GONDWANA UNIVERSITY

GADCHIROLI

CHOICE BASE CREDIT SYSTEM (CBCS)

SYLLABUS FOR

M.Sc.

TWO-YEARS DEGREE COURSE

IN

BIOTECHNOLOGY

From

Academic Year

2016-2017

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

M.Sc. Biotechnology (PG) Program under Faculty of Science

(Affiliated Colleges)

(W.e.f. Academic Year 2016-17)

Appendix-1

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in Biotechnology.

	Core Course	**Ability Enhancement**	**Skill Based Course**	**Discipline Specific Elective**
SEM I	Core 1 Th. Paper 1 (4 Credits) (4 Hours/Week)	Seminar I (1 Credit) (2 Hours/Week)		
	Core 2 Th. Paper 2(4 Credits) (4 Hours/Week)			
	Core 3 Th. Paper 3 (4 Credits) (4 Hours/Week)			
	Core 4 Th. Paper 4 (4 Credits) (4 Hours/Week)			
	Pract. Core Pr. 1 {Based on Core Th. 1&2} (4 Credits) (3-8 Hours/Week)			
	Pract. Core Pr. 2 {Based on Core Th. 3&4} (4 Credits) (3-8 Hours/Week)			

Total 25 Credits

	Core Subject	**Ability Enhancement**	**Skill Based Course**	**Discipline Specific Elective**
SEM II	Core 5 Th. Paper 5 (4 Credits) (4 Hours/Week)	Seminar II (1 Credit) (2 Hours/Week)		
	Core 6 Th. Paper 6 (4 Credits) (4 Hours/Week)			
	Core 7 Th. Paper 7 (4 Credits)			
	Core 8 Th. Paper 8 (4 Credits) (4 Hours/Week)			
	Pr. Core Pr. 3 {Based on Core Th. 5&6} (4 Credits) (3-8 Hours/Week)			
	Pr. Core Pr. 4 {Based on Core Th. 7&8} (4 Credits) (3-8 Hours/Week)			

Total 25 Credits

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program.

Semester I

Code	Theory / Practical	Teaching Scheme			Credit	Examination Scheme					
		Hrs/ week				Duration in hrs.	Max. Marks		Total	Minimum Marks	
		Theory	Practical	Total			External	Internal		Theory	Practical
Core 1	Paper 1	4	-	4	4	3	80	20	100	40	
Core 2	Paper 2	4	-	4	4	3	80	20	100	40	
Core 3	Paper 3	4	-	4	4	3	80	20	100	40	
Core 4	Paper 4	4	-	4	4	3	80	20	100	40	
Pract. Core 1 & 2	Practical 1	-	8	8	4	3-8*	80	20	100	40	40
Pract. Core 3 & 4	Practical 2	-	8	8	4	3-8*	80	20	100	40	40
Seminar 1	Seminar 1	2	-	2	1			25	25	10	
TOTAL		**18**	**16**	**34**	**25**		**480**	**145**	**625**	**170**	**80**

Semester II

Code	Theory / Practical	Teaching Scheme			Credit	Examination Scheme					
		Hrs/ week				Duration in hrs.	Max. Marks		Total	Minimum Marks	
		Theory	Practical	Total			External	Internal		Theory	Practical
Core 5	Paper 5	4	-	4	4	3	80	20	100	40	
Core 6	Paper 6	4	-	4	4	3	80	20	100	40	
Core 7	Paper 7	4	-	4	4	3	80	20	100	40	
Core 8	Paper 8	4	-	4	4	3	80	20	100	40	
Pract. Core 5 & 6	Practical 3	-	8	8	4	3-8*	80	20	100	40	40
Pract. Core 7 & 8	Practical 4	-	8	8	4	3-8*	80	20	100	40	40
Seminar 2	Seminar 2	2	-	2	1			25	25	10	
TOTAL		**18**	**16**	**34**	**25**		**480**	**145**	**625**	**170**	**80**

Project Work/Dissertation Scheme / Guidelines for the Students, Supervisors and Examiners

Every student is required to carry out a project work in semester IV. The project can be of following types. A) Experimental Project Work; OR B) Field Based Project Work; OR C) Review writing based Project Work.

Experimental Project Work and Field Based Project Work:

Student can carry out Experimental / Field Based Project Work on a related research topic of the subject /course. It must be an original work and must indicate some degree of experimental work / Field work. On

the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical / lab Examination of Semester IV. The project report shall comprise of Introduction, Material and Methods, Results, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator / Director of the Department / Centre or the Principal of the College.

Review writing based Project Work.

Student can carry out review writing Based Project Work on a related topic of the subject / course. It must be a review of topic based on research publications. Student shall refer peer reviewed original research publications and based on findings, write a summary of the same. The pattern of review writing shall be based on reputed reviews published in a standard, peer reviewed journals. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical / lab Examination of Semester IV. The project report shall comprise of Abstract, Introduction, detailed review, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator / Director of the Department / Centre or the Principal of the College.

*The supervisors for the Project Work shall be from the following.

A person shall be an approved faculty member in the relevant subject. OR

Scientists of National Laboratories / Regional Research Laboratories/ Experts from R&D in Industry who are approved by competent authority in such facilities by the Union Government / the State Government / Gondwana University / Other Universities recognized by UGC.

The Project Work will carry total 100 marks and will be evaluated by both external and internal examiner in the respective Department / Center / Affiliated College.

The examiners will evaluate the Project Work/Dissertation taking into account the coverage of subject matter, arrangement and presentation, references, etc.

For written Project work	**40**	**Marks – Evaluated jointly by External & Internal examiner**
Oral Presentation	20	Marks – Evaluated jointly by External & Internal examiner
For Viva-Voce	20	Marks – Evaluated by External examiner
Internal Assessment	20	Marks – Evaluated by Internal examiner
Total	100	

Seminar

Guidelines for Students, Supervisors and Examiners

In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.

The students should submit the seminar report typed and properly bound in two copies to the head of the department. The said shall be evaluated by the concerned supervisor / head of the department. The marks of the seminar shall be forwarded to the university within due period through head of the Department. The record of the seminar should be preserved till the declaration of the final result.

Internal Assessment:

1. The internal assessment marks shall be awarded by the concerned teacher.
2. The internal assessment marks shall be sent to the University after the Assessment in the prescribed format.
3. For the purpose of internal assessment, the University Department / College shall conduct any three assignments described below. Best two scores of a student in these tests shall be considered to obtain

the internal assessment score of that student.

4. If the student does not appear for the Practical Exam, he shall be declared failed in Practical Examination irrespective of marks obtained in Internal Practical Assessment. However, the Internal Practical Assessment marks will be carried forward for his next supplementary Practical Exam.
5. General guidelines for Internal Assessment are:
   a) The internal assessment marks assigned to each theory paper as mentioned in Appendix 1 shall be awarded on the basis of assignments like class test, attendance, home assignments, study tour, industrial visits, visit to educational institutions and research organizations, field work, group discussions or any other innovative practice / activity.
   b) There shall be three assignments (as described above) per course.
   c) There shall be no separate /extra allotment of work load to the teacher concerned. He/ She shall conduct the Internal assessment activity during the regular teaching days / periods as a part of regular teaching activity.
   d) The concerned teacher / department / college shall have to keep the record of all the above activities until six months after the declaration of the results of that semester.
   e) **At the beginning of each semester, every teacher /department/college shall inform his/her students unambiguously the method he / she proposes to adopt and the scheme of marking for internal assessment. (Prescribed in syllabus of respective Subjects).
   f) Teacher shall announce the schedule of activity for internal assessment in advance in consultation with HOD / Principal.

   **To be included in syllabus by BOS.

Practical Examination

1. Each practical carries 100 marks. The scheme of marking shall be as per given in the syllabi of respective subjects.
2. Practical performance shall be jointly evaluated by the External and Internal Examiner. In case of discrepancy, the External Examiner's decision shall be final.
3. Duration of practical examination will be as per given in the syllabi of respective subjects.

The Practical Record of every student shall carry a certificate as shown below, duly signed by the teacher-in-charge and the Head of the Department. If the student fails to submit his / her certified Practical Record duly signed by the Teacher-In-Charge and the Head of the Department, he / she shall not be allowed to appear for the Practical Examination and no Marks shall be allotted to the student.

4. The certificate template shall be as follows:

C E R T I F I C A T E

Name of the college / institution _

Name of the Department: _

This is to certify that this Practical Record contains the bonafide record of the Practical work of Shri / Shrimati / Kumari _ of M. Sc. _ _ _ _ _ _ _

_ _ _ _ _ _ _ Semester _ _ _ _ _ _ _ _ _ during the academic year _ _ _ _ _ _ _. The candidate has satisfactorily completed the experiments prescribed by Gondwana University Gadchiroli for the subject _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Dated _ _ _ / _ _ _ / _ _ _ _ _

Signature of the teacher who taught the examinee Head of the Department

1. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ 2. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

General Rules and Regulations regarding pattern of question paper for the semester end examination: *A) Pattern of Question Paper*

1. There will be four units in each paper.
2. Maximum marks of each theory paper will be 80.
3. Question paper will consist of five questions, each of 16 marks.
4. Four questions will be on four units with internal choice (One question on each unit).
5. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

Index:

Semester-I
Paper-I
Cell Biology

Course Code	PSMB101	Topic/Title	Credit
PSBIT-101	Unit-I	***Ultra structure and function of cell and cell organelles*** A. Discovery of cell B. General structure of plant cell C. Structure of animal cell and types D. Plasma membrane: fluid mosaic model E. Cell walls: archae, bacteria, plant cell. F. Mitochondria G. Chloroplasts H. Golgi complex, endoplasmic reticulum, lysosomes, plastids	04
	Unit-II	***Cell cycle and Cell signaling*** A. Cell cycle: cytological events in mitosis and meiosis, Go-G1 transition. chromosome condensation, regulation of cell division B. Cell signaling: signal transduction in animal and plant cell (tyrosine kinase, light induced signaling, programmed cell death-apoptosis C. Cytoskeleton and cell locomotion	
	Unit-III	***Plant and Animal Tissue*** A. Structure and function of i. Meristematic tissue and permanent tissue. ii. Parenchyma, collenchymas, sclerenchyma iii. Stomata, xylem, phloem B. Structure and function of muscle tissue, nervous tissue, connective tissue C. Cell junction (gap junction), cell adhesion, cell-cell interaction	
	Unit-IV	***Chemistry of Cell*** A. Chemistry of carbohydrates: energy storage molecules – starch, glycogen. building blocks – cellulose, chitin. B. Chemistry of lipids : triglycerides, phospholipids, glycolipids, sphingolipids, sterols, lipoproteins C. Proteins: amino acids and peptides. primary, secondary, and tertiary structures. collagen structure. Ramachandran plot. models of protein folding, roles of chaperones and chaperonins. D. Nucleic acids: structure of DNA and RNA: A, B, and Z forms of DNA, Topological structure of DNA.	

References:

1. Cell Biology Genetics Mole Biology Evolution And Ecology, P. S. Verma, 2005, S. Chand
2. Biotechnology (E.H.), B. D. Singh, 2008, Kalyani Publication
3. Cell And Molecular Biology Gerald Karp, 2007. John Willey And Son Pvt. Ltd.
4. Cell Biology, C.B. Powar, 2005, Himalaya Publishing House.
5. Cell, B. Lewin, 2007, Jones And Bartlett Publisher, London.
6. Cytology, Verma And Argawal, 2005, S. Chand, Newdelhi

Semester-I
Paper-II
Microbiology

Course Code	PSMB102	Topic/Title	Credit
PSBIT-102	**Unit-I**	***History and Development of Microbiology*** A. Contribution of Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister B. Classification of microorganism, Whittaker classification, Bergey's System of bacterial classification (2nd and 9th edition). C. Concept of prokaryotes and eukaryotes, comparision i. Structure of typical bacterial cell ii. Structure and function of bacterial cell organelles – capsule, slime layer, flagella, pili, iii. Endospore, nucleoid	04
	Unit-II	***Microscopy and Staining*** A. Compound microscopy- numerical apperture and its importance, resolving power, oil immersion objective and their significance. i. Principles and application of dark field, phase contrast, fluorescent microscopy, ii. Electron microscopy- principle, working, application (TEM and SEM) iii. Atomic force microscopy, confocal microscopy B. Basic concept of dye and stain. i. Types of stains- acidic, basic and neutral Stains. ii. Differential staining- Gram staining. iii. Procedure and mechanism of endospore staining, capsule staining, negative staining,	
	Unit-III	***Microbial Physiology*** A. Nutrition: basic nutritional requirements, nutritional classification, types of biological complex media B. Reproduction and growth: concept of growth and reproduction, binary fission, growth curve, measurement of growth C. Microbial control: definition of sterilization, disinfection, antiseptics, germicides D. Methods of sterilization physical and chemical methods, dynamics of sterilization,	
	Unit-IV	***Microbial Diversity*** A. Algae: general characteristics, reproduction and Applications in biotechnology. B. Fungi (yeast and mould): General characteristics, reproduction and applications in biotechnology. C. Viruses: general characters and structure D. Life cycles of virus : lytic and lysogeny (lambda phage) E. Viroids and prions	

References

1. Microbial Physiology and Metabolism by Caldwell D.R. 1995Brown Publishers.
2. Microbial Physiology by Moat A.G. and Foster J. W. 1999. Wiley.

3. Prokaryotic Development by Brun. Y.V. and Shimkets L.J. 2000. ASM Press.
4. Advances in Microbial Physiology. Volumes. Edited by By A.H. Rose. Academic Press, New York.
5. Applied Microbial Physiology by Rhodes.
6. Biosynthesis by Smith.
7. The Bacteria. Volumes by I.C. Gunsalus and Rogery Stanier, Acadenic Press.
8. Microbial Physiology by Benjam.
9. Metabolic Pathways .By:-David M.Greenberg.
10. Dawes, E. A. Microbial Energetics, New York: Chapman.
11. White, D. The Physiology and Biochemistry of Prokaryotes, Oxford University Press,
12. History of Microbiology and Microbiological Methods by A.B. Solunke, V.S. Hamde, P.R. Thorat, R.S. Awasthi, Atharva Publishers Jalgaon.

Semester-I
Paper-III
Biophysical Techniques

Course Code	PSMB103	Topic/Title	Credit
PSBIT-103	**Unit-I**	***Biophysical techniques - I*** A. Chromatography : types and principles of partition, adsorption, gel filtration, affinity, ion exchange, paper chromatography. brief concept of GLC and HPLC. B. Electrophoresis: concept and principles of electrophoresis, gel electrophoresis (agarose, PAGE, SDS-PAGE), basic principles of disc gel electrophoresis, gradient electrophoresis, pulsed field gel electrophoresis, paper electrophoresis. C. Viscosity: basic principle, determination of molecular weight of biopolymer through viscosity	04
	Unit-II	***Biophysical techniques – II*** A. Centrifugation: basic principles, mathematics and theory (RCF, sedimentation coefficient etc) B. Types of centrifuge: microcentrifuge, high speed & ultracentrifuges. C. Preparative centrifugation: differential and density gradient centrifugation, applications (isolation of cell components). D. Analytical centrifugation: determination of molecular weight by sedimentation velocity	
	Unit-III	***Biophysical techniques- III*** **A.** Spectrophotometry: nature of light, Lambert and Beer's law. B. Principle working and application of spectrophotometry- UV-visible, infrared, fluorescence C. NMR (Nuclear Magnetic Resonance) D. Basic introduction to Raman and Mass spectrophotometry	
	Unit-IV	***Radioactivity*** A. Radioactive and stable isotopes, pattern and rate of radioactive decay, units of radioactivity. B. Measurement of radioactivity: basic principle, instrumentation and technique of i. Geiger-Muller counter. ii. Solid scintillation counter iii. Liquid scintillation counter	

		C. Brief idea of Cerenkov radiation, autoradiography. D. Measurement of stable isotopes: falling drop method and Mass spectrometry. E. Applications of isotopes in biochemistry- principles of tracer techniques, its advantages and limitations, distribution studies, metabolic studies, clinical application.	

References:

1. Methods of General and Molecular Bacteriology, 1993. Edited by Philip. Gerhardt, ASM Publications.
2. Biophysical Chemistry VOL:I,II,III; The conformation of biological macromolecules. By; Cantor and Schimmel. Hans-Peter schmauder,Michael schweizer,Lilian M.Schweizer.
3. Biophysical Chemistry By: Upadhaya Upadhyaya Nath.
4. Principles and Techniques of Practical Biochemistry by K. Wilson and J. Walker, Cambridge University Press
5. Morrison –Physical Biochemistry (Oxford).
6. Hames, B.D. and Rickwood, D. Gel Electrophoresis A practical Approach, Oxford University Press, New York.
7. Cotterill, R.M J. Biophysics An Introduction, John Wilely and Sans England.
8. Nolting, B. Methods in Modern Biophysics II Ed. Springer, Germany.
9. Narayana .P. Essentials of Biophysics New Age International Pub. New Delhi.
10. Keeler, J. Understanding NMR spectroscopy. John Wiely and Sons England.
11. Holler, F.J.,D.A. Skoog and S.R. Crouch, Principles of Instrumental Analysis IV ED.Thomson, Brooks/Cole Pub. US

Semester-I
Paper-IV
Molecular Biology

Course Code	PSMB104	Topic/Title	Credit
PSBIT-104	**Unit-I**	***Replication, Mutations and Repair*** A. Messelson and Stahl Experiment- semi-conservation replication. B. DNA Replication: in prokaryotic (detail). comparison between prokaryotic and eukaryotic DNA replication C. Mechanisms of DNA replication, enzymes and accessory proteins involved in DNA replication. D. Gene mutations: types of mutations. mutagens- chemical and physical mutagens E. DNA repair: direct repair, Ada protein, NER, BER, MMR, SOS repair, transcription-repair coupling, repair of double-strand breaks.	04
	Unit-II	***Transcription Post transcriptional Modifications of RNA*** A. Prokaryotic transcription: RNA polymerase holoenzyme and apoenzyme, different sigma factors. B. Details of transcription initiation, elongation, termination. C. Transcription regulation (lac operon, ara operon, trp operon, negative autogenous control). D. Eukaryotic transcription: three types of RNA polymerases. promoter of RNA polymerase II.	

		E. Packaging of chromosomes and its relation to transcription regulation. F. Modifications of RNA: 5' cap formation, polyadenylation, splicing of nuclear pre-mRNA, mRNA stability.	
	Unit-III	***Protein biosynthesis*** A. Genetic code: characteristics, deciphering the code. B. Protein biosynthesis**:** prokaryotic and eukaryotic translation, the translational machinery, mechanism of prokaryotic and eukaryotic translation initiation, elongation and termination. C. Post translation modification of protein. D. Couple transcription and translation	
	Unit-IV	***Genes: Molecular structure of prokaryote and eukaryote genes.*** A. Concept of gene- introns, exons, cistron, recon, split Genes, spacers, C-value paradox, idea of coy curve. B. Bacterial genetic system: recombination (transformation, conjugation, transduction and transposition) plasmids, salient features of the *E.coli* genetic map. C. Extra chromosomal inheritance: maternal effects, D. Types of genes- regulatory gene, structural gene,	

References:

1. Cell Biology Genetics Mole Biology Evolution And Ecology, P. S. Verma, 2005, S. Chand
2. Biotechnology (E.H.), B. D. Singh, 2008, Kalyani Publication
3. Cell And Molecular Biology Gerald Karp, 2007. John Willey And Son Pvt. Ltd.
4. Cell Biology, C.B. Powar, 2005, Himalaya Publishing House.
5. Cell, B. Lewin, 2007, Jones And Bartlett Publisher, London.
6. Cytology, Verma And Argawal, 2005, S. Chand, Newdelhi

PRACTICAL PAPER

Based on Theory I & II

PRACTICAL-I

Practical I (CELLULAR & MICROBIAL TECHNIQUES)

Compulsory Practicals

1. Isolation of mitochondria.
2. Isolation of Bacteria, fungi, Actinomycetes and Yeast.
3. Assay of viruses
4. Cell motility and flagella staining.
5. Cell types of plants- maceration of various tissue explants and identification of xylem, trachied, stomata, root hair, etc.
6. Isolation of neutrophils and demonstration of phagocytosis.
7. Determination of osmotic fragility of RBC membrane.
8. Isolation of chlorophyll and xanthophylls from spinach leaves.
9. Study of meiosis and mitosis.
10. Histological study of tissues by Microtomy.
11. Cleanliness, media preparation, sterilization, culturing methods, dilution techniques.
12. Staining techniques in microbiology; simple staining, gram staining, spore staining, capsule staining, flagella staining.
11. Isolation of pure culture by different techniques.
12. Replica plating technique.

PRACTICAL PAPER

Based on Theory III & IV

PRACTICAL-II

1. Separation of proteins by ion exchange chromatography
2. Separation of lipids by thin layer chromatography
3. Polyacrylamide gel electrophoresis: SDS-PAGE of proteins.
4. Estimation of proteins by Lowry's and Bradford method.
5. Qualitative analysis of Carbohydrate, protein, lipid and nucleic acids.
6. Estimation of protein by E280/E260 method
7. Introduction to measurements: balance and pipefitting, preparation of solutions of given molarity and normality.
8.. Measurement of pH: buffering capacity, to determine pKa value and hence the dissociation constant of a given acid using pH meter.
9.. Colorimetry: To determine the dissociation constant of a given indicator colorimetrically and to prepare buffer solutions in the pH range 2.2 to 8.0
10. Colorimetry: Assay of DNA by diphenylamine method.
11. Colorimetry: Assay of RNA by orcinol method.
12. Potentiometry: To determine redox potential of Fe++ and Fe+++.
13. Conductometry: to determine cell constant of 0.1 M KCl.
14. Conductometry: Titration of strong acid *vs* strong base, to find out equivalent conductance of salt formed.
15. Viscometry: To determine radius of glycerol molecule.
16. Viscometry: To determine molecular weight of protein and DNA.
17. Viscometry: To determine changes in the conformation of bovine serum albumin by viscosity measurements, effect of pH on conformation of BSA.

SEMESTER II

Semester-II
Paper-I
Enzymology

Course Code	PSMB105	Topic/Title	Credit
PSBIT-105	**Unit-I**	***General Enzymology, Specificity and its Kinetics*** A. Enzyme classification and nomenclature. B. Concept of holoenzymes, coenzymes, apoenzyme, Substrate, Inhibitor, Activator, Modulators etc. C. Commercial application of enzymes (food, industry, Research, Pharmaceutical field) Enzyme immobilization. D. Substrate Specificity- Lock and Key model, Induced fit model. E. Enzyme kinetics: Michaelis-Menten equation (derivation, significance and transformation). F. Lineweaver-Burk equation. G. Effect of pH, Temperature, Substrate Concentration, enzyme Concentration,	04
	Unit-II	***Enzyme inhibition*** A. Enzyme inhibition and types of inhibitors. B. Reversible and Irreversible Inhibitors, competitive, noncompetitive, uncompetitive inhibitors. **C.** Enzyme Inhibition Kinetics. D. Concept of multienzyme complexes: fatty acid synthase and dehydrogenase complexes.	
	Unit-III	***Mechanism of enzyme action*** A. Models enzyme action, catalysis by proximity effect, acid-base catalysis, covalent catalysis, metal ion catalysis, nucleophilic and electrophilic catalysis, electrostatic interaction, B. Unit of Enzyme activity, Enzyme assay. C. Purification and Isolation of enzymes D. Membrane bound enzymes and Isoenzymes	
	Unit-IV	***Enzyme Regulation*** A. Concept of enzyme regulation: Allosteric (example ATCase), Proteolytic Activation (example zymogen structure) B. Types of Allosteric regulation: homotropic allosteric modulator, heterotropic allosteric modulator C. Ping Pong mechanism. D. Chemical modification and calmodulin mediated regulation. Isoenzymes. Lysozymes	

Semester-II
Paper-II
Immunology and Immunological Techniques

Course Code	PSMB106	Topic/Title	Credit
	Unit-I	***History, Cells and Organs of immune system.*** A. Concept of Innate immunity, Acquired immunity B. Cells involved in immune response- lymphocytes, granulocytes and agranulocytes.	

PSBIT-106		C. Primary lymphoid organs (Bone marrow, Thymus,) D. Secondary lymphoid organs (MALT, GALT, Lymph Nodes, Spleen,) E. Antigen, Antigenicity F. Immunoglobulins: structure of Immunoglobulins and classes of Immunoglobulins.	04
	Unit-II	***Adaptive and Cell mediated immune response*** A. Humoral immune system- Main pathway of complement system, primary response, secondary response, B-cell, BCR, Activation of B Cells B. MHC-I, MHC-II molecules, antigen presentation. C. T-cell development, T Cell Receptor (TCR)- αβ T cells, γδ T cells, Structure of TCR, T-cell activation, Apoptosis in T cells. D. Humoral Immunity, NK cell mediated immunity, mechanism of cell mediated immunity. **E.** Cell-cell cooperation, role of cytokines- Cytokine receptors,	
	Unit-III	***Immunological Techniques*** Immunological techniques: Ag-Ab reactions, Lattice theory, Zone phenomenon, techniques based on precipitation, agglutination, immunodiffusion, RIA, ELISA, hybridoma Technology, CFT (complement fixation test)	
	Unit-IV	***Hypersensitivity and Vaccination*** B. General feature of Hypersensitivity, types of Hypersensitivity. C. Autoimmune Diseases: Addison's Disease, Grave's Disease. D. Vaccination: Discovery, Principle and Significance of vaccination. **E.** Concept of autoimmunity and immunological tolerance.	

Semester-II
Paper-III
Molecular Biology and Bioinformatics

Course Code	PSMB107	Topic/Title	Credit
PSBIT-107	**Unit-I**	***Recombination, Chromosome Transfer and Genome Mapping*** A. Homologous recombination: Holiday junction. B. FLP/FRT and Cre/Lox recombination, RecA. C. Molecular mapping of genome: Genetic and physical maps, choice of mapping population, D. southern and fluorescence in situ hybridization for genome analysis, **E.** Molecular markers- RFLP map, RAPD, and AFLP analysis, linked analysis, application of molecular markers in forensic, disease prognosis, genetic counseling, pedigree etc. STS, microsatellite.	04
	Unit-II	***Antisense, Ribozymes and Epigenetics*** A. Antisense and ribozyme technology: Molecular mechanism of antisense molecule, biochemistry of ribozyme, hammerhead ribozymes, applications of antisense and ribozyme technologies. **B.** Epigenetics**:** chromatin marking systems, Direct chemical modification of DNA, Basic concepts of RNAi.	

	Unit-III	***Cancer Biology*** A. Characteristics of Cancer cell, Methods to study cancer. B. Angiogenesis, positive and negative factors affecting angiogenesis. Metastatsis, biochemical parameters acquired by metastatic cells. C. **DNA Viruses and cancer:** Polyoma virus, SV40, adenovirus D. **Genetics of Cancer:** Oncogenes (ras, erb-B, abl), suppressor genes (p53, Rb). E. Cancer stem cells.	
	Unit-IV	***Bioinformatics*** A. **Computer concept:** computer organization, hardware, software, operating system (windows, unix, brief list of computer languages). B. **Concept of networking:** internet, internet concepts, web browsing, public domain resources in biology. C. **Concept of database management:** brief idea of data types, data structures, searching, sorting, designing a database, genomic, proteomic, and metabolic pathways databases. D. **Computer analysis of genetic sequences:** general concepts of sequence analysis, identification of functional sequences, homology, brief idea of BLAST, ENTREZ, and PuBMed. E. Bioinformatics tools in drug design.	

Semester-II
Paper-IV
Industrial Biotechnology

Course Code	**PSMB108**	**Topic/Title**	**Credit**
PSBIT-108	**Unit-I**	***Bioreactor technology-I*** A. Definition of fermentation B. Concept of Industrial Fermentation, Types of fermentation (Industrial Types) C. General layout of fermentation unit D. Design of fermenter- Geometry of fermenter E. Types of fermenter- Batch and continuous, airlift, fluidized bed, loop reactors, rotatory disc reactors, fed batch reactors,	04
	Unit-II	***Bioreactor technology-II*** A. Aeration and Agitation, Heat and mass transfer, KLa value, B. Rheology, Power number, Reynold number and other factors, types of microorganisms, medium composition, antifoaming agents, Product accumulation C. Up-stream processes: Medium composition, Raw materials and sterilization D. Inocullum buildup, Scale up E. Substrate utilization, oxygen sag, yield coefficient	

	Unit-III	***Downstream processing*** A. Filtration, ultrafiltration, Bioseparation, membrane filtration, centrifugation, sedimentation, flocculation B. Solvent extraction, counter current extraction C. Chromatographic techniques- ion exchange, affinity, gel filtration, adsorption D. Crystallization, reverse osmosis, drying E. Quality control Testing- Antibiotics F. Packaging and Storage	
	Unit-IV	***Industrial Production and*** **Immobilization** A. Industrial Production of amylase, penicillin ethanol, pigment-beta carotene, vitamin B12 and Gibberellin B. Biosensor C. Immobilized systems**-** adsorption, covalent bonding, entrapment, encapsulation, cross linking, diffusion characteristics, effective factors, instability factors, deactivation rates D. Immobilization of enzyme, lyophilization and crystallization of products	

PRACTICAL PAPER
Based on Theory I & II
PRACTICAL-I

1. Western blotting.
2. Determination of activity of invertase from immobilized cells of *Saccharomyces cerevisiae*
3. Assay of activity of LDH.
4. Purification of immunoglobulins, qualitative assessment.
5. Demonstration of immunochemical reactions (blood group, , pregnancy,)
6. Demonstration of ELISA
7. Demonstration of VDRL
8. Widal Test
9. Blood film preparation and identification of cells.
10. Ouchterlony immunodiffusion,
11. Determination of albumin by radial immunodiffusion.
12. Assay of activity of beta-galactosidase
13. Assay of activity of acid phosphatase,
14. Determination of activity in presence of activators.
15. Determination of activity in presence of inhibitors.
16. Enzyme purification by crystallization - urease.
17. Subcellular fractionation and assay of marker enzymes.

PRACTICAL PAPER
Based on Theory III & IV
PRACTICAL-II

1. Production of microbial products (Alcohol/Antibiotic) in bioreactors/fermenter and determine yield potential.
2. Separation of polyA RNA on oligo dT column.
3. Southern blotting.
4. Determination of rheological constant.
5. Determination of oxygen transfer rate, volumetric transfer coefficient.

6. Isolation of genomic DNA.
7. Isolation of plasmid DNA.
8. Isolation of RNA.
9. Endonuclease digestion of DNA and analysis of DNA fragments by agarose electrophoresis.
10. Restriction fragment length polymorphism.
11. Ames test.
12. Computer aided visualization of amino acid sequence of protein and its 3D structure.
13. Retrieving metabolic pathway using internet.
14. Homology searching using BLAST.
15. Computer aided survey of scientific literature.
16. Immobilization of cell/enzyme.

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