

**S.P. Mandali's
RAMNARAIN RUIA AUTONOMOUS COLLEGE**



Syllabus for: T.Y. B.Sc

Program: B.Sc. Biotechnology

Course Code: BIOTECHNOLOGY (RUSBTK)

(Choice Based Credit System (CBCS) with effect from academic year 2019-20)

PROGRAM OUTCOMES

| PO | PO Description |
|-------------|---|
| | A student completing Bachelor's Degree in Science program will be able to: |
| PO 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. |
| PO 2 | Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences. |
| PO 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. |
| PO 4 | Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results. |
| PO 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. |
| PO 6 | Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society. |
| PO 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. |
| PO 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 SPECIFIC OUTCOMES

| PSO | Description |
|--------------|--|
| | A student completing Bachelor's Degree in Science program in the subject of Biotechnology will be able to: |
| PSO 1 | Adept in basic sciences along with a thorough understanding of biotechnology principles and chemical sciences to create a foundation for higher education with the insights into interdisciplinary approach. |
| PSO 2 | Demonstrate the applications of fundamental biological processes from the molecular, cellular, industrial and environmental perspective. |
| PSO 3 | Develop effective communication skills with improved individual and team work abilities in the domain of scientific research writing. Showcase their innovative ideas and research work efficiently. |
| PSO 4 | Reflect, analyse and interpret information or data for investigating the problem in fields of biotechnology. Acquire scientific and entrepreneur skills to furnish sustainable solutions to coeval problems |
| PSO 5 | Illustrate the relevance of ethical implications and standard laboratory practices in tissue culture techniques, forensic biology, developmental biology and other fields of biotechnology. |
| PSO 6 | Apply the conceptual knowledge to develop coherent, efficacious and proficient practical, technical and analytical skills. |

S.P Mandali's
Ramnarain Ruia Autonomous College
Department of Biotechnology

Syllabus for T.Y.BSc Biotechnology

Credit based and Grading system
To be implemented from Academic year 2019-20

| Semester V | | | | |
|--|-------------|---|----------------|-----------------------|
| Course code | Unit | Topic | Credits | Lecture s/week |
| Paper I : Cell Biology RUSBTK501 | Unit I | Cell cycle and apoptosis | 2.5 | 1 |
| | Unit II | Cell signalling-I | | 1 |
| | Unit III | Cell signalling-II | | 1 |
| | Unit IV | Cancer biology | | 1 |
| Paper II: Biochemistry RUSBTK502 | Unit I | Carbohydrate metabolism | 2.5 | 1 |
| | Unit II | Protein biochemistry | | 1 |
| | Unit III | Endocrinology-I | | 1 |
| | Unit IV | Endocrinology-II | | |
| Paper III: Genetics and Molecular Biology RUSBTK503 | Unit I | Enzymes and vector | 2.5 | 1 |
| | Unit II | Cloning strategies and sequencing | | 1 |
| | Unit III | Genetic mapping | | 1 |
| | Unit IV | Gene editing and human genome | | 1 |
| Paper IV: Industrial Biotechnology RUSBTK504 | Unit I | Dairy technology | 2.5 | 1 |
| | Unit II | Brewing technology | | 1 |
| | Unit III | Downstream processing | | 1 |
| | Unit IV | Recent trends and development in industrial productions | | |
| Paper V AC- Biosafety RUSBTKAC501 | Unit I | Introduction to Biosafety | 2 | 1 |
| | Unit II | GLP | | 1 |
| | Unit III | GMP & QA- QC | | 1 |
| | Unit IV | Detection and testing of contaminants | | 1 |
| Practicals of Biotechnology | | Practical Based on all four papers | 6 | 16 |

| | | | | |
|---|--|------------------------|----|---|
| RUSBTKP501 & RUSBTKP502 | | | | |
| Practicals of AC RUSBTKACP501 | | Practicals based on AC | 2 | 3 |
| TOTAL CREDITS | | | 20 | |

| Semester VI | | | | |
|--|-------------|--|----------------|-----------------------------------|
| Course code | Unit | Topic | Credits | Lectures/week |
| Paper I: Immunology, Virology and Instrumentation RUSBTK601 | Unit I | Immunology | 2.5 | 1 |
| | Unit II | Virology | | 1 |
| | Unit III | Spectrometry and tracer techniques | | 1 |
| | Unit IV | | | Chromatography and centrifugation |
| Paper II: Developmental biology and transgenesis RUSBTK602 | Unit I | Developmental biology | 2.5 | 1 |
| | Unit II | Assisted reproductive technology and stem cell banking | | 1 |
| | Unit III | Genetic engineering of plants | | 1 |
| | Unit IV | Transgenic animals | | |
| Paper III: Pharmacology RUSBTK603 | Unit I | Chemotherapeutic agents | 2.5 | 1 |
| | Unit II | General principles of pharmacology | | 1 |
| | Unit III | Drug absorption and distribution | | 1 |
| | Unit IV | Basic and regulatory toxicology | | 1 |
| Paper IV: Environmental and Plant biotechnology RUSBTK604 | Unit I | Biofuels and biogas | 2.5 | 1 |
| | Unit II | Industrial effluent treatment | | 1 |
| | Unit III | Plant biotechnology | | 1 |
| | Unit IV | Biofertilizers and biopesticides | | 1 |
| Paper V: AC- Marine biotechnology and aquaculture RUSBTKAC601 | Unit I | Marine biotechnology introduction and bioprospecting | 2 | 1 |
| | Unit II | Applications of marine biotechnology | | 1 |
| | Unit III | Introduction to Aquaculture | | 1 |
| | Unit IV | Applications of Aquaculture | | 1 |
| Practicals of biotechnology RUSBTKP601 & RUSBTKP602 | | Practical Based on all four papers | 6 | 16 |
| Practicals of AC | | Practicals of AC | 2 | 3 |

| | | | | |
|---------------------|--|--|----|--|
| RUSBTKACP601 | | | | |
| TOTAL CREDITS | | | 20 | |

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APPLIED COMPONENT- BIOSAFETY

Course Objectives:

- To understand the importance of Biosafety and GLP
- To understand the importance of GMP
- To understand importance of QA & QC

Learning Outcomes: After completion of this course, student must be able to:

1. Enlist potential hazards in laboratory or workplace
2. To prepare SOPs of instruments
3. To document GMP practices
4. To study quality assurance and quality control

| Course Code | UNIT | TOPICS | Credits | Lectures |
|----------------------------------|--|--|----------|-----------|
| RUSBTKAC501 Biosafety | Unit I Introduction to Biosafety | Introduction , Biological Risk Assessment, Hazardous , Genetically modified hazards, Cell cultures , Hazardous Characteristics of Laboratory Procedures, Potential Hazards Associated with Work Practices, Safety Equipment and Facility Safeguards , Pathogenic risk and management Biosafety in biotechnology and rDNA technology | 2 | 12 |
| | Unit II GLP | Concept of GLP, Practicing GLP, Guidelines to GLP Documentation of Laboratory work, Preparation of SOPs Calibration records , Validation of methods, Documentation of results, Audits & Audit reports | | 12 |
| | Unit III GMP QA & QC | Concept of GMP, Requirements of GMP implementation, Documentation of GMP practices, Regulatory certification Quality control: concept of QC, Requirements for implementing QC, QA: concepts of QA, Requirements and implementation | | 12 |
| | Unit IV Detection and testing of contaminants | Microbial contamination in food and pharma product , Some common microbial contaminants , Microbiological Assays for pharmaceutical products, Regulatory Microbiological testing in pharmaceuticals | | 12 |
| | Total | | | 48 |

References:

1. Pharmaceutical Microbiology - Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers.
2. Biosafety in Microbiological and Biomedical Laboratories - 5th Edition, L. Casey Chosewood Deborah E. Wilson U.S. Department of Health and Human Services Centers for Disease Control and Prevention National Institutes of Health.
3. WHO handbook on GLP
4. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.

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PRACTICALS OF APPLIED COMPONENT

| COURSE CODE | TITLE | CREDITS |
|---------------------|--|----------------|
| RUSBTKACP501 | <ol style="list-style-type: none">1. First aid methods and safety in laboratory/ workplace2. Biosafety: Codes3. Validation of measuring cylinders, colorimeters4. Calibration of pH meter and weighing balance5. Testing for adulterants in food6. Making SOP for any 2 major laboratory instruments7. Sterility of injectables8. Bioassay of Vitamin b129. QA/QC of food/brewery products | 2 |

APPLIED COMPONENT: MARINE BIOTECHNOLOGY

- To study the different types of marine microorganisms, marine ecosystem
- To study the use of marine organisms in production of drugs, enzymes, functional foods, nutraceuticals and cosmetics
- To understand aquaculture and its application

Learning Outcomes: After completion of this course, student must be able to:

1. Obtain clarity on the functioning of marine ecosystem
2. Elucidate on the use of marine organisms and their applications in industry
3. Talk about the types and process of aquaculture
4. Understand the use of fish oil and fish foods
5. Understand the use of marine bio resources

| Course Code | UNIT | TOPICS | Credits | Lectures |
|-------------|--|---|---------|----------|
| RUSBTKAC601 | Unit I Marine biotechnology Introduction & Bioprospecting | Introduction to Marine Biotechnology, Bioprospecting, Methods for Microbial Bioprospecting in Marine Environments , Biotechnological Potential of Marine Microbes , Bioactive compounds from other Marine Organisms:fungi, Microalgae, Seaweeds, Actinomycetes, sponges | 2 | 12 |
| | Unit II Applications of marine biotechnology | Drugs from Marine organisms: Pharmaceutical compounds from marine flora and fauna Marine Microbial Enzymes- Marine Extremozymes and Their Significance Marine Functional Foods: Marine Marine Sources as Healthy Foods or Reservoirs of Functional Ingredients Marine Nutraceuticals : Marine Bioactives as Potential Nutraceuticals Cosmetics from Marine Sources: Definition, components and cosmeceuticals | | 12 |
| | Unit III Introduction to Aquaculture | Introduction to aquaculture - objectives, Selection of site and species, Types and | | 12 |

| | | | | |
|--|--|--|--|-----------|
| | | process, history and scope, present status, hazards, organisations, polyculture, integrated fish farming, extensive and semi-intensive culture of prawn Macroalgae/ seaweed cultivation | | |
| | Unit IV Applications of aquaculture | Products of fishing industry: Fish oils- preparation of body oils, composition, extraction, liver oil industry in India Fish as food- composition, nutritive value, fishery products, fish decomposition, Macroalgae applications market place in India | | 12 |
| | | Total | | 48 |

References:

1. Kim, S.K. Springer Handbook of Marine Biotechnology; Springer: Berlin, Germany; Heidelberg, Germany, 2015.
2. Nollet, Leo M. L- Marine microorganisms- extraction and analysis of bioactive compounds-CRC Press_Taylor& Francis (2017)
3. R. S. K. Barnes, R. N. Hughes(auth.)-An Introduction to Marine Ecology, Third Edition-Wiley-Blackwell (1999)
4. Blanca Hernández-Ledesma, Miguel Herrero-Bioactive Compounds from Marine Foods-Plant and Animal Sources-Wiley-Blackwell (2013)
5. Fabio Rindi, Anna Soler-Vila, Michael D. Guiry (auth.), Maria Hayes (eds.)-Marine Bioactive Compounds_ Sources, Characterization and Applications-Springer US (2012)
6. W. Evans-Trease and Evans Pharmacognosy 15 th ed.-Saunders (2010)
7. Hanbook of Fisheries And Aquaculture- Omprakash Sharma- Agrotech Publication

PRACTICALS OF APPLIED COMPONENT

| COURSE CODE | TITLE | CREDITS |
|---------------------|---|----------|
| RUSBTKACP601 | <ol style="list-style-type: none">1. DPPH assay for antioxidant extracted from marine organism2. Extraction and estimation of Gelatin / Collagen.3. Extraction of alkaloids/carotenoids from marine organisms and their separation by TLC.4. Isolation of bioluminescent organism from fish5. Extraction of body oil from fish6. Isin glass extraction from swim bladder of fish7. Length -Weight relationship of fish8. Preparation of fish meal / by fish by products9. Estimation of moisture content from fish tissue | 2 |

MODALITY OF ASSESSMENT

Theory Examination Pattern:

A) Internal Assessment - 40% :40 marks.

| Sr No | Evaluation type | Marks |
|-------|--|-------|
| 1 | One Assignment (Case study/Project based/Animation/ Review writing/ Video demonstration/ Pictorial or flow sheet representation/ Industrial visit report etc.) | 20 |
| 2 | One class Test (multiple choice questions / objective) | 20 |

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 **04** 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 (60% options)

| Questions | Options | Marks | Questions on |
|-----------|----------------|-------|--------------|
| Q.1)A) | Any 5 out of 8 | 5 | Unit I |
| Q.1)B) | Any 2 out of 3 | 10 | |
| Q.2)A) | Any 5 out of 8 | 5 | Unit II |
| Q.2)B) | Any 2 out of 3 | 10 | |
| Q.3)A) | Any 5 out of 8 | 5 | Unit III |
| Q.3)B) | Any 2 out of 3 | 10 | |
| Q.4)A) | Any 5 out of 8 | 5 | Unit IV |
| Q.4)B) | Any 2 out of 3 | 10 | |

Practical Examination Pattern:

(A) Internal Examination: Pattern for one Practical paper

| Heading | Practical |
|--------------------------------------|-----------|
| <i>Journal</i> | 10 |
| <i>*Test (2 practicals-15M each)</i> | 30 |
| Total | 40 |

(Internal Practical exam pattern is same for both practical papers and AC)

***Sem VI- Practical paper I (25M Internal project evaluation + 5M practical)**

(B) External (Semester end practical examination): Pattern for one practical paper

| Particulars | Practical |
|---------------------------|----------------|
| <i>Laboratory work</i> | 60 |
| <i>2 Major practicals</i> | 20 & 25 M each |
| <i>1 Minor practicals</i> | 10 M each |
| <i>Viva/ Spots</i> | 05 M each |
| Total | 60 |

(External Practical exam pattern is same for both practical papers and AC)

Skill based project in Semester VI - 50M

Internal evaluation- 25M

External evaluation- 25M

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 & VI

| Course | <i>RUSBTK501/601</i> | | | <i>RUSBTK502/602</i> | | | Grand Total |
|------------|-----------------------|----------|-------|----------------------|----------|-------|-------------|
| | Internal | External | Total | Internal | External | Total | |
| Theory | 40 | 60 | 100 | 40 | 60 | 100 | 200 |
| Course | RUSBTKP501/601 | | | | | | |
| | Internal | | | External | | | |
| Practicals | 40 | | | 60 | | | 100 |

| Course | <i>RUSBTK503/603</i> | | | <i>RUSBTK504/604</i> | | | Grand Total |
|------------|-----------------------|----------|-------|----------------------|----------|-------|-------------|
| | Internal | External | Total | Internal | External | Total | |
| Theory | 40 | 60 | 100 | 40 | 60 | 100 | 200 |
| Course | RUSBTKP502/602 | | | | | | |
| | Internal | | | External | | | |
| Practicals | 40 | | | 60 | | | 100 |

| Course | <i>RUSBTKAC501/601</i> | | Grand Total |
|------------|------------------------|----------|-------------|
| | Internal | External | |
| Theory | 40 | 60 | 100 |
| | RUSBTKP501/601 | | |
| Practicals | 40 | 60 | 100 |