AC/I(21-22).2(II).RUS13

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for T.Y.

Program: BSc (Applied Component Biotechnology)

Program Code: RUSACBT

(Credit Based Semester and Grading System for academic year 2022–2023)

GRADUATE ATTRIBUTES

GA	GA Description **A student completing Bachelor's Degree in Science program will be able to:**
GA 1	Recall and explain acquired scientific knowledge in a comprehensive manner and apply the skills acquired in their chosen discipline. Interpret scientific ideas and relate its interconnectedness to various fields in science.
GA 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences.
GA 3	Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools.
GA 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
GA 5	Take complex challenges; work responsibly and independently, as well as in cohesion with a team for completion of a task. Communicate effectively, convincingly and in an articulate manner.
GA 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
GA 7	Follow ethical practices at work place and be unbiased and critical in interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it.
GA 8	Keep abreast with current scientific developments in the specific discipline and adapt to technological advancements for better application of scientific knowledge as a lifelong learner

PROGRAM OUTCOMES

PO	Description **A student completing coursework in Applied Component-Biotechnology for Bachelor's Degree in Science program will be able to:**
PO 1	Recall basic concepts and principles of Genetic engineering and Industrial Biotechnology
PO 2	Apply knowledge of genetic engineering to understand the developments in improvement of characteristics of animal and plants for benefit of mankind
PO 3	Extrapolate the understanding of microbial properties and their modification for applications in various fields of biotechnology
PO 4	Analyse sequence data for DNA and protein using bioinformatics tools
PO 5	Evaluate the merits and demerits of various tools and techniques used in genetic engineering as well as Plant and Animal Biotechnology
PO 6	Understand scientific relevance of biotechnological advances and practices and critically evaluate them on social, legal and ethical grounds

PROGRAM OUTLINE

YEAR	SEM	COURSE CODE	COURSE TITLE	CREDITS
TY	V	RUSACBT501	Concepts in biotechnology	2
		RUSACBT P501	Practical Based on Above Courses	2
	VI	RUSACBT601	Applied biotechnology	2
		RUSACBT P601	Practical Based on Above Course	2

Course Code: RUSACBT 501

Course Title: Concepts in Biotechnology

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Recognise and develop a broader perspective on the scope and branches of modern biotechnology
CO 2	Explain and summarise the principles that form the basis for recombinant DNA technology and use them in genetic engineering
CO 3	Understand and apply general principles of generating transgenic plants, animals and microbes
CO 4	Recognise and apply the principles of bioinformatics
CO 5	Demonstrate working knowledge in techniques like PCR, genetic mapping, gene isolation and cloning, DNA sequencing, and bioinformatics
CO 6	Explain the different types of fermentations and their significance and illustrate the overall design of different types of fermenters used in production of biotechnological products
CO 7	Recognize, attribute and evaluate the importance of social, legal and ethical implications of biotechnology and apply the knowledge in different situations involving GMO's or genome editing

DETAILED SYLLABUS

Course Code	Sub-Unit	Course/ Unit Title	Credits/ Lectures
RUSACBT 501		**CONCEPTS IN BIOTECHNOLOGY**	**2/60**
I		**Importance of Biotechnology and Tools in Genetic Engineering**	**15**
	1.1	**Introduction to Biotechnology**	**03**
		a) History of Biotechnology – Traditional and Modern Biotechnology. b) Biotechnology as an interdisciplinary area c) Global impact and current excitements of Biotechnology- (Health care, Agriculture, human genome project, environment), Biodiversity and its preservation.	
	1.2	**Tools in Genetic Engineering**	**12**
		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.	
II		**Techniques in Genetic Engineering**	**15**
	2.1	**Cutting and joining of DNA**	**05**
		a) Exonucleases, Endonucleases, Restriction Endonucleases (Type I, II, III). Examples of some enzymes – DNA ligases, Alkaline Phosphatases, DNA polymerase b) Use of Linkers and Adaptors	
	2.2	**Cloning Vectors**	**05**
		a) Properties of good vector b) Cloning and Expression vectors. c) *E. coli* vectors – Plasmid, Cosmid, Phagmid	

		d) Bacteriophage vectors – Lambda and M13 e) Introduction to different vectors - Shuttle vectors, Yeast vectors (YAC), Bacterial Artificial Chromosome (BAC), Animal and Plant Vectors	
	2.3	**Steps in gene cloning**	**05**
		a) Isolation of desired gene, cDNA library, Genomic library, Introduction of vector in to suitable bacterial host (various transformation methods). b) Selection of recombinant clones, selection of clones containing recombinant vector, selection of clones containing specific DNA inserts, colony hybridization test.	
III		**Animal Biotechnology and Bioinformatics**	**15**
	3.1	**Introduction Animal Biotechnology**	**03**
		a) Basic Principles of mammalian cell culture b) Establishment of cell line c) Continuous cell lines d) Media and equipment for animal cell culture	
	3.2	**Methods in Animal Biotechnology**	**05**
		a) Methods of transfection b) Embryonic stem cell transfer c) Targeted gene transfer methods d) Methods of detection of transgenics and trans gene e) Invitro fertilization	
	3.3	**Applications of Animal Biotechnology**	**03**
		a) Hybridoma technology b) Transgenic animals c) Animal cloning	
	3.4	**Introduction to Bioinformatics**	**04**
		a) Introduction to Genomics, Proteomics and Bioinformatics b) Genomic and Protein data base c) Introduction to data similarity search BLAST and FASTA	

IV		**Plant Biotechnology and Industrial Biotechnology**	**15**
	4.1	**Introduction to Plant Biotechnology**	**04**
		a) Basic techniques in PTC: Plant tissue culture, Suspension culture, Organ culture and Callus culture b) Applications of PTC: Regeneration of plant, Germplasm bank, Artificial seeds	
	4.2	**Methods in Plant Biotechnology**	**04**
		a) Agro-mediated gene transfer b) Agro-infection methods c) Direct gene transfer methods d) Method for integration of transgene e) Methods for confirmation of transgenic plants	
	4.3	**Introduction to Industrial Biotechnology**	**04**
		a) Major types of Bioreactors b) Submerged and solid-state fermentation c) Fermentation media d) Fermentation control e) Downstream processing	
	4.4	**IPR and Bioterrorism**	**03**
		a) IPR: Types of IPR, Patent requirements, Indian patenting Law, Procedure of filing a patent, Patenting and biotechnology b) Bioterrorism	

References:

a) B. D. Singh. Biotechnology. Kalyani Publishers.
b) R.Ian.Freshney Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Science Publishers. Sixth Edition.
c) S.Ignacimuthu Basic Bioinformatics. Alpha Science International Ltd.
d) T.K.Attwood Introduction to Bioinformatics. Pearson Education Ltd.
e) Sant Saran Bhojwani Pant Tissue Culture: An Introductory Text. Springer.
f) Wulf Crueger Biotechnology: Textbook of Industrial Microbiology. 2nd Edition, Panima Publication Corporation, New Delhi.
g) Nduka Okafor. Modern Industrial Microbiology and Biotechnology. Science Publishers.
h) P.F.Stanbury Principles of Fermentation Technology. Academic Press. Second edition

i) S. N. Jogdand. Advances in Biotechnology. 2005. 5t Edition

j) H A Modi, “Fermentation Technology”, 2009, Volume 1 and 2, Pointer Publications, India.

k) IPR: WIPO Publication No. 450(E) ISBN 978-92-805-1555-0

l) Bioterrorism - CDC Emergency Preparedness, https://emergency.cdc.gov/bioterrorism/

m) B. Anderson, et. al, Microorganisms and Bioterrorism, Springer publication (2006)

Course Code	Course/ Unit Title	Credits/ Lectures
RUSACBTP 501	**CONCEPTS IN BIOTECHNOLOGY- Practicals**	**2/60 lectures**
	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 14. Demonstration of use of Bioinformatic tools	

Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	One Assignment/Case study/Project/ Presentation	15
2	One class Test (multiple choice questions / objective)	20
3	Active participation in routine class instructional deliveries	05
	TOTAL	**40**

B) External Examination- 60%- 60 Marks

Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:
   a. There shall be **four** questions each of **15** marks on each unit.
   b. All questions shall be compulsory with internal choice within the questions.

Paper Pattern:

Questions	Options	Marks	Total marks	Questions on
Q.1) A)	Any 2 out of 3	10		Unit I
Q.1) B)	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	15	
Q.2) A)	Any 2 out of 3	10		Unit II
Q.2) B)	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	15	
Q.3) A)	Any 2 out of 3	10		Unit III
Q.3) B)	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	15	
Q.4) A)	Any 2 out of 3	10		Unit IV
Q.4) B)	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	15	

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

Particulars	Marks
Journal	05
Experimental tasks	15
Group Activity	15
Participation	05
Total	**40**

B) External Examination: 60%- 60 Marks

Semester End Practical Examination:

Particulars	Marks
Laboratory work	50
Spots/Quiz/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 & Marks Distribution Pattern

Semester V

Course	RUSACBT501		
	Internal	**External**	**Total**
Theory	**40**	**60**	**100**
Practicals	**40**	**60**	**100**

Owing to the pandemic situation prevailing in 2020 and continuing in 2021, the external examinations (Semester End) may be conducted online as per the instructions/circulars received from the University of Mumbai and Maharashtra State notifications from time to time. The conventional mode of external examination will commence again only after the declaration of normalcy by the Government authorities.

Course Code: RUSACBT 601

Course Title: Applied Biotechnology

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand and apply basic principles of biotechnology to fields like food, beverage, pharmaceutical, and dairy industry and explain the role of microbes in their production
CO 2	Recognise and evaluate the application of microbes as biofertilizers and biopesticides.
CO 3	Recall the role of genetically modified plants and animals and attributing the different values and discussions involved around genetically modified organisms
CO 4	Explain the importance of biofuels and their manufacture
CO 5	Exemplify and apply the principles of gene manipulation for bioremediation of xenobiotics
CO 6	Explain the principles underlying working of biochips and biosensors
CO 7	Exemplify on the use of microbes and mammalian cells for the production of pharmaceutical products
CO 8	Organize and develop skills to execute an industrial fermentation process with necessary precautions and summarize significance of each step

DETAILED SYLLABUS

Course Code	Sub-Unit	Course/ Unit Title	Credits/ Lectures
RUSACBT 601		**APPLIED BIOTECHNOLOGY**	**2/60**
I		**Industrial Biotechnology**	**15**
	1.1	Exploitation of Microorganisms to produce primary and secondary metabolites: Amino acids (lysine) Antibiotics- Penicillin	**03**
	1.2	Alcoholic beverages (Wine), Dairy products (Cheese and Yogurt) Organic acids (citric acid)	**04**
	1.3	Introduction to SCP –Yeast, Spirulina, Mushroom	**03**
	1.4	Synthesis of Biopolymers – biogums, bioplastic	**02**
	1.5	Enzyme Technology: Methods of enzyme Immobilization & their applications Application of enzymes in detergent, leather, wool industry and food, dairy industry	**03**
II		**Agricultural and Livestock Biotechnology**	**15**
	2.1	Production of Biofertilizers- Types, carriers and application methods	**04**
	2.2	Biopesticides – Bacillus thuringiensis – Mode of action, Production & application, list of other examples	**03**
	2.3	Development of Insect, pathogen and herbicide resistant plants, golden rice, drought, salt and oxidative stress resistant plant, plants as bioreactors	**05**
	2.4	Application of transgenic animals, animal bioreactors, Introduction to molecular farming (pharming)	**03**
III		**Environmental Biotechnology**	**15**
	3.1	Sources of biomass, Biological fuel generation -ethanol and methane from biomass, Hydrogen production, Biodiesel, Algal oils	**05**
	3.2	Bioremediation: Methods of bioremediation, Bioremediation of hydrocarbons, dyes, paper and pulp industry, heavy metals, xenobiotics	**05**

	3.3	Vermicomposting and bioleaching, biosensors and biochips	**05**
IV		**Biotechnology in Healthcare**	**15**
	4.1	Disease prevention – vaccines: conventional vaccines, purified antigen vaccines, recombinant vaccines. DNA vaccines	**04**
	4.2	Disease Diagnosis – Probes, monoclonal antibodies and detection of genetic disease	**02**
	4.3	Disease treatment – Products from recombinant organisms, interferons, growth factors, antisense nucleotides as therapeutic agents, monoclonal antibodies	**04**
	4.4	Drug discovery, drug delivery and targeting, artificial tissue / organ, gene therapy, enzyme therapy, Genome variation and pharmacogenomics (introduction only)	**03**
	4.5	Forensic medicine	**02**

References:

a) Bernard R Glick and Jack J Pasternak. Molecular Biotechnology: Principles and Applications of recombinant DNA. 3rd Edition.
b) B. D. Singh. Biotechnology. Kalyani Publishers.
c) S. N. Jogdand. Advances in Biotechnology. 2005. 5t Edition.
d) S. B. Primrose. Modern Biotechnology 1989. Blackwell Scientific Publ.
e) Primrose and others. Principles of Gene manipulations. 6th edition. 2004 Blackwell Science.
f) Aluizino Borent and others. Understanding Biotechnology. 2004 Pearson Education.
g) James Watson and Others. Recombinant DNA. 2001. Scientific American Books.
h) Keith Wilson, John Walker. Principles Techniques of Biochemistry and Molecular Biology.2010 Cambridge University Press.
i) Michael J. Waiteset al. Industrial Microbiology: An Introduction. Blackwell Science Ltd. 2001
j) Marth and Steele. Applied Dairy Microbiology: 2nd Edition
k) Henry J Peppler, Microbial Technology: Microbial processes, Vol.1, Academic Press, 1979
l) Nduka Okafor, Modern Industrial microbiology and biotechnology, 2007, Science Publishers
m) Principles of Pharmacology, David E Golan, 2007, LWW
n) Phillip L. Gomez and James M. Robinson, Vaccine Manufacturing, (2018)
o) Stephan Kabasci, Bio-based plastics: Materials and Applications, Wiley Publications (2014)

Course Code	Course/ Unit Title	Credits/ Lectures
RUSACBTP 601	**APPLIED BIOTECHNOLOGY - Practicals**	**2/60**
	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	

Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	One Assignment/Case study/Project/ Presentation	20
2	One class Test (multiple choice questions / objective)	20
	TOTAL	**40**

B) External Examination- 60%- 60 Marks

Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:
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Q.2) A)	Any 2 out of 3	10		Unit II
Q.2) B)	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	15	
Q.3) A)	Any 2 out of 3	10		Unit III
Q.3) B)	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	15	
Q.4) A)	Any 2 out of 3	10		Unit IV
Q.4) B)	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	15	

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

Particulars	Marks
Journal	05
Experimental tasks	15
Group Activity	20
Total	**40**

B) External Examination: 60%- 60 Marks

Semester End Practical Examination:

Particulars	Marks
Laboratory work	50
Spots/Quiz/Viva	10
Total	**60**

PRACTICAL BOOK/JOURNAL

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Overall Examination & Marks Distribution Pattern

Semester VI

Course	RUSACBT601		
	Internal	**External**	**Total**
Theory	**40**	**60**	**100**
Practicals	**40**	**60**	**100**

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