Paper	Lecture hours	Practical hours	credits	Total credits
Semester I				
English-I	5	-	3	16
Additional language-I	5	-	3	
IM 1121:Foundation course-I(Core) (Fundamentals of Biochemistry)	**3**	**2**	**3**	
IM 1171-Vocational Course-I (Fundamentals of Microbiology)	**3**	**2**	**4**	
CH 1131.7Complementary course-I (Basic theoretical and analytical chemistry)	3	2	3	
Semester II				20
English-II	5	-	3	
Additional language-I	5	-	3	
IM 1241:Core course I (Environmental Studies)	**3**		**4**	
IM 1242: Core course II- Practicals (Qualitative analysis of aminoacids)		**2**	**2**	
IM 1221-Foundation Course-II (Microbial Taxonomy and Physiology)(Vocational)	**3**	**-**	**2**	
IM1271-Vocational Course-II (practicals)	-	2	3	
CH1231.7Complementary course-II(Physical chemistry)	3	2	3	
Semester III				16
English-III	5	-	3	
IM1341:Core course-II(Methods in Biochemistry)	**3**	**3**	**4**	
IM1371:Vocational course-III (Cell Biology)	**4**	**-**	**3**	
IM1372-Vocational Course-IV (Microbial genetics and biotechnology)	**3**	**2**	**3**	
CH1331.7Complementary course-III(Bio-organic chemistry)	3	2	3	
Semester IV				
English-IV	5	-	3	24
IM1441:Core course-III (Physiological aspects of Biochemistry)	**3**	**-**	**3**	
IM1442:Core course-IV (Qualitative analysis of carbohydrates)	**-**	**3**	**3**	
IM1471-Vocational Course-V(Environmental Microbiology)	**3**	**-**	**3**	
IM 1472 –Vocational course-VI(Food Microbiology)	**3**	**-**	**2**	
IM 1473 –Vocational course-VII (practicals)	**-**	**3**	**3**	
CH1431.7Complementary course-IV (Bio-inorganic and Electro chemistry)	3	-	3	
CH1432.7Complementary course-V(chemistry Lab)	-	2	4	

Paper	Lecture hours	Practical hours	credits	Total credits
Semester V				
IM1541:Core course-VI(Metabolism-I)	**2**	**-**	**3**	18
IM1542:Core course-VII(Metabolism-II)	**2**	**-**	**3**	
IM1543:Core course-VIII (Quantitative analysis of biomolecules)	**-**	**6**	**3**	
IM1571-Vocational Course-VIII (Fermentation Technology)	**4**	**-**	**3**	
IM 1572 Vocational course-IX(Microbiology practicals)	**-**	**6**	**4**	
IM 1551.1 / 1551.2 Open course(Core) Clinical approach to life /Lifestyle diseases	**3**	**-**	**2**	
Project(Core/Vocational)		2 hrs1hr- Core (Biochemistry)1hr- Vocational (microbiology)	**-**	
Semester VI				
IM1641:Core course-IX(Clinical Biochemistry)	**3**	**-**	**3**	26
IM1642:Core course-X(Molecular Biology)	**3**	**-**	**4**	
IM1643:Core course-XI(urine analysis& Hematology)	**-**	**4**	**3**	
IM1644-Core Course-XII(Serum estimation)	**-**	**4**	**3**	
IM 1671 Vocational course-X(medical Microbiology)	**3**	**-**	**3**	
IM 1672 Vocational course-XI(Microbiology practicals)	**-**	**6**	**4**	
IM1661 Elective course(Vocational)Immunology	**2**	**-**	**2**	
IM1645 Project			**4**	

Summary of courses and credits of various study components included in theProgramme

Study components	Numberof courses	Total credits		Total
Language courses 1. English	4	12	18	120
2. Additional Language	2	6		
Foundation courses	2	5		
Core courses	12	38		
Vocational courses	11	35		
Complementary courses	5	16		
Open courses	1	2		
Elective courses	1	2		
Project	1	4		

Accumulated Total Minimum Credits required for Programmes of study = 120 Credits. Minimum Credits for Social Services/Extension Activity = 1 Credit Minimum Duration = 6 Semesters

Scheme of Examination, Evaluation:

- ❒ Each theory examinations are of 3 hours (for core, elective and open).
- ❒ Practical examination is of six hours duration.
- ❒ Evaluation and grading are in accordance with the general guidelines given by the university.
- ❒ Evaluation of each course shall be done in percentage score and shall involve Continuous Evaluation (CE) and End Semester Evaluation.
- ❒ The CE and ESE ration shall be 1:4 for both courses with or without practical.
- ❒ There shall be a maximum of 80 marks for ESE and maximum of 20 marks for CE.

1. Attendance (Max. marks 5)

The allotment of marks for attendance shall be as follows:

Attendance less than 75 %	1 Mark
75 & less than 80%	2 Marks
80% & less than 85%	3 Marks
85% & less than 90%	4 Marks
90% & above	5 Marks

2. Assignments or Seminars: (Max. Marks 5)

Each student shall be required to do one assignment or one seminar for each Course. Valued assignments shall be returned to the students. The seminars shall be organized by the teacher/teachers in charge of CE and the same shall be assessed by a group of teachers including the teacher/teachers in charge of that Course. Assignments/Seminar shall be graded on the basis of their quality. The teacher shall define the expected quality of an assignment in terms of structure, content, presentation etc. and inform the same to the students. Due weight shall be given for punctuality in submission. Seminar shall be similarly evaluated in terms of structure, content, presentation, interaction etc.

3. Tests: (Max. Marks 10)

For each Course there shall be one class test during a Semester. Valued answer script shall be made available to the students for perusal within 10 working days from the date of the test. The marks of CE shall be consolidated by adding the marks for attendance, assignment / seminar and test paper respectively for a particular course.

The marks for the components of Practical for Continues Evaluation shall be as shown below.

a) Attendance 5 marks
b) Record 5 marks
c) Regularity consistency 5 marks
d) Performance 5 marks

Scheme for the Evaluation of Practical Examination

Weightage may be assigned for various components as follows

A. For Qualitative Analysis

Step 1. Result & Conclusion
Step 2. Confirmatory test 1
Step 3. Confirmatory test 2
Step 4. Neatly written scheme of experiments used for arriving at the final conclusion

B. For Quantitative Experiments

Step 1. Result of the reported value (minimum error)
Step 2. Calculation, presentation of the result (Graph)
Step 3. Procedure
Step 4. Skill

PROJECT

Components required: -

(a) Institutional visit (compulsory) + report
(b) Project work (lab work)
(c) Report of the project work done
(d) Viva voce of the work

Scheme for the Evaluation of Project

Weightage may be assigned for various components as follows

1. Rationale of the study
   General background of the study
   Relevance of the study
2. Objective & scope of the study
3. Methodology-Appropriateness & Accuracy
4. Results & Discussion
   Presentation (figures, graphs, legends etc) Analysis
   Relevance/ importance
5. References/literature up to latest reports & documentation

6. Conclusions
7. General presentation
   - Free of typographic errors
   - Free of redundant material

First Semester

Code:*IM 1121*

Foundation course I –Core related

Fundamentals of Biochemistry

Credits:3 **No. of contact hours: 54hrs (3 hrs/wk)**

Objective: To provide comprehensive information on fundamentals of Biochemistry , to provide an in-depth understanding on the origin and history of biochemistry . It also provides a perspective of research methodology and familiarizes the student with the varied branches of biochemistry,bioinformatics and biostatistics.

Module I **(8 hours)**

History of biochemistry, Contributions of several scientists to biochemistry-, Francis Crick, James Watson, Frederick Sanger and Arthur Kornberg– their discoveries and the classical experiments associated with them.

Types of knowledge: Practical, Theoretical and Scientific Knowledge. What is Science; laws of science, basis of scientific laws and factual truths. Hypotheses: Formulation of hypothesis; hypothetico-deductive model, inductive model.

Core Text:

- A history of the Life Sciences: Magner L N 2nd edition, Marcel Dekker , Inc
- Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6
- Biochemical methods.Pingoud A, Urbanke C, Hoggett J and Jeltsch A,Chapter 1.

Module II **(8 hours)**

Carbohydrates

Classification of carbohydrates, ketoses and aldoses C3 to C6 series exemplified by one in each group (structure only), reactions and structure of glucose, fructose, sucrose,maltose and lactose. Mutarotation-Inversion of cane sugar. glycosides,polysaccharides- starch, cellulose, and glycogen – important structural features. General reactions of carbohydrates-oxidation, reduction, osazone formation. Mucopolysacharides chondroitin sulphates, Heparin, Hyaluronic acid.

Ref: Fundamentals of Biochemistry by J.L.Jain, Sanju Jain & Nitin Jain (2008) PublishersChand and Co Ltd ISBN81- 219-2453-7 P 73,91,100,114

Module III **(8 hours) Lipids**

Classification of lipids, classification of fatty acids, Emulsification- Saponification- Glycerides. Phospholipids- lecithin, cephalins, plasmalogens, phosphatidyl inositides (indicate structure and function),cerebrosides, gangliosides, saponification number and acid number, iodine value, sterols-cholesterol-structure and two color reactions. Bile acids.

Ref: Fundamentals of Biochemistry by J.L.Jain, Sanju Jain & Nitin Jain (2008) Publishers Chand and Co Ltd ISBN81- 219-2453-7 P 230,244,265

Module IV Amino acids and Nucleic Acids **(10 hours)**

Classification of amino acids, abbreviated names of amino acids (one letter, three letter), optical activity, UV absorption, zwitter ion and titration of amino acid, general reactions of amino acids – ninhydrin reaction, formol titration, van slyke method, transamination. Purines, Pyrimidines, ribose, deoxyribose, nucleoside structure, nucleotide structure, differents types RNA - mRNA, tRNA and rRNA - basic structural features, Action of DNAase, RNAase, secondary and tertiaray structure of DNA, Watson and crick doble helix model of DNA.

Ref: Fundamentals of Biochemistry by J.L.Jain, Sanju Jain & Nitin Jain (2008) Publishers Chand and Co Ltd ISBN81- 219-2453-7 P 132,204,214. P. 280

Module V (10 hours) Bioinformatics

Overview of information technology: -Overview of operating system and major applications of software. Academic search techniques –, plagiarism - Introduction to use of IT in teaching and learning. Power point features and slide preparation.

Introduction, importance and scope of bioinformatics, internet concepts (PubMed). Introduction to data mining and data analysis methods. Applications of sequence searching tools- BLAST, Clustal X, RASMOL-Elementary study of databanks- Genbank, EMBL, PDB,

CoreText:

- Bioinformatics: A Beginner's Guide. By Jean-Michel Claverie and Cedric Notredame;Wiley Publishing, Inc.2003.
- Bioinformatics: A Practical approach. K.Mani and N.Vijayaraj, Aparnaa Publication,2004.

Module VI **(10 hours)**

Statistics

Significance of statistical methods in biological investigations, Introduction to statistical software SPSS-Probability theory, random variables. Basic idea about regression and correlation analysis. student's .t-test, Chi-square(X2). Correlation coefficient Data presentation- tables,histograms and pi diagrams.

(Study of the statistical terms and methods expected only in the biological perspective)

CoreText:

- Alexis and Mathews Leon, Fundamentals and Information and Technology. Leon Vikas ISBN0812590780.
- An Introduction to Biostatistics: A Manual for Students in Health Sciences by P. Sundar Rao, J. Richard publishers: Prentice-Hall Pvt. Ltd. ISBN 81-203-1008-X.

Suggested reading:-

- Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael MCox Publisher: W. H. Freeman; Fourth Edition edition (April 23, 2004) ISBN-10:0716743396 ISBN-13: 978-0716743392
- Biochemistry –Sixth edition by Mary K. Campbell, Shawn O. Farrell. Thomson Brooks/Cole
- Biochemistry (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500

- Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company – Koga ISBN:0697142752 ISBN-13: 9780697142757, 978-0697142757
- Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran,Gray Scrimgeour K Publisher: Pearsarson ISBN: 0131977369, ISBN-13:9780131977365, 978-0131977365
- Biochemistry 6th Edition (2007) by Jeremy M.berg John L.tymoczko Lubert Stryer Publisher: B.i.publicationsPvt.Ltd ISBN:071676766X ISBN-13: 9780716767664, 978-716767664
- Biochemistry (2008) by Rastogi Publisher: Mcgraw Hill ISBN:0070527954 ISBN-13:9780070527959, 978-0070527959

Core Practicals

No. of contact hours: 36 hrs.(2 hrs/wk)

Familiarisation with biochemistry laboratory

Reactions of Aminoacids- Tyrosine, Tryptophan, Methionine, Proline, Arginine, Cysteine, Cystine, Histidine.

Second Semester

Code: IM 1241

Core Course-I

Environmental Studies

Total teaching hours: 54

Credits 4 **3 hrs/wk**

Scope of the Course

The need for sustainable development is a key to the future of mankind. This course is designed to give a clear understanding of environmental concerns and to follow sustainable development practices.

Module I **(10 hrs)**

The multi disciplinary nature of environmental studies. Definition, Scope and importance, Need for public awareness.

Natural Resources: Renewable resources and non renewable sources. Natural resources and associated problems-

(a) Forest resources; Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

(b) Water resources- use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam benefits and problems.

(c) Mineral resources: Use and exploitation environmental effects of extracting and using mineral resources, case studies.

(d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Case studies.

(e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

(f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- ❒ Role of an individual in conservation of natural resources.
- ❒ Equitable use of resources for sustainable life-styles.

Module 11- Ecosystems **(10 hrs)**

Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposes. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids.

Introduction types, characteristic features, structure and function of the following ecosystem- (a) Forest ecosystem, (b) grassland ecosystem, (c) desert ecosystem and (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module 111- Biodiversity and its conservation **(10 hrs)**

- ❒ Introduction- Definition: genetic, species and ecosystem diversity.
- ❒ Biogeographical classification of India.
- ❒ Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- ❒ Biodiversity at global, national and local levels.
- ❒ India is a mega-diversity nation.
- ❒ Hot-spots of biodiversity.
- ❒ Threats to biodiversity: habitat less, poaching of wildlife, man wildlife conflicts.
- ❒ Endangered and endemic species of India.
- ❒ Conservation of biodiversity; In-situ and ex-situ conservation of biodiversity.

Module IV-Environmental pollution **(8 hrs)**

Definition

- ❒ Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards.
- ❒ Solid waste management: Causes, effects and control measures of urban and industrial wastes.
- ❒ Role of an individual in prevention of pollution.
- ❒ Pollution case studies.
- ❒ Disaster management: floods earthquake, cyclone and landslides.

Module V- Social issues and the environment **(8 hrs)**

- ❒ From unsustainable to sustainable development.
- ❒ Urban problems related to energy.
- ❒ Water conservation, rain water harvesting, watershed management.
- ❒ Resettlement and rehabilitation of people, its problems and concerns. Case studies
- ❒ Environmental ethics issues and possible solutions.
- ❒ Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- ❒ Waste land reclamation.
- ❒ Consumerism and waste products.
- ❒ Environment protection act.

- Air (Prevention and control of pollution) Act
- Water (Prevention and control of poll uti on) Act
- Wildlife Protection Act.
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

Module VI- **(8 hrs)**

Human population and environment **(3 hrs)**

- Population growth variation among nations.
- Population explosion -Family welfare Programme.
- Environment and human health.
- Human Rights.
- Value education.
- HIV/AIDS.
- Women and child welfare.
- Role of Information Technology on Environment and human health.
- Case Studies.

Field Work **5 hrs**

- Visit to a local area to document environmental assets- river/forest/grassland/ hill/ mountain.
- Visit to a local polluted site- Urban/Rural/Industrial/ Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes etc. (Field work equal to 5 lecture hours)

References

- Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
- Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad - 380 013, India, Email:mapin@icenet.net (R)
- Brunner RC., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
- Clark RS., Marine Pollution, Clanderson Press Oxford (TB)
- Cunningham, W.P. Cooper, TH. Gorhani, E & Hepworth, M.T 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
- De A.K., Environmental Chemistry, Wiley Eastern Ltd.
- Down to Earth, Centre for Science and Environment (R)
- Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
- Hawkins RE., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
- Heywood, V.H & Waston, RT 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
- Jadhav, H & Bhosale, VM. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
- Mckinney, M.L. & School, RM. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
- Mhaskar A.K, Matter Hazardous, Techno-Science Publication (TB)

- Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
- Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
- Rao M N. & Datta, A.K 1987. Waste Water treatment. Oxford & IBH Pub!. Co. Pvt. Ltd. 345p.
- Sharma B.K, 2001. Environmental Chemistry. Geol Publ. House, Meerut
- Survey of the Environment, The Hindu (M)
- Townsend c., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
- Trivedi RK, Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and II, Enviro Media (R)
- Trivedi R K and P.K Goel, Introduction to air pollution, Techno-Science Publication (TB)
- Wanger KD., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

(M) Magazine (R) Reference (TB) Textbook

Code:*IM 1242*

Core course II

Qualitative Analysis of Aminoacids
(Practicals)

Credits:2

Qualitative Analysis of any one of the given unknown aminoacid

Tyrosine, Tryptophan, Methionine, Proline, Arginine, Cysteine, Cystine, Histidine.

The student should have done and recorded atleast seven aminoacids from the above list. The practical exam of 3 hrs duration consists of identification of any one of the given unknown amino acid from the above list.

References

- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.
- Analytical Techniques in Biochemistry and Molecular Biology- By Rajan Katoch.Springer Publishers
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.
- Hawks Physiological Chemistry, Bernard L.Oser (ed).Tata McGRAW Hill Publishing Company LTD, New Delhi.
- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Despande(ed). I.K International Pvt. LTD, NewDelhi. ISBN 81-88237-41-8.

Third Semester

Code:*IM 1341*

Core Course-II

METHODS IN BIOCHEMISTRY

Credits: 4 **No. of contact hours : 54 hrs.**
3hrs/wk

Scope of the course

Advances in biochemistry are based on the careful design execution and data analysis of experiments designed to address specific questions or hypotheses. Biochemical experiments usually have much experimental

detail in common. The aim of this course is to address many of these common experimental techniques. A thorough learning of this course will enable one to independently understand, design and carry out scientific experiments.

Module I Centrifugation **(16 hours)**

Centrifugation-principle of sedimentation technique. Principle, procedure (only elementary details) and application of differential centrifugation, density gradient centrifugation, ultra centrifugation.Cell disruption techniques. Subcellular fractionation

Ref: - Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company ltd ISBN: 81-219-3016-2 p 177

Module II **(12 hours)**

Electrophoretic and Chromatographic techniques

PAGE, SDS-PAGE, agarose gel electrophoresis-separation of proteins and nucleic acids, staining and molecular weight determination.

Principle, procedure (only elementary details) and applications of Paper chromatography, TLC, ion exchange chromatography, gel filtration, affinity chromatography.

Ref: - Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company ltd ISBN: 81-219-3016-2 p 197

Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company ltd ISBN: 81-219-3016-2 p 183

Module III **(6 hours)**

Colorimetry and spectrophotometry

Principles and applications of colorimetry, spectrophotometry -Beer Lamberts law-Limitations-calculation of molar extinction co-efficient.

Ref: - Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company ltd. ISBN: 81-219-3016-2 p 166

Module IV **(8 hours)**

Principles of radioactivity and blotting techniques

Principles of radioactivity- types and properties of α, β and γ-rays. Technique of autoradiography. Basic principle and applications of blotting techniques-western, northern and southern blotting.

Ref: - Immunology by Roitt Publisher: Mosby ISBN: 0702025496 ISBN-13: 9780702025495.

Module V **(8 hours)**

Peptides

Peptide nomenclature, Properties of the peptide bond. Steps in the synthesis of simple peptide(-NH2 and COOH blocking –COOH activation and condensation, release of blocked group). Synthesis of peptide, hydrolysis of proteins and separation of amino acids.

Module VI **(12 hrs)**

Protein chemistry

Classification, physical properties, solubility, isoelectric Point, protein denaturation, isoelectric precipitation, salt effect, heavy metal precipitation.-Structure of proteins-primary, secondary, tertiary and quaternary- forces stabilizing each level of structure.

Determination of primary structure, N-terminal and C-terminal residues (one method each). Sequence of amino acid in polypeptide, digestion by enzyme (chymotrypsin & trypsin) oligopeptide separation and overlapping of amino acid.

References

- Fundamentals of Biochemistry by J.L.Jain, Sanju Jain & Nitin Jain (2008) Publishers Chand and Co Ltd ISBN81- 219-2453-7 P132,204,214
- Principles and techniques of biochemistry and molecular biology- Keith Wilson and John Walker. 6th edition, Cambridge university Press.
- Analytical Techniques in Biochemistry and Molecular Biology- By Rajan Katoch. Springer Publishers
- Instrumental Methods of analysis- Chatwal, Anand.
- Manuals of biochemistry- Satya narayana.
- Principles and techniques of practical biochemistry- Bryan L. Williams and Keith Wilson.
- A biochemical guide to principles and techniques of practical biochemistry- Keith Wilson and Kenneth H. Gouldin.
- Basic Techniques In Biochemistry And Molecular Biology By R. K. Sharma, S. P. S. Sangha

Core Practicals

No. of contact hours: 54 hrs **(3 hrs/wk)**

Study of the general reactions of Carbohydrates

Glucose, Fructose, Galactose, Xylose, Sucrose, Lactose, maltose, Starch.

Molisch's test, Benedict's test, Fehling's test, Barfoed's test, Bial's test, Phloroglucinol test, Hydrolysis test, Iodine test, Seliwanoff's test, Foulger's test, Osazone test.

Reference:

- Basic Techniques In Biochemistry And Molecular Biology By R. K. Sharma, S. P. S. Sangha- I.K.International Publishers PVt.Ltd.
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.
- Principles and techniques of biochemistry and molecular biology- Keith Wilson and John Walker. 6th edition, Cambridge university Press.

Fourth Semester

Code:*IM 1441*

CORE COURSE III

Physiological aspects of Biochemistry

Credits: 4 **No. of contact hours:54 hrs 3 hrs/wk**

Scope and Objective

Science of Physiology is the study of functions in living organisms. More recently, this field has proceeded apace, and biochemists have been really successful in learning the impeccable working of the body systems at a finer level. A thorough learning of Physiological Biochemistry will help the students understand themselves more, and to build up their own living standards.

Module I: Digestion, Absorption and nutrition (9 hours)

Digestion and absorption of carbohydrates, proteins and lipids. role of bile in lipid digestion and absorption. Defects in digestion and absorption.

Fundamentals of nutritional biochemistry

Nutrition: Calorific value. BMR Fat and water soluble vitamins. Functions and deficiency Diseases(Structure of vitamins not needed). Co-enzyme form of the vitamins and their functions.

Ref: -Textbook Of Medical Physiology, 11/e With Student Consult Access (2005) by Arthur C Guyton, John E Hall Publisher**:** Else ISBN: 8181479203 ISBN-13: 9788181479204**.**

Module II: Biochemistry of Blood (9 hours)

Constituents of Blood, types of blood cells, components of plasma, types of plasma proteins and functions. Mechanism of blood clotting (Extrinsic and Intrinsic pathway).Structure of hemoglobin.-Types of hemoglobin, sickle cell anemia.

Ref: -Principles Of Biochemistry, 6e (1959) by Abraham White, Philip Handler Publisher: Tata McGraw-hill Publishing Company Limited ISBN:0070590494 ISBN-13: 9780070590496, 978-0070590496

Module III: Biochemistry of Respiration and Renal function (9 hours)

Transport of oxygen and carbon dioxide in blood, oxygen dissociation curve and Bohr Effect, Carbonic anhydrase, Chloride shift.Structure of nephron, Mechanism of formation of Urine. Basic principles of acidosis and alkalosis-metabolic and respiratory.

Ref: - Textbook of Biochemistry – U. Satya Narayana.

Module IV: Biochemistry of specialized tissue (9 hours)

Muscle proteins, Organization of Contractile proteins and mechanism of muscle contraction.- Sliding filament theory. Sources of energy for muscle contraction.

Nerve: Structure of Neuron, Mechanism of nerve impulse transmission.

Ref: -Textbook Of Medical Physiology, 11/e With Student Consult Access (2005) by Arthur C Guyton, John E Hall Publisher**:** Else ISBN: 8181479203 ISBN-13: 9788181479204**,**

Module V: Endocrinology (9 hours)

Important functions of the following hormones.: -Thyroxin. GH, TSH, LH and FSH hormones. ADH and oxytocin. Cortisol, cortisone, corticosterone (mineralocorticoids), aldosterone (glucocorticoid). epinephrine and nor-epinephrine. Sex hormones- Testosterone, estrone and estrasdiol. (Structures of hormones in the above-mentioned list are not expected.)Salient features and the endocrine defect associated with the following disorders- Addisons disease, Cushings syndrome,Diabetes Mellitus, Goitre, Hypothyroidism and Hyperthyroidism, Hashimotos thyroiditis, Diabetes Insipidius, Acromegaly.

Ref: -Principles Of Biochemistry, 6e (1959) by Abraham White, Philip Handler Publisher: Tata McGraw-hill Publishing Company Limited ISBN:0070590494 ISBN-13: 9780070590496, 978-0070590496

Module VI: Enzymes (9 hours)

Introduction to enzymes, apoenzyme, holoenzyme, prosthetic group, classification of enzymes, lock and key model, induced fit model, active site, enzyme specificity and types.Enzyme kinetics, factors affecting the velocity of enzyme action. Enzyme concentration, temperature, pH, substrate concentration. Derivation of MM equation and Km Value determination, its significance. LB plot, Enzyme inhibition, reversible and irreversible,competitive, non- competitive and uncompetitive inhibition, allosteric enzymes. Isoenzymes, Zymogen form of enzyme and its activation.

References:

1. Enzymes-M.Dixon and E C Webb. Longman Publication.
2. Medical Biochemistry – Vasudevan and Sreekumari
3. Text book of Medical Physiology – A.C Guyton and J. E Hall, Saunder's Elsevier publication.
4. Human Physiology – Chatterjee, Medical allied agency
5. Mammalian Biochemistry – White A, Handler P and Smith P.L (Mc Graw Hill)
6. Review of Medical physiology – G. William, Mc Graw Hill Karan Books.
7. Principles of Anatomy and Physiology-Gerald J Tortora, Bryan Derrickson. John villey and sons, INC

Code:*IM 1442*

Core course IV

Qualitative Analysis of carbohydrates

(Practicals)

Credits:3 **No. of contact hours: 54 hrs. (3 hrs/wk)**

Qualitative analysis of any one of the given carbohydrate

Glucose, Fructose, sucrose, galactose, xylose, maltose, lactose, starch

The student should have done all the above experiments.

The practical exam will be of three hours duration and involves identification of the given carbohydrate from the above list.

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8.
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (Ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.
- Hawks Physiological Chemistry, Bernard L.Oser (ed).TATA McGRAW Hill Publishing Company LTD, New Delhi.

Fifth Semester

Code:*IM 1541*

Core course VI

Metabolism-I

Credits: 3 **No. of contact hours:36 hrs. 2 hrs/wk.**

Scope of the course

Life is a biochemical process involving thousands of reactions occurring in an organized manner. These reactions are collectively called metabolism. The major objective of learning this course is the complete understanding of all the metabolic reactions at a molecular level. This course is related to almost all the life sciences and without a background knowledge of this course, a thorough understanding of health and well-being is not possible.

Module I **(10 hrs)**

Glucose metabolism

Reactions and energetics of glycolysis (aerobic and anaerobic), galactose & fructose metabolism, oxidative decarboxylation- TCA cycle, anaplerotic reaction, gluconeogenesis, HMP shunt. galactosemia, fructosuria, essential pentosuria

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module II Glycogen Metabolism **(4 hrs)**

Glycogen Metabolism**:** Glycogenesis, glycogenolysis,Regulation of glycogen metabolism. Cori cycle, Brief study of the Glycogen storage diseases(Von Gierke, Pompes, Cori's or Forbe's, Anderson, Her's, McArdle, Tarui's).

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167- 2009-4, 4th Edition.

Module III Fatty acid metabolism **(8 hrs)**

Transport of fatty acid in to mitochondria,Carnitine shuttle: á, â, ù oxidation of saturated,monounsaturated and polyunsaturated fatty acid, Refsums disease, sources of acetyl Co A, Biosynthesis of saturated fatty acid.

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167- 2009-4, 4th Edition.
- Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module IV Lipid Metabolism **(8 hrs)**

Biosynthesis of triglycerides and important phospholipids(cephalin, lecithin). Ketone bodies- formation, utilization and significance. Ketoacidosis and ketonuria.Action of lipases and phospholipases. Gaucher's disease, Tay-Sach's disease

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167- 2009-4, 4th Edition.
- Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module V Steroid metabolism **(6 hrs)**

Biosynthesis of cholesterol. Formation of sex hormones and bile acids from cholesterol. Regulation of cholesterol biosynthesis.Brief idea about prostaglandins.

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Code:*IM 1542*

Core course VII

Metabolism II

No. of credits: 3 **No. of contact hours:36 hrs.**

2 hrs/wk.

Module I **(6 hrs)**

Nitrogen assimilation: conversion of nitrate to ammonia by plants, biological nitrogen fixation (symbiotic, non – symbiotic) Nitrogen balance (positive, negative).

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module II **(6 hrs)**

General reactions of amino acid metabolism: transamination, transdeamination, oxidative deamination and decarboxylation, Urea cycle and regulation, glucogenic and ketogenic amino acids, biosynthesis and degradation of glycine, phenyl alanine. Alkaptonuria, phenylketonuria,

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module III **(6 hrs)**

Nucleic acid metabolism**:** Sources of atoms of purines and pyrimidines, Biosynthesis and degradation of purines and pyrimidines- *de novo* and salvage pathways with regulation,Biosynthesis of adenylic acid, ATP and Uridylic acid (Outline pathway). gout, Lesch Nyhan syndrome

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module IV **(6 hrs)**

Electron Transport Chain: Structure of mitochondria, sequence of electron carriers: NADH dehydrogenase, Succinate dehydrogenase, cytochrome reductase and cytochrome oxidase (outline of electron transport chain), sites of ATP synthesis, inhibitors of electron transport chain.

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module V **(6 hrs)**

Oxidative phosphorylation: Sites of ATP production, hypothesis of mitochondrial oxidative Phosphorylation-Chemiosmotic theory, P/O ratio, inhibitors and uncouplers, transport of reducing potentials into mitochondria-Malate aspartate and glycerol-3-phosphate shuttle.

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module VI Photosynthesis **(6 hrs)**

Structure of chloroplast, light reaction, cyclic and noncyclic photophoshorylation, chlorophyll (structure only), dark reaction, fixation of CO2 and formation of carbohydrate (brief treatment only), C3 and C4 plants, photorespiration, CAM pathway.

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Code:*IM 1543*

Core course VIII

Quantitative Analysis of Biomolecules

(Practicals)

Credits:3 **No. of contact hours:108 hrs.**

6 hrs/wk.

I Quantitative Analysis

A. Estimation of Carbohydrates

1. Estimation of glucose by Nelson-Somogyi method
2. Estimation of glucose by anthrone method.
3. Estimation of pentose by Orcinol method.
4. Estimation of ketose by Roe-Papedopaulose method.

B. Estimation of Lipids

Estimation of Cholesterol Zak's method

C. Estimation of Aminoacids and Proteins

1. Estimation of aminoacid by Ninhydrin method.
2. Estimation of Protein by Biuret method.
3. Estimation of Protein by Folin-Lowry method.

D. Estimation of Nucleic Acids

1. Estimation of DNA by diphenylamine method.
2. Estimation of RNA by Orcinol method

II Food analysis

1. Estimation of cholesterol in egg-Zak's method
2. Estimation of reducing sugar in honey-Roe & Pappadopoulos method
3. Estimation of pentose in grapes-Bial's method.

The student should have done and recorded a minimum of eight experiments from the quantitative analysis section and two experiments from the food analysis section.

The core practical exam will be of three hours duration and involves colorimetric estimation of a biomolecule by the graphical method (from the above list of experiments)

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8.
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.
- Hawks Physiological Chemistry, Bernard L.Oser (ed).TATA McGRAW Hill Publishing Company LTD, New Delhi.

OPEN COURSE

The open course is to be studied by students from other departments of the college and will be handled by core (biochemistry) faculty. The department can choose any one of the open course available in the scheme-Either Clinical approach to life or Life style diseases.

Code: *IM 1551.1*

Open Course(Core): Clinical Approach to Life

Credits: 2 **No. of Contact Hours: 54**

3 hrs/wk

Objective: To provide layman knowledge to the students of common stream about the various biochemical tests done to determine disease conditions, and a general interpretation of lab results.

Note:This course is studied by students from other departments like music, Malayalam, Hindi etc. who may not even have studied biology at their higher secondary level. Hence only an introduction to the terms and their significance in everyday life is aimed at in the present course.

Course Outline Module I Blood (8 hrs)

Components of blood and their function,- difference between plasma and serum. Blood groups, Rh factor, hemolytic disease of the new born, Basic idea about blood transfusion.

Module II Routine Blood Analysis (10 hrs)

Clinical significance and normal values of glucose- (fasting blood sugar, random blood sugar, post prandial blood sugar,Hb1Ac),total Protein, albumin, Urea, bilirubin, Cholesterol- HDL and LDL.(determination methods of these parameters not needed).

Module III Hematology (9 hrs)

Normal values and and clinical significance of the routine hematological tests – RBC count, WBC count, ESR, PCV, hemoglobin concentration, platelet count, bleeding time, clotting time.(Detailed procedures not needed).

Module IV Urine analysis (9 hrs)

Routine examination of urine- Name of the normal constituents- Names and clinical significance of the abnormal constituents-Glucose, ketone bodies, blood, protein, bile pigments-. microbiological examination-casts, crystals, detection of infection.

Module V Function tests (18 hrs)

Liver function tests-List the functions of liver. Serum bilirubin. Jaundice-Features Names of enzymes used for diagnosis of liver diseases-AST/ALT.

Renal function test-List the functions of kidney.Renal threshold. Clearance tests-urea and creatinine clearance,. Dilution and concentration test.

Thyroid function test.-Significane of T3,T4 and TSH values. Definition of hypo-and hyper thyroidism.

Core Text:

Medical Laboratory Technology Volume I, Kanai. L. Mukharjee,

Medical Laboratory Technology-Ramnik Sood.

Textbook of Biochemistry for Medical Students, 6th Edition- By D. M. Vasudevan, Sreekumari S, Kannan Vaidyanathan.

Suggested Readings:

- Medical Laboratory Technology (Volume, II& III) By Kanai. L. Mukharjee.
- A procedure for routine diagnostic tests, Tata Mc. Graw- Hill Publishing Company Ltd., New Delhi, 12 th reprint, 1988)
- Fundamentals of Biochemistry for Medical students Dr. Mrs. Ambika Shanmugam, Published by 12, III- Cross street, West C.I.T. Nagar, Madras; III Edition, 1977)
- Bauer J.D. Clinical Laboratory Methods, C.V. Mosby, St. Louis 1982.
- Mollison P.L. Blood Transfusion in Clinical Medicine, 6th Ed, Blackwell Scientific Publications, Oxford; 1979.
- Bowley C. C., K.L.G. Goldsmith & Wd'A Maycock, Blood Transfusion: A guide to the formation & operation of a transfusion service, World Health Organisation, 1971.
- Bishop M.L.-J.L. Dlaufer & E.P. Fody, Clinical Chemistry, Lippincott Company, Philadelphia, 1985.
- Lamberg S.L., Laboratory Manual of Haematology and Analysis, AV I publishing Co. Inc., Westport, Connecticut, 1978.

Code: *IM 1551.2*

Open Course: Lifestyle Diseases (Core)

No. of Credits: 2 **No. of Contact Hours: 54**

3 hrs/wk.

Objective: To create awareness among students about the various diseases which originate and which could be prevented by controlling the life style. The course also covers the general aspects of diagnosis, methods of prevention and pharmaceutical intervention.

Course Outline

Module I **(9hrs)**

Concept of lifestyle diseases- importance of lifestyle factors in preventing disease development, diet, exercise, smoking, alcohol etc.

Module II **(9 hrs)**

Diabetes- Type 1 and type2, characteristics, causes, diagnosis, prevention and management

Module III **(9 hrs)**

Cancer:

Characteristics, Causes, Diagnosis, Prevention, Management, familiarization with treatment modalities

Module IV **(9 hrs)**

Body mass index, determination and significance Obesity- factors leading to development, prevention, management.

Module V **(6 hrs)**

Atherosclerosis and cardiovascular diseases- Myocardial infarction, congestive heart failure, ischemic diseases-Causes, diagnosis and management.

Module VI **(6 hrs)**

Importance of diet and exercise in health- balanced diet, BMR, calorific value, How to reduce cholesterol and risk of heart attack through life style changes, use of *life style medicine* to treat disorders.

Reference :

Guide to prevention of lifestyle diseases- M.N. Kumar, R.Kumar, Deep & DeepPublications, ISBN: 817629518.

Sixth semester

Code:*IM 1641*

Core course IX

CLINICAL BIOCHEMISTRY

Credits:3 **No. of contact hours:54 hrs.**

3 hrs/wk.

Scope

Clinical Biochemistry mainly deals with the biochemical aspects that are involved in several clinical conditions. The results of qualitative and quantitative analysis of body fluids assist the clinicians in the diagnosis, treatment, prevention of disease, drug monitoring, forensic investigation, tissue and organ transplantation.

Module I **(6 hrs)**

Sample collection and preservation methods of body fluids.

Collection and preservation procedures of blood, plasma, serum, and urine ,Preparation of swabs.

Module II Blood analysis **(12 hrs)**

Principle of estimation, normal values and clinical significance of the following parameters of blood-Glucose- fasting , random, post prandial, Hb1Ac- Glucose tolerance test, Hb, Uric acid, Lipid profile,-triglycerides, total cholesterol, HDLcholesterol and LDL cholesterol, Urea, Acid phosphatase, Creatine phosphokinase. (Detailed determination procedures not needed).

Module III Haematology **(10 hrs)**

Principle of determination, clinical significance of the following parameters-Total count, differential count, erythrocyte sedimentation rate, packed cell volume, prothrombin time, bleeding time and clotting time. Brief study of blood groups-anticoagulants, storage and transfusion of blood, hemolytic disease of the newborn.

Module IV Organ function test **(12 hrs)**

Principles of the following tests of liver function and the interpretation of the results- total protein, total and conjugated bilirubin,Jaundice-features-hemolytic and obstructive- AST , ALT, ALP,

Thyroid function test- T3, T4, TSH-determination of hypo-and hyperthyroidism.primary and secondary.

Renal function test- Urea, creatinine, urea clearance test.

Module V Urine analysis **(6 hrs)**

Urine – Names of normal constituents.Abnormal constituents-ketone bodies, protein, glucose, blood, bile pigments- procedures of qualitative analysis and their clinical significance.

Module VI Life style disorders **(8 hrs)**

Introduction to life style disorders-definition, lifestyle factors in the development of diseases- Diabetes-Types, causes, diagnosis, prevention and management.

Cancer-a basic idea about the disease.

References

- Tietz Text book of Clinical chemistry and Molecular Diagnostics. Carl A. Burtis, Edward R. Ashwood, David E. Bruns (6TH Eds), Elsevier (Saunders) 2006 ISBN: 8131213749, ISBN-13: 9788131212742, 978-8131213742.
- Notes on Clinical Biochemistry by John K. Candlish (1992) Publisher: World Scientific Publishing Company ISBN: 9810210663 ISBN-13: 9789810210663, 978-9810210663
- Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephen K. Bangert, Elizabeth S.m. Ed. S.m. Ed. Marshall (2008) Publisher: Elsevier Science Health Science Div ISBN: 0443101868 ISBN-13: 9780443101861, 978-0443101861
- Basic Medical Biochemistry: A Clinical Approach by Dawn B., PH.D. Marks, Allan D. Marks Colleen M. Smith (1996) Publisher: Lippincott Williams & Wilkins; illustrated edition ISBN-10: 068305595X ISBN-13: 978-0683055955
- Clinical Chemistry, 6/e Ie by William J Marshall, Stephen K Bangert (2008) Publisher: Else ISBN: 0723434603, ISBN-13: 9780723434603, 978-0723434603

- Tietz Fundamentals of Clinical Chemistry, 6/e by Carl A Burtis, Edward R Ashwood (2008) Publisher: Else ISBN: 8131213749, ISBN-13: 9788131213742, 978-8131213742
- Preventive and social medicine By K. Park
- Text book of medical Biochemistry by Sreekumari and Vasudevan

Code:*IM 1642*

Core course X Molecular Biology

Credits:4 **No. of contact hours:54 hrs.**

3 hrs/wk.

Scope of the course

Molecular biology is a new research field that is a result of traditional industrial microbiology and recombinant DNA technology. It is a revolutionary scientific discipline based on the ability of researchers in gene transfer. This very interesting course will definitely equip the students to surf the world of genetic engineering and genetic manipulations.

Module I: Introduction to Molecular Biology **(8 hrs)**

Classical experiments proving DNA as the genetic material- transformation experiments,Hershey Chase experiment, Central dogma of molecular biology, Concept of gene- Split genes- introns and exons. C-value paradox.

Ref:- Cell and molecular biology- concepts and experiments by Gerald Karp,Wiley 1807- 2007, ISBN 978-0-470-16961-2

MODULE II: Replication **(10 hours)**

Replication- Semi conservative replication, Messelson-Stahl experiment. DNA polymerase and other proteins required for replication. Replication fork-Continuous and discontinuous replication-Okazaki fragments. Mutation –Point and frame shift mutations. Mutagens-physical and chemical and their mode of action, Fundamental study about DNA repair- photoreactivation, excision repair and mismatch repair mechanisms.(detailed pathways not needed).

Ref: - Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1

MODULE III: **Transcription** **(9 hours)**

Prokaryotic Transcription – process-Initiation, elongation and termination, different forms of RNA- mRNA, tRNA, rRNA. Prokaryotic RNA polymerase-promoters and enhancers.Definition of splicing.

Ref: - Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1

MODULE IV: **Genetic code and translation** **(9 hours)**

Salient features of genetic code, codons, anticodons, recognition, Prokaryotic translation- aminoacid activation, initiation, elongation and termination- inhibitors of protein synthesis. Definition of protein folding and chaperones.

Ref: - Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1

MODULE V: **Regulation and expression in prokaryotes** **(6 hours)**

Constitutive and inducible enzymes, operon concept Brief study about lactose operon and tryptophan operon- Positive and negative regulation of lactose operon.

Ref: - Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1

MODULE VI: **Recombinant DNA technology** **(12 hours)**

Outline study of recombinant DNA technology- vectors, cosmid, plasmid, phage,restriction enzyme, palindromes, reverse transcriptase, construction of genome library, cloning, identification of clones, fingerprinting, DNA sequencing- Maxam Gilbert sequencing, Sanger's method, an introduction to PCR and RFLP.

REFERENCES:

- Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1
- Genes IX by Benjamin Lewin (2008) Publisher: J&b ISBN:0763752223 ISBN-13: 9780763752224, 978-0763752224
- Molecular Biology Of The Gene 5/e (s) by James D Watson, Tania A Baker, Stephen P Bell (2008) Publisher: Dorling Kindersley (India) Pvt Ltd ISBN: 8177581813, ISBN-13: 9788177581812, 978-8177581812
- Cell and Molecular Biology, 3e (2003) by Karp Publisher: Jw ISBN: 0471268909 ISBN-13: 9780471268901, 978-0471268901
- Molecular Cell Biology (2002) by H.S. Bhamrah Publisher: Anmol Publications ISBN: 8126111429 ISBN-13: 9788126111428, 978-8126111428
- Cell and Molecular Biology by S. Sundara Rajan (2003) Publisher: Anmol Publications ISBN: 8126113553 ISBN-13: 9788126113552, 978-8126113552

Code:*IM 1643*

Core course XI (Practicals)

Credits: 3 **No. of contact hours:72hrs**

4 hrs/wk

Urine analysis and Hematology

<u>Qualitative tests of urine: Abnormal constituents</u>

- Proteins (Coagulation test, sulfosalicylic acid test,)
- Sugars (Benedicts test)
- Hemoglobin (Benzidine test)
- Ketone bodies (Rothera test, Gerhardt's test)
- Bile pigments (Fouchet's test, Gmelin's test)
- Bile salts (Hay's test)

Hematology

ESR, PCV, TC/DC count, Blood Grouping, Hemoglobin

The student should have done a minimum of five abnormal constituents in urine analysis and four hematology experiments. The core practical exam will be of three hours duration and involves identification of an abnormal constituent in the given urine sample and a hematology experiment from the above list.

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8.
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (Ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.
- Hawks Physiological Chemistry, Bernard L.Oser (ed).TATA McGRAW Hill Publishing Company LTD, New Delhi.

Code:*IM 1644*

Core course XII (Practicals)

Credits: 3 **No. of contact hours:72hrs**

4 hrs/wk

Serum estimation

1. Estimation of blood glucose by Nelson – Somogyi Method
2. Estimation of serum Cholesterol by Zak's Method
3. Estimation of blood Urea by Diacetylmonoxime Method
4. Estimation of Total Protein in serum by Biuret Method
5. Estimation of total protein in serum by Folin-Lowry method
6. Estimation of Uric acid in serum using Phosphotungstic acid reagent
7. Estimation of inorganic phosphate in serum by Fiske-Subbarao Method
8. Estimation of serumBilirubin
9. Estimation of serum creatinine.

Clinical Enzymology:

10. Assay of serum alkaline phosphatase
11. Assay of Serum alanine amino transferases (ALT/SGPT)
12. Assay of serum aspartate amino transferases (AST/SGOT)

The student should have done and recorded a minimum of seven experiments from the above list. The core practical exam will be of three hours duration and involves estimation of a biomolecule in the given serum/blood sample.

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8.

- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.
- Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi.

IM 1645 Project

Credits:4

Contact hours: 36 hours (2 hrs/wk) **1hr/wk for core and 1hr/wk for vocational**

The students should do one project either in Biochemistry or Microbiology. The total number of students in the program should be equally divided into two batches and one batch should do a project in core subject and the other batch should do the project in the vocational subject. Which batch would come under which faculty can be decided by drawing lots.

The project report should be based on a mini-project work done by the students. This should include original laboratory work, analysis of results and should be presented along with relevant and current literature review. The evaluation of dissertation should be done on the basis of evaluation of the project report and a viva-voce examination of the student. The students will do the project in the fifth semester and have to submit their reports in the sixth semester.

A report of the industrial visit carried out to any industries/institutions relevant to the subject should accompany the project report.

Scheme for evaluation of project

Total weightage:	30
Project:	20
Industrial Visit:	10(The visit carries a weightage of 6 and the visit report carries a weightage of 4)

Scheme and syllabus of Industrial Microbiology for

Career related First Degree programme in "BIOCHEMISTRY AND INDUSTRIAL MICROBIOLOGY" Under CBCSS

EXAMINATION FOR VOCATIONAL MICROBIOLOGY

Semester	Course code	Paper	Duration
I	IM 1171	Vocational course- I Fundamental Microbiology	3 hours
II	IM1222	FOUNDATION COURSE II- Microbial Taxonomy and Physiology	3 hours
	IM 1271	Vocational course- II Microbiology Practicals	6 hours X2 days
III	IM1371	Vocational course- III Cell Biology	3 hours
	IM1372	Vocational course- IV Microbial Genetics & Biotechnology	3 hours
IV	IM 1471	Vocational course- V EnvironmentalMicrobiology	3 hours
	IM 1472	Vocational course- VI Food Microbiology	3 hours
	IM 1473	Vocational course- VII Microbiology Practical	6 hours X 2 days
V	IM 1571	Vocational course- VIII FermentationTechnology	3 hours
	IM 1572	Vocational course- IX Microbiology Practical	6 hours X 2 days
VI	IM 1671	Vocational course- X Medical Microbiology	3 hours
	IM 1661	Elective course- Immunology- Elective	3 hours
	IM 1672	Vocational course- XI Microbiology Practical	6 hours X 2 days

SEMESTER I CODE: IM1171

VOCATIONAL COURSE I Fundamentals of Microbiology

Total Hrs-54 CREDITS -4 **(3Hrs /week)**

MODULE I **(9 Hrs)**

Introduction and history of Microbiology-contribution of Louis Pasteur, Robert Koch, Alexander Fleming, Anton Van Leeuwenhoek, Joseph Lister, & Needham. Concepts of origin of life- abiogenesis and biogenesis, Spontaneous generation theory. Scope of Microbiology.

MODULE II **(9 Hrs)**

Microscopy- Principles & uses of bright field, dark field, phase contrast, fluorescent, electron microscopy (TEM&SEM). Principles of staining of bacteria- simple staining, Negative staining, Gram's staining, Acid fast staining (Ziehl Neelsen staining), spore staining & staining of metachromatic granules.

MODULE III **(9 Hrs)**

Morphology and anatomy of bacterial cell- Cell size, shape, arrangement. Structure of Prokaryotic plasma membrane, cell wall, capsule, slime layer, S-layer, flagella, pili, nucleoid, inclusion bodies, endospore.

MODULE IV **(9 Hrs)**

Culture media- Nutritional requirements of bacteria, classification of media. Methods of isolation of pure cultures - Serial dilution technique, streak plate method, pour plate method, spread plate method. Anaerobic culture methods. Preservation of cultures- refrigeration, deep-freezing, freeze drying (lyophilization).

MODULE V **(9 Hrs)**

Sterilization (physical and chemical methods)-Sterilization by heat (Moist heat, dry heat and incineration), radiation (ionizing radiations and Ultraviolet rays), aldehydes and disinfectants. Factors influencing sterilization.

MODULE VI **(9 Hrs)**

Distinguishing characters of bacteria, fungi, algae and protozoa. General structure of Fungi, Algae and Protozoa, General characters of viruses, structure, classification, multiplication and cultivation. Structure and replication of bacteriophages.

REFERENCES

1. Microbiology - Pelczar, Chan and Kraig (ISBN 0-07-462320-6)
2. Microbiology -Prescott, Harley and Klein (ISBN 0-07-111217-0)
3. Microbiology-Bernard D Davis
4. Foundations in Microbiology-Talaro and Talaro
5. Essentials of Microbiology (Sixth edition) - Purohit and Singh (ISBN 81-85031-67-3)

SEMESTER I

VOCATIONAL PRACTICAL

Total Hrs-36 CREDIT-0 (2Hrs /week) **Part I (18 Hrs)**

1. Laboratory precautions- General rules and regulations.
2. Common instruments in Microbiology laboratory.
3. Cleaning and sterilization of glass wares.
4. Preparation of media.
5. Isolation of pure culture - Isolation of bacteria by pour plate, streak plate and spread plate methods.
6. Cultural characteristics of Microorganisms - Colony morphology on culture plate.

Part II **(18 Hrs)**

7. Study of the various components of the microscope, its handling and maintenance.
8. Preparation of bacterial smear
9. Staining of bacteria:
   (a) Simple staining of bacteria, (b) Gram staining,
   (c) Negative staining, (d) Spore staining,
   (e) Volutin granule staining
10. Motility of bacteria by hanging drop method.
11. Lactophenol cotton blue mounting of fungi and study of fungal microscopic characteristics.

REFERENCES

1. Dubey R C and Maheswari, D K (2002). Practical Microbiology. S. Chand & Co Ltd. (ISBN 81-219-2153-8)
2. Microbiology A Laboratory Manual - James G Cappucino Natalie Sherman (ISBN 81-297-0265-7)
3. Experiments in Microbiology Plant Pathology and Biotechnology- K. R. Aneja

SEMESTER II

CODE: IM 1222

FOUNDATION COURSE II

Microbial Taxonomy and Physiology

Total Hrs-54 CREDITS-3 **(3 Hrs /week)**

MODULE I **(12 Hrs)**

Classification of microorganisms- Objectives and practical value of taxonomy. Criteria for classification- morphological, Nutritional, ecological, molecular. Numerical taxonomy, matching coefficients, dendrogram, phylogenetic tree. Phylogenetic relationship. Major systems of classification. Three-kingdom and Five kingdom classification. Bergy's manual.

MODULE II **(10 Hrs)**

Classification of fungi-with examples (brief account only). Classification of algae-green algae, brown algae and diatoms with examples.Classification of protozoa- flagellates, Amoebas, sporozoa and ciliates- (brief account) with examples.

MODULE III **(10 Hrs)**

Bacterial growth- Binary fission, Bacterial growth curve, factors affecting bacterial growth. Significance of various phases of growth. Batch, continuous culture, Fed batch, Synchronous growth.

MODULE IV **(12 Hrs)**

Bacterial Photosynthesis -: oxygenic and anoxygenic types, Nitrogen fixation: Symbiotic and non-symbiotic types.

MODULE V **(10 Hrs)**

Uptake of nutrients by bacteria- Passive diffusion, facilitated diffusion, active transport, group translocation, Iron uptake. Biosynthesis of cell wall peptidoglycan. Utilization of energy by halo bacteria. Bioluminescence and its Applications.

REFERENCES

1. Microbiology - Pelczar, Chan and Kraig (ISBN 0-07-462320-6)
2. Microbiology -Prescott, Harley and Klein (ISBN 0-07-111217-0)
3. Essentials of Microbiology-Purohit and Singh
4. Brock's Biology of Microorganisms-Mardigon Martinko And Parker
5. Microbial Genetics-Frifielder
6. Microbiology-Zins

SEMESTER II

CODE: IM1271

VOCATIONAL COURSE II

Microbiology Practical

Total Hrs-36 CREDITS-3 **(2Hrs /week)**

Part I **(18 Hrs)**

1. Isolation and enumeration of bacteria from soil.
2. Isolation and enumeration of bacteria from Water.
3. Isolation and enumeration of bacteria from Air.
4. Biochemical tests-
   (a) IMViC
   (b) Sugar fermentation
   (c) Urease test
   (d) TSI
   (e) Catalase and Oxidase

Part II **(18 Hrs)**

5. Candle jar method for cultivation of anaerobic bacteria.
6. Slide culture technique for fungi
7. Measurement of fungal growth by colony diameter method.
8. Germicidal effect of ultra violet light on bacterial growth.
9. Effect of different disinfectants and antiseptics on bacteria.

REFERENCES

1. Dubey R C and Maheswari, D K (2002). Practical Microbiology. S. Chand & Co Ltd. (ISBN 81-219-2153-8)
2. Microbiology A Laboratory Manual - James G Cappucino Natalie Sherman
3. Experiments In Microbiology Plant Pathology And Biotechnology- K.R Aneja

SEMESTER III

CODE: IM1371

VOCATIONAL COURSE III CELL BIOLOGY

Total Hrs-72 CREDITS -3 **(4 Hrs /week)**

MODULE I **(12 Hrs)**

Introduction to cell biology: Early conditions on earth, Origin of life on earth. Spontaneous generation theory, Darvin's concept about the orgin of life, Haldane and Oparin theory of the orgin of life, Urey-Miller experiment, Fox's experiments. Preliminary idea about speciation, natural selection and genetic drift. Robert Hooke –Discovery of cells and the cell theory.

MODULE II **(12 Hrs)**

Fundamentals of cell biology: ultrastructure of cell- prokaryotic and eukaryotic cell, Structure and functions of subcellular organelles- nucleus, mitochondria, chloroplast, ribosomes, Endoplasmic reticulum, Golgi bodies, lysosomes, microfilaments, microtubules, glyoxysomes and peroxisomes.

MODULE III **(12 Hrs)**

Cell-cell interactions, cell-matrix interactions, cell-cell adhesion, cell-cell signaling, Role of bacterial cell-cell signaling in virulence and pathogenesis.

MODULE IV **(12 Hrs)**

Apoptosis- definition, mechanism- difference between apoptosis and necrosis.Cell cycle- check points and arrest. Regulation of cell cycle. Analysis of cell cycle by flow cytometry. Cell division- mitosis and meiosis- different stages. Cell differentiation.

MODULE V **(12 Hrs)**

Chromosomal changes and cytogenetics: Euploidy, Aneuploidy, Chromosomal aberrations: structural alterations, gene mutations- complementation test, molecular changes, intra and interchromosomal aberrations, chromosome preparation, G-Banding, FISH. Disorders associated with chromosomal aberrations-Philadelphia chromosome.

MODULE VI **(12 Hrs)**

Genetic organization- chromatin and nucleoid structure, chromosomes-nucleosomes, plectonemic and solenoidal supercoiling, microsatellites. DNA binding protein families- Helix-loop-Helix, Helix loop Turn and Leucine zipper. Oncogenes and tumor suppressor genes- role in malignant transformation.

REFERENCES

1. Cell and Molecular Biology by Gerald Karp, John Wiley & Son, Inc. New York
2. Principles of Genetics by D. Peter Snustad and Michael J Simmons, John Wiley & Son,
3. Biochemistry by Lubert Stryer, W.H Freeman and Company, New York
4. Cell and Molecular Biology by De Robertis & De Robertis,jr.

SEMESTER III

CODE: IM1372

VOCATIONAL COURSE IV

Microbial Genetics and Biotechnology

Total Hrs-54 CREDITS -3 **(3 Hrs /week)**

Module I **(9 Hrs)**

Introduction to history of genetics, Mendel's laws of genetics, alleles, multiple alleles, Test cross and back cross. Basic idea about linkage and crossing over, Mapping, Sex linked inheritance, (simple numerical problems to be worked out) A brief idea about population genetics-Hardy Weinberg law.

Module II. **(9 Hrs)**

Prokaryotic replication & its types: ö- Theta mode and ó-sigma mode or rolling circle model of replications. Different method used for introducing foreign DNA into the cell: DNA direct transformation, electroporation, Microinjection and biolistic methods.

Module III **(9 Hrs)**

Gene transfer mechanisms- Transformation, conjugation and transduction- generalized and specialized transduction. Ames test & its significance

Module IV **(9 Hrs)**

Animal cell tissue culture- Preparation of culture media, primary culture, cell lines & its types. Maintenance of cell lines. Genetically modified organisms. Transgenic animals – engineering embryos (brief account only)..

Module V **(9 Hrs)**

Plant cell tissue culture- Media composition. Plant tissue culture techniques- callus culture, cell suspension culture, protoplast culture and somatic hybridization. Applications of plant tissue culture, Transgenic plants- improving crops and foods (brief account only).

Module VI **(9 Hrs)**

Ethical problems associated with the use of rDNA technology. Intellectual property: Intellectual property rights- patents, trade secrets, copyrights &trademarks). Patenting of transgenic organisms and isolated genes.

Reference:

1. Molecular Biology of the Gene by Watson, JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AAM.
2. Genes V by Lewin B, 1994. Oxford University press.
3. Molecular Cell Biology by Lodish, H, Baltimore D, Berk A, Zipursky SL, Matsudaira P, Darnell J.
4. Molecular Biology by Freifelder D., 1991 Narosa Publishing Home.
5. Principles of Gene Manipulation, 4th Ed., by R.S.Old and S.B.Primrose.
7. Principles of Genetics by Gardner EJ, Simmons MJ, Snustad DP.
8. Genes and Genomes by Singer M, Berg P.,1991 University Science Books.

SEMESTER III

VOCATIONAL PRACTICAL

Total Hrs 36 CREDITS-0 **(2 Hrs /week)**

Part I **(18 Hrs)**

1. Isolation of antibiotic resistant bacterial population by gradient plate method.
2. Isolation of streptomycin resistant mutant by replica plate technique.
3. Isolation of plasmid DNA.
4. Preparation of genomic DNA from bacteria.
5. Principle and application of agarose gel electrophoresis

Part II **(18 Hrs)**

6. Plant regeneration from callus or plant tissue.
7. Mushroom cultivation
8. Bioassay for evaluating the mutagen or carcinogen by Ames test.
9. Demonstration of genetic recombination in bacteria by conjugation.
10. Demonstration of Bacterial transformation.

REFERENCES

1. Lab manual in Biochemistry, Immunology and Biotechnology-Arti Nigam, Archana Ayyagari (ISBN 13:978-0-07-061767-4)
2. Dubey R C and Maheswari, D K (2002). Practical Microbiology. S. Chand & Co Ltd. (ISBN 81-219-2153-8)
3. Experiments in Microbiology plant pathology and Biotechnology- K.R.Aneja
4. Molecular Cloning: A Laboratory Manual, Volume 1& 2 : Joseph Sambrook, David William Russell.

SEMESTER IV CODE: IM1471

VOCATIONAL COURSE V

Environmental Microbiology

Total Hrs 54 CREDITS-3 **(3 Hrs /week)**

MODULE I **(9 Hrs)**

Microbial ecology-interactions. Microorganisms as components of ecosystem-as producers and decomposers. Bacterial life in extreme environments & effect of temperature, pH, pressure, salt and heavy metals.

MODULE II **(9 Hrs)**

Waste – types; Solid waste - treatment of solid waste – composting, incineration, land filling. Liquid waste - Conventional methods of treatment of liquid waste. House hold sewage treatment – septic tank, imhoff tank, cess pool. Municipal sewage treatment-primary, secondary and tertiary, disinfection.

MODULE III **(9 Hrs)**

Bioremediation: Degradation of pesticides, detergents, degradation of lignin, xenobiotic compounds, petroleum and hydrocarbon compounds. Microbes in mining. Bacterial leaching.

MODULE IV **(9 Hrs)**

Microorganisms in soil processes-carbon cycle-organic matter decomposition, humus formation Nitrogen cycle-nitrogen fixation -symbiotic, non-symbiotic, associative symbiotic nitrogen fixing organisms. Microbial transformation of phosphorous, iron, sulfur micronutrients in soil.

MODULE V **(9 Hrs)**

Rhizosphere concept. Rhizosphere microorganisms-their importance in plant growth. Mycorrhizae – brief account of ectomycorrihizae ,endo mycorrhizae and ecto-endo mycorrhizae. Applications of mycorrhizal fungi. Biofertilizers: microbial inoculants-definition and perspectives of agriculturally useful inoculants; brief account of production and application of *Rhizobium, Azotobacter, Azospirillum and cyanobacteria.*

MODULE VI **(9 Hrs)**

Plant pathology- Symptoms, etiology, epidemiology and management of the following plant diseases: mosaic disease of tobacco, bunchy top of banana, bacterial blight of paddy, damping off of tobacco, blight of maize/sorghum, leaf spot of paddy and citrus canker.

REFERENCES

1. Microbial Ecology Fundamentals and applications – Atlas and Bartha (ISBN 981-405-344-9)
2. Environmental Microbiology- K.Vijaya Ramesh (ISBN 81-8094-003-9)
3. Agricultural Microbiology- Rangaswamy G, D.J. Bhagyaraj (ISBN-81-203-0668-6)
4. Soil Microbiology an exploratory approach – Mark S.Coyne (ISBN 981-240-203-9)
5. Introduction to Soil Microbiology –Alexander
6. Soil Microbiology-Waksman
7. Soil Microorganisms And Its Growth-N.S. Subba Rao
8. Biofertilizers in Agriculture- Subha Rao

SEMESTER IV

CODE: IM1472

VOCATIONAL COURSE VI

Food Microbiology

Total Hrs 54 CREDITS-2 **(3 Hrs /week)**

ModuleI **(10 Hrs)**

Introduction: Importance of food and dairy Microbiology – Types of microorganisms in food – Source of contamination (primary sources) – Factors influencing microbial growth in foods (extrinsic and intrinsic)

ModuleII **(10 Hrs)**

Fermented food: Cheese, bread, wine, fermented vegetables – methods and organisms used. Food and enzymes from microorganisms –single cell protein, production of enzymes.

Module III **(10 Hrs)**

General principles underlying spoilage, Spoilage different kinds of foods, cereals and cereal products – sugar and sugar products – vegetable and fruits – meat and meat products –fish and other sea foods – eggs and poultry – dairy and fermentative products (icecream/milk/bread/wine).

Module IV **(12 Hrs)**

Food Poisoning: food borne infections and intoxications: Source, symptoms and Management of the following- (a) Bacterial (Staphylococcal, Brucella, Clostridium, Escherichia, Salmonella) (b) Fungal : Mycotoxins,(c) Viral: Hepatitis, (d) Protozoa – Amoebiasis. Management

ModuleV **(12 Hrs)**

Food preservation: Principles of food preservation – methods of preservation. Physical (irradiation, drying, heat processing, chilling and freezing, high pressure and modification of atmosphere). Chemical preservation- (Sodium benzoate Class I & II). Food Sanitation: Good manufacturing practices – HACCP, Presonnel hygiene.

REFERENCES

1. Food Microbiology by Adams, M.R. and Moss, M.O.1995. The Royal Society of Chemistry, Cambridge.
2. Food Microbiology by Frazier, W.C. and Westhoff, D.C.1988. TATA McGraw Hill Publishing company ltd., New Delhi.
3. Modern Food Microbiology by Jay, J.M.1987. CBS Publishers and distributors, New Delhi.
4. A Modern Introduction to Food Microbiology by Board, R.C.1983. Blackwell Scientific Publications, Oxford.
5. Dairy Microbiology by Robinson, R.K.1990. Elsevier Applied Science, London.
6. Food Poisoning and Food Hygiene, Hobbs, B.C. and Roberts, D.1993. Edward Arnold. London.

SEMESTER IV

CODE: IM 1473

VOCATIONAL COURSE VII Microbiology Practical

Total Hrs 54 CREDITS-3 **(3 Hrs/week)**

Part I **(27 Hrs)**

1. Determination of Biochemical oxygen Demand (BOD) of water.
2. Determination of Chemical oxygen Demand (COD) of water.
3. Bacteriological examination of water by multiple tube fermentation test.
   (a. Presumptive coliform test, b. Confirmed coliform test, c. Completed coliform test)
4. Isolation & culturing of *Rhizobium* from root nodules of higher plants.
5. Study of the following disease

   (a) Tobacco mosaic disease, (b) Bacterial blight of paddy, (c) Leaf spot of mulberry, paddy, (d) Bunchy top of banana, (e) Citrus canker

Part II **(27 Hrs)**

6. Determination of number of bacteria in milk by standard plate count.
7. Determination of quality of a milk sample by MBRT, phosphatase test.
8. Determination of TDT and TDP
9. Effect of pH on bacterial growth.
10. Effect of salt concentrations on bacterial growth.
11. Microbiological examination of foods-
    (a) Isolation and enumeration of bacteria and fungi from spoiled vegetables,
    (b) Isolation and enumeration of bacteria and fungi from spoiled fruits
    (c) Isolation and enumeration of bacteria and fungi from Spoiled fish or meat.
    (d) Isolation and enumeration of bacteria and fungi from soft drinks.

REFERENCES

1. Experiments in Microbiology, Plant pathology and Biotechnology- K. R. Aneja
2. Practical Microbiology- R C Dubey and D K Maheswari.

SEMESTER V

CODE: IM1571

VOCATIONAL COURSE VIII Fermentation Technology

Total Hrs 72 CREDITS-3 **(4 Hrs /week)**

MODULE I **(12 Hrs)**

Fermentation technology-isolation, screening and strain improvement of industrially important microorganisms. Introduction to fermentation processes- media for industrial fermentation, sterilization, inoculum preparation.

MODULE II **(12 Hrs)**

Design and parts of fermenter – agitation, aeration, pH, temperature, dissolved oxygen-control and monitoring, difference in fermentation process of biomass, chemicals and conversion products- comparative brief account. Cell and enzyme immobilization.

MODULE III **(12 Hrs)**

Recovery of fermentation product (Down-stream processing) - Methods for cell lysis, Physical separation, liquid extraction, Precipitation, chromatography, drying.

MODULE IV **(12 Hrs)**

Microbial products- raw materials, organism and industrial process involved in the production of penicillin, streptomycin, ethanol, butanol, acetone, vitamin B12, riboflavin, alpha lysine,amylase, protease, pectinase, citric acid. Biopesticide production.

MODULE V **(12 Hrs)**

Microbes in food industry-bacteria (lactics, acetics, proteolytic and lipolytic bacteria, Thermophillic and thermoduric bacteria, pigmented bacteria and coliform bacteria), molds (Mucor, rhizopus, penicillium, Aspergillus and yeasts (Genus Saccharomyces, zygosaccharomyces, Genus candida & salt tolerant yeast). Production of SCP.

MODULE VI **(12 Hrs)**

Fermentation -Bacteria grouped according to major products of glucose, dissimilation-Lactic acid fermentation, Homolactic fermentation, Heterolactic fermentation, Ethanolic fermentation, and propionicacid fermentation, mixed acid, fermentation, Butanediol fermentation and butyric acid fermentation. Amino acid fermentation (stickland reaction). Pasteur effect.

REFERENCES

1. Industrial Microbiology - L.E. Casida,JR (ISBN 0 85226 1012)
2. Industrial Microbiology-A.H.Patel (ISBN 0333 90842 2)
3. Prescott & Dunn's Industrial Microbiology Reed G (Ed) ISBN 81-239-1001-0) (Fourth Edition)
4. Food Microbiology-William C.Frazier Dennis .C Westhoff (ISBN 0-07-46210147)
5. Fermented foods Economic Microbiology Vol 7 rose A (ed)
6. Manual Of Industrial Microbiology And Biotechnology, Demin & Davis
7. Applied Microbiology-Musharraffudde

SEMESTER V

CODE: IM1572

VOCATIONAL COURSE IX Microbiology Practical

Total Hrs 108 CREDITS-4 **(6 Hrs /week)**

Part I **(54 Hrs)**

1. Yeast Cell immobilization
2. Isolation of amylase producers.
3. Demonstration of microbial antibiosis by crowded plate technique.
4. Production of wine from grapes.
5. Isolation of lipolytic microbes.
6. Isolation of protease producers.
7. Bioassay of antibiotic.

Part II **(54 H**rs)

8. Citric acid production by Aspergillus sp..
9. Amylase production by SSF.
10. Enrichment of coir pith degraders.
11. Analysis of Mycotoxin (Aflatoxin) in fungus- contaminated food materials.
12. Demonstration of fermentation by yeast.

REFERENCES

1. Experiments in Microbiology plant pathology and Biotechnology - K. R. Aneja
2. Practical Microbiology-R C Dubey and D K Maheswari.

IM1645 PROJECT (Core/Vocational)

Credit 4 **(1 Hr /week)**

The students should do one project either in Biochemistry or Microbiology. The total number of students in the program should be equally divided into two batches and one batch should do a project in core subject and the other batch should do the project in the vocational subject. Which batch would come under which faculty can be decided by drawing lots.

The project report should be based on a mini-project work done by the students. This should include original laboratory work, analysis of results and should be presented along with relevant and current literature review. The evaluation of dissertation should be done on the basis of evaluation of the project report and a viva-voce examination of the student. The students will do the project in the fifth semester and have to submit their reports in the sixth semester.

A report of the industrial visit carried out to any industries/institutions relevant to the subject should accompany the project report.

Scheme for evaluation of project

Total weightage:	30
Project:	20
Industrial Visit:	10 (The visit carries a weightage of 6 and the visit report carries a weightage of 4)

SEMESTER VI

CODE: IM1671

VOCATIONAL COURSE X Medical Microbiology

Total Hrs 54 CREDITS-3 **(3 Hrs /week)**

MODULE I (9 Hrs)

Normal Microbial flora- Resident flora and transient flora, Beneficial and harmful effects of normal flora. Brief account on normal flora of skin, conjunctiva, upper respiratory tract, mouth, teeth, stomach, upper and lower intestine, genitourinary tract. Nosocomial infection

MODULE II (9 Hrs)

Bacteriology: Pathogenicity, laboratory diagnosis, prevention and control of the diseases caused by (brief account only): Staphylococcus aureus, Streptococcus pyogenes , Neisseria gonorrhoeae, Escherichia coli, Salmonella typhi, Vibrio cholerae, Corynebacterium diptheriae, Clostridium tetani , Mycobacterium tuberculosis, Treponema pallidum, Mycoplasma pneumoniae & Chlamydia trachomatis.

MODULE III (9 Hrs)

Mycology: Brief account on the following fungal diseases: **Superficial mycoses-** Pityriasis versicolor, Tinea nigra. **Cutanaceous mycoses**- Dermatophytes, Candidiasis. **Subcutanaceous mycoses**- Mycotic mycetoma, Rhinosporidiosis. **Systemic mycoses-** Cryptococcosis, Histoplasmosis and **Opportunistic mycoses**- Aspergillosis, Penicilliosis.

MODULE IV (9 Hrs)

Virology: Air borne viral disease (Influenza, measles, mumps, rubella, small pox). Insect borne (yellow fever, dengue fever) food and water borne disease (polio). Direct contact diseases – Hepatitis B. rabies, AIDS.

MODULE V (9 Hrs)

Protozoology: Disease caused by Protozoa (Pathogenic mechanisms, Disease transmission and life cycle) – Plasmodia, Toxoplasma, Entamoeba histolytica, Trypanosoma.

MODULE VI (9 Hrs)

Antimicrobial chemo therapy: Antibiotics and their mode of action. Drug resistances– Mechanism of drug resistances.Antimicrobial sensitivity tests- diffusion and dilution techniques.

REFERENCES

1. Ananthanarayan and Panicker's Textbook of Microbiology- ISBN 81 250 2808 0
2. Notes on Medical Bacteriology – J.Douglas SleighMorag C.Timbury
3. Parasitology –B.Dasgupta
4. Medical Mycology – Rippon
5. Principles of Bacteriology Virology and immunity Vol 4 Lopka and Wilson
6. Fundamentals of medical Virology by Kucera and Myrvik

SEMESTER VI

CODE: IM1672

VOCATIONAL COURSE –XI Microbiology Practical

Total Hrs 108 CREDITS-4 **(6hrs/week)**

Part I **(54 Hrs)**

1. Antibiotic sensitivity testing- Kirby-Bauer method
2. Determination of MIC and MBC of antibiotics
3. Identification of common bacterial pathogens by using morphological, cultural and biochemical characters.
   a) Staphylococcus b) Streptococcus
   c) Escherichia coli, d) Pseudomonas
   e) Klebsiella
4. Tube agglutination test: WIDAL test.
5. RPR card test for syphilis.

Part II **(54 Hrs)**

6. ASO latex agglutination test
7. RA latex agglutination test
8. HBs Ag detection by using immunochromatographic technique
9. Urine culture and its microbiological analysis.
10. Isolation of Enteric pathogens from stool by direct plating methods.

REFERENCES

1. Lab manual in Biochemistry, Immunology and biotechnology-Arti Nigam, Archana Ayyagari (ISBN 13:978-0-07-061767-4)
2. Medical Laboratory technology –Methods and interpretation (ISBN 81-8448-449-6)
3. Mackie & McCartney Practical Medical Microbiology (ISBN 0 443 04906 8)

ELECTIVE COURSE

CODE: IM1661

ELECTIVE COURSE- IMMUNOLOGY

Total Hrs 36 CREDITS-2 **(2 Hrs /week)**

MODULE 1 **(6 Hrs)**

Infections, Source of infection, Epidemic, Pandemic and Endemic diseases. Determinants of microbial pathogenicity. Immunity, types of immunity -Innate immunity and acquired immunity- (natural and artificial active, natural and artificial passive), immune response-primary and secondary immune response. Mechanism of immune response.

MODULE II **(6 Hrs)**

Antigens, structure and types of antigens-endogenous and exogenous, & super antigens. Antigenicity and immunogenicity. Haptens, adjuvants and its types. Structure and functions of different classes of immunoglobulins (IgG, IgM, IgA, IgD& IgE)

MODULE III **(10 Hrs)**

Cells of immune system (Lymphocytes, Mononuclear cells, granulocytes, dendritic cells), Phagocytosis, Organs of immune system (primary and secondary lymphoid organs), Complement system and activation pathways (classical, alternate and lectin pathways), Membrane attack complex. Structure, and function of Major Histo compatability complex (MHC class 1 and Class II) –brief introduction only.

MODULE IV **(8 Hrs)**

Brief introduction to antigen and antibody reactions- complement fixation, neutralization, agglutination reactions, precipitation reactions and its types. Immunoassays of diagnostic importance-ELISA, RIA, VDRL and WIDAL test. Western Blotting, Production of monoclonal and poly clonal antibodies, and its applications.

MODULE V **(6 Hrs)**

Brief account on Immunodeficiency disorders, Hypersensitivity reactions, Immunohaematology (Blood groups and Rh incompatibilities), Autoimmunity, Vaccines, Immunology of organ and tissue transplantation and Immunology of malignancy

REFERENCES

1. Immunology: An Introduction by Ian R Tizard (2006) Publisher: Cengage Learning
2. Immunology and Immunotechnology by Chakravarty (2006)
3. Kuby Immunology by Thomas J. Kindt (2006) Publisher: W H Freeman & Co
4. Elements of Immunology (2009) by Khan Publisher: Dorling Kindersley (India) Pvt
5. Immunology by K.R. Joshi (2007) Publisher: Agrobios (India)
6. Basic Immunology, 3ed by: Abbas Publisher: Elsevier
7. Immunology by P.R. Yadav (2004) Publisher: Discovery Publishing House
8. Immunology by David A. Marcus, Richard A. Goldsby, Barbara A. Osborne (2003) Publisher: WH. Freeman & Company

UNIVERSITY OF KERALA

Scheme and syllabus of Biochemistry

for

career related First degree programme in Biochemistry (core)

and

Industrial Microbiology (vocational)

under

Choice Based Credit and Semester System

2015

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