GONDWANA UNIVERSITY

GADCHIROLI

CHOICE BASE CREDIT SYSTEM (CBCS)

SYLLABUS FOR

M.Sc.

TWO-YEARS DEGREE COURSE

IN

MICROBIOLOGY

From

Academic Year

2016-2017

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

M.Sc. Microbiology (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 Microbiology.

	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.

Sem. No.	Paper No.	Paper Title
I	I	**Microbial Diversity And Evolution (MDE)**
	II	**Microbial Physiology & Metabolism**
	III	**Enzymology And Techniques (ET)**
	IV	**Commercial Microbiology (CE)**
		Practical Based on Paper I & II
		Practical Based on Paper III & IV
		Seminar
II	I	**Advance Techniques in Microbiology (ATM)**
	II	**Membrane structure and Signal Transduction (MSST)**
	III	**Microbial Methods for Environment Management (MMEM)**
	IV	**NANOMICROBIOLOGY**
		Practical Based on Paper I & II
		Practical Based on Paper III & IV
		Seminar

Semester-I
Paper-I
Microbial Diversity and Evolution (MDE)

Course Code	PSMB101	Topic/Title	Credit
PSMBT-101	Unit-I	**Microbial Evolution and Systematic** Evolution of Earth and early life forms. **Primitive life forms:-**RNA world, molecular coding, energy and carbon metabolism, origin of Eukaryotes, endosymbiosis. **Methods for determining evolutionary relationships:-** Evolutionary chronometers,Ribosomal RNA sequencing, signature sequences, phyllogenetic probes, microbial community analysis. **Derivation of Microbial Phyllogeny:-** characteristics of domain of life, classical taxonomy, chemotaxonomy, bacterial speciation.	04
	Unit-II	**Microbial Diversity: Archea** General Metabolism and Autotrophy in archea **Phylum Euryarchaeota:-**Halophilic archaea, methanogens, thermoplasma. **Phylum Crenarchaeota:-**Energy metabolism, Thermoproteales, sulfolobales, desulfolobales. **Phyllum Nanoarchaeota:-** Nanoarchaeum. Heat stable biomolecules and extremophiles, Evolutionary significance of hyperthermophiles.	
	Unit-III	**Microbial Diversity: Bacteria** **Phylum Proteobacteria:-**Free living N2 fixing bacteria,purple phototrophic bacteria nitrifying bacteria, sulphur and iron oxidizing bacteria, sulphate and sulphur reducing bacteria. **Phylum prochlorophytes** and cyanobacteria, **Phylum:Planctomyces,** **Phylum;Verrucomicrobia.**	
	Unit-IV	**Microbial Diversity.** Phylum: Cytophaga, Phylum: Green Sulfur Bacteria. Phylum: Deinococci. Phylum: Green non –sulfur bacteria. Phylum: Branching Hyperthermophiles, Thermotoga and Aquifex. Phylum:Nitrospira and Deferribacter.	

Reference Books

1	Goodfellow, M. and Minnikin, D.E. (eds.), Chemical methods in bacterial systematics, The Society for Applied Bacteriology. Technical Series No.20, Academic Press.
2	Sneath, A.H.P., Mair, S.N. and Sharpe, E.M. (eds.), Bergey's manual of systematic bacteriology Vol.2. Williams & Wilkins Bacteriology Symposium, Series No 2, Academic Press, London/New York.
3	Goodfellow, M., Mordarski, M. and Williams, S.T. (eds.), The biology of the actinomycetes.
4	Barlow, A. (ed.), The prokaryotes: a handbook on the biology of bacteria: ecophysiology, isolation, identification, applications, Volume 1 Springer-Verlag.
5	Kurtzman, C.P., Fell, J.W. and Boekhout, T. (eds.), The yeasts- a taxonomic study.
6	Norris, J.R. and Ribbons, D.W. (eds.), (1971) Methods in microbiology, Vol.18 & 19.
7	Reddy, C.A. (ed.), Methods for general and molecular microbiology
8	Priest, F.G. and Austin, B. Modern bacterial taxonomy, Chapman and Hall.

Semester-I
Paper-II
Microbial Physiology & Metabolism

Course Code	PSMB102	Topic/Title	Credit
PSMBT-102	**Unit-I**	**BIOENERGETICS** Basic concept of bioenergetics and metabolism. Carbohydrate metabolism: glycolysis and its regulation, Feeder pathway of glycolysis and carbohydrate–homo and hetero lactic fermentation. Glycogenesis, Glycogenolysis. Gluconeogenesis ; pathways and regulation, Pentose phosphate pathway, kreb's cycle and glyoxalate pathway. Substrate level phosphorylation and oxidative phosphorylation, electron transfer reaction in mitochondria, electron carriers and multienzyme complex I to IV. ATP synthesis: chemiosmotic theory, shuttle system, regulation of oxidative phosphorylation and uncouplers, inhibitors of oxidative phosphorylation.	04
	Unit-II	**PHOTOSYNTHESIS AND LIPID METABOLISM** Photosynthesis: structure of chloroplast, light reaction and dark reaction; Kelvin cycle, C3 and C4 pathway. Mechanism of energy generation in cyanobacteria, green bacteria and purple sulphur bacteria and chemolithotrops. Lipid metabolism digestion absorption; oxidation of unsaturated fatty acid and odd chain fatty acid, ketone bodies. Lipid biosynthesis: biosynthesis of fatty acids, triacylglycerol and phospholipids and regulation of fatty acid metabolism.	
	Unit-III	**PROTEIN AND NUCLEIC ACID METABOLISM** Amino acid metabolism: biosynthetic families of amino acids, Breakdown of amino acids into six common intermediates and urea cycle and regulation of amino acid metabolism. Nucleotide metabolism; biosynthesis of purines and pyrimidines nucleotide by de novo and salvage pathways, Degradation of purines and pyrimidines nucleotides.	
	Unit-IV	**NITROGEN METABOLISM** Nitrification, denitrification and pathways of nitrate and ammonia assimilation. Nitrogen cycle, Assimilation of nitrogen: denitrogen fixation- free living and symbiotic, diazotrophic organisms. Biochemistry of nitrogen fixation: nitrogenase complex, function of nitrogenase, regulation of nitrogenase by oxygen and combined nitrogen sources, Genetics of nitrogen fixation; nif genes and their regulation.	

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,

Semester-I
Paper-III
Enzymology and Techniques (ET)

Course Code	PSMB103	Topic/Title	Credit
PSMBT-103	**Unit-I**	**Enzymes kinetics** Overview of Michaelis-Menten equation and its transformation, Evaluation of kinetic parameters, Kinetics of bisubstrate reaction, multistep reactions, kinetics of enzyme inhibition, Classification of enzymes	04
	Unit-II	**Catalytic mechanisms** Concept of active site, determination of active site, acid –base catalysis, covalent catalysis, metal ion cofactors, proximity and orientation effects, preferential binding. Active site determination and mechanism of ribonuclease, lysozyme, Active site determination and mechanism of serine protease.	
	Unit-III	**Regulation of Enzyme activity** Allosterism, Kinetic analysis of allosteric enzymes Covalent Modification, Feed -back inhibition Membrane bound enzymes, isoenzymes and marker enzymes-LDH, multienzyme complex with mechanism Constituitive and inducible enzymes.	
	Unit-IV	**Techniques** **Enzyme isolation and purification**- Importance of purification, methods of purification and fractionation, crieteria of purity Protein**:** ligand binding studies: association and dissociation constants, co-operative ligand binding MWC or concerted model, sequential model. **Enzyme biosensors**: General concept, Definitions, history and market needs. Glucose biosensor. Industrial applications of enzymes. Immobilized enzymes, Protein engineering.	

REFERENCES:

1. Advances in Enzymology by Alton Meister (1996), Interscience Publishers.
2. Allosteric enzymes – kinetic Behaviour by B.I Kurganov (1982) John Wiley and sons Inc., New York.
3. Biology enzymes in biotechnology by H.J.Rehm and G. Reed Verlag (1983) VCH Publishers. New York.
4. Enzymes as Drugs by John S. Hoilenberg and Joseph Roberts (2001). John Wiley and Sons New York.
5. Enzymes by Dixon, M., and E. C. Webb, 3rd edition, (1980), Academic Press. New York.
6. Enzymology by palmer
7. Hand Book of Enzyme Biotechnology by Wiseman (1985), Ellis Horwood.
8. Methods in Enzymology by W. A. Wood (1980) Academic Press New York.

9. Methods in Enzymology. Volume 22- Enzyme purification and related techniques by William B. Jakoby. Academic press, New York.
10. Methods of Enzymatic Analysis by Hans Ulrich. Bergmeyer (1974) Verlag Chemie.
11. Topics in enzymes and fermentation biotechnology by L.N.Weiseman, John wiley and Sons.
12.Enzymes:By: Trevor Palmer.
13.Enzyme structure and mechanism By:Alan Fersht.
14.Methods in Enzymology By: S.Berger,A.Kimmel.
15.Fundamentals of Enzymology By;N.Price,L.stevens.
16.Immobilization of Enzymes and cells.By:Gordon Bickerstaff.

Semester-I
Paper-IV
COMMERCIAL MICROBIOLOGY (CE)

Course Code	PSMB104	Topic/Title	Credit
PSMBT-104	**Unit-I**	**Petroleum Microbiology** Evidence regarding biogenesis of petroleum. Bacterial products as indicators of petroleum biodegradation. Apparatus for the detection of living microbial contaminants in petroleum products. **Exploration**: Microbiological Exploration for Petroleum Deposits; Geomicrobiological Methods of Ore and Petroleum Exploration. **Oil recovery**: Oil Recovery Process using Aqueous Microbiological Drive Fluids; Bacteriological Method of Oil Recovery. **Microbiological Oil Prospecting. Microbial solubilisation of coal.**	04
	Unit-II	**Cosmetic Microbiology:** Definition**;** Preparations of Skin whitening compositions from microbes like Ascomycetes, Black yeast, enzymes, and Mineral yeast ferments. Microbial Production of Alpha Arbutin; Hyaluronic acid; Kojic acid and their use in Cosmetics preparations. **Space Microbiology**: Monitoring of astronauts microbial flora: Alterations in the load of medically important microorganisms, ESA STONE experiment. Evaluating the Biological Potential in Samples Returned from Planetary Satellites and Small Solar System Bodies.	
	Unit-III	**Textile Microbiology:** Definitions: Antimicrobial fabrics; Antimicrobial garments; Antimicrobial carpets and tiles, Antimicrobial colorants. Bacteriostatic Sanitary napkins and towels. **Paper Microbiology**: Antibacterial Paper and Antibiotic Paper Production. Antimicrobial papers and Antimicrobial Currency.	

	Unit-IV	**Plastic Microbiology:** definition**,** **Bacteriostatic plastics**: Antimicrobial plastic composition and production. Antiseptic plastics. **Fungistatic plastics**: Definition and production. Production of Plastics Materials from Microorganisms. Methods for Producing Anti-Microbial Plastic Product. Plastic article containing a metallic bactericidal agent. **Casein Plastic.** **Rubber Microbiology**: Definition; Antimicrobial rubbers; Antimicrobial rubber compositions.	

References:

1. Cosmetic Microbiology: A Practical Approach Edit. By Philip A.Geis.Taylor & Francis New York London.
2. FDA Bacteriological Analytical Manual, 7th ed., Association of Official Analytical Chemists, Washington, D.C., 1992.
3. CTFA Microbiology Technical Guidelines, Cosmetic, Toiletry, and Fragrance Association, Washington, D.C., 1993.
4. Petroleum Microbiology by Bernard Ollivier, Michel Magot, American Society for Microbiology Press.

Websites:

1. **http://www.ecomii.com/science/encyclopedia/petroleum- microbiology**
2. **http://lizinan.wordpress.com/2010/06/24/microbial- enhanced- oil- recovery/**
3. **http://www.metamicrobe.com/petroleum- microbiology/**

PRACTICAL PAPER

Based on Theory I & II

PRACTICAL-I

1) Detection of enzyme activity of lipase, Urease, invertase, protease, Tween 80 hydrolysis.
2) Determination of kinetic constant of amylase:-Amylase activity,Vmax.Km.
3) Effect of pH and temperature on amylase activity.
4) Effect of inhibitors on amylase activity.
5) Estimation of protein:
6) Production, isolation and purification of enzyme and determination of fold purification(any one enzyme)
7) Estimation of sucrose in presence of glucose.
8) UV absorption of proteins, DNA and RNA.
9) Estimation of L-leucine by colourimetric method.
10) Determination of pka of an amino acid.

*Minimum seven experiments must be performed in the semester.

PRACTICAL PAPER

Based on Theory III & IV

PRACTICAL-II

1) Isolation of microflora from different ecological nitches such as freshwater, mangroves, salt pan bed, hot water spring, acid –zone soil,rhizosphere etc.(any two nitches)

2) Demonstration microbial Interactions:-competition, syntrophy, antagonism and isolation of nitrogen fixing bacteria.

3) Development of biofilm on metal strips.

4) Isolation and purification of Photosynthetic pigments.

5) Determination of Shannon index as a measure of evenness H/Hmax from garden soil.

6) To study the decolorization of distillery or textile industrial waste.
7) To study the application of lignocellulolytic enzymes in bleaching of paper pulp.
8) Antibacterial activity assessment of textile materials.
9) Evaluation of antifungal property of treated textile materials.
10) Testing for antibacterial activity and efficacy on textile products, Qualitative and quantitative.
11) Textile fabrics Determination of antibacterial activity Agar diffusion plate test.
12) Microbiological Tests of Cosmetics, Perfumes and Essential Oils.
13) Antimicrobial assessment of finished textiles.

SEMESTER II

Semester-II
Paper-I
Advance Techniques in Microbiology (ATM)

Course Code	PSMB105	Topic/Title	Credit
PSMBT-105	**Unit-I**	**Biophysical Techniques-I** Determination of size, shape and Molecular weight of Macromolecules:-by Viscosity, CD/ORD, Light scattering, diffusion sedimentation and Centrifugation techniques.	04
	Unit-II	**Biophysical Techniques-II** Electrophoresis: Agarose Gel, SDS-page, two-dimensional gel electrophoresis, capillary electrophoresis, immune-electrophoresis.	
	Unit-III	**Microscopical Techniques.** Electron Microscopy: SEM, TEM, Staining procedures and microscopy. Fluorescent Microscopy: Staining procedures and Microscopy, FISH. Laser scanning, confocal microscopy. Scanning tunneling and atomic force microscopy. Immunoelectron microscopy, cryoelectron microscopy.	
	Unit-IV	**Other advance techniques** **Blotting techniques:** Western, southern, northern, Radioimmunoassay. NMR and its biological importance. Site-directed mutagenesis, transcriptional start point mapping.	

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-II
Paper-II
Membrane structure and Signal Transduction (MSST)

Course Code	PSMB106	Topic/Title	Credit
PSMBT-106	**Unit-I**	**Structure and organization of membranes** Mitochondria, endoplasmic reticulum, prokaryotic membrane, membrane junctions (Gap & tight junctions), techniques for membrane study: electron microscopic method, membrane vesicles, differential scanning colorimetry, flouroscence photobleaching recovery, flow cytometry.	04
	Unit-II	**Membrane Transport** Active and Passive transport, uniport, ATP powered pumps, non-gated ion channels, cotransport by symporters and antiporters, transepithelial transport.	
	Unit-III	**Signal Transduction** General concept of cell signaling, G-protein coupled receptors and their effectors. RTK and MAP Kinases. Down regulations of pathways. Cytokine receptors and their mechanism (JAK-STAT pathway).	
	Unit-IV	**Bacterial signal transduction** Basic two component system. Histidine kinase pathway Sporulation as a model of bacterial signal transduction. Osmoregulatory pathways. Heat shock proteins. Mating types of yeast.	

References:

1.The Biochemistry of copper By: Jack Peisach,Phillip Aisen.
2,Biochemistry:-By:Rex Montgomery.
3.Lehninger Principles of BiochemistryBy:-David L. Nelson and Cox
4.Principles of Biochemistry.By:Donald J.voet,Judith G.Voet,Charlotte W.Pratt.
5. Getzen berg, R.H.and E.E.Bittar, Cell Structure and Signalling, Elsevier Science.
6. Ernet, J.M. Helmreich, The Biochemistry of Cell Signalling, Oxford Press.
7. Boyer,P. D. The ATP synthase- A splendid moleculear machine. Ann. Rev.
8. Cossart et al., Cellular Microbiology
9. S. Ram Reddy and S.M. Reddy, Microbial Physiology, Scientific Pub, Jodhpur.
10. Dawes, I.W., Sutherland ,I.W Microbial Physiology 2nd ed London:Blackwell scientificPublishers

Semester-II
Paper-III
Microbial Methods for Environment Management (MMEM)

Course Code	PSMB107	Topic/Title	Credit
PSMBT-107	**Unit-I**	**Eutrophication, Biodeterioration and Biomagnification** **Eutrophication:** Microbial changes induced by organic and inorganic pollutants, factors influencing eutrophication process and control of eutrophication. **Biodeterioration:** Definition and concept of biodeterioration, biodeterioration of woods and pharmaceutical products. **Biomagnification:** concept and consequences, Biomagnifications of chlorinated hydrocarbons and pesticides.	04
	Unit-II	**Biotransformation and Bioleaching, Biodegradation** **Biotransformations:** metals and metalloids, mercury transformations, biotransformation of pesticides such as hexachlorobenzene. **Bioleaching:** Bioleaching of ores, leaching techniques and applications. **Biodegradation:** Biodegradation of plastics.	
	Unit-III	**Pollution Management** Waste water management using activated sludge, aerated lagoons, trickling filter, rotary biological contractors, fluidized bed reactors, stabilization ponds. Concept of phytoremediation and applications.	
	Unit-IV	**Global Environmental Problems** Ozone depletion, UV-B, green house effect, acid rain, their impact and biotechnological approaches for management. Acid mine drainage and associated problems. Global warming and climate change.	

References:

1.Environmental Microbiology By: Ralph Mitchell, John Wiley and Sops. Inc.
2.Environmental Biotechnology By: C.F. Froster and D.A. John Wase, Elis Horwood.
3.A manual of environment Microbiology. By: Christon J. hurst, ASM publication.
4.Environmental Microbiology By: R.M.Maier,I.C.Papper and C.P.Gerba.
5. Experimental Microbial Ecology. By: Arosison Academic Press.
6. Microbiology of Extreme environments, edited by Clive Edward, Open University press, Milton Keynes.

Semester-II
Paper-IV
NANOMICROBIOLOGY

Course Code	PSMB108	Topic/Title	Credit
PSMBT-108	**Unit-I**	**Microbial Nanotechnology**: Definition – Evolution of Nano science. Definition of nano scale with reference to biosystems, Scope and future prospects. Manipulation of matter at the molecular level to create new products with atom by–atom precision. Nanoscale lithography, e-beam lithography, Heterogeneous nano structure and composites, nanoscale biostructres. Polymer nano-electronics and nano-colloids.	04
	Unit-II	Bacterial structure relevant to nanomicrobiology, Cubosomes, Dendrimers, DNA Nanoparticle Conjugates, DNA Octahedron, Fullerenes, Nanoshells, Carbon Nanotubes, Nanopores, Nano structured Sillicon. Viruses as nano-particles, nano chemicals and application. DNA based Nanostructures- DNA-protein nanostructures-Methods- Self assembled DNA nanotubes—Nucleic acid Nanoparticles, DNA as a Biomolecular template-DNA branching-Metallization- Properties	
	Unit-III	**Nanopartical Synthesis**: Biosynthesis of Metalloid Containing Nanoparticles by Aerobic Microbes. Intracellular synthesis of gold nanoparticles by a novel alkalotolerant actinomycete and *Rhodococcus* species. **Quantam dots(QD):** definition, and biosynthesis and its application in immuno-nanotechnology; Characteristics and applications of quantum dots. Quantum dot as Biological fluorescent tag. **Synthesis of Nanoparticles by Fungi**: silver nanoparticles (SNPs)	
	Unit-IV	**Method for preparation of nanoparticles and apparatus for the production.** Production of Sulfur-Free Nanoparticles by Yeast Functional Nanomaterials with Antibacterial and Antiviral Activity. Nano particle based immobilization assays. Nanocarbon ball as deodorizer in ferment process.	

Reference:

- Nanobiotechnology- concepts, applications and perspectives, Niemeyer, Christof m. Mirkin, Chad A., Wiley publishers.
- Nanobiotechnology of biomimetic membranes, Martin, Donald (edt), Springer Verlag publishers.
- Melgardt M.deVilliers, Pornanong Aramwit, Glen S.Kwon, Nanotechnology in Drug Delivery, Springer-American Association of Pharmaceutical Scientists Press
- The Handbook of Nanomedicine, Kewal K.Jain
- Bio Nanotechnology, Elisabeth S.Pappazoglou, Aravind Parthasarathy

• Biomedical Nanostructures, Kenneth E.Goonsalves, Craig R.Halberstadt, Cate T. Laurecin, Lakshmi S.Nair

Web Sites

1. www.nanotechnologyfordummies.com
2. www.nanobotblogspot.com
3. www.azonano.com
4. www.nano.gov
5. www.forbesnanotech.com
6. www.foresight.org
7. www.nanotech-now.com

PRACTICAL PAPER
Based on Theory I & II
PRACTICAL-I

1) Separation of DNA by agarose gel electrophoresis and estimation of DNA by Diphenylamine method.
2) Estimation of RNA by Orcinol method.
3) Separation of amino acids by paper chromatography.
4) Separation of serum proteins by paper electrophoresis.
5) Thin layer chromatography of mycotoxins
6) SDS-Page of proteins.
7) Performance of affinity chromatography.
8) Performance of Gel filtration chromatography.
9) Demonstration of blotting technique.[any one].
10) Ion exchange chromatography

PRACTICAL PAPER
Based on Theory III & IV
PRACTICAL-II

1) Isolation of Yeast.
2) Isolation of Actinomycetes.
3) Membrane disruption and separation subcellular organelles.
4) Production of microbial pigments using any pigment producing organism.
5) Biotransformation of toxic chromium (+6) into nontoxic (+3) by *Pseudomonas* species.
6) Microbial dye decolourization.
7) Isolation of Mercury resistant bacteria.
8) Immobilization of dyes.
9) Determination of Laboratory bioleaching process.