ಮಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

MANGALORE UNIVERSITY

(Accredited by NAAC with 'A' Grade)

ಕ್ರಮಾಂಕ/No. MU/ACC/CR6/CBCS-PG(SLB)/2017-18/A2

ಕುಲಸಚಿವರ ಕಚೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ - 574 199
ಕರ್ನಾಟಕ, ಇಂಡಿಯ
Office of the Registrar
Mangalagangothri - 574 199
Karnataka, India

ದಿನಾಂಕ/Date : 8/5/2017

NOTIFICATION

Sub: III & IV semester Choice Based Credit System syllabus of M.Sc. in Biotechnology degree programme.

Ref: 1) This office Notification No. MU/ACC/CR7/CBCS-PG(SLB)/ 2016-17/A2, dated: 17-8-2016.
2) Academic Council decision dated 3-2-2017 vide Agenda No. 3:11 (2016-17)

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In continuation to this office Notification cited under ref. (1) above, the syllabus of III & IV semester M.Sc. in Biotechnology degree programme which approved by the Academic Council at meeting held on 3-2-2017 is hereby notified for implementation with effect from the academic year 2017-18 and onwards (for students of 2016-17 batch and onwards).

REGISTRAR

To:

1) The Chairman of the Department concerned/ The Coordinator of the degree programme concerned.
2) The Principal of the college concerned.
3) The Registrar [Evaluation], Mangalore University.
4) The Chairman of the Board of Studies concerned.
5) The Superintendent [ACC], Office of the Registrar, Mangalore University.
6) Guard file.

Scheme and Syllabus for M.Sc. Biotechnology 2016-17

THIRD SEMESTER

Paper Code	COURSE TITLE	Teaching Hrs/week	Exam Hrs.	Marks		Total	Credits
				IA*	Exam		
	HARD CORE COURSES -THEORY						
BTH 501	Microbial Biotechnology	4	3	30	70	**100**	4
BTH 502	Plant Biotechnology	4	3	30	70	**100**	4
	SOFT CORE COURSES -THEORY (CHOOSE ANY TWO)						
BTS 503	Immunotechnology	3	3	30	70	**100**	3
BTS 504	Bioinformatics and Biostatistics	3	3	30	70	**100**	3
BTS 505	Medical Biotechnology						
	PRACTICALS						
BTP 506	Microbial Biotechnology	4	3	15	35	**50**	2
BTP 507	Plant Biotechnology	4	3	15	35	**50**	2
BTP 508	Immunotechnology	4	3	15	35	**50**	2
BTP 509	Bioinformatics and Biostatistics	4	3	15	35	**50**	2
BTP 510	Medical Biotechnology						
	OPEN ELECTIVES (CHOOSE ANY ONE)						
BTE 511	Environmental Biotechnology	3	3	30	70	**100**	3
BTE 512	Medical Biotechnology						
	Total					**700**	**25**

FOURTH SEMESTER

Paper Code	COURSE TITLE	Teaching Hrs/week	Exam Hrs.	Marks		Total	Credits
				IA*	Exam		
	HARD CORE COURSES –THEORY						
BTH 551	Animal Biotechnology	4	3	30	70	**100**	4
BTH 552	Environmental Biotechnology	4	3	30	70	**100**	4
	SOFT CORE COURSES -THEORY (CHOOSE ANY ONE)						
BTS 553	Regulations and Intellectual Property Rights	3	3	30	70	**100**	3
BTS 554	Nanobiotechnology						
	PRACTICALS						
BTP 555	Animal Biotechnology	4	3	15	35	**50**	2
BTP 556	Environmental Biotechnology	4	3	15	35	**50**	2
	PROJECT WORK						
BTP 557	Project Work and Dissertation	-	-	30	70	**100**	4
	Total					**500**	**19**
	Grand Total					**2500**	**92**

IA includes Seminar/Assignment (per course), tests (per course), MCQs (per course) = 30

Scheme of M.Sc. Biotechnology Programme (CBCS)

SEM	HARD CORE COURSES			SOFT CORE COURSES			OPEN ELECTIVES	PROJECT	TOTAL
	No of Courses	Credits	Total Credits	No of Courses	Credits	Total Credits	Total Credits		
I	3Th+3Pr	4+2	18	1Th+1Pr	3+2	5			23
II	2Th+2Pr	4+2	12	2Th+2Pr	3+2	10	3		25
III	2Th+2Pr	4+2	12	2Th+2Pr	3+2	10	3		25
IV	2Th+2Pr	4+2	12	1Th	3	3		4	19
Total			54=58%			28=30%	6	4	92

NOTE:

BASIS FOR INTERNAL ASSESSMENT: Internal Assessment marks in theory papers shall be awarded on the basis of theory test (70 Marks), Objective Test (MCQs)(15 Marks), Seminars and Assignments (15 Marks). The marks obtained shall be reduced to 30. The tests may be conducted 14 weeks after the start of a Semester. Practical Internal Assessment marks shall be based on practical test and records. 30 marks for Practical test and 5 marks for Class record. The marks obtained shall be reduced to 15. The test may be conducted 14 weeks after the start of a Semester. 30 marks for project work (Report/Dissertation and Presentation/Viva).

THEORY QUESTION PAPER PATTERN: Question Papers in all the four semesters consists of three sections (Model question paper enclosed). Section I: Write short notes on any ten out of twelve: (10x2=20 Marks) Section II: Write explanatory notes on any five out of seven: (5x6=30 Marks). Section III: Answer any two out of four: (2x10=20 Marks). Questions are to be drawn from all the units of the syllabus by giving equal weightage to all the units.

PRACTICAL QUESTION PAPER PATTERN: 30 marks for practical exam proper (Major experiment-10 marks, Minor experiments- 05+05 marks, Identify and Comment on-5x2=10 marks) and 05 marks for Class record. The Project work may be conducted either in the department or any other Institution or in an Industry. Project Report/Dissertation carries 70 marks and evaluated as per regulations.

III SEMESTER

BTH 501 MICROBIAL BIOTECHNOLOGY Hours: 52

UNIT I (13 hrs)

Microbial products: Microbial Biomass, Primary metabolites, secondary metabolites microbial enzymes, transformed products. Gene cloning in microorganisms other than *E. coli* (*Salmonella, Rhizobium, Agrobacterium, Bacillus subtilis, Streptomycetes, Aspergillus niger*). Microbial primary and secondary metabolites: Amino acids (Glutamic acid, L-lysine), Vitamins and hormones (vitamin B12, vitamin A, riboflavin, gibberellins). Organic acids and other industrial chemicals (Lactic acid, citric acid, alcohol, acetic acid, glycerol, acetone). Antibiotics (Penicillin, streptomycin, tetracycline), peptide antibiotics (lantibiotics)

UNIT II (13 hrs)

Microbial Enzymes: Microbial production of enzymes (Protease, amylase, invertase, pectinase, xylanase) substrate, production, purification of enzymes, immobilization, their application in food and other industries. Microbial exopolysaccharides (EPS), classification and applications (health, industrial, pharmaceutical and food): Alginate, Cellulose, Hyaluronic acid, Xanthan, Dextran, Gellan, Pullulan, Curdlan, polysaccharides of lactic acid bacteria; Chitin, chitosan and chitin derivatives.

UNIT III (13hrs)

Microbial beverages and food: Production of wine, beer, and vinegar. Microbial food: Oriental foods, Baker's yeast, cheese, SCP, SCO (PUFA), mushroom cultivation, sauerkraut, silage, probiotics. Nutraceuticals. Bioconversion, biofuels, biogas. Waste utilization to generate biofuels.

UNIT IV (13 hrs)

Biofertilizers: *Rhizobium, Azotobacter, Azospirillum,* Cyanobacteria, *Mycorrhiza*, phosphate solubilizers, *Frankia.* Biopesticides: *Bacillus thuringiensis, Bacillus popillae, Trichoderma*, Baculoviruses. Plant growth promoting Rhizobacteria (PGPR)

References

1. Comprehensive Biotechnology. Vol. 1, 2, 3 & 4. Moo-Young, M., Pergamon Press, 2011
2. Fundamentals of Biotechnology. Prave,P.et al., Wiley-Blackwell Pub., 1987
3. Industrial Microbiology. Cassida, L.E., John Wiley & Sons, 1968
4. Industrial Biotechnology. Crueger, W.&Crueger,A., Sinauer Associates Inc., 1990
5. Industrial Biotechnology. Demain, A.L., American Society for Microbiology, 1986
6. Microbial Biotechnology. Glazer, A.G., WH Freeman and Company, 1994
7. Microbial Technology. Peppler, H.J., Vol. 1 & 2. Academic Press, 1979

BTH 502 PLANT BIOTECHNOLOGY Hours: 52

UNIT I (13 hrs)

Plant genome structure, gene families in plants, organization of chloroplast genome, mitochondrial genome and their interaction with nuclear genome, RNA editing in plant mitochondria. Mitochondrial DNA and Cytoplasmic male sterility. Plant breeding mechanism: types and applications**.** Biological oxidation: Electron transport chain, chemiosmotic hypothesis, ATP synthesis, oxidative phosphorylation, substrate level phosphorylation, uncouplers and inhibiters of respiration. Photosynthesis, regulation, Calvin cycle, C3-C4 plants

UNIT II (13 hrs)

Regulation of gene expression in plant development: Germination, apical meristem, floral development, leaf development, seed development and seed storage proteins. Plant hormones (auxins, cytokinins and gibberellins, IBA, NAA, 2-4-D, TD2). Plant tissue culture, history, laboratory design, aseptic conditions, methodology, media, techniques of callus cultures, meristem cultures, anther culture, embryo culture, micropropagation, protoplast culture, somaclonal variation, synthetic seeds; Methods of plant tissue preservation and applications (cryopreservation).

UNIT III (13 hrs)

Cell suspension cultures and bioreactor technology, plant biosynthesis and production, regulation, commercial importance of secondary metabolites by tissue culture. Plant-derived vaccines, plantibodies and pharmacognosy.

Gene rearrangement. Nitrogen fixation by symbiotic and non-symbiotic microbes. *nif* and *nod* genes.

UNIT IV (13 hrs)

Development of transgenic plants for virus, bacteria, fungi, insect resistance. Transgenic crops for improved quality (Bt cotton, Bt brinjal, golden rice), herbicide tolerant, stress resistant plants, delayed fruit ripening, terminator seed technology, GM foods and human health. Molecular diagnosis of plant diseases.

References

1. Biotechnology in Agriculture and Forestry. Bajaj, Y.P.S., Springer, 2007.
2. Biotechnology of Higher Plants. Russell, G.E. Intercept Pub., 1988
3. Plant Cell and Tissue Culture. A Lab manual. Reinert, J.& Yeoman, M.M., Springer, 1982
4. Plant Biotechnology. Mantell, S.H. & Smith, H. Cambridge University Press, 1983
5. Introduction to Plant Biotechnology. Chawla, H.S. Science Publ. Inc., 2002

BTS 503 IMMUNOTECHNOLOGY (SOFT CORE COURSE) Hours: 40

UNIT I (13 hrs)

History and scope of immunology. Types of immunity – humoral and cell-mediated. Innate and adaptive immunity. Specificity and memory. Primary and secondary lymphoid organs; immunization. Cells involved in immune response-T-cells, B-cells. Clonal selection theory. Lymphocyte activation, clonal proliferation, differentiation. Effector mechanisms in immunity-macrophage activation. Lymphokines – Interleukins and their role in immune regulation. Toxin and Toxin resistance.

UNIT II (13 hrs)

Antigens and haptens, determinants; types of immunoglobulins: structure, distribution and function. Antigen-antibody reactions – Antigen equilibrium, dialysis, precipitation reactions, immunodiffusion. Affinity and Avidity. Immunization and antibody response. Antibody diversity - V, D, J, gene segments and DNA rearrangements, molecular biology of antibody synthesis. Complement system. Human and mouse, MHC, Transplantation immunology. HLA in human health and disease HLA tissue typing. Immune-suppression in transplantation.

UNIT III (14 hrs)

Hypersensitivity reaction, treatment approaches. Immunological tolerance. Autoimmune diseases. Thyrotoxicosis, Systemic Lupus Erythematosus, Antinuclear antibodies. Tumor immunology – tumor antigens, immuno-surveillance, immunological escape. Immune deficiency diseases – AIDS; Immunological tolerance. Production, purification and characterization of monoclonal antibodies. Polyclonal antibodies versus monoclonal antibodies. T-cell cloning and their applications. ELISA, RIA, Western blotting, Fluorescent techniques, Fluorescent activated cell sorter (FACS). Concepts in vaccine development. Types of vaccines. Immunotherapeutic approaches to disease treatment-immunotoxins, Lymphokine- activated killer cells.

References

1. Cellular and Molecular Immunology. Abbas, A.K. et al., Elsevier Saunders Co., 2015
2. Essential Immunology. Riott, I.M., Blackwell Scientific Publications, 1994
3. Handbook of Experiments in Immunology, Vol. 1 & 2, Weir D.M., Wiley, 1997
4. Kuby Immunology. Kindt T.J. et at., W.H. Freeman & Co. 2007
5. Immunology. Riott, I.M., BrostoffJ., Male, D. Mosby Pub., 2001
6. Immunobiology. Janeway C.A. and Travers, P. Churchill Livingstone Pub., 1996
7. Practical Immunology. Hudson L. and Hay F.C., Blackwell Scientific Pub., 1989

BTS 504 BIOINFORMATICS AND BIOSTATISTICS (SOFT CORE COURSE)
Hours: 40

UNIT I (13 hrs)

Introduction to Bioinformatics. Basics of UNIX OS and PERL Programming. Biological databases: Nucleotide and protein sequence and structure (primary and secondary) databases, File formats, Molecular visualization softwares. Sequence analysis. Sequence Alignment: Gap penalties, scoring matrices, Alignment algorithms - Global and Local alignments, Dynamic programming and Heuristic methods (BLAST, FASTA). Multiple Sequence Alignment: Tree alignment, Star alignment, Progressive alignment methods and tools. Stand alone packages for sequence alignment: GCG Wisconsin and EMBOSS package.

UNIT II (13 hrs)

Phylogenetics. Representation of phylogeny. Methods of phylogeny: Maximum Parsimony, Maximum Likelihood, Distance method, UPGMA. Softwares for phylogenetic analysis: PHYLIP, CLUSTAL, Tree viewing and editing softwares. Nucleotide sequence and structure prediction methods and tools: Promoter Scan, Gen Scan, CENSOR, Repeat Masker. Whole genome analysis. Genome sequencing strategies, Restriction mapping, Primer designing. Gene Expression analysis - microarray techniques. Protein sequence and structure prediction, Molecular modeling softwares and servers, Protein folding, Threading. Computer-aided Drug Designing: Molecular Docking. Distributed computing approach: Genome@home, Folding@home.

UNIT III (14 hrs)

Statistics – Definition, Application of statistics in Bioscience, Classification and tabulation, Graphical representation of data, Histogram, frequency polygon, frequency curve. Measures of central tendency, Measures of dispersion. Normal distribution, Binomial, Poisson, Probability, non-parametric statistics, Correlation and regression; Sign test, Rank sum test, Rank correlation. Testing of hypothesis: Significance of t-test and ANOVA, Multiple range test, Chi-square test. Experimental designs. Diversity measures and evenness (e.g. Simpson and Shannon). Statistical packages.

References

1. Beginning Perl for Bioinformatics. Tisdall, J.D., San Val Pub., 2001
2. Bioinformatics: Sequence and Genome Analysis. Mount, D.W., CSHL Press, 2004
3. Bioinformatics: Methods and protocols. Misener, S., &Krawetz,S. A., Humana Press, 2000
4. Fundamental Concepts of Bioinformatics. Krane, D.E.& Raymer, M.L., Pearson Ed., 2002
5. Introduction to Protein Structure. Branden,C.-I. & Tooze,J., Garland Pub., 1999
6. Introduction to Bioinformatics. Attwood, T.& Parry-Smith, D., Prentice Hall Pub., 1999
7. Introductory Statistics for Biology. Parker, R.E., Hodder Arnold Pub., 1979
8. Statistics for Biological Sciences. Schefler,W. C., Addison Wesley Pub., 1979
9. Biostatistical Analysis. Zar, J. H. Prentice Hall, 2010
10. Biostatistics. Lewis,A. E.. Prentice Hall, 2010

BTS 505 MEDICAL BIOTECHNOLOGY Hours: 40

UNIT I (13 hrs)

Immunology: Overview: concept of self and nonself, antigens, antibodies; immune response, evolution of immune response, immunological tolerance, hypersensitivity, humoral and cell-mediated immunity, active and passive immunization, antigen processing and MHC. Immunobiology: blood groups and transplantation antigens, HLA. Immune deficiencies and disorders – AIDS. Allergy. Diagnostic tools: Antigen-antibody reaction, agglutination, immunoelectrophoresis, immunofluorescence, enzyme-linked immunosorbant assay (ELISA), radioimmunoassay (RIA). Immunization and vaccines – new types of vaccines, edible vaccines. Organ transplantation.

UNIT II (13 hrs)

Genetics: Structure, organization and types of eukaryotic chromosomes, Heterochromatin, euchromatin, telomeres, types of chromosomes. Cell division. Molecular and cellular biology of fertilization *in-vitro* fertilization, assisted reproductive techniques, cloning. Karyotyping - heritable diseases and syndromes. Prenatal diagnosis (amniocentesis and chorionic villus sampling), Diagnosis of genetic diseases, Gene therapy, PCR.

UNIT III (14 hrs)

Cancer biology: Cell cycle and its regulation. Apoptosis. Carcinogenic agents and molecular biology of cancer, Abnormal cell growth: mechanism of transformation of cells. Genetic basis of Cancer, Physical and chemical carcinogenic agents; Viral and cellular oncogenes, tumor suppressor genes, Telomerases and their role in cancer. Recent advances in therapeutic approaches to disease treatment: Stem cells - types and applications. Cancer therapy – immunotoxins and gene therapy.

References

1. The Cell. A Molecular Approach. Cooper, G.M. Sunderland: Sinauer Associates, Inc., 2000
2. Basic Genetics. Hartl D.L. & Jones E.W.Jones & Bartlett Pub., 1998
3. Kuby Immunology. Kindt T.J. et at., W.H. Freeman & Co. 2007

BTP 506 MICROBIAL BIOTECHNOLOGY

Submerged and solid state fermentation
Estimation of microbial biomass
Estimation of microbial enzymes, mycotoxins, organic acids and antibiotics
Microbiological assays (antibiotics, amino acids and vitamins)
Properties of microbial exopolysaccharides (e.g. cell immobilization)
Uses of Chitin and its derivatives
Pilot scale production of alcoholic beverages
Microbial interactions with plants (rhizobia, mycorrhizas) and plant production
Assessment of nitrogen fixation (acetylene reduction test)
Phosphate solubilization in bacteria, fungi and actinomycetes
Qualities of biofuels (e.g. biodiesel, biogas)

BTP 507 PLANT BIOTECHNOLOGY

Estimation of plant hormones (e.g. auxins, gibberellins)
Plant tissue culture methods
Callus culture (compact and friable)
Ovule and anther culture
Cell suspension cultures
Embryogenesis
Synthetic seeds
Protoplast preparation
Protoplast fusion techniques
Plant cell immobilization
Methods of inducing resistance through tissue culture

BTP 508 IMMUNOTECHNOLOGY

Study of immune system in rats
Blood film preparation and study of immune cells
Histology of organs of immune system
Study of insect hemocytes
Production of antiserum
Isolation of lymphocytes
Antigen-antigen reactions (*in vitro*)
Phagocytosis (*in vitro*)
Immunodot technique
Immunodiffusion technique
Immunological diagnosis of pregnancy and infection
Demonstration of ELISA technique

BTP 509 BIOINFORMATICS AND BIOSTATISTICS

Biological databases - BLAST, FASTA
Restriction mapping
Mean SEM, Histogram
Student's t-test
ANOVA

BTP 510 MEDICAL BIOTECHNOLOGY

Hemagglutination test
Antibiotic sensitivity

Karyotype preparation
Chromosomal staining techniques
Avidin-biotin technique in immunohistochemical staining
Immunoblot

BTE 511 ENVIRONMENTAL BIOTECHNOLOGY (OPENELECTIVE) Hours: 40

UNIT I (13 hrs)
Biogeochemical Cycles: Carbon, nitrogen, oxygen, phosphorous, sulphur, iron and calcium. Environmental pollution: Soil (ecotoxicology of pollutants; fate of insecticides, fungicides and pesticides in soil; physicochemical and microbiological analysis), water and air pollution monitoring (e.g. SO_2 and NO_x); Pollution indicator organisms (plants, animals and microbes) (e.g. algae, Chironomids, coliforms, *Salmonella, Shigella, Vibrio*, Hepatitis A).

UNIT II (13 hrs)
Microbial degradation of toxic chemicals (pesticides, detergents, plastics). Degradation of organic compounds (cellulose, lignin, hydrocarbons: aliphatic, aromatic, alicyclic hydrocarbons). Microbial deterioration of textiles, paper, leather, wood. Biomaterials, microbial mining (uranium, copper, gold, iron), microbial influenced corrosion and remedies, bioaccumulation, biomagnification, biogas production as non-conventional energy sources

UNIT III (14 hrs)
Principles of microbial bioremediation, *in situ* and *ex situ* bioremediation, microbiological treatment of solid wastes – composting, land farming, bioreactors. Biological treatment of liquid wastes – aerobic and anaerobic treatments sewage and effluent treatments. Hazardous wastes: microbial processing and disposal (radioactive wastes, sewage, pharmaceuticals, refinery and leather). Waste management and utilization (plantation crop wastes, aquatic weeds, kitchen/garden waste, poultry waste). GMOs, Environmental release and monitoring of GMOs, Ethical issues

References
1) Ecology. Odum
2) Environmental biotechnology. Jogdand SN., Himalaya Pub. House., 2012
3) Environmental and biochemistry. KudesiaVP. andJetley UK., PragathiPrakashan Pub., 1991
4) Microbial ecology: fundamental and applications. Atlas RA. and Bartha R., Benjamin/Cummings, 1997
5) Microbial biotechnology. Glazer AN., WH Freeman and Co., 1995
6) Sewage and Industrial Effluent Treatment: A practical guide. Arundel J., Blackwell Science Pub. 1995
7) Soil Microbiology. Subba Rao N.S., Oxford & IBH Pub.
8) Waste Water Engineering. Metcalf & Eddy Inc. McGraw-Hill International

BTE 512 MEDICAL BIOTECHNOLOGY (OPEN ELECTIVE) Hours: 40

UNIT I (13 hrs)

Immunology: Overview: concept of self and nonself, antigens, antibodies; immune response, evolution of immune response, immunological tolerance, hypersensitivity, humoral and cell-mediated immunity, active and passive immunization, antigen processing and MHC. Immunobiology: blood groups and transplantation antigens, HLA. Immune deficiencies and disorders – AIDS. Allergy. Immunization and vaccines. Organ transplantation.

UNIT II (13 hrs)

Genetics: Structure, organization and types of eukaryotic chromosomes, Heterochromatin, euchromatin, telomeres, types of chromosomes. Cell division. Molecular and cellular biology of fertilization *in-vitro* fertilization, assisted reproductive techniques, cloning. Karyotyping - heritable diseases and syndromes. Prenatal diagnosis (amniocentesis and chorionic villus sampling). Diagnosis of genetic diseases and gene therapy.

UNIT III (14 hrs)

Cancer biology: Carcinogenic agents and molecular biology of cancer, Abnormal cell growth: mechanism of transformation of cells. Genetic basis of Cancer, Physical and chemical carcinogenic agents; Viral and cellular oncogenes, tumor suppressor genes, Telomerases and their role in cancer. Cell cycle and its regulation. Apoptosis. Recent advances in therapeutic approaches to disease treatment: Stem cells - types and applications. Cancer therapy – immunotoxins.

References

1. The Cell. A Molecular Approach. Cooper, G.M. Sunderland: Sinauer Associates, Inc., 2000
2. Basic Genetics. Hartl D.L. & Jones E.W.Jones & Bartlett Pub., 1998
3. Kuby Immunology. Kindt T.J. et at., W.H. Freeman & Co. 2007

IV SEMESTER

BTH 551 ANIMAL BIOTECHNOLOGY Hours: 52

Unit I (13 hrs)

Animal tissue culture, history, laboratory design, aseptic conditions, methodology and types of media. Role of carbon dioxide, serum and supplements. Equipments and materials for animal cell culture technology. Basic techniques of mammalian cell culture *in vitro*; desegregation of tissue and primary culture; maintenance of cell culture; Cell lines-characteristics and routine maintenance. Biology and characterization of the cultured cells, measuring parameters of growth. Measurement of viability and cytotoxicity.

Unit II (13 hrs)

Cell synchronization, Cell separation techniques. Somatic cell fusion, Cell cloning. Organ and histotypic cultures. Three-dimensional culture - Tissue engineering. Application of animal cell culture - Stem cell cultures, embryonic stem cells, mesenchymal stem cells, induced pluripotent stem cells and their applications. Culture of fish, molluscan and crustacean cells and their applications: Culture of secretory/ glandular cells to produce hormones, Pearl oyster mantle cells to produce pearls.

Unit III (13 hrs)

In vitro fertilization (IVF) and embryo transfer (ET), Sex determination or sex specific markers, sexing of sperm and embryos, Assisted reproductive technology (ART). *In vitro* gamete maturation, Intracytoplasmic sperm injection, Cryopreservation of gametes and embryo, Animal cloning-reproductive cloning, therapeutic cloning, xenotransplantation. Animal genes and their regulation, some specific promoters for tissue specific expression. Gene manipulation in animals-cloning vectors and expression vectors for gene transfer to animal cells. Gene transfer methods in animal cells, Animal cells as cloning hosts. Gene expression in cell culture.

Unit IV (13 hrs)

Improvements of animals using transgenic approach with specific examples, animals as bioreactors: Applications of biotechnology in sericulture. Production of Transgenic fishes. General steps to make and analyze transgenic fish and Genetically Improved Farmed Tilapia (GIFT). Genetic engineering for production of regulatory proteins, blood products, vaccines and hormones. Applications of recombinant DNA in humans: mapping and cloning human disease genes, DNA based diagnosis of genetic diseases, gene therapy, types of gene therapy, somatic versus germline gene therapy, mechanism of gene therapy, Immunotherapy, gene knockout.

References

1. Animal Transgenesis and Cloning. Houdebine,L.-M., John Wiley & Sons, 2003
2. Animal Cell Culture and Technology. Butler, M., BIOS Scientific Publishers, 2004
3. Animal Cloning: The Science of Nuclear Transfer. Panno, J., Facts on File Inc., 2005
4. At the Bench: A Laboratory Navigator. Barker, K. CSHL Press, 2005
5. Basic Cell Culture: A Practical Approach. Davis, J.M. Oxford University Press, 2002
6. Culture of Animal Cells: A Manual of Basic Technique., Freshney R.I. Wiley-Blackwell. 2010
7. Gene VII. Lewin,B., Oxford University Press, New York, 2000
8. Gene Biotechnology. Wu, W. et al., CRC Press, 2004

9. Molecular Biotechnology, Glick, B.R. & Pasternak,J.J.ASM Press, Washington, 2010
10. Principles of Gene Manipulation. Primrose, S.B. et al., Blackwell Publishers, 2006
11. Principles of Cloning. Cibelli, J.B. et al.Academic Press, 2008
12. Recombinant DNA. Scientific Americans Books/W.H.Freeman& Co., 1992
13. Fish Biotechnology. RangaM.M. & Q.J. ShammiAgrobios, New Delhi, 2010

BTH552 ENVIRONMENTAL BIOTECHNOLOGY (HARD CORE) Hours: 52

UNIT I (13 hrs)

Biogeochemical Cycles: Carbon, nitrogen, oxygen, phosphorous, sulphur, iron and calcium; cycling of toxic metals (Cd, Hg, Pb). Environmental pollution: Soil (ecotoxicology of pollutants; fate of insecticides, fungicides and pesticides in soil; physicochemical and microbiological analysis), water and air pollution monitoring (e.g. SO_2 and NO_x); Pollution indicator organisms (plants, animals and microbes) (e.g. algae, Chironomids, coliforms, *Salmonella, Shigella, Vibrio,* Hepatitis A).

UNIT II (13 hrs)

Microbial degradation of toxic chemicals (pesticides, detergents, plastics). Degradation of organic compounds (cellulose, lignin, hydrocarbons: aliphatic, aromatic, alicyclic hydrocarbons). Microbial deterioration of textiles, paper, leather, wood. Biomaterials, microbial mining (uranium, copper, gold, iron), microbial influenced corrosion and remedies, bioaccumulation, biomagnification, biogas production as non-conventional energy sources

UNIT III (13 hrs)

Principles of microbial bioremediation, *in situ* and *ex situ* bioremediation, microbiological treatment of solid wastes – composting, land farming, bioreactors. Biological treatment of liquid wastes – aerobic and anaerobic treatments sewage and effluent treatments. Pollution control measures, international and national pollution regulatory acts; Permissible limits and indices for pollutants; Hazardous wastes: microbial processing and disposal (radioactive wastes, sewage, pharmaceuticals, refinery and leather). Waste management and utilization (plantation crop wastes, aquatic weeds, kitchen/garden waste, poultry waste).

UNIT IV (13 hrs)

Natural products (wood, rubber, coir and gums). Food processing (dairy, bakery, beverages, vegetable and cashew). Coastal regulatory zone (CRZ) and environmental issues of aquaculture; biofouling (microfouling and macrofouling); biofilms; biomolecules from the sea; scope of marine biotechnology. GMOs, Environmental release and monitoring of GMOs, Ethical issues

References

1) Ecology. Odum
2) Environmental biotechnology. Jogdand SN., Himalaya Pub. House., 2012
3) Environmental and biochemistry. KudesiaVP. andJetley UK., PragathiPrakashan Pub., 1991
4) Microbial ecology: fundamental and applications. Atlas RA. and Bartha R., Benjamin/Cummings, 1997
5) Microbial biotechnology. Glazer AN., WH Freeman and Co., 1995
6) Sewage and Industrial Effluent Treatment: A practical guide. Arundel J., Blackwell Science Pub. 1995
7) Soil Microbiology. Subba Rao N.S., Oxford & IBH Pub.
8) Waste Water Engineering. Metcalf & Eddy Inc. McGraw-Hill International

BTS 553 REGULATIONS AND INTELLECTUAL PROPERTY RIGHTS

Hours: 40

UNIT I (13 hrs)

Biosafety and research: General guidelines for recombinant DNA research activity. Containment facilities and biosafety practices; Rules for import and export of biological materials. Biological warfare and Bioterrorism.

UNIT II (13 hrs)

CBD, GAAT, TRIPs, Plant variety protection, International Union for the Protection of new Varieties of Plants (UPOV), plant protection act, registration of new varieties, rights and obligations, farmer's rights; traditional ecological knowledge. Traditional knowledge digital library (TKDL). Plant germplasm conservation, characterization and documentation. Seed certification (laws, regulations and standards), seed patent law.

UNIT III (14 hrs)

Intellectual property rights (IPR) (meaning, classification and forms), importance of IPR in Science and Technology. Patents, patenting procedures, patent applications and patenting laws; Biopiracy. Patent-related litigations and controversies (neem, basmathi rice, turmeric). Salient features of Indian Patent Law.

References

1. Biotechnology, Biosafety and Biodiversity. Shantharam, S. & J.F. Montegomery. Science Pub., 1999
2. Biotechnology. Rehm H.-G.& G. Reed, Wiley Blackwell Pub., 1983
3. Biotechnology and the Law: IPR Vol.1 & 2. Cooper, I.P. Clark Boardman Co., 1989
4. Ethical guidelines for Biomedical Research on Human participants, Indian Council for Medical Research, Govt. of India, New Delhi, 2006
5. Good Clinical Practices for Clinical Research in India, Central Drugs Standard Control Organization, Ministry of Health and Family Welfare, Govt. of India, 2013

BTS 554 NANOBIOTECHNOLOGY (SOFT CORE COURSE) Hours: 40

Unit I (13 hrs)

Principles of nanotechnology - Nanostructures, nanoparticles and their properties. Carbon Nano Structures: Introduction; Carbon buckyballs, fullerenes, nanostructures; quantum dots, nanotubes, magnetic nanoparticles, noble metal nanoparticles. Nanoscale properties and applications.

Unit II (13hrs)

Characterization of nanomaterials: UV-Vis Spectroscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy. Making nanostructures: Top-down and bottom-up approaches. Biological methods of synthesis of nanoparticles: Use of bacteria, fungi, Actinomycetes, Magnetotactic bacteria and plants.

Unit III (14 hrs)

Applications in diverse fields: medicine, dentistry, environment, agriculture etc. Toxic effects of nanoparticles on the environment. Toxicity detection. Nanocomposite biomaterials; teeth and bone substitution, Food packaging - materials and properties. Applications of nanoparticle-based products in health-care and hygiene. Hybrid systems: Bioelectronic systems based on nanoparticle-enzyme hybrids; nanoparticle-based bioelectronics biorecognition events. DNA-based nanomechanical devices. Biosensors and biochips. Pharmaceutically important nanomaterials, drug nanoparticles, nanoparticles for crossing biological membranes. Fundamentals of nanosized targeted drug delivery systems.

References

1. Nanostructures and nanomaterials: Synthesis, properties and applications, Cao, G and Wang Y. 2011, World Scientific, Imperial College Press
2. Plenty of Room for Biology at the Bottom, An introduction to Bionanotechnology: Ehud Gazit, Imperial College Press,
3. Nanotechnology Booker R and Boysen E .Wiley Dreamtech Publ. New Delhi
4. Nanotechnology: A gentle introduction to the next big idea. Ratner M and Tatner D. Pearson Edition New Delhi

BTP 555 ANIMAL BIOTECHNOLOGY

Cleaning and sterilization methods for tissue culture
Preparation of media, buffers
Maintenance of cultures (normal and tumor cell lines)
Separation of peripheral blood mononuclear cells
Cell counting (hemocytometer)
Lymphocyte culture technique
In vitro macrophage culture from mouse
Preparation of human metaphase chromosomes
Cell viability tests
Cell proliferation assay
Growth kinetics of cells in culture
In vitro fertilization and embryo transfer techniques
Cryopreservation techniques
Cytotoxicity tests

BTP 556 ENVIRONMENTAL BIOTECHNOLOGY

Production of compost (methods)
Vermicompost and its analysis
Cultivation of mushrooms
Biogas (biofuels) production
Wastewater treatment methods
Solid waste treatment methods
Experiments on biofouling and biofilms
Experiments on industrial waste treatment methods (e.g. distillery, whey)

BTP 557 PROJECT WORK

M.Sc. Biotechnology (CBCS) 2016-17
Model question paper

BIOTECHNOLOGY
PAPER NUMBER AND TITLE

Time: 3 Hours Max. Marks: 70

Part A
Write short notes on **any TEN** of the following (not exceeding 1 page each): 10×2=20
Question No. 1: a-l

Part B
Write explanatory notes **any FIVE** of the following (not exceeding 3 pages): 5×6=30
Questions No. 2 to 8

Part C
Answer **any TWO** of the following (not exceeding 7 pages): 2×10=20
Question No. 9 to 12