University of Kota, Kota

M.Sc. (P/F) Biotechnology-2013

Eligibility: B.Sc. under the 10+2+3 scheme with Chemistry, Zoology, Botany/Microbiology/Biotechnology/Medicine/Pharmacy/Agriculture with a minimum of 50 % marks.

(45% for candidates belonging to the reserved category SC/ST/OBC)

Selection: Common Entrance Test to be conducted by Scheme of Examination and Courses of Study

1. The number of papers and the maximum marks for each paper/practical are shown in the syllabus. It will be necessary for a candidates to pass in the theory part as well as in the practical part (wherever prescribed) separately.
2. A candidate for a pass at each of the Previous and the Final Examinations shall be required to obtain (i) at least 36% marks in the aggregate of all the papers prescribed for the examination and (ii) at least 36% marks in practical(s) / wherever prescribed at the examination, provided that if a candidate fails to secure at least 25% marks in each individual paper at the examination and also in the Test / Dissertation/ Survey Report / Field Works, wherever prescribed, he shall be deemed to have failed at the examination not withstanding his having obtained the minimum percentage of marks required in the aggregate for that examination.

   No division will be awarded at the previous Examination. Division shall be awarded at the end of the Final Examination on the combined marks obtained at the Previous and the Final Examinations taken together, as noted below:

   First Division 60% On the aggregate mark taken together in the Prev. & Final Exam.
   Second Division48%
3. If a candidate clears any paper(s) prescribed at the Previous and/ or Final Examination after a continuous period of three years, then for the purpose of working out his division the minimum pass marks only viz. 25% (36% in the case of Practical) shall be taken into account in respect of such paper(s)/Practical(s) are cleared after the expiry of the aforesaid period of three years; provided that in case where a candidate requires more than 25% marks in order to reach the minimum aggregate as many marks out of those actually secured by him will be taken into account as would enable him to make up the deficiency in the requisite minimum aggregate.
4. A total of eight theory papers (3 hours duration each) are prescribed (4 in previous and 4 in final).A combined Practical Examination (10 hrs. duration in two days) shall be conducted each year. Paper setter shall be asked to set total 9 questions for each theory paper (which have been divided into three sections) or 10 questions for each theory paper (which have no sections) out of which the examinee shall be asked to attempt any five questions. The list of papers is as below:

1. A candidate failing at M.Sc. Previous examination may be provisionally admitted to the M. Sc. Final Class, provided that he passes in at least 50% papers as per Provisions of 0.235 (i)

A candidate may be allowed grace marks in only one theory papers up to the extent of 1 % of the total marks prescribed for that examination.

M.Sc. (Final) Biotechnology, 2013
Teaching and Examination Scheme for

B.	Theory Papers	Max. Marks
5.	Cell and Tissue Culture	100
6.	Environmental Biotechnology	100
7.	Biostatistics, Bioinformatics & Computer Application	100
8.	Industrial Biotechnology	100
9.	Combined Practical	200
	a. Major Exercise (2) 30 marks each	60
	b. Minor Exercise (2) 15 marks each	30
	c. Preparation (Slide/Mounting)	10
	d. Spotting (4) 05 marks each	20
	e. Project work (Experimental Study/Review)	30
	f. Record	20
	g. Viva-voce	30
	Total	**600**

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Paper- V Cell and Tissue Culture

Min. pass marks: 36 *Duration: 3 hours* *Max. marks: 100*

Note: Attempt any five questions, taking atleast one question from each section. Each question carries equal marks.

Unit- I

Introduction and history of plants tissue culture. Tissue Culture media (composition and preparation).Types of culture. Initiation and maintenance of callus. suspension culture, single cell culture and somaclonal variation. Organogenenesis : somatic embryogenesis, and clonal propagation transfer and establishment of whole plants in soil.

Unit-II

In vitro pollination, embryo culture and embryo rescue.

Protoplast isolation, culture and fusion; selection of hybrid cell and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids. Anther and pollen culture: production of haploid plants and homozygous lines. Crop preservation and germplasm conservation.

Unit-III

Transgenic plants and Gene transfer methods. Selection of clones, marker and reporter genes in screening methods. RFLP, RAPD and other molecular markers. . Natural Products with special reference to alkaloids: production in plant tissue culture. Optimization, extraction of alkaloids and steroids, selection for cells for higher yields. Biotransformation, immobilization, elicitors and hairy root culture for production of useful metabolites. Antisense RNA technology and its application.

Unit-IV

Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Biology of the cultured cells, Organ and Histotypic culture. Measuring parameters of growth. Basic technique of mammalian cell cultures in vitro. Microcarrier culture, cell syncronization and cell culture. Application of animal cell culture. Hybridoma technology and monoclonal antibodies.

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Unit-V

Methods of Micropropagation and their application in forestry, Floriculture, agriculture and conservation of biodiversity and threatened plants.

Applications of plants biotechnology in breeding and crop improvement anther, embryo and endosperm culture, production of haploids, Male sterile plant.

Application of plants tissue culture in plant pathology. Development of virus free plants. Growth of obligate parasites in culture. Development of disease resistance. Screening of germplasm.

Reference books:

1. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005
2. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach, 3rd Edition, Oxford University Press, 2000.
3. Plant Tissue Culture by MK Razdan
4. Plant Tissue Culture by MK Razdan & SS Bhojwani (1996) Elsevier
5. Plant Physiology by L Taiz & E Zeiger 4th Edition (2006) Sinauer Associates Inc, Publishers
6.Plant Biotechnology by H.S. chawla.
7. Plant Biotechnology and Transgenic Plants, Edited by Kirsi Marja Oksman-Caldentey, Wolfgang Barz Marcel Dekker 2002
8.Plant Tissue Culture Concepts and Laboratory Exercises, Second Edition, Robert N Trigiano, Dennis J Gray, CRC Press November 1999

Paper VI Environmental Biotechnology

Min. Pass Marks: 36 Duration 3 hrs. Max. Marks: 100

Note: Attempt any five questions, taking atleast one question from each section. Each question carries equal marks.

Unit-I

Environmental biotechnology: Current status of biotechnology in environmental protection. Cleaner technology. Biotechnology for pollution abatement: Bioscrubbers and biofilters; Biotechnology for air and water pollution abatement. Aerobic and anaerobic biological treatment. Use of immobilized enzymes and microbial cells for effluent treatment.

Unit- II

Bioremediation: In situ technique- bioventing, biostimulation , bioaugmentation, air sparging, natural attenuation. Ex-situ techniques- land farming, solid phase, slurry phase treatment. Factors influencing bioremediation. Phytoremediation: Phytoextraction, phytostabilization, Phytostimulation, Phytotransformation, Rhizofiltration. Mechanism of phytoremediation. Future of Phytoremediation. Transgenic plants for phytoremediation.

Unit-III

Biomineralization: Modes of biomineralization; Organisms for mineralization ; Metal- microbe interaction; Bacterial, fungal, algal remediation. Mechanisms of bioleaching-direct and indirect. Bichemical reactions involved in bioleaching. Biomineralization of metals-iron, zinc,copper,gold and uranium.
Biaccumulation: Bioaccumulation process-uptake, storage, elimination, state of dynamic equilibirium.Factors affecting bioaccumulation.

Unit-IV

Biomagnification of pesticides and heavy metals. Consequences of biomagnification.
Bioinsecticides for productivity improvement and crop protection.Microbial pesticides, Bt insectices, Neem insecticides. Biofertilizers:Applications of bacteria, algae, fungi and azolla. Production technology for biofertilizers. Green manure and aquatic plants as biofertilizers. Composting and Vermicomposting technologies. Integrated nutrient management (INM).

Unit-V

Biomonitoring: Scope of the concept. Objectives of biomonitoring.Parameters for biomonitoring. Micro-organisms, lower plants, and higher plants as bioindicators. Algae, fungi, leaf, stem, root, flower, pollen germination, cell and chromosome, human system as indicator of pollution. Significance of bioindicators. Applications of bioindicators.
Spiderwort strategy for detection of low level atomic radiation.Excellent test systems.Increase of somatic mutation. Importance of concentration of radiation.
Role of Dianococcus radiodurans in disposal of radioactive waste material and its future in environmental biotechnology.

Reference Books:

1. Environmental Biotechnology: Concepts and Applications Hans-Joachim Jördening, Josef Winter John Wiley & Sons,
2. Advanced Environmental Biotechnology By S.K.Agarwal APH Publishing,
3. Environmental Biotechnology By S.N Jogdand Himalaya Publishing
4. Textbook of Environmental Biotechnology By Mohapatra I. K. International Pvt Ltd
5. Environmental Biotechnology: Basic Concepts and Applications By Indu Shekhar Thakur
6. Environmental Biotechnology: Theory and Application By Gareth G. Evans , Judy Furlong

Paper- VII Biostatistics, Bioinformatics & Computer Applications

Min. Pass Marks: 36 Duration 3 hrs. Max. Marks: 100

Note: Attempt any five questions, taking atleast one question from each section. Each question carries equal marks.

Unit-I

Collection, organization and representation of data: Collection of data, Primary and Secondary data. Sampling & sampling design- Census method, sample method, random and non-random sampling. Size of sample . Tabulation and graphics representation. Measure of central tendency and dispersion: Mean, Median and Mode. Measure of dispersion: Range, Standard deviation, Lorenz curve. Skewness and kurtosis: Objectives and measures of skewness. Karl Pearson's coefficient of skewness. Bowley's coefficient of skewness. Kelly's measure of skewness. Kurtosis. Correlation analysis: Types of correlation- Partial and Negative correlation, Linear and non-linear correlation, Methods of studying correlation- scatter diagram, graphic method, Karl Pearson's coefficient of correlation. Correlation of grouped data, Rank correlation, Concurrent deviation method, Partial and multiple correlation.

Unit-II

Regression analysis: Regression Line, regression equations- of X on Y and Y on X. regression in a bivariate grouped frequency distribution. Multiple regression. Probability theory: Types of probability- Mathematical, posterior and axiomatic probability. Theorems of probability- Addition and multiple theorem. Theorems of probability- Addition and multiple theorem. Theoritical distributions: Binomial, Poission and Normal distribution.

Unit-III

Sampling and test of significance: Steps in tests of hypothesis. Sampling distribution. Standard error. Test of significance for attributes. Test for number of success and proportion of success. Test of significance for variables (Large samples)- tests of differences between means of two samples and between two standard deviations. Tests of significance for variables (Small samples)- Students t-distribution to test the difference between means of two samples, and test the significance of an observed correlation coefficient. Variance ratio test (or F-Test). Chi-square test and goodness of fit: Characteristics of x^2 test, use of X-test, Yates correlation. Analysis of variance: One way and two way classification. Multivariate analysis.

Unit-IV

Bioinformatics: Introduction, historical resume, definitions. Bioinformatics and pharmaceutical industry, Concept of discovery of drug, post- genomic era, role of bioinformatics in pharmaceutical industry, Challenges. Bioinformatics business- Commercialization of bioinformatics, Biotechnology and bioinformatics, Current market study, Future prospects of bioinformatics business. Role of intranet and internet in bioinformatics. Bioinformatics career, Future prospects, Current prospects, career outlook, Geographical considerations. Ethical issues.

Unit-V

Introduction to Macro and Micro-computers, Attachments and peripherals. Hardware and Software. Application of computer in statistical data processing. Software packages for statistical analysis: SAS, MINITAB, BMDP, SPSS, S-plus, MATLAB. Academic and research software- XGobi, Xlisp-Start, ExplorN, MANET. Pitfalls of data analysis by employing statistics: problem with statistics, Source of bias, Problem with interpretation.

Reference books:

1. Bioinformatics(2002) Bishop Martin
2. Molecular databases for protein and sequence and structure studies: Sillince A. and Sillince M.
3. Sequence Analysis primers : Gribskov, M. and Devereux, J.
4. Bioinformatics: Sequence and Genome Analysis By David W. Mount, University of Arizona, Tucson
5. Discovering Genomics, Proteomics, & Bioinformatics, Second Edition By A. Malcolm Campbell, Davidson College; Laurie J. Heyer, Davidson College; With a Foreword by Francis S. Collins
6. Biostatistics:P.N.Arora ,P.K.Malha
7. Introductory statistics for Biology: Mahajan , S. K.

8. Statistical Methods : Mishra and Mishra
9. Fundamental of computeres by P.K.Sinha

Paper VIII Industrial Biotechnology

Min. Pass Marks: 36 Duration 3 hrs. Max. Marks: 100

Note: Attempt any five questions, taking atleast one question from each section. Each question carries equal marks.

Unit-I

Isolation, preservation and maintenance of industrial microorganisms, strain improvement Microbial growth and death kinetics, media for industrial fermentation air and media sterilization,
Types of Fermentations: batch, continuous, fed-batch, solid state, sub-merged, aerobic and anaerobic, dual and multiple fermentations, their advantages and disadvantages. Fermentor: Basic design and Types, environmental control ,analysis of mixed microbial populations.

Unit-II

Down stream processing: Biomass separation by centrifugation, filtration, flocculation and other recent developments.
Cell disintegration: Physical, chemical and enzymatic methods.
Extraction: Solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction. Purification by different methods. Concentration by precipitation, ultra-filtration, reverse osmosis. Drying and crystallization.

Unit-III

Industrial production of alcohol (ethanol), acids (citric acid and gluconic) solvents (glycerol, acetone butanol), antibiotics (Penicillin, Streptomycin, Tetracycline), amino acids (Lysine, Glutamic acid), steroids transformation, hormones and vaccines : types and production. Whole cell immobilization and industrial applications

Unit-IV

Introduction to food technology -elementary idea of Canning and packing, Sterilization and pasteurization of food products, Production of mushroom. cheese, single cell protein, single cell oil .
Synthetic seeds-Progress and potentials. Scaling-up production and automation in plant propagation. Use of robotics in plant production. Mass scale plant production facilities: design and planning clean area transfer and examination and control. Sericulture. Silkworm- Improvement through biotechnology

Unit-V

Production planning and scheduling. Air conditioning, air handling and demineralization, distillation, reverse osmosis. Hardening and acclimatization - success and bottlenecks. Green-house management and operations.
Quality control. packaging and shipment, cost benefit analysis. Global market, commercial opportunities in plant tissue culture with special reference to plant tissue culture industries in India.

Reference Books

1. Sullia S. B& Shantharam S: (1998) General Microbiology, Oxford & IBH Publishing Co. Pvt.Ltd.
2. Glaser A.N & Nilaido.H (1995) Microbial Biotechnology,W.H Freeman & Co.
3. Prescott & Dunn (1987) Industrial Microbiology 4th Edition, CBS Publishers & Distributors.
4. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
5. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, PanimaPublishing Corp.
6. Stanbury P.F, Ehitaker H, Hall S.J (1997) Priciples of Fermentation Technology., Aditya Books (P) Ltd.
7. S.N.Jogdan (2006) Industrial Biotechnology, Himalaya Publishing House

PRACTICALS

Min. Marks: 72 Duration: 10 Hrs. (2 days) Max Marks: 200

1. Descriptive statistics: systematic tabular summarization of data (before analysis), measures of central tendency, measures of dispersion. measures of skewness (using calculators).
2. Correlations (product-moment coefficient, Spearman's rank coefficient) and regression (linear regression, curve fitting).
3. Statistical distributions: fitting discrete uniform, bionomial, Poisson and normal probability distribution of given data.
4. Testing of hypotheses -Tests of significance (Mean, Standard Deviation, and Correlation coefficient), Chi-square test for good-ness-of-lit, test for independence of attributes, non-parametric tests (run test) using calculators and printed tables, and using Minitab.
5. Sampling (drawing random samples using random number, tables, computer programs for random number generation), Design of experiments, ANOVA (one-way and two-way).
6. Molecular modelling and construction to long chain proteins: i) conversion of internal coordinates of a molecule of Cartesian coordinates ii) from cartesian coordinates to internal coordinates iii) fourth atom fixation.
7. Acquaintance with tissue culture laboratory..
8. Preparatory techniques: Washing of glassware, dry and steam sterilization. Maintenances of aseptic conditions. Sterilization techniques.
9. Preparation of culture Media. Media preparation: Filter sterilization. Sterility tests, media storage. Serum inactivation.
10. Short term cultures: a) Primary culture of cells b) Organ culture.
11. Growth studies, Cell count, protein estimation.
12. Staining of cultures and observations under microscope.
13. Development and maintenance of a cell line.
14. Staining and screening of cells/sera for mycoplasma, viruses.
15. Freeze-storing and revival of cultured cells.
16. Karyotyping. Virus propagation in cells/ embryogenated eggs. Plaque/Focus formation assay.
17. Cytopathogenic response of cells to viruses.
18. Clonogenic assay cell - cell interaction -Coculture of normal and mutant cells.
19. Cell cloning by single cell dilution method.
20. Cell synchronization (determination of mitotic index and cell cycle time).
21. LDH isozyme analysis of the given cell lines.
22. Introduction to plant tissue culture technique role of nutrients in plant growth and development and hormonal regulation in plants, incubation conditions, types of cultures and tabulations of results.
23. Embryo development: permanent mounts and experimental: a) chick developmental stages and Gastrulation b) plant embryo: developmental stages (permanent slides and fresh preparation)
24. Cell motility and flagella staining.
25. Cytology and Histology of various organs (permanent slides and fresh preparation)
26. Cell types of plants -maceration of various tissue explant and identification or xylem vessels, trachiaeds, stomata, root hair etc.
27. Chromatography: Paper, TLC. SDS – PAGE.
28. Isolation of antibiotics producing microbes from soil by crowded plates technique and demonstration of antibiotic sensitivity by giant colony inhibition spectrum
29. Fermentation of grape juice and estimation of alcohol by distillation.
30. Enzyme immobilization using sodium alginate.
31. Production microbial enzyme (amylase) and conversion of starch to glucose.
32. Separation of cells by flocculation. Use of alum as a flocculating agent to separate yeast from fermentation broth.
33. Comparative study of surface culture (Mat culture of *aspergillus niger/Pencillin*), solid state fermentation (Mushrooms) and submerged cultures.
34. Purification of a product secreted by a functional cell line.
35. Estimation of hormones secreted by a hormone -secreting cell line.
36. Cell/hybridization. .
37. Immunohistochemical staining (oncogene expression),
38. Transplantations -tumors, organs, cells.