

**M.Sc. Biotechnology (CBCS) I Semester 2015-16**  
**CC1(M1BT01CT01): INSTRUMENTATION AND ANALYTICAL TECHNIQUES**

**(Credits: Theory-4, Practicals-2)**

**THEORY**

**Lectures: 40 hours, Tutorials: 10 hours, Additional contact hours: 10** (Seminar, quiz, assignments, group, discussion etc)

**Faculty: Dr. Khudil Khan**

External Marks: 80

Internal marks: 20

**Unit I:** **No. of Hours: 10**

Laboratory instrumentation: principle, components, assembly, working and applications of: Laminar clean air flow bench, autoclave, incubators, weighing balances, pH meter, water bath, hot air oven, colony counter and microtome. Laboratory safety measures.

**Unit II:** **No. of Hours: 10**

Aseptic techniques: Principles of sterilization, Brief idea of various methods of sterilization, Physical, chemical, disinfectants, membrane filtration, pasteurization, tyndallization. Definition and classification of compounds used for sterilization, antibiotics and antimicrobials. Evaluation of effectiveness of antimicrobial/antiseptic compounds.

**Unit III:** **No. of Hours: 15**

Microscopy: Types, principle, components, working, specimen, preparation and applications of Light, Bright field, Dark field, Phase contrast, Electron (SEM, TEM). Scanning tunneling. Fluorescence, Nomarsky differential interference contrast, Confocal, Atomic force microscopes.

**Unit IV:** **No. of Hours: 15**

Chromatography: General Principles, process and applications of Paper and Thin Layer

Chromatography. GLC, HPLC, Absorption, Ion Exchange, Gel filtration, Affinity chromatography, Radioactive tracer technique, autoradiography, Gamma and Scintillation counters, Brief idea of NMR, IR, GC-MS.

**UNIT V:**

**No. of Hours: 10**

Centrifugation and spectrophotometry: Types of centrifuges. Principles, working and applications of preparative, Analytical, Microcentrifuge. Refrigerated ultracentrifuge. Colorimeter and types of spectrophotometer: principle, working and application.

Lecture No. 1 h each	Topic	Text/Reference
1	Laboratory instrumentation: principle, components, assembly, working and applications	Molecular Biology and Biotechnology, S.D. Purohit and Neelu Joshi Chapter No.1, Page No. 1-36
2	Laboratory instrumentation: Laminar clean air flow bench and Autoclave	Molecular Biology and Biotechnology, S.D. Purohit and Neelu Joshi Chapter No.1, Page No. 4 & 22
3	Laboratory instrumentation: Incubators, Weighing balances	Manual of Microbiology-Tools and Technique, Kanika Sharma, Chapter No.2, Page No. 94 & 80
4	Laboratory instrumentation: pH meter, Water bath	Manual of Microbiology-Tools and Technique, Kanika Sharma, Chapter No.2, Page No. 62 & 87
5	Laboratory instrumentation: Hot air oven Colony counter	Manual of Microbiology-Tools and Technique, Kanika Sharma, Chapter No.2, Page No. 93 & 97
<i>Tutorial 1</i>	Laboratory Instrumentation- II	Lecture notes
Seminar 1	Laboratory Instrumentation: Handling and Precautions	
5	Laboratory instrumentation: Microtome	Lecture notes

6	Aseptic techniques	Microbiology, Prescott Harley and Klein Chapter 7 Pg 149-164
7	Principles of sterilization	Microbiology, Prescott Harley and Klein Chapter No.7, Page No.149-164
8	Methods of sterilization-Physical and chemical-I	Microbiology, Prescott Harley and Klein Chapter No.7, Page No.149-164
<i>Tutorial 2</i>	Methods of sterilization-Physical and chemical-II	Lecture notes
Seminar 2	Laboratory safety measures	
9	Disinfectants, Membrane filtration	Microbiology, Prescott Harley and Klein Chapter No.7, Page No.147
10	Pasteurization and Tyndallization	Microbiology, Prescott Harley and Klein Chapter No.7, Page No.143
11	Classification of compounds used for sterilization	Microbiology, Prescott Harley and Klein Chapter No.7. Page No.156
12	Evaluation of effectiveness of antimicrobial/antiseptic compounds	Microbiology, Prescott Harley and Klein Chapter No.7, Page No.158
13	Microscopy: Types, principle, components, working-I	Microbiology, Prescott Harley and Klein Chapter No.2, Page No.25-28
<i>Tutorial 3</i>	Microscopy: Types, principle, components, working-II	Lecture notes
Seminar 3	Antibiotics, Antimicrobials and their effect	
14	Microscopy:Specimen preparation	Introduction to Instrumentation in Life Sciences, Prakash S. Bisen and Anjana Sharma, Chapter No. 1, Page No. 1
15	Microscopy:Light microscope	Microbiology, Prescott Harley and Klein Chapter No. 2, Page No.18
16	Microscopy:Bright field, Dark field microscope	Microbiology, Prescott Harley and Klein Chapter No.2, Page No. 18-22
17	Microscopy:Phase contrast microscope	Microbiology, Prescott Harley and Klein Chapter

		No.2, Page No.21-23
18	Microscopy:Electron microscope (SEM)	Microbiology,Prescott Harley and Klein Chapter No.2, Page No.30-34
<i>Tutorial 4</i>	Microscopy-I	Lecture notes
Seminar 4	Techniques in Microscopy	
19	Microscopy: Electron microscope (TEM)	Microbiology,Prescott Harley and Klein Chapter No. 2 Page No. 28-30
20	Microscopy:Scanning tunneling microscope	Introduction to Instrumentation in Life Sciences, Prakash S. Bisen and Anjana Sharma, Chapter No. 1, Page No. 20-21
21	Microscopy:Fluorescence microscope	Introduction to Instrumentation in Life Sciences, Prakash S. Bisen and Anjana Sharma, Chapter No. 1, Page No. 13-15
22	Microscopy:Nomarsky differential interference microscope	Introduction to Instrumentation in Life Sciences, Prakash S. Bisen and Anjana Sharma, Chapter No. 1, Page No. 13
23	Microscopy:Confocal microscope	Introduction to Instrumentation in Life Sciences, Prakash S. Bisen and Anjana Sharma, Chapter No. 1, Page No. 21-23
24	Microscopy:Atomic force microscope	Microbiology,Prescott Harley and Klein Chapter No.2, Page No.25-28
<i>Tutorial 5</i>	Microscopy-II	Lecture notes
Seminar 5	Advantages and Disadvantages of Different Microscopic Techniques	
25	Chromatography: General Principles and process	Biotechnology Secondary metabolites, K.G. Ramawat and J.M Merillon Chapter No.3 Page No.51
26	Chromatography: Paper and Thin Layer	Biotechnology Secondary metabolites, K.G.

		Ramawat and J.M Merillon Chapter No.3 Page No.54- 57
27	Chromatography:GLC	Biotechnology Secondary metabolites, K.G. Ramawat and J.M Merillon Chapter No.3 Page No. 60-63
28	Chromatography:HPLC-I	Biotechnology Secondary metabolites, K.G. Ramawat and J.M Merillon Chapter No.3 Page No.63- 66
Tutorial 6	Chromatography:HPLC-II	Lecture notes
Seminar 6	A comparative Analysis of various chromatographic techniques	
29	Chromatography: Gel filtration	Biotechnology Secondary metabolites, K.G. Ramawat and J.M Merillon Chapter No.3 Page No.57-59
30	Radioactive tracer technique	Basic Biophysics, M. Daniel, Chapter No.3, Page No.151
31	Autoradiography	Basic Biophysics, M. Daniel, Chapter No.3, Page No.152
32	Gamma and Scintillation counters	Basic Biophysics, M. Daniel, Chapter No.3, Page No. 154
Tutorial 7	Affinity Chromatography	Lecture notes
Seminar 7	Chromatographic separation and its application	
33	Spectrophotometry: NMR	Basic Biophysics, M. Daniel, Chapter No. 3, Page No. 130-138
34	Spectrophotometry: IR	Introduction to Instrumentation in Life Sciences, Prakash S. Bisen and Anjana Sharma, Chapter No. 5, Page No. 129-130
35	Spectrophotometry: GC-MS	Basic Biophysics, M.

		Daniel, Chapter No.3, Page No. 145-150
36	Centrifugation : Principles and working-I	Introduction to Instrumentation in Life Sciences, Prakash S. Bisen and Anjana Sharma, Chapter No. 6, Page No. 163-181
Tutorial 8	Centrifugation-II	Lecture notes
Seminar 8	Types of Centrifugal Separations and its application	
37	Types of centrifuges. Principles, working and applications of preparative, Analytical, Microcentrifuge	Introduction to Instrumentation in Life Sciences, Prakash S. Bisen and Anjana Sharma, Chapter No. 6, Page No. 163-181
38	Centrifugation :Refrigerated ultracentrifuge	Introduction to Instrumentation in Life Sciences, Prakash S. Bisen and Anjana Sharma, Chapter No. 6, Page No. 163-181
39	Colorimeter	Introduction to Instrumentation in Life Sciences, Prakash S. Bisen and Anjana Sharma, Chapter No. 5, Page No. 122-123
40	Spectrophotometer: principle, working and application	Introduction to Instrumentation in Life Sciences, Prakash S. Bisen and Anjana Sharma, Chapter No. 5, Page No. 115-130
Tutorial 9	Spectrophotometer	Lecture notes
Seminar 9	Cell Fractionation and Metabolic Studies	
Tutorial 10	Autoradiography	Lecture notes
Seminar 10	Most widely used radioisotopes and their application	

For additional information the student may consult following reference books:-

### **Suggested Readings**

1. Pattabhai, V. and Gautham (2002), N. Biophysics. 2<sup>nd</sup> edition Narosa pub.
2. Narayan, P. Essentials of Biophysics. New Age International.
3. Roy, R.N. A Text Book of Biophysics. New Central Book Agency.
4. Daniel, M. Basic Biophysics. Agrobios.
5. Rodney Cottegril (2003), Biophysics: an introduction 2<sup>nd</sup> edition, John wiley & sons publication.

**M.Sc. Biotechnology (CBCS) I Semester 2015-16**

**CC2 (M1BT02CT02): CELL BIOLOGY AND MOLECULAR GENETICS**

**(Credits: Theory-4, Practicals-2)**

**THEORY**

**Lectures: 40 hours, Tutorials: 10 hours, Additional contact hours: 10** (Seminar, quiz, assignments, group, discussion etc)

**Faculty: Dr. Divya Vyas**

External Marks: 80

Internal marks: 20

**Unit I**

**No. of Hours: 10**

Structure and organization of cell. Intra-cellular compartmentalization. Structure, function and significance of cell wall, plasma membrane, Membrane proteins and transport across biomembrane. Structure, function and significance of Cell organelles, flagella, cilia, cytoskeleton. Genetic organization of Mitochondria and chloroplast.

**Unit II**

**No. of Hours: 15**

Nucleus: nuclear membrane, nucleolus and nuclear pore complex. Chromatin; structure, types organization and chemistry of the chromosome. C-value paradox, Nuclear dyes and their application in staining of chromosomes. Karyotyping, Polytene, lambrush and B-chromosomes. Chromosome banding and its staining.

Cell cycle events, regulation of cell division: cyclins, cyclin-dependent kinases, inhibitors, control of cell division in multicellular organisms.

**Unit III**

**No. of Hours: 15**

Brief idea of model organisms of genetic studies: *Drosophila*, *Neurospora*, *C. elegans*, *Acetabularia*. Gene interaction: modification of mendelian ratios. Linkage and crossing over, linkage map, linked gene inheritances. Genetic recombination at molecular level

(Holliday model). Role of RecA protein in recombination. Numerical and structural changes in chromosomes.

**Unit IV**

**No. of Hours: 10**

Mutation – molecular basis of spontaneous and induced mutations. Adaptive mutations in bacteria. Detection of mutations: Ames test, Luria-delbruck fluctuation test. Molecular mechanism of radiation and chemical mutagenesis: use of base analogs, ionizing radiations and alkylating agents for mutagenesis.

**Unit V**

**No. of Hours: 10**

Transposons: Types, structure, properties and their significance. Mechanism of transposition, transposon mutagenesis. Integrons, Insertion sequences (IS), Composite transposons. Replicative and non replicative transpositions. Role of transposase and resolvase. Examples of Transposable elements, Retrotransposon.

Lecture No. 1 h each	Topic	Text/ Reference
1	Structure and organization of cell. Structure, function and significance of cell wall	Cell and Molecular Biology, S.C. Rastogi, chapter-1, page 4-14 and chapter -5, page 120-125
2	Structure, function and significance of cell wall	Cell and Molecular Biology, S.C. Rastogi, chapter-5, page 120-125
3	Plasma membrane, Membrane proteins and transport across biomembrane	The world of cell, Becker, chapter-7 & 8, page 159-188 & page 195-220.
4	Genetic organization of Mitochondria and chloroplast	The world of cell, Becker, chapter-14 & 15, page 400-404 & 447-448
<i>Tutorial 1</i>	Differentiate between prokaryotic and eukaryotic cells	Cell biology, Gupta, Jangir, chapter-1, page 13.
Seminar 1	Various Model of Plasma membrane	

5	Intra-cellular compartmentalization	The world of cell, Becker, chapter-12, page 323-363
6	Structure, function and significance of Cell organelles, flagella, cilia, cytoskeleton	Cell biology third ed., Bolsover, S.R., Hyams J.S., chapter-17, page 283-294
<i>Tutorial 2</i>	Types of cytoskeletons	Cell biology, David E Sadava, Chapter 9, page 311-351
<i>Seminar 2</i>	Brief idea about membrane bound organelles	
7	Nucleus: nuclear membrane, nucleolous and nuclear pore complex	Cell and Molecular Biology, S.C. Rastogi, chapter-8, page 236-243
8	Chromatin; structure, types and organization.	Cell biology, Gupta, Jangir, chapter-14, page 210-332.
9	Karyotyping, Polytene, lambrush	Cell and Molecular Biology, S.C. Rastogi, chapter-8, 236-243. Cell biology, Gupta, Jangir, chapter-14, page 310-332
10	C-value paradox and B-chromosomes.	Lecture notes
11	Chemistry of the chromosome.	Cell biology, Gupta, Jangir, chapter-14, page 210-332
<i>Tutorial 3</i>	Nuclear membrane and its pore complex	Cell and Molecular Biology, S.C. Rastogi, chapter-8, page 236-243
<i>Seminar 3</i>	Molecular structure of eukaryotic chromosome	
12	Chromosome banding and its staining	Lecture notes
13	Nuclear dyes and their application in staining of chromosomes	Lecture notes
14	Cell cycle events	Cell and Molecular Biology, S.C. Rastogi, chapter-9, page 255-269.
15	Regulation of cell division	Cell and Molecular Biology, S.C. Rastogi,

		chapter-9, page 255-269.
16	Cyclins, cyclin-dependent kinases	The world of cell, becker, chapter-17, page 554-562
17	Inhibitors, control of cell division in multicellular organisms.	The world of cell, becker, chapter-17, page 554-562.
<i>Tutorial 4</i>	Cell cycle and its regulation	Cell and Molecular Biology, S.C. Rastogi, chapter-9, page 255-269.
Seminar 4	Chromosome banding and its staining	
18	Brief idea of model organisms of genetic studies: <i>Drosophila</i>	Molecular cell biology, Lodish, chapter-14, page 554-556.
19	Brief idea of model organisms of genetic studies: <i>Neurospora</i>	Lecture Notes
20	Brief idea of model organisms of genetic studies: <i>Acetabularia</i>	Lecture Notes
21	Brief idea of model organisms of genetic studies: <i>C.elegans</i>	Lecture Notes
22	Gene interaction: modification of mendalian ratios	Plant breeding theory and practice, Neal C. Stoskopf, chapter-3, page 69-70.
<i>Tutorial 5</i>	Gene interaction: modification of mendalian ratios	Plant breeding theory and practice, Neal C. Stoskopf, chapter-3, page 69-70.
Seminar 5	Brief idea of model organisms of genetic studies: <i>Drosophila</i>	
23	Linkage and crossing over	Cell biology, Bolsover, S.R., Shephard, E.A., chapter18, page 302-303
24	Linkage map and linked gene inheritances.	Cell biology, Bolsover, S.R., Shephard, E.A., chapter18, page 302-303
25	Genetic recombination at molecular level (Holliday model).	Genome-3, T.A. Brown, chapter-17, page 543-547
<i>Tutorial 6</i>	Genetic recombination at molecular level (Holliday model).	Genome-3, T.A. Brown, chapter-17, page 543-547
Seminar 6	Linkage, Linkage map and linked gene inheritances	Cell biology, Bolsover, S.R., Shephard, E.A., chapter18, page 302-303

26	Role of RecA protein in recombination	Genome-3, T.A. Brown, chapter-17, page 543-547
27	Numerical changes in chromosomes.	Advanced Molecular Biology, R.M.Twyman, chapter-4, page45-56
28	Structural changes in chromosomes.	Advanced Molecular Biology, R.M.Twyman, chapter-4, page 45-46
<i>Tutorial 7</i>	Numerical and structural changes in chromosomes	Advanced Molecular Biology, R.M.Twyman, chapter-4, page 45-46
<i>Seminar7</i>	Role of different proteins in recombination	
29	Mutation – molecular basis of spontaneous Induced mutations.	Molecular biology and microbial genetics, K. Rajapandiyam and S.Shanthi, chapter-17, page 147-153
30	Molecular basis of spontaneous Induced mutations	Molecular biology and microbial genetics, K. Rajapandiyam and S.Shanthi, chapter-17, page 147-153
31	Adaptive mutations in bacteria	Lecture Notes
32	Detection of mutations: Ames test, Luria-delbruck fluctuation test. Molecular mechanism of radiation	Molecular biology and microbial genetics, K. Rajapandiyam and S.Shanthi, chapter-18, page 158-159
<i>Tutorial 8</i>	Mutation – molecular basis of spontaneous Induced mutations	Molecular biology and microbial genetics, K. Rajapandiyam and S.Shanthi, chapter-17, page 147-153
<i>Seminar 8</i>	DNA repair mechanism	
33	Molecular mechanism of radiation mutagenesis	Lecture notes

34	Molecular mechanism chemical mutagenesis: use of base analogs Alkylating agents for mutagenesis	Fundamental of molecular biology, Allison, L.A., chapter-7, page 156-158
<i>Tutorial 9</i>	Molecular mechanism chemical mutagenesis	Fundamental of molecular biology, Allison, L.A., chapter-7, page 156-158
Seminar 9	Chemical mutagens	
35	Transposons: Types, structure, properties and their significance.	Molecular biology and microbial genetics, K. Rajapandiyam and S.Shanthi, chapter-26, page 217-219
36	Mechanism of transposition	Molecular biology, David Freifelder, chapter-21, page 685-698
37	Insertion sequences (IS), Replicative transpositions	Molecular biology, David Freifelder, chapter-21, page 698
38	Transposon mutagenesis. Integrations, Composite transposons.	Fundamental of molecular biology, Allison, L.A., chapter-12, page 414-417
39	Non replicative transpositions. Role of transposase and resolvase.	Genome-3, T.A. Brown, chapter-15, page 553 and lecture notes
40	Transposable elements, Retrotransposon	Molecular biology, David Freifelder, chapter-21, page 699-704
<i>Tutorial 10</i>	Mechanism of transposition	Molecular biology, David Freifelder, chapter-21, page 685-698
Seminar 10	Transposons: Types, structure, properties and their significance	

For additional information the student may consult following reference books:-

### **Suggested Readings**

1. Alberts, B., Bray, D. Lewis, J., Raff, M., Roberts, K. and Watson, J.D. 1999. Molecular Biology of Cell. Garland Publishing Co. New York, USA.
2. Snustad, D.P. and Simmons, M.J. 2000. Principles of genetics. John Wiley and Sons.
3. Russel, P.J. 1998. Genetics. The Benjamin/Cumming Publishing Co.
4. Gasque, E. Manual of Laboratory experiments in cell Biology. W.C. Wilson Public.
5. Robertis, E.D.P., Robertis, E.M.F. Cell and Molelcular Biology. Sauder College Publication.
6. Beeker, W.M. The world of the cell. Pearson Education.
7. Karp, G. Cell and Molecular Biology. John Willey and sons.
8. Lodish and Baltimore. Molecular Cell Biology. W.H. Freeman and Co.

**M.Sc. Biotechnology (CBCS) I Semester 2015-16**  
**Core Course 3(M1MB03CT03): FUNDAMENTALS OF MICROBIOLOGY**  
**(Credits: Theory-4, Practicals-2)**

**THEORY**

**Lectures: 40 hours, Tutorials: 10 hours, Additional contact hours: 10** (Seminar, quiz, assignments, group, discussion etc)

**Faculty: Dr. Harshada Joshi**

External Marks: 80

Internal marks: 20

**Unit-I**

**No. of Hours: 10**

Historical events and contributions of important microbiologists. Kingdom and domain system of classification. Bacterial nomenclature and taxonomy. Numerical taxonomy, Chemotaxonomy, Bergey's manual of systematic bacteriology. Problems and paradoxes associated with bacterial taxonomy. Evolutionary relationships and phylogeny. Analysis of dendrograms and cladograms.

**Unit-II**

**No. of Hours: 15**

Archaea, Cyanobacteria, Actinobacteria: Discovery, General characters, classification, morphology, structural organization, reproduction, economic and ecological significance: differences and similarities with bacteria. L forms, Rickettsia, Chlamydia, Spirochaetes, viroids, prions, virusoids: Brief idea of general characteristics, structural organization and significance.

**Unit-III**

**No. of Hours: 10**

Bacteria: Morphological types. Structure, arrangement and function of flagella and pili. Cell membrane, Cell wall: types, structural organization, significance, Gram staining, Significance of LPS and role in pathogenicity. Nucleoid: organization and significance. Plasmids: properties and types. Important diseases caused by bacteria.

**Unit-IV****No. of Hours: 10**

Virus: Structural organization, classification, multiplication, transmission and significance. Mycoplasma, Spiroplasma and Phytoplasma: General characters, reproduction, transmission and significance. Important diseases caused by viruses, mycoplasma, spiroplasma and phytoplasma.

**Unit V****No. of Hours: 15**

Techniques of microbial culture, Anaerobic culture. Culture media; types, composition, preparation. Selective culture methods, Enrichment culture. Isolation and development of pure culture. Maintaining and preservation of cultures, Enumeration of microbes. Principles of Staining, Nature of dyes and types of staining; Characterization and identification of microbes based on morphology, cultural physiological and biochemical characteristics, serology and molecular methods of identification.

Lecture No. (one hour each)	Topic	Text /Reference
<b>Unit I</b>		
1	Historical events of Microbiology	Microbiology, Prescott, Harley and Klein, Chapter 1, Page no. 3-13
2	Kingdom and domain system of classification	Pharmaceutical Microbiology, Joshi and Chaudhary, Chapter 2, Page no. 23-27.
3	Bacterial nomenclature	Pharmaceutical Microbiology, Joshi and Chaudhary, Chapter 2, Page no. 17-18
4	Bergey's manual of systematic bacteriology	Microbiology, Prescott, Harley and Klein, Chapter 19, Page no. 400-407
Tutorial 1	Analysis of dendrograms and cladograms	Lecture notes
Seminar 1	Contributions of important microbiologists	
5	Chemotaxonomy	Microbiology: An Introduction, Tortora, Funke, Case. Chapter 10, Page no. 288-290.
6	Numerical taxonomy	Pharmaceutical Microbiology, Joshi and Chaudhary, Chapter 2, Page no. 18-19
Tutorial 2	Evolutionary relationships and phylogeny	Microbiology, J.G. Black, Chapter 9, Page no. 256-258

Seminar 2	Problems and paradoxes associated with bacterial taxonomy	
<b>Unit II</b>		
7	Archaea: General characters, classification, morphology and reproduction	Microbial Life, Staley. Chapter 5, Page no. 505-507,108-109, 154-156,517-518
8	Cyanobacteria: General characters, classification, morphology and reproduction	Microbial Life, Stanley. Chapter 21, Page no. 634,650-651,656-658
9	Actinobacteria: General characters, classification, morphology and reproduction	Microbial Life, Stanley. Chapter ,20 21. Page no. 654,621
Tutorial 3	Archaea, Cyanobacteria, Actinobacteria: Economic Importance	Lecture notes
Seminar 3	Archaea, Cyanobacteria, Actinobacteria: differences and similarities with bacteria	
10	L-forms: General characteristics and structural organization	Microbiology, Prescott Harley and Klein, Page no. 58
11	Rickettsia: General characteristics and structural organization	Microbiology: An Introduction, Tortora, Funke, Case. Chapter 11 Page no. 304
12	Chlamydia: General characteristics and structural organization	Microbiology, Prescott Harley and Klein, Chapter 20 ,Page no. 432-34
13	Spirochaetes: General characteristics and structural organization	Microbiology, Prescott Harley and Klein, Page no. 416-418
14	Viroids: General characteristics and structural organization	Fundamentals of Microbiology, J.C. Pommerville, Chapter 12, Page no. 461
15	Prions: General characteristics and structural organization	Fundamentals of Microbiology, J.C. Pommerville, Chapter 12, Page no. 462-464
16	Virusoids: General characteristics and structural organization	Introductory microbial world, H.A. Modi, Ch-14, page no. 273
17	Rickettsia and Chalmydia: Significance	Microbiology ,Prescott, Harley and Klein, Chapter 38 page no. 780-782, 777-779
Tutorial 4	L- forms and Spirochaetes: Significance	Introductory microbial world, H.A. Modi, Ch- 3, page no.-56
Seminar 4	Viroids, Prions and Virusoids: Significance	
<b>Unit III</b>		
18	Bacteria: Morphological types and Ultra-structure	Microbiology, Prescott Harley and Klein. Chapter 3, Page 38-49
19	Arrangement and function of flagella	Bacteria- Paul Singleton. Chapter 2.

		Page no. 31-34 ,39-41
20	Structure and Function of pili and cell membrane	Microbiology, Prescott Harley and Klein. Chapter 3. Page-42-44
21	Cell wall: types, structural organization, significance.	Bacteria- Paul Singleton. Chapter 2. Page no.21-29
Tutorial 5	Gram staining	Microbiology, J.G. Black, Chapter 3, page 69-71
Seminar 5	Significance of LPS and role in pathogenicity.	
22	Nucleoid: organization and significance.	Microbiology, Prescott Harley and Klein. Chapter 3. Page no. 49
23	Plasmids: properties and function	Microbiology, Prescott, Harley and Klein. Chapter 3. Page no. no. 50-51,280-283
Tutorial 6	Difference between gram positive and gram negative bacterial cell wall	Pharmaceutical Microbiology, Joshi and Chaudhary, Chapter 3, Page no. 39-42
Seminar 6	Important diseases caused by bacteria.	
<b>Unit IV</b>		
24	Viruses: Structural organization and classification	Fundamentals of Microbiology Pommerville. J. C. Chapter 12, Page no.421-431,440-445
25	Viruses: Multiplication and transmission	Fundamentals of Microbiology Pommerville. J. C. Chapter 12, Page no.432-439
Tutorial 7	Significance of Viruses	Fundamentals of Microbiology Pommerville. J. C. Chapter 12, Page no.452-460
Seminar 7	Plant and Human Diseases caused by viruses	
26	Mycoplasma: General characters and reproduction	A text book of fungi, bacteria and viruses, H.C. Dubey. Chapter 11. Page no.164-168
27	Spiroplasma: General characters and reproduction	Lecture notes
28	Phytoplasma: General characters and reproduction	Plant pathology. G.N. Agrios. Ch-1, Page no.-26
29	Transmission of Mycoplasma, Spiroplasma and Phytoplasma	Lecture notes
Tutorial 8	Significance of Spiroplasma and Phytoplasma	Plant pathology, G.N. Agrios. Ch-12, Page no. 687-691
Seminar 8	Important diseases caused by Mycoplasma, Spiroplasma and Phytoplasma	
<b>Unit V</b>		
30	Techniques of microbial culture.	Microbiology, Prescott, Harley and Klein. Chapter 5 Page no. 108-110

31	Anaerobic culture	Microbiology, Prescott, Harley and Klein Page no. 131; Microbiology- A lab manual, Cappuccino and Sherman Chapter 18. Page no.-113-115
32	Types of Culture media	Microbiology, Prescott, Harley and Klein. Chapter 5. Page no. 106-108; Microbiology: An Introduction, Tortora, Funke, Case. Chapter 6. Page no.161-165
33	Selective culture methods	Lecture Notes
34	Isolation and development of pure culture.	Pelczar, Page no. 133-139
35	Maintaining and preservation of cultures	Microbiology, Pelczar, Chan and Kreig, , Page no. 139-143
Tutorial 9	Composition and Preparation of Media	Microbiology, Prescott Harley and Klein. Chapter 5. Page no.- 106-108
Seminar 9	Enrichment culture	
36	Enumeration of microbes	Microbiology, Prescott, Harley and Klein ,Chapter 6, Page no. 117-121
37	Principles of Staining, Nature of dyes and types of staining	Microbiology, Pelczar, Chan and Kreig, Page no. 64-68
38	Characterization and identification of microbes based on morphological and cultural characteristics	Microbiology: An Introduction, Tortora, Funke, Case. Chapter 10, Page no.-284.
39	Characterization and identification of microbes based on physiological and biochemical characteristics	Microbiology: An Introduction, Tortora, Funke, Case. Chapter 10, Page no.-284-286; Pharmaceutical Microbiology, Joshi and Chaudhary, Chapter 9, Page no. 130-135
40	Characterization and identification of microbes based on serology and molecular methods of identification	Microbiology: An Introduction, Tortora, Funke, Case. Chapter 10, Page no. 286-294.
Tutorial 10	Cultural characteristics of bacteria	Pharmaceutical Microbiology, Joshi and Chaudhary, Chapter 9, Page no. 130-131
Seminar 10	Conditions required for microbial growth	

For additional information the student may consult following reference books:-

### **Suggested Readings**

1. Tortora GJ, Funke BR, and Case C.L. (2004). *Microbiology: An Introduction*. 4<sup>th</sup> edition. Pearson Education.
2. Atlas RM. (1997). *Principles of Microbiology*. 2nd edition. WM.T.Brown Publishers.
3. Cappucino J and Sherman N. (2010). *Microbiology: A Laboratory Manual*. 9<sup>th</sup> edition. Pearson Education limited.
4. Madigan MT, Martinko JM and Parker J. (2009). *Brock Biology of Microorganisms*. 12th edition. Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). *Microbiology*. 5th edition. McGraw Hill Book Company.
6. Dubey, R.C. and Maheshwari, D.K. A Text Book of Microbiology. S. Chand and Company.
7. Prescott, H. and Klein. 2000. *Microbiology*. McGraw Hill.

**M.Sc. Biotechnology (CBCS) I Semester 2015-16**

**CC4 (M1BT04CT04): BIOMOLECULES AND METABOLISM (THEORY)**

**(Credits: Theory-4, Practicals-2)**

**THEORY**

**Lectures: 40 hours, Tutorials: 10 hours, Additional contact hours: 10** (Seminar, quiz, assignments, group, discussion etc)

**Faculty: Dr. Manish Chittora**

External Marks: 80

Internal marks: 20

**No. of Hours: 10**

Bioenergetics: entropy, enthalpy, Gibbs free energy concept, Laws of thermodynamics. Acids and Bases, redox potential, pH and Buffers, Henderson and Hasselbach equation, pKa, pKb. Preparation of buffers. Electron transport mechanism (chemi-osmotic theory), Energy rich molecules. Mechanism of ATP synthesis.

**Unit II**

**No. of Hours: 10**

Carbohydrates: classification, structure, properties and functions. Role of carbohydrates in signaling, glycosylation of other biomolecules. Carbohydrate derivatives: mucins, glycoproteins, glycolipids, peptidoglycan. Carbon fixation, Glycolysis (aerobic and anaerobic), TCA, HMP, PPP and other pathways, Gluconeogenesis, Glycogenesis, Glycogenolysis.

**Unit III**

**No. of Hours: 10**

Lipids: classification, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, sterols and terpenes, Conjugated lipids - lipoproteins. ketone bodies, Lipids with specific biological functions, micelles and liposomes. Biosynthesis of saturated and unsaturated fatty acids,  $\beta$ -oxidation.

**Unit IV****No. of Hours: 15**

Amino acids: general properties and biosynthesis, Transamination, Deamination, Decarboxylation; glutamine and glutamic acid pathway, urea cycle, uric acid biosynthesis. Protein structure (primary, secondary, tertiary and quaternary). Ramachandran plot. Protein sequencing, Vitamins and Co-enzyme (biological and biochemical functions).

**Unit V****No. of Hours: 15**

Electrophoresis: Types, Principles and applications: Gel electrophoresis, SDS PAGE, Affinity electrophoresis, Capillary electrophoresis, Dielectrophoresis, DNA electrophoresis, Electrophoresis, Electroblotting, Electrofocusing, Immunoelectrophoresis, Isotachopheresis, Pulsed field gel electrophoresis. Methods of studying metabolism: Use of biochemical mutants, Isotopic labeling, Metabolome and its applications.

<b>Lecture No. 1 h each</b>	<b>Topic</b>	<b>Text/Reference</b>
<b>1</b>	Bioenergetics: entropy, enthalpy	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 3 , Page no. 60, 58
<b>2</b>	Gibbs free energy concept	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 3 , Page no. 62
<b>3</b>	Laws of thermodynamics	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 3 , Page no. 55-65
<b>4</b>	Acids and Bases, redox potential, pH and Buffers	Biochemistry, Lehninger, second edition, chapter no. 2, page no. 47-51
<b>Tutorial 1</b>	Henderson and Hasselbach equation, pKa, pKb.	Biochemistry, Lehninger, second edition, chapter no. 2, page no. 50
<b>Seminar 1</b>	Laws of Thermodynamics	
<b>5</b>	Preparation of buffers	The Realm of Biochemistry, Mathews Van Holde,

		Chapter no. 2 , Page no. 42
<b>6</b>	Electron transport mechanism (chemi-osmotic theory)	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 17 , Page no. 527
<b>7</b>	Energy rich molecules.	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 3 , Page no. 72
<b>8</b>	Mechanism of ATP synthesis.	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 17 , Page no. 536
<b>Tutorial 2</b>	Carbohydrates: classification, structure, properties and functions	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 9 , Page no. 278-289
<b>Seminar 2</b>	Structural and functional role of carbohydrates	
<b>9</b>	Role of carbohydrates in signaling, glycosylation of other biomolecules.	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 9 , Page no. 312-313
<b>10</b>	Carbohydrate derivatives: mureins, glycoproteins, glycolipids, peptidoglycan.	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 9 , Page no. 304-309
<b>11</b>	Carbon fixation I	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 17 , Page no. 588
<b>12</b>	Carbon fixation II	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 17 , Page no. 588
<b>Tutorial 3</b>	Glycolysis and other pathways,	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 17 , Page no. 448
<b>13</b>	Gluconeogenesis ,Glycogenesis,	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 17 , Page no.

		554
<b>14</b>	Glycogenolysis.	Biochemistry, U. Satyanarayana, Chapter No. 13, Page No. 271-274
<b>15</b>	Lipids: classification, structure, properties and functions of fatty acids, ,	Biochemistry, U. Satyanarayana, Chapter No. 3, Page No. 29-32
<b>16</b>	triacylglycerols, phospholipids, sterols and terpenes	Biochemistry, U. Satyanarayana, Chapter No. 3, Page No. 33-41
<b>17</b>	Conjugated lipids - lipoproteins.	Biochemistry, U. Satyanarayana, Chapter No. 3, Page No. 38
<b>Seminar 3</b>	Role of lipids in cell membranes	
<b>Tutorial 4</b>	ketone bodies	Biochemistry, U. Satyanarayana, Chapter No. 14, Page No. 303-305
<b>18</b>	Lipids with specific biological functions, micelles and liposomes.	Biochemistry, U. Satyanarayana, Chapter No. 3, Page No. 41-42
<b>19</b>	Biosynthesis of saturated and unsaturated fatty acids I	Biochemistry, U. Satyanarayana, Chapter No. 14, Page No. 306-311
<b>Seminar 4</b>	Essential and non essential fatty acids and their role	
<b>20</b>	Biosynthesis of saturated and unsaturated fatty acids II	Biochemistry, U. Satyanarayana, Chapter No. 14, Page No. 306-311
<b>21</b>	$\beta$ -oxidation.	Biochemistry, U. Satyanarayana, Chapter No. 14, Page No. 296-299
<b>22</b>	Amino acids: general properties	Biochemistry, U. Satyanarayana, Chapter No. 4, Page No. 45-53
<b>23</b>	Amino Acid Biosynthesis Part I	Biochemistry, U. Satyanarayana, Chapter No. 15, Page No. 345-350
<b>Tutorial 5</b>	Amino Acid Biosynthesis Part II	Biochemistry, U. Satyanarayana, Chapter No. 15, Page No. 345-350
<b>Seminar 5</b>	Role of cholesterol in human body	
<b>24</b>	Transamination, Deamination, Decarboxylation	Biochemistry, U. Satyanarayana, Chapter No. 15, Page No. 345-347
<b>25</b>	Glutamine and glutamic acid pathway	Biochemistry, U. Satyanarayana, Chapter No. 15, Page No. 285-386
<b>26</b>	Urea cycle	Biochemistry, U. Satyanarayana, Chapter No.

		15, Page No. 350-351
27	Uric acid biosynthesis.	Biochemistry, U. Satyanarayana, Chapter No. 17, Page No. 401-408
<b>Tutorial 6</b>	Protein structure (primary, secondary, tertiary and quaternary).	Biochemistry, U. Satyanarayana, Chapter No. 4, Page No. 55-63
<b>Seminar 6</b>	Role of different interactions involved in protein structure	
28	Ramachandran plot.	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 6 , Page no. 171
29	Protein sequencing	Biochemistry, U. Satyanarayana, Chapter No. 4, Page No. 57-58
30	Vitamins and Co-enzyme (biological and biochemical functions).	The Realm of Biochemistry, Mathews Van Holde, Chapter no. 11 , Page no. 388-392
31	Electrophoresis: Types, Principles and applications	Biochemistry, U. Satyanarayana, Chapter No. 34, Page No. 644-645
<b>Tutorial 7</b>	Gel electrophoresis, SDS PAGE	Modern Experimental Biochemistry, Rodney Boyer, Chapter No. 4, Page no. 113, 122
<b>Seminar 7</b>	2-D gel electrophoresis	
32	Affinity electrophoresis	Lecture Notes
33	Capillary electrophoresis	Modern Experimental Biochemistry, Rodney Boyer, Chapter No. 4, Page no. 130
34	Dielectrophoresis,	Lecture Notes
35	DNA electrophoresis, Electroblotting,	Modern Experimental Biochemistry, Rodney Boyer, Chapter No. 4, Page no. 113-114
<b>Tutorial 8</b>	Electrofocusing,	Modern Experimental Biochemistry, Rodney Boyer, Chapter No. 4, Page no. 127
<b>Seminar 8</b>	Electrophoresis : Principles and applications	
36	Immuno-electrophoresis,	Modern Experimental Biochemistry, Rodney Boyer, Chapter No. 4, Page no. 132
37	Isotachopheresis,	Lecture Notes

<b>38</b>	Pulsed field gel electrophoresis.	Modern Experimental Biochemistry, Rodney Boyer, Chapter No. 4, Page no. 126
<b>39</b>	Methods of studying metabolism: Use of biochemical mutants	Lecture Notes
<b>40</b>	Isotopic labeling	Modern Experimental Biochemistry, Rodney Boyer, Chapter No. 6, Page no. 183
<b>Tutorial 9</b>	Metabolome and its applications,	Lecture Notes
<b>Seminar 9</b>	Metabolomics: Introduction	
<b>Tutorial 10</b>	Sequential induction technique. Computational methods.	Lecture Notes
<b>Seminar 10</b>	Various computational methods for the determination of protein structure	

For additional information the student may consult following reference books:-

### **Suggested Readings**

1. Voet and Voet. 2000. Biochemistry. John Wiley.
2. Lehninger. 2000. Principles of Biochemistry. CBS Publishers.
3. Stryer, L. 2002. Biochemistry. W.H. Freeman.
4. Harper. 2003. Biochemistry. McGraw-Hill.
5. Zubay. 1995. Biochemistry. Brown Publishers.
6. Trehan, K. Biochemistry. Wiley Eastern Publications.
7. Jain, J.L. Fundamentals of Biochemistry. S. Chand and Company.
8. Deb, A.C. Fundamental of Biochemistry.
9. Methew, C.K. Biochemistry. Pearson Education.
10. Horton and Moran. Principles & Biochemistry. Prentice Hall.