

**Course Structure : Semester 1**

S.No	Paper Code	Paper Name	ESE	CCE	Total Marks
1	BMIC 101	History & scope of Microbiology	70	30	100
2	BMIC 102	Bacteriology	70	30	100
3	BMIC 103	Microbial Physiology & metabolism	70	30	100
4	BMIC 104	Biochemistry	70	30	100
5	BENG 105	Communicative English I	35	15	50
6	BENV 106	Environmental Sciences	35	15	50
7	BMICP 107	Microbiology	35	15	50
8	BBIOP 108	Biochemistry	35	15	50
			420	180	600

**ITM-U/BMIC 101 History & scope of Microbiology**

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	History of Development of Microbiology	10 hours	Lecture/ power point	Written
2	Diversity of Microorganisms, Systems of classification : Binomial nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Prokarya: Archaea and Bacteria, Eukarya: Algae, Fungi and Protozoa) giving definitions and citing examples.	6 hours	Lecture/ power point	Written
3	Relevance of Microbiology to Human Health & Environment Medical microbiology and immunology: List of important human diseases and their causative agents (Tuberculosis, Anthrax, Cholera, Typhoid, Diphtheria, Tetanus, Plague, Syphilis, Amoebic dysentery, Giardiasis; AIDS, Polio, Measles, Mumps, Ringworm) Definitions of immunity (active/passive), primary and secondary immune response, antigen, antibody and their types Environmental microbiology: Definitions and examples of important microbial interactions- mutualism, commensalism, parasitism, mycorrhizal and actinorrhizal relationships; Definitions and microorganisms used as biopesticides, in biodegradation, bioremediation and	10 hours	Lecture/ power point	Written

bioremediation (e.g. hydrocarbons in oil spills)			
Industrial Microbiology, Definition of fermentation, primary and secondary metabolites, types of fermentations and fermenters and microbes producing ethanol, antibiotics (penicillin and streptomycin), enzymes (amylase and lipase) and organic acids (citric acid and acetic acid)	8	Lecture/ power point	Written
Food and Dairy Microbiology- A brief description on production and importance of Single Cell Protein and probiotics, microorganisms involved in producing fermented foods such as bread, cheese and curd	5	Lecture/ power point	Written
Total	39 hours		

## SUGGESTED READING

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2009). Brock Biology of Microorganisms. 12th edition. Pearson International Edition
3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited

## ONLINE READING MATERIAL

1. Introduction to Microbiology : [www.mona.uwi.edu/biochem/.../bc10m\\_introduction\\_microb.ppt](http://www.mona.uwi.edu/biochem/.../bc10m_introduction_microb.ppt)
2. Industrial Microbiology : [www.sku.ac.ir/academic/members/.../Industrial %20Microbiology.pdf](http://www.sku.ac.ir/academic/members/.../Industrial%20Microbiology.pdf)

**ITM-U/BMIC 102 BACTERIOLOGY**

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Cell- Organization archaeal flagellar structures, twitching, gliding and spirochete motility, cell wall organization Cytoplasm: Ribosomes, inclusions, nucleoid, plasmids, bacterial cytoskeleton	8 hours	Lecture/ power point	Written
2	Culture media, Sterilization and Pure Cultures- Nutritional categories: A brief overview Culture media: Components of media, Synthetic or defined media, Complex media, supportive media, enriched media, selective media, differential media, enrichment culture Sterilization: Physical methods of heat, filtration and radiations Pure culture isolation: Streaking, serial dilution and plating methods. Cultivation, maintenance and stocking of pure cultures, cultivation of anaerobic bacteria.	8 hours	Lecture/ power point	Written
3	Growth and Reproduction in Bacteria Asexual	6 hours	Lecture/ power point	Written

	methods of Reproduction Phases of growth: Logarithmic representation of bacterial populations, calculation of generation time, synchronous growth			
4	Bacterial Systematics- Introduction to taxonomy, nomenclature and systematic Types of classification Taxonomic ranks Techniques for determining microbial taxonomy and phylogeny 4.5Phylogenetic trees Evolution of three domains of life	10	Lecture/ power point	Written
5	Important Archaeal and Eubacterial Important archaeal and eubacterial groups according to Bergey's Manual of Systematic Bacteriology Archaea: General characteristics of genera belonging to Nanoarchaeota (Nanoarchaeum), Crenarchaeota (Sulfolobus, Thermoproteus), Euryarchaeota (Thermophiles), 5.2Eubacteria:Morphology, ecological significance and economic importance Gram Negative: Nonproteobacteria Deinococcus, Thermus, Spirochetes Alpha proteobacteria- Rhizobium, Agrobacterium Beta proteobacteria – Neisseria, Burkholderia, Thiobacillus Gamma proteobacteria – Enterobacteriaceae family, Purple sulphur bacteria, Pseudomonas Gram positive: Low G+C: Mycoplasma, Bacillus, Clostridium, Lactobacillus, Staphylococcus. High G+C: Streptomyces, Bifidobacterium, Corynebacterium, Mycobacterium Cyanobacteria: General account and importance	10	Lecture/ power point	Written
	Total	42 hours		

### References

- (Chapter 6, Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM and Woolverton CJ, 8th Ed., McGraw Hill Higher Education, 2011. Pages: 140, 146-152)
- (Chapter 7, Microbiology: An Introduction by Tortora GJ, Funke BR and Case CL., 9th Ed., Person Education, 2008, Pages: 190-196)
- (Chapter 8, Microbiology by Pelczar Jr MJ, Chan ECS and Krieg NR. 5th Ed. Tata McGraw Hill, 2011 (Reprint), Pages: 136-146)
- 1.Black JG (2008) Microbiology: Principles and Explorations. 7th edition. Prentice Hall
  - 2.Madigan MT and Martinko JM (2006) Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.
  - 3.Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005) General Microbiology. 5th edition. McMillan
  4. Srivastava S and Srivastava PS (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Microbial Growth and Effect of Environment on Microbial Growth- Definitions of growth, Batch culture, Continuous culture, generation time and specific growth rate Temperature and temperature ranges of growth pH and pH ranges of growth Effect of solute and water activity on growth Effect of oxygen concentration on growth Nutritional categories of microorganisms	7 hours	Lecture/ power point	Written
2	Nutrient uptake and Transport- Passive and facilitated Diffusion Primary and secondary active transport, concept of uniport, symport and antiport Group translocation Iron uptake	6 hours	Lecture/ power point	Written
3	Chemoheterotrophic Metabolism – Aerobic Respiration Concept of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP, ED, Pentose phosphate Pathway, TCA cycle, Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors	6 hours	Lecture/ power point	Written
4	Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation- Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction), Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways	5		
	Chemolithotrophic and Phototrophic Metabolism- Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction) Introduction to phototrophic metabolism -groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria and cyanobacteria	9		
	Total	33 hours		

**Reference:**

(Chapter 10, Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM and Woolverton CJ, 7th Ed., McGraw Hill Higher Education, 2008, Pages: 235-238)

**SUGGESTED READINGS**

1. Madigan MT, and Martinko JM (2006). Brock Biology of Microorganisms. 10th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India

**ITM-U/BOPT 104 BASIC BIOCHEMISTRY**

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
1	<b>Bioenergetic</b>	6 hours	Lectures Demonstration	Written
	1.1 First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy and Entropy and mathematical relationship among them	2 hours	Lectures Demonstration	Written
	1.2 Standard free energy change and equilibrium constant	1 hour	Lectures Demonstration	Written
	1.3 Coupled reactions and additive nature of standard free energy change 1.4 Energy rich compounds: Phosphoenolpyruvate, 1,3-Bisphosphoglycerate, Thioesters, ATP	3 hours	Lectures Demonstration	Written

**References** (Chapter 14, Lehninger Principles of Biochemistry by Nelson DL and Cox MM, 5th Ed., W.H. Freeman and Company, 2008, Pages: 490-509)

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
2	<b>Carbohydrates</b>	10 hours	Lectures Demonstration	Written
	2.1 Families of monosaccharides: aldoses and ketoses, trioses,	2 hours	Lectures Demonstration	Written

	tetroses, pentoses, and hexoses.			
	2.2 Stereo isomerism of monosaccharides, epimers	1 hour	Lectures Demonstration	Written
	2.3 Mutarotation and anomers of glucose. Furanose and pyranose forms of glucose and fructose. Haworth projection formulae for glucose; chair and boat forms of glucose	2 hours	Lectures Demonstration	Written
	2.4 Sugar derivatives, glucosamine, galactosamine, muramic acid, N- acetyl neuraminic acid	2 hours	Lectures Demonstration	Written
	2.5 Disaccharides; concept of reducing and non-reducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose	2 hours	Lectures Demonstration	Written
	2.6 Polysaccharides, storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose, peptidoglycan and chitin	2 hours	Lectures Demonstration	Written

*References (Chapter 9, Lehninger Principles of Biochemistry by Nelson DL and Cox MM, 5th Ed., W.H. Freeman and Company, 2008, Pages: 293-321)*

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
3	<b>Lipids</b>	10 hours	Lectures Demonstration	Written
	3.1 Definition and major classes of	2 hours	Lectures Demonstration	Written

	storage and structural lipids.			
	3.2 Storage lipids. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties. Saponification	2 hours	Lectures Demonstration	Written
	3.3 Structural lipids. Phosphoglycerides: Building blocks, General structure, functions and properties. Structure of phosphatidylethanolamine and phosphatidylcholine. Sphingolipids: building blocks, structure of sphingosine, ceramide. Special mention of sphingomyelins, cerebroside and gangliosides	3 hours	Lectures Demonstration	Written
	3.4 Lipid functions: cell signals, cofactors, prostaglandins	1 hours	Lectures Demonstration	Written
	3.5 Introduction of lipid micelles, monolayers, bilayers	2 hours	Lectures Demonstration	Written

**Reference:** (Chapters 11&12, Lehninger Principles of Biochemistry by Nelson DL and Cox MM, 5th Ed., W.H. Freeman and Company, 2008, Pages: 363-379 &389-393).

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
4	<b>Proteins</b>	10 hours	Lectures Demonstration	Written
	4.1 Functions of proteins	1 hour	Lectures Demonstration	Written

	4.2 Primary structures of proteins: Amino acids, the building blocks of proteins. General formula of amino acid and concept of zwitterion. Titration curve of amino acid and its significance	2 hours	Lectures Demonstration	Written
	4.3 Classification, biochemical structure and notation of standard protein amino acids Ninhydrin reaction. Natural modifications of amino acids in proteins hydrolysine, cystine and hydroxyproline	2 hours	Lectures Demonstration	Written
	4.4 Non protein amino acids: Gramicidin, beta-alanine, D-alanine and D- glutamic acid	1 hour	Lectures Demonstration	Written
	4.5 Oligopeptides: Structure and functions of naturally occurring glutathione and insulin and synthetic aspartame	1 hour	Lectures Demonstration	Written
	4.6 Secondary structure of proteins: Peptide unit and its salient features. The alpha helix, the beta pleated sheet and their occurrence in proteins	1 hour		
	4.7 Tertiary and quaternary structures of proteins. Forces holding the polypeptide together.	1 hour		



	Human haemoglobin structure			
	4.8 Quaternary structures of proteins	1 hour		

*Reference: Chapter 4, Biochemistry by Voet,D. and Voet J.G., 3rd Ed., John Wiley and Sons, 2004: Pages: 65-78); Chapter 8, Biochemistry by Voet,D. and Voet J.G., 3rd Ed., John Wiley and Sons, 2004, Pages: 219-240; 265-266 )*

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
5	<b>Enzymes</b>	10 hours	Lectures Demonstration	Written
	5.1 Structure of enzyme: Apoenzyme and cofactors, prosthetic group-TPP, coenzyme NAD,metal cofactors	2 hours	Lectures Demonstration	Written
	5.2 Classification of enzymes	1	Lectures Demonstration	Written
	5.3 Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis. Significance of hyperbolic, double reciprocal plots of enzyme activity, Km, and allosteric mechanism Definitions of terms – enzyme unit, specific activity and turnover number	2	Lectures Demonstration	Written
	5.4 Multienzyme complex :	2	Lectures Demonstration	Written

	pyruvate dehydrogenase; isozyme: lactate dehydrogenase			
	5.5 Effect of pH and temperature on enzyme activity. Enzyme inhibition: competitive- sulfa drugs; non-competitive-heavy metal salts	2	Lectures Demonstration	Written

*Reference : (Chapter 8, Prescott, Harley and Klein's Microbiology by Willey MJ, Sherwood, LM & Woolverton C J. 7th Ed., McGrawHill, 2008, Pages: 117-182; Chapter 13, Biochemistry by Voet, D. and Voet J.G., 3rd Ed., John Wiley and Sons, 2004: Pages: 459-471).*

#### **SUGGESTED READING**

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H. Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H. Freeman and Company

#### **ONLINE READING MATERIAL**

1. Chapter on Structures and Functions of Biomolecules URL--<http://nsdl.niscair.res.in/handle/123456789/59>
2. Chapter on Enzymes in Microbial Physiology and Biochemistry URL-<http://nsdl.niscair.res.in/handle/123456789/392>

#### **ITM-U/BENG 105 Communicative English**

Parts of speech: Noun, Pronoun, verb, adverb, adjective, preposition, conjunction, interjection.

Exercises for all parts of speech

Past tense, present tense

Positive, Comparative and superlative form of adjectives.

Make sentences

Vocabulary building: synonyms, antonyms

Use of older, elder, near, next, farther, further

#### **Letter writing:**

Apology letter

Request for leave

Acknowledgement letter

Request for permission

Request for information

Friendly letters

## REFERENCE:

Wren &amp; Martin

**ITM-U/BENV 106 ENVIRONMENTAL SCIENCES****Definition, Scope and Importance****Natural Resources: Renewable and Nonrenewable Resources**

**Unit I** – Forest, Water and Mineral resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forests and tribal people and relevant forest Act. Use and over-utilization of surface and ground water, floods drought, conflicts over water, dams benefits and problems and relevant Act. Use and exploitation, environmental effects of extracting and using mineral resources.

**Unit II-** food, Energy and Land resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging , salinity. Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Land as a resource, land degradation, man induced landslides soil erosion and desertification.

**UNIT III- ECOSYSTEM****Concept, Structure and Function of and ecosystem**

Producers, consumers and decomposers. Energy flow in the ecosystem, Ecological succession

Food chains, food webs and ecological pyramids. Introduction, Types, Characteristics Features, Structure and Function of Forest, Grass, Desert and Aquatic Ecosystem.

**Unit IV- Biodiversity and its Conservation**

Introduction - Definition: genetic. species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: Consumptive use. productive use, social ethics, aesthetic and option values, Biodiversity at global, National and local levels, India as mega-diversity nation, Hot spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wild life, conflict,dangered and endemic species of India, Conservation of biodiversity: In situ and Ex-situ conservation of biodiversity.

**UNIT V- Causes, effect and control measures of**

Air water, soil, marine, noise, nuclear pollution and Human population, Solid waste management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Disaster Management: floods, earthquake, cyclone and landslides.

## REFERENCE:

Textbook of environmental studies- Erach Bharucha, University PRESS

**PRACTICALS****BMICROP 107 : MICROBIOLOGY**

S.No	Name of Practical	Hours	Method
1	<b>Basic Lab glassware:</b> Test tubes, screw capped tubes, pipette, Pasteur pipettes, Erlenmeyer flask, Eppendorf tubes, pipette tips, cover slip and slides.	10 hours	Practical
2	<b>Basic Lab instrumentation:</b> Autoclave, incubator, Hot air oven, pH meter, Centrifuge, Laminar air flow. Separatory funnel, centrifuge, pH meter, Electric balance, hot plate	5 hours	Practical
3	Serial dilution with methyl orange indicator	3 hours	Practical
4	Principles & Working of the pH meter	3 hours	Practical
5	Determination of pH of water samples from different sources.	3 hours	Practical
6	Determination of pH of various solutions using a pH meter – NaOH, sulphuric acid, distilled water	3 hours	Practical

**BBIACP 108 : BIOCHEMISTRY**

S.No	Name of Practical	Hours	Method
1	<b>Basic Lab requirements</b> Volumetric flask, falcons, mortar and pestle, watch glass, wash bottle, beaker, measuring cylinder, dropper, burette, spatula, reagent bottle, test tube stand, pipette stand, tripod stand, Bunsen burner, wire gauze, crucible, funnel, centrifuge tubes	5 hours	Practical
2	<b>Instruments</b> Separatory funnel, centrifuge, pH meter, Electric balance, hot plate	4 hours	Practical
3	Determination of pH of various solutions using a pH meter – NaOH, sulphuric acid, distilled water	3 hours	Practical
4	Preparation of Normal solution- NaOH	3 hours	Practical
5	Preparation of percentage/ vov-vol solutions- Sulphuric acid	3 hours	Practical
6	Paper Chromatography- Isolation of the pigments from leaves of Raddish	3 hours	Practical

**Course Structure : Semester 2**

S.No	Paper Code	Paper Name	ESE	CCE	Total Marks
------	------------	------------	-----	-----	-------------

1	BMIC 201	Virology	70	30	100
2	BMIC 202	Microbial tools and implementation	70	30	100
3	BMIC 203	Phycology & Mycology	70	30	100
4	BMIC 204	Cell Biology	70	30	100
5	BENG 205	Communicative English II	35	15	50
6	BCBM 206	Basic of Computer/Math for Biologists	35	15	50
7	BBLTP 207	Practical Basic Lab Technology	35	15	50
8	BMICP 208	Practical Microbiology	35	15	50
			420	180	600

### ITM-BMIC- 201- Virology

**Learning Objective:** This module is a general introduction to the basic concepts of Virology. The module also gives insight to importance of Viruses and pathogenicity in human diseases.

**Teaching Methodology :** Lectures and demonstration by audio visual aids, seminars & group discussions.

#### **Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b>Nature and properties of Viruses</b> 1.1 Introduction: Discovery of viruses, nature and definition of viruses, general properties concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin 1.2 Structure of Viruses: Capsid symmetry, enveloped and non- enveloped viruses 1.3 Isolation, purification and cultivation of viruses 1.4 Viral taxonomy: Classification and nomenclature of different groups of viruses	10 hours	Lecture/ power point	Written
2	<b>Bacteriophage</b> Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage	8 hours	Lecture/ power point	Written
3	<b>Viral Transmission, Salient features of</b>	7 hours	Lecture/ power point	Written

	<p><b>viral nucleic acids and Replication</b></p> <p>3.1 Modes of viral transmission: Persistent, non-persistent, vertical and horizontal</p> <p>3.2 Salient features of viral Nucleic acid : Unusual bases (TMV,T4 phage), overlapping genes (<math>\phi</math>X174,Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage) terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus), capping and tailing TMV</p> <p>3.3 Viral multiplication and replication strategies: Interaction of viruses with cellular receptors and entry of viruses. Replication strategies of viruses as per Baltimore classification (phi X 174, Retroviridae, Vaccinia, Picorna) Assembly, maturation and release of virions</p>			
4	<p><b>Viruses and Cancer</b></p> <p>4.1 Introduction to oncogenic viruses</p> <p>4.2 Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes</p>	8 hours	Lecture/ power point	Written
5	<p><b>Prevention &amp; control of viral diseases</b></p> <p>5.1 Antiviral compounds and their mode of action</p> <p>5.2 Interferon and their mode of action</p> <p>5.3 General principles of viral vaccination</p>	8 hours	Lecture/ power point	Written

**References:**

(Chapters 2, 3 & 10, *Virology: Principles and Applications*, by Carter J and Saunders V; John Wiley and Sons, 2007, Pages: 9-29, 39-48, 116-119)

*(Chapter 19, Understanding Viruses, by Shors Teri; Jones & Bartlett Learning USA, 2013, Pages:588-595, 605-608)*

*(Chapter 19, Virology: Principles and Applications, by Carter J and Saunders V; John Wiley and Sons, 2007, Pages: 229-254)*

*(Chapter 21, Understanding Viruses, by Shors Teri; Jones & Bartlett Learning USA, 2013, Pages: 647-652)*

*(Chapters 4-8, Virology: Principles and Applications, by Carter J and Saunders V; John Wiley and Sons, 2007, Pages:50-101)*

*(Chapters 6-11, Introduction to Modern Virology, 6th Ed., by Dimmock NJ, Easton AL, Leppard KN; Blackwell Publishing Ltd, 2007, Pages: 79-189)*

*(Chapters 4, 6 & 20, Understanding Viruses, by Shors Teri; Jones & Bartlett Learning USA, 2013, Pages: 68-85, 616- 620)*

*(Chapter 22, Virology: Principles and Applications, by Carter J and Saunders V; John Wiley and Sons, 2007, Pages: 286-296)*

*(Chapter 10, Understanding Viruses, by Shors Teri; Jones & Bartlett Learning USA, 2013, Pages: 268-292) (Chapter 20, Introduction to Modern Virology, 6th Ed., by Dimmock NJ, Easton AL, Leppard KN; Blackwell Publishing Ltd, 2007, Pages: 341-361)*

*(Chapters 9, 24 & 25, Virology: Principles and Applications, by Carter J and Saunders V; John Wiley and Sons, 2007, Pages: 105-106, 181-213, 306-322)*

*(Chapter 21, Introduction to Modern Virology, 6th Ed., by Dimmock NJ, Easton AL, Leppard KN; Blackwell Publishing Ltd, 2007, Pages: 364-399)*

**Suggested reading:**

1. Cann AJ (2012) *Principles of Molecular Virology*, Academic Press Oxford UK
2. Wagner EK, Hewlett MJ, Bloom DC, Camerini D (2008 ) *Basic Virology 3rd edition*. Blackwell publishing. Malden USA
3. Mathews. (2004) *Plant Virology*. Hull R. Academic Press New York US
4. Nayudu MV (2008) *Plant Viruses*. Tata Mc Graw Hill, India

**ONLINE READING MATERIAL**

<http://www.virology.net>

<http://ictvonline.org/>

**ITM-BMIC- 202- Microbial tools and Instrumentation**

**Learning Objective :** This module is a general introduction to the basic tools and usage of instruments in the laboratory.

**Teaching Methodology :** Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b>Light Microscopy</b> 1.1Parts of a compound microscope, principle of light microscopy 1.2Determination of cell size 1.3Use of different objective lenses (10X, 40X, Oil immersion) 1.4Principles of phase contrast microscopy, fluorescence microscopy, electron microscopy	10 hours	Lecture/ power point	Written
2	<b>Chromatographic Techniques:</b> 2.1 Paper and thin layer chromatography 2.2 Column chromatography: Column packing and molecular exclusion	5 hours	Lecture/ power point	Written
3	<b>Electrophoresis: Principle and Applications :</b> 3.1Polyacrylamide gel electrophoresis: SDS-PAGE 3.2Agarose gel electrophoresis (demonstration) 3.3Staining and destaining of electrophoresed gels 3.4Graphical determination of molecular weight of electrophoresed macromolecules	5 hours	Lecture/ power point	Written
4	<b>Spectrophotometry and Colorimetry: Principle :</b> 4.1Determination of $\lambda_{max}$ for an unknown sample 4.2Preparation of standard curve of glucose using DNSA 4.3Turbidometric analysis of a bacterial culture	6 hours	Lecture/ power point	Written
5	<b>Centrifugation: Basic Principle</b>	10 hours	Lecture/ power point	Written



5.1 Types of centrifuges (Preparative/Analytical) and Rotors (Fixed Angle / Swinging bucket)			
5.2 Concept of rpm, RCF, sedimentation coefficient			
5.3 Separation of components of a given mixture using a lab scale centrifuge			

**References:**

(Chapter 4, *Principles and Techniques of Biochemistry and Molecular Biology* by Wilson K and Walker J, 7<sup>th</sup> Ed., Cambridge University Press, 2010, Pages:100-116)

(Chapter 18, *Cell and Molecular Biology: Concepts and Experiments* by Karp G, 6th Ed., John Wiley & Sons.Inc., 2010, Pages: 716-730)

(Chapter 11, *Principles and Techniques of Biochemistry and Molecular Biology* by Wilson K and Walker J, 7th Ed., Cambridge University Press, 2010, Pages:433-437, 459-470). (Chapter 18, *Cell and Molecular Biology: Concepts and Experiments* by Karp G, 6th Ed., John Wiley & Sons. Inc., 2010, Pages: 735-737)

(Chapter 10, *Principles and Techniques of Biochemistry and Molecular Biology* by Wilson K and Walker J, 7th Ed., Cambridge University Press, 2010, Pages: 399-411)

(Chapter 18, *Cell and Molecular Biology: Concepts and Experiments* by Karp G, 6th Ed., John Wiley & Sons. Inc., 2010, Pages: 737-739, 742-743)

(Chapter 12, *Principles and Techniques of Biochemistry and Molecular Biology* by Wilson K and Walker J, 7th Ed., Cambridge University Press, 2010, Pages: 477-492)

(Chapter 3, *Principles and Techniques of Biochemistry and Molecular Biology* by Wilson K and Walker J, 7th Ed., Cambridge University Press, 2010, Pages: 73-99).

(Chapter 18, *Cell and Molecular Biology: Concepts and Experiments* by Karp G, 6th Ed., John Wiley & Sons. Inc., 2010, Pages: 733-735, 743-744).

**SUGGESTED READING**

*Cell and Molecular Biology* by De Robertis and De Robertis, 8th ed., Wolters Kluwer Pvt. Ltd. (India)

*Prescott, Harley and Klein's Microbiology* by Willey, Sherwood and Woolverton, 7th ed. McGraw Hill Higher Education

*Lehninger Principles of Biochemistry* by Nelson and Cox, 4th ed., W H Freeman & Co., NY

*The world of the Cell* by Becker, Kleinsmith, Hardin and Bertoni, 7th ed., Pearson Benjamin Cummings Publishing

*Lab Manual in Biochemistry, Immunology and Biotechnology* by Nigam and Ayyagari, Tata McGraw Hill

**ONLINE READING MATERIAL**

1. [www.ruf.rice.edu/~bioslabs/.../microscopy/microscopy.html](http://www.ruf.rice.edu/~bioslabs/.../microscopy/microscopy.html)
2. [www.rpi.edu/dept/chem-eng/Biotech.../chromintro.htm](http://www.rpi.edu/dept/chem-eng/Biotech.../chromintro.htm)
3. [www.chemguide.co.uk/analysis/chromatography/paper.html](http://www.chemguide.co.uk/analysis/chromatography/paper.html)
4. [www.ruf.rice.edu/~bioslabs/methods/.../spectrophotometer.htm...](http://www.ruf.rice.edu/~bioslabs/methods/.../spectrophotometer.htm...)
5. [homepages.gac.edu/~cellab/chpts/chpt4/intro4.htm](http://homepages.gac.edu/~cellab/chpts/chpt4/intro4.htm)
6. [homepages.gac.edu/~cellab/appds/appd-f.htm](http://homepages.gac.edu/~cellab/appds/appd-f.htm)
7. [www.wou.edu/las/physci/ch462/Gel%20Electrophoresis.pdf](http://www.wou.edu/las/physci/ch462/Gel%20Electrophoresis.pdf)
8. [www.und.edu/dept/chromatography/.../Chromatography.pdf](http://www.und.edu/dept/chromatography/.../Chromatography.pdf)
9. [media.rsc.org/.../MCT5%20Chromatography.pdf](http://media.rsc.org/.../MCT5%20Chromatography.pdf)
10. <http://www.seedtechnology.net/docs/ELBasics2010.pdf>

### ITM-BMIC- 203 – Phycology & Mycology

**Learning Objective:** The module is designed to provide introduction Phycology and Mycology.

**Teaching Methodology :** Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b>Phycology Introduction</b> 1.1 General characteristics of algae including occurrence, thallus organization, algal cell ultra structure 1.2 Algal pigments, flagella, eyespot food reserves 1.3 Vegetative, asexual and sexual reproduction 1.4 Different types of life cycles in algae: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles	8	Lecture/ power point	Written
2	<b>Classification of algae</b>	8	Lecture/ power point	Written
3	<b>Study of the following classes with reference to genera listed below</b> <b>Cyanophyta (BGA):</b> 3.1 General characteristics – <i>Nostoc</i> 3.2 Chlorophyta: General characteristics	6	Lecture/ power point	Written

	lamydomonas 3.3 Bacillariophyta: General account – Diatoms 3.4 Phaeophyta: General characteristics with importance - Ectocarpus 3.5 Rhodophyta: General characteristics with importance			
4	<b>Mycology Introduction</b> 4.1 General characteristics of fungi including habitat, distribution, nutritional requirements 4.2 Fungal cell ultra - structure, thallus organization and aggregation, fungal wall structure 4.3 Asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism	6	Lecture/ power point	Written
5	<b>Classification of Fungi - basic to current</b>	2	Lecture/ power point	Written
6	<b>Study of the following classes (occurrence, somatic structure, reproduction and fruiting bodies)</b> 6.1 Oomycota – General characteristics. Life cycle of <i>Achylya</i> , <i>Phytophthora</i> , <i>Peronospora</i> 6.2 Ascomycota - General characteristics. Life cycle of <i>Saccharomyces</i> , <i>Penicillium</i> , <i>Neurospora</i> Asexual Ascomycota – General characteristics – <i>Candida</i> & <i>Alternaria</i> 6.3 Basidiomycota – General characteristics. Life cycle of <i>Puccinia</i> , <i>Ustilago</i> Asexual Basidiomycetes – <i>Cryptococcus neoformans</i> (Teleomorph: <i>Filobasidiella neoformans</i> )	6	Lecture/ power point	Written

**References:**

1. (Chapters 1, 2, Introductory Phycology by Kumar HD. 2nd Ed., Affiliated East Western Press. 2007(Reprint), Pages: 2-5; 8-13; 16-26.
2. Chapters 1, 2, 4, 5 Textbook of Algae by Sharma OP. Tata McGraw Hill Publishing Co. Ltd. 2007, Pages: 2-15; 35-48; 51-57; 59-65)
3. (Chapter 1, Introductory Phycology by Kumar HD. 2nd edition. Affiliated East Western Press. 2007(Reprint), Page: 5; 27-33
4. Chapter 2, Textbook of Algae by Sharma OP. Tata McGraw Hill Publishing Co. Ltd. 2007, Pages: 20- 33).
5. Chapter 3, Introductory Phycology by Kumar HD. 2nd Ed., Affiliated East Western Press.

- 2007(Reprint), Pages: 87-109; 115-120; 127-129
6. Chapter 8, Textbook of Algae by Sharma OP. Tata McGraw Hill Publishing Co. Ltd. 2007, Pages: 81- 99; 106-110)
  7. (Chapter 12, Introductory Phycology by Kumar HD. 2nd Ed., Affiliated East Western Press. 2007(Reprint), Pages: 344-347; 349-353; 358-369; 406-414
  8. Chapter 9, Textbook of Algae by Sharma OP. Tata McGraw Hill Publishing Co. Ltd. 2007, Pages: 121-130; 134-147; 195-214)
  9. (Chapter 9, Introductory Phycology by Kumar HD. 2nd Ed., Affiliated East Western Press. 2007(Reprint), Pages: 263-281)
  10. Chapter 11, Textbook of Algae by Sharma OP. Tata McGraw Hill Publishing Co. Ltd. 2007, Pages: 278-293)
  11. (Chapter 11, Introductory Phycology by Kumar HD. 2nd Ed., Affiliated East Western Press. 2007(Reprint), Pages:296-313
  12. Chapter 12, Textbook of Algae by Sharma OP. Tata McGraw Hill Publishing Co. Ltd. 2007, Pages: 298-313)
  13. (Chapter 4, Introductory Phycology by Kumar HD. 2nd Ed., Affiliated East Western Press. (Reprint), Pages: 144-162; 188-195
  14. Chapter 13, Textbook of Algae by Sharma OP. Tata McGraw Hill Publishing Co. Ltd. 2007, Pages: 337-346; 355-365).
  15. (Chapters 2, 7, Introductory Mycology by Alexopoulos CJ, Mims CW and Blackwell M. 4th Ed., John Wiley and Sons, 2012(Reprint), Pages: 26-56 ;196-197)
  16. (Chapter 3, Introductory Mycology by Alexopoulos CJ, Mims CW and Blackwell M. 4th Ed., John Wiley and Sons, 2012(Reprint) :Pages: 61-65)
  17. Chapter 1, Introductory Mycology by Alexopoulos CJ, Mims CW and Blackwell M. 3rd Ed., John Wiley and Sons,2012(Reprint): Pages:37-40)
  18. (Chapter 23, Introductory Mycology by Alexopoulos CJ, Mims CW and Blackwell M. 4th edition, John Wiley and Sons, Inc. 2012(Reprint), Pages: 683-694 ; 698-704; 717-726) (Chapters 7, 10, 11, 12, Introductory Mycology by Alexopoulos CJ, Mims CW and Blackwell
  19. M. 4th Ed., John Wiley and Sons, Inc. 2012(Reprint), Pages: 180-207; 273-280; 283-284; 311-318 ; 359-361) Chapters 8, 10 Introductory Mycology by Alexopoulos CJ, Mims CW and Blackwell M. 4th edition, John Wiley and Sons, Inc. 2012(Reprint), Pages: 214-230; 276-277, 306-314.
  20. (Chapters 16, 17, 20,Introductory Mycology by Alexopoulos CJ, Mims CW and Blackwell M. 4th Ed., John Wiley and Sons, Inc. 2012(Reprint), Pages: 488-501; 508-515; 517-522; 617-628; 639-652.)

**SUGGESTED READING***Section A - Phycology*

1. Lee RE. (1999). *Phycology*. 4th edition. Cambridge Press
2. Graham LE, Graham JM and Wilcox LW. (2009). *Algae*, 2nd edition. Benjamin Cumming, New York
3. Barasanti L and Guaaltieri P. (2006). *Algae: Anatomy Biochemistry and Biotechnology*. Taylor and Francis Group, New York

*Section B - Mycology*

1. Sumbali G. (2005). *The Fungi*. 2nd edition. Narosa Publishing India House
2. Webster J and Weber. (1980). *Introduction to Fungi*. 3rd edition. Cambridge University Press.

**ONLINE READING MATERIAL**

Online reading: [books.google.co.in](http://books.google.co.in), Lee RE. (1999). *Phycology*. 4th edition. Cambridge Press.

Online reading: <http://www.fungionline.org.uk> 3. <http://freemicrobiologybooks.com/category/mycology>

**ITM-BMIC- 204- Cell Biology**

**Learning Objective:** This module is a general introduction to cell biology, its importance in pathology body functioning.

**Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b>Structure of Cell</b> 1.1 Plasma membrane: Structure and transport of small molecules 1.2 Cell Wall: Eukaryotic cell wall, Fluid mosaic model and details, Extra cellular matrix and cell matrix interactions Cell-Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects) 1.3 Ribosomes, chloroplasts and peroxisomes 1.4 Cytoskeleton: Structure and organization	10	Lecture/ power point	Written

	of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules			
2	<b>Nucleus</b> 2.1 Nuclear envelope, nuclear pore complex and nuclear lamina 2.2 Chromatin –Molecular organization 2.3 Nucleolus	4	Lecture/ power point	Written
3	<b>Protein sorting &amp; transport</b> 3.1 Endoplasmic Reticulum Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids 3.2 Golgi Organization, protein glycosylation, and Apparatus protein sorting and export for Golgi apparatus 3.3 Lysosomes	6	Lecture/ power point	Written
4	<b>Cell Signalling</b> 4.1 Signalling molecules and their receptors 4.2 Function of cell surface receptors 4.3 Pathways of intra-cellular receptors – Cyclic AMP pathway, cyclic GMP and MAP kinase pathway	9	Lecture/ power point	Written
5	<b>Cell Cycle, Cell Death and Cell Renewal</b> 5.1 Eukaryotic cell cycle and its regulation 5.2 Development of cancer, causes and types 5.3 Programmed cell death 5.4 Stem cells 5.5 Embryonic stem cells induced pluripotent stem cells	7	Lecture/ power point	Written

**References:**

1. (Chapters 11, 12, 13 & 14, *The Cell : A Molecular Approach* by Geoffrey. M. Cooper and Robert. E. Hausman, 5th Ed., Sinauer Associates, 2009, Pages: 433-444, 452-459, 464-468, 473, 479-487, 496- 511, 529-557, 571-596)
2. (Chapter 9, *The Cell : A Molecular Approach* by Geoffrey. M. Cooper and Robert. E. Hausman. 5th Ed., Sinauer Associates, 2009, Pages: 355-361, 370-378)

3. (Chapter 10, *The Cell: A Molecular Approach* by Geoffrey. M. Cooper and Robert. E. Hausman. Fifth Edition Sinauer Associates, 2009, Pages : 383-407, 408-415, 423-428)
4. (Chapter 15, *The Cell : A Molecular Approach* by Geoffrey. M. Cooper and Robert. E. Hausman. Fifth Edition Sinauer Associates, 2009, Pages : 603-621, 622-624, 630-634 )
5. (Chapters 16 17,& 18, *The Cell : A Molecular Approach* by Geoffrey. M. Cooper and Robert. E. Hausman. 5th Ed., Sinauer Associates, 2009, Pages: 653-672, 725-734, 693-705, 705-714,714-720)

### **ITM-BENG- 205 – Communicative English II**

**Learning Objective:** The module is designed to provide introduction to Communicative English. It also gives scope to develop proficiency in the language and will help increase the usage of better vocabulary.

**Learning outcomes:** After successful completion of this module the students would be able to understand and write the language with confidence which would help in their personality development.

**Teaching Methodology :** Lectures and demonstration by audio visual aids, seminars & group discussions.

#### **Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 06

Theory hours: 25 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Vocabulary building: Synonyms & antonyms	5	Lecture/ power point	Written
2	Parts of speech: Noun, pronoun, verb, adverb, adjective, conjunction, interjection & prepositions and Exercises, Jumbled sentences, correct the spellings	10	Lecture/ power point	Written
3	Reading Comprehension	5	Lecture/ power point	Written
4	Sentences: Simple, compound, Complex	4	Lecture/ power point	Written
5	Essay writing	6	Lecture/ power point	Written

#### **References:**

1. Wren & Martin

### **ITM-BCBM- 206 – Basics of Computer & Math for Biologists**

**Learning Objective:** The module is designed to provide introduction to Basic math and provides practical approach to hone your computer skills.

**Learning outcomes:** After successful completion of this module the students would be able to use basic computers to make their projects, presentations and perform statistical functions.

**Teaching Methodology :** Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 06

Theory hours: 25 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Basic integrals	8	Lecture/ power point	Written
2	Basic statistics: Mean, median, mode	6	Lecture/ power point	Written
3	Word, power point, excel	10	Lecture/Practical	Written
4	Internet and its advantages & disadvantages ** Scholarly article search engine, sites	6	Lecture/Practical	Written

**Practicals**

**ITM-BBLTP- 207 – Basic Lab Technology**

**Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 6

Practical hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b><u>Spots and techniques</u></b> di. Cotton plugs preparation dii. Method of sterilization diii. Auclaving div. Microscope dv. Media dvi. Plating methods	8	Practical	Written/Practical
2	Media preparation	8	Practical	Written/Practical
3	Plating techniques, slant preparation	6	Practical	Written/Practical
4	Stab culture	4	Practical	Written/Practical
5	Isolation of bacteria from air, soil, water	6	Practical	Written/Practical
6	Preparation of blood smear	2	Practical	Written/Practical



7	Identification of blood group (Kit)	4	Practical	Written/Practical
8	Amylase test	2	Practical	Written/Practical
9	Protein estimation by Folin Ciocalteu Reagent (Lowry method)	2	Practical	Written/Practical
10	Buffer Preparation (Sodium)	2	Practical	Written/Practical
	Total hours	42		

**ITM-BMICP- 208 – Microbiology****Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 6

Practical hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b>Spots</b> 1. TMV 2. Diatoms 3. Chlamydomonas 4. Nostoc 5. Ectocarpus 6. Rhodophyta 7. Yeast 8. Penicillin 9. Oscillatoria	15	Practical	Written/Practical
2	1. Blood cell	5	Practical	Written/Practical
3	Bread mold	6	Practical	Written/Practical
4	Motility from curd	2	Practical	Written/Practical
5	Bread preparation – Yeast fermentation	2	Practical	Written/Practical
6	Methylene blue reductase test for milk quality	2	Practical	Written/Practical
7	Screening of extracellular enzyme producing microbes (amylase)	6	Practical	Written/Practical
	Total hours	38		

**B.Sc MICROBIOLOGY -Semester 3**

S.No	Paper Code	Paper Name	ESE	CCE	Total Marks
1	BMIC 301	Industrial Microbiology	70	30	100

2	BMIC 302	Basic concepts of Genetics & Genomics	70	30	100
3	BMIC 303	Plant Pathology	70	30	100
4	BMIC 304	Molecular Biology I	70	30	100
5	BENG 305	Communicative English III	35	15	50
6	BCBM 306	Analytical reasoning I	35	15	50
7	BMICP 307	Industrial Microbiology practical	35	15	50
8	BMICP 308	Molecular Biology Practical	35	15	50
		Total	420	180	600

### ITM-BMIC- 301- Industrial Microbiology

**Learning Objective:** This module is a general introduction to Industrial Microbiology.

**Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 40 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b>Introduction to industrial microbiology &amp; fermentation process</b> 1.1 Brief history and developments in industrial microbiology <b>1.2 Types of fermentation processes</b> - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (eg. baker's yeast) and continuous fermentations	8 hrs	Lecture/ power point	Written
2	<b>Types of Bioreactors &amp; measurement of fermentation parameters</b> 2.1 Components of a typical bio-reactor 2.2 Types of bioreactors- Laboratory, pilot-scale and production fermenters, constantly stirred tank and air-lift fermenters 2.3 Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration	8 hrs	Lecture/ power point	Written
3	<b>Isolation of industrially important microbial strains &amp; fermentation media</b> 3.1 Sources of industrially important microbes and methods for their isolation 3.2 Preservation and maintenance of industrial strains, strain improvement	10 hrs	Lecture/ power point	Written

	3.3 Crude synthetic and media; molasses, corn-steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates			
4	<b>Down steam processing</b> Cell disruption, filtration, centrifugation, extraction, solvent precipitation, lyophilization and spray drying	7 hrs	Lecture/ power point	Written
5	<b>Microbial production of industrial products ( media, micro organisms, fermentation conditions, downstream processing)</b>  5.1 Citric acid penicillin,, ethanol, glutamic acid, Vitamin B12  5.2 Enzymes (amylase, protease, lipase)  5.3 Wine, beer	7 hrs	Lecture/ power point	Written

## SUGGESTED READINGS

1. Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited
2. Okafor N. (2007). Modern Industrial Microbiology and Biotechnology. 1st edition. Bios Scientific Publishers Limited. USA
3. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001). Industrial Microbiology: An Introduction. 1st edition. Wiley – Blackwell
4. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and Company
5. Industrial Microbiology – Casida

**ITM-BMIC- 302- Basic concepts of Genetics & Genomics****Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 45 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b>Introduction to Genetics</b> 1.1 Historical developments 1.2 Model organisms in genetic analyses and experimentation: Escherichia coli, Saccharomyces cerevisiae, Neurospora crassa, Caenorhabditis Drosophila elegans melanogaster,	8 hrs	Lecture/ power point	Written

	Arabidopsis thalian.			
2	<b>Mendelian Analysis</b> 2.1Mendel's Laws 2.2Rediscovery of Mendel's principles 2.3Chromosome theory of inheritance. 2.4Extensions Mendelian genetics: Allelic interactions, concept of dominance,recessiveness. 2.5Incomplete dominance and co-dominance 2.6 Multiple alleles 2.7Epistasis, penetrance and expressivity.	10 hrs	Lecture/ power point	Written
3	<b>Mendelian Analysis</b> 3.1Linkage and recombination of genes 3.2Cytological basis of crossing over 3.3Crossing over at four-strand stage 3.4Molecular mechanism of crossing over	8 hrs	Lecture/ power point	Written
4	<b>Extra-Chromosomal Inheritance</b> 4.1Rules of extra nuclear inheritance 4.2Organelle heredity – Chloroplast mutations in Chlamydomonas, mitochondrial mutations in Saccharomyces. 4.3Maternal effects – Shell coiling in Limnaea peregra. 4.4 Infectious heredity – Kappa particles in Paramecium.	7 hrs	Lecture/ power point	Written
5	<b>Characteristics of Chromosomes</b> 5.1 5.1Structural organization of chromosomes- centromeres, telomeres and repetitive DNA. 5.2 Packaging DNA molecules into chromosomes. 5.3Concept of euchromatin and heterochromatin. 5.4Normal and abnormal karyotypes of human chromosomes. 5.5Chromosome banding 5.6Giant chromosomes:Polytene and lampbrush chromosomes. 5.7Variations in chromosome structure. 5.8Variation in chromosomal number and structural abnormalities,-Turner syndrome Klinefelter syndrome, Down syndrome.	12 hrs	Lecture/ power point	Written

**SUGGESTED READING**

- 1.Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
- 2.Snustad DP, Simmons MJ (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.
- 3.Weaver RF, Hedrick PW (1997). Genetics. 3rd Ed. McGraw-Hill Education
- 4.Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10<sup>th</sup> Ed. Benjamin Cummings
- 5.Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis. 9th Ed. W.H.Freeman and Co., New York
- 6.Hartl DL, Jones EW (2009). Genetics: Analysis of Genes and Genomes. 7th Ed, Jones and Bartlett Publishers
- 7.Russell PJ. (2009). i Genetics - A Molecular Approach. 3rd Ed, Benjamin Cummings

**ONLINE READING MATERIAL**

- 1.[http://www.ebook3000.com/Concepts-of-Genetics--8th-Edition-\\_104663.htm](http://www.ebook3000.com/Concepts-of-Genetics--8th-Edition-_104663.htm)
- 2.[http://highered.mcgraw-hill.com/sites/0073525332/information\\_center\\_view0/3](http://highered.mcgraw-hill.com/sites/0073525332/information_center_view0/3).[http://www.freebookspot.es/Description.aspx?Element\\_ID=293661](http://www.freebookspot.es/Description.aspx?Element_ID=293661).

**ITM-BMIC- 303- Plant Pathology****Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 45 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Introduction and History of plant pathology Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases. Significant landmarks in the field of plant pathology- Contributions of Anton De Bary, Millardet, Burrill, E. Smith, Adolph Mayer, Ivanowski, Diener, Stakman, H.H. Flor, Van Der Plank, molecular Koch's postulates. Contributions of eminent Indian plant pathologists.	4	Lecture/ power point	Written
2	Stages in development of a disease Infection, invasion, colonization, dissemination of pathogens and perennation. Plant disease epidemiology Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, forecasting of	4	Lecture/ power point	Written

	plant diseases and its relevance in Indian context.			
3	<p>Host Pathogen Interaction</p> <p>A. Microbial Pathogenicity</p> <p>Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction).</p> <p>B. Genetics of Plant Diseases</p> <p>Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis, types of plant resistance: true resistance– horizontal &amp; vertical, apparent resistance.</p> <p>C. Defense Mechanisms in Plants</p> <p>Concepts of constitutive defense mechanisms in plants, inducible structural defenses (histological-cork layer, abscission layer, tyloses, gums), inducible biochemical defenses [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts].</p>	13	Lecture/ power point	Written
4	<p>Control of Plant Diseases</p> <p>Principles &amp; practices involved in the management of plant diseases by different methods, viz.</p> <p>regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material</p> <p>cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches</p> <p>chemical - protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals.</p> <p>biological - suppressive soils, antagonistic microbes-bacteria and fungi, trap plants</p> <p>genetic engineering of disease resistant plants-with plant derived genes and pathogen derived genes</p>	7	Lecture/ power point	Written
5	<p>Specific Plant diseases</p> <p>Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology and control</p>	16	Lecture/ power point	Written

<p>A. Important diseases caused by fungi</p> <p>White rust of crucifers - <i>Albugo candida</i></p> <p>Downy mildew of onion - <i>Peronospora destructor</i></p> <p>Late blight of potato - <i>Phytophthora infestans</i></p> <p>Powdery mildew of wheat - <i>Erysiphe graminis</i></p> <p>Ergot of rye - <i>Claviceps purpurea</i></p> <p>Black stem rust of wheat - <i>Puccinia graminis tritici</i></p> <p>Loose smut of wheat - <i>Ustilago nuda</i></p> <p>B. Important diseases caused by phytopathogenic bacteria</p> <p>Angular leaf spot of cotton, bacterial leaf blight of rice, crown galls, bacterial cankers of citrus</p> <p>C. Important diseases caused by phytoplasmas</p> <p>Aster yellow, citrus stubborn</p> <p>D. Important diseases caused by viruses</p> <p>Papaya ring spot, tomato yellow leaf curl, banana bunchy top, rice tungro</p> <p>E. Important diseases caused by viroids</p> <p>Potato spindle tuber, coconut cadang cadang</p>			
---	--	--	--

#### SUGGESTED READINGS

1. Agrios GN. (2006). Plant Pathology. 5 th edition. Academic press, San Diego,
2. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3 rd edition. Blackwell Science, Oxford.
3. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
4. Rangaswami G. (2005). Diseases of Crop Plants in India. 4 th edition. Prentice Hall of India Pvt. Ltd., New Delhi.
5. Singh RS. (1998). Plant Diseases Management. 7 th edition. Oxford & IBH, New Delhi.

#### **ITM-BMIC- 304- Molecular Biology I**

**Learning Objective:** This module is a general introduction to cell biology, its importance in pathology body functioning.

#### **Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars & group discussions.

#### **Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 45 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Nucleic Acids convey Genetic Information DNA as the carrier of genetic information, Key experiments establishing-The Central Dogma, DNA Double helix, Genetic code, Direction of Protein Synthesis, Genomics.	12 hrs	Lecture/ power point	Written
2	The Structures of DNA and RNA / Genetic Material DNA Structure: Miescher to Watson and Crick-historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves. DNA topology - linking number, topoisomerases; Organization of DNA Prokaryotes, Viruses, Eukaryotes. RNA Structure Organelle DNA -- mitochondria and chloroplast DNA.	8 hrs	Lecture/ power point	Written
3	Genome Structure, Chromatin and the Nucleosome Genome Sequence and Chromosome Diversity, Chromosome Duplication and Segregation, The Nucleosome Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin. Regulation of Chromatin Structure and Nucleosome Assembly. Organization of Chromosomes	8 hrs	Lecture/ power point	Written
4	The Replication of DNA (Prokaryotes and Eukaryotes) Chemistry of DNA synthesis, general principles - bidirectional replication, Semiconservative, Semi discontinuous, RNA priming, Various models of DNA replication including rolling circle, D-loop (mitochondrial), $\Theta$ (theta) mode of replication, replication of linear ds-DNA, replicating the 5' end of linear chromosome. Enzyme involved in DNA replication – DNA polymerases, DNA ligase, Primase, Telomerase and other accessory proteins	10 hrs	Lecture/ power point	Written
5	The Mutability and Repair of DNA	7 hrs	Lecture/ power point	Written



Definitions, Mutation, muton, replicon, principles of mutation, Replication Errors, DNA Damage, different types of mutations, deletions, duplications, UV induced mutations, repair mechanisms against mutations and their importance.			
--	--	--	--

**SUGGESTED READINGS**

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.

**ONLINE READING MATERIAL**

1. <http://www.ebooks-share.net/molecular-biology-of-the-gene-6th-edition/>

**ITM-BENG- 305 – Communicative English III**

**Learning Objective:** The module is designed to provide introduction to Communicative English. It also gives scope to develop proficiency in the language and will help increase the usage of better vocabulary.

**Learning outcomes:** After successful completion of this module the students would be able to understand and write the language with confidence which would help in their personality development.

**Teaching Methodology :** Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 6

Theory hours: 25 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1.	Sentence formation	5	Lecture/Power point	Written
2	Details of tenses	5	Lecture/Power point	Written
3.	Essay writing	5	Lecture/Power point	Written
4.	Listening comprehensions.	5	Lecture/Power point	Written
5	Dictations, Reading Skills -Types Of Reading	5	Lecture/Power point	Written

**ITM-BARI- 306 – Analytical Reasoning I**

**Teaching Methodology :** Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 6

Theory hours: 25 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b>Verbal Reasoning:</b> • Analogy	2	Lecture/ power point	Written
2	• Classification	3	Lecture/ power point	Written
3	• Word formation	2	Lecture/ power point	Written
4	• Statement and conclusions	5	Lecture/ power point	Written
5	• Syllogism • Statement and assumptions • Statement and arguments	6	Lecture/ power point	Written
6	• Coding Decoding • Blood Relations • Passage and conclusions	7	Lecture/ power point	Written

**ITM-BMICP- 307 – Practical Industrial Microbiology**

**Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 6

Practical hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1.	For Syllabus refer to the theory part	35	Practical	Written/Practical

**ITM-BMICP- 308 – Practical Molecular Biology**

**Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 6

Practical hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1.	For Syllabus refer to the theory part	35	Practical	Written/Practical

**Course details-Semester 4**

S.No	Paper Code	Paper Name	ESE	CCE	Total Marks	Credits
1	BMIC 401	Molecular biology II	70	30	100	3
2	BMIC 402	Food & Dairy Microbiology	70	30	100	3
3	BMIC 403	Immunology I	70	30	100	3
4	BMIC 404	Recombinant DNA technology	70	30	100	3
5	BENG 405	Communicative English IV	35	15	50	1.5
6	BCBM 406	Analytical reasoning II	35	15	50	1.5
7	BMICP 407	Food & Dairy Microbiology practical	35	15	50	1.5
8	BMICP 408	Molecular Diagnostic practical	35	15	50	1.5
		Total	420	180	600	18

**ITM-BMIC- 401- Molecular Biology II**

**Learning Objective:** This module is a general introduction to molecular biology, transcription & protein synthesis.

**Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 30 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Mechanism of Transcription RNA Polymerase and the transcription unit, Transcription in Prokaryotes, Transcription in Eukaryotes RNA Modifications Split genes, concept of introns and exons, removal of Introns, spliceosome machinery, splicing pathways, alternative splicing, exon shuffling, RNA editing, and mRNA transport	8	Lecture/ power point	Written
2	Translation (Prokaryotes and Eukaryotes)	6	Lecture/ power point	Written

	Assembly line of polypeptide synthesis - ribosome structure and assembly, various steps in protein synthesis. Charging of tRNA, aminoacyl tRNA synthetases. Proteins involved in initiation, elongation and termination of polypeptides. Fidelity of translation. Inhibitors of protein synthesis. Regulation of translation Translation-dependent regulation of mRNA and Protein Stability.			
3	Transcription Regulation in Prokaryotes Transcription Regulation in Prokaryotes: Principles of transcriptional regulation, regulation at initiation with examples from lac and trp operons, regulation of transcription termination.	8	Lecture/ power point	Written
4	Transcription Regulation in Eukaryotes Conserved mechanism of regulation, Eukaryotic activators, Signal integration, combinatorial control, transcriptional repressors, signal transduction and control of transcriptional regulator, Gene Silencing	4	Lecture/ power point	Written
5	Regulatory RNAs Transcription Regulation in Eukaryotes & Regulatory RNAs: Conserved mechanism of regulation, Eukaryotic activators, Signal integration, combinatorial control, Riboswitches, RNA interference, miRNA, siRNA, Regulatory RNA and X inactivation	4	Lecture/ power point	Written

## SUGGESTED READINGS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

**ITM-BMIC 402- Food & Dairy Microbiology**

**Learning Objective:** This module is a general food & dairy Microbiology.

**Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 42 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b>Foods as a substrate for microorganisms</b> 1.1 Basic concepts and scope of food and dairy microbiology. 1.2 Study of primary sources of microorganisms in foods 1.3 Effect of intrinsic (pH, moisture content) and extrinsic (temperature and relative humidity) factors on microbial growth in various foods.	8 hrs	Lecture/ power point	Written
2	<b>Microbial Spoilage of various foods</b> 2.1 Effect of outer covering –spoilage of intact fruits and fruits with damaged skins. 2.2 Study of spoiled vegetable, bread and egg samples. 2.3 Study of spoilage of milk for acid, gas and proteolysis.	8 hrs	Lecture/ power point	Written
3	<b>Methods of food Preservation</b> 3.1 Comparison of shelf life of pasteurized, UHT milk, raw milk both at low and room temperature. 3.2 Aseptic packaging – layers of tetra packs and comparison of shelf life of such packaged fruit juices 3.3 Study of specimens of various canned foods (vegetables, fruits, pickles etc) and treatments given to them for preservation. 3.4 Food preservation: Physical, chemical and biological methods.	10 hrs	Lecture/ power point	Written
4	<b>Microbiology and Process of Fermented Foods</b> 4.1 Use of starter cultures and preparation of Dahi. 4.2 To perform various tests such as pH and titratable acidity of various fermented milk products (yogurt, market dahi, etc) available in market. 4.3 Surveying of probiotic drinks available in the market	8 hrs	Lecture/ power point	Written
5	<b>Food-Borne Diseases</b> 5.1 Case study of food intoxications: Staphylococcus aureus, Clostridium botulinum. 5.2 Case study of food infections: E. coli,	8 hrs	Lecture/ power point	Written

Salmonellosis.			
----------------	--	--	--

**SUGGESTED READINGS**

1. Doyle, MP and Beuchat, LR. (2007). Food Microbiology: Fundamentals and Frontiers. 3rd Edition. ASM Press, Washington DC, USA
2. Montville, TJ and Matthews, KR (2008). Food Microbiology: An introduction. 2nd Edition. ASM Press, Washington DC, USA
3. Ray B and Bhunia AK (2008) Fundamental Food Microbiology. 4th Edition, CRC Press
4. Frazier WC and Westhoff DC. (2008). Food Microbiology. 4th edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India
5. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India

**ONLINE READING MATERIAL**

1. [http://www.fooddoctors.com/FSF/S\\_aureus.pdf](http://www.fooddoctors.com/FSF/S_aureus.pdf)
2. [kmvd.agrobiologie.cz/randova/FOODMICROBIOLOGY.pdf](http://kmvd.agrobiologie.cz/randova/FOODMICROBIOLOGY.pdf)
3. <http://www.foodsafety.gov/>
4. U.S. Food and Drug Administration: <http://www.fda.gov/>

**ITM-BMIC 403- Immunology I**

**Learning Objective:** This module is a general introduction to the human immune system.

**Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 45 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b>Introduction</b> 1.1 Concept of Innate and Adaptive immunity 1.2 Immune dysfunction and its consequences.	4 hrs	Lecture/ power point	Written
2	<b>Immune Cells and Organs</b> 2.1 Structure, Functions and Properties of Immune Cells -T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Dendritic cell. 2.2 Structure and Functions of Immune Organs -Bone Marrow, Thymus, Lymph Node, Spleen, GALT.	8 hrs	Lecture/ power point	Written
3	<b>Antigens</b> 3.1 Antigenicity versus Immunogenicity. 3.2 Haptens	8 hrs	Lecture/ power point	Written

	3.3 Characteristics of an antigen - Foreignness, Molecular size and Heterogeneity. 3.4 T-dependent and T- independent antigens 3.5 Adjuvants.			
4	<b>Antibodies and Humoral Immune Response</b> 4.1 Basic structure of antibody- CDRs, Framework region, Hinge. 4.2 Primary and secondary immune response. 4.3 Antibody mediated effector function. 4.4 Types and properties of antibodies 4.5 Monoclonal antibodies- preparation and applications. 4.6 Antigen-antibody interaction–Precipitation, Agglutination, Immunoelectrophoresis, Immunofluorescence, ELISA.	8 hrs	Lecture/ power point	Written
5	<b>Major Histocompatibility Complex and Cell Mediated Immunity</b> 5.1 Organization and inheritance of MHC locus in humans. 5.2 Structure and functions of MHC I & II molecules 5.3 Cellular expression of MHC molecules 5.4 Antigen processing and presentation - Cytosolic and Endocytic pathways. 5.5 Killing mechanisms by CTL, NK cells and ADCC.	10 hrs	Lecture/ power point	Written
6	<b>Complement System</b> 6.1 Components of the complement system. 6.2 Activation pathways- Classical, Alternative and Lectin pathway. 6.3 Biological consequences of complement activation.	7 hrs	Lecture/ power point	Written

**SUGGESTED READINGS**

1. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford
2. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York
3. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York

**ONLINE READING MATERIAL**

1. <http://books.google.co.in/books/immunology/elgert>

2.<http://books.google.co.in/books/immunology/coico>

### **ITM-BMIC 404- Recombinant DNA Technology**

**Learning Objective:** This module is a general introduction to the advanced techniques in DNA Technology, its importance in pathology body functioning.

#### **Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars & group discussions.

#### **Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 42 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b>Introduction to Genetic Engineering</b> 1.1 Milestones in genetic engineering and biotechnology 1.2 Restriction modification systems: types i, ii and iii. Mode of action, nomenclature, applications of type ii restriction enzymes in genetic engineering. 1.3 Analysis of restricted DNA: agarose gel electrophoresis and southern blotting. 1.4 DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyltransferase, kinases and phosphatases, and ligases. 1.5 Cloning: use of linkers and adaptors. 1.6 Transformation of DNA: By chemical method.	10 hrs	Lecture/ power point	Written
2	<b>vectors</b> 2.1 Cloning vectors: definition and properties 2.2 Plasmid vectors: pbr and puc series 2.3 Bacteriophage lambda and m13 based vectors. 2.4 Cosmids, bacs, yacs 2.5 Expression vectors: e.coli lac and t7 promoter-based vectors, yeast yip, yep and ycp vectors, baculovirus based vectors mammalian sv40-based expression vectors.,	10 hrs	Lecture/ power point	Written
3	<b>DNA Amplification And DNA Sequencing</b> 3.1 PCR: basics of pcr, rt-pcr, real-time pcr 3.2 Sanger's method of DNA sequencing: traditional and automated sequencing 3.3 Primer walking and shotgun sequencing.	7 hrs	Lecture/ power point	Written



4	<b>Construction and screening of genomic and cDNA libraries</b> 4.1 Genomic and cDNA libraries: preparation and uses. 4.2 Screening of libraries: colony hybridization and colony PCR. 4.3 Chromosome walking and chromosome jumping.	7 hrs	Lecture/ power point	Written
5	<b>Applications of DNA Technology</b> 5.1 Gene delivery: microinjection, electroporation, biolistic method (gene gun), liposome and viral-mediated delivery, 5.2 Products of recombinant DNA technology: products of human therapeutic interest - insulin, hgh.	8 hrs	Lecture/ power point	Written

**SUGGESTED READING**

1. Brown ta. (2010). Gene cloning and dna analysis. 6th edition. Blackwell publishing, oxford, u.k.
2. Clark dp and pazdernik nj. (2009). Biotechnology: applying the genetic revolution. Elsevier academic press, usa
3. Primrose sb and twyman rm. (2006). Principles of gene manipulation and genomics, 7th edition. Blackwell publishing, oxford, u.k.
4. Sambrook j and russell d. (2001). Molecular cloning-a laboratory manual. 3rd edition. Cold spring harbor laboratory press
5. Wiley jm, sherwood lm and woolverton cj. (2008). Prescott, harley and klein's microbiology. Mcgraw hill higher education
6. Brown ta. (2007). Genomes-3. Garland science publishers
7. Primrose sb and twyman rm. (2008). Genomics: applications in human biology. Blackwell publishing, oxford, u.k.

**ITM-BENG- 405 – Communicative English IV**

**Learning Objective:** The module is designed to provide introduction to Communicative English. It also gives scope to develop proficiency in the language and will help increase the usage of better vocabulary.

**Learning outcomes:** After successful completion of this module the students would be able to understand and write the language with confidence which would help in their personality development.

**Teaching Methodology :** Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 6

Theory hours: 25 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Conversational english	5	Lecture/ power point	Written
2	Rephrasing	5	Lecture/ power point	Written
3	Writing skill development	5	Lecture/ power point	Written
4	Paragraph, Letter Writing, Essay writing, Memo, Circular, Notice, Cover Letter, Resume, Thesis, Summary, Précis, Speaking	10	Lecture/ power point	Written

### **ITM-BARI- 406 – Analytical Reasoning II**

**Learning outcomes:** After successful completion of this module the students would be able to understand and write the language with confidence which would help in their personality development.

**Teaching Methodology :** Lectures and demonstration by audio visual aids, seminars & group discussions.

#### **Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 6

Theory hours: 25 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Alphabet test • Series Test • Number , Ranking and time sequence	5	Lecture/ power point	Written
2	• Direction sense Test • Decision making test	5	Lecture/ power point	Written
3	• Figure series • Input/output, Assertion and reasoning • Sitting Arrangement	5	Lecture/ power point	Written
4	<b>Non-Verbal Reasoning:</b> • Series test • Odd figure Out	5	Lecture/ power point	Written
5	• Analogy • Miscellaneous Test etc.	5	Lecture/ power point	Written

### **ITM-BMICP- 407 – Practical Food & Dairy Microbiology**

#### **Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 6

Practical hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1.	For Syllabus refer to the theory part	35	Practical	Written/Practical

### **ITM-BMICP- 408 – Practical Molecular Diagnostics**

#### **Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 6

Practical hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1.	For Syllabus refer to the theory part	35	Practical	Written/Practical

### **Course details -Semester 5**

S.No	Paper Code	Paper Name	ESE	CCE	Total Marks
1	BMIC 501	Medical Microbiology	70	30	100
2	BMIC 502	Microbial Biotechnology	70	30	100
3	BMIC 503	Immunology II	70	30	100
4	BMIC 504	Microbial Ecology	70	30	100
5	BMICP 505	Immunology Practical	35	15	50
6	BMICP 506	Clinical Diagnostic Practical	35	15	50
		Total	350	150	500

### **ITM-BMIC 501-Medical Microbiology**

**Learning Objective:** This module is a general introduction to cell biology, its importance in pathology body functioning.

#### **Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars & group discussions.

#### **Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 46 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<p><b>Normal microflora of the human body and host pathogen interaction</b></p> <p>1.1 Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract.</p> <p>1.2 Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections, Transmission of infection, Pathophysiologic effects of LPS.</p>	10 hrs	Lecture/ power point	Written
2	<p><b>Bacterial diseases: Symptoms, mode of transmission, prophylaxis and control</b></p> <p>2.1 Respiratory Diseases: Streptococcus pyogenes, Haemophilus influenzae, Mycobacterium tuberculosis.</p> <p>2.2 Gastrointestinal diseases: Escherichia coli, Salmonella typhi, Vibrio cholerae, Helicobacter pylori.</p> <p>2.3 Others: Staphylococcus aureus, Bacillus anthracis, Clostridium tetani, Treponema</p>	10 hrs	Lecture/ power point	Written
3	<p><b>Viral diseases: Transmission, symptoms, prophylaxis and control</b></p> <p>3.1 Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu</p>	8 hrs	Lecture/ power point	Written
4	<p><b>Protozoan diseases: Symptoms, transmission and control</b></p> <p>4.1 Malaria, Kala-azar.</p>	2 hrs	Lecture/ power point	Written
5	<p><b>Fungal diseases: Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention</b></p> <p>5.1 Cutaneous mycoses: Tinea pedis (Athlete's foot)</p> <p>5.2 Systemic mycoses: Histoplasmosis</p> <p>5.3 Opportunistic mycoses: Candidiasis.</p>	6 hrs	Lecture/ power point	Written
6	<p><b>Antimicrobial agents: General</b></p>	10 hrs	Lecture/ power point	Written

<p><b>characteristics and mode of action</b></p> <p>6.1 Antibacterial agents : Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism.</p> <p>6.2 Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin.</p> <p>6.3 Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine.</p>				
---	--	--	--	--

**SUGGESTED READING**

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2010) Jawetz, Melnick and Adelberg's Medical Microbiology. 25th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2008) Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education

**ON-LINE READING MATERIAL**

1. Baron, S. Medical Microbiology, 4th edition.  
[http://www.ncbi.nlm.nih.gov/books/NBK7627/?redirect-on-error=\\_\\_HOME\\_\\_&depth=2](http://www.ncbi.nlm.nih.gov/books/NBK7627/?redirect-on-error=__HOME__&depth=2)
2. MicrobeWorld (Published by The American Society of Microbiology):  
<http://www.microbeworld.org/>

**ITM-BMIC 502-Microbial Biotechnology**

**Learning Objective:** This module is a general introduction to cell biology, its importance in pathology body functioning.

**Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 30 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Microbial Biotechnology and its Applications	7 hrs	Lecture/ power point	Written

	Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology .Use of prokaryotic and eukaryotic microorganisms in biotechnological applications. Genetically engineered microbes for industrial application: Bacteria and yeast			
2	herapeutic and Industrial Biotechnology Recombinant microbial production processes in pharmaceutical industries -Streptokinase, recombinant vaccines (Hepatitis B vaccine) Microbial polysaccharides and polyesters Microbial production of bio-pesticides, bioplastics Microbial biosensors	6	Lecture/ power point	Written
3	Microbial based transformation of steroids and sterols. Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute	5	Lecture/ power point	Written
4	Microbial product purification: filtration, ion exchange & affinity chromatography techniques Immobilization methods and their application: Whole cell immobilization	2	Lecture/ power point	Written
5	Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents	5	Lecture/ power point	Written
6	RNAi and its applications in silencing genes, drug resistance, therapeutics and hostpathogen interactions	5	Lecture/ power point	Written

## SUGGESTED READING

1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.
2. Demain, A. L and Davies, J. E.(1999). Manual of Industrial Microbiology and Biotechnology, 2nd

Edition, ASM Press.

3. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.
4. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.
5. Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications
6. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press
7. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
8. Stanbury PF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2nd edition., Elsevier Science
9. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauer associates, Inc.

### **ITM-BMIC 503-Immunology II**

**Learning Objectives:** Clinically diagnose, investigate and manage a whole spectrum of immune-mediated disorders. Practically perform and interpret the common laboratory techniques used in the Immunology Laboratory. Plan and undertake research in Clinical Immunology in the clinic, laboratory and community.

**Teaching Methodology :** Lectures and demonstration by audio visual aids, seminars & group discussions.

#### **Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 37 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Auto immunity & auto immune disorders	4 hours	Lecture/ power point	Written
2	<b>Hypersensitivity :</b> Reactions and types	3 hours	Lecture/ power point	Written
3	<b>Immunodiagnostics</b> 3.1 Evaluating immunological functions. 3.2 Detection of specific antibodies 3.3 Flowcytometry 3.4 HLA typing and matching 3.5 Lymphoproliferation assays 3.6 Molecular methods	12 hours	Lecture/ power point	Written
4	<b>Immunodeficiency</b> <b>Prin</b> 4.1 Approach to evaluation of the immunodeficient host, Primary immunodeficiency	10 hours	Lecture/ power point	Written

	disorders, HIV/AIDS, HIV vaccine development, Ageing and immune system, Secondary immunodeficiency (excluding AIDS).			
5	<b>Treatment of immunological diseases</b> 5.1 Bone-marrow transplantation, IVIG therapy, Cancer vaccines, Therapeutic antibodies, Gene therapy. 5.2 Anti-inflammatory medications: steroids, NSAIDs and antihistamines.	8 hours	Lecture/ power point	Written

**Suggested reading**

Kuby

**ITM-BMIC 504-Microbial Ecology**

**Learning Objective:** This module is a general introduction to cell biology, its importance in pathology body functioning.

**Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars &amp; group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 41 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	History, significance and developments in the field of microbial ecology Contributions of Beijerinck, Winogradsky, Kluver, Van Niel, Martin Alexander, Selman A. Waksman, Environmental chemistry, Atmospheric pollutants, Types of wastes, The Atmosphere, Organization of life, Ecosystems.	2 hrs	Lecture/ power point	Written
2	Microorganisms & their natural habitats A. Terrestrial Environment: Soil characteristics, Soil profile, Soil formation, Soil as a natural habitat of microbes, Soil microflora B. Aquatic Environment: Stratification & Microflora of Freshwater & Marine habitats C. Atmosphere: Stratification of the Atmosphere,	15 hrs	Lecture/ power point	Written



	<p>Aeromicroflora, Dispersal of Microbes</p> <p>D. Animal Environment: Microbes in/on human body (Microbiomics) &amp; animal (ruminants) body.</p> <p>E. Extreme Habitats: Extremophiles: Microbes thriving at high &amp; low temperatures, pH, high hydrostatic &amp; osmotic pressures, salinity, &amp; low nutrient levels.</p>			
3	<p>Succession of microbial communities in the decomposition of plant organic matter</p> <p>Biological Interactions</p> <p>A. Microbe–Microbe Interactions</p> <p>Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, Predation, Biocontrol agents</p> <p>B. Microbe–Plant Interactions</p> <p>Roots, Aerial Plant surfaces, Biological Nitrogen fixation (symbiotic/nonsymbiotic - biofertilizers)</p> <p>C. Microbe–Animal Interactions</p> <p>Role of Microbes in Ruminants, Nematophagus fungi, Luminescent bacteria as symbiont</p>	10	Lecture/ power point	Written
4	<p>Biogeochemical cycles an introduction</p> <p>Carbon cycle:</p> <p>Microbial degradation of polysaccharide (cellulose, hemicellulose, lignin, chitin)</p> <p>Nitrogen cycle:</p> <p>Ammonification, nitrification, denitrification &amp; nitrate reduction. Nitrate pollution.</p> <p>Phosphorous cycle:</p> <p>Phosphate immobilization and phosphate solubilization</p> <p>Sulphur Cycle:</p> <p>Microbes involved in sulphur cycle</p>	8	Lecture/ power point	Written
5	<p>Solid Waste Management</p> <p>Sources and types of solid waste, methods of disposal of solid waste (incineration, composting, sanitary landfill)</p> <p>Liquid Waste Management</p> <p>Composition of sewage; strength of sewage (BOD and COD); Primary, secondary (aerobic – oxidation pond, trickling filter, rotating biological contractor/biodisc system, activated sludge process and anaerobic – septic tank, imhoff tank, anaerobic digester) and</p>	13	Lecture/ power point	Written

tertiary sewage treatment			
Bioleaching			
Biodeterioration			
Microbial deterioration of metals (corrosion), textile and paper			

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4 th edition. Benjamin/Cummings Science Publishing, USA.
2. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2 nd Edition, MacMillan Publishing Company, New York.
3. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12 th edition. Pearson/ Benjamin Cummings.
4. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
5. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
6. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
7. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2 nd edition, Academic Press.
8. Martin A. (1977). An Introduction to Soil Microbiology. 2 nd edition. John Wiley & Sons Inc. New York & London.
9. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
10. Subba Rao NS. (1999). Soil Microbiology. 4 th edition. Oxford & IBH Publishing Co. New Delhi.

### **ITM-BMICP- 505 – Practical Immunology**

#### **Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 6

Practical hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1.	For Syllabus refer to the theory part	35	Practical	Written/Practical

### **ITM-BMICP- 506 – Practical Clinical Diagnostic**

#### **Standard of passing:**

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper

Passing Marks: 14

15 marks : CCE

Passing Marks: 6

Practical hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1.	For Syllabus refer to the theory part	35	Practical	Written/Practical

**Course details-Semester 6 - Paper code -Credits**

S.No	Paper Code	Paper Name	ESE	CCE	Total Marks
1	BMIC 601	Scientific methodology, Biostatistics & Technical writing	70	30	100
2	BMIC 602	Applied Microbiology	70	30	100
3	BMIC 603	Dissertation	100		100
			240	60	300

**ITM-BMLT- 601- Scientific methodology, Biostatistics & Technical writing**

**Learning Objectives:** The student will learn to collect, tabulate, & analyze data as a researcher.

**Teaching Methodology :** Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 30 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	<b>Research Methodology</b> 1.1 Introduction & types,y. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.	8 hours	Lecture/ power point	Written
2	<b>Literature survey</b> 2.1 Importance & Primary and secondary sources	4 hours	Lecture/ power point	Written
3	<b>Research Design</b> 3.1 Basic principles, Characteristics of a good design.	4 hours	Lecture/ power point	Written
4	<b>Formulation of hypothesis</b>	4 hours	Lecture/ power point	Written

	Meaning, Techniques and Precautions of Interpretation.			
5	<b>Research Report Writing</b> Structure and components of scientific reports, Types of report, Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables , Bibliography, referencing and footnotes.	10 hours	Lecture/ power point	Written

**Suggested reading**

Research Methodology 3<sup>rd</sup> edition-Kothari & Garg

**ITM-BMIC 602 -Applied Microbiology**

**Learning Objective:** This module is a general introduction to cell biology, its importance in pathology body functioning.

**Teaching Methodology :**

Lectures and demonstration by audio visual aids, seminars & group discussions.

**Standard of passing:**

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper

Passing Marks: 28

30 marks : CCE

Passing Marks: 12

Theory hours: 30 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	-Water microbiology Significance of bacteriological analysis of water, collection and handling of water samples, indicators of excretal pollution, bacteriological analysis of water for coliforms and faecal streptococci (MTFT, MFT), water treatment using SSF and RSF, methods of chlorination, differences between fecal and non fecal organisms	7 hrs	Lecture/ power point	Written
2	Waste water treatment Sewage types, composition, physical, chemical and biological characteristics, BOD, COD, ThOD, trickling filter, activated sludge, RBC, sludge digester, oxidation pond, septic tank, imhoff tank	6 hrs	Lecture/ power point	Written

3	Air and Soil microbiology Microbial analysis of air , settling plate and Anderson technique, bacteria and fungi as biopesticides, biofertilizers, PSB, mycorrhiza, microbial leaching of copper and uranium	5	Lecture/ power point	Written
4	Food microbiology Food spoilage organisms, canning process, pasteurization, low temperature preservation, chemical preservation Food borne diseases and food intoxication	2	Lecture/ power point	Written

### Assessment and Evaluation Pattern

Each semester will consist of both Continuous and Comprehensive Evaluation (CCE) throughout the semester and End Semester Examination (ESE) conducted in June/December for the subjects prescribed in the syllabus for each semester. The faculty will conduct the examination as per schedule prepared and communicated by the Department of Medical Laboratory Technology.

**1.CCE (Continuous and comprehensive evaluation) :** It is for 30 marks where a complete assessment will be done throughout the semester. The break up for the 30 marks is as follows:

**a. Theory examination :**

- i) Mid Term written examinations for 30 marks conducted in the mid, of the semester (March/October).
- ii) Class Tests (CT) written examinations for 20 marks each, conducted in the first half and second half of the semester (September, November /February, May).

**b. Assignment :** It will be class or home assignment given individually to the student after first month of the academic theory sessions.

**c. Presentation :** It will be an oral presentation to be given by the student individually on the topic given by the faculty. It is to improve the communication skills and aiming towards overall personality development. It increases self confidence and reduces stage fear. I also enhances the content development skills as students have to prepare and present on the given topic.

**d. Attendance :** Attendance of a student is allotted a total of 5 marks per subject. A minimum of 70 % attendance is compulsory for a student to be able to appear for the semester-end examination. The theory exams will be averaged for 20 marks, while the assignments and presentations for 5 marks and the attendance for another 5 marks, making up 30 marks of the internal/ CCE.

**2. ESE ( End Semester Examination) :** It comprises of a 100 Marks Written Paper for each subject at the End of Each Semester (June/December).

**3. Practical Examination :** Each subject will assessed 35 marks for the practicals in two subjects. The practical examination will conducted before/after the ESE individually for the subjects.



**ITM University  
Naya Raipur  
B.Sc Annual Examination  
(Faculty of Life & Allied Sciences)**

**Paper Code:-**

**Name of Subject:-**

**Time: 3 hr**

**Date:**

**Total Marks: 70**

-----  
Instruction to Candidates:

- dx. All questions except quest 1 carry equal marks
- dxii. Q.1 is compulsory
- dxiii. Attempt any four questions from Q.2 to Q.5

-----  
Q.1. Multiple choice questions/ short answers

(20 x 1) = [20 marks]

- 2. -----
- 3. -----
- 4. -----
- 5. -----
- 6. -----
- 7. -----
- 8. -----
- 9. -----
- 10. -----
- 11. -----
- 12. -----
- 13. -----
- 14. -----
- 15. -----
- 16. -----
- 17. -----
- 18. -----
- 19. -----
- 20. -----
- 20.-----

**Attempt any 3 questions from Q.2 to Q.5 -**

**30 marks**

Q.2. Write a short note one:- (any two)

[5x2=10]

a) -----

b) -----

c) -----

Q.3. Long answer question: (answer any 2)

[5x2=10]

a) -----

b) -----

Q.4. Write short answers of the following:- (any two)

[5 x2= 10]

a) -----

b) -----

c) -----

d) -----

e) -----

Q.5. Long answer question (answer any 1):-

[10]

a) -----

b) -----

Q.6. Answer any 2 -Short answers

[5x2=10]

a) -----

b) -----

c) -----

Q.7. Answer any 1 -Long answers

[10]

a) -----

b) -----



**Time Table**

---

The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.