MASTER OF SCIENCE IN INDUSTRIAL MICROBIOLOGY

(Choice Based Credit System)

DEPARTMENT OF MICROBIOLOGY

SRI VENKATESWARA UNIVERSITY:TIRUPATI

SRI VENKATESWARA UNIVERSITY::TIRUPATI
COLLEGE OF SCIENCES
CBCS Pattern (With effect from 2017-2018)
M.Sc. Industrial Microbiology Course
Department of MICROBIOLOGY

SEMESTER – I

Sl. No.	Course Code	Components of Study	Title of the Course	Contact Hours	No. of Credits	IA Marks	End SEM Exam Marks	Total
1.	IMB-101	Core - Theory	Biological Chemistry & Analytical Techniques	04	04	20	80	100
2.	IMB-102	Core - Theory	Enzymology & Microbial Physiology & Metabolism	04	04	20	80	100
3.	IMB-103	Core - Practical	Biological Chemistry & Analytical Techniques	04	04	-	-	100
4.	IMB-104	Core - Practical	Enzymology & Microbial Physiology & Metabolism	04	04	-	-	100
5.	IMB-105	Compulsory Foundation **(Related to Subject)**	Introductory Microbiology	04	04	20	80	100
6.	IMB-106	Elective Foundation **(Human Values and Ethics)**	Human Values and Professional Ethics – I	04	04	20	80	100
		Total		**24**	**24**			**600**

SEMESTER – II

Sl. No.	Course Code	Components of Study	Title of the Course	Contact Hours	No. of Credits	IA Marks	End SEM Exam Marks	Total
1.	IMB-201	Core - Theory	Immunology	04	04	20	80	100
2.	IMB-202	Core - Theory	Medical Microbiology	04	04	20	80	100
3.	IMB-203	Core - Practical	Immunology	04	04	-	-	100
4.	IMB-204	Core - Practical	Medical Microbiology	04	04	-	-	100
5.	IMB-205	Compulsory Foundation **(Related to Subject)**	Basics of Virology	04	04	20	80	100
6.	IMB-206	Elective Foundation **(Human Values and Ethics)**	Human Values and Professional Ethics –II	04	04	20	80	100
		Total		**24**	**24**			**600**

SEMESTER – III

Sl. No.	Course Code	Components of Study	Title of the Course	Contact Hours	No. of Credits	IA Marks	End SEM Exam Marks	Total
1.	IMB-301	Core - Theory	Fundamentals of Industrial	04	04	20	80	100

			Microbiology					
2.	IMB-302	Core - Theory	Food Microbiology and Fermentation Technology	04	04	20	80	100
3.	IMB-303	Core - Practical	Fundamentals of Industrial Microbiology	04	04	-	-	100
4.	IMB-304	Core - Practical	Food Microbiology and Fermentation Technology	04	04	-	-	100
5.	IMB-305	Generic Elective* **(Related to Subject)**	a) Bioprocessing of Industrial Microorganisms and their Products b) Bioprocess Engineering and Technology	04	04 04	20 20	80 80	100 100
6.	IMB-306	Open Elective* **(For other department)**	a) Industrial Biotechnology b)Immuno Technology and Human Health	04	04	20	80	100
		Total		**24**	**24**			**600**

***Among the Electives a student shall choose one.**

SEMESTER – IV

Sl. No.	Course Code	Components of Study	Title of the Course	Contact Hours	No. of Credits	IA Marks	End SEM Exam Marks	Total
1.	IMB-401	Core - Theory	Downstream Processing Technology	04	04	20	80	100
2.	IMB-402	Core - Theory	Cell and Pharmaceutical technology	04	04	20	80	100
3.	IMB-403	Core - Practical	Downstream Processing Technology & Cell and Pharmaceutical technology	04	04	-	-	100
4.	IMB-404	Core – Practical/ Project Work	Field Trip/ Industrial Tour Report / Dissertation	04	04	-	-	100
5.	IMB-405	Generic Elective* **(Related to Subject)**	a) Biostatistics & Bioinformatics b) Biosafety, Bioethics and Intellectual property rights	04	04 04	20 20	80 80	100 100
6.	IMB-406	Open Elective* **(For other department)**	a) Microbes in Human Welfare b) Medical and Diagnostic Microbiology	04	04	20	80	100
		Total		**24**	**24**			**600**

***Among the Electives a student shall choose one.**

FIRST SEMESTER

IMB – 101: BIOLOGICAL CHEMISTRY &ANALYTICAL TECHNIQUES

Course learning Objectives

1. Provides basic foundation on carbohydrates, lipids, thermodynamic principles.
2. Gives detailed knowledge about amino acids and peptides and proteins.
3. Provides in-depth knowledge about nucleic acids and nucleic electrophoresis and centrifugation theory and practice.
4. Understands the principle, Equipment and able to apply various chromatography and spectroscopy methods.

UNIT – I

Principles of thermodynamics, Redox reactions , Free energy, Biosensors, biological uses of radioisotopes, laboratory safety measures in handling isotopes

Carbohydrates : Classification of Carbohydrates; Outline structure and properties of important mono-, di-, and oligosaccharides and their identification and analysis; structure, occurrence and biological importance of structural polysaccharides (cellulose, chitin, agar, alginic acids, pectins, proteoglycans, sialic acids, blood group polysaccharides, bacterial cell wall polysaccharides).

Lipids: Building blocks of lipids. Classification of lipids. Fatty acids-physico-chemical properties, distribution in nature characterization and saponification and iodine number. Nomenclature, outline structures, properties and functions of glycerides, neutral lipids (waxes, fats, oils, phospholipids, sphingolipids and glycolipids). Steroids – plant sterol, ergosterol, stigmasterol, cholesterol.

UNIT-II

Amino acids : Classification, structure, physico-chemical properties, acid-base behaviour of amino acids.
Peptides : Characteristics of peptide bond, peptides of non-protein origin, properties and functions of peptides, determination of amino acid composition and sequence in peptides, chemical synthesis of peptides, peptide profiling.

Proteins : Classification, properties and biological functions of proteins; Structural organization of proteins – primary, secondary, tertiary and quaternary; Ramachandran's plot; proteins denaturation and renaturation ; structure-function relationships of certain proteins – myoglobin, haemoglobin, collagen; chaperones. Protein folding-Anfinsen,s experiment on ribonuclease and Creighton,s studies of BPT1

UNIT-III

Nucleic acids :Structures of purines, pyrimidines, modified bases, Chargaff's rule,nucleosides, nucleotides and polynucleotides; types and structural polymorphism of DNA and RNA; denaturation and renaturation of nucleic acids,melting curves,cot curves, factors influencing denaturation and renaturation,Hybridization.Depolymerization and hydrolysis of nucleic acids by chemical and enzymatic methods. Chemical synthesis of oligonucleotides. Sequencing of Nucleotides.
Centrifugation : Simple theory of preparative and analytical centrifuges and rotors; sedimentation analysis; differential, rate-zonal and equilibrium density gradient centrifugations. Applications – isolation of cells, subcellular organelles, viruses and macromolecules

Electrophoresis (Principles and applications) : Types of electrophoresis – paper, gel (starch, acrylamide and agarose) disc, vertical, horizontal submarine, gradient, 2-dimentional, pulse-field and capillary;

isoelectrofocussing; isolation and analysis of gel separated molecules – recovery of molecules from paper/gels.

UNIT-IV

Chromatography : Adsorptin,Partition,Ion Exchange,Gel filtration ,Affinity-Chromatography-Paper,TLC,GLC,HPLC,FPLC.

Spectroscopy : Electromagnetic spectrum of light; simple theory of light absorption by biomolecules; Beer's – Lambert law; transmittance; extinction co-efficient; light sources; monochromators; types of detectors; working principle and applications of visible, UV-visible, IR, Raman, ESR, mass, plasma emission, atomic absorption, and NMR spectrophotometry; fluorimetry and flame photometry; ORD and CD; X-ray diffraction and X-ray crystallography.

Principles and applications of Cell sorting and Flow cytometry (Principles and applications), Biosensors.

Radioisotope techniques - Nature and types of radioactivity, half-life of isotopes; detection and measurement of radioactivity-GM counter, liquid scintillation counter, gamma-ray counter, Cerenkov counting and autoradiography; quenching and quench correction;

Suggested Books:

1. Principles of Biochemistry, Lehninger, 6th edition, 2012 by Nelson and Cox (Worth).
2. Biochemistry, Stryer 8th edition, W.H. Freeman, 2015.
3. Microbial Physiology and Metabolism. 1999, by D.R. Caldwell. 2nd edition. Wm.C. Brown Publ.
4. Microbial Physiology. 2002, 4th ed. By A.G. Moat & J.W. Foster. Wiley-Liss.
5. Foundations in Microbiology. 2015. By K. Talaro & A. Talaro, 9th edition. Wm. C. Brown Publ.
6. Practical biochemistry: Principles and Techniques 2010, 7th ed. by K. Wilson and J. Walker, Cambridge University Press.
7. Modern Experimental Biochemistry. 1993. 2nd ed. by R.F. Boyer. The Benjamin Cummings Publ. Company.
8. Physical Biochemistry: Applications to Biochemistry and Molecular Biology, 1982, 2nd ed. by David Freifelder. W.H. Freeman and company.
9. Introduction to Practical Biochemistry. 2005. by S.K. Sawhney and Randhir Singh (2nd ed). Narosa Publ. House.
10. Biochemical Methods for Agricultural Sciences. 1992 by S. Sadasivam and A. Manikam. Wiley Eastern Ltd.

Course Learning Out comes

1. Be able to identify and analyze carbohydrates lipids.
2. Be familiar with behavior of amino acids, and structure functional relationships of proteins and their profiling.
3. Be able to Isolation centrifugation, Electrophoresis.

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	**PO_2** Analysis	**PO_3** Design	**PO_4** Development	**PO_5** Modern Tools	**PO_6** Society	**PO_7** Environment	**PO_8** Ethics	**PO_9** Team work	**PO_{10}** Communication	**PO_{11}** Programme Management	**PO_{12}** Lifelong Learning
CO_1	3	2	2	2	2	2	2	-	-	-	1	1

CO_2	3	2	2	2	2	2	1	-	-	-	1	1
CO_3	3	2	2	2	3	2	2	-	-	-	1	1
CO_4	3	2	2	2	2	2	2	-	-	-	1	1

Outcomes:

Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

IMB - 102: ENZYMOLOGY & MICROBIAL PHYSIOLOGY & METABOLISM

Course learning Objectives

1. Gives detailed information on cells and organs of the immune system.
2. Give in depth knowledge about Antigen-antibody interaction.
3. Provides the details on immune pathology.
4. Gives central concepts in transplantation and transfusion immunology.

UNIT – I

Nutrition : Elemental nutrient requirements of microbes; nutritional groups of bacteria; autotrophy-photoautotrophy and bacterial photosynthesis; chemoautotrophy and autotrophic metabolism; heterotrophy – photoheterotrophy and chemoheterotrophy, heterotrophic metabolism in bacteria; nutritional mutants and their use in metabolic studies.

Photosynthesis : Oxygenic and anoxygenic photosynthesis, photosynthetic pigments, basic photochemistry of PS I and PS II and photosynthetic electron transport; modes of CO_2 fixation, halobacterial photosynthesis, sulphur, nitrogen and iron assimilating bacteria. Chloroplast mediated electron transport; chemolithotrophic electron transport systems. Biolumenescence.

Uptake and Transport of nutrients in microbes – Structural organization of plasma membrane in relation to transport, types and mechanisms of transport (passive, simple, facilitated, active, chemical modification) with reference to sugars, amino acids and ions; methods for studying of transport, coupling of transport of ions and metabolites to ATP/proton gradient.

Microbial growth: The concept of growth and definition, Cell cycle in microbes and generation time Growth phases of bacteria –survival of microbial cells. Importance of each growth phase. Synchronous cultures – methods of synchronous culturing.

Nature and properties of spores – Physiology and biochemistry of sporulation and germination of spores.

UNIT – II

Carbohydrate metabolism: Pathways underlying the utilization of different sugars (EMP, ED, HMP and phosphoketolase) in microorganisms, gluconeogenesis; synthesis of peptidoglycans and glycoproteins.

Aerobic respiration: TCA cycle – intracellular location and reactions of the cycle, amphibolic nature of the cycle, energetics of the cycle; the glyoxalate cycle. Mechanisms of substrate-level phosphorylation;

respiratory electron transport in mitochondria and bacteria along with its components (carriers); mechanism of oxidative phosphorylation, uncouplers, inhibitors;

Anaerobic respiration : nature of fermentation, the relationship of oxygen to growth and fermentation, biochemical mechanisms of lactic acid, ethanol, butanol, citric acid and acetone fermentations, study of fermentations, relationships between fermentation and energy production; nitrate and sulphate respiration

UNIT – III

.**Protein metabolism:** Assimilation of inorganic nitrogen and sulphur, biochemistry of nitrogen fixation; hydrolysis of proteins-exo-and endo-proteinases, outlines of biosynthesis and catabolism of amino acids in microbes (deamination, decarboxylation and transamination reactions). Urea cycle.

Catalytic proteins(enzymes) : Classification, nomenclature, composition and structure of enzymes, kinetics of enzymes derivation, factors influencing enzyme catalyzed reactions, regulation of enzyme activity – activators and inhibitors and mechanism of action of enzymes (chymotrypsin). Regulatory enzymes – allosteric enzymes of michaelis – menter constant, determination of V_{max} and K_{ml} modela explaining allosteric behavior – KMF, MWC models, feed back inhibition in metabolism. Isoenzymes, coenzymes, ribozymes, abzymes

Extra cellular enzymes of Microrganism: Extra cellular enzymes and their Applications.

UNIT – IV

Lipid metabolism: Biosynthesis of triacyl glycerols, phospholipids and glycolipids; oxidation of saturated and unsaturated fatty acids; microbial metabolism of aromatic and aliphatic hydrocarbons

Nucleotide metabolism : biosynthesis of bases, nucleosides and nucleotides including deoxyribonucleotides, regulation of nucleotide synthesis; break down of nucleic acids – exo-and endo-nucleases (RNases and DNases) and phosphodiesterases, salvage pathways; catabolism of purines and pyrimidines

Secondary metabolism: Utilization of secondary metabolites for production of vitamins, toxins (aflatoxin and corynebacterial), hormones (GA), and antibiotics (penicillin and streptomycin).

Suggested Books:

1. Microbial Physiology and Metabolism. 1999, 2nd edition by D.R. Caldwell. Wm.C. Brown Publ.
2. Microbial Physiology. 2002, 4th ed. by A.G. Moat & J.W. Foster. Wiley-Liss.
3. Principles of Biochemistry. Lehinger. 2000.4th edition
4. Foundations in Microbiology. 2015. 9th edition by K. Talaro & A. Talaro, Wm. C. Brown Publ.
5. Microbiology. 2015. By Prescott et al. 6th edition. Wm. C. Brown Publ.
6. Molecular Cell Biology. 2012 – by Lodish et al. 7th edition.
7. General Microbiology, 1999 by Stainer et al., Macmillan Educational Ltd.

Course Learning Out comes

1. Able to describe immunology basics.
2. Able to theoretical principles of invitroselogical tests.
3. Able to explain allergic reactions.
4. Able to explain immunization procedure and immunization programmes.

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	**PO_2** Analysis	**PO_3** Design	**PO_4** Development	**PO_5** Modern Tools	**PO_6** Society	**PO_7** Environment	**PO_8** Ethics	**PO_9** Team work	**PO_{10}** Communication	**PO_{11}** Programme Management	**PO_{12}** Lifelong Learning
CO_1	3	2	2	2	2	2	2	-	-	-	1	1
CO_2	3	2	2	2	2	2	2	-	-	-	1	1
CO_3	3	2	2	2	2	2	2	-	-	-	1	1
CO_4	3	2	2	2	2	2	2	-	-	-	1	1

Outcomes:

Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

IMB-103: PRACTICALS: BIOLOGICAL CHEMISTRY & ANALYTICAL TECHNIQUES

1. Qualitative tests for identification of Carbohydrates, amino acids, nucleic acids
2. Quantitative tests for Protein, glucose, glycine, bilirubin, cholesterol, Inorganic phosphorous
3. Measurement of pH
4. Micrometry for cell size determination
5. Cell counting by Haemocytometer
6. Beer's Law
7. Determination of λ max for coloured solutions
8. Determination of DNA & RNA by UV spectrophotometry
9. Determination of nucleic acid Bases by UV spectrometry
10. Paper chromatography for separation of amino acids / pigments
11. TLC for separation of lipids / amino acids
12. Separation of proteins by SDS-PAGE

IMB – 104: PRACTICALS: ENZYMOLOGY & MICROBIAL PHYSIOLOGY & METABOLISM

1. Quantitative estimation of the levels of cellular.
2. Estimation of Amylase enzyme activity (I.U) and calculation of specific enzyme activity.
3. Determine the kinetic enzyme activity.
4. Detection of Peroxidase/Catalase as Isoenzyme.
5. Estimate the acid Phosphophatase activity.
6. Determine Polyphenol activity.
7. Estimation of the lipase activity.
8. Determine the protease activity
9. Spore staining.
10. Biochemical tests: IMVIC; Catalse, Sugar fermentation, oxidation, Fermentation tests H_2S test triple sugar Iron test.

11. Winogradsky's column.
12. Contact slide techniques.
13. Preparation of different media for cultivation of bacteria & fungi.
14. Evaluation of Alcohol effectiveness.
15. Phenol coefficient method.

IMB- 105: INTRODUCTORY MICROBIOLOGY

UNIT – I

History and Scope of Microbiology - Discovery of microorganisms and development of microbiology - Contributions of pioneers- Prokaryotic and Eukaryotic microorganisms - Origin and evolution of microorganisms. Distinguishing of different microorganisms-Scope and relevance of Microbiology - Future of Microbiology.

Microbial Structure - Microscopy – principles and applications of light microscope-Bright field- Dark-field, Phase – contrast, Fluorescent, Scanning and Transmission electron microscopes, Confocal microscopy, Scanning tunneling microscope. Preparation of microbiological samples for microscopy-simple and differential staining, special and structural staining. Negative contrast staining for virus samples. Preparation of tissues for thin sectioning (fixation, dehydration, infiltration, embedding and sectioning).

Physical and Chemical methods of sterilization and disinfection : Heat, radiation, pH, atmospheric pressure, filters, various chemical agents, safety precautions. The concept of containment facility.

UNIT – II

Microbiological media : Types of media-natural and synthetic; autotrophic, heterotrophic and prototrophic media; basal, defined, complex, enrichment, selective, differential, maintenance and transport media.

Isolation, cultivation and enumeration of microorganisms : Isolation from different natural sources. Approaches for obtaining pure cultures. Cultivation of aerobes and anaerobes. Continuous, batch, synchronous broth and stock cultures. Enumeration / measurement of growth of microorganisms.

Maintenance and preservation of microbial cultures : Repeated sub-culturing, sterile soil/sand preservation, glycerol-deep freezing, oil overlay, drying methods, freeze-drying.

UNIT-III

Microbial Taxonomy : Classification of microorganisms – introduction – Hackel's three kingdom concept – Whittaker's five kingdom concept – three domain concept of Carl Woese. Basis of microbial classification. Concepts, nomenclature and taxonomic ranks; major characteristics used in Taxonomy – morphological, physiological and metabolic, ecological, numerical taxonomy; genetic and molecular classification systems; the kingdoms of organisms and phylogenetic trees. Characteristics of prokaryotes and eukaryotic cells.

UNIT – IV

Prokaryotic microorganisms : Brief outlines on discovery, nature, origin, evolution, morphology and structure, composition, reproduction and other characteristics of Bacteria (Eubacteria) Spirochetes,

Rickettsias, Chlamydias, Pseudomonads, Acetic acid bacteria, Mycloplasmas, Cyanobacteria, Archaebacteria, Actinomycetes (Actinobacteria).
Note: Viruses are dealt in separate paper with title "Basics of Virology-MB – 302".

Eukaryotic microorganisms:

Fungi: Classification, structure, composition, reproduction and other characteristics of fungal divisions – *Zygomycota, Ascomycota, Basidiomycota* and *Deuteromycota* and slime and water molds. General characteristics and importance of fungi – *Saccharomyces, Candida, Pichia, Pencillium, Neurospora, Rhizopus, Aspergillus, Agaricus, Cryptococcus, Fusarium, Trichoderma, Claviceps.*

Algae : Classification, structure, reproduction and other characteristics of algal divisions. Characteristics of *Chlorella, Senedesmus, Gelidiella* and *Gracellaria.* Economic importance of algae, phytoplantanic microalgae.

Protozoan parasites : Classification, morphology and structure, reproduction and other characteristics of pathogenic protozoa like *Entamoeba, Plasmodium, Leishmania, Cryptosporidium, Trichomonas, Taxoplasma, Trypanosoma, Giardia.*

Suggested Books:

1. Brock Biology of Microorganisms. 1997, 8th ed. Madigan et al., Prentice-Hall International, Inc.
2. Microbiology. 1999. 3rd ed. Prescott et al. Wm. C. Brown Publ.
3. Principles of Microbiology. 1997. 2nd ed. R.A. Atlas. Wm.C. Brown. Publ.
4. Foundations in Microbiology. 1996. 2nd ed. K. Talaro and A. Talaro. Wm. C. Brown Publ.
5. Microbiology. 1996. 5th ed. Pelczar et al. Tata McGram-Hill Publ. Company Ltd.
6. General Microbiology, 1999 by S.B. Sullia, Oxford and IBH Publishers.
7. General Microbiology, 1999 by Stainer et al., Macmillan Educational Ltd.
8. Instant Notes in Microbiology. 1999. J. Nicklin et al. Viva Books Pvt. Ltd.
9. Microorganisms, Biotechnology and Disease : Students Book. 1997 by Pauline Lourie and Susanwells. Cambridge University Press.
10. Introductory Mycology. 1996. 4th ed. Alexopoulos et al., John Wiley and Sons.
11. Introductory Psychology by H.D. Kumar. 2nd ed. 1999. East West Press.

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	**PO_2** Analysis	**PO_3** Design	**PO_4** Development	**PO_5** Modern Tools	**PO_6** Society	**PO_7** Environment	**PO_8** Ethics	**PO_9** Team work	**PO_{10}** Communication	**PO_{11}** Programme Management	**PO_{12}** Lifelong Learning
CO_1	3	2	2	2	2	2	2	-	-	-	1	1
CO_2	3	2	2	2	2	2	2	-	-	-	1	1
CO_3	3	2	2	2	2	2	2	-	-	-	1	1
CO_4	3	2	2	2	2	2	2	-	-	-	1	1

Outcomes:

Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

IMB-106: HUMAN VALUES AND PROFESSIONAL ETHICS – I

UNIT-I

Definition and Nature of Ethics- Its relation to Religion, Politics, Business, Law, Medicine and Environment. Need and Importance of Professional Ethics- Goals – Ethical Values in various Professions.

UNIT-II

Nature of Values- Good and Bad, Ends and Means, Actual and potential Values, Objective and Subjective Values, Analysis of basic moral concepts- right, ought, duty, obligation, justice, responsibility and freedom, Good behavior and respect for elders, Character and Conduct.

UNIT-III

Individual and society: Ahimsa (Non-Violence), Satya (Truth), Brahmacharya (Celibacy), Asteya (Non possession) and Aparigraha (Non-stealing). Purusharthas (Cardinal virtues)-Dharma (Righteousness), Artha (Wealth), Kama (Fulfillment Bodily Desires), Moksha (Liberation).

UNIT-IV

Bhagavad Gita – (a) Niskama karma. (b) Buddhism – The Four Noble Truths – Arya astanga marga, (c) Jainism – mahavratas and anuvratas. Values Embedded in Various Religions, Relirious Tolerance, Gandhian Ethics.

UNIT-V

Crime and Theories of punishment – (a) Reformative, Retributive and Deterrent. (b) Views on manu and Yajnavalkya.

Suggested Books:

1. John S Mackenjie: A manual of ethics.
2. "The Ethics of Management" by Larue Tone Hosmer, Richard D. Irwin Inc.
3. "Management Ethics – integrity at work" by Joseph A. Petrick and John F. Quinn, Response Books: New Delhi.
4. "Ethics in Management" by S.A. Sherlekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today
6. Maitra, S.K: Hindu Ethics
7. William Lilly: Introduction to Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manu Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil(ed.) G.C. Haughton.
10. Susruta Samhita: Tr. Kaviraj Kunjanlal, Kunjalal Brishagratha, Chowkamba Sanskrit series, Vol. I, II and III, Varnasi, Vol I OO, 16-20, 21-32 and 74-77 only.
11. Caraka Samhita: Tr. Dr. Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series office, Varanasi I,II,III Vol I PP 183-191.

12. Ethics, Theory and Contemporary Issues, Barbara Mackinnon, Wadsworth/Thomson Learning, 2001.
13. Analyzing Moral Issues, Judith A. Boss, Mayfield Publishing Company, 1999.
14. An Introduction to Applied Ethics (Ed.) John H. Piet and Ayodhya Prasad, Cosmo Publications.
15. Text book for Intermediate logic, Ethics and Human Values, board of Intermediate Education & Telugu Academic Hyderabad.
16. I.C. Sharma Ethical Philosophy of India. Nagin & co Julundhar.

CO-PO Attainment in Outcome Based Education -2017

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	PO_1 Know ledge	**PO_2** Analysis	**PO_3** Design	**PO_4** Development	**PO_5** Modern Tools	**PO_6** Society	**PO_7** Environment	**PO_8** Ethics	**PO_9** Team work	**PO_{10}** Communication	**PO_{11}** Programme Management	**PO_{12}** Lifelong Learning
CO_1	3	2	-	-	2	2	1	3	-	-	-	3
CO_2	3	2	-	-	2	1	1	3	-	-	-	3
CO_3	3	2	-	-	2	1	1	3	-	-	-	3
CO_4	3	2	-	-	2	1	1	3	-	-	-	3

Outcomes:

Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

SECOND SEMESTER

IMB – 201: IMMUNOLOGY

Course learning Objectives

1. Gives detailed information on cells and organs of the immune system.
2. Give in depth knowledge about Antigen-antibody interaction.
3. Provides the details on immune pathology.
4. Gives central concepts in transplantation and transfusion immunology.

UNIT – I

History: Historical perspective of Immunology, milestones in immunology.

Cells and Organs of the Immune system: Hematopoiesis, Lymphoid cells, stem cells, Mononuclear cells, Granulocytes, Mast cells, Dendritic cells. Lymphoid organs – Primary and Secondary lymphoid organs.

Types of immunity: Innate immunity and adaptive immunity, comparative immunity, Immune dysfunction and its consequences.

Immune responses to infectious diseases: Viral, bacterial, protozoan and other parasitic diseases.

Antigens: types, properties, study of antigenicity, immunogenicity versus antigenicity, factors influencing immunogenicity. Epitopes, haptens, mitogens, superantigens. Viral and bacterial antigens

UNIT – II

Antibodies : Basic and fine structure of Immunoglobulins, classes and biological activities of Immunoglobulins, Antigenic determinants – Iso, allo and idiotypes. Immunoglobulin super family, antibody diversity, organization and expression of immunoglobulin genes. Production of polyclonal antibodies-animals, additives, adjuvants, routes, dose, collection and preservation of antisera, purification of immunoglobulins, quantitative and qualitative analysis of immunoglobulins.

Monoclonal antibodies : Hybridoma technology – principle and production of monoclonal antibodies, advantages and disadvantages over polyclonal antibodies, application of monoclonal antibodies.

Recombinant antibodies : Production and their advantages over conventional antibodies.

Antigen and Antibody interactions : Affinity, Avidity, Cross reactivity.

***In vivo* serological reactions :** Phagocytosis, Opsonization, Neutralization, Protection tests.

***In vitro* serological tests :** Precipitation tests in liquid and semisolid media, single and double immuno diffusion tests. Immuno electrophoresis tests (Rocket, counter current). Agglutinations tests-HA and HI, latex agglutination. Complement fixation tests, Labeled antibody based tests – Enzyme linked immunosorbent assays (ELISA), Western blotting, Radio immuno assay (RIA), Immunoflueorescent and Immuno specific electron microscopy. Infectivity neutralization test. The relative advantages and disadvantages and their applications in Microbiology.

UNIT – III

Humoral immune response : Primary and secondary immune responses, induction, regulation of the immune effector response.

Cell mediated immune response : Induction and mechanism, antibody-dependent cell mediated cytotoxicity (ADCC).

Immune effector mechanisms : Cytokines, Lymphokines, Chemokines and their classification, properties and functions.

Complement cascade system : Complements nomenclature, classification, complement components, functions, activation, regulation, biological consequences, complement deficiencies.

Hypersensitive and Allergic reactions : Classification, types I, II, III and IV.

Immunopathology : Immunodeficiencies – Primary immunodeficiency (genetic) diseases due to B cell, T-cell and combined defects (Hypogamma globulinemia, SCID, ADA) phagocyte and complement defects. Autoimmune diseases – Autoimmunity, induction, mechanism of tissue damage in autoimmunity. Autoimmune diseases – Organ specific (Autoimmune anemias, Autoimmune thyroid diseases, Diabetes mellitus, Multiple sclerosis), Systemic autoimmune diseases (Rheumatoid arthritis, Systemic lupus erythematousus) and their therapy.

UNIT-IV

Major histocompatability complex (MHC) : Organization and Inheritance of MHC, cellular distribution of MHC molecules, regulations of MHC expression, MHC-immune responsiveness, disease susceptibility, MHC restriction, HLA antigens-Class I, II, III and their functions, Murine antigens and its functions.

Transfusion Immunology: Blood cell components, blood group systems in human and in animals, Rh typing, transfusion reactions, diseases associated with blood transfusion – Haemolytic anemias, Erythroblastosis featalis.

Transplantation Immunology : Transplantation antigens, types of transplants, Graft versus host reactions – immunological basis of graft rejection mechanism, prevention of graft rejection, clinical manifestations of graft rejection, Immunosuppressive therapy of allograft response, clinical transplantation.

Tumor immunology: Cancer and the Immune system, tumor specific antigens, tumors of the immune system, immune response to tumors, cancer immunotherapy.

Vaccinology : Type of immunization procedures, active and passive immunization, designing of vaccines, classical and novel/modern approaches for the production of vaccines, purified macromolecules as vaccines, Recombinant – vector vaccines, DNA vaccines, Synthetic peptide vaccines, Multivalent sub-unit vaccines, uses of vaccines, benefits of vaccination, mass immunization programmes.

Suggested Books:

1. Immunology. 2000. 4th edition. J. Kuby. W.H. Freeman and Company.
2. Immunology. 2003. 5th edition. I. Roitt, J. Brostoff and David Male. Mosby publications.
3. Fundamental Immunology. 1992. 2nd edition. R.M. Coleman, M.F. Lombard and R.E. Sicard. Wm. C. Brown Publishers.
4. Immunology. 1997. 3rd edition. R.M. Hyde. B.I. Waverly Pvt. Ltd.
5. Immunology. 1995. 4th edition. I.R. Tizard. Saunders College Publishing.
6. Immunology – The Science of self and non-self discrimination. 1982. Jon Klein. John Wiley and Sons.
7. Immunology – An illustrated outline. 2013. 5th edition. David Male. Churchill Living Stone.
8. Viruses that affect immune system. 1991. H.Y. Fan, I.S.Y. chen, N. Rosenberg and W. Sugden. American Society for Microbiology.
9. Immunobiology : The immune system in health and disease, 1994. C.A. Janeway, Jr., P. Travers. Current biology Ltd.

Course Learning Out comes

1. Able to describe immunology basics.
2. Able to theoretical principles of invitroselogical tests.
3. Able to explain allergic reactions.
4. Able to explain immunization procedure and immunization programmes.

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	**PO_2** Analysis	**PO_3** Design	**PO_4** Development	**PO_5** Modern Tools	**PO_6** Society	**PO_7** Environment	**PO_8** Ethics	**PO_9** Team work	**PO_{10}** Communication	**PO_{11}** Programme Management	**PO_{12}** Lifelong Learning
CO_1	3	2	2	2	2	2	-	-	-	-	-	2
CO_2	3	2	2	2	2	2	-	-	-	-	-	2
CO_3	3	2	2	2	2	2	-	-	-	-	-	2
CO_4	3	2	2	2	2	2	-	-	-	-	-	2

Outcomes:

Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

IMB –202: MEDICAL MICROBIOLOGY

Course learning Objectives

1. Provides information on infections and pathogenesis.
2. Helps to clean chemotherapy principle.
3. Be able to explain the symptoms of bacterial infections.
4. Be able to explain the symptoms of viral, fungal and parasitic diseases.

UNIT – I

Principles of Medical Microbiology: Historical developments Classification of medically important microorganisms. Normal microbial flora of human body: Origin of normal flora; Infectious diseases.

Infection: Sources of infection for man; vehicles or reservoirs of infection. Exogenous infection: 1) Patients 2) carriers – (Healthy; convalescent; contact; paradoxical and chronic) 3) Infected animals (zoonosis) 4) Soil endogenous infection. Mode of spread of infection: 1) Respiratory 2) skin 3) Wound and burn infection 4) Venereal infections 5) Alimentary tract infection 6) Arthorpod-borne blood infections 7) Laboratory infections. Nosocomial infections: common types of hospital infections, their diagnosis and control.

Pathogenesis: Adhesion in various hosts, cell damage, release of pathogens, Transmissibility, infectivity and Virulence. Opportunistic pathogens and True pathogens. Toxigenicity: Invasiveness, other aggressins (Hyaluronidase), coagulase, fibrinolysins or kinase, depolymerizing enzymes, (mucinase, lipases, proteases, nucleases, collagenase, neuraminidase). Organotropism, variation and virulence.

UNIT – II

Microbial Toxins: Types of microbial toxins, Endotoxins, Exotoxins, LC_{50} of toxins, Effective dose of toxins, Assay of toxins, Mechanism of action of Diphtheria, Cholera, Staphylococcal toxin and Clostridial neurotoxins. Virulence and virulence factors of microbial toxins. Signs and symptoms of microbial intoxication.

Diagnostic methods: Collection, transport and preliminary processing of clinical samples. Clinical, microbiological, immunological and molecular diagnosis of microbial diseases.

Principle of Chemotherapy: Chemotherapeutic agents, Mechanism of action of antimicrobial agents, Synthetic compounds and antibiotics and their assay in body fluids, drug resistance, Mechanisms of drug resistance, MDR. Various methods of drug susceptibility testing. Brief account on available vaccines and schedules, passive prophylactic measures.

UNIT – III

Bacterial diseases: Symptoms, diagnosis , treatment and prevention of the diseases caused by *Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, Bacillus, Clostridium, Actinomycete, Rickettsiae, Chlamydiae, Mycoplasma, Enterobacteriacea*, *Vibrios*, *Yersinia; Haemophilus; Bordetella, Brucella; Mycobacteria, Spirochetes; Salmonella* species.

UNIT – IV

Viral diseases: Virus-host interactions at cellular and organism levels. Common diseases caused by Poxviruses; Herpes virus; Adeno viruses; Picorna viruses; Orthomyxo viruses; Paramyxo viruses; Arbo viruses, Rhabdo viruses, Hepatitis viruses; Oncogenic viruses; Human Immuno deficiency viruses (HIV/AIDS). Prion diseases – Kuru, CJD disease and GSS syndrome.

Fungal diseases: Diseases caused by dermatophytes, dimorphic fungi and opportunistic fungal pathogens. Description and classification of pathogenic fungi and their laboratory diagnosis.
Parasitic diseases: Disease caused by parasites like *Entamoeba, Plasmodium, Trichomonas, Leishmania* and *Toxoplasma, Giardia, Wuchereria, Dracunculus.*

Suggested Books :

1. Ananthanarayan R, Panikar CKJ (2000). Textbook of Microbiology. 2013. 9th Edition. Orient Longman Ltd.
2. Warren Levinson (2014).Review of Medical Microbiology and Immunology. Mc Graw Hill education.
3. Bailey & Scott's (2013). Diagnostic Microbiology (13th Edition), Published by: Mosby.
4. Color atlas and Text book of Diagnostic microbiology (6th Edition), 2005, edited by: Eimer W Koneman, published by: Lippinctt.
5. Subash CP (2000). Text Book of Medical Parasitology, by published by : All India Publishers & Distributors. 1st edition.
6. Jayaran Paniker C.K, Text Book of Medical Parasitology (7th Edition), 2013, by Published by: Jaypee Brothers.
7. Cruichshank *et al.,*(2012). Manual of Clinical Microbiology, 7th ed. by E.H. Lennette et al. ASM Publications.
8. Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller (2012), 7th edition. Medical Microbiology. Elsevier saunders.
9. Koen Venema and Ana Paula do Carmo (2015). Probiotics and Prebiotics: Current Research and Future Trends. Caister Academic Press.
10. Sergio Sánchez and Arnold L. Demain (2015). Antibiotics: Current Innovations and Future Trends. Caister Academic Press.

Course Learning Out comes

1. Be able to explain about various infections
2. Be able to understand the diagnostic methods.

3. Be able to explain the symptoms of bacterial infections.
4. Be able to explain the symptoms of viral, fungal and parasitic diseases.

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	**PO_2** Analysis	**PO_3** Design	**PO_4** Development	**PO_5** Modern Tools	**PO_6** Society	**PO_7** Environment	**PO_8** Ethics	**PO_9** Team work	**PO_{10}** Communication	**PO_{11}** Programme Management	**PO_{12}** Lifelong Learning
CO_1	3	2	2	2	2	2	-	-	-	-	-	2
CO_2	3	2	2	2	2	2	-	-	-	-	-	2
CO_3	3	2	2	2	2	2	-	-	-	-	-	2
CO_4	3	2	2	2	2	2	-	-	-	-	-	2

Outcomes:

Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

IMB- 203: Practicals: Immunology

Course learning Objectives

1. Gives hands on experience in Immuno precipitation test.
2. Provides hands on experience on various ELISA methods.
3. Will gain knowledge in immunoglobulin's purification and to perform electrophoresis.

1. Purification of immunoglobulins
2. Electrophoretic separation of normal and immunoserum.
3. Ouchterlony double Immuno diffusion
4. Single radial Immuno diffusion
5. Immuno precipitation test
6. Rocket Immuno electrophoresis
7. Counter current Immuno electrophoresis
8. Isolation & Identification of Rosettee cells.
9. Dot ELISA
10. Sandwich ELISA
11. Antigen Capture ELISA
12. Antibody Capture ELISA
13. ASO titre.
14. Complement fixation test

Course Learning Out comes

1. Able perform various immuno precipitations tests.
2. Be able to perform various types of ELISA methods.
3. Be able to gain practical knowledge about immunoglobulin's and there separation.

IMB- 204: Practicals: Medical Microbiology

Course learning Objectives

1. Gives hands on experience on blood related tests
2. Gives knowledge on virus cultivation
3. Provides hands on experience on various diagnostic tests.

1. Widal Test
2. VDRL Test
3. Total counting of RBC & WBC
4. Differential count of WBC
5. Hemoglobin estimation
6. Latex agglutination test
7. Blood typing and Rh determination
8. Identification of pathogenic organisms based on HIV& DOT-BLOT test
9. Hanging drop experiment for bacterial motility.
10. Microbiological staining techniques – Simple, Gram negative, spore, capsular, acid fast and Lactophenol-cotton blue staining.
11. Isolation of bacteriophages from sewage water.
12. Cultivation of viruses in embryonated Chicken eggs: different routes of virus inoculation – Yolk sac, Allontoic and Chorio Allontoic Membrane (CAM).

Course Learning Out comes

1. Be able to perform widal, VDRL and types.
2. Be able to perform various staining procedures.
3. Be able to identify blood cell types.

IMB – 205: BASICS OF VIROLOGY

Course learning Objectives

1. Gives basics concepts on Animal & Plant virus cultivation
2. Provides in depth knowledge on properties and purification of Viruses.
3. Gives outlines on nomenclature and classification of viruses.
4. Give in-depth understanding on viral genomes and their replication.

UNIT – I

History of Virology: Discovery of viruses and development of Virology (contribution of pioneers). Nature, origin and evolution of viruses. New emerging viruses.

Isolation and cultivation of viruses: Animal viruses - experimental animals, embryonated eggs, animal cell cultures-primary and secondary cell cultures. Plant viruses - experimental plants and tissue cultures. Infectivity assay methods of viruses- physical, serological and chemical approaches. Assay and maintenance of viruses, qualitative and quantitative analysis of viruses.

UNIT – II

Purification of viruses : Extraction of viruses from tissues, clarification, concentration of viruses in clarified extracts by physical and chemical methods, further purification of viruses by rate zonal / equilibrium density gradient centrifugation, approaches and criteria of virus purity, quantification and preservation of purified virus preparations.

Properties of viruses : Biological characteristics of viruses, host-range, transmission (vector and non-vector), virus stability. Physical-morphology and structure, sedimentation, electrophoretic mobility, buoyant density. Biochemical – chemical composition, nucleic acids, proteins, enzymes, lipids, carbohydrates, polyamines, cations. Antigenic nature of viruses.

Architecture of viruses : Morphology, structure and composition of viruses-Principles of virus structure-Icosahedral, helical and binal symmetry.

UNIT-III

Nomenclature and classification of viruses: Criteria used for naming and classification of viruses. Current ICTV classification of viruses of bacteria, plants, animals, humans, algae, fungi and protozoans. Major characteristics of the virus families / genera / groups.

Sub-viral agents : Characteristics of sub-viral agents – Viroids, Satellite viruses, Satellite nucleic acids and Prions.

UNIT – IV

Viral genomes: Diversity of viral genomes – DNA genome – linear and circular, single stranded and double stranded. RNA genomes – positive and negative, linear and circular, single and double stranded, partite of viral genomes – mono, bi, tri and multipartite genomes.

Replication of viruses: Outlines of replication of viruses – approaches to study replication of viruses, replication strategies of viruses – Baltimore strategies of viral genome replication and expression. Replication of viruses like MS_2, T_4, Lambda, Phi X-174, M_{13}, TMV, cauliflower mosaic virus, geminivirus, parvovirus, polio, HIV, Influenza, reovirus, SV-40 and poxviruses.

Prevention and Control of viruses: The infection control policyaseptic techniques, cleaning and disinfection, protective clothing, isolation; Prevention – sanitation, vector control, vaccines and immunization; Control- chemoprophylaxis, chemotherapy (antiviral drugs, Interferon therapy), efficacy of infection control.

Suggested Books:

1. Virology: 1994. 3rd ed. Frankel-Conrat et al, Prentice-Hall.

2. Fundamental Virology, 1996. 3rd ed. B.N. Fields et al. Lippincott-Raven.
3. Principles of Virology : 2000. by S.J. Flint et al., ASM Press.
4. Introduction to Modern Virology. 1994. 4th ed. Primrose and Dimmock. Blackwell Scientific Publ.
5. Principles of Molecular Virology. 2005. 4th ed. A. Cann. Academic Press.
6. Basic Virology, 1999. By Waginer and M. Hewlett, Blackwell Science Publ.
7. Plant Virology, 4th ed. 2001 by R. Hull (R.E.F. Matthews). Academic Press.
8. Applied Plant Virology. 1985. D.G.A. Walkey. Heinemann Publications.
9. Fields Virology. 1996. B.N. Fields, D.M. Knipe and P.M. Howley. Lippincott-Raven Publishers.
10. Encyclopedia of Virology. 1994. R.G. Webster and Allan Granoff (Eds). Vol I,II,III. Academic Press.

Course learning Outcomes

1. Be able to explain about viruses cultivation method.
2. Be able to describe properties of viruses.
3. Be able to classify the viruses according to ICTV.
4. Be able to conversant with viral genome diversity and control of viruses.

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	**PO_2** Analysis	**PO_3** Design	**PO_4** Development	**PO_5** Modern Tools	**PO_6** Society	**PO_7** Environment	**PO_8** Ethics	**PO_9** Team work	**PO_{10}** Communication	**PO_{11}** Programme Management	**PO_{12}** Lifelong Learning
CO_1	3	2	2	2	2	2	-	-	-	-	-	2
CO_2	3	2	2	2	2	2	-	-	-	-	-	2
CO_3	3	2	2	2	2	2	-	-	-	-	-	2
CO_4	3	2	2	2	2	2	-	-	-	-	-	2

Outcomes:
Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

IMB- 206: - Human Values and Professional Ethics –II

Course learning Objectives

1. Provides concepts on Human Values.
2. Outlines the medical ethics.
3. Given knowledge on business Environmental, Social ethics.

Unit - I

Value Education- Definition - relevance to present day - Concept of Human Values - self introspection - Self esteem. Family values-Components, structure and responsibilities of family- Neutralization of anger - Adjustability - Threats of family life - Status of women in family and society - Caring for needy and elderly - Time allotment for sharing ideas and concerns.

Unit - II

Medical ethics- Views of Charaka, Sushruta and Hippocratus on moral responsibility of medical practitioners. Code of ethics for medical and healthcare professionals. Euthanasia, Ethical obligation to

animals, Ethical issues in relation to health care professionals and patients. Social justice in health care, human cloning, problems of abortion. Ethical issues in genetic engineering and Ethical issues raised by new biological technology or knowledge.

Unit - III

Business ethics- Ethical standards of business-Immoral and illegal practices and their solutions. Characterics of ethical problems in management, ethical theories, causes of unethical behavior, ethical abuses and work ethics.

Unit - IV

Environmental ethics- Ethical theory, man and nature- Ecological crisis, Pest control, Pollution and waste, Climate change, Energy and population, Justice and environmental health.

Unit - V

Social ethics- Organ trade, Human trafficking, Human rights violation and social disparities, Feminist ethics, Surrogacy/pregnancy. Ethics of media- Impact of Newspapers, Television, Movies and Internet.

Suggested Books:

1. John S Mackenjie: A manual of ethics.
2. "The Ethics of Management" by Larue Tone Hosmer, Richard D. Irwin Inc.
3. "Management Ethics - integrity at work' by Joseph A. Petrick and John F. Quinn, Response Books: New Delhi.
4. "Ethics in Management" by S.A. Sherlekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today
6. Maitra, S.K: Hindu Ethics
7. William Lilly : Introduction to Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manava Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed.) G.C.Haughton.
10. Susruta Samhita: Tr.Kaviraj Kunjanlal, Kunjalal Brishagratha, Chowkamba Sanskrit series, Vol I,II and III, Varnasi, Vol I OO, 16-20, 21-32 and 74-77 only.
11. Caraka Samhita :Tr. Dr.Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series office, Varanasi I, II, III Vol I PP 183-191.
12. Ethics, Theory and Contemporary Issues., Barbara Mackinnon, Wadsworth/Thomson Learning, 2001.
13. Analyzing Moral Issues, Judith A. Boss, Mayfield Publishing Company, 1999.
14. An Introduction to Applied Ethics (Ed.) John H.Piet and Ayodhya Prasad, Cosmo Publications.
15. Text Book for Intermediate First Year Ethics and Human Values, Board of Intermediate Education-Telugu Akademi, Hyderabad.
16. I.C Sharma Ethical Philosophy of India. Nagin&co Julundhar

Course learning Outcomes

1. Helps to inculcate human values in their own life.
2. Be able to understand the medical ethics concepts.
3. Beable to explain business, environmental and social ethics.

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team work	PO_{10} Communication	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO_1	3	2	-	-	2	2	1	3	-	-	-	3
CO_2	3	2	-	-	2	1	1	3	-	-	-	3
CO_3	3	2	-	-	2	1	1	3	-	-	-	3
CO_4	3	2	-	-	2	1	1	3	-	-	-	3

Outcomes:

Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

THIRD SEMESTER

IMB – 301: FUNDAMENTALS OF INDUSTRIAL MICROBIOLOGY

Course learning Objectives

1. To give indepth information about industrially important microorganisms.
2. To prove information about recombinant molecular in pharmaceuitical, health , agricultural and industrial sectors.
3. To helps to understand the role of microorganisms in various industries.
4. To gain concepts in Bioremediation.

UNIT – I

Definition and scope of Industrial Microbiology - Historical development – chronological order of outstanding scientific achievements, concepts and practices of microbiology proceeded to Industrial Microbiology.

Industrially important microorganisms – Introduction to industrially important microorganisms – Bacteria, fungi, actinomycetes, microalgae, viruses – culture collection centers. Generally regarded as safe (GRAS) microorganisms – Bacteria, Yeasts, Filamentous fungi, Industrial strains, improvement of strains and study of strain stability.

UNIT-II

Microbial production of recombinant molecules: Requirement of recombinant molecules in pharmaceutical, health, agricultural and industrial sectors and in research / diagnostic labs. Rationale for the design of vectors for oven expression of recombinant proteins; selection of suitable promoter sequences, ribosome binding sites, transcription terminator, fusion protein tags, purification tags, protease cleavage sites and enzymes, reporter/marker genes, plasmid copy number, inducible expression systems. Over expression conditions, production of inclusion bodies, solubulisation of insoluble proteins. Purification protocols and up-scaling products.

Determination of purity and activity of over expressed proteins. Experiments using model systems : *E. coli*, Yeast, *Baculovirus* and *Agrobacterium.*

UNIT-III

Role of microorganisms in various industries: Food – yeast, mushroom, microalgae and food spoilage organisms. Pharmaceuticals – production of amino acids, antibiotics, diagnostic proteins, enzymes, hormones, vaccines, vitamins and role of transformed microorganisms in pharmaceuticals. Agriculture – Biofertilizers, biopesticides, biocontrol of microbial pathogens. Industrial enzymes-microbial enzymes, application in food, leather, textile, paper, detergent industries, role of transformed microorganisms in enzymes production.

UNIT-IV

Bioremediation -pesticides, fungicides, preservatives, waste recycling, industrial effluent treatment. Dairy – important microbes in dairy and dairy products. Conventional and recombinants microorganisms involved in the production of ethanol, amino acids, organic acids – Methanogens and methylotrops.

Suggested Books:

1. Waites MJ *et al. (*2001) Industrial Microbiology. by Blackwell Science.
2. Casida LE (1999) Industrial Microbiology. by Jr. New Age International Publ.
3. Nathan S. Mosier, Michael R. Ladisch (2009)Modern Biotechnology: Connecting Innovations in Microbiology and Biochemistry to Engineering Fundamentals. by wiley
4. Michael R. Ladisch (2001) Bioseparations Engineering: Principles, Practice, and Economics by wiley.

Course learning outcomes

1. Be able to assess "GRAS'.
2. Be able to have clear cut about the production of recombinant molecules.
3. Be conversant with Biofertilizer, Biopesticides and microbial enzymes.
4. Be able to to gain the concepts in waste recycling and industrial efficient.

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	**PO_2** Analysis	**PO_3** Design	**PO_4** Development	**PO_5** Modern Tools	**PO_6** Society	**PO_7** Environment	**PO_8** Ethics	**PO_9** Team work	**PO_{10}** Communication	**PO_{11}** Programme Management	**PO_{12}** Lifelong Learning
CO_1	3	2	2	2	2	2	-	-	-	-	-	2
CO_2	3	2	2	2	2	2	-	-	-	-	-	2
CO_3	3	2	2	2	2	2	-	-	-	-	-	2
CO_4	3	2	2	2	2	2	-	-	-	-	-	2

Outcomes:

Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

IMB-302: FOOD MICROBIOLGY AND FERMENTATION TECHNOLOGY

Course learning Objectives

1. To provide knowledge on quality control of food products.
2. To provide indepth knowledge about food poisining and fermentation product.
3. To understand the about fermentation technology concepts.
4. To gain concentrate knowledge on microbials application modern technology.

UNIT – I

Food and Microbes: Food as a substrate for microbial growth, sources of food contamination, extrinsic and intrinsic factors influencing microbial growth in food. Biochemical changes in food by microorganisms.

Quality control of food products: Analytical methods and standards for raw, canned and fermented foods.

Food Preservation methods: Principles involved – Asepsis, high and low temperatures, irradiation, drying and food additives. Preservation of vegetables and fruits, milk and milk products, meat and meat products and canned foods.

UNIT – II

Food Poisoning and food infections: Microbial food contamination sources and spoilage of cereals vegetables, fruits, meat, milk, sugar and their products. Fish, sea food, poultry and canned foods. Detection of spoilage and their characterization. Food-borne infections – Bacterial infective and toxic types, *Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Staphylococuus, Vibrio* and *Yersinia.* Non-bacterial – Protozoa, algae, nematodes, fungi and viruses. Food – borne outbreaks – laboratory testing procedures, prevention and control measures.

Microbes as sources of food: Cheese, bread, Vinegar, fermented Vegetables and dairy products, experimental and industrial production methods, spoilage and defects of fermented dairy products. Fermented foods, their quality and standards. Microbial cells as food – single cell proteins, mushroom and legume inoculants.

Microbes as fermentation products: Microbial insecticides and Baker's yeast. Microbial enzymes as fermented products: Industrial enzymes production – Amylases – Fungal and bacterial amylases; proteolytic enzymes – Fungal and bacterial proteases; Pectinases, Invertase and other enzymes. Immobilization of enzymes and microbial cells – methods involved and industrial applications.

UNIT – III

History and development of fermentation Technology: Purposes for large scale cultivation of Microorganisms. Concept of microbial strains, sources of strains – culture collectors, Research laboratories and Industries. screening program: An ores views. Improvement of industrial strains: An overview.

Fermentation equipment: An overview on the media for industrial fermentation, scaling – up of fermentation processes levels of fermentation, design of fermentors and industrial sterilization processes.

UNIT – IV

Microbial fermentations: Metabolic pathways and metabolic control mechanisms. Industrial production of organic acids (citric and lactic acids) and amino acids (Lysine and glutamic acids), enzymes (amylases and proteases), alcohol, acetone and butanol.

Microbial production of therapeutic compounds: Microbial production of therapeutic compounds (β lactam, aminoglycosides, Ansamycins (Rifamycin) peptide antibiotics Quinolinones), biotransformation of steroids, vitamin B 12 and riboflavin fermentation.

Modern trends in microbial production: Modern trends in microbial production of bioplastics (PHB and PHA), bioinsecticides (thuricide), biopolymer (dextran, alginate, xanthan and pullulan), Biofertilizers (nitrogen fixer Azotabacter and Phosphate solubilizing microorganisms), single Cell Protein and production of biological weapons with reference to anthrax.

Biofuels: Useful features of bio-fuels. The substrate digester and the microorganisms in the process of biogas production (biomethanation). Production of bioethanol from sugar, molasses, starch and cellulosic materials. Ethanol recovery. Microbial production of hydrogen gas, biodiesel from hydrocarbons.

Suggested Books:

1. Reed G (2004) Industrial Microbiology, by CBS Publishers (AVI Publishing Co.)
2. Davis JE and Demain AL (1999) Manual of industrial Microbiology and Biotechnology 2nd edition by by ASM publications.
3. Doyle *et al*. MP (2001) Food Microbiology: Fundamentals and frontiers. 2nd Ed. by ASM Press.
4. Byong H. Lee (2014) Fundamentals of Food Biotechnology, 2nd Edition. Springer
5. Helmut Traitler, Birgit Coleman, Karen Hofmann (2014) Food Industry Design, Technology and Innovation. Springer.
6. David A. Mitchell (2006) Solid-State Fermentation BioreactorsFundamentals of Design and Operation. Springer.
7. Hongzhang Chen (2013) Modern Solid State Fermentation Theory and Practice. Springer.
8. Hiroshi Takagi, Hiroshi Kitagaki (2015)Stress Biology of Yeasts and Fungi Applications for Industrial Brewing and Fermentation. Springer.
9. Ashok Pandey, Carlos Ricardo Soccol (2008) Current Developments in Solid-state Fermentation. Springer.

Course learning outcomes

1. Be able to understand presentation methods.
2. Be able to understand the food infections and microbial sancer.
3. To gain knowledge on Fermentation process.
4. Be able to know the advantages and biofuels and microbial frerapeulic compounds

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	**PO_2** Analysis	**PO_3** Design	**PO_4** Development	**PO_5** Modern Tools	**PO_6** Society	**PO_7** Environment	**PO_8** Ethics	**PO_9** Team work	**PO_{10}** Communication	**PO_{11}** Programme Management	**PO_{12}** Lifelong Learning
CO_1	3	2	2	2	2	2	-	-	-	-	-	2
CO_2	3	2	2	2	2	2	-	-	-	-	-	2
CO_3	3	2	2	2	2	2	-	-	-	-	-	2
CO_4	3	2	2	2	2	2	-	-	-	-	-	2

Outcomes:

Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

IMB- 303: Core Practical: FUNDAMENTALS OF INDUSTRIAL MICROBIOLOGY

Course learning Objectives

1. Gives knowledge on various isolation procesures.
2. Give knowledge about staining methods.

1) Isolation of Industrial Microorganisms
2) Staining techniques of Industrially important microorganisms: Simple, differential and special staining- spore, capsule and flagellar staining.
3) Identification of Industrial Microorganisms
4) Culturing of industrially important microbes from different natural sources.
   a) Bacteria
   b) Yeast
   c) Fungi.
   d) Algae
   e) Protozoa
5) Techniques of maintenance of stock cultures.

IMB – 304: Core Practical: FOOD MICROBIOLGY AND FERMENTATION TECHNOLOGY

Course learning Objectives

1. Gives knowledge on various isolation procesures.

2. Give knowledge about staining methods.

1. Microbiological examination of spoiled foods.
2. Enumeration of surface microflora of vegetables.
3. Production and characterization of citric acid using *A. Niger.*
4. Role of Yeast in bread making
5. Determination of lactic acid concentration in commercial curd samples.
6. Preparation of wine from grape juice and estimation of alcohol by dichromate method
7. Microbial production of glutamic acid.
8. Production of rifamycin using Nocardia strain.
9. Comparison of ethanol production using various Organic wastes / raw Material (Free cells/immobilized cells).
10. Production of citric acid by fungus and its estimation.
11. Microbial production of dextran by Leuconostoc mesenteroides.
12. Microbial production of hydrogen gas by algae/bacteria.
13. Study of growth substrate utilization and product formation – Flask cultures
14. Formulation different simple and complex fermentation media.
15. Biomass Production by Solid substrate fermentation.
16. Estimation of biomass.
17. Estimation of substrate product analysis.

Course learning outcomes

1. Be able to analyse the substrate product relationship.

IMB – 305: a) BIOPROCESSING OF INDUSTRIAL MICROORGANISMS AND THEIR PRODUCTS

Course learning Objectives

1. Give elaborate knowledge on Health care products
2. Provide in depth knowledge about microbial antibodies and recombinant products
3. Provide detailed knowledge about organic acids and enzymes
4. Gives in depth knowledge on oxidative transformation.

UNIT – I

An introduction to industrially important microorganisms and bioprocessing of them for products of varied importance.

Health care products – Pharmaceutical sources of drugs, Microbial based antibiotics, vitamins, steroids, ergot alkaloids, vaccines, Recombinant therapeutic proteins, DNase, Erythropoietin, Hormones – Cytokines, Interferons, Interleukins I and II, Tissue plasminogen activator (tPA) – Human growth hormone (somatotrophin), Insulin, Tumor necrosis factor (Tnf), collagen, Bacteriophages as therapeutic agents.

UNIT – II

Production of Antibiotics from - Penicillin, Cephalosporin, Streptomycin – Vitamins from *Streptomycin sp*., *Bacillus sp*., *Propioni bacterium sp*.- Steroids from *Rhizopus sp.*, *Cunning*

hamella sp. – Vaccines, BCG, Anthrax, conventional and recombinant vaccines for viral infections, bacterial – Insulin and *E.coli* through Recombinant DNA technology.

UNIT – III

Production of organic acids – Lactic acid – *Lactobacillus sp. ,* Citric acid – *Aspergillus niger* and Alpha ketoglutaric acid, Gluconic acid – *Aspertillus niger*, *Acetobacter sp*., and *Pseudomonas sp*., Fumaric acid – *Rhizopus nigricans,* Itaconic acid – *Aspergillus terreus,* Kojic acid – *Aspergillus sp*., Gibberllic acid – *Gibberella sp.*, *Agaricus sp*., *Phallus sp*., *Boletus sp*., and *Grifola sp*. Amino acids – Production of L-Lysine and Glutamic acid.

Production of enzymes – Proteases, Amylases, pectic enzymes; Production of solvents – Acetone, Butyl alcohol and glycerol; Production of bio fuels –Methane, Ethanol and Hydrogen, Hydrocarbons, Recovery of minerals – golden microorganism and Recovery of oil.

UNIT – IV

Microbial oxidative transformation of substrate – Vinegar, *Acetabacter sp., Saccharomyces sp.* Dairy products – production of butter – *Lactococcus sp.,* Yoghurt – *Streptococcus sp., Lactobacillus sp.,* Cheese – *Lactococcus sp., Streptococcus sp.* Probiotics – *Lactobacillus sp., Bifidobacterium bifidum, Saccharomyces boulardii, Salmonella enteritidis, Lactobacillus salivarius.* Microbial fermented products of meat, fish, plant (Bread sauer kraut, soyabean coffee, cocoa, tea).

Suggested Books:

1. Ratiedge and Kristiansen. Basic Biotechnology (2001) 2nd ed. by Cambridge University Press.
2. Demain AL (1999) Manual of Industrial Microbiology and Biotechnology, Second edition. by ASM Press.
3. Crueger W and Crueger A (2000) Biotechnology : A test Book of Industrial Microbiology. Second edition, by Panima Publishing corporation.
4. Waites MJ *et al*. (2001) An Introduction to Industrial Microbiology. by Blackwell Science.
5. Prescott and Dunn's (1999) Industrial Microbiology. Fourth edition, by CBS Publishers and distributors.
6. Shyam S. Sablani, Ashim K. Datta, M. Shafiur Rahman, Arun S. Mujumdar (2006) Handbook of Food and Bioprocess Modeling Techniques. By CRC press.
7. Saravanamuthu R (2010) Industrial Exploitation of Microorganisms. By IK international pvt ltd.
8. Ghasem Najafpour (2015) Biochemical Engineering and Biotechnology. By Elsevier.

Course learning outcomes

1. Be able to understand the sources of microbes for the production of health care products
2. Be able to understand Microbial products
3. Be able to have detailed idea about organic acids and enzymes
4. Be able to have clear cut idea about dairy products and fermented products

IMB – 305: b) BIOPROCESS ENGINEERING AND TECHNOLOGY

Course learning Objectives

1. Gives basics of fermentation concept
2. Provides information ma transfers
3. Give in depth knowledge on downstream and upstream processings
4. Gives knowledge on validation principles

UNIT – I

Isolation, selection and Strain improvement: Screening and isolation of microorganisms, primary and secondary metabolites, enrichment, specific screening for the desired product. Mutation and screening of improved cultures, protoplast fusion techniques for strain improvement of primary and secondary metabolites, improvement of characters other than products and its application in the industry.

Growth of cultures in the fermentors: Design of a basic fermentor, Importance of media in fermentation, media formulation and modification. Kinetics of growth in batch culture, continuous culture with respect to substrate utilization, specific growth rate, steady state in a chemostat, fed-batch fermentation, yield of biomass, product, calculation of productivity, substrate utilization kinetics.

UNIT – II

Bioreactors: Bioreactor configuration, design features, individual parts, baffles, impellers, foam separators, sparger, culture vessel, cooling and heating devices, probes for online monitoring, measurement and control of fermentation process.

Reactors for specialized applications: Tube reactors, packed bed reactors, fluidized bed reactors, cyclone reactors, trickle flow reactors, their basic construction and types for distribution of gases.

Mass transfer in reactors: Transport phenomena in fermentation, Gas liquid exchanged and mass transfer. Techniques oxygen transfer, critical oxygen concentration, determination of Kla, basic concepts of heat transfer, aeration/agitation and its importance. Sterilization of Bioreactors, nutrients, air supply, products and effluents, process variables and control, scale-up of bioreactors.

UNIT – III

Fermentation process: Inoculum development. Storage of cultures for repeated fermentations, scaling up of process form shake flask to industrial fermentation.

Downstream processing: Biomass separation by centrifugation, filtration, flocculation and other recent developments.

Cell disintegration: Physical, chemical and enzymatic methods.

Extraction: Solvent, two phases, liquid extraction, whole broth, aqueous multiphase extraction. Batch extraction, Staged extraction, Differential extraction, Fractional extractions

Adsorption: Batch adsorption, Continuous stirred tank adsorption and fixed bed adsorption

Purification by different methods: Concentration by precipitation, ultra-filtration, reverse osmosis, Drying and crystallization, Product purification and Elution, chromatography, Adsorbents yield and purity scaling up chromatography. Precipitation with non-solvent, Salt precipitation, Temperature precipitation.

UNIT – IV

Removal of insolubles: Filtration – General theory for filtration. Conventional filtration, Continuous rotary filters, Microfiltration, Centrifugation, Chemical and mechanical methods of cell disruption.

Crystallization and Drying: Basic concepts of crystallization, Nucleation Crystal growth Crystal size distribution, Recrystallization, Basic concepts of drying Conduction Adiabatic Spray drying methods.

Principles of Validation: Based on WHO norms-The concept of ISO certification, Preparation of SOPs, validation protocols for methods in quality control and process validation, Exercises on preparation of SOPs, operation and validation for analytical methods.

Suggested Books:

1. Michael Shiler and Kargi (2011) Bioprocess Engineering. by prentice Hall publishers.
2. Enfors Hoggstrom (2000) Bioprocess Technology: Fundamentals and Applications. Stockholm KTH
3. Chand (2005) Fermentation Biotechnology: Industrial Perspectives. Indian biotech association.
4. Bailey and Ollis (2006) Biochemical Engineering Fundamentals. by Tata McGraw Hill, N.Y.
5. Veith WF. Bioprocess Engineering Kinetics, Mass Transport, Reactors, and Gene expressions by John Wiley and Sons.
6. Heinz-Gerhard Kessler (2002) Food and bio process engineering. By verlag.
7. Pauline M. Doran (2013) Bioprocess Engineering Principles. By Academic press.
8. Clarke KG (2013) Bioprocess Engineering: An introductory Engineering and Life Science Approach. By Elsevier.

Course learning outcomes

1. Be able to understand fermentation kinetics
2. Be able to have clear cut idea about specialized application of bio-reaction
3. Be able to gradual upstream and down stream processing
4. Be able to write own SOP

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team work	PO_{10} Communication	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO_1	3	2	2	2	2	2	-	-	-	-	-	2
CO_2	3	2	2	2	2	2	-	-	-	-	-	2
CO_3	3	2	2	2	2	2	-	-	-	-	-	2
CO_4	3	2	2	2	2	2	-	-	-	-	-	2

Outcomes:

Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

IMB – 306: a) INDUSTRIAL BIOTECHNOLOGY:

Course learning Objectives

1. Gives knowledge on Design and application of biotechnology.
2. Give deep understanding about product recovery.
3. Gives knowledge of industrial products.
4. Provides detailed information on microbial teaching.

UNIT - I

Raw materials used as media for industrial fermentations. Development of inocula for industrial fermentations. Isolation, preservation and strain improvement of industrially-important microorganisms.

Bioreactor - Designing and appliaction of a biofermentor. Aerobic and anaerobic reactors. Aeration, agitation and sterilization of fermentors. Surface, submerged, batch and continuous fermentations. Scale-up of fermentations.

UNIT - II

Bioprocessing - Recovery of particulates, product isolation, extraction, precipitation, chromatography, centrifugation, membrane separation, electrophoresis, distillation, use of resins super-critical fluid extraction, whole broth processing, online processing integrated product separation, and purification.

Single cell protein (SCP) - production from cellulose and sewage. Food from microorganisms – edible mushrooms and cultivation of mushrooms (button).

Commercial production of cheese, yogurt, production of flavoring components.

Biofuels – Methane, hydrogen, alcohol (gasohol).

UNIT - III

Industrial production of (1) antibiotics - streptomycin, penicillin, cephalosporin, and tetracyclin, (2) biomass of *Bacillus megaterium*, *Acinetobacter cerificans*, *Candida utilis* using hydrocarbons, (3) organic acids - citric acid, lactic acid, (4) amino acids - L-lysine, (5) enzymes -

amylases, proteases and laccases, stabilization of enzymes, (6) vaccines - rabies, FMD vaccine, hepatitis B, (7) alcohol - ethanol and butanol. Esterification of biofuels, Steroid transformations.

UNIT - IV

Microbial leaching - Organisms of leaching, chemistry of microbial leaching, commercial process.
immobilization of cells - methods, applications, advantages and disadvantages. Recombinant DNA products - interferon.

Fermentation economics - Market potential, some effects of legislation on production of antibiotics and recombinant proteins, plant and equipment, continuous culture, recovery costs, water usage and recycling, effluent treatment.

Suggested Books:

1. Principles of fermentation technology (2nd edition) by STANBURY, WHITAKER & HALL.
2. Biotechnology: A Text Book of Industrial microbiology 2nd edition by CRUEGER. & CRUEGER
3. Microbial Technology Vol I by PEPPLER & PEARLMAN (Editors).
4. Microbial Technology Vol II by PEPPLER & PEARLMAN (Editors).
5. Microbial enzymes and bioconversions by ROSE.
6. Microbial Biotechnology: Fundamentals of Applied Microbiology (2nd edition) by GLAZER & NIKAIDO.
7. Prescott & Dunn's Industrial Microbiology 4th edition Editor REED.
8. Biotechnology Vol III. DELLWEG (Editor).
9. Concepts in Biotechnology by BALASUBRAMANIAN, BRYCE, DHARMALINGAM, GREEN & JAYARAMAN.
10. Immobilized cells: Principles and Application by TAMPION & TAMPION.
11. Industrial Microbiology by THOMA.
12. Methods in Food and Dairy Microbiology by DILIELLO.
13. Industrial Microbiology by CASIDA.
14. Industrial Microbiology by MILLER & LITSKY.
15. Microbiology: A Laboratory Manual by CAPPUCCINO & SHERMAN.

Course learning outcomes

1. Be able to gain knowledge on strain improvement.
2. Be able understand the whole broth processing.
3. Gain knowledge on production of industrial products.
4. Be able to understand on efficient trident process.

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	**PO_2** Analysis	**PO_3** Design	**PO_4** Development	**PO_5** Modern Tools	**PO_6** Society	**PO_7** Environment	**PO_8** Ethics	**PO_9** Team work	**PO_{10}** Communication	**PO_{11}** Programme Management	**PO_{12}** Lifelong Learning
CO_1	3	2	2	2	2	2	-	-	-	-	-	2
CO_2	3	2	2	2	2	2	-	-	-	-	-	2

CO_3	3	2	2	2	2	2	-	-	-	-	-	2
CO_4	3	2	2	2	2	2	-	-	-	-	-	2

Outcomes:

Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

Behavior & Values

IMB – 306: b) IMMUNO TECHNOLOGY & HUMAN HEALTH

Course learning Objectives

1. Given an idea about humeral and cellular immunity.
2. Provide knowledge on cancer biology and immunology.
3. Give various concepts involved in Health and hygiene.
4. Provide deep insights into sanitary microbiology.

UNIT – I

History and evolution of immunology, Humoral and cellular immunity, Primary body defence mechanisms, Innate immune systems –Skin, Tears, Saliva and gastric enzymes, cells of immune system B and T lymphocytes, NK cells, antigen presenting cells, phagocytic cells, phagocytosis. Primary and secondary lymphoid organs, antigen recognition by T cells, antigen processing and presentation pathways of exogenous and endogenous antigens, Major classes of antigens, functions of antigens, structure and functions of antibodies, Protection, Immune responses to different infections Up-regulation of immune system against popular and communicable diseases, Applications of immune-based and serological tests in diagnosis of diseases

UNIT – II

Cancer Biology and Immunology: Cancer, types of cancers (Carcinoma, Sarcoma, Lymphoma and Myeloma, & leukemia, germ cell tumours) Pathologilocal symptoms- local,systemic symptoms and metastasis, Benign tumours and malignant tumours, immune system of tumors & cancers, Immuno-surveillance, immunoediting, viruses in development of cancers, cancer therapy

UNIT - III

Health and Hygiene – Home and everyday life hygiene, Hand Hygiene, House hold water treatment & safe storage, Hygiene in Kitchen, Bath rooms and toilets, Laundry Hygiene, Medical hygiene, Safeand potable drinking water, Intake of Healthy diet, nutritional quality of diet, High fibre diet, healthy heart and strong muscles, medical care and dental care. Elements of

Mental Health, Handling of stress, Public health, community health, Vaccination, Health Hazards –Tobacco, Alcohol, Drug Abuse

UNIT - IV

Sanitary Microbiology – Faecal and sewage contamination, outbreaks of diseases during natural calamities and floods, microbiological hazards, Microbiological monitoring of indicator microorganisms (bacteriological standards) in water and food, applications of novel technology for microbiological analysis of water and food

Suggested Books:

1. Immunobiology - The immune system in Health and disease by JANEWAY & TRAVERS.
2. Immunology - An Introduction by TIZARD.
3. Text Book of Immunology by UNANI & BENACERRAF.
4. Fundamentals of Immunology by PAUL.
5. Immunology by KUBY.
6. Immunology - A short course by BENZAINI, SUNSHINE & LESROWITZ.
7. Basic and clinical immunology by STITES, TERR & PARSLOW.
8. Antibodies: A Laboratory Manual by HARLOW & LANE.
9. Practical Immunology by HUDSON & HAY.
10. Manual of Clinical Immunology by ROSE & FRIEDMAN.
11. Immunochemistry in Practice by JOHNSTONE & THROPE.
12. Hand Book of Experimental Immunology, Vol I & II by WEIR.
13. Immunology by ROIT
14. Microbial Ecology: Fundamentals and Applications (4th edition) by ATLAS & BARTHA.
15. Food Microbiology by William C Frazer & Dennis Westhoff

Course learning outcomes

1. Be able to understand the innate immune centre and adoptive immunity.
2. Be able to understand pathological system of cancer biology
3. Be able to understand the everyday life hygiene
4. Be able to have clear cut idea about microbiological hazards

FOURTH SEMESTER

IMB – 401: DOWN STREAM PROCESSING TECHNOLOGY

Course learning Objectives

1. To gives detailed knowledge about upstream and downstream processing during vitamins, Antibodies, microbial enzymes and Recombinant and synthetic vaccines.
2. To Gives information on various seperation processess.
3. To Gives information on membrane seperation & enrichment operations.
4. To understands the various technologies (such as chromatography, chromato focusing, electrophored C, Dialysis and crystallization methods) used for tradition of downstream processed production.

UNIT-I

Processing: Industrial fermentations: Importance of upstream processing (USP) and downstream processing (DSP). Role of downstream processing in industrial fermentation process.

Downstream processing during fermentation:

1) Growth and product formation during fermentation.
2) Concept of primary (growth associated) and secondary (growth non-associated) metabolites and their control, kinetics of growth and product fermentation (growth rate, yield coefficient, efficiency etc.).
3) Production, Recovery, Assay and Applications of (a) Vitamin C (b) Antibiotics (cycloheximide, tetracyclins) (c) Microbial enzymes (Penicillin acylase, Chitinasa, Lipase) (d) Recombinant and synthetic vaccines.

Distillation and various finishing steps: crystallization, drying. Inclusion bodies and the role of genetic engineering in DSP. Economics of downstream processing.

UNIT-II

Physico- chemical basis of bio-separation processes: Recent development in product isolation, one step purification, reverses microcellular extraction, on line membrane separation. Primary separation and recovery process – cell disruption methods for intracellular products, removable of insoluble biomass separation techniques, flocculation and sedimentation and filtration methods.

UNIT-III

Membrane separation: Membrane based separation – micro and ultrafiltration theory, design and configuration of membrane separation and applications of equipment used.

Enrichment operation: Precipitation methods – salts, organic solvents, polymers, extractive separations, aqueous two-phase extraction, supercritical extraction, *in situ* product removal and integrated bioprocessing.

UNIT-IV

Separation and product resolution: Fractionation of downstream processed products by using different technologies – electrophoresis (1D and 2D gels), chromatography – (Paper, TLC, absorption, Ion exchange, Gel filtration, Affinity chromatographic separation, GC, HPLC, FPLC and Chromato focusing electrophoretic separations). Dialysis, crystallization, super liquid extraction, foam based separation.

Suggested Books:

1) Ratiedge C and Kristiansen B (2001) Basic biotechnology 2nd ed. Ed by Cambridge University press.
2) Demain AL (1999) Manual of industrial microbiology and biotechnology, Second edition. Editor in Chief, ASM Press.
3) Crueger W and Crueger A (2000) Biotechnology: A textbook of industrial microbiology. Second edition, Ed. Panima Publishing corporation.

4) M. J. Waites (2001) Industrial microbiology: An introduction by Blackwell Science.
5) Prescott and Dunn's industrial microbiology (1999) Fourth edition, Edition by Gerald Reed. CBS Publishers and distributors.
6) Colin Ratledg and Jorn Kristiansen (2001) Basic biotechnology editor (second edition). By Cambridge university press.
7) Laurence R. Weatherley (2013) Engineering Processes for Bioseparations. By Elsevier.
8) Ronald W. Rousseau (2009) Handbook of Separation Process Technology. wiley.
9) Michael C. Flickinger. (2013) Downstream Industrial Biotechnology: Recovery and Purification. By wiley.
10) Harker JH, Backhurst JR, Richardson JF (2013) Chemical Engineering, Volume 2.By Butterworth HeinemannRatiedge C and Kristiansen B (2001) Basic biotechnology 2nd ed. Ed. by Cambridge University press.

Course Learning Out comes

1. Be able to produce and assay the various Industrial products.
2. Be familiar with various physics-chemical methods involved in bio-seperation process.
3. Be acquint themselves with enrichment operations and membrane seperations.
4. Be able to carry out seperation and product resolution.

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	**PO_2** Analysis	**PO_3** Design	**PO_4** Development	**PO_5** Modern Tools	**PO_6** Society	**PO_7** Environment	**PO_8** Ethics	**PO_9** Team work	**PO_{10}** Communication	**PO_{11}** Programme Management	**PO_{12}** Lifelong Learning
CO_1	3	2	2	2	2	2	-	-	-	-	-	2
CO_2	3	2	2	2	2	2	-	-	-	-	-	2
CO_3	3	2	2	2	2	2	-	-	-	-	-	2
CO_4	3	2	2	2	2	2	-	-	-	-	-	2

Outcomes:
Knowledge
Skill
Attitude
Behavior & Values

Level: 1. Slight/Low
2. Moderate
3. Substantial

IMB – 402: CELL AND PHARMACEUTICAL TECHNOLOGY

Course learning Objectives

1, Gives indepth information on Animal cell culture.
2. Provides detailed information on plant cell culture.
3. Gives broader picture of microorganisms role in pharmaceuitical manufactureres.
4. Helps understand the drug targeting, process of drug development and Immunopharmacology.

UNIT – I

Animal Cell Culture: Scope of animal cell culture, principles and methodology of animal cell cultures, physical chemical and metabolic function of the constituents of culture media and reagents, primary, secondary and continuous cell lines, stem cell and embryonic cell isolation and culture, organ culture. Sub culturing, maintenance and preservation of cell cultures.
Transgenesis for improvement of traits and use of animals as bioreactors for production of proteins of pharmaceuticals value, marker assisted selection and genetic improvement of livestock, Germplasm, maintenance and Biodiversity.

Industrial importance of animal cell culture products – viral vaccines for human and animal use, production of interferon, interleukins, retroviruses and adenoviruses and produced for use in gene therapy, large scale production of Bio-Insecticides – Baculoviruses, NPV, GV, cell cultures used for diagnostic assay system, therapeutics.

UNIT – II

Plant cell culture – Embryo culture, meristem culture, callus culure, anther culture, protoplast culture, cell suspension, spore culture, protoplast isolation culture and fusion regeneration and somatic hybridization and regeneration of plants.
Scope of plant cell culture – Major sources of pharmaceuticals, dyes, food colours and flavours, enzymes, polysaccharides, fragrances, insecticides, herbicides, products of secondary metabolites. Production of Shikonim and culturing of Microalgae. Industrial advantages and disadvantages of plant tissue culture – Cell and organ differentiation – Clonal propagation or micropropagation. Application of cell culture for mutant selection, production of secondary

metabolites, transformations, production of transgenic plants for herbicide resistance, insect resistance and disease resistance, nutritional quality improvement, as bioreactors for vaccines.

UNIT – III

Historical review of the involvement of microbiology with pharmaceutical practice, the impact of microorganisms in pharmaceutical device manufacture, microbial contamination control in pharmaceutical manufacturing, implementation of Rapid Microbiological Methods(RMM) for pharmaceutical laboratories, the broader picture of microorganisms and pharmaceutical manufacturing: Challenges, Solutions and Pharmacopoeial guidance.

UNIT – IV

Drug targeting principles: Targeting, Principles and its importance in therapeutics, Methods in drug targeting, advantages and disadvantages in targeting, protein and peptide based drug delivery systems.
The drug development process: Drug Discovery the impact of genomics and related technologies upon drug discovery. Delivery of Biopharmaceuticals-Oral delivery systems – Pulmonary delivery – Nasal, transmucosal and transdermal delivery systems.

Immunopharmacology: The interferon family, cytokines as Biopharmaceuticals. TNF – therapeutic aspects. Haemopoietic growth factors, Growth factors, Hormones of therapeutic interest, Blood products, therapeutic enzymes and Nucleic acid therapeutics.

Suggested Books:

1. Tim Sandle, (2011)Selection of Microbiological Culture Media and Testing Regimes
2. Sandy Rubio,(2011) Validation of Microbiological Methods by Business Horizons;
3. Masakazu Tsuchiya,(2010)Bacterial Endotoxins Test by bioprocess awards
4. Michael J. Miller,(2013)The Implementation of Rapid Microbiological Methods by European Pharmaceutical company
5. Matts Ramstorp,(2012) Microbiology and Sterility Assurance in Pharmaceuticals and Medical Devices by Madhu Raju Saghee, Tim Sandle and Edward C. Tidswell,UK
6. Sandle, T. (2012). The CDC Handbook: A Guide to Cleaning and Disinfecting Cleanrooms, Grosvenor House Publishing: Surrey, UK
7. Sandle, T. and Saghee, M.R. (2013). Cleanroom Management in Pharmaceuticals and Healthcare, Euromed Communications: Passfield, UK
8. Wulf Crueger and annelies Crueger (2000) Biotechnology : A Text book of Industrial Microbiology (2ed) Panima publishing Mc Graw Hill book
9. Peppler (2003) Microbial techonology. by CRC Press, Canada.
10. Jogdand (2001) Medical Biotechnology, by New Age Publishers, New Delhi
11. Gary Walsh (2013) Pharmaceutical Biotechnology: Concepts and Applications. By wiley.
12. Fowler MW, Warren GS, Murray Moo-Young (2013) Plant Biotechnology: Comprehensive Biotechnology Second Supplement. Elsevier.
13. John M. Davis (2011) Animal Cell Culture: Essential Methods. By Wiley.

Course Learning Out comes

1. Be able to understand the principles abd methodology of animal cell culture and it's applications.
2. Be able to understand the industrial advantages of plant tissue culture.
3. Be able to implement Rapid microbiology methods for pharmaceuitical laboratories.
4. Be able to acquint themselves with drug delevary system and immuno therapeutics.

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team work	PO_{10} Communication	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO_1	3	2	2	2	2	2	-	-	-	-	-	2
CO_2	3	2	2	2	2	2	-	-	-	-	-	2
CO_3	3	2	2	2	2	2	-	-	-	-	-	2
CO_4	3	2	2	2	2	2	-	-	-	-	-	2

Outcomes:

Knowledge Level: 1. Slight/Low

Skill 2. Moderate
Attitude 3. Substantial
Behavior & Values

IMB – 403: Core Practical: DOWN STREAM PROCESSING TECHNOLOGY AND CELL AND PHARMACEUTICAL TECHNOLOGY

Course learning Objectives

1. Gives hands on experience solid liquid seperations (various down stream process upstream process).
2. Gives hands on experience in cell and synophan methods.
3. Gives hands on experience in plant cell culture.
4. Gives hands on experience on pharmaceuitical practices

1.Cell disruption techniques.
2. Solid & liquid separation methods – filtration, sedimentation, centrifugation.
3. Product enrichment operation –Precipitation, ultrafiltration, two phase aqueous extraction.
4. High –resolution purification, preparative liquid chromatography techniques.
5. Product crystallization and drying.
6. Plant tissue culture techniques- meristem, embryo, protoplast
7. Secondary metabolites production from plant cell cultures.
8. Collection and study of antibiotics sensitivity by invitro.
9. Isolation of Bacteriophages from sewage and soil.
10. Isolation and identification of polymeric material degrading organisms.
11. Antibiotic assay preservative test
12. Bioburden Testing
13. Microbial Limit test (MLT)
14. Bacterial Endotoxins Test

Course Learning Out comes

1. Able to perform solid liquid seperations.
2. Able to throw product crystllization & drug.
3. Able to perform plant tissue culture techniques.
4. Able to perform rapid microbial methods in pharmaceuitical industries.

IMB – 404 : Core Practical : Field Trip / Industriel Tour Report / Project :

Course learning Objectives

1. Gives practical experience in locating, collecting and interpretent the scientific information.

Practical experience in locating, collecting and interpreting the scientific information for the purpose of MSc., Industrial Microbiology field trip/industrial tour report. The student works individually, under faculty/Scientist supervision in laboratories, Research labs, Industries, National Institutes to perform the procedures, record the results and present the project work at the end of the Fourth Semester. The project work of the student will be evaluated by seeing the performance of presentation and interpretation of the results.

Course Learning Out comes

1. Able to design procedues, record research methodology and interpret the research.

IMB: 405: a) Biostatistics & Bioinformatics:

Course learning Objectives

1. Gives basic information on data classification and tabulation.
2. Understand the correlation & linear repressions and small sample tests.
3. Provider information on basic bioinformatics.
4. Gives information on sequence alignment analysis and proteomics.

UNIT - I

Data - Data types, collection of data, classification and tabulation. Measures of central tendencies – Mean, median and mode. Measures of variation - Range, quartile deviation, mean deviation and standard deviation. Coefficient of variation. Probability – Addition and multiplication theories, conditional probability and probability distributors – Binomial, poisson and normal distribution.

UNIT - II

Correlation and linear regression – Scatter diagram method – Karnal Pearson's Rank correlation methods. Regression lines – fitting of regression lines by least squares method – Regression coefficients and properties. Small sample tests – t, F and chi square tests. ANOVA – one way and two way classifications. Duncan's multiple range (DMR) test.

UNIT - III

Introduction - Origin of bioinformatics biological data (genome projects), computer and information technology contributions. Disciplines of bioinformatics – Genomics, transcriptomics, proteomics, functional genomics, structural genomics, metabolomics, pharmacogenomics, structure prediction and drug design.

Genome projects **-** General introduction to genome projects (rice genome project and Mycobacterium tuberculosis genome project). Special emphasis on Human Genome Project (HGP) – Science behind HGP, benefits of HGP, ELSI of HGP in use of genetic information, genetic testing standard, quality and commercialization.

Biological database - Introduction of database (DB), need, organization, search of DB. An over view of biological databases - NCBI, EMBL, DDBJ, SWISS-PROT, PDB, and KEGG.

UNIT - IV

Database querying with NCBI using key words, sequences (proteins and genes), finding similarities, identifying genes and proteins from different organisms.
Sequence alignment - Introduction, significance of sequence alignments and use of dot matrices. Pair wise and multiple sequence alignment (MSA) using Clustal programs.

Sequence analysis - concepts of sequence analysis and their importance. BLAST – blastn, blastp, blastx, tblastx, output analysis matrix BLOSSUM, PAM, e-value.

Proteomics - Introduction, principle, technique, 2-D database. Gel analysis software, post gel analysis, MALDI-TOF. Significance and applications of proteomics in modern biology.

Suggested Books:

1. Statistical methods. S.P. Gupta
2. Fundamentals of mathematical statistics. S.C Gupta & Kapoor
3. Statistical methods in biological and Health Science. J. S. Milton & J.O. Tsokan.
4. Primrose SB. Principles of Genome Analysis: a guide to mapping and sequencing DNA from different organisms. 2nd Ed. 1998.Blackwell Science: Oxford. ISBN 0-632-04983-9.
5. Genome Mapping: A practical approach. Dear P (Editor). 1st Ed.2000. Oxford University Press: Oxford, New York.
6. Developing Bioinformatics Skills. Alfonso Valencia and Blaschke. L (2005) Oreille's Publication.
7. Bioinformatics sequence, structure and data banks ed. By Des Higgins Willie Taylor.(2006)

Course Learning Out comes

1. Be able to perform calculations on measures of variation, central tendencies and probabilities.
2. Be able to perform sample tests such as t , F a chi square and ANOVA.
3. Be also to understand the genome production and biological data basis.
4. Be able to use crustal programs and BLAST.

IMB: 405 - b) Biosafety, Bioethics and Intellectual property rights:

Course learning Objectives

1. Gives detail information on containment facilities.
2. Provides basics on biosafety and regulatory affairs involved in transgenic research.
3. Introducer various bioethics issues.
4. Provides information on patent laws and concepts.

UNIT-I

Biosafety – Definition, biosafety requirement, regulations, consideration, types of containments, personal practices, primary and secondary containment barriers (biosafety levels 1, 2, 3, 4),

containment for production activities, practical consideration, possible hazards from industrial production and use of pathogens. Biosafety and biodiversity of genetically modified foods.

UNIT-II

Biosafety for human health and environment – Use of genetically modified microorganisms and their release into the environment, special procedures for recombinant DNA based products.

Regulatory affairs – regulatory requirements for drugs and biologicals. Biosafety in relation to transgenic research and applications.

UNIT-III

Bioethics – Introduction to Bioethics, solid and ethical issues related to industrial genetically manipulated microorganisms (GMM). Social and ethical issues, Bioethics and patenting Institutional bioethics.

UNIT-IV

Intellectual property rights – Importance of Intellectual property, history of patent concept, composition of a patent, general patent information – patent laws, patentable subject matter, apply for patent, requirements for patentability, issuance of a patent, infringement of a patent. Obtain patent protection – applying for patent protection, patent prosecution, appeals and interference proceedings, applying for foreign patent protection. Patent laws in US, India and other countries.

Suggested Books:

1. 1. Sateesh MK (2010) Bioethics and Biosafety. By IK international.
2. Vaver D (2006) Intellectual Property Rights: Critical Concepts in Law. By Taylor and Franscis
3. Deepa Goel, Shomini Parashar. IPR, Biosafety and Bioethics. Pearson education.India.

Course Learning Out comes

1. Be able to differentiate various biosafety levels.
2. Be aqua to understand various regulatory requirements for biologicals and drugs.
3. Be able to understand social and ethical issues.
4. Be able to know the requirements for patentability.

CO-PO Attainment in Outcome Based Education -2017

CO-PO Mapping Matrix/Programme Articulation Matrix:

	PO_1 Know ledge	**PO_2** Analysis	**PO_3** Design	**PO_4** Development	**PO_5** Modern Tools	**PO_6** Society	**PO_7** Environment	**PO_8** Ethics	**PO_9** Team work	**PO_{10}** Communication	**PO_{11}** Programme Management	**PO_{12}** Lifelong Learning
CO_1	3	2	2	2	2	2	-	-	-	-	-	2
CO_2	3	2	2	2	2	2	-	-	-	-	-	2
CO_3	3	2	2	2	2	2	-	-	-	-	-	2
CO_4	3	2	2	2	2	2	-	-	-	-	-	2

Outcomes:

Knowledge
Skill
Attitude

Level: 1. Slight/Low
2. Moderate
3. Substantial

Behavior & Values

IMB – 406: a) Microbes in Human Welfare:

Course learning Objectives

1. Gives detailed knowledge on traditional microbial technologies.
2. Privides information on alternates sancer energy and biodegradable polymers.
3. Gives information on skill based technologies mushroom, sincell protein.
4. Provides information on microorganisms role in sustainable agriculture.

UNIT - I

Microorganisms in the service of man in past, present and future Basics of microbiology: Microbial diversity & types of microorganisms - Viruses, fungi, bacteria, algae, protozoa

Cultivation of microbes - Sterilisation of media and glass wares, growth of microbes on culture media in fermentors/bioreactors/flasks

Traditional microbial technologies – Curdling of milk, yoghurt, cheese, probiotics. Bread and wine making, alcohol and alcoholic beverages, other traditional foods of india

UNIT – II

Production of pharmaceutically and commercially important products – antibiotics, enzymes, vitamins, monoclonal antibodies vaccines

Alternate sources of energy - Bio-fuel methane, hydrogen and alcohol. Current status and prospects of commercial production of microbial fuels

Biodegradable polymers and surfactants from microorganisms - polylactate and polyhydroxyalkaonoates.

UNIT – III

Single cell proteins & single cell organisms, mush room cultivation Genetically engineered organisms–applications in health, industries, agriculture and environment.

UNIT - IV

Bio-catalysis for steroidal transformation Role of Microorganisms in Sustainable agriculture: Biocontrolagents/biopesticides – Bacterial, fungi and viruses. Biofertilisers-production, formulations and applications Microbial Standards for water and food. Quality control

Suggested Books:

1. Principles of fermentation technology (2nd edition) by STANBURY, WHITAKER & HALL.

2. Biotechnology: A Text Book of Industrial microbiology 2nd edition by CRUEGER. & CRUEGER
3. Microbial Technology Vol I by PEPPLER & PEARLMAN (Editors).
4. Microbial Technology Vol II by PEPPLER & PEARLMAN (Editors).
5. Microbial enzymes and bioconversions by ROSE.
6. Microbial Biotechnology: Fundamentals of Applied Microbiology (2nd edition) by GLAZER & NIKAIDO.
7. Prescott & Dunn's Industrial Microbiology 4th edition Editor REED.
8. Biotechnology Vol III. DELLWEG (Editor).
9. Concepts in Biotechnology by BALASUBRAMANIAN, BRYCE, DHARMALINGAM, GREEN & JAYARAMAN.
10. Immobilized cells: Principles and Application by TAMPION & TAMPION.
11. Industrial Microbiology by THOMA.
12. Methods in Food and Dairy Microbiology by DILIELLO.
13. Industrial Microbiology by CASIDA.
14. Industrial Microbiology by MILLER & LITSKY.
15. Brock Biology of Microorganism (9th edition) by MADIGAN, MARTINKO & PARKER.

Course Learning Out comes

1. Be able to understand about microbial diversity.
2. Be able to understand green technology.
3. Be able to understand the single cells and genetically engimed organims applications.
4. Be able to understand about bio castro agencies and Biofertilizers.

IMB – 406: b): MEDICAL AND DIAGNOSTIC MICROBIOLOGY

Course learning Objectives

1. Gives information on public health and communication diseases.
2. Provides depth knowledge on patrogeny prophylasis of various bacteria.
3. Gives information on mycotic and protozoic diseases.
4. Gives detailed information on various virus associated diseases.

UNIT - I

Historical developments, public health and importance of communicable diseases. Diagnosis of infectious diseases, guidelines to practice and management. Specimen collection and transport, specimen primary observation, processing and preservation of culture and laboratory safety, Host-parasite interactions in bacterial infections, bacterial toxins - types and modes of action, symptoms and syndromes of bacterial diseases. Epidemiology - transmission of pathogens, pathogenic mechanisms. Nosocomical infections - An overview, classification, epidemiology, host biological environment, physical environment and inanimate environment. Nosocomical infections, urinary tract infections.

UNIT - II

Cocci and their clinical importance. General characters, pathogenicity and prophylaxis of *Streptococcu*s, *Staphylococcus*, *Neisseria, Corynebacterium diphtheriae* and *Clostridium tetani.* Bacilli of medical importance - gram positive and negative bacilli, endospore-forming aerobic bacilli, acid fast bacilli, *Mycobacterium tuberculosis* and *M. leprae*.

Antimicrobial chemotherapy, mechanisms of action of clinically used antimicrobial drugs. Antimicrobial drugs for systemic administration - penicillins, cephalospirins, tetracyclins, erythromycins, anti-tubercle drugs.

UNIT - III

Mycotic diseases - Superficial mycosis, deep mycosis, respiratory allergies due to fungi, *Candida albicans*, *Aspergillus fumigatus*, *Blastomyces dermatidis*, mycotic poisoning, Protozoa-parasitic species, pathogenic and molecular aspects of severe malaria, *Plasmodium vivax* and *P. falciparum*, Amoebiasis, Leishmaniasis. Sources and pathogenic mechanism of *Leishmania* disease.

UNIT - IV

Pathology and laboratory diagnosis of virus associated human diseases, Human papilloma virus, Hepatitis B virus, Herpes simplex virus and AIDS virus. Molecular diagnostic methods in the detection of diseases, diagnosis of bacterial infections, diseases caused by prions - Kuru, CJD disease, sub-acute spongiform, encephalopathy.

Suggested Books:

1. Reviews of Medical Microbiology by JAWETZ, MELNICK & ADEBERY
2. Medical Microbiology by CRUICKSHANK Vol. I and II
3. A text book of Microbiology (6th edition) by ANANTANARAYAN
4. Clinical diagnosis and management – Laboratory methods by JOHN BERNARD HENRY
5. Zinser Microbiology by JOKLIK, WILLE, AMOS & WILFERT
6. Microbiology (4th edition) by BERNARD, DAVIS, DULBECCO
7. Text book of Medical parasitology (4th edition) by JAYARAM PANIKER
8. Bailey and Scott's Diagnostic microbiology by MOSBY

Course Learning Out comes

1. Be able to understand the epidemology of pathogens.
2. Be able to know the clinical important of Cocci and bacilli and antimicrobial therapy.
3. Be able to identify sancer and pathogenic mechanism of mycotic and protozoan disease.
4. Be able to understand the pathology and laboratory disgnosis of viruses associated with human diseases.

CO-PO Attainment in Outcome Based Education -2017

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CO_3	3	2	2	2	2	2	-	-	-	-	-	2
CO_4	3	2	2	2	2	2	-	-	-	-	-	2

Outcomes:

Knowledge Level: 1. Slight/Low

Skill
Attitude
Behavior & Values

2. Moderate
3. Substantial