AC/II(22-23).3.RPS3

(Credit Based Semester and Grading System for academic year 2023–2024)

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for M.Sc Part II

Program: M.Sc

Program Code: Biotechnology (RPSBTK)

GRADUATE ATTRIBUTES

S. P. Mandali's Ramnarain Ruia Autonomous College has adopted the Outcome Based Education model to make its science graduates globally competent and capable of advancing in their careers. The Bachelors Program in Science also encourages students to reflect on the broader purpose of their education.

GA	GA Description **A student completing Master's Degree in Science program will be able to:**
GA 1	Demonstrate in depth understanding in the relevant science discipline. Recall, explain, extrapolate and organize conceptual scientific knowledge for execution and application and also to evaluate its relevance.
GA 2	Critically evaluate, analyze and comprehend a scientific problem. Think creatively, experiment and generate a solution independently, check and validate it and modify if necessary.
GA 3	Access, evaluate, understand and compare digital information from various sources and apply it for scientific knowledge acquisition as well as scientific data analysis and presentation.
GA 4	Articulate scientific ideas, put forth a hypothesis ,design and execute testing tools and draw relevant inferences. Communicate the research work in appropriate scientific language.
GA 5	Demonstrate initiative, competence and tenacity at the workplace. Successfully plan and execute tasks independently as well as with team members. Effectively communicate and present complex information accurately and appropriately to different groups.
GA 6	Use an objective, unbiased and non-manipulative approach in collection and interpretation of scientific data and avoid plagiarism and violation of Intellectual Property Rights. Appreciate and be sensitive to environmental and sustainability issues and understand its scientific significance and global relevance.
GA 7	Translate academic research into innovation and creatively design scientific solutions to problems. Exemplify project plans, use management skills and lead a team for planning and execution of a task.
GA 8	Understand cross disciplinary relevance of scientific developments and relearn and reskill so as to adapt to technological advancements.

PROGRAM OUTCOMES

PO	Description **A student completing Master's Degree in Science program in the subject of Biotechnology will be able to:**
PO 1	Perceive the fundamental and advanced concepts in depth in the areas of biochemistry, molecular biology, immunology, medical microbiology and applying the conceptual knowledge to address the real time problems and exploring plausible solutions.
PO 2	Annotate the vast amount of biological data by retrieving, processing and analyzing through various tools of bioinformatics and biostatistics.
PO 3	Criticize and assess the phases encountered from laboratory to premarketing stages in clinical research along with reviewing case studies.
PO 4	Identify local and global environmental issues and establish scientific strategies to devise economical solutions converging towards sustainable development
PO 5	Comprehend the process of patent documentation .Employ the relevance of legal and ethical implications in intellectual property rights, GMO ,developmental biology and other fields of biotechnology.
PO 6	Outline, execute ,Analyze experimental procedures and research proposal thus ameliorate their scientific writing temperament and soft skills consequently refining their abilities to troubleshoot any research problems.
PO 7	Deduce the underlying principle of nanotechnological and biotechnological processes and develop the skills to offer contemporary solutions.

PROGRAM OUTLINE

Msc Part –II

Semester	Courses	Code	Credits Theory	Credits Practical
3	Core I	Medical Microbiology (RPSBTK301)	4	2
	Core II	Developmental Biology (RPSBTK302)	4	0
	Skill Enhancement Course	Tissue Culture (RPSBTK303)	4	2
	Research Project/ Internship	Research Project/ Internship (RPSBTKP304)	0	8
4	Core I	Bioinformatics (RPSBTK401)	4	2
	Core II	Bioprocess Technology (RPSBTK402)	4	2
	Core III	Biostatistics (RPSBTK403)	4	0
	Research Project/Internship	Research Project (RPSBTKP404)	0	8

Msc Part II

(Credit based Semester and Grading system)

SEMESTER III

Course Code: RPSBTK301

Course Title: Medical Microbiology

Academic year 2023-24

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	DESCRIPTION
CO 1	Elaborate on different types of chromosomal aberrations
CO 2	Comment on the working of different techniques for detection of chromosomal abnormalities
CO 3	Describe the pathogenesis of different diseases
CO 4	Analyse different samples using molecular techniques
CO 5	Formulate and develop molecular diagnostic techniques for various infections
CO 6	Determine the role of biofilms in the field of medicine

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credit/Hours 4/60
RPSBTK301	I	**Cytogenetics** Chromosomal disorders, Karyotyping, G-banding, Chromosome analysis, variations, Chromosome painting, Molecular Cytogenetics, FISH,CGH	15
	II	**Medical microbiology** Infections of Respiratory tract- Pneumonia, GI tract infection- , Shigella, Vibrio,Salmonella, Nosocomial- S.pyogenes, Klebsiella. Viral infections- HIV, Hepatitis (ELISA), Fungal- Candidiasis. Parasitic: Malaria, Leishmania and Dengue, Ebola, SARS, Nipah, Corona Virus	15
	III	**Molecular diagnostics** Introduction to molecular diagnostics, pros and cons, importance, molecular techniques, amplification based techniques (probe, signal and target amplification). Molecular diagnostics for Pneumonia, Tuberculosis, Pseudomonas, HIV, Hepatitis. Candidiasis	15
	IV	**Biofilms** Biofilms in medicine: Outline specifications: Stages in biofilm formation, Quorum sensing, biofilm in medical devices- implants & treatments, biofilms in pathogenesis, biofilm forming organisms- *E.coli, Pseudomonas spp, S.aureus*	15

References:

1. Industrial Microbiology an Introduction Michael, Neil, John & ;Gary
2. DiagnosticMicrobiology 5thedition Elmer Koneman,StephenAllen Lippincott
3. Molecular Microbiology: Diagnostic Persing, Tenover, ASM press Washington
4. Principles & Practice (2004) Versalone DC
5. Pharmaceuticalmicrobiology7thed.,(2004)HugoRussell'sEditedbyStephenP.Denyer, Hodges and Sean P.Gorman

Course Code: RPSBTKP301

Course Title: Practicals based on RPSBTK301

DETAILED SYLLABUS

Course Code	Course/ Unit Title	Credits
RPSBTKP301	1.Medical diagnostic – Identification of organisms from specimens (Salmonella, Shigella , Klebsiella pneumonia). 1. Staining of Biofilms 2. ELISA for Hepatitis, 3. PCR based diagnosis for Malaria 4. Identification of SARS/COVID through serological tests 5. Karyotyping with giemsa staining.	2

Course Code: RPSBTK302

Course Title: DEVELOPMENTAL BIOLOGY

Academic year 2023-24

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	DESCRIPTION
CO 1	Apply the key principles of developmental biology toward evaluating and analyzing primary literature in the field.
CO 2	Explain significant concepts including mechanisms by which differential gene activity controls development, mechanisms that determine cell fate and mechanisms that ensure consistency and reliability of development.
CO 3	Describe the post fertilization events.
CO 4	Explain the molecular mechanisms of sex hormone.
CO 5	Justify changes in immune system behavior in female body during pregnancy
	Elucidate the causes and corrective measures of infertility in male sand females
CO 6	Comment on the ethical issues in embryo research.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours 4/60
RPSBTK302	I	**Human Embryonic development** Human Embryonic development: Events during fertilization, in-vitro fertilization, Zona pellucida, glycoprotein, Oelemma protein and their role in fertilization, sperm antigens and their functional	15

		significance. Molecular and biochemical events during sperm function	
	II	**Post fertilization events** Post fertilization events: early embryonic development, establishing multi cellularity, formation of blastula, embryonic germ layer, tracking of migrating cells.	**15**
	III	**Sex hormones and Implantation** Molecular mechanism of sex hormone action and regulation of gene expression. Implantation and endometrium antigens involved in implantation Immunology of pregnancy. Superovulation, embryo culture and embryo transfer technology	**15**
	IV	**Infertility and reproductive vaccines** Infertility and reproductive vaccines. Frontiers in contraceptive research. Cryopreservation of sex gametes and embryos. Ethical issues related to embryo research	**15**

References:

1. Langman's Medical Embryology (9th Edition 2004) T. W.Sadler. Lippincott Williams &Wilkins
2. Essential Developemental Biology (2nd Edition 2006) J. M. W. SlackBlackwell Publishing
3. Developemental Biology (8th Edition 2006) Scott F. Gilbert SinauerAssociates,Inc

Course Code: RPSBTK303

Course Title: TISSUE CULTURE

Academic year 2023-24

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	DESCRIPTION
CO 1	Categorize different plant secondary metabolites based on their chemical nature
CO 2	Explain different techniques used for secondary metabolite production
CO 3	Elaborate on the cryopreservation strategies for the preservation of ATC and PTC products and cell lines.
CO 4	Discuss the concept of cell line establishment and maintenance.
CO 5	Illustrate the techniques used for immortalization of cell lines
CO 6	Application of fundamentals of tissue culture in therapeutics.
CO 7	Optimization of plant tissue culture media formulation of synthetic seeds for preservation

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/Hours 4/60
RPSBTK303	I	**Plant tissue culture** Introduction to primary and secondary metabolism, important pathways leading to biosynthesis of secondary metabolites in plants, Metabolic products produced from invitro culturing of plant	

		cells ,selection of plant cells/ tissues for production of a specific products, culture system in secondary plant product .Biotransformation of precursors by cell culturing, metabolic engineering for production of secondary metabolites, Hairy root culture, elicitation	**15**
	II	**Plant tissue culture-II** Cryopreservation -Principle and types. Germplasm conservation, Transgenic plants- Edible vaccine, Golden rice	**15**
	III	**Animal tissue culture-I** Biology of cultured cells, Culture vessels, Culture Media, Microbial contamination, cross contamination. Cryopreservation, Primary culture: Types, isolation of tissues, culturing of different cells. Cell lines: Development, Subculture and propagation	**15**
	IV	**Animal tissue culture-II** Immortalization of cell line, cell line designation, selection of cell lines, routine maintenance, Cytotoxicity, Transformation, Culture of tumor cells, Scaffolds for Tissue Engineering: Classification of scaffold materials - examples, criteria for ideal scaffold, control of architecture, Scaffold design and fabrication techniques. Bioartificial organs: Artificial tissue and artificial skeleton. Three dimensional cell culture and tissue growth, 3D printing of tissue, cells and organs. Bioartificial heart, Bioartificial kidney. Tissue regeneration: Tissue regeneration driven by growth hormones, Stem Cells as source in regeneration of tissues, Therapeutic applications: Tissue therapy, Drug-vaccine-viral delivery in RM Bioethical Issues.	**15**

Course Code: RPSBTKP303

Course Title: Practicals based on RPSBTK303

DETAILED SYLLABUS

Course Code	Course/ Unit Title	Credits
RPSBTKP303	1. Media preparation (MS, B5 and coconutwater) . 2. Seed sterilization: Physical & Chemical methods. Check the efficiency of seed sterilization using bothThe methods. 3. Explant preparation ,inoculation &;initiation of Tissue culture. 4. Callus induction and characterisation 5. Subculture of callus and plantlet establishment 6. Synthetic seed 7. Somatic embryogenesis . 8. Establishment of suspension cultures. (Periodic subculture of callus can be done on solid media/ semisolid media / liquid media) 9. Dissection of chick embryo 10. Monolayer formation (fibroblast) and passaging. 11. To assay the radical scavenging activity of tissue hydrolysate- DPPH method 12. Techniques for cell preservation 13. Observation of Normal and transformed cell line 14. Toxicology MTT Assay 15. Candling , observing chick embryo- stages of development, prepared slides/ preserved specimen .	2

Modality of Assessment

Semester III

Theory Examination Pattern

A. Internal assessment -40%-40 Marks

Sr.No	Evaluation Type	Marks
1	One Assignment /case study/project based/Written assignment/Presentations	20
2	One class test (Multiple choice questions)	20

B. External Examination- 60%-60 Marks Semester End Theory Examination:

1. Duration: These examination shall be of 2.5 hrs
2. Theory question paper pattern
   - There shall be 4 questions each of 15 Marks. On each unitthere will be one question
   - All questions shall be compulsory with internal choice within the questions

Paper Pattern:

Questions	Pattern	Marks	Question based on
Q.1 A)	Any 1 out of 2	8	Unit I
Q.1 B)	compulsory	7	
Q.2 A)	Any 1 out of 2	7	Unit II
Q.2 B)	compulsory	8	
Q.3 A)	Any 1 out of 2	8	Unit III
Q.3 B)	compulsory	7	
Q.4 A)	Any 1 out of 2	7	Unit IV
Q.4 B)	compulsory	8	
	TOTAL	60M	

Practical Examination Pattern:

A. External Examination- 50 Marks
Semester End Practical Examination

Particulars	Paper
Laboratory Work	40
Journal	05
Viva	05
Total	50

Overall Examination and Marks Distribution Pattern

Semester III

Course	RPSBTK301/302/303/304			Grand Total
	Internal	External	Total	
Theory	40	60	100	400
Practicals	-	50	50	200

SEMESTER IV

Course Code: RPSBTK401

Course Title: Bioinformatics
Academic year 2023-24

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Classify different types of biological databases.
CO 2	Summarize different computational methods and tools used for protein secondary structure prediction and genome analysis
CO 3	Describe different sequence alignment tools and its significance
CO 4	Explain important concepts of evolution and population genetics.
CO 5	Use different bioinformatic tools for phylogenetic analysis
CO 6	Demonstrate molecular docking of different biomolecules using molecular docking softwares
CO 7	Utilize different bioinformatics tools for analysis of different biomolecule

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Credits/Hours 4/60
RPSBTK401	I	**Introduction to Bioinformatics – Sequence Analysis**Database search using ENTREZ (G Query) , Hidden Marker Model, Equation (Ex :Gene finding/ exon-intron finding, Signalpeptide finding), Motif finding using HMM, ANN(Ex:Prosite) Sequence alignment, MSA- algorithm under Clustal W ,Protein sequence analysis,Protein structure analysis, Secondary, (Chou Fasman algorithm, GOR algorithm, Tertiary (Homology modelling, Threading, Ab initio, Structure prediction) Reactome, Introduction to molecular docking by softwares	15
	II	**Applications of Bioinformatics** Microarray data analysis,Printingtechniques,Features of microarray,Flag features of microarray,Data normalization in microarray,Human genome project and specialised databases under NCBI (Eg OMIM, chromosome, PubMed),Proteomics, Consesnsus sequence, PSSM,Sequencelogo.	15
	III	**Phylogenetics** Darwinism and neo Darwinism theories of evolution. Population genetics and different forces acting on it. Bioinformatics tools for phylogenetic analysis.	15

	IV	**Molecular Docking** Introduction to docking , Types of docking, preparation of ligand, softwares used for molecular docking-Autodock,Swiss Dock, Online docking servers , Applications and case studies of docking	15

References:

1. Bioinformatics – A practical guide to the analysis of genes and proteins byA.D. Baxvanis
2. Bioinformatics by N. Gautam(2006)
3. Bioinformatics:SequenceandGenomeAnalysis(SecondEdition2004),DavidW. Mount , (Coldspring Harbor Laboratory Press)
4. Bioinformatics and Functional Genomics (2003), Jonathan Pevsner, JohnWileyandsons.
5. iGenetics by Peter J.Russel, 3rd Edition, PearsonPublications
6. Handbook of Vitamins:https://ods.od.nih.gov/factsheets/list-VitaminsMineral

Course Code:
RPSBTKP401

Course Title: Practicals based on RPSBTKP401

Course Code	Title	Credits
RPSBTKP401	1. Classification of biological databases speciallycover NCBI andINSDC 2. Phylogenetic tree usingBootstrap 3. BLAST – orthologs, paralogs andhomologs 4. Motiffinding 5. KEGG 6. Structureofproteins–identificationofchainshelices, special groups, metal ionsetc. 7. CATH/SCOP classification of a givenprotein 8. Homologymodelling 9. Primer Designing. 10. Preparation of protein structure. 11. protein-ligand docking. 12. protein -ligand interaction profiling.	2

Course Code:RPSBTK402

Course Title: Bioprocess Technology

Academic year 2023-24

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Explain the effect of process parameters on fermentation, their measurement and control.
CO 2	Illustrate effects of different aeration and agitation parameters on growth of microbial, animal, and plant cells.
CO 3	Elaborate the role of different vitamins in various metabolic processes
CO 4	Analyze the role of microbes and enzymes in processing and production of food.
CO 5	Describe different types of enzymes and their significance
CO 6	Derive the equations for ideal enzyme substrate reaction and comment on factors affecting it.
CO 7	Detect presence of different enzymes in food products using different techniques

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Credits /Hours 4/60
RPSBTK402	I	**Aeration and agitation in bioprocess** Large scale animal and plant cell cultivation; Aeration and agitation in bioprocess; KLa, Measurement and control of bioprocess parameters. Introduction to Food Rheology, Food rheology vs Food texture, Rheology of food dispersion, Food polymers and gels, foams and dough rheology, processing and food rheology, test and application of food rheology.	15

I	**Vitamins** National Institutes of Health Office of Dietary Supplements (ODS) for sources, activity of vitamins,Production, deficiency disorders, overconsumption effects of Vitamins: Water soluble- B1, 2,3,5,6,7,12 Fat soluble- A, D, E, K	15
III	**Applications of microbes and enzymes in food processing** Enzymic bioconversions e.g. starch and sugar conversion processes; High-Fructose Corn Syrup; Interesterified fat, Hydrolyzed protein and their downstream processing, baking by amylases, deoxygenation and desugaring by glucoses oxidase. Food ingredients and additives prepared by fermentationandtheirpurification;fermentationasa method of preparing and preservingfoods. Microbesandtheiruseinpickling,producingcolours andflavours. Process wastes-whey, molasses, starch substratesand other food wastes for bioconversion to useful products. Bacteriocins from lactic acid bacteria - Production and applications in food preservation	15
IV	**Enzymology** Enzyme – Concept and kinetics, active site formation and its significance, Michaelis- Mentonequation – Derivation and transformation, Enzyme inhibition and types of inhibitors, control of enzyme activity, allosteric regulations, parameters affecting enzyme activity. Types of enzymes: isoenzymes, ribozymes, abzymes, substrate specificity and coenzymes	15

References:

1. Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall,Engelwood Cliffs,1991.

2. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2ndEdition, Prentice Hall, Engelwood Cliffs,2002.

3. Stanbury RF and Whitaker A., Principles of FermentationTechnology,Pergamon press, Oxford,1997.

4. Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2ndEdition, McGraw-Hill Book Co., New York,1986.

5. Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2ndEdition, University of Tokyo press,Tokyo,1973.

6. Comprehensive Biotechnology: The Principles, Applications and Regulations of BiotechnologyinIndustry,AgricultureandMedicine,Vol1,2,3and4.YoungM.M., Reed Elsevier India Private Ltd, India,2004.

7. El-Mansi, Bryle CFA. Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor & Francis Ltd, UK,2007.

8. Biochemistry, L Stryer, Freeman and Co,NY

9. Principlesofbiochemistry,Lehninger,5thedition,CoxandNelson,W.H.Freeman company.

Course Code: RPSBTKP402

Course Title: Practicals based on RPSBTK402

DETAILED SYLLABUS

Course Code	Course/ Unit Title	Credits
RPSBTKP402	1. Bioremediation- isolation of metal tolerant organisms & study their growth characteristicsandpattern. 2. GMO validation – kit based/demo 3. Isolation of pesticides degraders 4. Pollution indicators- Detection andIdentification. 5. Spectrophotometric estimation of Vitamin A 6. Demonstration of Placket Burman design for formulation of fermentation media. 7. Pigment production and isolation from microbial source (yeast ,fungi and bacteria) 8. Physico-chemical characterization of industrial effluents 9. Detection of different food enzymes by simple tests (amylase, catalase ,inverta se, papain, pectinase and pepsin) 10. Study of pickling process (sauerkraut/pickled cucumbers) with respect to physical ,chemical /biochemical and biological changes occurring during the pickling process	2

Course Code:RPSBTK403

Course Title: Biostatistics

Academic year 2023-24

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	DESCRIPTION
CO 1	Calculate standard normal scores and resulting probabilities
CO 2	Interpret and explain a p-value
CO 3	Perform a two-sample t-test and interpret the results; calculate a 95% confidence interval for the difference in population means
CO 4	Discuss and interpret results from Analysis of Variance (ANOVA), a technique used to compare means amongst more than two independent populations
CO 5	Analyse and interpret relative risks and odds ratios when comparing two populations
CO 6	Evaluate correlation and regression

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours 4/60
RPSBTK403	**I**	**Introduction to Statistics** Statistical population, sample from population, Random sample. Central Tendency: Mean, Median and Mode, Standard Deviation Confidence intervals	**15**
	II	**Gaussian distribution and normality** Gaussian Distribution and testing for normality,Nonparametric tests (Sign test, Wilcoxon test, Mann- Whitney Test, Krushkal- Whllis test,), transforming data to create Gaussian Distribution	**15**

	III	**Hypothesis testing** Test of Significance. Hypothesis testing:- Theory o errors - Type I and Type II errors, Null hypothesis, P values-one v/s two tail P values,t test(paired & unpaired), z-test, Chi square test, contingency table	15
	IV	**ANOVA** Comparing three or more groups- Introduction to ANOVA, One way ANOVA, repeated measures ANOVA, Friedman Test. Correlation and Regression: Linear and multiple Correlation and Regression	15

References:

1. Introduction to Biostatistics (Second Edition-2005) N. Gurumani M J P Publishers
2. Basic Biostatistics (2008) B. Burt Gerstman Jones and Bartlet Publishers
3. Biostatistics: A foundation For Analysis In Health Sciences (7th Edition 1999) Wayne W. Daniel John Wiley &; Sons Inc.
4. Fundamentals of Biostatistics (2006) Veer Bala Rastogi Ane Books India
5. Biostatistics- The Bare Essentials (Second Edition 2000) Nosman Streiner B.C.Decker Inc.

Modality of Assessment

Semester IV

Theory Examination Pattern

A. Internal assessment -40%-40 Marks

Sr.No	Evaluation Type	Marks
1	One Assignment /case study/project based/Written assignment/Presentations	20
2	One class test (Multiple choice questions)	20

B. External Examination- 60%-60 Marks Semester End Theory Examination:

1. Duration: These examination shall be of 2.5 hrs
2. Theory question paper pattern
   - There shall be 4 questions each of 15 Marks. On each unitthere will be one question
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Paper Pattern:

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Q.1 B)	compulsory	7	
Q.2 A)	Any 1 out of 2	7	Unit II
Q.2 B)	compulsory	8	
Q.3 A)	Any 1 out of 2	8	Unit III
Q.3 B)	compulsory	7	
Q.4 A)	Any 1 out of 2	7	Unit IV
Q.4 B)	compulsory	8	
	TOTAL	60M	

Practical Examination Pattern:

students will have to undergo mandatory hands on project for 200M in an established laboratory /college laboratory for 4-6 months

A. Semester End Examination: (200 marks)

Particulars	Marks
Guide	50
Panel departmental teachers	50
Internal examiner	50
External examiner	50
TOTAL	200

Overall Examination and Marks Distribution Pattern
Semester IV

Course	RPSBTK401/402/403/404			Grand Total
	Internal	External	Total	
Theory	40	60	100	400
Practicals	-	50	50	200

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