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S.P. Mandali's

Ramnarain Ruia Autonomous College

Syllabus for T.Y.B.Sc.

Program: B.Sc.

Course: Applied component Biotechnology (RUSACBT)

(Credit Based Semester and Grading System with effect from the academic year 2019–2020

SEMESTER V

COURSE CODE	UNIT	TITLE	Credits	Lec/ Week
RUSACBT 501		**CONCEPTS IN BIOTECHNOLOGY**	**2**	
	I	Importance of Biotechnology and Tools in Genetic Engineering		**1**
	II	Techniques in Genetic Engineering		**1**
	III	Methods in Industrial Biotechnology and Bioinformatics		**1**
	IV	Methods in Animal and plant biotechnology		**1**
RUSACBT P 501	**Practicals based on above four courses**		**2**	**4**

SEMESTER VI

COURSE CODE	UNIT	TITLE	Credits	Lec/ Week
RUSACBT 601		**APPLIED BIOTECHNOLOGY**	**2**	
	I	Industrial Biotechnology		**1**
	II	Animal and Plant Biotechnology		**1**
	III	Environmental Biotechnology		**1**
	IV	Health Care Biotechnology		**1**
RUSACBTP 601	**Practicals based on above four courses**		**2**	**4**

Course Code: RUSACBT 501

Course Title: Concepts in Biotechnology
Academic year: 2019-20

Learning objectives:

Biotechnology is a multidisciplinary subject that is an amalgamation of science and technology. Itis an discipline that explores and applies biological systems for manufacture of desired products.

This course is specifically designed to enable the learner understand this amalgamation and to strengthen his/her foundations in technologies used in modifying the biological system for production of desired metabolites.

The course begins with familiarizing the learner to the subject and its branches and then moves on to introducing the tools and techniques used for genetic engineering of biological systems. Once the learner is familiarized with tools like electrophoresis, spectrophotometry and blotting, the course deals with techniques in gene cloning and expression in details. This way the course will give the learner a complete foundation on gene manipulation techniques that can be applied in modifying living systems.

To equip the learner with skill sets required in modern techniques for sequence analysis and BIG data analysis, the curriculum also includes basics of 'omics'.

No scientific research can be useful to mankind unless it can be scaled up to industrial production. The next unit covers the basics of design of fermenters and their types.

Scientific research can be used for benefit or also for harming mankind. So that the learner understands the social implications of scientific methods, the legal aspects associated with problems arising due to issues like plagiarism and stealing of intellectual property and also about ethics of scientific research, an entire subunit has been included in this course.

Although, traditionally biotechnology was limited to microbial systems, developments in cell culture of plant as well as animal cells has extended to using these systems for large scale production of metabolites produced by them. The last unit familiarizes the learner with techniques in tissue culture and techniques of manipulation of genes in these systems.

Learning outcomes:

Upon successful completion of this course the student will be able to:

- recognize the scope and branches of modern biotechnology
- explain the principles that form the basis for recombinant DNA technology
- explain the general principles of generating transgenic plants, animals and microbes
- apply theprinciples of bioinformatics.

- Demonstrate working knowledge in techniques like PCR, genetic mapping, gene isolation and cloning, DNA sequencing, and bioinformatics.
- Explain types of fermentations and their significance
- Explain the overall design of different types of fermenters
- recognize the importance of social, legal and ethical implications of biotechnology

Detail Syllabus

Course Code	UNIT	TOPICS	Credits	Lectures / Sem
RUSACBT 501		**CONCEPTS IN BIOTECHNOLOGY**	**2**	**(60 lectures)**
	I	**Importance of Biotechnology and Tools in Genetic Engineering** **1.1** History of Biotechnology – Traditional and Modern Biotechnology. Biotechnology as an interdisciplinary area, Global impact and current excitements of Biotechnology. (Health care, Agriculture, human genome project, environment), Biodiversity and its preservation. **1.2** Tools in Genetic Engineering a) Basic requirements: Electrophoresis, agarose gel electrophoresis, Pulse field gel electrophoresis (PFGE), SDS-PAGE, 2D gel electrophoresis. b) Mass Spectrometry – Introduction to new terminologies (MALDI, ESI), Spectrophotometry - UV and Visible, PCR and types of PCR c) Blotting Techniques: Southern, Northern and Western blotting. DNA sequencing, Probes, ELISA, RIA, Nick translation and in situ Hybridization.		**15 Lectures** **03** **04** **04** **04**
	II	**Techniques in Genetic Engineering** **2.1** Cutting and joining of DNA, Exonucleases, Endonucleases, Restriction Endonucleases (Type I, II, III). Examples of some enzymes – DNA ligases, Alkaline Phosphatases, DNA polymerases, Use of Linkers and Adaptors **2.2** Cloning Vectors : Properties of good vector, Cloning and Expression vectors. *E. coli* vectors – Plasmid, Cosmid, Phagmid, Bacteriophage vectors – Lambda and M13 Introduction to different vectors - Shuttle vectors, Yeast		**15 lectures** **05** **05**

		vectors (YAC), Vectors for animals and plants. **2.3** Steps in gene cloning. Isolation of desired gene, cDNAlibrary, Genomic library, Introduction of vector in to suitable bacterial host (various transformation methods). Selection of recombinant clones, selection of clones containing recombinant vector, selection of clones containing specific DNA inserts, colony hybridization test.		**05**
	III	**Methods in Industrial Biotechnology and Bioinformatics** **3.1** Bioreactors- Major types, submerged and solid – state fermentation, Fermentation media, Fermentation control, Downstream processing. **3.2**Introduction to types of IPR & patenting in Biotechnology and Bioterrorism **3.3**Introduction to Genomics, Proteomics and Bioinformatics. – Genomic and Protein data base, Introduction to data similarity search BLAST and FASTA		**15 Lectures** **07** **05** **03**
	IV	**Methods in Animal and Plant Biotechnology** **4.1** Animal cell cultures – Principles of mammalian cell culture, establishment of cell line. Continuous cell lines. Media and equipment for animal cell culture. Hybridoma technology, *In vitro* fertilization and embryo transfer **4.2** Transgenic animals, transfection methods, embryonic stem cell transfer, targeted gene transfer, detection of transgenic and trans gene transfer, In vitro fertilization and embryo transfer, animal cloning. **4.3** Plant tissue cell, organ culture and Callus culture - regeneration of plants, germplasm bank, and artificial seeds. **4.4** Genetic engineering of plants, *Agrobacterium* mediated gene transfer, Agro infection and direct gene transfer methods, integration, confirmation of transgenic plants.		**15 Lectures** **04** **05** **03** **03**

RUSACBTP 501 Practicals:			
RUSACB TP501	1. Basic techniques in Microbiology 2. Preparation of culture media, M9 and LB medium 3. Isolation of plasmid DNA from *E. coli* 4. Restriction digestion of DNA and study of restriction gene map. 5. Gel electrophoresis of DNA 6. Isolation of genomic DNA (bacterial / yeast or onion) 7. PAGE for proteins. 8. Plant Tissue culture 9. Western blot technique 10. Transformation in bacterial cultures. 11. Cloning and expression of bacterial gene 12. PCR 13. Quantification of DNA and Protein using U.V absorption	**Credits: 2**	**60 L / Sem**

References

Course: 501

1. Bernard R Glick and Jack J Pasternak. Molecular Biotechnology: Principles and Applications of recombinant DNA. 3rd Edition.
2. B. D. Singh. Biotechnology. Kalyani Publishers.
3. S. N. Jogdand. Advances in Biotechnology. 2005. 5t Edition.
4. S. B. Primrose. Modern Biotechnology 1989. Blackwell Scientific Publ.
5. Primrose and others. Principles of Gene manipulations. 6th edition. 2004 Blackwell Science.
6. Aluizino Borent and others. Understanding Biotechnology. 2004 Pearson Education.
7. James Watson and Others. Recombinant DNA. 2001. Scientific American Books.
8. Keith Wilson and John Walker. Principles Techniques of Biochemistry and Molecular Biology.2010 Cambridge University Press.
9. Michael J. Waites and others. Industrial Microbiology: An Introduction. Blackwell Science Ltd. 2001

RUSACBT 601 SEMESTER VI

Learning objectives:

This course emphasizes on the application of recombinant DNA technology to animals, plants and microorganisms. It describes the use of genetically engineered products to solve environmental problems and cure human diseases. It begins with the industrial applications of microorganisms in manufacture of alcoholic beverages, dairy products, condiments and also products like biogums, enzymes and pharmaceutical products.
Biotechnology has several applications in agriculture and livestock management. The next unit details out the applications like biofertilizers, pest management, genetically modified fruits, flowers and grains. It also covers the modification in livestock for the benefit of mankind.
Exploiting biological systems for addressing the environmental problems is the need of the hour. The learner is introduced to several methods for manufacture of biofuels and for bioremediation of waste.The topics on biochips and biosensors will acquaint the learner to new technologies using biological systems.
Last but not the least, using biotechnological principles for manufacturing products that can treat and prevent infections is covered to make the learner aware of the range of medical problems that can be addressed with biotechnological products.
Overall, this course is designed to make the student aware of areas where work has been done using biotechnological principles and moreover where he/she can contribute in this fast- growing field.

Learning outcomes:

Upon successful completion of this course the student will be able to:

- Apply basic principles of biotechnology to fields like food, beverage, pharmaceutical, and dairy industry and explain the role of microbes in their production
- Explain the application of microbes as biofertilizers and biopesticides.
- Recognize the role of genetically modified plants and animals
- Elaborate on the importance of biofuels and their manufacture
- Apply the principles of gene manipulation for bioremediation of xenobiotics
- Explain the principles underlying working of biochips and biosensors
- Provide examples on how to use microbes and mammalian cells for the production of pharmaceutical products.

DETAIL SYLLABUS

Course Code	UNIT	TOPICS	Credits	Lec /Sem
RUSACBT 601		**APPLIED BIOTECHNOLOGY**	**2**	**(60 Lectures)**
	I	**Industrial Biotechnology** 1.1 Exploitation of Microorganisms to produce primary and secondary metabolites : Amino acids (lysine) Antibiotics- Penicillin 1.2 Alcoholic beverages (Wine), Dairy products (Cheese and Yogurt) Organic acids (citric acid) 1.3 Introduction to SCP –Yeast, Spirulina, Mushroom 1.4 Synthesis of Biopolymers – biogums, biopolysaccharides, bioplastic. 1.5 Enzyme Technology: Methods of enzyme Immobilization & their applications Application of enzymes in detergent, leather, wool industry and food, dairy industry		**15Lectures** **03** **04** **03** **02** **03**
	II	**Agricultural and Livestock Biotechnology** 2.1 Production of Biofertilizers- Types, carriers and application methods 2.2 Biopesticides – *Bacillus thurengenesis* – Mode of action, Production & application, list of other examples 2.3 Development of Insect, pathogen and herbicide resistant plants. plants as bioreactors 2.4 Application of transgenic animals, animal bioreactors, Introduction to molecular farming (pharming), cloning livestock by nuclear transfer.		**15 Lectures** **04** **03** **04** **04**

	III	**Environmental Biotechnology** **3.1** Sources of biomass, Biological fuel generation - ethanol and methane from biomass, Hydrogen production, Biodiesel, Algal oils **3.2** Bioremediation: Methods of bioremediation, Bioremediation of hydrocarbons, dyes, paper and pulp industry, heavy metals, xenobiotics. **3.3** Vermicomposting and bioleaching, biosensors and biochips		**15 Lectures** **05** **05** **05**
	IV	**Biotechnology in Healthcare** **4.1** Disease prevention – vaccines: conventional vaccines, purified antigen vaccines, recombinant vaccines. DNA vaccines **4.2** Disease Diagnosis – Probes, monoclonal antibodies and detection of genetic disease **4.3** Disease treatment – Products from recombinant organisms, interferons, growth factors, antisense nucleotides as therapeutic agents, monoclonal antibodies. **4.4** Drug designing, pharmacogenomics, drug delivery and targeting, artificial tissue / organ, gene therapy, enzyme therapy **4.5** Forensic medicine.		**15 Lectures** **04** **02** **04** **03** **02**

RUSACBTP 601 Practicals:			
RUSAC BTP601	1. Production of wine 2. Preparation of yoghurt 3. Production of yeast SCP and estimation of protein content 4. Production of Microbial polysaccharide and determination of yield. 5. Isolation and cultivation of *Azotobacter, Rhizobium*, Phosphate solubilizers and preparation of biofertilizers. 6. Immobilization of *Saccharomyces cerevisiae* using alginate and invertase assay. 7. Cultivation of Edible mushroom 8. Detection of enzyme activity in detergents 9. Enrichment of phenol degraders and estimation of phenol degraded 10. Detection of disorders using kits 11. Demonstration of ELISA	**Credits 2**	**60 Lec/Sem**

References

Course: 601

1. Bernard R Glick and Jack J Pasternak. Molecular Biotechnology: Principles and Applications of recombinant DNA. 3rd Edition.
2. B. D. Singh. Biotechnology. Kalyani Publishers.
3. S. N. Jogdand. Advances in Biotechnology. 2005. 5t Edition.
4. S. B. Primrose. Modern Biotechnology 1989. Blackwell Scientific Publ.
5. Primrose and others. Principles of Gene manipulations. 6th edition. 2004 Blackwell Science.
6. Aluizino Borent and others. Understanding Biotechnology. 2004 Pearson Education.
7. James Watson and Others. Recombinant DNA. 2001. Scientific American Books.
8. Keith Wilson and John Walker. Principles Techniques of Biochemistry and Molecular Biology.2010 Cambridge University Press.
9. Michael J. Waites and others. Industrial Microbiology: An Introduction. Blackwell Science Ltd. 2001
10. Marth and Steele. Applied Dairy Microbiology: 2nd Edition

MODALITY OF ASSESSMENT

Theory Examination Pattern:

A) Internal Assessment - 40% :40 marks.

Sr No	Evaluation type	Marks
1	One Assignment/Case study/Project	10
2	One class Test (multiple choice questions / objective)	20
3	Active participation in routine class instructional deliveries(case studies/ seminars/presentation)	05
4	Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05

B) External examination - 60 %

Semester End Theory Assessment - 60 marks

i. Duration - These examinations shall be of **2 hours** duration.

ii. Paper Pattern:

1. There shall be **FOUR** questions each of **15** marks. On each unit there will be one question.
2. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q.1)A)	Any 2 out of 4	12	Unit I
Q.1)B)	Any 3 out of 5	3	
Q.2)A)	Any 2 out of 4	12	Unit II
Q.2)B)	Any 3 out of 5	3	
Q.3)A)	Any 2 out of 4	12	Unit III
Q.3)B)	Any 3 out of 5	3	
Q.4)A)	Any 2 out of 4	12	Unit IV
Q.4)B)	Any 3 out of 5	3	

Practical Examination Pattern:

(A)Internal Examination:

Heading	**Practical I**
Journal	*5*
Test	*15*
Group Activity	*15*
Participation	*5*
Total	40

(B) External (Semester end practical examination):

Particulars	**Practical 1**
Laboratory work	*50*
Viva	*10*
Total	**60**

PRACTICAL BOOK/JOURNAL

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / Incharge of the department; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern

Semester---- V

Course	***501***		
	Internal	**External**	**Total**
Theory	**40**	**60**	**100**
Practicals	**40**	**60**	**100**

Semester---- VI

Course	***601***		
	Internal	**External**	**Total**
Theory	**40**	**60**	**100**
Practicals	**40**	**60**	**100**
