

CURRICULUM FOR ONE YEAR
(TWO SEMESTER)
P.G. DIPLOMA COURSE IN

=====
: BIOTECHNOLOGY (TISSUE CULTURE) :
: Effective from Session :
=====

=====
UNDER DEVELOPMENT
=====

=====
:Semester System :
=====

Prepared By

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: Curriculum Development Cell :
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INSTITUTE OF RESEARCH DEVELOPMENT
& TRAINING, U.P., KANPUR

APPROVED BY

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: BOARD OF TECHNICAL EDUCATION :
: U.P. LUCKNOW, on dated 19.04.2017:
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Corrected and Approved By B.T.E. On Dated 19.04.2017

STUDY AND EVALUATION SCHEME FOR
ONE YEAR (TWO SEMESTER) POST GRADUATE DIPLOMA IN BIO TECHNOLOGY(TISSUE CULTURE)
(Effective From)

I SEMESTER

Curriculum						S U B J E C T	Scheme of Examination								
Periods Per Week							Theory				Practical			Grand Total	
Lec.	Tutorial	Dr.	Lab	Work Shop	Total		Examination	Sess. Marks	Total Marks	Examination	Sess. Marks	Total Marks			
						Dur.	Marks		Dur.	Marks					
6	-	-	6	-	12	1.1 Analytical Biochemistry	3.0	75	25	100	3.0	30	20	50	150
6	-	-	6	-	12	1.2 Molecular Biology and Genetic Engineering	3.0	75	25	100	3.0	30	20	50	150
6	-	-	6	-	12	1.3 Industrial Microbiology	3.0	75	25	100	3.0	30	20	50	150
6	-	-	6	-	12	1.4 Plant Tissue Culture Technology	3.0	75	25	100	3.0	30	20	50	150
24	-	-	24	-	48	<-----TOTAL----->	-	300	100	400	-	120	80	200	600
Games/NCC/Social and Cultural Activity Community Development Work+Discipline (15 + 10)												25			
Aggregate												625			

II SEMESTER

6	-	-	6	-	12	2.1 Green House Technology	3.0	75	25	100	3.0	30	20	50	150
4	-	-	-	-	4	2.2 Environmental Education(*) And Disaster Management	2.5	50	--	--	--	--	--	--	--
-	-	-	24	-	24	2.3 Project Work	-	--	--	-	120	80	200	200	
10	-	-	30	-	40	<-----TOTAL----->	-	75	25	100	-	150	100	250	350
Games/NCC/Social and Cultural Activity Community Development Work+Discipline (15 + 10)												25			
Aggregate												375			
100% OF I Semester												625			
Grand Total												1000			

- NOTE:-
- (1) Each period will be of 50 minutes duration.
 - (2) Each session will be of 16 weeks.
 - (3) Effective teaching will be at least 14 weeks.
 - (4) Remaining periods will be utilised for revision etc.
 - (5) Structured and supervised task oriented project work to be organised during teaching. Student will submit a report there will be 200 marks for this project. Each marks will be awarded by the examiner (examination Marks 120 : Sess. Marks 80)
 - (6) Environment Awareness Camp :To be organised at a stretch for 3 days. No Examination. Entrepreneurship Camp : To be organised at a stretch for 1 week No examination.
 - (7) (*) It is compulsory to appear & to pass in examination, But marks will not be included for division and percentage of obtained marks.

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1. SALIENT FEATURES OF THE COURSE

- 1.1 Name of the Course : Post Graduate Diploma in
Biotechnology(Tissue Culture)
- 1.2 Entry Qualification : B.Sc (Biology With Chemistry/Bio Chemistry)
- 1.3 Duration : One Year (Two Semester)
- 1.4 Type of Course : Full Time
- 1.5 Pattern of Course : Semester System
- 1.6 Intake of Students : 60 Students
- 1.7 Mode of Admission : Through Entrance Examination

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NEED ANALYSIS

Technological advancements have brought revolutionary changes in the world of work. The need for reevaluation of the availability and use of existing natural resources is essential in view of the onset of the energy, environmental and economic crisis whose dents have begun to appear on our National Budget. The interaction of biological, physical and chemical engineering sciences have produced a great quantum of new knowledge in the integrated stream of biotechnology. These integrated efforts, through living organisms can provide for the solution of many of our problems like food, energy, health care and environmental pollution etc. The broad areas of the application of biotechnology are agriculture/forestry/ horticulture, medicine and health, food, chemical and other industry, environment/ecology and energy production. Wide scope and applications of biotechnology require trained manpower.

The present curriculum is an effort to meet the need in the coming years, of such personnels having studied the course, the students will be able to :-

1. Work as Assistant Biotechnologist in research lab, educational institute, chemical and pharmaceutical industries.
2. Can start his own testing lab.

PROLOGUE TO REVISION

It was considered essential to revise the curriculum of Post Graduate Diploma In Industrial Bio Technology to accommodate new areas of technology as well as update and modernize the existing course contents so as to make it more relevant to the need of the world of work. The world of knowledge is ever growing and there always remains something to add to make the students update, So it is imperative to make relevant changes in the curriculum in the form and contents both. Accordingly a work shop was held to look into the gaps in existing curriculum and revise the same. A number of professionals, representing various fields, organization, higher technological institute and polytechnic were involved in updating the contents and upshots of these work shops have been properly arranged to systematised classroom teaching.

The important features of the presently proposed curriculum are as given below -

1. Bio chemistry and Cell Physiology paper has been redesigned and irrelevant portion deleted
2. Microbiology paper has been redesigned and some new portion is added.
3. Molecular cell biology paper has been redesigned and named as Molecular Biology and Genetic Engineering
4. Animal Tissue Culture has been deleted
5. Plant Tissue Culture paper has been redesigned and some irrelevant portion deleted and some new portion added.

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LIST OF EXPERTS

List of experts whose deliberation helped the revision of curriculum for One Year Post Graduate Diploma In Bio Technology (Tissue Culture) in a workshop held on 28.01.2002 at I. R. D. T.,U. P., Kanpur are honourably named below -

1. Dr. G. S. Randhawa
Professor
Bio Sciences and Bio Technology Deptt.
I. I. T., Roorkee
2. Dr. Shubhjit Dutta
Scientist
Bio Technology Center
Indian Institute of Pulse Research, Kanpur
3. Mrs. Shikha Sharma
Lecturer -Bio Technology
D. N. Polytechnic, Meerut
4. Dr. Har Govind Singh
Lecturer - Chemistry
Government Polytechnic, Faizabad
5. Er. Gurdeep Singh
Director
Institute of Research, Development & Training, U. P., Kanpur
6. Dr. Anita Bajpai
Asstt. Professor
Institute of Research, Development & Training, U. P., Kanpur

List of experts whose deliberation helped the revision of curriculum for One Year Post Graduate Diploma In Bio Technology (Tissue Culture) in a workshop held on 28.11.2007 and 08.02.2008 at I. R. D. T.,U. P., Kanpur are honourably named below -

1. Dr. P. Singh
Professor
Plant Breeding and Genetic Engineering Deptt.
C. S. A., Kanpur
2. Dr. Gauri Shanker
Retd. Professor
Bio Technology Department
H.B.T.I., Kanpur
3. Dr. H. M. Shukla
Associate Professor
Horticulture
C. S. A., Kanpur

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4. Dr. S. P. Singh
Associate Professor
Animal Science & Husbandary Department
C. S. A., Kanpur
5. Dr. Mukesh Mohan
Assistant Professor
Bio Chemistry Department
C. S. A., Kanpur
6. Mr. Brijesh Singh Katiyar
Assistant Professor
Bio Technology Department
H.B.T.I., Kanpur
7. Mr. Arun Kumar
Lecturer
Bio Tech.
D. N. Polytechnic, Meerut
8. Shri Dhruv Narayan
Assistant Professor
I. R. D. T. U. P., Kanpur

List of experts whose deliberation helped the revision of curriculum for One Year Post Graduate Diploma In Bio Technology (Tissue Culture) in a workshop held on 20.07.2010 at I. R. D. T.,U. P., Kanpur are honourably named below -

1. Dr. Shubhjeet Dutta
Scientist, Bio Technology,
I. I. P. R., Kanpur
2. Dr. Gauri Shanker
Retd. Professor
Bio Technology Department
H.B.T.I., Kanpur
3. Dr. Shesh Mani Tripathi
Associate Professor, Horticulture
C. S. A., Kanpur
4. Dr. H. M. Shukla
Associate Professor
Horticulture
C. S. A., Kanpur
5. Mr. Brijesh Singh Katiyar
Assistant Professor
Bio Technology Department
H.B.T.I., Kanpur
6. Mr. Arun Kumar
Lecturer
Bio Tech.
D. N. Polytechnic, Meerut
7. Mr. Durgesh Chandra
Assistant Professor
I.R.D.T., Kanpur

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8. Mr. M. P. Singh
Professor
I.R.D.T., Kanpur

List of experts whose deliberation helped the revision of curriculum for One Year Post Graduate Diploma In Bio Technology (Tissue Culture) in a workshop held on 04.08.2010 at S.H.I.A.T.S., Nani, Allahabad are honourably named below -

1. Dr. Eapen P. Koshy
Assistant Professor
S.H.I.A.T.S., Allahabad
(Formely Allahabad Agricultural Institute, Nani, Allahabad)
2. Mr. Om Hari Singh
Lecturer, Agricultural Engg.
G. G. Polytechnic, Allahabad
3. Mr. M. P. Singh
Professor
I.R.D.T., Kanpur

List of experts whose deliberation helped the revision of curriculum for One Year Post Graduate Diploma In Industrial Bio Technology in a workshop held on 26.11.2014 at I.R.D.T., U. P., KANPUR are honourably named below -

1. Mr. Brijesh Singh Katiyar
Associate Professor
Bio Technology Department
H.B.T.I., Kanpur
2. Smt. Neeraja Srivastava
Assistant Professor
C.S.J.M. University, Kanpur
3. Ms. Poornima K. N.
Scientist
I.I.P.R, Kanpur
4. Shri M. S. Rajpoot
Assistant Professor
A.I.T.H., Kanpur
5. Shri Arun Kumar
Lecturer
D.N. Polytechnic, Meerut
6. Shri Lital Kumar
H.O.D. (Electronics)
I.R.D.T., U.P., Kanpur

LIST OF EXPERT (SEMESTER SYSTEM)

List of experts whose deliberation helped the revision of curriculum for One Year (Two Semester) Post Graduate Diploma In Bio Technology (Tissue Culture) in a workshop held on 27.04.2015 at I.R.D.T., U. P., KANPUR are honourably named below -

1. Shri Arun Kumar
Lecturer
D.N. Polytechnic, Meerut
2. Shri Lital Kumar
H.O.D. (Electronics)
I.R.D.T., U.P., Kanpur

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LIST OF EXPERT (SEMESTER SYSTEM)

List of experts whose deliberation helped the revision of curriculum for One Year (Two Semester) Post Graduate Diploma In Bio Technology (Tissue Culture) in a workshop held on 21.10.2016 at I.R.D.T., U. P., KANPUR are honourably named below -

1. Dr. Brijesh Singh Katiyar
Associate Professor
Bio Technology Department
H.B.T.U., Kanpur
2. Dr. Kalpana Katiyar
H.O.D., Bio Technology
A.I.T.H., Kanpur
3. Smt. Shruti Gangwar
Lecturer, Bio Technology
G. P., Faizabad
4. Shri Vikas Kulshestra
Assistant Professor
I.R.D.T., U.P., Kanpur

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PROFILE DEVELOPMENT

A tool in the form of questionnaire for getting information about job potential, job opportunity and manpower requirement and job activities of diploma holder in bio technology.

The draft curriculum has been finalised and validated by sending a copy of it to various experts and teaching institutions. The comments received from them have been duly incorporated in the final curriculum document which contains following elements:

1. Employment opportunities and activity profile of diploma in Industrial Biotechnology
2. Broad Curriculum Objectives and learning experiences to be provided to the students by offering various subjects
3. Detailed time distribution in terms of lectures, tutorial and practical for each subject.
4. Study and Evaluation Scheme
5. Detailed Content details of various curriculum areas.
6. Resources and infrastructure required for effective implementation

In order to expose the students to field practices and develop problem solving abilities in them, elements of project work of 6 period in a week has been kept in the curriculum. The Curriculum Development Centre of this Institute wishes to thank all those, who helped in designing the curriculum. It is hoped that this curriculum will be implemented in the spirit it has been designed and the teachers will provide appropriate learning experiences to students for the fulfillment of stated objectives and developing relevant competencies in the students.

EMPLOYMENT OPPORTUNITIES

Micropropagation of true to type and disease free ornamental plants, fruit and forest trees in large number through tissue culture throughout the year has already been highly commercialized into multi million dollar industry in India and abroad. Various techniques of plant tissue and cell cultures viz; wide hybridization through embryo rescue, somatic cell hybridization, callus cultures from another culture, genetic engineering and genetic transformation are being extensively used for plant improvement synthetic/artificial seeds are being produced through somatic embryogenesis. The plant cells are grown in bioreactors for production of secondary plant metabolites and bioprocessing. The plants multiplied or regenerated through tissue cultures have to be suitably acclimatized and hardened for long distance transportation and field plantation, in green houses with controlled temperature, humidity and light regimes. Both imported and indigenously developed green house technology is in great demand for production of high valued ornamental and off season vegetables for export. Bioreactors and fermentors are being used for bulk production of biopesticides, biofertilizers, antibiotics, vitamins, amino acids, enzymes, and food processing using various micro-organisms. Animal cell culture has vast application and potential in human and animal health care diagnostic and pharmaceutical industries for production of diagnostic kits, antibodies, vaccines, drug testing embryo transfer technology and genetic engineering.

Keeping in view the application of industrial biotechnology in various biotechnological approaches for plant, animal and microbial improvement, production and utilization, considerable number of trained technicians are required to meet the research and development and industrial manpower requirements. It is anticipated that the technicians trained under this programme will find wage and self-employment opportunities in the following areas:

1. Plant propagation and improvement
2. Green house fabrication installations, operation and maintenance
3. Research and Development Activities in Universities and Institutes
4. Health care and pharmaceutical industries
5. Biopesticides and biofertilizer industries
6. Development departments and corporations of agriculture, horticulture and forestry etc.
7. Food industry

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COMPETENCY PROFILES

- a) Basic understanding of bio technology and emphasis on specially on tissue culture
- b) Competency in establishment and maintenance of different related bio technology tissue culture laboratory, instruments, chemicals and different specialised techniques and green house
- c) Knowledge and skills in handling cell/tissue cultures in septic environment, instruments, chemicals and different specialised techniques.
- d) Competency for large scale production and utilization of plants, microbes and animal cells
- e) Ability to handle sophisticated instruments like fermentors, ELISA reader, fluorescent and phase contrast microscopy ultra centrifuges, UV/visible/ spectro photometer, HPLC and electrophoresis etc.

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I Semester

1.1 ANALYTICAL BIOCHEMISTRY

L T P
Periods/week 6 - 6

RATIONALE

Basic knowledge about Analytical Biochemistry is essential for the students of diploma in Biotechnology (Tissue Culture). The elements of biomolecules, carbohydrate metabolism, lipid metabolism, enzymes, nitrogen metabolism, photosynthesis and physiology are important part of biochemistry which shall be taught to the students through this subject besides introduction about spectrophotometry, microscopes etc.

DETAILED CONTENTS

1. General principles of analytical biochemistry.
2. The concept of pH, Properties of water, dissociation and ionization of acids and bases, pKa, buffers and buffering mechanisms, dissociations of amino acids and determination of pKa.
3. Structure of proteins and metabolism, carbohydrates and lipids.
4. Chromatography: principles and application of adsorption, partition, ion-exchange, gel filtration, affinity and high performance liquid chromatography.
5. Electrophoresis : moving boundary and zonal electrophoresis, paper and gel electrophoresis, isoelectric focusing technique.
6. Centrifugation techniques and application.
7. Electroanalytical methods.
8. Principles and applications of ultraviolet and visible light spectrophotometry, NMR spectroscopy, spectrofluorimetry and atomic spectroscopy, mass spectroscopy.
9. Tracer techniques, ELISA, RIA, IRMA, Scintillation counters.

LIST OF PRACTICALS

1. To prepare various buffer solutions required for tissue culture and bio-chemical work.
2. Separation of leaf pigment adsorption chromatography.
3. Separation of amino acids by TLC.
4. Qualitative and quantitative analysis of carbohydrates.
5. Determination of acid value of fat.
6. Determination of iodine number of fat.

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7. Qualitative and quantitative analysis of proteins.
8. Estimation of Enzyme activity.
9. Protein purification by gel filtration chromatography.
10. Molecular weight determination of protein through SDS PAGE.
11. Centrifugation and separation of cell components.

RATIONALE

The course will deal with the knowledge of types of cells, composition, function and genome organization of various cell types and an acquaintance with manipulation of DNA.

DETAILED CONTENTS

1. Introduction, Development, Present Status and Prospects of Molecular Biology and Genetic Engineering.
2. Replication of DNA, Types, Structure and properties of DNA and RNA and the genetic code.
3. Genome organization in viruses, Prokaryotes and eukaryotes.
4. Central Dogma, Transcription, Translation, Regulation of Gene expression.
5. A brief account of repetitive DNA sequences, split genes, transposons.
6. Introduction to gene mapping, Genomics and Metabolomics, ionomics, phenomics and proteomics.
7. Fundamentals of recombinant DNA technology: DNA extraction, labelling of nucleic acids, Restriction endonucleases, cloning vectors, Isolation and cloning of genes, gene libraries.
8. Fundamentals of molecular techniques and their uses PCR, Gel documentation and Blotting techniques.

PRACTICALS

1. Isolation of plasmid DNA from E. Coli. (Transformed) cells.
2. Quantitation of nucleic acids by gel electrophoresis and spectrophotometry.
3. Isolation of DNA from plant and microbial cells.
4. Spectrophotometric Determination of melting temperature of DNA.
5. Demonstration of digestion of DNA by restriction endonuclease and agarose gel electrophoresis.
6. Isolation of RNA.

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7. Mutation in yeast by physical multagenic agents.

1.3 INDUSTRIAL MICROBIOLOGY

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RATIONALE

In order to exploit medicinal and industrial application of cellular processes in tissue culture it is essential to understand the basic concepts of cell structure, function and interactions in microbes. This subject has been designed giving more emphasis on fundamentals of various principles involved. Students will be able to utilize their skill in the application of microbial techniques towards commercial application.

DETAILED CONTENTS

1. Microbial growth and nutrition, Fermentation Media.
2. Microbial metabolism, Glycolysis, TCA and Secondary metabolic path ways.
3. Classes and properties of micro-organisms relevant to water, food, alcohol, dairy bio fertilizer and bio operative industries etc. Industrial microorganisms, important for water, food alcohol, dairy, biofertilizer biopesticide industries, etc..
4. Fermentation systems, Aerobic and anaerobic, Solid and submerged, Surface culture.
5. Bioreactors- types and uses. Downstream processing-step and methods.
6. Microbial enzymes, Protease, Amylases, Lipases and their application.
7. Fuels and industrial products Ethanol, Acetone, Butanol.
8. Health care products, Therapeutic and Antibiotics.
9. Food and beverages fermentations Systems.
10. Food additives, Vitamins and Aminoacids.
11. Waste water treatment : Characterization techniques and Methods.

LIST OF PRACTICALS

1. Sterilization of glasswares and preparation of culture media for microbial growth.
2. Simple and differential staining of different microorganisms.
3. Microbial growth measurement by different methods : (Counting, O D., measurement).
4. Effect of pH, temperature and substrate conc. on growth of microorganisms.
5. Fermentative production of alcohol.
6. Determination of total dissolved solids of water.
7. Determination of biological oxygen demand (BOD) of water.
8. Determination of chemical oxygen demand (COD) of water.
9. Colony characterization of micro organisms.
10. Microscopic determination of shape and size of yeast cell.
11. Screening and isolation of Azoto bacter.
12. Maintenance of culture on agar medium.
13. Production of invertase enzyme.

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1.4 PLANT TISSUE CULTURE TECHNOLOGY

Periods/week L T P
6 6 - 6

RATIONALE

Since the students will be engaged in the use of Tissue Culture in biotechnology, the fundamentals of Tissue Culture Technology will help them to gain knowledge and skill in Plant Tissue Culture which can be used for improvement of varieties of crops, e.g., grain quality, fibre quality, disease resistance insect resistance, herbicide resistance etc.

DETAILED CONTENTS

1. Introduction: Definition, history, present status, future prospects of tissue culture, Cellular totipotency.
2. Composition of different culture Media, Role of chemicals and growth regulators in tissue culture.
3. Sterilization of media, tissues and other accessories, Inoculation of cultures.
4. Callus Induction and plant regeneration. Organogenesis and Embryogenesis.
5. Suspension culture, Protoplast isolation, culture and fusion.
6. Clonal propagation : Shoot-tip and axillary bud culture.
7. Techniques of cell and tissue culture: Preparation of explant materials, initiation of cultures, micropropagation through organogenesis and embryogenesis, artificial seeds.
8. Anther Culture: Development of haploids, diploidization and its applications.
9. Embryo culture.
10. Somaclonal variations and in vitro selections towards crop improvement.
11. Industrial application of plant tissue culture for production of Secondary metabolites.
12. Plant biotechnology and crop improvement for grain quality, fiber quality, disease resistance, insect resistance, herbicide resistance, stress resistance (basic outlines).

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PRACTICALS

1. Orientation : Introduction to tissue culture laboratory; washing chamber, media preparation laboratory, transfer laboratory, sterilization laboratory inoculation laboratory, culture room.
2. Tissue culture requirements; glass ware, water distillation Unit, chemicals, instruments; Autoclave, pH meter, sterile air flow chamber (Laminar flow).
3. Preparation of Media.
4. Sterilization: Media, Explant, glassware.
5. Inoculation, Callus Induction and clonal propagation.
6. Subculturing and Regeneration of roots, shoots and plants.
7. Preparation of regenerated plants for hardening.
8. Protoplast Isolation and culture(demonstration).
9. Induction of embryogenic callus and encapsulation of artificial seeds.
10. Anther culture: Regeneration of plants from anthers/pollens.
11. Agrobacterium - mediated transformations (demonstration).

II Semester

2.1 GREEN HOUSE TECHNOLOGY

	L	T	P
Periods/week	6	-	6

RATIONALE

After passing the programme the students will have to work in green house or some of them may opt to start their own green house. Appropriate knowledge and relevant skills are necessary in order to establish and maintain the green houses. The course will help to plan and fabricate suitable green house with controlled environmental parameters for different climatic zones to harden tissue culture derived plants and grow high value ornamentals, cut flowers and vegetables to meet market demand in off season and, export.

DETAILED CONTENTS

1. Environmental parameters for optimum plant growth.
2. Photoperiodism, vernalization.
3. Green House and polyhouse materials, designs & fabrication.
4. Cooling, shading, misting, drip irrigation, fertilization and fumigation.
5. Recording and Computerisation of environmental parameters and cultural operations.
6. Hydroponics.
7. Pots, potting mixtures and soil sterilization.
8. Cultivation of Horticultural plants.
9. Hardening of tissue culture derived horticultural plants.
10. Post harvest technology.
11. Packaging and transportation.
12. Intellectual Property Rights.

PRACTICALS

1. Raising of off-season nursery in poly houses.
2. Preparation of tissue culture derived plants for hardening.

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3. Preparation of soil mix and sterilization.
4. Hardening of tissue culture derived plants.
5. Soil culture and hydroponics, sand culture of roses and selected vegetables in green house.
6. Harvesting, preparation, cooling of cut flowers and vegetables.
7. Packing and transportation (Demonstration only).

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2.2 ENVIRONMENTAL EDUCATION & DISASTER MANAGEMENT

L T P
4 - -

RATIONALE:

A diploma student must have the knowledge of different types of pollution caused due to industrialisation and construction activities, so as he may help in balancing of eco-system and control pollution by providing controlling measures. They should be also aware of the environmental laws for effectively controlling the pollution of environment. The topics are to be taught in light of legislation Para-3.

TOPIC WISE DISTRIBUTION OF PERIODS:

SL. NO.	TOPIC	L	T	P
1.	Introduction	6		
2.	Pollution	4		
2.1	Water Pollution	8		
2.2	Air Pollution	8		
2.3	Noise Pollution	4		
2.4	Radio Active Pollution	6		
2.5	Solid Waste Management	6		
3.	Legislations	4		
4.	Environmental Impact Assessment	4		
5.	Disaster Management	6		
TOTAL		56	-	-

DETAILED CONTENTS

1. INTRODUCTION :

- Basics of ecology, Ecosystem, Biodiversity Human activities and its effect on ecology and eco system, different development i.e. irrigation, urbanization, road development and other engineering activities and their effects on ecology and eco system, Mining and deforestation and their effects.
- Lowering of water level , Urbanization.
- Biodegradation and Biodegradability, composting, bio remediation, Microbes .Use of biopesticides and biofungicides.
- Global warning concerns, Ozone layer depletion, Green house effect, Acid rain,etc.

2. POLLUTION :

Sources of pollution, natural and man made, their effects on

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living environments and related legislation.

2.1 WATER POLLUTION :

- Factors contributing water pollution and their effect.
- Domestic waste water and industrial waste water. Heavy metals, microbes and leaching metal.
- Physical, Chemical and Biological Characteristics of waste water.
- Indian Standards for quality of drinking water.
- Indian Standards for quality of treated waste water.
- Treatment methods of effluent (domestic waste water and industrial/ mining waste water), its reuse/safe disposal.

2.2 AIR POLLUTION :

Definition of Air pollution, types of air pollutants i.e. SPM, NOX, SOX, CO, CO₂, NH₃, F, CL, causes and its effects on the environment.

- Monitoring and control of air pollutants, Control measures techniques. Introductory Idea of control equipment in industries i.e.
 - A. Settling chambers
 - B. Cyclones
 - C. Scrubbers (Dry and Wet)
 - D. Multi Clones
 - E. Electro Static Precipitations
 - F. Bog Fillers.
- Ambient air quality measurement and their standards.
- Process and domestic emission control
- Vehicular Pollution and Its control with special emphasis of Euro-I, Euro-II, Euro-III and Euro IV.

2.3 NOISE POLLUTION :

Sources of noise pollution, its effect and control.

2.4 RADISACTIVE POLLUTION :

Sources and its effect on human, animal, plant and material, means to control and preventive measures.

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2.5 SOLID WASTE MANAGEMENT :

Municipal solid waste, Biomedical waste, Industrial and Hazardous waste, Plastic waste and its management.

3. LEGISLATION :

Preliminary knowledge of the following Acts and rules made thereunder-

- The Water (Prevention and Control of Pollution) Act - 1974.
- The Air (Prevention and Control of Pollution) Act - 1981.
- The Environmental Protection (Prevention and Control of Pollution) Act -1986. Rules notified under EP Act - 1986 Viz.
 - # The Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000
 - # The Hazardous Wastes (Management and Handling) Amendment Rules, 2003.
 - # Bio-Medical Waste (Management and Handling) (Amendment) Rules, 2003.
 - # The Noise Pollution (Regulation and Control) (Amendment) Rules, 2002.
 - # Municipal Solid Wastes (Management and Handling) Rules, 2000.
 - # The Recycled Plastics Manufacture and Usage (Amendment) rules, 2003.

4. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) :

- Basic concepts, objective and methodology of EIA.
- Objectives and requirement of Environmental Management System (ISO-14000) (An Introduction).

5. DISASTER MANAGEMENT :

Definition of disaster - Natural and Manmade, Type of disaster management, How disaster forms, Destructive power, Causes and Hazards, Case study of Tsunami Disaster, National policy- Its objective and main features, National Environment Policy, Need for central intervention, State Disaster Authority- Duties and powers, Case studies of various Disaster in the country, Meaning and benefit of

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vulnerability reduction, Factor promoting vulnerability reduction and mitigation, Emergency support function plan.

Main feature and function of National Disaster Management Frame Work, Disaster mitigation and prevention, Legal Policy Frame Work, Early warning system, Human Resource Development and Function, Information dissemination and communication.

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The purpose of introducing project work is to enable the students to apply the knowledge, skills and attitudes, acquired during the entire course, to the solution of specific problems related to practical world of work. It is expected that students will be sent to various organisations at a stretch for 8 weeks and be asked to take up any live problem of the organisation as project work. Students may also be given option to take up entrepreneurial projects and projects related to environment/ecology and waste management/utilisation. The project identification should be done by the students in consultation with teachers and personnel from the organisations where the student is going to undertake the project activity on the basis of basic principle; "problem needing to immediate solution". Each teacher should guide 3 - 4 students for project work throughout this activity. The students will have to go through all the steps of problem solving such as defining the problem, analysis of the problem, collection of required information and resources, formulating alternatives, selecting best solution and reduction in practice.

The project work aims at, besides developing problem solving abilities in the students, development of confidence and expertise in a particular field. The student may get training to analyse the problem, use of instruments, use of techniques and orientation of learning experiences towards their applications in the world of work. Some of the suggested projects are given below:

PLANT TISSUE CULTURE

Initiation of a culture and finally production of plant in tissue culture system

These are only some of the suggestive projects, infact, students can totally ignore this list and identify projects with the help of their teachers/personnel from industry/organisation.

Students will be assessed on the basis of the project report and viva voce examination by internal and external examiners on the pattern suggested below:

1. Punctuality and regularity	15 percent
2. Level/Proficiency of Practical Skills Demonstrated	25 percent
3. Sense of initiative and responsibility	10 percent
4. Interpersonnel skills/Human Relations/Behaviour during the project work	10 percent
5. Report Writing	25 percent
6. Viva Voce	15 percent

TOTAL	100 percent

ENVIRONMENTAL AWARENESS CAMP

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RATIONALE

A post diploma holder in Bio-technology (Tissue Culture) must have the knowledge of different types of pollution caused due to industrialisation and construction activities so as he may help in balancing the eco system and control pollution by providing controlling measures. He should be also aware of the environmental laws for effectively controlling the pollution of environment.

DETAILED CONTENTS

This is to be organised at a stretch for two to three days. Lectures will be delivered on the following broad topics. There will be no examination for this subject.

1. Basics of ecology, eco system and sustainable development
2. Conservation of land forms, preservation of species, prevention of advancements of deserts and lowering of water table.
3. Sources of pollution - Natural and man made, their effects on living and non-living organisms
4. Pollution of water - causes, effects of domestic wastes and industrial effluent on living and non living organisms
5. Pollution of air - causes and effects of man, animal, vegetation and on non-living organisms
6. Sources of noise pollution and its effects
7. Mining, blasting, deforestation and their effects
8. Legislations to control environment
9. Environmental Impact Assessment (EIA) Elements for preparing EIA statement.

ENTREPRENEURSHIP AWARENESS CAMP

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RATIONALE

Besides finding employment in any organization there is a great scope for the students of post diploma in Biotechnology (Tissue Culture) to get self employed and establish their own units. For this purpose knowledge about feasibility report based on the market research, financial and other institutions which can provide different types of support/assistance to the entrepreneurs and management is very essential. It is proposed to organise an entrepreneurship awareness camp for one week at a stretch for the students toward the end of academic session.

DETAILED CONTENTS

1. Concept of entrepreneurship, need and development of entrepreneurial attitudes and qualities
2. Market research and feasibility report - methods for market research and preparation of feasibility report
3. Basic resources finance, infrastructure, manpower and training, technology and information resources - their sources, prominent procedure and budgeting etc
- *4. Assistance available from District Industries Centres, Commercial Banks, State Financial Corporation, Small Industries Service Institute, Research and Development Laboratories/Organisations and other Financial and Developmental Organisations
5. Book keeping and material inventory control
6. Quality management, sales and marketing techniques

NOTE: The students should be given at least one exercise for preparation of feasibility report for any product.

- * Experts from various organisations/Institutions may be invited to explain the type of facilities available and procedures for availing these facilities from their prospective organisations/institutions

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STAFF STRUCTURE

1.	Head of Department	1	B.Tech. (Bio Technology) OR M.Sc.(Biotechnology) with minimum 8 years experience as Lect./Sr. Lecturer OR M.Sc.(Life Science) inc- lusive of Plant Science & Bio-Chemistry preferably specialisation in tissue culture with minimum 8 years experience as Lect./Sr. Lecturer
2.	Lecturer	4	B.Tech.(Bio Tech.) or M.Sc.(Biotechnology) or M.Sc.(Life Science) inc- lusive of Plant Science & Bio-Chemistry preferably specialisation in tissue culture
3.	Technician	2	B.Sc.(Life Science) or Diploma in Agriculture or P.G. Diploma in Biotechnology
4.	Lab Assistant	3	P.G. Dioploma in Bio Technology
5.	Green House Attendent	1	10+ (Matric Pass)

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SPACE REQUIREMENT

Following workshops/laboratories are recommended to setup. Space requirement of laboratories/workshop is given below (for space requirements for other purpose, please see AICTE norms) :

- | | | |
|----|--|--------------|
| 1. | Molecular and cell Biology Laboratory
(with 7X14 sq.m instrumentation dust free AC room) | 10 X 20 Sq.m |
| 2. | Plant Tissue Culture Technology Laboratory
(with 7X14 sq.m instrumentation dust free AC room) | 10 X 20 Sq.m |
| 3. | Microbiology and Industrial Bio Technology
(with 7X14 sq.m instrumentation dust free AC room) | 10 X 20 Sq.m |
| 4. | General Instrumentation room
(with some work benches) | 15 X 25 Sq.m |
| 5. | Green house and Environmental Chamber
(In the field) | 10 X 20 Sq.m |

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LIST OF EQUIPMENT

Sr. No.	Item	Qty	Cost
1.	Dissecting Microscopes	4	40,000
2.	Microtome with accessories	1	40,000
3.	Light Microscopes	10	2,50,000
4.	Fluorescence and phase contrast microscope	2	8,00,000
5.	Refrigerator(double door 165 Lit. each)	2	30,000
6.	CO2 incubator with accessories (Cylinders)	1	3,00,000
7.	Autoclave Horizontal (Large) Approx. 200 lit. capacity	1	2,50,000
8.	Autoclave Vertical (Small) Approx. 20 lit. capacity	4	60,000
9.	Laminar Air flow Benches(3X4 Sq.ft each)	4	3,00,000
10.	Liquid nitrogen cylinder with supply	1	75,000
11.	DNA Transilluminator	1	2,00,000
12.	BOD incubators with light (NSW India, Max Size)	4	2,00,000
13.	Incubator Shaker	1	4,00,000
14.	DNA Thermal cycler	1	1,50,000
15.	HPLC, High pressure liquid	1	2,00,000
16.	Centrifuges(Coolings REMI C-24)	2	2,50,000
17.	Freezer(-) 20oC(210 Lit. horizontal)	1	40,000
18.	Freezer(-) 80oC(210 Lit. horizontal)	1	4,00,000
19.	Water Bath	4	60,000
20.	Drying and Sterilizing ovens		
21.	Water Purification System (Millipore) approx. 40-50 lit. Water with accessories	1	4,50,000
	A. Pre filtration system		
	B. Reverse osmosis system		
	C. Ion Exchangers		
21A.	Glass Water Distillation Unit	4	50,000
22.	pH meters	4	50,000
23.	Ordinary centrifuge Speed 5000 rpm, 8 tubes each	4	40,000

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Sr. No.	Item	Qty	Cost
24.	Horizontal and vertical electrophoresis apparatus and power supplies	2 each	1,00,000
25.	U.V/Vis Spectroscope with computers	1	3,00,000
26.	Shakers, Temperature Control Indigenous clamps with trays for flask holding	4	6,00,000
27.	Microfuges	2	1,20,000
28.	Cell counter	2	4,000
29.	Magnetic stirrer	4	12,000
30.	Pipette aids and automatic pipetting	LS	1,60,000
31.	Fraction collector complete unit with columns, U.V monitor Recorder, peristaltic Pump	1	4,00,000
32.	Filtration units (for medium Sterilization) with pump	3	90,000
33.	Top Pan Balances	5	50,000
34.	Colony counters		
35.	Dispensers and diluters	3	90,000
36.	Spectrophotometer	2	1,80,000
37.	Electronic Balance	1	1,00,000
38.	Chemicals	LS	2,00,000
39.	Glassware	LS	2,00,000
40.	Miscellaneous	LS	2,00,000
41.	Ovens	2	50,000
42.	Green house	1	4,50,000
43.	Pentium Server with Accessories Laser Printer and Colour Monitor	1	2,00,000
44.	Ocular and Stage Micrometer	20	20000
45.	Haemo Cytometer	20	20000
46.	Micro Pipette (Set of 3, 2-20 ul, 20-200ul, 200-1000ul)	10	100000
47.	Bio reactors For Plant Cell Culture	1	120000

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LIST OF BOOKS

GREEN HOUSE TECHNOLOGY

1. Plants, Chemicals and growth by F.C. Steward and AD Krikovian, Published Academic Press, New York and London
2. Plant physiology a treatise by FC Stewmel, Published Academic Press, New York and London
3. Plant Biotechnology by Shain Dew King and Chales J Arntzen, published by Pastens Institute, Paris etc
4. Biotechnology in Agriculture and Forestry II, Edited by YPS Bajab published Springs - Verlag Berlin Heidelberg, New York Tokyo
5. Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture edited by J Reinert and VPS Bajaj, published Springs - verlag Berlin Heidelberg, New York Tokyo
6. Biochemistry by Zubey W.C.B.,Australia
7. Biochemistry by Stryer Freeman N Y

INDUSTRIAL BIOTECHNOLOGY

1. L. Stryer. : Biochemistry, CBS, New Delhi, 1986.
2. A.L. Lehninger : Principles of Biochemistry, CBS Publishers and Distributors, New Delhi, 1985.
3. R.L. Foster, The Nature of Enzymology Joan Wiley & Sons. New York, 1980.
4. A. Fersht, : Enzyme Structure and Function, W.H. Ereeman & Co., New York, 1985.
5. D.V. Roberts : Enzyme Kinetics, Cambridge Chemistry Text Books, Cambridge University Press, Oxford, 1977.
6. H.J. Rehm and G. Reed : Biotechnology (vol. 7a) VCH, Berlin, 1987.
7. P.W. Carr and L.L. Bowers, : Fundamentals and Applications of Immobilized Enzymes in Analytical and Chemical Industry, John Wiley & Sons. New York, 1980.
8. A.P.F. Turner and G.S. Wilson : Biosensors; Fundamentals and Applications, Oxford Science Publications, Oxford, 1987.
9. W.M. Fogarty : Microbial Enzymes and Biotechnology, Applied Science Publishers, London, 1983.
10. G.G. Birch, N. Blakebrough and K.J. Parker : Enzymes & Food Processing, Applied Science Publishers. London, 1981.
11. J. Woodward : Immobilized Cell & Enzymes - A practical approach, IRL Press, Oxford, 1985.
12. M.D. Trevan, : Immobilized Enzymes - an introduction & application in Biotechnology, John Wiley & Sons. New York,

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1980.

13. B. Reed : Prescott & Dunn's Industrial Microbiology, Macmillan Publishers Ltd, Connecticut, 1982.
14. P.F. Stanbury and A. Whitaker : Principles of Fermentation Technology, Pergamon Press, New York, 1984.
15. M. Moo-Young : Comprehensive Biotechnology, (Vol. 3 & 4) Pergamon Press, New York, 1985.
16. P. Prave, B. Faust, W. Sitting and D.A. Sukatesh : Fundamentals of Biotechnology, WCH Weinheim, 1987.
17. J. Higgins, D.J. Best and J. Jones : Biotechnology, Principles and Applications, Blackwell Scientific Publications, London, 1985.
18. R.H. Rehm and G. Reed : Biotechnology, (vol. 4,5,6 & 7a) Verlag Press, New York, 1982 & 1987.
19. J.R. Norris and M.H. Richmond : Essays in Applied Microbiology, John Wiley & Sons, New York, 1981.
20. D.R. Berry, I. Russel and G.G. Stewart : Yeast Biotechnology Allen & Unwin, Boston, 1987.
21. G.G. Stewart : Critical Reviews on Biotechnology, CRC Press Inc., New York, current issues.
22. M. Moo-Young, J.D. Bullock, C.L. Cooney and B.R. Glick-Biotechnology Advances, Pergamon Press. New York, current issues.

MOLECULAR BIOLOGY AND GENETIC ENGINEERING

1. R.I. Freshney : Animal Cell Culture, A.R. Liss Inc., New York, 1989.
2. M. Buttler : Animal Cell Culture Technology, Open University Press, Buchingham, 1987.
3. R.W. Oid and S.B. Primrose : Principles of Gene Manipulations Blackwell Scientific Publication, 1990.
4. R.H. Rehm and G. Reed : Fundamentals of Genetic Engineering (Vol. 12), Verlag Press New York, 1993.
5. P.J. Barr : Yeast Genetic Engineering, Wiley, New York, 1989.
6. J. Sambrook, E.F. Fritsch and T. Maniatis : Molecular Cloning, Cold Spring Harbor, New York, 1989.
7. T.A. Brown : Gene Cloning, Van Nosterand and Reinhold, New York, 1982.
8. W. Raznikoff and L. Gold : Maximizing Gene Expression, Butterworths, London, 1986.
9. R. Williamson : Genetic Engineering, (vol, 1,2,3 & 4) Academic Press, New York, 1981.
10. R. Wu, L. Grossman and K, Moldane (ed.) : Recombinant DNA

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methodology Academic Press, San Deigo 1989.

11. D. Grierson and S.N. Covey : Plant Molecular Biology, Blackle Publication, London, 1984.
12. R. Walden : Genetic Transformation in Plants, Open University Press, Buchingham, 1988.

PLANT TISSUE CULTURE & BIOTECHNOLOGY

1. S.S. Bhojwani and M.K. Razdan : Plant Tissue Culture - Theory & Practice, Elsevier, London, 1983.
2. J. Reinert and Y.P.S. Bajaj : Plant Cell, tissue and Organ Culture, Narosa Publishing House, New Delhi, 1989.
3. W.B. Jakoby and F.H. Pastan : Cell Culture - Methods in Enzymology, Academic Press, London, 1979.
4. K. Vasil and I. Vasil : Cell Culture and Somatic Cell Genetics, Academic Press, London, 1985.
5. J. Reinart and Y.P.S. Bajaj : Plant Tissue Culture Methods - Applications in Agriculture, Springer - Verlag, Berlin, 1989.
6. A. Stafford and G. Warren : Plant Cell Culture. Open University Press, Buchingham, 1990.
7. H. Maitell, J. Mathew and R.A. Mackee : Principles of Plant Biotechnology, Blackwell Scientific Publishers, Oxford, 1985.
8. M.M. Yeoman : Plant Cell Culture Technology, Blackwell Scientific Publication, Oxford, 1986.
9. J. Reinert and M.M. Yeoman : Plant Cell & Tissue Culture - a laboratory manual, Narosa Publishing House, New Delhi, 1982.
10. Animal Cell Culture : Freshney, Oxford Univ. Press
11. Introduction to Plant Tissue Culture, Razdan, Oxford and BH, Delhi
12. Plant from Test tubes; Kyte and Kleyn, Timer Press, Portland

ANALYTICAL BIOCHEMISTRY

1. Biochemistry : Principles of Cell Structure & Function by A.L. Lehninger, CBS Publishers, New Delhi, 1983.
2. Biochemistry by L. Stryer. CBS Publishers and Distributors, New Delhi, 1986.
3. Harper's Review of Biochemistry by D.W. Martin, P.A. Mayes V.W. Rodwell & D.K. Grammer, Lange Medical Publication Maruzen Co. Ltd, 1990.
4. Fundamentals of Nitrogen Fixation by J.R. Postgate, Cambridge University Press, Oxford, 1982.
5. Biochemistry by D. Voet & J.G. Voet, John Wiley & Co. (1990).
6. Outlines of Biochemistry by E.E. Conn and P.K. Stumpf. Wiley

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Eastern Ltd., New Delhi, 1989.

7. Lipid Biochemistry - An Introduction by M.I. Gurrand, A.I. James, Chapman and Hall Ltd., London, 1980.
8. Introduction to Plant Biochemistry by T.W. Goodwin and E.I. Mercer, Pergamon Press, Oxford, 1983.
9. Text Book of Biophysical Chemistry (Vol 2 & 3) by A. Cantor, W.H. Freeman & Co. 1980.
10. Physical Chemistry with Application to Biological Systems by Ratmoud Chang. Macmillan Publishing Co., Inc., Collier Macmillan Publishers, 1981.

MOLECULAR BIOLOGY AND GENETIC ENGINEERING

1. Molecular Biology of the Cell by B. Alberts, D. Bray, J. Lewis, M. Raft, K. Robertis and J. Watson. Garland Publishing Inc., New York, 1988.
2. Molecular Biology by D. Friefelder, Narosa Publishing House, New Delhi, 1988.
3. Biochemistry : Molecular Basis of Cell Structure & Function by A.L. Lehninger, Kalyani Publishers, New Delhi, 1983.
4. The Molecular Biology of Bacterial & Virus Systems by G. Hobom, Springer Book (Pvt) Ltd., New Delhi, 1988.
5. Molecular Biology of Gene by J.D. Watson, N.H. Hopking, J.W. Roberts, J.A. Steig and A.M. Weins. The Benjamind Kummings Publications Co., Amsterdam, 1988.
6. Cenes V By B. Lewin. John Willey & Sons, New York, 1994.
7. Microbial Genetics by D. Friefelder. Narosa Publishing House, New Delhi, 1989.
8. Principles of Genetics by J. Gardner and D.P. Snustad, John Willey & Sons, New York, 1988.
9. Genetics of Microbes by A brainbridge. Blackie & Sons Ltd., New York, 1987.
10. Molecular Biology and Human Dieases by A. Macleod and S. Sikora, Blackwell Scientific Publications Ltd., London, 1984.
11. Molecular Biology of the Cell - Wilson and Hunt; Garland Pub, NY
12. Molecular Cell Biology, Lodish, Harvey Scientific American, NY
13. Microbiology by M.J.R. Pelczar Jr., E.C.S. Chain and N.R. Kreig. McGraw-Hill Book Co. Toronto, 1986.
14. The Microbial World by R.Y. Stanier, J.L. Ingram, M.L. Wheelis and P.R. Painter, Prentice Hall India, Pvt. Ltd., New Delhi, 1986.
15. Microbes and Biotechnology by M.R. Ingle, Basil Blackwell, London, 1986.

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16. Fundamental Principle of Bacteriology by A.J. Salle, Tata McGraw-Hill, New Delhi, 198...
17. Microbiology by D. Davies, R. Dulbecco, H.N. Eisen & H.S. Ginsberg. Harper & Row Publishers, Hagerstown, 1990.
18. Source Book of Experiments for the teaching of Microbiology by S.B. Primrose and A.C. Wardlaw. Academic Press, London, 1982.
19. Basic and Clinical Immunology by D.P. Stitis, J.D. Stobo, H.H. Fudunberg and J.V. Wells, Academic Press, New York, 1987 and 1993.
20. Experimental Foundation of Modern Immunology by R.C. William, John Wiley and Sons, 1986.
21. Handbook of Practical Immunology by G.P. Talwar. Vikas Publishing House, India, New Delhi, 1987.
22. Hybridoma Techniques in the Biosciences and Medicine by T.A. Springer Plenum Press, New York, 1985.
23. Hybridoma Techniques : A Laboratory Courseby by V.R. Muthukkaruppan. S. Baskar and F. Sinigalia, McMilan India Ltd., New Delhi, 1986.
24. Monoclonal Antibodies - Principles and Practice by J.W. Goding. Academic Press, New York, 1983.
25. Monoclonal Antibodies in Clinical Medicine by A.J. Me Michael and J.W. Fabre. Academic Press, New York, 1982.
26. Vaccines-86 : New Approaches to Immunization by F. Brown, R.M. Chanock and R.A. Lerner. Cold Spring Harbour Laboratories, USA, 1986.
27. Maintenance of Microganisms - A Manual of Laboratory Methods by BE Kirsop & J,JS Snell, Academic Press, London, 1984.

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ANNEXURE- QUESTIONNAIRE

INSTITUTE OF RESEARCH, DEVELOPMENT AND TRAINING U.P. KANPUR -208024

SUBJECT: Questionnaire for ascertaining the job potential and activities of diploma holder in Industrial Biotechnology

PURPOSE: To design and develop One Year diploma curriculum in Industrial Biotechnology

NOTE: 1. Please answer the questions to the points given in the questionnaire.
2. Any other point or suggestion not covered in this questionnaire may be written on a separate paper and enclosed with the questionnaire.

1. Name of the organisation: _____

2. Name & Designation of the officer _____
filling the questionnaire _____

3. Name of the department/section/ _____
shop _____

4. Important functions of the _____
department/section/shop _____

5. Number of diploma holder employees _____
under your charge in the area of _____
Industrial Biotechnology

6. Please give names of modern equipments/machines handled by a diploma holder in Industrial Biotechnology

1.	2.	3.
4.	5.	6.

7. What proficiencies are expected from a diploma holder in Industrial Biotechnology.

1.	2.	3.
4.	5.	6.

8. Mention the approximate percentage of the following desired in Diploma teaching.

1. Theoretical knowledge	-----%
2. Practical knowledge	-----%
3. Skill Development	-----%

9. Do you think " on the job training" / Industrial training

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19. Kindly state whether your organisation can contribute towards improvement of curriculum in above field. Yes/ No
If yes : Please give names of experts in your organisation to whom contact.
20. Kindly give your valuable suggestions for being considered at the time of finalisation of curriculum.
21. What changes in technologies are to be incorporated in the development of curriculum in Industrial Biotechnology.

(Signature)

Kindly mail the above questionnaire duly filled to:-

VIKAS KULSHRESHTHA
Assistant Professor
Institute of Research, Development & Training, U.P.
Govt. Polytechnic Campus
Kanpur-208024

(Please note that all information in this survey is confidential for the use of curriculum design only)

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