Curriculum for

POST GRADUATE DIPLOMA COURSE
In
BIOTECHNOLOGY(TISSUE CULTURE)
For the State of Uttar Pradesh

Prepared by:

Institute of Research Development & Training
U. P. Kanpur

CONTENTS

FIRST SEMESTER

SECOND SEMESTER

1. SALIENT FEATURES OF P.G. DIPLOMA PROGRAMME IN BIOTECHNOLOGY(TISSUE CULTURE)

1.1 Name of the Course:		Post Graduate Diploma in Biotechnology (Tissue Culture)
1.2 Entry Qualification:		B.Sc. (Biology with Chemistry/Bio Chemistry/ Life Science)
1.3 Duration	:	One Year (Two Semesters)
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
1.8 Ratio between theory and *Practice*	:	57 : 43 (Approx.)

1.9 Ecology, Environment and Entrepreneurship Development:

As per Govt. of India directives, a subject on Environmental Education and Disaster Management, Environmental awareness camp and Entrepreneurship awareness camp has been incorporated in the curriculum.

1.10Student Centered Activities:

A provision of organizing Student Centered Activities for overall personality development of students. Such activities will comprise of co–curricular activities such as expert lectures, self study, games and other cultural activities, disaster management and safety etc.

1.11 Project work

The purposeof introducing project work is to enable the students to apply the knowledge, skills and attributes, acquired during the entire course, to the solution of specific problems related to practical work. It is expected that students will be sent to various organizations at a stretch for 6-8 weeks and be asked to take up any live problem of the organization/ society as project work.

2. EMPLOYMENT OPPORTUNITIES

Mass propagation of true to type and disease free, quality ornamental plants, fruit and forest trees 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 hybridization, callus cultures from another culture, genetic engineering and genetic transformation are being extensively used for plant improvement. Synthetic/artificial seeds are being developed through encapsulation of somatic embryos in sodium alginate beads. The plant cells are grown in bioreactors for the enhanced production of secondary 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 ornamentals and off season vegetables for local market and export. Bioreactors and fermenters are being used for bulk production of biopesticides, biofertilizer, antibiotics, vitamins, amino acids, enzymes and food processing using various micro-organisms.

Keeping in view the applications 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 demand of human resources in different sectors of research and development. It is anticipated that the technicians trained under this programme will find job opportunities and also self-employment prospects in the following areas:

1. Plant propagation and improvement.
2. Green house fabrication installations, operation and maintenance.
3. Research and Development sector in:

   I. Universities and Institutions.

II. Health care and pharmaceutical industries

III. Biopesticides and biofertilizer industries

IV. Food industry

2 LEARNING OUTCOMES OF P.G. DIPLOMA PROGRAMME IN BIOTECHNOLOGY (TISSUE CULTURE):

Sr.	LEARNING OUTCOMES
After undergoing this programme, students will be able to:	
1.	Understand the knowledge of Biotechnology and its application / significance in day to day life
2.	Understand the basic and advanced Diagnostics/ Molecular Biology Techniques and instrumentation.
3.	Understand the Molecular mechanism of life with cloning techniques
4.	Apply and understand the role of Microorganism in various industries viz; Food, alcohol, biofertilizers, biopesticides, biofuel.
5.	Understand the significance of Microorganism in waste water treatment plant/ Bioremediation
6.	Use various *invitro* culture techniques for plant / crop improvement.
7.	Become an entrepreneur by developing its own Plant Tissue Culture lab.
8.	Have relevant knowledge and skill to establish and maintain green house for Hi Tech Agriculture/ Farming.

3 CURRICULUM AREAS DERIVED FROM LEARNING OUTCOMES OF THE PROGRAMME

The following curriculum area subjects have been derived from learning outcomes:

Sr. No.	Learning Outcomes	Curriculum Areas/Subjects
1.	Understand the knowledge of Biotechnology and its application / significance in day to day life	Molecular Biology& Genetic Engg./ Plant Tissue Culture Technology/ Industrial Microbiology
2.	Understand the basic and advanced Diagnostics/ Molecular Biology Techniques and instrumentation.	Molecular Biology& Genetic Engg./ Analytical Biochemistry
3.	Understand the Molecular mechanism of life with cloning techniques	Molecular Biology& Genetic Engg.
4.	Apply and understand the role of Microorganism in various industries viz; Food, alcohol, biofertilizers, biopesticides, biofuel.	Industrial Microbiology
5.	Understand the significance of Microorganism in waste water treatment plant/ Bioremediation	Industrial Microbiology/ EEDM
6.	Use various *invitro* culture techniques for plant / crop improvement.	Plant Tissue Culture Technology
7.	Become an Entrepreneur by developing its own Plant Tissue Culture lab.	Plant Tissue Culture Technology/ Green House Technology
8	Have relevant knowledge and skill to establish and maintain green house for Hi Tech Agriculture/ Farming.	Green House Technology

7. STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN ELECTRICAL ENGINEERING

FIRST SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
1.1	Analytical Biochemistry	6	-	6	7	25	20	45	75	3	30	3	105	150
1.2	Molecular Biology and Genetic Engineering	6	-	6	7	25	20	45	75	3	30	3	105	150
1.3	Industrial Microbiology	6	-	6	8	25	20	45	75	3	30	3	105	150
1.4	Plant Tissue Culture Technology	6	-	6	8	25	20	45	75	3	30	3	105	150
#Student Centered Activities		-	-	1	1	-	30	30	-	-	-	-	-	30
Total		24	-	25	31	100	110	210	300	-	120	-	420	630

Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self study etc.

SECOND SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	**T**	**P**		*Th*	**Pr**	**Tot**	**Th**	**Hrs**	**Pr**	**Hrs**	**Tot**	
2.1	Green House Technology	*6*	-	6	*8*	*25*	20	45	75	3	30	3	105	150
2.2	Environmental Education and Disaster Management	*6*	-	-	*6*	-	-	-	50	2 ½	-	-	50	--
2.3	Project Work		-	28	*12*	--	***80***	80	--	--	120	3	120	200
2.4	Entrepreneurship Awareness Camp			6	*2*	--	--	--	--	--	--	--	--	Satisfactory / Unsatisfactory
#Student Centered Activities		-	-	6	*2*		20	20	-	-	-	-	-	20
Total		*12*	**-**	**46**	*30*	*25*	**120**	**145**	**125**	**-**	**150**	**-**	**225**	**370**

FIRST SEMESTER: 630 } TOTAL: 1000
SECOND SEMESTER: 370 }

* Common with other diploma programmes
** Common with diploma in Chemical Engg.
# Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self study etc.

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 basic analytical techniques.

Learning outcomes:

1. Students would be skilled in electrophoresis, centrifugation, ELISA, RIA used in various labs/industries.
2. They can be adopted by pathological center, testing labs and research institutions.
3. Students would be skilled as technical analyst required for recent industrial/ research advancement.

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, HPTLC.

5. Electrophoresis: moving boundary and zonal electrophoresis, paper and gel electrophoresis, isoelectric focusing technique.

6. Centrifugation techniques and application (Ultracentrifuge and preparative centrifuges).

7. Electroanalytical methods (TDS, Total soluble solids).

8. Principles and applications of ultraviolet and visible light spectrophotometry, NMR spectroscopy, spectroflurimetry 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 by 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.
7. Qualitative and quantitative analysis of proteins.
8. Estimation of Enzyme activity.
9. Centrifugation and separation of cell components.

INSTRUCTIONAL STRATEGY

The basic instructional strategy to teach various analytical techniques viz., electrophoresis, centrifugation, ELISA, RIA etc should be conceptual and practical based used in various labs and industries.

MEANS OF ASSESSMENT

- Assignment and Quiz
- Class test and end term written exam
- Practical exam (day to day evaluation, record and viva voice)

RECOMMENDED BOOKS

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 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.

SUGGESTED DISTRIBUTION OF MARKS

Unit	Time Allotted (Periods)	Marks Allotted (%)
1	05	05
2	10	10
3	09	10
4	12	15
5	12	15
6	08	15
7	06	05
8	12	15
9	10	10
	84	**100**

1.2 MOLECULAR BIOLOGY AND GENETIC ENGINEERING L T P

Periods/week 6 - 6

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 and its applications.

Learning outcomes:

Students:

1. Can carry out DNA, RNA isolation and identification from different sources.
2. Would be able to isolate the gene and can use it for cloning
3. Can operate and maintain PCR, electrophoresis, western blotting and other molecular techniques.

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, labeling of nucleic acids, Restriction endonucleases, cloning vectors, Isolation and cloning of genes, gene libraries. Various gene transfer methods.

8. Fundamentals of molecular techniques and their uses PCR,Gel documentation and Blotting techniques.

PRACTICALS

1. Isolation of plasmid DNA from E. Coli.

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.

INSTRUCTIONAL STRATEGY

Teacher may use various teaching aids viz., power point presentation, subject related videos, e lectures, demonstration and hands on training of various Molecular Biology and Genetic Engineering Techniques. The Teacher should impart intangible knowledge and practical application of the subject.

MEANS OF ASSESSMENT

- Assignment and Quiz
- Class test and end term written exam
- Practical exam (day to day evaluation, record and viva voice)

RECOMMENDED BOOKS

1. Molecular Biology of the Cell by B. Alberts, D. Bray, J. Lewis, M. Raft, K. Roberts 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. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. The BenjamindKummings Publications Co., Amsterdam, 1988.

6. Genes 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.

16. Fundamental Principle of Bacteriology by A.J. Salle, TataMcGraw-Hill, New Delhi,

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 Methodsby BE Kirsop& J,JS Snell, Academic Press, London, 1984.

SUGGESTED DISTRIBUTION OF MARKS

Unit	Time Allotted (Periods)	Marks Allotted (%)
1	08	10
2	12	15
3	08	10
4	11	15
5	08	10
6	10	15
7	15	15
8	12	10
	84	**100**

1.3 INDUSTRIAL MICROBIOLOGY

L T P

periods/week 6 - 6

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.

Learning outcomes:

Students will:

1. be skilled to operate production scheme for industrial products.
2. able to select and improve strains for optimized yield and recovery.
3. be able to develop microbial inoculums starting from slants.
4. able to understand the manufacturing of valuable microbial products using low cost materials.

DETAILED CONTENTS

1. Microbial growth, nutrition and Fermentation Media.

2. Microbial metabolism, Glycolysis, TCA and Secondary metabolic path ways, strain improvement.

3. Industrial microorganisms, important for water, food alcohol, dairy, biofertilizer, Biopesticides 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, Amylase, Lipase, cellulase 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 glassware's and preparation of culture media for microbial growth.
2. Simple and differential staining of different micro-organisms.
3. Microbial growth measurement by different methods: (Counting, O D., measurement).
4. Effect of pH, temperature and substrate conc. on growthofmicroorganisms.
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 microorganisms.
10. Microscopic determination of shape and size of yeast cell.
11. Screening and isolation of Azatobacter.
12. Maintenance of culture on agar medium.

INSTRUCTIONAL STRATEGY

Teacher should impart basic conceptual knowledge to keep abreast of the latest advances in the various techniques of industrial microbiology, developing practical applications of the subject

MEANS OF ASSESSMENT

- Assignment and Quiz
- Class test and end term written exam
- Practical exam (day to day evaluation, record and viva voice)

RECOMMENDED BOOKS

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, 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 BiotechnologyAllen & Unwin, Boston, 1987.

21. G.G. Stewart : Critical Reviews on Biotechnology, CRC Press Inc., New York, current issues.

22. M. Moo-Young, J.D. Bulock, C.L. Cooney and B.R. Glick-Biotechnology Advances, Pergamon Press. New York, current issues.

SUGGESTED DISTRIBUTION OF MARKS

Unit	Time Allotted (Periods)	Marks Allotted (%)
1	05	05
2	09	10
3	09	10
4	08	10
5	10	15
6	08	10
7	05	05
8	08	10
9	05	05
10	08	10
11	09	10
	84	**100**

1.4 PLANT TISSUE CULTURE TECHNOLOGY L T P

Periods/week 6 - 6

RATIONALE

Knowledge and skill in Plant Tissue Culture is important and useful tool for the large scale plant propagation, disease elimination, plant improvement (e.g., grain quality, fiber quality, disease resistance, insect resistance, herbicide resistance etc) and production of secondary metabolites. This course offers comprehensive hands on training for learning the basics with an insight to laboratory practices along with exposure to "lab- to-land" transfer.Entrepreneur's, who wish to establish their own labs will be benefitted with the lab-to-land training.

Learning outcome:

Students:

1. Would be able to initiate tissue culture and establish their own lab.
2. Would be skilled to execute/ accomplish micro propagation through budculture, organogenesis and somatic embryogenesis.
3. Can develop/produce artificial seeds.
4. Can enhance secondary metabolite content in different medicinal plants through *in vitro*culture techniques.

DETAILED CONTENTS

1. Introduction: Definition, Concept of cellular totipotency, history, present status and future prospects of plant tissue culture.

2. Composition of different culture Media, Role of chemicals and growth regulators in plant tissue culture.

3. Sterilization of media, tissues and other accessories, Inoculation of cultures.

4. Suspension culture, Protoplast isolation, culture and fusion.

5. Clonal propagation: Shoot-tip and axillary bud culture.

6. Techniques of cell and tissue culture: Preparation of explant materials, initiation of cultures, micropropagation through organogenesis and embryogenesis, artificial seedsand embryo culture

7. Anther Culture: Development of haploids, diploidization and its applications.

8. Somaclonal variation and *in vitro* selection for crop improvement.

9. Industrial application of plant tissue culture for production of Secondary metabolites.

10. Plant biotechnology and crop improvement for grain quality, fiber quality, disease resistance, insect resistance, herbicide resistance, stress resistance (basic outlines).

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. Sub culturing 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. Agro bacterium - mediated transformations (demonstration).

INSTRUCTIONAL STRATEGY

Teacher may take help of various teaching aids to make student verse with basic laboratory setup, handling of explants, nutrient medium, establishment and maintenance of culture. Teacher must plan a tour of various Plant Tissue Culture labs in order to explore facilities and process in various labs.The main focus is to provide interesting and motivational learning environment that can enhance the skill and knowledge of students in Plant Tissue Culture. The student should be equipped to effectively utilize PTC techniques in different areas like crop improvement, secondary metabolite enhancement, germplasm conservation and mass propagation of quality Plants.

MEANS OF ASSESSMENT:

- Assignment and Quiz
- Class test and end term written test
- Practical exam (day to day evaluation, record and viva voice)

RECOMMENDED BOOKS

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. H.S. Chawla: Introduction to Plant Biotechnology. CRC Press, New Delhi, 2007.

4. W.B. Jakoby and F.H. Pastan : Cell Culture - Methods in Enzymology, Academic Press, London, 1979.

5. K. Vasil and I. Vasil : Cell Culture and Somatic Cell Genetics, Academic Press, London, 1985.

6. J. Reinart and Y.P.S. Bajaj : Plant Tissue Culture Methods - Applications in Agriculture, Springer - Verlag, Berin, 1989.

7. A. Stafford and G. Warren : Plant Cell Culture. Open University Press, Buchingham, 1990.

8. H. Maitell, J. Mathew and R.A. Mackee : Principles of Plant Biotechnology, Blackwell Scientific Publishers, Oxford, 1985.

9. M.M. Yeoman : Plant Cell Culture Technology, Blackwell Scientific Publication, Oxford, 1986.

10. J. Reinert and M.M. Yeoman : Plant Cell & Tissue Culture - a laboratory manual, Narosa Publishing House, New Delhi, 1982.
11. Animal Cell Culture : Freshney, Oxford Univ. Press
12. Introduction to Plant Tissue Culture, Razdan, Oxford and BH, Delhi.
13. Plant from Test tubes; Kyte and Kleyn, Timer Press,Portland

SUGGESTED DISTRIBUTION OF MARKS

Unit	Time Allotted (Periods)	Marks Allotted (%)
1	06	05
2	07	05
3	06	05
4	07	05
5	08	10
6	10	15
7	10	15
8	10	15
9	10	10
10	10	15

	84	**100**

II Semester

2.1 GREEN HOUSE TECHNOLOGY

L T P
Periods/week 6 - 6

RATIONALE

Appropriate knowledge and relevant skills of green house technology are necessary to establish and maintain the Shade net house, Naturally ventilated and Hi Tech Poly house. The course will help to plan and fabricate suitable green house with controlled environmental parameters for different climatic zones to harden tissue culture raised plants and grow high value ornamentals, cut flowers and vegetables to meet market demand in off season and, export.

Learning outcome:

Students:

1. Would be able to raise quality seedlings in polyhouses.
2. Would be able to fabricate, operate and maintain green house.
3. Would be skilled in hardening of in vitro raised plants.
4. Would be able to produce off season vegetables, cut flowers, high value ornamentals.

.

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 Computerization of environmental parameters and cultural operations.
6. Hydroponics.
7. Pots, potting mixtures and soil sterilization.
8. Cultivation of Horticultural, high value ornamental plants.
9. Hardening of *in vitro* raised 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 soil mix and sterilization.

3. Hardening of tissue culture raised plants.

4. Soil culture and hydroponics, sand culture of roses and selected vegetables in green house.

5. Harvesting, preparation, cooling of cut flowers and vegetables.

6. Packing and transportation (Demonstration only).

INSTRUCTIONAL STRATEGY

Various smart teaching aids should be used to teach different techniques of providing favorable environment condition to the Plants. Teacher should incorporate student input and gather feedback, lastly mentor should impart knowledge through multiple project based learning. Bring in few guest faculties for motivational lecturers. Teacher should impart basic and applied training in the subject for development of skills for Hi- Tech Agriculture for a successful career in entrepreneurship; generate technically trained Human resource for Tissue culture industries and as instructors in labs.

MEANS OF ASSESSMENT:

- Assignment and Quiz
- Class test and end term written test
- Practical exam (day to day evaluation, record and viva voice)

RECOMMENDED BOOKS

1. Plants, Chemicals and growth by F.C. Steward and AD Krikovian, Published Academic Press, New York and London

2. Plant physiology a treotise 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 ZubeyW.C.B.,Australia

7. Biochemistry by Stryer Freeman N Y

SUGGESTED DISTRIBUTION OF MARKS

Unit	Time Allotted (Periods)	Marks Allotted (%)
1	07	05
2	05	05
3	07	05
4	07	10
5	08	10
6	05	05
7	05	05
8	12	15
9	08	10
10	07	10
11	06	10
12	07	10
	84	**100**

2.2 ENVIRONMENTAL EDUCATION & DISASTER MANAGEMENT **L T P**

6 - -

RATIONALE:

A diploma student must have the knowledge of different types of pollution caused due to industrialization 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.

Learning outcome of syllabus:

Students:

1. Would be able to understand the numerous pollutants responsible for causing various types of pollutions.
2. Would be able to understand the role of microorganism in controlling the various pollution systems.
3. Would be able to understand the disaster management system.

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.

- 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 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, GO, 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 RADIOACTIVE POLLUTION :

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

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, StateDisaster Authority- Duties and powers, Case studies of various Disaster in the country, Meaning and benefit of 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.

INSTRUCTIONAL STRATEGY

Various smart teaching aids should be used to communicate knowledge of the environment, attitudes towards the environment, and skills in designing and learning that contains various means to control environmental pollution.

MEANS OF ASSESSMENT

- End term written exam

SUGGESTED DISTRIBUTION OF MARKS

Unit	Time Allotted (Periods)	Marks Allotted (%)
1	06	10
2	04	10
2.1	08	15
2.2	08	15
2.3	04	05
2.4	06	10
2.5	06	15
3	04	05
4	04	05
5	06	10
	56	**100**

2.3 PROJECT WORK

L	T	P
-	-	28

The purposeof introducing project work is to enable thestudents to apply the knowledge, skills and attributes, acquired during the entire course, to the solution of specific problems related to practical work. It is expected that students will be sent to various organizations at a stretch for 6- 8 weeks and be asked to take up any live problem of the organization as project work. Students may also be given option to take up entrepreneurial projects and projects related to environment/ ecology and waste management/utilization. The project identification should be done by the students in consultation with teachers and personnel from the organizations 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 analyze the problem, use of instruments, use of techniques and orientation of learning experiences towards their applications in the world of work. Students should identify projects with the help of their teachers/personnel from industry/organization.

Learning outcome of syllabus:

Students:

1. Will carry out remedies for societal related problems
2. Will work on need/ result oriented objectives.

INSTRUCTIONAL STRATEGY

Teacher should incorporate student knowledge/ societal related problem to provide a specific output based objectives to the students. Objectives should be result oriented.

MEANS OF ASSESSMENT

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. Interpersonal 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

RATIONALE

A post diploma holder in Bio-technology (Tissue Culture) must have the knowledge of different types of pollution caused due to industrialization 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 organized 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

L	T	P
-	-	6

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 organize 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/Organizations and other Financial and Developmental Organizations

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 organizations/Institutions may be invited to explain the type of facilities available and procedures for availing these facilities from their prospective organizations/institutions.

LIST OF PARTICIPANTS

The following experts have participated in workshop for Developing Curriculum Contents of PG diploma courses in Biotechnology (Tissue Culture)

1 - Dr Brijesh Singh , Pof BEFT Dept. HBTU Kanpur

2 - Smt Pragati Mishra , Asst . Professor Tissue Culture , SHUATS Prayagraj

3 - Mr. Preetam Verma HOD **PG diploma courses** in Biotechnology (Tissue Culture) , Govt Polytechnic Ayodhaya

4 - Smt Kalpana Katiyar , Lecturer , AITH Kanpur