J.J. COLLEGE OF ARTS AND SCIENCE (Autonomous)

DEPARTMENT OF MICROBIOLOGY

B.Sc. MICROBIOLOGY

Proposed Course Structure under Autonomous Status
Under Choice Based Credit System
(Applicable for the candidates admitted from academic year 2016-2017 onwards)

SEM	Part	Course code	Course Title	Hrs/ Week	Credit	Exam Hours	Marks Int	Marks Ext	Total Marks
I	I	U1RTL1/ HL1/FL1	Language Course – I	6	3	3	25	75	100
	II	U1REL1	English Language course – I	6	3	3	25	75	100
	III	U1RMBCC1	CC-I Fundamentals of Microbiology	6	5	3	25	75	100
		UIRMBCC2P	CC-II Practical I Covering Core papers I & III	3	*	-	-	-	-
		U1RMBAC1	Allied Course (First) - I Biochemistry-I	6	3	3	25	75	100
		U1RMBAC2P	Allied Course (First) - II Allied Practical AC I & AC III	3	*	-	-	-	-
			TOTAL	**30**	**14**				**400**
II	I	U2RTL2/ HL2/FL2	Language Course – II	5	3	3	25	75	100
	II	U2REL2	English Language course – II	5	3	3	25	75	100
	III	U2RMBCC2P	CC-II Practical I Covering Core papers I & III	3	5	3	40	60	100
		U2RMBCC3	CC-III Microbial Physiology	5	5	3	25	75	100
		U2RMBAC2P	Allied Course (First) - II Allied Practical AC I & AC III	3	3	3	40	60	100
		U2RMBAC3	Allied Course (First) - III Biochemistry II	4	3	3	25	75	100
	IV	U2RES	Environmental Science Course	3	2	3	25	75	100
		U2RVE	Value Education Course	2	2	3	25	75	100
			TOTAL	**30**	**26**				**800**

SEM	Part	Course code	Course Title	Hrs/ Week	Credit	Exam Hours	Marks Int	Marks Ext	Total Marks
III	I	U3RTL3/ HL3/FL3	Language Course – III	5	3	3	25	75	100
	II	U3REL3	English Language course – III	5	3	3	25	75	100
	III	U3RMBCC4	CC-IV Virology	5	5	3	25	75	100
		U3RMBCC5	CC-V Immunology	5	5	3	25	75	100
		U3RMBCC6P	CC-VI Practical- II Covering Core papers IV,V & VII	3	*	-	-	-	-
		U3RMBAC4	Allied Course (Second) – IV Biostatistics	4	3	3	25	75	100
		U3RMBAC5P	Allied Course (Second) - V Allied Practical AC IV & AC VI	3	*	-	-	-	-
			TOTAL	**30**	**19**	**-**	**-**	**-**	**500**
IV	I	U4RTL4/ HL4/FL4	Language Course – IV	5	3	3	25	75	100
	II	U4REL4	English Language course – IV	5	3	3	25	75	100
	III	U4RMBCC6P	CC-VI Practical- II Covering Core papers IV,V & VII	3	5	3	40	60	100
		U4RMBCC7	CC-VII Medical Microbiology	5	5	3	25	75	100
		U4RMBAC5P	Allied Course (Second) – V Allied Practical AC IV & AC VI	3	3	3	40	60	100
		U4RMBAC6	Allied Course (Second) – VI Bioinformatics	5	3	3	25	75	100
	IV	U4RMBSBE1	Vermitechnology	4	2	3	25	75	100
			TOTAL	**30**	**24**	**-**	**-**	**-**	**700**

SEM	Part	Course code	Course Title	Hrs/ Week	Credit	Exam Hours	Marks Int	Marks Ext	Total Marks
V	III	U5RMBCC8	CC-VIII Microbial Genetics	5	5	3	25	75	100
		U5RMBCC9	CC-IX Agriculture and Environmental Microbiology	5	5	3	25	75	100
		U5RMBCC10	CC-X Industrial Microbiology	5	5	3	25	75	100
		U5RMBCC11P	CC-XI Practical- III Covering Core papers VIII & IX	3	*	-	-	-	-
		U5RMBCC12P	CC-XII Practical- IV Covering Core papers X, XIII & XIV	3	*	-	-	-	-
		U5RMBMBE1	Major Based Elective Course – I Bioinoculants	5	4	3	25	75	100
		U5RMBSBE2	Organic Farming	2	2	3	25	75	100
	IV	U5RMBIDC1	Basic concepts of computers	2	2	3	25	75	100
			TOTAL	**30**	**23**	**-**	**-**	**-**	**600**
VI	III	U5RMBCC11P	CC-XI Practical- III Covering Core papers VIII & IX	3	5	3	40	60	100
		U5RMBCC12P	CC-XII Practical- IV Covering Core papers X, XIII & XIV	3	5	3	40	60	100
		U6RMBCC13	CC-X III Molecular Biology	5	5	3	25	75	100
		U6RMBCC14	CC- XIV Microbial Biotechnology	5	5	3	25	75	100
		U6RMBMBE2	Major Based Elective Course – II Food Microbiology	5	4	3	25	75	100
		U6RMBMBE3	Major Based Elective Course – III Bioinstrumentation	5	4	3	25	75	100
	IV	U6RMBSBE3	Mushroom Technology	2	2	3	25	75	100
		U6RMBIDC2	Basic concepts of internet	2	2	3	25	75	100
	V		Gender Studies		1	3	25	75	100
			Extension activities		1				
			TOTAL	**30**	**34**	**-**	**-**	**-**	**900**
			Grand Total		**140**				**3900**

*Carried over Paper – Exam at the end of the next semester

CC-Core Course / AC – Allied Course /MBE – Major based Elective / SBE – Skill based Elective/ IDC – Inter disciplinary course/P – Practical* / T – Theory

Total Credit – 140 / Total Marks – 3900

Extension activities shall be outside the instruction hours.

Skill Based Elective papers (Any three from the list)

1. Vermitechnology
2. Organic Farming
3. Medical Lab Technology
4. Ethno Medicine
5. Pharmacognosy
6. Herbs and Drug action

Major Based Elective papers (Any three from the list)

1. Microbial inoculants
2. Food Microbiology
3. Bioinstrumentation
4. Cell Biology
5. Microbial Diversity

Inter disciplinary course (offered by the department)

1. Biofertilizer
2. Microbes in Human Welfare
3. Basic Microbiology

Inter disciplinary course (Taken by the department)

1. Introduction to Internet Concepts – Computer Application
2. Internet Skill Development Course – Computer Science

CC I: FUNDAMENTALS OF MICROBIOLOGY

Paper Code: U1RMBCC1 **Semester: I**
No. of Credits: 5 **No. of hours per week: 6**

Objectives:

- To know the historical background and the progress of this field to the modern times
- To become familiar with the basics in microbiology
- To learn the sterilization methods
- To know the culture collection and preservation
- To understand the scope of microbiology in various fields, so that students can prepare themselves for the future

Unit I: Introduction

History and Scope of Microbiology – Spontaneous generation theory – Contribution of Leuvenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister, Winogradsky, Waksman, John Tyndall. Classification of micro organisms - Haeckel's three kingdom concept, Whittaker's Five kingdom concept, Bacterial classification according to Bergey's manual of systemic Bacteriology (9^{th}edition).

Unit II: Microscopy

Microscopy and Staining - Microscopy – Principles and application – Bright field, Dark field, Phase contrast, Fluorescence, SEM & TEM - Specimen preparation of electron microscopy – Freeze etching- Staining- Stains and Staining reactions – Types of staining – Simple, Differential (Grams, Spore, AFB), Capsule staining, Nuclear and Flagella staining - Albert staining.

Unit III: Sterilization methods

Sterilization and Disinfection- Principles- Methods of Sterilization – Physical methods – Dry heat- Moist heat, Filtration (Membrane & HEPA) - Radiation – Chemical Sterilization -Chemical agents, Mode of action.

Unit IV: Morphological characteristics of microbes

Ultra structure of bacteria, sub cellular structures and cell envelop-slime, capsule, cell wall ,Pili, flagella, cell inclusions. General characteristics of Archaebacteria, Eubacteria, Cyanobacteria, Mycoplasmas, Rickettsiae, Chlamydias, Spirocheates, Actinomycetes, Protozoa, Algae, Fungi and Viruses.

Unit V: Cultivation and preservation of microbes

Types of culture media – simple, defined, enriched, differential and transport media with specific examples for each type. Methods of maintenance and preservation of microbes. Microbial culture collection centres.

Text Books:

1. Pelczar Jr,M.J.Chan, E.C.S. and Kreig,N.R. (1993). Microbiology, Mc,Graw Hill.Inc, New York (All units covered).
2. Prescott,L.M. Harley,J.P. and Klein, D.A.(2003). Microbiology (5^{th} edition) McGraw Hill, New York (All units covered).
3. Madigan,M.T. Martinko,J.M and Parker,J..Brock, T.D.(1997). Biology of Microorganism(8^{th} edition). Prentice Hall International lnc, London (All units covered).
4. Geeta Sumbali and Mehrotra R.S. (2009).Principles of Microbiology.Tata McGraw Hill Education private Limited.
5. Sambamurthy A.V.S.S(2005).Text Book of Algae .I.K.International Pvt Ltd.

Reference Books:

1. Alexopolus, C.J. and Mims,C.W.(1993). Introductory Mycology (3th edition) . Wiley Eastern Ltd, New Delhi.
2. Elizabeth Moore- Landecker.(1996). Fundamentals of the fungi. (4^{th} edition). Prentice Hall International, lnc London.
3. Holt,J.S.Kreig, N.R. Sneath, P.H.A and Williams,S.T. Bergey's Manual of Determinative Bacteriology (9^{th} edition),Williams and Wilkins., Baltimore.

4. John Webster (1993). Introduction to Fungi (2th edition) . Cambridge University Press, Cambridge.
5. Salle, A.J.(1996). Fundamental principles of Bacteriology ,(7th edition).Tata McGraw- Hill publishing company Ltd, NewDelhi.

CC-II Practical I Covering Core papers I & III
Practical – Fundamentals of Microbiology and microbial physiology

Fundamentals of Microbiology

1. Microscope and its operation
2. Preparation of culture media, Cleaning of glasswares and sterlization methods – autoclaving and hot air oven
4. Quantification of microbial population by viable cell count and haemocytometer.
5. Observation of permanent slides to study the structural characteristics of algae (*Anabena, Nostoc, Spirulina, Oscillotoria*), fungi (*Pythium, Rhizopus, Saccharomyces, Pencillium, Aspergillus, Agaricus*) and protozoa (*Entamoeba hystolytica* and *Plasmodium spp.*).
6. Isolation of microorganism from soil and water (Bacteria, fungi and cyanobacteria).
7. Pure culture techniques - Streak plate, Pour plate and Spread plate.
8. Test for motility of bacteria – Hanging drop method.
9. Staining techniques – Simple staining, Gram's staining, Spore-staining, Capsular staining, Lactophenol cotton blue staining.

Microbial Physiology

1. Bacterial growth curve: Cell count/viable count/absorbance(total count)
2. Carbohydrate fermentation tests:Glucose, Lactose, Sucrose and Mannitol.
3. Biochemical test for identification of bacteria: IMViC tests - TSI agar test-Urease-Catalase-Oxidase.

Reference books:

1. K.R.Aneja (2010). Experiments in Microbiology, Plant pathology and biotechnology. New Age International Pvt.Ltd.NewDelhi.
2. Cappuccino and James, G (1996) Microbiology a laboratory manual, Addison Wesley Publishing Company Inc. 4th edition, England, California.
3. Mackie and McCartney (1989). Practical Medical Microbiology, Churchill Livingston.
4. R.C.Dubey (2002). Microbiology practical manual. S.Chand and Company LTD.
5. Kannan.N (2002) Lab manual in General Microbiology. Panima Publishing Corporation.

ALLIED COURSE (FIRST) – I – BIOCHEMISTRY
Paper Code: U1RMBAC1 **Semester: I**
No. of Credits: 3 **No. of hours per week: 6**

Objectives:

- To know the structure of Biomolecules
- To become familiar with the basics in Biochemistry
- To learn the functions of Biomolecules

Unit – I Carbohydrates

Carbohydrate – Definition, Classification – (monosaccharide, disaccharide, oligosaccharide and polysaccharides), structure of glucose, biological significance, digestion and absorption of carbohydrate.

Unit – II **Proteins**

Proteins – Definition, classification and structure (Primary, secondary, tertiary), Amino acids – Structure - classifications (Essential and non essential, protein and non-protein amino acids).

Unit – III Lipids

Lipids: Definition, classification (Simple, compound and derived lipids), structure, properties and functions,Fatty acids – Definition, classification (Essential, non essential, saturated and unsaturated fatty acids).

Unit – IV Nucleic Acids

Nucleic acids – DNA structure, forms and functions – RNA types (tRNA, mRNA, rRNA) structure and functions.

Unit – V Vitamins

Vitamins – Introduction – Fat soluble vitamins (A, D, E, & K). Water soluble vitamins (B Complex & C). Sources, functions and deficiency syndromes.

Text Books:

1. Sathyanarayana,U and Charapani,C.(2010).Biochemistry. Books and allied (P) Ltd
2. Deb,A.C., (1989). Fundamentals of Biochemistry (3rd Edition). New central agency.
3. Jain, J.L., (2005). Fundamentals of Biochemistry (6th Edition), S.Chand Publications
4. Ashokan .P. (2006) Enzymes .Chinna Publications
5. Freifelder, D. (1996) Molecular Biology, II Edition, Narosa Publishing House, New Delhi.

Reference:

1.David E. Metzler and Carol M. Metzler (2001). Biochemistry-The chemical reactions of living cells- Vol1&2.(2nd edition).Harcourt/Academic press, Newyork.

2.Donald Voet and Judith G. Voet (1995). Biochemistry – Second Edition. John Willey and Sons, Inc.

3. Leninger,A.L., Nelson, D.L., Cox, M.M., (1993). Principles of Biochemisry,(2nd Edition).CBS Publishers,

4.Geofferey, L and Zubay (1998). Biochemsitry. (Fourth Edition) Wm. C. Brown Publishers.

5.Stryer, L. (1995). Biochemistry. 4th Ed. W.H. Freeman and Company, New York

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First Allied Course – II (AC)– Practical – Biochemistry

Biochemistry

1. Qualitative and quantitative estimation of carbohydrates, amino acids, proteins, lipids and Nucleic acids.
2. Estimation of ascorbic acid (from biological sample)

Reference books.

1. Keith Wilson and John Walker. (1995). Principles & Techniques of Practical Biochemistry.(4th edition).Cambridge University press, Britain.
2. Oser, B.L.Hawks, (1965). Physiological Chemistry, TATA Mc Graw Hill.
3. Shawn O' Farrell and Ryan T. Ranallo. (2000). Experiments in Biochemistry: A Hands on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia.
3. Strolv, B.A. Makavora, V.C.(1989). Laboratory manual in Biochemistry. MIR Publisher,

CC-III MICROBIAL PHYSIOLOGY

Paper Code: U2RMBCC3 **Semester: II**

No. of Credits: 5 **No. of hours per week: 5**

Objectives:

- To acquire with basic knowledge in physiology
- To familiarize with the enzymes
- To understand the energy production
- To know the details of biosynthesis
- To know the scope in fermentation industries

Unit I - Nutrition and growth of microorganisms

Nutrition and growth of microorganisms: Nutitional types of microorganisms, nutritional requirements. Factors influencing the growth of microorganisms – temperature, pH, osmotic pressure, moisture, radiations and different chemicals. Physiology of growth – significance of various phases of growth. Growth measurements – batch, continuous and synchronous.

Unit II - Enzymes

Bacterial enzymes – classification - oxidoreductase, transferase, hydrolase, lyase, isomerase and ligase, properties, coenzymes and cofactors, isozymes. Mechanism of enzyme action, conditions affecting enzyme activity.

Unit III – Energy production

Metabolism of carbohydrates: Anabolism – photosynthesis: Oxygenic and anoxoygenic, Synthesis of carbohydrate, catabolism of glucose – Embden Meyer Hoff - Parnas pathway, pentose pathway, Kreb's cycle (TCA), electron transport system and ATP production.

Unit IV - Biosynthesis

Metabolism of proteins- metabolic pathways of nitrogen utilization, synthesis of amino acids, peptides, proteins. Purine biosynthesis and pyrimidine biosynthesis and nucleotide biosynthesis.

Unit V - Fermentation

Anaerobic Respiration – Nitrate, sulphate & methane respiration – Fermentations: alcoholic, mixed acid, lactic acid fermentation – Anabolic and catabolic processes of lipids, gluconeogenesis.

Text Books:

1. Moat, A.G., Foster, J.W. and Spector, M. P (2002) Microbial Physiology (4th Edition).John Wiley & Sons, New York.
2. Pelczar Jr, M.J. Chan, E.C.S. and Kreig, N.R.(1993) Microbiology, Mc. Graw Hill.Inc, New York
3. Hans G. Schlegel (1995) General Microbiology, Seventh edition, Cambridge University Press
4. Ronald M. Atlas. (1997) Principles of Microbiology, 2nd edition. Wm. C. Brown Publishers
5. Michael T. Madigan, John M. Martinko, Jack Parker. (1997) Brock Biology of Microorganisms, 8th edition, Prentice Hall, New Jersy.

References:

1. Doelle, H.W. (ed.)(2005) Micorbial Metabolism, Academic Press.
2. Gerhart, G., (1986) Bacterial Metabloism, Springer Verlag.
3. Lansing M. Prescott, John P., Harley and Donald A. Klein. (2003) Microbiology (5th edition). McGraw Hill Company, New York.
4. Mathews C.K. and Holde K.E.V. (1996) Biochemistry- The Benjamin/Cummings Publishing Company, Inc., New York
5. Saife, A.J. (1996) Fundamental Principles of Bacteriology (7th edition). Tata Mc Graw Hill publishing Company ltd., New Delhi.

ALLIED COURSE (FIRST) – BIOCHEMISTRY II

Paper Code : U2RMBAC3 **Semester : II**

No. of Credits : 3 **No. of hours per week : 4**

Objectives:

- To study to the blood and Endocrine glands
- To understand the synthesis of phytohormones and plant pigments
- To know the structure of cell

UNIT-I

Blood – origin, composition and functions, characterization and coagulation. Collection of blood – anticoagulants, types and mode of action – preparation of serum and plasma.

UNIT-II

Cytochemistry –structure and biochemical composition of cell wall and plasma membrane-fluid mosaic model. Trilaminar model, receptor concept, sodium - potassium pumps.

UNIT-III

Endocrine glands- Pituitary, thyroid, parathyroid, adrenal and pancreas, testes and ovary, Hormones – Definition – classification, functions, diseases associated with deficiency of hormones.

UNIT-IV

General account and biosynthesis – major and accessory plant pigments – chlorophylls, carotenoids, phycobilins and anthocyanins.

UNIT-V

Phytohormones and plant's secondary metabolites – structure and functions of auxin, gibberllins, cytokines, ethylene and abcisic acid.

Text Books

1.Hubert, Styer, 1995. Biochemistry-Freeman and Company, New York(All units covered).
2.Subramaniam, S. and Madhavan Kutty, K. 1971. The Text Book of Physiology, 1st ed., Orient Longman Ltd.
3. Sathyanarayana,U and Charapani,C.(2010).Biochemistry. Books and allied (P) Ltd
4. Deb,A.C., (1989). Fundamentals of Biochemistry (3rd Edition). New central agency.
5. Jain, J.L., (2005). Fundamentals of Biochemistry (6th Edition), S.Chand Publications
7. Sembulingam.K and Prema Sembulingam (2003). Essentials of medical physiology (2nd Edition). Jaypee Brothers Medical Pulishers (P) Ltd.

References

1. Donald voet and Judith voet.1990. Biochemistry. John Wiley and Sons, New York.
2.Henry , R.Mahler and Eugene, H.Cerdesz,1966. Biological Chemistry. Harper International Edition, New York.
3.Dawn, B.Markus ,1994. Biochemistry. Harwal publishing,NewYork.
4.William, J.Marshall and Stephan, K.Bangert.1995.Clinical Biochemistry- Metabolism and Clinical Aspects-Churchill Livingston, New York.
5.Guyton, A.C. Functions of the Human Body, W.B. Saunders Co., Philadelphia.
6.Vander, A.J, Sherman, J.H. and Luciano, D.S. Human Physiology - the Mechanisms of Body Functions, 2nd ed., TMH Pubiishing Co., Ltd.,

CC-IV VIROLOGY

Paper Code: U3RMBCC4 **Semester: III**
No. of Credits: 5 **No. of hours per week : 5**

Objectives

- What is a virus
- How do viruses multiply
- How are viruses classified
- What are some of the diseases viruses cause

Unit I: Introduction

Introduction – Definition, History of virology. General properties of viruses - Ultrastructure of viruses – cultivation of Viruses – Animal inoculation - Embryonated egg – Cell / tissue culture – classification of Viruses.

Unit II: Purification and characterization

Virus: Assay, purification and characterization of viruses. Separation and characterization of viral components (Nucleic acid, proteins, lipids and carbhohydrates) and enumeration of viruses.

Unit III: Bacterial Viruses

Bacterial Viruses – structure of bacteriophage, The Lytic life cycle (T-Even coliphages) –one step growth experiment, Lysogenic life cycle (*Escherchia coli*, Phage Lambda)-Replication.

Unit IV: Plant Viruses

Plant Viruses- general characters – morphology – structure – replication – transmission- common plant viral diseases: TMV, Bunchy top of banana, Cauliflower Mosaic Virus. Satellite virus, Viroid.

Unit V: Animal Viruses

Animal viruses: morphology, replication, pathogenesis and laboratory diagnosis, prevention and treatment of prions, Rinder pest, Blue tongue, Raniket dion, Foot and Mouth Diseases. Viral vaccines. Antiviral agents.

Text Books

1. Lansing M. Prescott., John P. Harley and Donald A. Klein. (2003). Microbiology (5thedition) McGraw Hill, New York.
2. Conrat HF, Kimball PC and Levy JA. (1988). Virology. II edition. Prentice Hall,Englewood Cliff, New Jersey.
3. Amitha Biswas (2007). An Introduction to viruses. Vikas Publishers, Delhi.
4. Dimmock N.J. and Primrose S.B. (1994). Introduction to Modern Virology. IV edition. Blackwell scientific Publications, Oxford.
5. Topley and Wilson's(1990). Principles of Bacteriology, Virology and Immunity. VIII edition Vol.IV Virology, Edward Arnold, London.

References

1. Ann Giudici Fettner. (1990). The Science of Viruses.Quill, William Marrow, New York.
2. Flint SJ, Enquist LW, King RM, Racaniell VR and Shalka AM (2000). Principles of Virology - Molecular Biology, pathogenesis and control, ASM Press, WashingtonDC.
3. Morag, C. Timbury (1994). Medical Virology. X edition. Churchill Livingston.
4. Nicklin, J. Greame-Cook and Killington, R. (2003). Instant Notes I Microbiology.(2ndedition).Viva Books private limited, New Delhi.
5. Robert I. Krasner. (2002). The microbial challenge: Human Microbe Interactions,American society for Microbiology, Washington.
6. Roger Hull.2002.Mathews' Plant Virology.(4thEdition).Academic press-A Harcourt Science and technology company, New York.

CC – V IMMUNOLOGY

Paper Code: U3RMBCC4 **Semester : III**
No. of Credits: 5 **No. of hours per week : 5**

Objectives:

- To acquire with basic knowledge in immunology
- To familiarize with the immunity
- To understand the antigen antibody reactions
- To study the immunity to microbial infections

UNIT – I

Introduction: Terminologies – History of Immunology – Immunohematology, Blood groups – ABO and Rh typing, Blood transfusion – Rh – incompatibilities – immunity – types of immunity – innate and acquired, Innate – Anatomical, physiological, phagocytic and inflammatory barriers, Acquired – cell mediated and humoral immunity. Hematopoiesis.

UNIT – II

Immune systems: Anatomy of lympho- recticular system – Primary lymphoid organs- bone marrow and thymus –. Secondary lymphoid tissue – spleen, lymphnodes, MALT and GALT – cells of the immune system – detailed aspects of T and B lymphocytes – receptors – activation and function.

UNIT – III

Antigens: Types, properties, immunogen, epitope, paratope, haptens – adjuvants – vaccines – types whole organisms vaccine, purified macromolecule vaccine, recombinant vaccine, anti-idiotype vaccine and DNA vaccine – toxoids, antitoxins. Antibody – structure, types and properties. Theories of antibody production. Complement pathway- classical and alternate.

UNIT – IV

Antigen – antibody reactions – in vitro methods; Agglutination – Widal test, Haemagglutination, HAI, Precipitation – Immunodiffusion and Immunoelectrophoresis, Complement fixation, Immunofluorescence, Enzyme linked immunosorbent assay (ELISA), Radioimmuno assay (RIA) and Fluorescent insitu hybridization (FISH).

UNIT – V

Hypersensitivity reactions – antibody (IgE) mediated - Type I anaphylaxis, Type II – Antibody dependent cellmediated cytotoxicity, Type III – immune complex reactions – respective diseases and immunologic methods of diagnosis – cell mediated immune responses – Lymphokines, Cytokines. Type IV – Hypersensitivity reactions, in vivo methods; Skin tests – immune complex tissue demonstrations, MHC and transplantation.

Text Books:

1. Ivan Roitt. Jonathan Brostoff and David Male. (2007). Immunology(7th edition).Elsevier science Ltd., New York
2. Janis Kuby (1994). Immunology. (2nd edition). W.H. Freeman and company,New York.
3. N.V.Shastri (2005). Principles of Immunology.(5th Edition).Himalaya Publishing House, Mumbai.
4. I.Kannan (2007). Immunology. MJP Publishers.
5. S.C.Rastogi (2008). Elements of Immunology. CBS publishers, New Delhi.
6. Lydyard, Whelan and Fanger (2002), Instant notes in Immunology, Bios scientific publishers.

Reference books:

1. Charles A. Janeway,Jr. Paul Travers. Mark Walport and Donald Capra,J.(1999). Immunobiology-The immune system in health and disease.(4th edition).Current Biology Publications, London.
2. Richard A., .Goldsby Thomas J. Kindt and Barbera A. Osborne. (2002). Kuby Immunology.(5th edition).W.H. Freeman and company, New York.
3. Abul K. Abbas. Andrew H. Lichtman and Jordan S.Pober.(1994). Cellular and Molecular Immunology.(2nd edition).W.B. Saunders company, Philadelphia.
4. Ian.R.Tizard (2004). Immunology – An introduction.4th Edition. Joshi & Osama (1998). Immunology (Serology, Hematology), Agro Botanica.

ALLIED COURSE (SECOND) - IV– BIOSTATISTICS

Paper Code: U3RMBAC4 **Semester: III**

No. of Credits: 3 **No. of hours per week: 4**

UNIT – I Introduction about Biostatistics

Biostatistics – definition, characters of statistics –importance of statistics – Limitation of biostatistics – Application of Biostatistics.

UNIT – II Collection of data and presentation of data

Collection of data- primary data – secondary data, sampling methods – simple, stratified and systematic (Definition and example), classification of data – types of classification – tabulation of data – parts of a table. Diagrammatic representation: Rules, limitations – Bar diagram (Simple, multiple, component, percentage) – pie diagram – histogram – frequency polygon – frequency curve – ogive curve.

UNIT – III Measures of central tendency

Measures of central tendency : Introduction – characteristics of a good average – arithmetic mean – mean – median – mode – geometric mean (definition, merits and demerits, problems based on raw, discrete and continuous data.

UNIT – IV Measures of variation

Measures of dispersion: definition – characteristics of a good variation – range- quartile derivation – mean derivation – standard deviation – coefficient of variation (definition, merits & demerits, related problems).

UNIT – V Correlation and Skewness

Correlation : Definition – scatter diagram – karl pearson correlation coefficient – rank correlation – definition – related problems.

Text Books

1. Biotatistics – PN.Arora & PK.Malhan – Himalaya Publishing house.
2. Fundamentals of Biostatistics – Veer Bala Rastogi – Ane Books India.

Reference Books

1. Introduction to Biotatistics – Sokal & Rohit – Toppan co. Japan.
2. Primer of Biostatistics – Veer Bala Rastogi – Ane Books India.

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ALLIED COURSE (SECOND) – PRACTICALS – BIOSTATISTICS

BIOSTATISTICS

UNIT – I Construction of discrete frequency distributions – continuous frequency distribution (Univariate and bivariate)

UNIT – II

Graphical representation of statistical data – simple bar diagram, multiple bar diagram, component bar diagram, percentage bas diagram, rectangle bar diagram.

UNIT – III

Diagrammatic representation of statistical data – Histrogram, Frequency polygon, frequency curve, ogive curve.

UNIT – IV

Calculation of arithmetic mean, median, mode, coefficient of variance, using biological materials.

UNIT – V

Test of significance t-test single mean and two means. Chi-square test of independence of attributes and goodness of fit.

Text Books

1. Biotatistics – PN.Arora & PK.Malhan – Himalaya Publishing house.
2. Fundamentals of Biostatistics – Veer Bala Rastogi – Ane Books India.

Reference Books

1. Introduction to Biotatistics – Sokal & Rohit – Toppan co. Japan.
2. Primer of Biostatistics – Veer Bala Rastogi – Ane Books India.

CC – VII MEDICAL MICROBIOLOGY

Paper Code: U4RMBCC7 **Semester: IV**

No. of Credits: 5 **No. of hours per week: 5**

Objectives:

- To know the basic mechanism involving in host microbe interaction.
- To acquire the knowledge of many etiological agents responsible for global infectious diseases.
- To enable them to work in medical research laboratory.
- To make beware of newly emerging disease

Unit I: Introduction to Medical Microbiology

Normal microbial flora of the human body, Host microbe interaction-virulence factors, Entry of pathogen. Infections - sources of infections and transmission - types of infections. Definitions-epidemic, pandemic, endemic diseases.

Unit II: Laboratory Diagnosis

Diagnostic microbiology - collection and transport of specimen for microbiological examination - Pus, sputum, urine, faeces, CSF, throat swab - General methods for isolation and identification of medically important bacteria – *E.coli, Salmonella, Shigella, V. cholerae and Pseudomonas.*

Unit III: bacterial diseases

Clinical symptoms, Epidemiology, pathogenesis, laboratory diagnosis, preventrion and treatment of the following bacterial infection *Staphylococcus aureus, Streptococcus pyogenes, Bacillus anthracis, Corynebacterium diptheriae,Clostridium perfringens, Clostridium tetani, Escherichia coli, Klebsiella pneumoniae, Proteus, Mycobcterium tuberculosis, Mycobacterium leprae, Treponema pallidum, Chlamydias, Rickettsiae.*

Unit IV: Mycosis and protozoan diseases

Clinical symptoms, Epidemiology, pathogenesis, laboratory diagnosis, prevention and treatment of the following fungal and Protozoan infection (a) superficial infections, subcutaneous infection,

cutaneous infection- Opportunistic fungal infections. (b)Parasitic diseases- amoebiasis, Malaria. Zoonotic diseases (Rabies, Plague), Hospital acquired infection and hospital waste management.

Unit V: Viral diseases

Clinical symptoms, Epidemiology, pathogenesis, laboratory diagnosis, prevention and treatment of the following viral infections. (a) Respiratory diseases-common cold, influenza, Avian flu, SARS (b) Heamorragic disease – Dengue, (c) Liver disease- hepatitis, (d) Sexually transmitted disease –Herpes and HIV.

Text Books

1. Ananthanarayanan, R and C K Jayaram Panicker. 2009. Textbook of Microbiology, 8th edition, Orient Longman
2. Jawetz E Melnic JL and Adelberg EA 1998, Review of Medical Microbiology Lange
3. David Greenwood.Richard C.B Slack and Jhon F.Peuthere.2000.Medical Microbiology 15th edition, ELBS with Churchill Livingston Publications.
4. Chatterjee K.D.2007. Medical Microbiology, 7th edition.
5. Prescott, Harley, Klein's. 2007. Microbiology. 7th edition, McGraw Hill Medical Publications Division.

Reference Books

1. Jawetz E Melnic JL and Adelberg EA 1998, Review of Medical Microbiology Lange Medical Publications, USA
2. Bailey and Scotts, 1994, Diagnostic Microbiology, 9th edition, Baron and Finegold CV Mosby Publications.
3. E.Jean stokes, G.L.Ridgway and M.W.D Wren (1993).Clinical Microbiology.7th edition, Eddward Arnold. A division of Hodder and Stoughton.
4. Huge W B and Russel A.D (1989). Pharmaceutical Microbiology IVedition.Black Well Scientific Publication
5. Collee, JG. Duguid JP, Fraser AG, Marimon BP. (1989) Mackie and Mc Cartney Practical Medical Microbiology, 13th Edition. Churchill Livingstone.

CC-VI Practical- II Covering Core papers IV, V & VII
Practicals II
Virology, Immunology and Medical microbiology

Virology

1. Isolation on Bacteriophage from Sewage
2. Concentration of bacteriophages
3. Study of selected bacterial, Plant and Animal viuses – T4 phage, M13 Phage, TMV, CaMV, HIV, Influenza, HSV, HBV, Rabies and Blue tongue virus

Immunology

1. ABO blood grouping, Rh Typing
2. Total count (RBC &WBC)
3. Differential count of Leucocytes
4. WIDAL test, RPR, CRP and ASO
5. Double immune diffusion
6. Demonstration of ELISA

Medical Microbiology

1. Isolation of Bacteria from Urine, Stool and Sputum
2. Identification of *Escherichia coli, Streptococcus pneumonia, Staphylococcus aureus and Klebsiella pneumonia.*
3. Saline and iodine wet mount (Cyst,ova,trophozoites)
4. Giemsa staining for the demonstration of blood parasites
5. KOH and Lactophenol Cotton blue mount
6. Germ tube technique (Candida)

Reference

1. James G. Cappucina, Natalie Sherman. (1996). Microbiology – A laboratory manual,The Benjamin (Cummings Publishing Company, Inc.)

2. Mackie and McCartney. (1989). Practical Medical Microbiology, Churchill Livingston.
3. Albert Balows, Hens G. Truper., Martin Dworkin, Wim, Hardes, Karl-heinz Schoeifer(eds). (1992). A Hand book on the biology of bacteria, ecophysiology, isolation,identification and applications, Springer Publications.
4. Sundarrajan (2007). Medical Microbiology Practical manual. Aswathi publications.

ALLIED COURSE (SECOND) – VI-BIOINFORMATICS

Paper Code: U4RMBAC6 **Semester: IV**

No. of Credits: 3 **No. of hours per week: 5**

Objectives:

- To learn the basics of computer in bioinformatics
- To understand the network system
- To know the basic information of bioinformatics
- To provide knowledge in various biological databases
- To learn the sequence analysis methods and their diverse utilities

UNIT I: Basic computer

Introduction to Computers – History of Computers – its developing technology andgeneration of Computers – Operating Systems – Windows, Unix – Hardware, Software,disc operating systems.

UNIT II: Internet

Working of Internet – Local area and wide area network – Types of files – HTML, TXT,PDF – Search engines and its types and applications.

UNIT III: Bioinformatics

Introduction to bioinformatics – its history and its development - Applications of Bioinformatics. Biological databases – NCBI, EMBL, DDBJ, PDB, Swiss Prot. Data retrieval- Entrez and SRS.

UNIT IV: Sequence alignment

Introduction to Sequence alignment. Sequence analysis – pairwise sequence comparison. Database search for similar sequences using FASTA and BLAST Programs. Multiple sequence alignments.

UNIT V: Evolutionary analysis

Evolutionary analysis: distances, Cladistic and Phenetic Method. Clustering Methods. Rooted and Unrooted tree representation. Bootstrapping strategies, Uses of Clustal W and PHYLIP, MEGA

Text Books:

1. Alexis Leon & Mathews Leon. Fundamentals of Information Technology.VikasPublication.Chenai. (Unit I & II)
2. S.C. Rastogi, NamitaMendiratta, ParagRastogi. Bioinformatics – Concepts, Skills, Applications". (Unit III & IV)
3. Dubey R.C(2007) Text Book of Biotechnology. S.Chand& Company Ltd.(Unit –V)
4. Shanmughavel, P. 2005. Principles of Bioinformatics, Pointer Publishers, Jaipur, India.
5. Teresa. K. Atwood and David J. Parry-Smith Introduction to Bioinformatics.

Referrences;

1. Cynthia Gibas& Per Jambeck (2001). Developing Bioinformatics Computer Skills:Shroff Publishers & Distributors Pvt. Ltd (O'Reilly), Mumbai
2. HH Rashidi& LK Buehler (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London
3. Des Higgins & Willie Taylor (2002). Bioinformatics: Sequence, structure and databanks, Oxford University Press
4. Baxevanis AD & Ouellette BEF (2001) Bioinformatics: A practical guide to the analysis of genes and proteins, Wiley Interscience – New York
5. Teresa. K. Atwood and David J. Parry-Smith Introduction to Bioinformatics.10BIIA13C

CC-VIII MICROBIAL GENETICS

Paper Code: U5RMBCC8 **Semester: V**
No. of Credits: 5 **No. of hours per week: 5**

Objectives:

- To familiarize with the basic knowledge in genetics
- To understand the gene structure and function
- To know the gene transfer mechanisms
- To get knowledge in Operon concepts
- To apply the gene mechanisms for research and industrial purposes

Unit I – Genetic Material

History – experiments of Hershey Chase and Griffith, DNA as the genetic material –discovery of DNA structure – RNA as a genetic material – Genetic code – major features of genetic code, organization and deciphering of genetic code, elucidation of codons.

Unit II – Genome organization and function

Organization and functioning of genetic material – Bacterial and viral. Details of *E.coli* chromosome. Replication of DNA – rolling circle model – theta model. Replication of RNA – reverse transcriptase. Brief account of plasmid – structure – types

Unit III – Gene expression

Regulation of gene expression – The Operon concept, positive regulation (*ara* Operon of *E. coli*) and negative regulation (*lac* Operon of *E. Coli*). and attenuation control - Control sequences- Induction and Repression, promotors, operators, attenuators and antiterminators- Trp operon.

Unit IV – Gene Transfer

Gene transfer mechanisms – conjugation - F^+ x F^- mating , Hfr, F' x F^- conjugation. Transduction: Generalized and specialized transduction.– transformation – Natural gene transfer. Transposable genetic elements: Discovery -Insertion sequences in prokaryotes - Complex transposons (Tn10, Tn5, Tn9 and Tn3), Reteroposans.

Unit V – Gene mutation and repair

Mutagenesis – mutation – mutants –spontaneous and induced mutations, phenotypic mutants – Mechanism of repair: Photo reactivation, excision repair, recombinational repair - The SOS and adaptive responses and their regulation – Heat shock response.

Text Books

1. David Frifelder.(1990). Microbial Genetics, Narosa publishing house, New Delhi.
2. Lansing M. Prescott., John P. Harley and Donald A.Klein.(2003). Microbiology (5^{th} edition) McGraw Hill, New York.
3. Malor Sr, Cronan Jr. JE. Freifelds D (1994). Microbial Genetics. Jones and Bartlett Publishers.
4. Daniel L. Hartl and Elizabeth W. Jones.(2001). Genetics-Analysis of Genes and Genomes, Jones and Bartlett publishers, UK.

Reference Books

1. Lewin B. (2000). Genes VII. Oxford University press
2. Gardner E.J., Simmons M.J., Snustad D.P. (1991). Principles of Genetics. John Wiley & sons.
3. Jeremy M. Dale. (1998). Molecular Genetics of Bacteria (3rd edition).John Wiley and sons,NewYork.
4. Larry Synder and Wendy Champness. (2003). Molecular Genetics of Bacteria (2nd edition).American Society for Microbiology, Washington.
5. Lodish, H., Baltimore, D. Berk, A. Zipsury, S.L., Matsudaira, P. Darnell, J. (1995). Molecular Cell Biology. Scientific American Books.

CC - IX AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY

Paper Code: U5RMBCC9 **Semester: V**
No. of Credits: 5 **No. of hours per week: 5**

Objectives:

- To know the physico chemical characteristics of soil and role of microbes in improving soil fertility.
- To become familiar with some important Indian crop diseases
- To inculcate the spread of air born and water born diseases
- To Acquire the knowledge of Aquatic ecosystem
- To know the solid and liquid waste management

Unit I: Introduction to soil microbiology

Soil microbiology - Introduction – Soil as an environment for microorganisms. Classification of soil, physical and chemical properties of soil, structure of soil – soil microorganisms – biogeochemical cycles – C, N and P.

Unit II: Microbial interactions

Microbial interactions definition and types - mutalism, commensalism amensalism – synergism - parasitism – predation - competition. Brief account of diseases – bacterial (blight of paddy, citrus canker) fungal (late blight of potato, stem rust of wheat) viral (tobacco mosaic virus, cucumber mosaic virus).

Unit III: Aeromicrobiology

Composition of air, kinds of organisms in air, distribution and sources. Droplets nuclei, aerosol and infectious dust, assessment of air quality. Brief account of air – borne diseases.

Unit IV: Aquatic ecosystems

Types of aquatic ecosystems: fresh water – ponds, lakes, streams. Marine habitats –estuaries, mangroves, deep sea, saltpan, coral reefs. Zonation – upwelling – eutrophication. Potability of water - microbial assessment of water quality – water purification. Brief account of water borne diseases.

Unit V: Waste management

Types of wastes – solid and liquid waste treatment. Solid waste treatment – saccharification – gasification – composting. Liquid waste treatment – primary –secondary – tertiary treatment. Utilization of liquid and solid wastes – food (SCP) –fuel (methane).

Text Books

1. Atlas Ronald, M., Bartha, and Richard (1987). Microbial Ecology (2nd Edition). Benjamin/Cummings Publishing Company, California (Unit III and IV covered).
2. Subba Rao N .S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. pvt. Ltd. New Delhi (Unit I and II covered).
3. Joseph, C. Daniel.(1999). Environmental Aspect of Microbiology (2nd Edition).Bright sun publication (Unit V covered).
4. Munn, C.B. (2004). Marine Microbial Ecology and Applications. Bio scientific publishers, New York.

Reference Books

1. Blackie. (1998). Plant Molecular Biology. (2nd edition). Chapman Hall, New York.
2. Burns, R.C. and Slater, J.H. (1992).Experimental microbial Ecology- Blackwell Scientific publication, Oxford London.
3. Christon J. Hurst. (2002). Manual of Environmental Microbiology.(2nd edition). American Society for Microbiology, Washington.
4. Marshall, K.C. (1985). Advances in Microbial Ecology. Vol-8.Plenum press.

CC - X INDUSTRIAL MICROBIOLOGY

Paper Code: U5RMBCC10 **Semester: V**
No. of Credits: 5 **No. of hours per week: 5**

Objectives:

- To be aware of the historical background of industrial microbiology
- To understand how fermenters are used in the processes of the synthesis of important products
- To know the downstream process
- To understand the production of pharmaceutical products
- To focus an opportunities to find jobs in such fermentation industries

Unit I – Historical background

Historical development of Industrial Microbiology, Industrially important microorganisms, Major classes of products, Improvement of industrially important microbial strains-auxotrophic mutants - mutants resistant to analogue .

Unit II – Fermenter design and media

Design of a fermenter, types of fermenters and basic functions, Fermentation media formulation strategies, economic means of providing energy, carbon, nitrogen, vitamin and mineral sources, role of buffers, precursors, inhibitors, inducers and antifoams.

Unit III – Downstream process

The recovery and purification of fermentation products (intracellular and extracellular), cell disruption, precipitation, filtration, centrifugation, solvent recovery, chromatography, ultracentrifugation, drying, cell immobilization and its applications.

Unit IV – Pharmaceutical products

Microbial products of pharmaceutical value – raw materials, organism, industrial processes involved and recovery of the products in the production of penicillin, Streptomycin, vitamin B12 and rabies vaccine.

Unit V – Industrial products

Microbial products of industrial value – raw materials, organism and Industrial processes involved in the production of ethanol, vinegar, amylase, protease, glutamic acid. Recycling of industrial wastes through microbes.

Text Books:

1. Stanbury. P.F. Whitaker. A, Hall. S.J. (1995). Principles of Fermentation Technology, Pergamon Press. (Unit IV, V)
2. Patel A.H. (2006). Industrial Microbiology, Rajiv Beri for MacMillan India Ltd., New Delhi. (Unit I, II, III)
3. Casida,J.R(2009).Industrial Microbiology. New age international (P) Limited.
4. Kalaichelvan, P T. & Arul Pandi (2007) Bioprocess Technology . MJP Publishers Chennai.
5. Sateesh M.K,(2008).Bioethics and Biosafety .I.K.International Publishing house Pvt .Ltd.

Reference Books

1. Glick, B.R. Pasternak, J.J. (1994) Molecular Biotechnology – ASM Press.
2. Demain A.L. Solomon N.A. (1986) Manual of Industrial Microbiology and Biotechnology ASM Press.
3. Prave, P.Faust, V.Sitting, W.,Sukatsch. D.A.(1987) Fundamentals of Biotechnology ASM Press.
4. Reed. G. (1982) Prescott and Dunn's Industrial Microbiology. Macmillan Publishers.
5. Sikyta. B. (1983) Methods in Industrial Microbiology. Ellis Horwood limited.

CC-XI Practical- III Covering Core papers VIII & IX

Microbial genetics

1. Isolation of Auxotrophic mutants
2. Genomic DNA & Plasmid DNA isolation from bacteria

Agricultural and Environmental microbiology

1. Water analysis by MPN technique – presumptive coliform test – confirmed coliform test and completed coliform test.

2. Microbial assessment of air quality – open plate method and air sampler-technique.
3. Isolation and counting of faecal bacteria from water.
4. Soil Analysis -pH, chlorides, nitrate, calcium, magnesium and total phosphorus.
5. Isolation of cyanobacteria from water.
6. Isolation of Azospirillum, Azotobacter from paddy field.
7. Isolation of Rhizobium form legume nodule.
8. Identification of VAM.

References:

1. K.R.Aneja (2010). Experiments in Microbiology, Plant pathology and biotechnology. New Age International Pvt.Ltd.NewDelhi.
2. R.C.Dubey (2002). Microbiology practical manual. S.Chand and Company LTD.
3. Kannan.N (2002) Lab manual in General Microbiology. Panima Publishing Corporation.

MBE- I MICROBIAL INOCULANTS

Paper Code: U5RMBMBE1 **Semester: V**
No. of Credits: 5 **No. of hours per week: 5**

Objectives

- Isolate, identify and screen efficient and effective strains of microbial inoculant
- Findout a suitable carriers for mass production of microbial inoculant
- Develop a suitable techniques of mass production of biofertilizer
- Recommend optimum dose, time and methods of biofertilizers
- Supply of quality liquid biofertilizer on no loss no profit basis

Unit I: Introduction

General account of the microbes used as biofertilizers for crop plants and their advantages. Introduction – definition – advantages.Biocontrol agent – *Pseudomonas.* Green Manure – *Azolla.*

Unit II: Symbiotic N_2 fixers

Rhizobium - Cyanobacteria – Frankia – Isolation, identification, characterization, mass inoculum production and applications.

Unit III: Non - symbiotic N_2 fixer

Azospirillum - Free living – *Azotobacter* - isolation, characterization, mass inoculum production and field application.

Unit IV: Phosphate solubilizers

Phosphate solubilizing microbes – Isolation, characterization, mass inoculum production, field application – Phosphate solubilization mechanism.

Unit V: Mycorrhizae

Mycorrhizae - classification - Taxonomy of mycorrhizae - Isolation of VA mycorrhiza - Mass inoculums production of VAM – field application of Ectomycorrhizae and VAM.

Text Books

1. Kannaiyan,S (2003). Biotechnology of Biofertilizers,CHIPS, Texas.
2. Kumaresan.V (2009). Biotechnology.Saras Publications.
3. Subba Rao N .S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. pvt. Ltd. New Delhi.
4. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology.(5^{th} edition).McGraw-Hill company, New York
5. Text book of Microbiology. R.C.Dubey Maheshwari (2006).Chand and company (P)LTD

Reference Books

1. Mahendre K.Rai (2005). Hand book of microbial biofertilizers. The Howorth Press ,Inc.New York.
2. Reddy, S.M. *et al* (2002) Bioinoculants for sustainable agriculture and forestry , Scientific Publishers.
3. Subba Rao N.S (1988) Biofertilizers in Agriculture and forestry Oxford and IBH publishing Co...Ltd...New Delhi.

CC – XIII MOLECULAR BIOLOGY

Paper Code: U6RMBCC13 **Semester: VI**
No. of Credits: 5 **No. of hours per week: 5**

Objectives:

- To be aware of the basics about nucleic acid
- To understand the different vectors
- To know the enzymes used in molecular biology
- To familiarize with the gene manipulation
- To understand how these tools are used in research and industries

Unit I: Nucleic acids

Nucleic acids: Structure and properties of DNA and RNA, Types and forms – DNA, RNA (t-RNA, r-RNA, m-RNA) – Definition and functions. Difference between DNA and RNA.

Unit II: Vectors

Cloning vectors – plasmids, phage vector, phagemids and cosmids, Ti-plasmid, pBR322, pSC101, pUC, Shuttle vectors and expression vectors – Yeast Artificial Chromosome (YAC), Bacterial Artificial Chromosome (BAC).

Unit III: Enzymes

Enzymes– Nucleases – Exonucleases and Endonucleases, Concept of restriction and modification – Restriction endonucleases, ligases, polymerases, DNA modifying enzymes, Topoisomerases, Methylases – their uses and applications.

Unit IV: Gene manipulation

Gene and its manipulation techniques – Definition of a gene, structure, cloning techniques, methods of Gene transfer, construction of genomic libraries and c-DNA Libraries. RNA splicing, Brief account of DNA sequencing.

Unit V: Hybridization techniques

Nucleic acid and protein hybridization technique – Southern, Northern and Western blotting techniques. DNA amplification using polymerase chain reaction (PCR): types and applications of PCR, DNA fingerprinting and its applications.

Text Books:

1. Dubey R.C(2007) Text Book of Biotechnology. S.Chand & Company Ltd.
2. Freifelder D. (1991). Molecular Biology. Narosa Publishing Home.
3. Brown, T.A., (2006), Gene Cloning, Garland science Publications
4. Joghand, S.N., (2007). Gene Biotechnology (2nd Edition).Himalaya Publishing company, India.
5. Richard M. Twyman. (2003). Advanced Molecular Biology(1st edition).Viva Books private Ltd, New Delhi.

Reference books.

1. Veer Bala Rastogi (2008).Fundmentals of Molecular Biology. Anne Books, India.(Unit-1)
2. James D. Watson. Michael Gilman. Jan Witkowski and MarkZoller. (2001). Recombinant DNA. Scientific American Books, New York.
3. Lewin, B. (2000). Genes VII. Oxford University press.
4. Lodish, H, Baltimore D, Berk A, Zipursky SL, Matsudaira P, Darnell J. (1995). Molecular Cell Biology. Scientific American Books.
5. Michael Blackburn and Michael J. Gait. (1996). Nucleic acids in chemistry and Biology.(2nd edition).Oxford University press.

CC – XIV MICROBIAL BIOTECHNOLOGY

Paper Code: U6RMBCC14 **Semester: VI**
No. of Credits: 5 **No. of hours per week: 5**

Objectives:

- To be aware of the history and scope of biotechnology
- To familiarize with the enzyme technology
- To know the recombinant DNA technology
- To understand the nanotechnology
- To understand the importance of patents in research

Unit I: History and scope

Biotechnology - Definition – concepts - history, scope and importance, emergence of modern biotechnology - global impact and current excitement of biotechnology (Health care, agriculture, human genome project, environment, genomics and proteomics and bioformatics), biotechnology in India and development.

Unit II: Enzyme technology

Enzyme production technology through microbes, problems and applications. Enzyme immobilization - definition, advantages of using immobilized enzymes, various methods of immobilization: adsorption, entrapment, ionic bonding, cross linking and encapsulation.

Unit III: rDNA technology

Principles and application of recombinant DNA technology, production of recombinant vaccine, Insulin, interferon, hormones. Production of Monoclonal antibodies and its applications,Gene therapy – types (somatic cell gene therapy, germ line gene therapy, enhancement and eugenic genetic engineering).

Unit IV: Nanotechnology

History and development of nanotechnology, introduction, definitions of nanoparticles, nanotubes, nanowires, microbial production of nanoparticles and its applications.

Unit V: Intellectual property rights

IPR-Tools of IPR (copy rights, patenting, trade mark & trade secret), patenting of biological materials, GATT, WTO, WIPO. Biosafety and Bio ethics – Definitions, principles, Bio safety guide lines for Microbiology Laboratory.

Text Books:

1. Text book of Biotechnology. R.C.Dubey (2006).Chand and company (P)Ltd.
2. Glick. B, R and Pasternak J. J (2001) Molecular biotechnology. ASM press,Washington.
3. Kumaresan . V (2009) Biotechnology. Saras Publication.
4. Singh B. D (2006).Biotechnology.KalyaniPublication.
5. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology.(5th edition).McGraw-Hill company, New York

References Books:

1. Helen Kreuzerand Massey (1996).Recombinant DNA and Biotechnology, American society for Microbiology, Washington
2. Trevan,M,D,Boffey,S.Coulding K.Hand Stanburry.p.(1990)Biotechnology the basic principles-Tata McGraw Hill edition.
3. Nanotechnology Fundamentals and applications I.K.International Publishing House Pvt.Ltd,Neu Delhi.
4. Sathyanarayana, U (2008).Biotechnology.Books and allied (P) Ltd

CC-XII Practical- IV Covering Core papers X,XIII & XIV

Industrial Microbiology, Molecular biology and Microbial Biotechnology

1. Assessment of milk quality by methylene blue reduction test
2. Isolation of bacteria from bread, tomato and any one beverage
3. Wet mount preparation of spoiled bread, tomato, grapes, potato.
4. Whole cell immobilization – alginate.
5. Estimation of ethanol,Citric acid
6. Mushroom cultivation
7. Demonstration

-Agarose gel electrophoresis
-Transformation techniques

Reference Books:

1. Atlas, R.M. and Bartha, R. (1993). Microbial Ecology: Fundamentals and Applications,3rd Ed., Benjamin and Cummings Pub. Co. New York.20
2. David M. Sylvia, Jeffry J. Fuhrmann, Peter Hastell, David A. Zuberer, 1st Ed. PrenticeHall.
3. James G. Cappuccino and Natalie Sherman. (1996). Microbiology-A Laboratory Manual(4th edition).The Benjamin publishing company, New York.
4. Paul, I.A., and Clark, F.E. (2000). Soil Microbiology and Biochemistry, 2nd Ed.Academic press.
5. Rangaswamy, G. and Bagyaraj, D.J. (2001). Agricultural Microbiology, 2nd Ed. Prentice Hall of India Pvt. Ltd., New Delhi.
6. Russell F. Bey. (2001). Microbiology Laboratory Manual, BROOKS/COLE, Australia.
7. Subba Rao, N.S. (2002). Soil Microbiology, 4th Ed. (soil Microorganisms and plant growth), Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

MBE- II FOOD MICROBIOLOGY

Paper Code: U6RMBMBE2 **Semester: VI**
No. of Credits: 5 **No. of hours per week: 5**

Objectives

- Identify the extrinsic and intrinic parameters that affect bacterial growth
- List the primary sources of microorganisms in various food products
- Identify the food borne pathogens
- List the types of food preservations

Unit I: Introduction

Importance of food microbiology – Types of microorganisms in food- Factors influencing microbial growth in food - Intrinsic and extrinsic factors – primary sources of microbes in food.

Unit II: Microbial food

History- mass production- growth requirements- uses of SCP - *Spirulina* - Yeast and Bacteria.

Unit III: Contamination, spoilage and preservation

Cereals and cereal products, sugar and sugar products. Vegetables and fruits, meat and meat products, egg and egg products and milk and milk products.

Unit IV: Food borne diseases and food poisoning

Staphylococcus, Escherichia coli and *Salmonella* infections. Hepatitis, Amoebiosis. Food poisoning (*Clostridium spp.)* and Mycotoxins.

Unit V: Food preservation

Food preservations-principles, methods of preservations-physical and chemical methods, pasteurization of milk. Food sanitations, Microbiological criteria and food safety, good manufacturing practices.

Text Books

1. Frazier and Westhoff, DC. 1988. Food Microbiology. TATA McGraw Hill Publishing, Company LTD., New Delhi.
2. Adams, M.R and Moss, MO. 1995. Food Microbiology. The Royal Society of chemistry, Cambridge.
3. Banwart GJ. 1989, Basic food microbiology, Chapman & Hall, New York.
4. Sivasankar B. 2005. Food Processing and preservation, Prentice-Hall of India Pvt.Ltd.
5. James M.Jay. 2003. Modern Food Microbiology, 4th edition, CBS Publishers and distributers

Reference Books

1. Andrews AT, Varley J. 1994. Biochemistry of milk products. Royal Society of Chemistry.
2. Robinson RK. 1990. The microbiology of milk. Elsevier Applied Science, London.
3. Ramanathan N. 2009.A Textbook of Food Microbiology, OM Sakthi pathipagam
4. Shirly J. VanGarde, Margy Woodburn. 2005. Food Preservation and Safety, Surabhi Publications.

5. Pelczar Jr,M.J.Chan, E.C.S. and Kreig,N.R. (1993). Microbiology, Mc,Graw Hill.Inc, New York.

MBE- III - BIOINSTRUMENTATION

Paper Code: U6RMBMBE3 **Semester: VI**
No. of Credits: 5 **No. of hours per week: 5**

UNIT - I

Balances, Centrifuges – Bench top, refrigerated and ultracentrifuges. Incubator, Waterbath, Water Still, Refrigerator, Laboratory glassware and its uses – Types of pipettes, calibration of pipettes, syringes and needles.

UNIT - II

Basic chemistry – acids, bases, buffers- measurements – pH meter. Preparation of solutions – units of weights and volume, Calculation of concentration and methods of expressing concentration of solutions – normality and molarity solutions.

UNIT – III

Colorimetry, UV – Visible Spectrophotometer – Theoretical aspects, types, selection of wavelength, use of blank and determination of concentration in the test sample..

UNIT – IV

Tracer techniques: Radioactive isotope – Half life, GM counter, Liquid scintillation counter, Autoradiography, Semi auto analyzer, ELISA Reader, Thermal cycler and cold storage.

UNIT – V

Laminor air flow chamber, electrophoresis –SDS – PAGE; Agarose gel, Chromatography – principle, instrumentation and application of column Chromatography, ion exchange chromatography, Thin layer Chromatography and HPLC.

Text Books:

1. Veerakumari (2005). MJP Publishers.
2. Palaivelu.P (2002) Analytical Biochemistry, MKU University.
3. B.Sivakumar (2005). Bioseperations - Principles and Techniques.Prentice-Hall of India Pvt.ltd.
4. P.Asokan (2002). Analytical Biochemistry. Chinna Publications.
5. Dubey, R.C. (2006). Text book of Biotechnology. Chand and company (P)Ltd.
6. Upadhayay Nath, 2001.Biophysical chemistry.

Reference books:

1. P Sambrrok, J. and Ruseell, D.W. (2001) Molecular Cloning – A Laboratory Manual (3rd eidition, Vol. 1,2,3) Cold Spring Laboratory Press, New York. Ress
2. Glick, B.R. and Pasternak, J.J. (1994). Molecular Biotechnology, ASM Press.
3. John G. Webster. (2004). Bioinstrumentation. University of Wisconsin, John Wiley & Sons, Inc.
4. Wilson, K. and Walker.J (2005). Practical Biochemistry Principles and Techniques,6th edition, Cambridge University/
5. Holme.J and Peck.H (1993). Analytical Biochemistry 2nd edition. Longman Scientific and Technical.
6. Chatwal Anand, 2003. Instrumental methods of chemical analysis,

IDC -MUSHROOM TECHNOLOGY

No. of Credits: 2 **No. of hours per week: 2**

Objectives:

- To give the basics of mushrooms in human food
- To know mushroom propagation for food industries
- To give an opportunity for future entrepreneurship

Unit I: Introduction

Introduction – History – scope of edible mushroom cultivation – Types of edible mushroom available in India – *Calacybe indica, Volvariella volvacea, Pleurotus sajor-caju. Agaricus bisporus.*

Unit II: Pure culture

Pure culture – preparation of media (PDA and Oatmeal agar media) sterilization – Preparation of test tube slants to store mother culture – culturing of Pleurotus mycelium on petriplates – Preparation of mother spawn in saline bottle and polypropylene bags and their multiplication.

Unit III: Cultivation Technology

Cultivation Technology: Infra structure, locally available substrates, polythene bags, vessels, inoculation hood, inoculation loop, low cost stove, sieves, Culture rack, Mushroom unit (Thatched house) – Mushroom bed preparation – Paddy straw, sugarcane trash, maize straw, banana leaves.

Unit IV: Storage and nutrition

Storage and nutrition: Short term storage – long term storage (scanning, pickles, papads, drying, storage in salt solutions) – Nutrition: Proteins, amino acids, mineral elements. Nutrition : Carbohydrates – Crude fiber content, vitamins.

Unit V: Food preparation

Food preparation: Types of foods prepared from mushroom – soup, cutlet, omlette, samosa, pickles, curry. Research centers – National level and Regional level. Cost benefit ratio – Marketing in India and abroad – Export value.

Text Books:

1. Nita Bahl (1988) Hand Book of Mushrooms, II edition Vol I & II.
2. Shu Ting Chang, Philip G. Miles, Chang. S.T. (2004). Mushrooms: Cultivation, nutritional value, medicinal effect and environmental impact. 2nd edition, CRC press.

Reference Books:

1. Paul Stamets, J.S. and Chittom, J.S. (2004). Mushroom Cultivator: A Practical guide to grow mushrooms at home, Agarikon press.
2. Marimuthu*et al*.,(1991) Oyster Mushrooms, Dept. of Plant Pathology, TNAU, Coimbathore.
3. Tewari and PankajKapoor S.C. (1988) Mushroom cultivation, Mittal Publications, Delhi.
4. Swaminathan M. (1990) Food and Nutrition. Bappco. The Bangalore Pritning and Publishing Company Ltd., Bangalore.

IDC- BIOFERTILIZER

No. of Credits: 2 **No. of hours per week:2**

Objectives:

- To give the basics of bio fertilizers for better soil management
- To learn importance of symbiotic and non symbiotic N2 fixers
- To know how microbes are utilized in agriculture
- To learn the phosphate solubilizers and mycorrhizal

Unit I: Introduction

General account of the microbes used as biofertilizers for crop plants and their advantages. Symbiotic N2 fixers*: Rhizobium* – Isolation, characterization, Identification, Classification, inoculum production and applications.

Unit II: Non - symbiotic N2 fixer

Non - symbiotic N2 fixer - *Azospirillum*- Free living – *Azotobacter, Clostridium, Klebsiella and Anabaena* - free isolation, characterization, mass inoculum production and field application.

Unit III: Symbiotic N2 fixers

Symbiotic N2 fixers - Cyanobacteria, *Azolla*- Isolation, characterization, mass multiplication – Role in rice cultivation- Crop response - field application. Frankia - Isolation, characterization – actinorrhizal nodules – non leguminous crop symbiosis.

Unit IV: Phosphate solubilizers

Phosphate solubilizers - Phosphate solubilizing microbes – Isolation, characterization, mass inoculum production, field application – Phosphate solubilization mechanism.

Unit V: Mycorrhizal

Mycorrhizal - classification - Taxonomy of mycorrhizae - Isolation of VA mycorrhiza - Mass inoculum production of VAM – field application of Ectomycorrhizae and VAM.

Text Books

1. Kannaiyan,S.(2003). Biotechnology of Biofertilizers,CHIPS, Texas.
2. SubbaRao N .S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. pvt. Ltd. New Delhi.
3. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology.(5th edition).McGraw-Hill company, New York
4. Text book of Microbiology. R.C.DubeyMaheshwari(2006).Chand and company (P)LTD

Reference Books

1. MahendreK.Rai(2005). Hand book of microbial biofertilizers. The HoworthPress ,Inc.New York.
2. Reddy, S.M. *et al* (2002) Bioinoculants for sustainable agriculture and forestry , Scientific Publishers.
3. SubbaRao N.S (1988) Biofertilizers in Agriculture and forestry Oxford and IBH
4. publishing Co...Ltd...New Delhi.

MBE IV - MICROBIAL DIVERSITY

UNIT – I

Microbial diversity – siginifcance – microbial evolution – general methods of classifying bacteria - Taxanomy – Principles – Modern approaches – Numerical - Genetic, Serotaxonomy and Chemotaxonomy.

UNIT – II

Taxanomy of Eubacteria and Actinomycetes – Detailed classification upto genus level with general characters of each group – Bergey's Manual and its importance.

UNIT – III

Taxanomy of Photosynthetic Eubacteria and Archaebacteria- General characteristics.

UNIT – IV

Taxanomy of Fungi (Alexopolous) - General Characteristics - Life Cycles of Mucor, Neurospora ,Agaricus, Dictyostelium.

UNIT – V

Taxanomy of Algae -General Characters and its importance –Cholorophyta- Euglenophyta – Chrysophyta- Phaeophyta - Rhodophyta – Pyrrophyta-Taxonomy of Protozoa – General characters and its importance – Mastigophora, Rhizopoda, Ciliata, Sporozoa.

References

1. Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers.
2. Michael J. Pelczar, Jr. E.C.S. Chan, Moel : Microbiology Mc Graw Hill Book R. Krieg, 1986 Company
3. Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R. 1986 The Microbial world, 5th edition. Eagle Works Cliffs N.J. Prentica Hall.

MBE V - CELL BIOLOGY

UNIT – I

Ultrastructure of Eubacteria- Cell wall – Cell membrane- Extra mural layer - Slime – Capsule – Cytoplasmic inclusions – Mesosomes – Nuclear material – Reserve materials - Pigment – Cell appendages – Flagella – Pili.

UNIT – II

Ultrasturcute and functions of Eukaryotic cell organelles – Cell wall – Cell membrane - Mitochondria – Chloroplast – Endoplasmic reticulum – Golgi complex – Nucleus – Ribosomes – Other cell inclusions and Flagella.

UNIT III

Cell division in Bacteria – Binary fission - Cell division of Eukaryotes – Mitosis and Meiosis.

UNIT IV

Transport mechanisms – Diffusion - Facilitated diffusion – Active transport – Group translocation – Phagocytosis – Pinocytosis.

UNIT V

Archaebacterial cell wall and cell membranes of Methanogens - Halophiles - Thermoacdiphiles.

References

1. Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers.
2. Michael J. Pelczar, Jr. E.C.S. Chan, Moel : Microbiology Mc Graw Hill Book R. Krieg, 1986 Company
3. Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R. 1986 The Microbial world, 5th edition. Eagle Works Cliffs N.J. Prentica Hall.

BASIC MICROBIOLOGY

UNIT – I

History and Scope of Microbiology – Spontaneous generation theory – Contribution of Leuvenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister, Winogradsky, \Waksman, John Tyndall clasification of micro organisims - Haeckl's threekingdom concept,Whittaker's Five kingdom concept.

UNIT – II

Microscopy and Staining -Microscopy – Principles and application – Bright field, Dark field, Phase contrast, Fluorescence, SEM & TEM- Specimen preparation for electron microscopy – freeze etching

UNIT – III

Sterilization and Disinfection- Principles- Methods of Sterilization – Physical methods – Dry heat- Moist heat, Filtration (Membrane & HEPA) - Radiation – Chemical Sterilization -Chemical agents, Mode of action – Phenol coefficient test- Sterility testing.

UNIT – IV

General characteristics of Archaebacteria, Eubacteria, Cyanobacteria, Mycoplasmas, Rickettsiae,Chlamydias,Spirocheates ,Actinomycetes,Protozoa,Algae,Fungi,and Viruses.

UNIT – V

Ultra structure of bacteria, sub cellular structures and cell envelop-slime, capsule, cell wall ,Pili, flagella,cell inclusions.Methods of maintenance and preservation of microbes

Text Books

1. Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers(All Units)
2. Michael J. Pelczar, Jr. E.C.S. Chan, Moel : Microbiology Mc Graw Hill Book R. Krieg, 1986 Company(All Units).
3. Text Book of Microbiology R.C.Dubey and Maheswary. S.Chand and company (P)LTD.

References

1. Salle A.J. : Fundamental Principles of Bacteriology 7th edition, Tata Mc Hill Publishing Company Ltd.,
2. Michael J. Pelczar, Jr. E.C.S. Chan, Moel : Microbiology Mc Graw Hill Book R. Krieg, 1986

Company
3. Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R. 1986 The Microbial world, 5th edition. Eagle Works Cliffs N.J. Prentica Hall..
4. William claus. G.W. 1989. Understanding Microbes – A Laboratory textbook for Microbiology,W.H. Freeman and Co., New York.
5. Wilson. K and Goulding. K.H. 1986. A Biologist's Guide to Principles and Techniques of Practical Biochemistry, ELBS, London
6. Tauro P., Kapoor, K.K. Yadav,K.S.An introduction to Microbiology first Edition ,New Age International Publishers.