematical / statistical problem solving. Proportionate marks should be assigned to each section in practical examination.

Third Year: Add-On Advance Diploma course in Vocational Biotechnology
(60 Lectures each)

Theory Syllabus

Bioprocess Technology

- I. Plant Biotechnology [16]
- i. Tissue culture technology for plant manipulation and propagation [2]
 - ii. Plant Tissue culture –
 - a. various culturing methods, [4]
 - b. differentiation, [1]
 - c. protoplast culture, [1]
 - d. micro-propagation, [1]
 - e. somatic embryogenesis, [1]
 - f. crop improvement, [1]
 - g. transgenic plants, [1]
 - h. secondary plant metabolites and contributions in Agro-Industry [4]
- II. Animal Biotechnology [16]
- a. Tissue culture technology for human and animal cells and Tissues
 - b. Cloning, human organ transplantation and xeno-transplantation,
 - c. cancer biology and treatment,
 - d. artificial animal breeding
 - e. transgenic animals
 - f. Immunological applications in diagnostics and vaccines
- III. Enzyme Technology [6]
- a. Role of Enzyme in Industry – advantages and disadvantages
 - b. Applications in food and beverage industry, leather, silk and textile industry, chemical synthesis,
 - c. Applications as formulations – dietetics, stain removers, detergents, feed additives etc
 - d. Environmental and diagnostic applications.
- IV. Environmental and Agricultural Biotechnology – [10]
- a. Pollution control – oils, plastics and other recalcitrant waste, waste and waste water treatments, mineral recovery
 - b. Ecological engineering, rhizosphere engineering
 - c. Biofertilizer and Biocontrol agents
- V. Entrepreneurial Skills [8]
- a. Perspective of Entrepreneurship spirit
 - b. Self-assessment as entrepreneur
 - c. Identifying and evaluating business opportunities
 - d. Planning process for new business / enterprise
 - e. Managerial and legal aspects
 - f. Money management
 - g. Indian scenario
- VI. Recent advances in The field of Biotechnology [2]
- Nanobiotechnology – biological machines – biosensors, biochips, bio-films

Third Year: Add-On Advance Diploma course in Vocational Biotechnology

List of Textbooks and Reference Books

1. Purohit S. S., (2001), "Biotechnology Fundamentals and Applications", 3rd Edition, Agrobios, Jodhpur
2. Glick B.R. & Pasternak J. J., (2003), "Molecular Biotechnology, Principles and applications of recombinant DNA", 3rd Edition, ASM Press, Washington, USA
3. Palmer, T. ; (2000), "Enzymes, Biochemistry, Biotechnology, Clinical Chemistry", 5th Edition, Affiliated East-West Press Pvt. Ltd. New Delhi, India
4. Maier, R. M., Pepper, I. L., Gerba, C. P., (2000), "Environmental Microbiology", Academic Press.
5. Walker, J. M. & Rapley, R. (2003), "Molecular Biology and Biotechnology", 4th Edition, Panima Publishing Corporation, New Delhi, India.
6. Ratledge, C. & Kristiansen, B. (2001), " Basic Biotechnology", 2nd Edition, Cambridge University Press,

Third Year: Add-On Advance Diploma course in Vocational Biotechnology

Practical syllabus (60 Lecture equivalents)

- I. Plant Biotechnology [Equivalent of 10]
 - a. Induction of callus formation using stem, leaf, seeds, roots and its long term maintenance (Students are required to present their well maintained callus culture to examiners at the time of practical examination), use of this callus for regeneration of shoot, root and micro-propagation of plant
 - b. Establishment of suspension culture and demonstration of its utility for the metabolite production
- II. Animal Biotechnology [Equivalent of 10]
 - a. Establishment of primary tissue culture using various tissues obtained from chick embryo (or equivalent) and their propagation for at least three passages
 - b. Study of cell fusion techniques by using kidney cells and liver cells from rat or mice or equivalent tissues (monoclonal antibodies).
 - c. Lymphocyte culture and demonstration of phagocytosis
- III. Enzyme Technology [Equivalent of 10]
 - a. Large scale production of amylase or cellulase
 - b. Preparation of enzyme tagged antibodies and demonstrating their efficacy in detecting analyte
 - c. Demonstration of polymerization of phenols using Radish / soybean Peroxidase
- IV. Environmental and Agricultural Biotechnology [Equivalent of 10]
 - a. Preparation of liquid / peat based biofertilizer and checking their efficacy
 - b. Isolation of biocontrol agents Trichoderma and demonstrating its antifungal property
 - c. Demonstration of iron recovery by Thiobacillus from iron ore (Group Experiment)
 - d. Isolation of degraders of different wastes and demonstration of their ability to degrade waste (Group Experiment)

V. Entrepreneurial Skills

[Equivalent of 6]

- a. Self analysis - evaluating capacity of as an entrepreneur (Individual exercise)
- b. Writing a proposal for a novel biotechnological venture (Individual exercise) and its defense. This proposal is to be submitted separately along with journal and project at the time of final practical examination.

(Help from successful entrepreneurs, financial / bank managers, experts, counselors may be taken for self-evaluation as well as preparation and evaluation of a realistic project.)

VI. Project Work

[Equivalent of 14]

- a. Project work is to be carried out individually by student.
- b. The emphasis should be on the development of preferably novel biotechnological products rather than routine pure science research project. Collaborative work with industry or interaction with successful entrepreneurs should be encouraged. Patent literature can offer wealth of ideas and products and also will provide guidance as to the direction in which biotechnology industry is currently moving.
- c. The project work is to be submitted separately, along with journal and proposal (entrepreneurship skills) at the time of final practical examination. Project work and entrepreneurship skill proposal may be integrated / concurrent or independent.
- d. An exhibition of various projects undertaken by the students may be organized to encourage entrepreneurial spirit amongst the student community.

In practical examination proportionate marks be assigned for project work (20% - 25%) and entrepreneurship report (10%). Examination can be of 3 hrs each on two consecutive days, since it will involve certain culture work.

As mentioned earlier, since it is difficult to complete experiments related to plant tissue culture in two days examination (mainly due to long incubation periods) representative material generated (callus, regenerated shoot, root, micro-propagated plantlets or suspension culture) by each student during Plant tissue culture practical should be presented (with due certification by teacher concerned) at the time of practical examination.