



AMITY UNIVERSITY
— R A J A S T H A N —

**AMITY INSTITUTE OF MICROBIAL TECHNOLOGY
(AIMT)**

**Master of Science
(Industrial Microbiology)**

Programme Code: MMC

12292

Duration – 2 Years Full Time

(Programme Structure)

Choice Based Credit System (CBCS)

2021

AMITY UNIVERSITY RAJASTHAN

Program Learning Outcomes - PLO

- Students will be able to acquire, articulate, retain and apply knowledge relevant to microbiology.
- Students will acquire and demonstrate competence in microbiology laboratory skills applicable to relevant industries and research.
- The student will communicate scientific concepts, experimental results, and analytical arguments clearly.
- Students will develop skill to become efficient entrepreneur, R & D or industry professional.

Credits Summary

M.Sc. Industrial Microbiology (02Years/ 04 Semesters)							
Semester	Core Course (CC)	Domain Electives (DE)	Value Added Course (VAC)	Open Electives (OE)	Non-Teaching Credit Courses (NTCC)	Anandam	Total
I	22	3	4	-	-	2	31
II	16	3	4	3	-	2	28
III	17	3	4	3	3	2	32
IV	-	-	-	-	25	-	25
Total	55	9	12	6	28	6	116

CC = Core Course

DE = Domain Elective

OE = Open Elective

VA = Value Added Course

NTCC= Non-Teaching Credit Courses (NTCC)



AMITY UNIVERSITY

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AMITY INSTITUTE OF MICROBIAL TECHNOLOGY (AIMT)

Program Name: M.Sc. -INDUSTRIAL MICROBIOLOGY

FIRST SEMESTER

Course Code	Course Title	Category	Lectures(L) Hours per week	Tutorial (T) Hours per week	Practical (P) Hours per week	Total Credits
MMC 101	Introduction to Industrial Microbiology	CC	4	-	-	4
MMC 102	Microbial Physiology	CC	3	1	-	4
MMC 103	Enzyme Technology and Biosensors	CC	3	1	-	4
MMC 104	Microbial Genetics & Strain Improvement	CC	3	1	-	4
MMC 121	Introduction of Industrial Microbiology Lab.	CC	-	-	4	2
MMC 122	Microbial Physiology Lab.	CC	-	-	2	1
MMC 123	Enzyme Technology and Biosensors Lab.	CC	-	-	2	1
MMC 124	Microbial Genetics & Strain Improvement Lab.	CC	-	-	4	2
Domain Elective-I: Choose anyone from the following courses						
MMC 111	Biostatistics, IPR, Biosafety and Bioethics	DE	3	-	-	3
MMC 112	Industrial Safety & Management					
Value Added Courses						
BCS 111	Communication Skills - I	VA	1	-	-	1
BSS 111	Behavioural Science - I [Self-Development and Interpersonal Skills]	VA	1	-	-	1
FLT 111 FLG 111 FLS 111 FLC 111	Foreign Language - I French German Spanish Chinese	VA	2	-	-	2
AND 001	Aanandam I	NTCC	2	-	-	2
	TOTAL					31



Program Name: M.Sc. -INDUSTRIAL MICROBIOLOGY

SECOND SEMESTER

Course Code	Course Title	Category	Lectures(L) Hours per week	Tutorial (T) Hours per week	Practical (P) Hours per week	Total Credits
MMC 201	Immunology	CC	4	-	-	4
MMC 202	Fermentation Technology and Metabolic Pathways	CC	3	-	-	3
MMC 203	Food and Dairy Microbiology	CC	3	-	-	3
MMC 221	Immunology Lab	CC	-	-	4	2
MMC 222	Fermentation Technology and Metabolic Pathways Lab	CC	-	-	4	2
MMC 223	Food and Dairy Microbiology Lab	CC	-	-	4	2
Domain Elective-II :Choose any one from the following courses						
MMC 211	Pharmaceutical Microbiology & Herbal Technology	DE	3	-	-	3
MMC 212	Nanobiotechnology					
MMC 213	Bio- entrepreneurship					
Open Elective-I		OE				3
BCS 211	Communication Skills - II	VA	1	-	-	1
BSS 211	Behavioural Science – II [Behavioural Communication and Relationship Management]	VA	1	-	-	1
FLT 211 FLG 211 FLS 211 FLC 211	Foreign Language – II French German Spanish Chinese	VA	2	-	-	2
AND002	Aanadam-II	NTCC	2	-	-	2
	TOTAL					28

Note: -Term Paper/ Case Study topic distribution before summer vacations and will be evaluated in Third Semester.



Program Name: M.Sc. -INDUSTRIAL MICROBIOLOGY

THIRD SEMESTER

Course Code	Course Title	Category	Lectures(L) Hours per week	Tutorial (T) Hours per week	Practical (P) Hours per week	Total Credits
MMC 301	RDT & Genomics	CC	3	1	-	4
MMC 302	Environment & Agricultural Microbiology	CC	3	-	-	3
MMC 303	Clinical Microbiology	CC	3	1	-	4
MMC 321	RDT & Genomics Lab	CC	-	-	4	2
MMC 322	Environment & Agricultural Microbiology Lab	CC	-	-	4	2
MMC 323	Clinical Microbiology Lab	CC	-	-	4	2
Domain Elective-III: Choose any one from the following courses						
MMC 311	Instrumentation & Techniques in Microbiology	DE	3	-	-	3
MMC 312	Marine Microbiology					
MMC 313	Cellular Microbiology					
Open Elective- II		OE				3
MMC 330	Term Paper	NTCC	-	-	-	3
BCS 311	Communication Skills – III	VA	-	-	-	1
BSS 311	Behavioural Science – III [Leading Through Teams]	VA	-	-	-	1
FLT 311 FLG 311 FLS 311 FLC 311	Foreign Language – III French German Spanish Chinese	VA	-	-	-	2
AND 003	Aanandam III	NTCC	2	-	-	2
	TOTAL					32



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Program Name: M.Sc. -INDUSTRIAL MICROBIOLOGY

FOURTH SEMESTER

Course Code	Course Title	Lectures(L) Hours per week	Tutorial (T) Hours per week	Practical (P) Hours per week	Total Credits
MMC 460	Research Project & Dissertation	-	-	-	25
	TOTAL	-	-	-	25

Total Credits (31+28+32+25) = 116



AMITY INSTITUTE OF MICROBIAL TECHNOLOGY (AIMT)

Program Name: M.Sc. –INDUSTRIAL MICROBIOLOGY

FIRST SEMESTER

Course Code	Course Title	Category	Lectures(L) Hours per week	Tutorial (T) Hours per week	Practical (P) Hours per week	Total Credits
MMC 101	Introduction to Industrial Microbiology	CC	4	-	-	4
MMC 102	Microbial Physiology	CC	3	1	-	4
MMC 103	Enzyme Technology and Biosensors	CC	3	1	-	4
MMC 104	Microbial Genetics & Strain Improvement	CC	3	1	-	4
MMC 121	Introduction of Industrial Microbiology Lab.	CC	-	-	4	2
MMC 122	Microbial Physiology Lab.	CC	-	-	2	1
MMC 123	Enzyme Technology and Biosensors Lab.	CC	-	-	2	1
MMC 124	Microbial Genetics & Strain Improvement Lab.	CC	-	-	4	2
Domain Elective-I: Choose anyone from the following courses						
MMC 111	Biostatistics, IPR, Biosafety and Bioethics	DE	3	-	-	3
MMC 112	Industrial Safety & Management					
Value Added Courses						
BCS 111	Communication Skills – I	VA	1	-	-	1
BSS 111	Behavioural Science – I [Self-Development and Interpersonal Skills]	VA	1	-	-	1
FLT 111 FLG 111 FLS 111 FLC 111	Foreign Language – I French German Spanish Chinese	VA	2	-	-	2
AND 001	Aanandam I	NTCC	2	-	-	2
	TOTAL					<u>31</u>

Introduction to Microbiology

Course Code: MMC 101

Credit Units: 04

Course Objective: -

The aim of the course is to aware the students of the industrial applications of various microbes and their possible cultivations

Module I: - Bacteriology

Morphological features and arrangement of bacterial cells; eubacterial cell structure: Gram-positive and Gram-negative bacteria; Extracellular appendages: flagella- arrangement, basic structure, function; pili- different types, related functions; fimbriae- occurrence, function; glycocalyx- composition and role and capsule- microcapsule and slime.

Structure of gram-negative and gram-positive bacterial cell wall, spheroplasts, L-forms, periplasm; molecular and chemical structure of cell membrane; bacterial cytoskeleton (tubulin and actin filaments); General characteristics of archaea, archaeal cell wall, and cell membrane; Bacterial reproduction- Binary fission and other forms of reproduction in bacteria, endospore-formation, and biological role; general account of mycoplasma

Module II: - Virology

The general properties of viruses, nomenclature, and classification of viruses; morphology and ultrastructure; capsids and their arrangements; types of envelopes

Viral structure- different types, Viral genomes- dsDNA, segmented DNA genomes. ssDNA, dsRNA. ssRNA (+) strand, ssRNA (+) sense with DNA intermediate, ssRNA (-) sense, Ambisense RNA genomes, Viral assembly; virus-related agents (viroids, prions).

Cultivation of viruses in embryonated eggs, experimental animals, and cell cultures;

Module III: - Mycology

General features of fungi, Classification of fungi, Different forms- Hyphae and non-motile unicells, motile cells, spores, dormancy, growth of population, and colonies. Nutrition, heterothallism, sex hormones in fungi, physiological specialization in fungi, fungi and ecosystem- saprophytic parasitic,

mutualistic and symbiotic relationship with plants and animals,
Reproduction in fungi: asexual, sexual, and parasexual.

Classification of fungi; Introduction to different classes- Acrasiomycetes,
Myxomycetes, Chytridiomycetes, Oomycetes, Zygomycetes, Ascomycotina,
Basidiomycotina, Deuteromycetes

Module IV: Phycology

Introduction of algae: Occurrence and distribution, thallus structure,
characteristics, nutrition, classification and reproduction, green algae,
diatoms, euglenoids, brown Rhodophyta, pyrrophyta, Lichens and their
biological significance

Module V:- Other eukaryotic microorganisms

Protozoa- general account, Diversity, cellular structure, classification,
reproduction, life cycles, nutrition

Helminthes- general account, reproduction, classification, flatworms, thorny-
headed worms, tapeworms, flukes, nematodes

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attd	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Prescott's Microbiology by J. Willey, L. Sherwood and C. J. Woolverton. 10th edition. McGraw Hill Education. 2017.
2. Brock Biology of Microorganisms by M. Madigan, K. Bender, D. Buckley, W. Sattley, D. Stahl. 15th Edition. Pearson Education. 2018.
3. Alcamo's Fundamentals of Microbiology by J. C. Pommerville. 10th Edition. Jones and Bartlett Learning. 2013.
4. General Microbiology by R. Stanier, J. Ingraham, M. Wheelis, R.Painter. 5th edition. Macmillan, Hampshire & London Publishers. 1992.
5. Microbiology by M. Pelczar, E. Chan & R. Reid. 4th Edition. McGraw Hill Education. 1998

Microbial Physiology

Course Code: MMC 102

Credit Units: 04

Course Objective:-

The objective of this course is to make students familiar with microbial physiology and its metabolism in detail.

Module 1:-Principles of Microbial Nutrition

Bacterial nutrition: Basic nutritional requirements, nutritional classification, Membrane transport - Simple diffusion and facilitated diffusion. Passive transport - glucose transporter, anion transporter and porins. Primary active transporters - P type ATPases, V type ATPases, F type ATPases. Secondary active transporters - lactose permease, Na⁺ -glucose symporter. ABC transporters. Ion channels - voltage-gated ion channels (Na⁺ /K⁺ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor), aquaporins, bacteriorhodopsin. Ionophores.

Module II: - Microbial 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 the respiratory chain, comparison of mitochondrial and bacterial. ETC, electron transport phosphorylation, uncouplers and inhibitors.

Lipid metabolism: Biosynthesis of fatty acids and lipids. Oxidation of fatty acids. Nucleotide metabolism: Biosynthesis of purine and pyrimidine nucleotides. Catabolism of nucleotides.

Inorganic Nitrogen assimilation- nitrate and ammonia assimilation; General account of amino acid biosynthesis and protein utilization, Bacterial photosynthesis- Carbondioxide fixation.

Module III: - Microbial Growth

Introduction to microbial growth, components of culture media, different types of media, phases of growth, growth curve, the kinetics of growth, measurement of growth, continuous & batch culture, synchrony, chemostat, and turbidostat.

Microbial growth in response to environment - Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH

(acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), barophilic.

Module IV: Bacterial Secretion Systems

Bacterial secretion system: Introduction; Sec secretion pathway; SecB secretion pathway; SRP pathway; Tat pathway; Type I, Type II, Type III (T3SS; injectisome, injectosome), Type IV, Type V, Type VI; Sec A2, Sortases and Type VII secretion systems.

Module V: - Yeast & Solvent tolerance in microbes:

Cytology and Physiology of wine Yeasts: types of wine yeast, the biology, and cytology of yeasts, alternative nuclear phase and alternative life cycles of yeast, homothallism, and heterothallism. morphology of yeast during vegetative multiplication, sexual reproduction, and spore formation, colonial morphology, formation of pseudo and true mycelia of yeast, active dry/compressed yeast. Habitat & distribution of solvent tolerant organisms, genes for solvent tolerance; Partition coefficient log P as an index of solvent tolerance in Microorganisms.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attd	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox. Fifth Edition, W.H. Freeman and Company;2008
2. Microbial Physiology by Albert G. Moat and John W. Foster. Third Edition John Wiley and Sons;2002
3. Freeman WH (2001) Biochemistry, Stryer 5th edition
4. Biochemistry by Geoffrey L. Zubay. 4th Edition. Brown Co, USA. 1999
5. The Physiology and Biochemistry of Prokaryotes by D. White, J. Drummond, C. Fuqua. 4th Edition. Oxford University Press. 2011.
6. Microbial Biochemistry by G. N. Cohen. 2nd Edition. Springer. 2014.
7. Caldwell D.H. 1995 Microbial Physiology and Metabolism. Win C Brown publishers.

Enzyme Technology and Biosensors

Course Code: MMC 103

Credit Units: 04

Course Objective:-

The objective of the course is to familiarize students with Enzymology, enzyme technology, and biosensors.

Module I: - Introduction to Enzymology & Enzyme Kinetics

Enzyme: Classification, Active site, mechanism of enzyme action.

Enzyme kinetics: factors affecting rates of enzyme-mediated reactions.

Michaelis-Menton equation and its significance in enzyme kinetic studies.

Lineweaver-Burke plot, Haldane-Briggs relationship, Anomalous kinetics of competitive, uncompetitive, non – competitive inhibition, End product inhibition with examples. Co-enzymes and Co-factors: Substrate enzyme relationship. Classification of co-enzymes as group transfer, hydrogen transfer, co-enzymes, function of nucleotide co-enzymes, CoA, NAD.NADP, FMN/FAD, Biotin, Folic acid, Vit.-B-12.

Module II: - Enzyme Purification

Importance of enzyme purification, different sources of enzymes. Extracellular and intracellular enzymes. Physical and Chemical methods used for cell disintegration. Enzyme fractionation by precipitation (using Temperature, salt, solvent, pH, etc.), liquid-liquid extraction, ionic exchange, gel chromatography, affinity chromatography, and other special purification methods. Enzyme crystallization techniques. Criteria of purity of enzymes, large-scale enzyme extraction, purification, and stabilization.

Module-III: - Enzyme Immobilization

Physical and Chemical techniques for enzyme Immobilization - adsorption. Matrix entrapment, encapsulation. cross-linking. covalent binding - examples; Advantage and disadvantage of different Immobilization techniques. Overview of applications of immobilized enzyme systems, the effect of pH, temperature on immobilized reaction kinetics.

Module IV: - Protein Engineering

Design and construction of novel proteins and enzymes, Conformation of proteins in general and enzymes in particular, Effect of amino acids on the

structure of proteins, Structure-function relations of enzymes, Physical methods such as x-ray crystallography for determination of protein structure, Site-directed mutagenesis for specific protein function, Gene shuffling and chimeric enzymes. Over expression and folding of proteins. Specific examples of enzyme engineering. A general account and applications of designer enzymes including- Abzymes, ribozymes

Module V: - Biosensors

Definitions, history, and market needs. Target analytes. Sensors based on: nucleotides, antigen-antibody, enzymes, and whole cells. Transducers: electrodes, photometric and acoustic. Signal processing. Case studies: immuno-sensors. Clinical, environmental, industrial, and military applications, future prospects.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attd	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Allosteric Enzymes - Kinetic Behaviour. 1982. by B.I. Kurganov. JohnWiley and Sons. Inc., New York.
2. Biotechnology. Volume 7 A - Enzymes in Biotechnology. 1983 Edited byH. J. Rehm and G. Reed. Verlag Chemie.
3. Handbook of enzyme biotechnology: Edited by Alan Wiseman. Pp. 276. Published by Ellis Horwood Ltd., Chichester, U.K. and distributed by John Wiley and Sons Ltd., 1975.

Microbial Genetics and Strain Improvement

Course Code: MMC 104

Credit Units: 04

Course Objective: -

Module-I: -Introduction

Genetic material- nature, properties. Types, properties, structure, and chemical nature of DNA and RNA. C- value paradox, denaturation-renaturation kinetics topology, DNA superhelicity, linking number. Organization of prokaryotic and eukaryotic chromosomes and genomes. Repetitive DNA, Transposition: Structure of Transposons, mechanism of transposition, transposon mutagenesis. Plasmids: Plasmids as extrachromosomal genetic elements; types and properties. Structure different plasmids: Col E1, F1, R, and Ti plasmids.

Module-II: -Mutagenesis& Recombination

Molecular basis of mutations, Types of gene mutations, suppression of mutations. Radiation induced mutations, toxicity testing. Systems that safeguard DNA – DNA methylation and DNA repair mechanisms –Daughter – strand gap repair (in lesions)bypass synthesis, transcription-coupled DNA repair, Direct reversal of DNA damage, excision repair, mismatch repair, error-prone repair, homologous recombination and repair, end-joining repair, SOS repair

Genetic recombination; Hollyday model, Meselson-Radding model, and illegitimate recombination.

Bacterial Conjugation: mechanism, interrupted mating, mapping genes in bacteria. Bacterial Transformation: competence, the molecular mechanism of transformation, mapping by transformation. Bacterial Transduction: Specialized and generalized transduction, co- transduction and linkage, mapping by co-transduction.

Module-III: - Maintenance and Expression of Genetic Information

Mechanism, regulation of prokaryotic & eukaryotic DNA replication.

The mechanism, regulation of prokaryotic & eukaryotic RNA transcription. Role of enzymes and transcription factors. Post-transcriptional modification of RNA- splicing, editing capping, polyadenylation, mRNA stability, and export

from the nucleus. Processing of other RNA's ribosome formation; RNA dependent synthesis of RNA and DNA.

Genetic code and mechanisms of translation in prokaryotes & eukaryotes. Regulation of translation, inhibitors of translation. Post-translation processes: Protein modification, folding, chaperones, transportation; The Signal Hypothesis, protein degradation.

Module-IV:- Gene Regulation

Organization of gene in prokaryotes and Eukaryotes - Introduction, Operon concept, lac and Trp operons, promoters and repressors, regulation of gene expression - Transcriptional control - promoters, terminators, attenuators and anti-terminators; Induction and repression; the lac operon - catabolite repression; Biosynthesis; trp operon - upstream activator sequences and enhancers, two-component regulatory systems. Translational control - ribosome binding, codon usage, antisense RNA; post-translational control. Global, stringent, and heat-shock response in bacteria.

Module-V

Isolation, selection, and Screening of industrial microorganisms. Strain improvement for the selected organism: mutation and screening of improved cultures, random and strategic screening methods, strategies of strain improvement for primary, secondary metabolites with relevant examples. Use of recombinant DNA technology, protoplast fusion techniques for strain improvement of primary and secondary metabolites. Production of recombinant molecules in the heterologous system, problems associated with strain improvement program, improvement of characters other than products, and its application in the industry. Preservation of cultures after strain improvement program.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attd	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Gene IX by Benjamin Lewin, Jones and Bartlett Publishers, Sudbury, Massachusetts, 2007

2. Molecular Biology of the Gene by J. D. Watson, T.A. Baker, S. P. Bell , A. Gann, M. Levin, R. Losick, 6th edition, Benjamin Cummings, San Francisco, USA,2007.
3. Molecular Biology of the Cell by B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walter, 5th edition, Garland Science, New York and London,2007
4. Biochemistry (5th edition) by J.M. Berg, J.L. Tymoczko, L. Stryer, W.H. Freeman and Company, New York, USA, 2008.
5. Concepts of Genetics by W.S. Klug, and M.R. Cummings 2004. Publisher: Pearson Education
- 6.** Genome by T.A. Brown.2nd edition Publisher: Oxford: Wiley-Liss; 2002.

Introduction of Industrial Microbiology Lab.

Course Code: MMC 121

Credit Units: 02

Course objectives

The course aims to give hands-on training to students for enhancing their practical skills in the subject domain.

Course Content

A minimum of 8 laboratory exercises will be conducted based on theory papers MMC 101

Examination Scheme:

Components	C T	Performance	Case Study	Practical Record	Attd	EE
Weightage (%)	15	10	10	10	5	50

Microbial Physiology Lab.

Course Code: MMC 122

Credit Units: 01

Course objectives

The course aims to give hands-on training to students for enhancing their practical skills of the subject domain.

Course Content

A minimum of 8 laboratory exercises will be conducted based on theory papers
MMC 102

Examination Scheme:

Components	C T	Performance	Case Study	Practical Record	Attd	EE
Weightage (%)	15	10	10	10	5	50

Enzyme Technology and Biosensors Lab.

Course Code: MMC 123

Credit Units: 01

Course objectives

The course aims to give hands-on training to students for enhancing their practical skills of the subject domain.

Course Content

A minimum of 8 laboratory exercises will be conducted based on theory papers MMC 103

Examination Scheme:

Components	C T	Performance	Case Study	Practical Record	Attd	EE
Weightage (%)	15	10	10	10	5	50

Microbial Genetics & Strain Improvement Lab.

Course Code: MMC 124

Credit Units: 02

Course objectives

The course aims to give hands-on training to students for enhancing their practical skills of the subject domain.

Course Content

A minimum of 8 laboratory exercises will be conducted based on theory papers
MMC 104

Examination Scheme:

Components	C T	Performance	Case Study	Practical Record	Attd	EE
Weightage (%)	15	10	10	10	5	50

Biostatistics, IPR, Biosafety and Bioethics

Course Code: MMC 111

Credit Units: 03

Course Objective:-

The course aims to develop expertise for the application of stats on biological data and to make the students aware of protecting intellectual property and planning research while considering biosafety and bioethics.

Module I:- Biostatistics

Statistics, its meaning and objectives, Population samples, frequency tables, and their graphs, measures of central tendency (mean, mode, median), and their dispersion. Concepts of moments, Skewness, and kurtosis. Intuitive definition of random variables, probability mass function, and probability density function, expectation, and variance. Standard distribution; binomial, Poisson, and normal distribution with their important properties and significance.

Module II:- Biostatistics

Fitting of main distributions and testing of goodness-of-fit with special reference to χ^2 -test, t-test, Z-test. Fitting of trends; linear and quadratic with least square method. Lines of regression, coefficient of correlation, coefficient of variation, and their significance. Analysis of variance; one-way and two-way classification.

Module III:- IPR

Objectives of Intellectual Property Rights, tangible and intangible property; concept and classification of intellectual property: Copyrights and related rights, Trademarks and Geographical indications, Rights of traditional Knowledge, and Protection of Plant Varieties. IPR- National and International perspective, WTO, TRIPS, and WIPO.

Patent- Basic criterion for patentability, Patentable subjects, patentable inventions, patent acquisition, infringement of patent, discovery vs invention, product patenting vs process patenting, special issue in biotechnology patent, Patenting laws in Indian and International perspective, Case studies: Basmati case, Neem controversy, Turmeric case.

Module IV:- Biosafety

Biosafety: definition, concepts and issues. Introduction to Biological Safety Cabinets; Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals.

Biosafety Guidelines: Biosafety guidelines and regulations (National and International)- operation of biosafety guidelines and regulations of Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

Module IV:- Bioethics

Bioethics: Definition ethics/ bioethics, Principles of bioethics- framework for ethical decision making; biotechnology and ethics- benefits and risks of genetic engineering-ethical aspects of genetic testing- ethical aspects relating to use of genetic information- genetic engineering and biowarfare; Animal ethics - Norms in India - Licensing of animal house - Ethical clearance norms for conducting studies on human subjects.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attd	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings:-

1. Beauchamp, T. L., Walters, L., Kahn, J. P., Mastroianni, A. C. 2007. Contemporary Issues in Bioethics. 7th Edition. Wadsworth Publishing Company, California.
2. Paul, R.C. 2000. Situation of Human Rights in India. Commonwealth Publishers, New Delhi.
3. Daniel, Wayne W.: Biostatistics — A Foundations for Analysis in the Health Sciences. Wiley & Sons, New York, 6th ed. 1995,
4. Biostatistics: A manual of Statistical Methodology for use in Health, Nutrition and Anthropology, K. Visweswara Rao. Publisher: Jaypee Brothers, Second edition (1 January 2007).

5. Fundamentals of Mathematical Statistics, Eleventh Edition (2014)S.C Gupta and V.K Kapoor. Publisher: S. Chand & Co
6. Bareact, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
7. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007
8. Singh K. Intellectual Property Rights on Biotechnology, BCIL, and Newdelhi-1993.
9. Shaleesha A. Stanley, Bioethics, Wisdom educational service-2010
10. S. Ignacimuthu. Bioethics.Alpha Science International, 2009.

Industrial Safety and Management

Course Code: MMC 112

Credit Units: 03

Course Objective:-

Course addresses management and engineering design concepts required for process safety in chemical and biotechnology systems, with pharmaceutical manufacturing applications.

Module I: - Hazards

Classification: Chemical hazards. Radiation hazards and control of exposure to radiation. Types of fire and fire prevention methods. Mechanical hazards. Electrical hazards. Biological hazards.

Module II: - Psychology and Hygiene

Industrial psychology Industrial hygiene. Safety in plant site selection and plant layout. Industrial lighting and ventilation. Industrial noise.

Module III: - Occupational diseases and control

Occupational diseases and prevention methods. Safe housekeeping, Instrumentation for safe operation. Personal protective equipment. Safety in chemical operations and processes.

Module IV: - Management

Safety organization – safety committee – safety education and training. Management process. Philosophy and need for Industrial safety. Role of Government in Industrial safety. Waste management (Effluent treatment).

Module V: - Laws

Factory Act. ESI Act, Environmental Act. Workplace – compensation Act. Advantages of adopting safety laws.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attd	EE
Weightage (%)	15	10	10	10	5	50

Text and Reference Books:-

1. Safety and Accident Prevention in Chemical Operation 2nd Edn., H.H. Fawcett& W.S .Wood Wiley Interscience(1982)
2. Industrial Safety Management by L M Deshmukh Publisher Tata McGraw-Hill Education(2005)
3. Industrial Safety and Health Management by C. Ray Asfahl , David W. Rieske, 6th Edition Publisher: Prentice Hall(2009)

COMMUNICATION SKILLS - I

Course Code: BCS 111

Credit Units: 01

Course Objective:

The Course is designed to give an overview of the four broad categories of English Communication thereby enhance the learners' communicative competence.

Course Contents:

Module I: Listening Skills

Effective Listening: Principles and Barriers
Listening Comprehension on International Standards

Module II: Speaking Skills

Pronunciation and Accent
Reading excerpts from news dailies & magazines
Narrating Incident; Story telling.
Extempore & Role Plays

Module III: Reading Skills

Vocabulary: Synonyms, antonyms, diminutives, homonyms, homophones
Idioms & phrases
Foreign words in English

Module IV: Writing Skills

Writing Paragraphs
Précis Writing
Letter writing
Coherence and structure
Essay writing

Module V: Activities

News reading
Picture reading
Movie magic
Announcements

CAF – Communication Assessment File

GD – Group Discussion

GP – Group Presentation

Text & References:

- Working in English, Jones, Cambridge
- Business Communication, Raman – Prakash, Oxford
- Speaking Personally, Porter-Ladousse, Cambridge
- Speaking Effectively, Jermy Comfort, et.al, Cambridge

Behavioural Science - I
(Self-Development and Interpersonal Skills)

Course Code: BSS 111

Credit Units: 01

Course Objective:

This course aims at imparting an understanding of:
Self and the process of self exploration
Learning strategies for development of a healthy self esteem
Importance of attitudes and their effect on work behaviour
Effective management of emotions and building interpersonal competence.

Course Contents:

Module I: Understanding Self

Formation of self concept
Dimension of Self
Components of self
Self Competency

Module II: Self-Esteem: Sense of Worth

Meaning and Nature of Self Esteem
Characteristics of High and Low Self Esteem
Importance & need of Self Esteem
Self Esteem at work
Steps to enhance Self Esteem

Module III: Emotional Intelligence: Brain Power

Introduction to EI
Difference between IQ, EQ and SQ
Relevance of EI at workplace
Self assessment, analysis and action plan

Module IV: Managing Emotions and Building Interpersonal Competence

Need and importance of Emotions
Healthy and Unhealthy expression of emotions
Anger: Conceptualization and Cycle
Developing emotional and interpersonal competence
Self assessment, analysis and action plan

Module V: Leading Through Positive Attitude

Understanding Attitudes
Formation of Attitudes
Types of Attitudes
Effects of Attitude on
Behaviour
Perception
Motivation
Stress
Adjustment
Time Management
Effective Performance
Building Positive Attitude

Module VI: End-of-Semester Appraisal

Viva based on personal journal

Assessment of Behavioural change as a result of training

Exit Level Rating by Self and Observer

Text & References:

- Towers, Marc: Self Esteem, 1st Edition 1997, American Media
- Pedler Mike, Burgoyne John, Boydell Tom, A Manager's Guide to Self-Development: Second edition, McGraw-Hill Book Company.
- Covey, R. Stephen: Seven habits of Highly Effective People, 1992 Edition, Simon & Schuster Ltd.,
- Khera Shiv: You Can Win, 1st Edition, 1999, Macmillan
- Gegax Tom, Winning in the Game of Life: 1st Edition, Harmony Books
- Chatterjee Debashish, Leading Consciously: 1998 1st Edition, Viva Books Pvt. Ltd.
- Dr. Dinkmeyer Don, Dr. Losoncy Lewis, The Skills of Encouragement: St. Lucie Press.
- Singh, Dalip, 2002, Emotional Intelligence at work; First Edition, Sage Publications.
- Goleman, Daniel: Emotional Intelligence, 1995 Edition, Bantam Books
- Goleman, Daniel: Working with E.I., 1998 Edition, Bantam Books.

French - I

Course Code: FLT 111

Credit Units: 02

Course Objective:

To familiarize the students with the French language

- with the phonetic system
- with the syntax
- with the manners
- with the cultural aspects

Course Contents:

Module A: pp. 01 to 37: Unités 1, 2, Unité 3 Object if 1, 2

Only grammar of Unité 3: object if 3, 4 and 5

Contenu lexical: Unité 1: Découvrir la langue française: (oral et écrit)

1. se présenter, présenter quelqu'un, faire la connaissance des autres, formules de politesse, rencontres
2. dire/interroger si on comprend
3. Nommer les choses

Unité 2: Faire connaissance

1. donner/demander des informations sur une personne, premiers contacts, exprimer ses goûts et ses préférences
2. Parler de soi: parler du travail, de ses activités, de son pays, de sa ville.

Unité 3: Organiser son temps

1. dire la date et l'heure

Contenu grammatical:

1. organisation générale de la grammaire
2. article indéfini, défini, contracté
3. nom, adjectif, masculin, féminin, singulier et pluriel
4. négation avec « de », "moi aussi", "moi non plus"
5. interrogation : Inversion, est-ce que, qui, que, quoi, qu'est-ce que, où, quand, comment, quel(s), quelle(s)
Interro-négatif : réponses : oui, si, non
6. pronom tonique/disjoint- pour insister après une préposition
7. futur proche

C – Project +Presentation

I – Interaction/Conversation Practice

Text & References:

- le livre à suivre : Campus: Tome 1

German - I

Course Code: FLG 111

Credit Units: 02

Course Objective:

To enable the students to converse, read and write in the language with the help of the basic rules of grammar, which will later help them to strengthen their language.

To give the students an insight into the culture, geography, political situation and economic opportunities available in Germany

Course Contents:

Module I: Introduction

Self introduction: heissen, kommen, wohnen, lernen, arbeiten, trinken, etc. All personal pronouns in relation to the verbs taught so far.

Greetings: Guten Morgen!, Guten Tag!, Guten Abend!, Gute Nacht!, Danke sehr!, Danke!, Vielen Dank!, (es tut mir Leid!),

Hallo, wie geht's?: Danke gut!, sehr gut!, prima!, ausgezeichnet!,
Es geht!, nicht so gut!, so la la!, miserabel!

Module II: Interviewspiel

To assimilate the vocabulary learnt so far and to apply the words and phrases in short dialogues in an interview – game for self introduction.

Module III: Phonetics

Sound system of the language with special stress on Diphthongs

Module IV: Countries, nationalities and their languages

To make the students acquainted with the most widely used country names, their nationalities and the language spoken in that country.

Module V: Articles

The definite and indefinite articles in masculine, feminine and neuter gender. All Vegetables, Fruits, Animals, Furniture, Eatables, modes of Transport

Module VI: Professions

To acquaint the students with professions in both the genders with the help of the verb "sein".

Module VII: Pronouns

Simple possessive pronouns, the use of my, your, etc.

The family members, family Tree with the help of the verb "to have"

Module VIII: Colours

All the color and color related vocabulary – colored, colorful, colorless, pale, light, dark, etc.

Module IX: Numbers and calculations – verb "kosten"

The counting, plural structures and simple calculation like addition, subtraction, multiplication and division to test the knowledge of numbers. "Wie viel kostet das?"

Module X: Revision list of Question pronouns

W – Questions like who, what, where, when, which, how, how many, how much, etc.

C – Project +Presentation

I – Interaction/Conversation Practice

Text & References:

- Wolfgang Hieber, Lernziel Deutsch
- Hans-Heinrich Wangler, Sprachkurs Deutsch
- Schulz Griesbach, Deutsche Sprachlehre für Ausländer
- P.L Aneja, Deutsch Interessant- 1, 2 & 3
- Rosa-Maria Dallapiazza et al, Tangram Aktuell A1/1, 2
- Braun, Nieder, Schmöe, Deutsch als Fremdsprache 1A, Grundkurs

Spanish – I

Course Code: FLS 111

Credit Units: 02

Course Objective:

To enable students acquire the relevance of the Spanish language in today's global context, how to greet each other. How to present / introduce each other using basic verbs and vocabulary

Course Contents:

Module I

A brief history of Spain, Latin America, the language, the culture...and the relevance of Spanish language in today's global context.
Introduction to alphabets

Module II

Introduction to 'Saludos' (How to greet each other. How to present / introduce each other).
Goodbyes (despedidas)
The verb *llamarse* and practice of it.

Module III

Concept of Gender and Number
Months of the years, days of the week, seasons. Introduction to numbers 1-100, Colors, Revision of numbers and introduction to ordinal numbers.

Module IV

Introduction to *SER* and *ESTAR* (both of which mean To Be). Revision of 'Saludos' and 'Llamarse'. Some adjectives, nationalities, professions, physical/geographical location, the fact that Spanish adjectives have to agree with gender and number of their nouns. Exercises highlighting usage of *Ser* and *Estar*.

Module V

Time, demonstrative pronoun (Este/esta, Aquel/aquella etc)

Module VI

Introduction to some key AR /ER/IR ending regular verbs.

C – Project +Presentation

I – Interaction/Conversation Practice

Text & References:

- Español, En Directo I A
- Español Sin Fronteras

Chinese – I

Course Code: FLC 111

Credit Units: 02

Course Objective:

There are many dialects spoken in China, but the language which will help you through wherever you go is Mandarin, or Putonghua, as it is called in Chinese. The most widely spoken forms of Chinese are Mandarin, Cantonese, Gan, Hakka, Min, Wu and Xiang. The course aims at familiarizing the student with the basic aspects of speaking ability of Mandarin, the language of Mainland China. The course aims at training students in practical skills and nurturing them to interact with a Chinese person.

Course Contents:

Module I

Show pictures, dialogue and retell.

Getting to know each other.

Practicing chart with Initials and Finals. (CHART – The Chinese Phonetic Alphabet Called “Hanyu Pinyin” in Mandarin Chinese.)

Practicing of Tones as it is a tonal language.

Changes in 3rd tone and Neutral Tone.

Module II

Greetings

Let me Introduce

The modal particle “ne”.

Use of Please ‘qing’ – sit, have tea etc.

A brief self introduction – Ni hao ma? Zaijian!

Use of “bu” negative.

Module III

Attributives showing possession

How is your Health? Thank you

Where are you from?

A few Professions like – Engineer, Businessman, Doctor, Teacher, Worker.

Are you busy with your work?

May I know your name?

Module IV

Use of “How many” – People in your family?

Use of “zhe” and “na”.

Use of interrogative particle “shenme”, “shui”, “ma” and “nar”.

How to make interrogative sentences ending with “ma”.

Structural particle “de”.

Use of “Nin” when and where to use and with whom. Use of guixing.

Use of verb “zuo” and how to make sentences with it.

Module V

Family structure and Relations.

Use of “you” – “mei you”.

Measure words

Days and Weekdays.

Numbers.

Maps, different languages and Countries.

C – Project +Presentation

I – Interaction/Conversation Practice

Text & References:

- “Elementary Chinese Reader Part I” Lesson 1-10



Program Name: M.Sc. -INDUSTRIAL MICROBIOLOGY

SECOND SEMESTER

Course Code	Course Title	Category	Lectures(L) Hours per week	Tutorial (T) Hours per week	Practical (P) Hours per week	Total Credits
MMC 201	Immunology	CC	4	-	-	4
MMC 202	Fermentation Technology and Metabolic Pathways	CC	3	-	-	3
MMC 203	Food and Dairy Microbiology	CC	3	-	-	3
MMC 221	Immunology Lab	CC	-	-	4	2
MMC 222	Fermentation Technology and Metabolic Pathways Lab	CC	-	-	4	2
MMC 223	Food and Dairy Microbiology Lab	CC	-	-	4	2
Domain Elective-II :Choose any one from the following courses						
MMC 211	Pharmaceutical Microbiology & Herbal Technology	DE	3	-	-	3
MMC 212	Nanobiotechnology					
MMC 213	Bio- entrepreneurship					
Open Elective-I		OE				3
BCS 211	Communication Skills - II	VA	1	-	-	1
BSS 211	Behavioural Science – II [Behavioural Communication and Relationship Management]	VA	1	-	-	1
FLT 211 FLG 211 FLS 211 FLC 211	Foreign Language – II French German Spanish Chinese	VA	2	-	-	2
AND002	Aanadam-II	NTCC	2	-	-	2
	TOTAL					28

Note: -Term Paper/ Case Study topic distribution before summer vacations and will be evaluated in Third Semester.

Immunology

Course Code: MMC 201

Credit Units: 04

Course Objective:-

The aim to teach immunology and Immuno technology to make a better understanding of the immune system, types, and mechanism, immune responses, their tolerance, and suppression as well as transplantation and tumor immunology.

Module-I: -History-Structure and Function

History and scope of Immunology. Types of immunity-innate, acquired, passive and active. physiology of immune response- HI and CMI, specificity and memory. Antigen, antibody reactions. Antigens types, Hapten, immunoglobulin structure, distribution, and function.

Molecular biology of Ig synthesis, Lymphoid tissues, origin and development, differentiation of lymphocytes. Lymphocyte subpopulation of human beings. Structure and function of class I and II molecules

Module-II: -Immune Cell Receptors

Detailed structure and development of B cell (Ig) and T cell (TcR) receptors; Structure of CD4, CD8, MHC-I, MHC-II molecules, cellular adhesion molecules; Pattern Recognition Receptors (PRRs); Markers of suppressor/regulatory cells- CD4⁺CD25⁺Foxp3⁺ T_{reg}, iNKT.

Module-III:-Genetic Organization

Organization of the genes for B and T cell receptors. Genetic organization of MHC-I and MHC-II complex (both HLA and H-2). Molecular mechanisms are responsible for generating a diversity of antibodies and T cell receptors. Peptide loading and expression of MHC-I and MHC-II molecules; Hybridoma technology and monoclonal antibodies, antibody engineering.

Module-IV:-Immune responses, Autoimmunity, and hypersensitivity

Humoral and cell-mediated immune response; Innate immune response and pattern recognition; Recent advances in innate immune response especially

NK-DC interactions; Cytokines, their types and their role in immune mechanisms: TNF, IFN, IL-1, IL-2, IL-4, IL-6, IL-10, IL-12, IL-17, TGF β

Central and peripheral tolerance, and their mechanism; Mechanisms of autoimmunity; Autoimmune components of diabetes mellitus (DM), multiple sclerosis (MS) experimental autoimmune encephalitides (EAE); Infections leading to autoimmune diseases.

Comparative study of different hypersensitivities with examples.

Module-V: Immunological Disorders, Transplant & Tumor immunology

Deficiencies /defects of T cells, B cells, complement, and phagocytic cells;

Transplantation immunity- organ transplantation and HLA tissue typing,

Alloreactive response; Graft rejection and GVHD; HLA- matching; Transgenic

animals for xenotransplantation, Use of CRISPR-Cas for generating transgenic animals for xenotransplantation

Tumor antigens, immune response to tumors, and immunotherapy of tumors.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attendance	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Kuby Immunology by Kindt TJ, Goldsby RA, Osborne BA, Kuby J: 6th edition. New York. WH Freeman;2006
2. Cellular and Molecular Immunology by Abbas, Abul K; Lichtman, Andrew H; Pillai, Shiv. Eighth edition, Philadelphia, PA : Elsevier/Saunders, [2015]
3. Roitt's Essential Immunology by Delves PJ, Martin SJ, Burton DR, Roitt IM; 11th edition. Blackwell Publishing/Oxford Univ.Press;2006

Fermentation Technology and Metabolic Pathways

Course Code: MMC 202

Credit Units: 03

Course Objective:-

The objective of the course is to explain fermentation processes and their products, their industrial uses, and recent advances.

Module-I: -Fermentation and Metabolic Engineering

Historical introduction to Fermentation, Definition of Metabolism, Catabolism, Anabolism. Microbial fermentations, Classification of fermentations- Alcoholic, Mixed acid, Lactic acid etc. Regulation of primary & secondary metabolite production

Metabolic Engineering: Concepts, Metabolic pathways, control of metabolic networks, regulation of enzyme activities, regulation of enzyme concentration, tools for metabolic engineering, the extension of substrate range, the extension of the product spectrum, Enhancement of productivity, improvement of cellular properties, xenobiotic degradation, Metabolic flux analysis with examples.

Module-II:- Metabolite Production & Down Stream Processing

Media formulation at large scale & substrates for industrial fermentation. Sterilization- kinetics of thermal death of microorganisms, batch, and continuous sterilization. Inoculum development and scale-up of fermentation
Downstream processing: Biomass separation by centrifugation, filtration, flocculation, and other recent developments.

Cell disintegration: Physical, chemical, and enzymatic methods.

Extraction: Solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction. Purification by different methods.

Concentration by precipitation, ultra-filtration, reverse osmosis. Drying and crystallization.

Module-III: -Bioreactor

Design of a basic fermenter, bioreactor configuration, design features, individual parts- baffles, impellers, foam separators, sparger, culture vessel, cooling and heating devices, probes for online monitoring, computer control of fermentation process, measurement, and control of the process. Reactors

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

Module-IV: - Mass transfer reactions & Fermentation Economics

Transport phenomena in fermentation: Gas-liquid exchange and mass transfer, oxygen transfer, critical oxygen concentration, determination of $K_L a$, heat transfer, aeration/agitation, its importance. Sterilization of Bioreactors, nutrients, air supply, products and effluents, process variables and control, scale-up of bioreactors.

Viable fermentation processes, cost, and market potential of the product

Module-V: - Metabolite Production

Primary Metabolites: Production processes of Organic acids (e.g. citric acid, acetic acid); Amino acids (Glutamic, lysine, aspartic acid & Phenylalanine); and Alcohols (ethanol).

Secondary Metabolites: Penicillin and Streptomycin, Vitamin(B12) and Steroids

Enzymes: amylases, protease, lipase, cellulase. Enzymes for the food pharmaceutical industries. Production of recombinant proteins (Insulin)

Alcoholic beverages: Beer, Whisky, Wines, Rum, Brandy, Vodka etc.

Natural biopreservatives: Bacteriocin/ nisin

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attendance	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. "Principles of Fermentation Technology" by Stanbury, Whitaker and Hall, (1997) Aditya Books(P)Ltd., New Delhi
2. "Fermentation Microbiology and Biotechnology" Edited by E.M.T. El-Mansi, C.F.A. Bryce, A.L. Demain and A.R. Allman (2007), Taylor and Francis Grp., London.
3. "Bioprocess Engineering: Basic Concepts" by Michael L. Shuler and F. Kargi (2003) Prentice-Hall.
4. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox. Fifth Edition, W.H. Freeman and Company; 2008

5. Microbial Physiology by Albert G. Moat and John W. Foster. Third Edition John Wiley and Sons;2002
6. Freeman WH (2001) Biochemistry, Stryer 5th edition.
7. Biotechnology : A Text Book of Industrial Microbiology by W. Crueger and A. Crueger, Panima Publishing Corporation, New Delhi/Bangalore,2000
8. Modern Industrial Microbiology and Biotechnology by N. Okafer, Scientific Publishers, Enfield, USA.,2007
9. Industrial Microbiology: An Introducton by Waites, Morgan, Rockey and Highton, Blackwell Science, 2001.

Food and Dairy Microbiology

Course Code: MMC 203

Credit Units: 03

Course Objective:-

The course will make the students aware of the application and roles of microbes in various aspects of food science.

Module I: Introduction of Food & Dairy Microbiology

Historical development, Food as a substrate for microbes- classification of foods, chemistry of microbial food spoilage. Microbes important to food microbiology- molds, yeasts, bacteria, viruses, and protozoa. Factors affecting the growth and survival of microorganisms in foods: Intrinsic, Extrinsic.

Microflora associated with milk and milk products and their importance, Importance of somatic cell counts in milk, Sources of microbial contamination of raw milk and their relative importance in influencing the quality of milk during production, collection, transportation, and storage.

Module II: Food Spoilage

Microbiology of spoilage of specific foods – Bread, Cakes, Fresh fruits, cereals vegetables, Juices, Bottled water, Milk & milk products (cream, butter, ice-cream, evaporated & sweetened condensed milk, and dried milk), Tea & coffee, Meat & meat products (Fresh and ground meat, sausages), Poultry, Eggs, Seafood, Fish and spoilage of canned foods. Spoilage and defects of fermented dairy products. Detection of food spoilage and characterization.

Microbiological spoilage aspects of thermally processed milks; Role of psychrotrophic, thermoduric, thermophilic bacteria and their metabolites in milk spoilage, biofilms. Bacteriological grading of raw and heat-treated milk

Module III: Food Preservation

Heat (D, Z, and F values), Low-temperature storage, Freezing, Dehydration & water availability, Lyophilization, Osmotic pressure, Filtration, Irradiation, Chemical & natural preservatives, modified atmospheres, canning. Bactofugation, thermisation, and pasteurization

Module IV: Food Borne Diseases

Sources of food contamination, Foodborne intoxication, and infections: Major differences and examples of infective and toxic types, Botulism,

Staphylococcal food poisoning, *Clostridium perfringens* food poisoning, *Bacillus cereus* gastroenteritis, Salmonellosis, *Escherichia coli* diarrhea and colitis, *Vibrio cholerae*. Fungal poisonings: *Aspergillus*, *Penicillium*, *Claviceps*, *Fusarium*, mycotoxins, Protozoan poisonings: Amoebiasis (*Entamoeba histolytica*), Giardiasis (*Giardia lamblia*). Viral diseases: Enterovirus, Hepatitis A & E, Norovirus, Rotavirus. Pathogenic microbes in milk and milk products

Module V: Microbial Production of Foods and their Quality Control

Application of microbial enzymes and baker’s yeast in the food industry, Sauerkraut, Pickles, Silage, Bread, cheese, vinegar, Yogurt, acidophilus milk, bifidus milk, single-cell protein- substrates for SCP, advantages of SCP, Industrially used SCP (Quorn, Pruteen), mushroom Production, fermented meats & fish, Indian fermented foods, Soy sauce fermentation, oriental fermented foods, tea and coffee fermentations, fermented cereal products. Genetically modified foods. Dairy products as functional / health foods: LAB as probiotics in development of health foods

Module VI: Advanced Food Microbiology and Quality Assurance

Biosensors in the food industry, utilization of byproducts of the food industry, Microbiological examination of foods – sampling, culturing/analysis including newer methods such as PCR, magnetic separation, plant sanitation & hygiene, Food Safety Act and Trade Regulations, Good Manufacturing Practice (GMP) and Quality Systems, Government regulations- BIS, FPS, FDA, EPA, HACCP, ISO, FSSAI and assessment formats.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attendance	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Food Microbiology. 2nd Edition by Adams, M.R. and Moss, Maurice O. Published by Royal Society of Chemistry (2000)
2. Basic Food Microbiology by Banwart George J. 2nd Edition, Published by Van Nostrand Reinhold (1989)
3. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2 by Dr. V. K. Joshi, Ashok Pandey, Educational Publishers & Distributors, 1999.

4. Essentials of Food Microbiology by John Garbutt; Publisher: CRC Press; 2 editions (1997) Arnold International.
5. Microbiology of Fermented Foods. Volume I and II.,2nd Edition,by B.J. Wood, Brian J.B. Wood, Published 1997 by Elsevier Applied Science Publication.
6. Dairy Microbiology by Robinson. Volume I and II.Wiley-Blackwell; 3rd Edition (2002)
7. Food Microbiology by Bibek Ray.CRC Press; 4 edition (2007)

Immunology Lab.

Course Code: MMC 221

Credit Units: 02

Course objectives

The course aims to give hands-on training to students for enhancing their practical skills of the subject domain.

Course Content

A minimum of 10 laboratory exercises will be conducted based on theory papers MMC 201

Fermentation Technology and Metabolic Pathway Lab.

Course Code: MMC 222

Credit Units: 02

Course objectives

The course aims to give hands-on training to students for enhancing their practical skills of the subject domain.

Course Content

A minimum of 10 laboratory exercises will be conducted based on theory papers MMC202

Food and Dairy Microbiology Lab.

Course Code: MMC 223

Credit Units: 02

Course objectives

The course aims to give hands-on training to students for enhancing their practical skills of the subject domain.

Course Content

A minimum of 10 laboratory exercises will be conducted based on theory papers MMC 203

Pharmaceutical Microbiology and Herbal Technology

Course Code: MMC 211

Credit Units: 03

Course Objective:

The main objectives are to cover representative pharmaceutical dosage forms and general issues of formulation, production, quality requirements, validation, and uses and to gain an understanding of the challenges associated with quality pharmaceutical manufacturing

Module -I: Introduction to Physical Pharmaceutics – Metrology, Calculations, and Posology.

Particulate Technology: Particle Size, Size reduction, Size Separation, Powder Flow, and Compaction.

Unit Operations: Mixing, Evaporation, Filtration, Centrifugation, Extraction, Distillation, Sterilization, and Drying

Regulatory Practices, Quality assurance, and Validation

Introduction about IP, BP & USP. Drug & Cosmetic Act & Rules, Government regulatory practices and policies, FDA perspective. Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry. Regulatory aspects of quality control. Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification.

Module-II: Pharmaceutical Dosage Forms & Drug Delivery Systems

Introduction to different dosage forms, their classification with examples (Official formulation), their relative application. Various route of drug administration.

Drug Discovery and Development

Introduction of drug discovery and development process, Stages of new drug discovery & developments, Pre-Clinical research, Clinical research, Pharmacovigilance, Pharmacokinetic, Pharmacodynamic and Toxicological considerations in drug development.

Module-III: - Herbal Technology-I

Herbal based Industry: Scope, study of infrastructure, staff requirement, project profiles, plant and equipment, processing, research and development, regulatory requirement. Pilot plant scale up techniques

Principles of Ayurvedic systems of medicine. Introduction to different dosage forms, Preparation and evaluation methods of Ayurvedic medicines i.e. Asavas

and Aristas, Arkas, Avalehas, Churnas, Ghritas and Tailas, Guggulu preparations, Ksara, Lauha kalpas, Lepas, Vatika and Bhasmas.

Standardization of polyherbal formulations: syrups, powders, ointments and other semisolid preparations, tablets and capsules.

Module-IV: - Herbal Technology-II

Extraction, isolation, purification estimation and uses of following phytoconstituents:

Alkaloids: Caffeine, Atropine, Berberine, Piperine

Glycosides: Sennosides, Digoxin

Flavonoids: Rutin, Hesperidin

Terpenoids: Taxol, Andrographolide

Saponins: Diosgenin, Glycyrrhizin

Pharmaceutical Aids: Study of Pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatin, and natural colors.

Neutraceuticals: Introduction, probiotics & Prebiotics, Study of some plant constituents and their products in the international market, study of lycopene, proanthocyanidin and grape products, ornithine, flaxseed and flax oil, melatonin, and ornithine.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attendance	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Mukherjee Pulok, Quality Control of Herbal Drugs, Business Horizons Limited, New Delhi.
2. Advances in Natural Product Chemistry, extraction and isolation of biologically active compounds. S. Natori et al., Wiley, New York.
3. Kalia AN, Textbook of Industrial Pharmacognosy, CBS publishers and Distributors.
4. Pharmacognosy by C.K. Kokate, A.P. Purohit and S.B. Gokhale, Nirali Prakashan, 2007
5. The Aurvedic Pharmacopoeia of India, 1999. Government of India, Ministry of Health and Family Welfare, Department of Indian Systems of Medicine and Homeopathy, New Delhi.

6. Textbook of Physical Pharmaceutics by C.V.S. Subrahmanyam, Vallabh Prakashan.
7. Text book of Pharmaceutical Engineering by C.V.S. Subrahmanyam, Vallabh Prakashan.
8. Pharmaceutical Dosage forms and Drug Delivery Systems, H.C. Ansel , L.V. Allen, N.G. Popovich, Lippincott Williams and Wilkins Publishers.
9. Drug Discovery and Clinical Research, by S.K Gupta, Published by JAYPEE Brothers Medical Publishers (P) Ltd
10. New Drug Development: Design, Methodology, and Analysis, by J. Rick Turner, Published by John Wiley & Sons, 2007.

Nanobiotechnology

Course Code: MMC 212

Credit Units: 03

Course Objective:-

This paper aims to explain nanomaterials and their application in various industries including Agricultural, Pharmaceutical, etc.

Module I: - Nanomaterials

Bio-mineralized Inorganic Nanomaterial – Nanostructure and Dynamics of Biocompatible Surfactant monolayer's and bilayers -Bioconjugation, Biometrix based on bioinspired phospholipids polymers.

Module II: - Applications

Self-assembly of ionic – complementary peptides and their applications in Nanobiotechnology – from nanocluster assays to optical biochips, bioactive nanomaterials in bone grafting, and tissue engineering inorganic /polymers nanocomposites for dental restoration and bone replacement applications.

Module III: - Nanostructures

DNA-based artificial nanostructures; fabrication, properties, and application – Nucleic acid engineered nanomaterials and their applications. Protein patterning for applications in biomaterials and biodevices.

Module IV: - Polymers

Polymers nanofibers and their applications in bioengineering - Functional polymers for bone tissue engineering applications

Module V: - Applications in Pharmaceuticals

Vesicles and liposomes in sensor technology- self-assembling nanostructure injectable polymeric gels for drug delivery – Engineering surface erodible polyanhydrides with tailored microstructure for controlled drug and protein delivery.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attendance	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Challa S.S.R. Kumar (Ed.).2006. Biological and Pharmaceutical nonmaterial's Wiley- VCH Verlag Gmbh and Co., KgaA.

2. K.K. Jain 2006 Nanobiotechnology in Molecular Diagnostics: Current Techniques and Applications Horizon Biosciences.
3. Niemeyer, C.M. Mirking C.A., (Eds.) 2004. Nono biotechnology concepts.

Bio-entrepreneurship

Course Code: MMC 213

Credit Units: 03

Course Objective: -

The objective of this course is enabling the scholars about the various concepts of entrepreneurship. Also expose scholars to regulatory agencies and startup opportunities.

Module-I: - Introduction

Entrepreneurship: Concept – Evolution – Theories, Role in Economic Development, and entrepreneurial traits.

Module-II: - Market Research

Market Study – Questionnaire Design / Survey, potential Consumers & Competitors, Market Strategy Development.

Module-III: - IPR & Regulatory Agencies

Introduction to IPR, Trademarks, Copywrites, Trade Secrets. Protection of IPR. Technology Transfer & Commercialization, Licensing Deal, Relevant National & International Agencies.

Module-IV: - Resource Management

Government & Non-Government schemes, fund raising, Bank Loans & Asset Values, Strategic Partners & Angel Investors. Business Incubation Centers.

Module-V: - Project Management & Start up Methodology

Procedure and Legal Formalities for startup, Project drafting, Bio – business modeling, new venture creation, pitching, Recruitment of relevant expertise.

E – Learning Links:

http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000023MA/P001403/M016027/ET/1465203437Module-7Entre.pdf

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attendance	EE
Weightage (%)	15	10	10	10	5	50

Text and Reference Books: -

- 1 Drucker, P. Innovation and Entrepreneurship. 2Rev Ed edition. ButterworthHeinemann, 2010.
- 2 Hopkins, Bruce. A Legal Guide to Starting and Managing a Nonprofit Organization. 3rd edition. Wiley, 2000.
- 3 Jensen, Bill. Simplicity: The New Competitive Advantage in a World of More, Better, Faster. Perseus, 2001.
4. P. Saravanelu, "Entrepreneurship Development", Eskapee Publications.
- 5 N.P. Srinivasan & G.P.Gupta, "Entrepreneurship Development", Sul tanchand & Sons.
- 6 Barringer M.J. "Entrepreneurship", Prentice-Hall, 1999
- 7 Robert D. Hisrich, Michael P. Peters, "Entrepreneurship Development", Tata McGraw Hill
8. Vasanth Desai, "Dynamics of Entrepreneurial Development and Management", Himalayas Publishing House

COMMUNICATION SKILLS - II

Course Code: BCS 211

Credit Units: 01

Course Objective:

To enrich the understanding of English language and communication, structure, style, usage, and vocabulary for global business purposes.

Course Contents:

Module I: Fundamentals of Communication

Role and purpose of communication: *7 C's of communication*

Barriers to effective communication

Enhancing listening

Forms of Communication: one-to-one, informal and formal

Module II: Verbal Communication (Written)

Business Letter

Social correspondence

Writing resume and Job applications

Module III: Speaking skills

Conversational English

Guidelines to give an effective presentation

Activities to include:

Presentations by students

Just a minute

Examination Scheme:

Components	CT1	CT2	CAF	V	GD	GP	A
Weightage (%)	20	20	25	10	10	10	5

CAF – Communication Assessment File

GD – Group Discussion

GP – Group Presentation

Text & References:

- Business Communication, Raman – Prakash, Oxford
- Textbook of Business Communication, Ramaswami S, Macmillan
- Speaking Personally, Porter-Ladousse, Cambridge

BEHAVIOURAL SCIENCE - II
(BEHAVIOURAL COMMUNICATION AND RELATIONSHIP MANAGEMENT)

Course Code: BSS 211

redit Units: 01

Course Objective:

This course aims at imparting an understanding of:
Process of Behavioural communication
Aspects of interpersonal communication and relationship
Management of individual differences as important dimension of IPR

Course Contents:

Module I: Behavioural Communication

Scope of Behavioural Communication
Process – Personal, Impersonal and Interpersonal Communication
Guidelines for developing Human Communication skills
Relevance of Behavioural Communication in relationship management

Module II: Managing Individual Differences in Relationships

Principles
Types of issues
Approaches
Understanding and importance of self disclosure
Guidelines for effective communication during conflicts

Module III: Communication Climate: Foundation of Interpersonal Relationships

Elements of satisfying relationships
Conforming and Disconfirming Communication
Culturally Relevant Communication
Guideline for Creating and Sustaining Healthy Climate

Module IV: Interpersonal Communication

Imperatives for Interpersonal Communication
Models – Linear, Interaction and Transaction
Patterns – Complementary, Symmetrical and Parallel
Types – Self and Other Oriented
Steps to improve Interpersonal Communication

Module V: Interpersonal Relationship Development

Relationship circle – Peer/ Colleague, Superior and Subordinate
Initiating and establishing IPR
Escalating, maintaining and terminating IPR
Direct and indirect strategies of terminating relationship
Model of ending relationship

Module VI: End-of-Semester Appraisal

Viva based on personal journal
Assessment of Behavioural change as a result of training
Exit Level Rating by Self and Observer

Text & References:

- Vangelist L. Anita, Mark N. Knapp, Inter Personal Communication and Human Relationships: Third Edition, Allyn and Bacon
- Julia T. Wood. Interpersonal Communication everyday encounter
- Simons, Christine, Naylor, Belinda: Effective Communication for Managers, 1997 1st Edition Cassell
- Harvard Business School, Effective Communication: United States of America
- Beebe, Beebe and Redmond; Interpersonal Communication, 1996; Allyn and Bacon Publishers.

FRENCH - II

Course Code: FLT 211

Credit Units: 02

Course Objective:

- To enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French.
- To make them learn the basic rules of French Grammar.

Course Contents:

Module A: pp.38 – 47: Unité 3: Objectif 3, 4, 5, 6

Module B: pp. 47 to 75 Unité 4, 5

Contenu lexical: Unité 3: Organiser son temps

1. donner/demander des informations sur un emploi du temps, un horaire SNCF – Imaginer un dialogue
2. rédiger un message/ une lettre pour ...
 - i) prendre un rendez-vous/ accepter et confirmer/ annuler
 - ii) inviter/accepter/refuser
3. Faire un programme d'activités
imaginer une conversation téléphonique/un dialogue
Propositions- interroger, répondre

Unité 4:Découvrir son environnement

1. situer un lieu
2. s'orienter, s'informer sur un itinéraire.
3. Chercher, décrire un logement
4. connaître les rythmes de la vie

Unité 5: s'informer

1. demander/donner des informations sur un emploi du temps passé.
2. donner une explication, exprimer le doute ou la certitude.
3. découvrir les relations entre les mots
4. savoir s'informer

Contenu grammatical:

1. Adjectifs démonstratifs
2. Adjectifs possessifs/exprimer la possession à l'aide de :
 - i. « de »
 - ii. A+nom/pronom disjoint
3. Conjugaison pronominale – négative, interrogative - construction à l'infinitif
4. Impératif/exprimer l'obligation/l'interdiction à l'aide de « il faut... »/ «il ne faut pas... »
5. passé composé
6. Questions directes/indirectes

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project +Presentation

I – Interaction/Conversation Practice

Text & References:

- le livre à suivre : Campus: Tome 1

GERMAN – II

Course Code: FLG 211

Credit Units: 02

Course Objective:

To enable the students to converse, read and write in the language with the help of the basic rules of grammar, which will later help them to strengthen their language.

To give the students an insight into the culture, geography, political situation and economic opportunities available in Germany

Introduction to Grammar to consolidate the language base learnt in Semester I

Course Contents:

Module I: Everything about Time and Time periods

Time and times of the day.

Weekdays, months, seasons.

Adverbs of time and time related prepositions

Module II: Irregular verbs

Introduction to irregular verbs like to be, and others, to learn the conjugations of the same, (fahren, essen, lessen, schlafen, sprechen und ähnliche).

Module III: Separable verbs

To comprehend the change in meaning that the verbs undergo when used as such

Treatment of such verbs with separable prefixes

Module IV: Reading and comprehension

Reading and deciphering railway schedules/school time table

Usage of separable verbs in the above context

Module V: Accusative case

Accusative case with the relevant articles

Introduction to 2 different kinds of sentences – Nominative and Accusative

Module VI: Accusative personal pronouns

Nominative and accusative in comparison

Emphasizing on the universal applicability of the pronouns to both persons and objects

Module VII: Accusative prepositions

Accusative prepositions with their use

Both theoretical and figurative use

Module VIII: Dialogues

Dialogue reading: 'In the market place'

'At the Hotel'

Examination Scheme:

Components	CT1	CT2	C	I	V	A
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Weightage (%)	20	20	20	20	15	5
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C – Project +Presentation

I – Interaction/Conversation Practice

Text & References:

- Wolfgang Hieber, Lernziel Deutsch
- Hans-Heinrich Wangler, Sprachkurs Deutsch
- Schulz Griesbach, Deutsche Sprachlehre für Ausländer
- P.L Aneja, Deutsch Interessant- 1, 2 & 3
- Rosa-Maria Dallapiazza et al, Tangram Aktuell A1/1,2
- Braun, Nieder, Schmöe, Deutsch als Fremdsprache 1A, Grundkurs

SPANISH – II

Course Code: FLS 211

Credit Units: 02

Course Objective:

To enable students acquire more vocabulary, grammar, Verbal Phrases to understand simple texts and start describing any person or object in Simple Present Tense.

Course Contents:

Module I

Revision of earlier modules.

Module II

Some more AR/ER/IR verbs. Introduction to root changing and irregular AR/ER/IR ending verbs

Module III

More verbal phrases (eg, Dios Mio, Que lastima etc), adverbs (*bueno/malo, muy, mucho, bastante, poco*).

Simple texts based on grammar and vocabulary done in earlier modules.

Module IV

Possessive pronouns

Module V

Writing/speaking essays like my friend, my house, my school/institution, myself....descriptions of people, objects etc, computer/internet related vocabulary

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project + resenatation

I – Interaction/Conversation Practice

Text & References:

- Español, En Directo I A
- Español Sin Fronteras

CHINESE – II

Course Code: FLC 211

Credit Units: 02

Course Objective:

Chinese is a tonal language where each syllable in isolation has its definite tone (flat, falling, rising and rising/falling), and same syllables with different tones mean different things. When you say, “ma” with a third tone, it means horse and “ma” with the first tone is Mother. The course aims at familiarizing the student with the basic aspects of speaking ability of Mandarin, the language of Mainland China. The course aims at training students in practical skills and nurturing them to interact with a Chinese person.

Course Contents:

Module I

Drills

Practice reading aloud

Observe Picture and answer the question.

Tone practice.

Practice using the language both by speaking and by taking notes.

Introduction of basic sentence patterns.

Measure words.

Glad to meet you.

Module II

Where do you live?

Learning different colors.

Tones of “bu”

Buying things and how much it costs?

Dialogue on change of Money.

More sentence patterns on Days and Weekdays.

How to tell time. Saying the units of time in Chinese. Learning to say useful phrases like – 8:00, 11:25, 10:30 P.M. everyday, afternoon, evening, night, morning 3:58, one hour, to begin, to end etc.

Morning, Afternoon, Evening, Night.

Module III

Use of words of location like-li, wai, hang, xia

Furniture – table, chair, bed, bookshelf,.. etc.

Description of room, house or hostel room.. eg what is placed where and how many things are there in it?

Review Lessons – Preview Lessons.

Expression ‘yao’, ‘xiang’ and ‘yaoshi’ (if).

Days of week, months in a year etc.

I am learning Chinese. Is Chinese difficult?

Module IV

Counting from 1-1000

Use of “chang-chang”.

Making an Inquiry – What time is it now? Where is the Post Office?

Days of the week. Months in a year.

Use of Preposition – “zai”, “gen”.

Use of interrogative pronoun – “duoshao” and “ji”.

“Whose”??? Sweater etc is it?

Different Games and going out for exercise in the morning.

Module V

The verb “qu”

Going to the library issuing a book from the library

Going to the cinema hall, buying tickets

Going to the post office, buying stamps

Going to the market to buy things.. etc

Going to the buy clothes Etc.

Hobby. I also like swimming.

Comprehension and answer questions based on it.

Examination Scheme:

Components	CT1	CT2	C	I	V	A
Weightage (%)	20	20	20	20	15	5

C – Project +Presentation

I – Interaction/Conversation Practice

Text & References:

- “Elementary Chinese Reader Part I” Lesson 11-20



Program Name: M.Sc. -INDUSTRIAL MICROBIOLOGY

THIRD SEMESTER

Course Code	Course Title	Category	Lectures(L) Hours per week	Tutorial (T) Hours per week	Practical (P) Hours per week	Total Credits
MMC 301	RDT & Genomics	CC	3	1	-	4
MMC 302	Environment & Agricultural Microbiology	CC	3	-	-	3
MMC 303	Clinical Microbiology	CC	3	1	-	4
MMC 321	RDT & Genomics Lab	CC	-	-	4	2
MMC 322	Environment & Agricultural Microbiology Lab	CC	-	-	4	2
MMC 323	Clinical Microbiology Lab	CC	-	-	4	2
Domain Elective-III: Choose any one from the following courses						
MMC 311	Instrumentation & Techniques in Microbiology	DE	3	-	-	3
MMC 312	Marine Microbiology					
MMC 313	Cellular Microbiology					
Open Elective- II		OE				3
MMC 330	Term Paper	NTCC	-	-	-	3
BCS 311	Communication Skills – III	VA	-	-	-	1
BSS 311	Behavioural Science – III [Leading Through Teams]	VA	-	-	-	1
FLT 311 FLG 311 FLS 311 FLC 311	Foreign Language – III French German Spanish Chinese	VA	-	-	-	2
AND 003	Aanandam III	NTCC	2	-	-	2
	TOTAL					32

RDT & Genomics

Course Code: MMC 301

Credit Units: 04

Course Objective:-

The objective of this course is to explain molecular techniques and their applications in the cloning and expression of genes.

Module I: - Basics of Recombinant DNA Technology

Restriction enzymes- types, properties, DNA modifying enzymes - klenow enzymes, T4 DNA polymerase, DNA ligase, SI nuclease, bacterial alkaline phosphates, polynucleotide kinase., ligation- cohesive and blunt end, linkers, adaptors, homopolymer tailing, Labelling of DNA- nick translation, random priming, non-radioactive probes, Hybridization- Southern, Northern and Colony hybridization

Module II: - PCR and its applications

The basic concept of PCR, Primer design, Gradient PCR, touchdown PCR, Hot Start PCR, Real-time PCR- syber green assay, Taqman assay, Reverse transcriptase PCR, quantitative Reverse transcriptase PCR, Long PCR, inverse PCR, nested PCR, multiplex PCR, 3' & 5' RACE, overlap PCR, *in situ* PCR, droplet PCR (3rd generation PCR), Ligation PCR, overlap PCR, site-specific mutagenesis

Module III: - Cloning & Expression- Vectors & Methodologies

Cloning using different kinds of vectors- plasmids, phages, cosmids, Artificial chromosome vectors, TOPO and TA vector, Ti and Ri vectors, Expression vectors, use of His-tag, GST-tag, MBP-tag in protein expression, codon optimization, selection and screening of cloning vectors, reporter genes, Foreign DNA insertion to host- transformation, transfection, liposomes, electroporation, micro-injection, hosts for overexpression, c-DNA and genomic DNA libraries

Module IV: - Genomics, Transcriptomics & Proteomics

Sequencing methods- enzymatic sequencing, chemical sequencing, pyrosequencing whole-genome shotgun sequencing, next-generation sequencing, In-vitro transcription & translation, Promoter characterization, Genetic and physical maps, restriction mapping, molecular markers of genome analysis- RFLP, RAPD, AFLP, analysis of protein-DNA interactions, Chromosome walking, Gene Silencing, Details and applications of antisense technology and ribozyme in genetic engineering

Module V: - Genomics, Transcriptomics & Proteomics

Gene expression analysis- DNA microarrays, EST analysis, Serial analysis of gene expression, PAGE, 2D electrophoresis, isolation and sequence analysis of individual proteins, protein microarray, Enzymatic and bioluminescent reporters. Reporters used in protein localization and trafficking studies

Module VI: - Bioinformatics

Computational methods- biological databases, homology search (BLAST, FASTA search, pairwise & multiple alignments) for proteins and nucleic acids, identification of ORFs (ORF finder), Protein structure and function analysis, DNA analysis for repeats, phylogenetic analysis- concepts and tree construction

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attendance	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Clarke, D. P., Pazdernik, N. J. 2013. Molecular Biology.2nd edition; Elsevier Academic Press.
2. Sambrook, J., Russell, D. 2001. Molecular Cloning: A laboratory manual. Volume 1, 2 & 3. 3rd edition. Cold Spring Harbor Laboratory Press.
3. Watson, J. D. 2007. Recombinant DNA. W.H. Freeman and Company.
4. Brown, T. A. 2002. Genome. 2nd Edition. BIOS Scientific Publishers Ltd.
5. Brown, T. A. 2010. Gene Cloning and DNA Analysis. 6th Edition. John Wiley & Sons Ltd..

6. Primrose, S. B., Twyman, R. M., Old, R. W. 2001. Principles of gene manipulation. 6th Edition. Blackwell Science Ltd.

Environmental & Agricultural Microbiology

Course Code: MMC 302

Credit Units: 03

Course Objective: -

The course focuses on the role of microbes in maintaining the critical agricultural functions environment and their use in enhancing the quality of agriculture practices and reducing the environmental pollution.

Module-I: - Soil-Aquatic-Air Microbiology

Types of Soil, Soil Profile- Physico-Chemical properties, Suitability of soil for agriculture, Soil Enzymes, Inter-relationship of soil and microbes, microbial interactions in soil and mineralization, Rhizosphere and Rhizoplane microflora. Soil pollution

Aquatic microbiology: drinking water microbiology and quality control, biofilms and water-borne diseases, water pollution

Aerobiology: Outdoor-indoor microflora, aerosol-aeroallergens, air pollution & air quality assessment

Module-II:- Beneficial Microbes, Ecosystem & Microbial Diversity

Importance of soil microorganisms, Plant growth-promoting Rhizobacteria (PGPR), Nitrogen Fixing Microbes and mechanisms, Phosphate mobilizing microbes, and Mycorrhizal fungi. Overview and applications of Biofertilizers & Biopesticides: Bacteria, fungi, and viruses. Ligno-cellulolytic microorganisms- bio-pulping, bio-bleaching, textiles, biofuels, animal feed production. Bio-mining- Bio-leaching of copper, gold, and uranium. Bioremediation of environmental pollutants: Petroleum hydrocarbons and pesticides

Biotic and abiotic components and their interaction, Bio-energetics, Food webs, Ecological successions, and important mineral cycles (C, N, P, S, Fe).

Microbial diversity: Culture-dependent approaches and their limitations, Culture-independent methods, Metagenomic approaches. Analysis of diversity by DNA hybridization, ARDRA, FAME profiles, BIOLOG microtitre plates, G+C analysis, slot-blot hybridization, and FISH.

Module- III Pathogenesis in plants & Defense Response

Plant diseases – Epidemiology and plant disease forecasting, Principles of plant pathology: entry and establishment of pathogens, host-parasite

interaction, the role of toxins and enzymes. Disease resistance in plants– protection and defense, mechanisms of resistance (performed and induced defense, local signals, programmed cell death, induced structural barriers, phytoalexins, Systemic Acquired Resistance (SAR), and Local Acquired Resistance (LAR). Pathogenesis Related Proteins (PR proteins)- chitinases and glucanases. Transgenic Resistance: Gene-to-gene resistance (horizontal and vertical), plant resistance genes. Transformation for disease resistance, Resistance to viruses, fungi, bacteria and insects, Mycoviruses.

Module- IV:- Plant Diseases & Genetic Engineering

Bacterial (bacterial blight of paddy, angular leaf spot of cotton, common scab of potato, citrus canker), fungal (early & late blight of potato, downy mildew of grapes, Loose smut of wheat, smut of bajra, covered smut of barley, blast disease of rice, red rot of sugarcane, Tikka of Groundnut), viral (tobacco mosaic, leaf curl of tomato, yellow vein mosaic of bhindi), viroid diseases of crop plants and their symptoms.

Post-harvest diseases – grains, mode of infection and factors influencing post-harvest diseases, strategies for postharvest disease control (fungicides, irradiation, fumigation and VHT - Vapour Heat treatment etc.).

Genetic Engineering: methods of plant cell transformation, vectors, transgenic plants, molecular farming, Genetic engineering for insect, pest resistance and herbicide resistance, Impact of GMO’s and issues related to environmental safety.

Module-V:- Waste Management

Wastes types, solid & liquid wastes characterization, solid & liquid waste treatments – physical, chemical, biological (aerobic – anaerobic – primary – secondary – tertiary). Solid waste treatment – saccharification – gasification – composting, Utilization of solid wastes – food (SCP, mushroom, yeast): fuel (ethanol, methane, hydrogen), fertilizer (composting), liquid waste treatment – trickling, activated sludge, oxidation pond – oxidation ditch. Bioremediation of hydrocarbons, pesticides, air pollutants and natural products.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attendance	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Agricultural Microbiology Biotechnological approaches in soil microorganisms for sustainable crop production by Dadarwal 1997
2. Agricultural Microbiology by N.S. SubbaRao
3. Microbial Ecology By Atlas R.M. , Bartha R., Benjamin Cummings Publishing Co, Redwood City,CA.,1993
4. Environmental Microbiology by A.H. Varnam and M.G. Evans, Manson Publishing Ltd., 2000.
5. Lignocellulose Biotechnology: Future Prospects by R.C. Kuhad and A. Singh ,I.K. International,2007
6. Advances in Applied Bioremediation by A. Singh, R.C. Kuhad and O.P. Ward, Springer,2009
7. Burns R.G., and Slater J.H. (1982) Experimental Microbial Ecology- Blackwell Scientific Publications, Oxford, London.

Clinical Microbiology

Course Code: MMC 303

Credit Units: 04

Course Objective:-

The course aims to make the students familiar with diagnostic and public health microbiology, modern techniques for the identification of pathogens in diagnostic laboratories, and antimicrobial chemotherapy inpatient care.

Module-I: - Introduction to Medical Microbiology

Koch postulates, sources of infection for man- exogenous infections, - patient, carrier (healthy, convalescent, contact, paradoxical and chronic), infected animals, soil, and endogenous infections. Mode of spread of infections- Respiratory, skin, wound & burn, venereal, alimentary tract, arthropod borne, blood infection, laboratory infection, nosocomial infections, infections in immune-compromised patients etc., systemic infections, Normal microflora of human body and its significance, Gnotobiotic animals and their use, bio-films. Global warming: effect on the increase in the incidence of vector-borne and water-borne infectious diseases, Vaccines- types

Module III:- Diagnostic Microbiology & Antimicrobial Studies

Staining approaches, cultural methods, biochemical characterization, nucleic acid detection, automated instruments for detection/diagnosis of infectious agents (BACTAC and Vitek-2, GeneExpert). Immunological approaches: precipitation, agglutination, ELISA, immunodiffusion. Automated instruments for detection / diagnosis of infectious agents (BACTAC and Vitek-2, GeneExpert).

Concept of point-of-care diagnosis (PoCD): lateral-flow assays, bedside nucleic acid detection

Antibiotics, susceptibility testing, mechanism of drug resistance, and its spread

Module-III: - Host-pathogen interactions & Epidemiology

Host susceptibility, predisposing factor, Host-pathogen interaction- Receptors for pathogens, Infection establishment, spreading, tissue damage and anti-phagocytic factors; mechanism of bacterial adhesion, colonization, and invasion of mucous membranes of respiratory, enteric and urogenital tracts, virulence, virulence factors, pathogenicity islands, toxins, intracellular life,

organotropisms. Type three secretion system (TTSS, T3SS), Biofilm formation and its role in pathogenesis, quorum sensing mechanism and its role in microbial Pathogenicity

Molecular microbial epidemiology: Objectives of microbial epidemiology. Biochemical and Immunological tools - biotyping, serotyping, phage typing, multilocus enzyme electrophoresis (MLEE); Molecular typing: RAPD, IS-based typing, PFGE, AFLP, MLST, VNTR and whole-genome sequence; geographical information system (GIS) for microbial epidemiology.

Module-III: - Bacterial and Viral Infections

Bacterial Pathogens: Mode & Mechanism of Infection, diagnosis, treatment & Prevention- *Staphylococcus*, *Streptococcus*, *Pneumococcus*, *Neisseria*, *Campylobacter*, *Clostridium*, *Shigella*, *Vibrio*, *Yersinia*, *Listeria*, *Haemophilus*, *Bordetella*, *Brucella*, *Mycobacteria*, *Spirochaetes*, *Rickettsiae*, *Chlamdiae*

Viral Pathogens: Mode & Mechanism of Infection, diagnosis, treatment & Prevention- Orthopox viruses, Influenza virus, rhinovirus, dengue, Chikungunya, adenovirus, rabies, Hepatitis viruses, Norovirus, Rotavirus, Herpes virus, HIV, oncogenic viruses

Module-IV: - Fungal, Protozoan & Helminthes Infections

Fungal infection- Pathogenesis, diagnosis, treatment and prevention- Aspergillosis, Blastomycosis, Candidiasis, *Coccidioides immitis*, Cryptococcosis, Histoplasmosis, Tinea pedis.

Protozoan's and Helminthes infections- Amebiasis, Ascariasis Fascioliasis, Fasciolopsiasis, Kala azar (Black fever), Malaria, Taeniasis & cysticercosis.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attendance	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Boyd, R.F. 1987. General Microbiology. 2nd Edition. Times Mirror/Mosby College publishing, St. Louis).
2. Ananthanarayan, R., Panicker, C. K. J. 2005. Text Book of Microbiology. 7th Edition. Orient Longman Private Limited.

3. Collee, J. G. 1997. Practical Medical Microbiology. 14th Edition. Churchill Livingstone.
4. Baron E. J., Peterson, L. R., Finegold, S.M. 1994. Bailey and Scott's Diagnostic Microbiology.
5. Mackie & McCartney Practical Medical Microbiology (1996). Collee, J.G., Fraser,
6. A.G., Marmion, B.P. and Simmons, A (eds.), Churchill Livingstone,Edinburgh.
7. Baron, E.J., Peterson, L.R., and Finegold, S.M.(1990). Bailey and Scott's Diagnostic Microbiology.

RDT & Genomics Lab.

Course Code: MMC 321

Credit Units: 02

Course objectives

The course aims to give hands-on training to students for enhancing their practical skills of the subject domain.

Course Content

A minimum of 10 laboratory exercises will be conducted based on theory papers MMC 301

Environment & Agricultural Microbiology Lab.

Course Code: MMC 322

Credit Units: 02

Course objectives

The course aims to give hands-on training to students for enhancing their practical skills in the subject domain.

Course Content

A minimum of 10 laboratory exercises will be conducted based on theory papers MMC 302

Clinical Microbiology Lab.

Course Code: MMC 323

Credit Units: 02

Course objectives

The course aims to give hands-on training to students for enhancing their practical skills of the subject domain.

Course Content

A minimum of 10 laboratory exercises will be conducted based on theory papers MMC303

Instrumentation & Techniques in Microbiology

Course Code: MMC 311

Credit Units: 03

Course Objective:-

The course aims to make the students familiar with instruments & techniques and their applications in frontier areas of Microbiology

Module I: - Basic Laboratory Instruments & Centrifugation

Principle & Theory of pH meter, Laminar air flow, Bio-safety cabinets, and chemical hoods. Principle of centrifugation, Preparatory & analytical centrifuge, differential centrifugation, density gradient centrifugation, and analytical ultra-centrifugation.

Module II: - Chromatography

Chromatography- Principle, Theory & Applications, Paper Chromatography, TLC, GLC and HPLC, Ion Exchange, Affinity Chromatography and GPC

Module III: - Spectroscopy

Theory and Principle of Spectroscopy, Applications of UV, Visible, IR, NMR, ESR, Fluorescence, Atomic Absorption, Mass Spectroscopy, MALDI-TOF

Module IV: -Microscopic Techniques

Theory, Principle and Applications- Bright Field Microscopy, Dark Field Microscopy, Inverted Microscope, Phase Contrast Microscope, Fluorescent Microscope, Confocal Microscope, Electron Microscope- SEM, TEM & STEM, Atomic Force Microscope, Micrometry, Microphotography, FISH

Module V: - Electrophoresis

Basic Principle of Electrophoresis, Applications of Agarose Gel Electrophoresis, Native and Denaturing PAGE, Iso-electric Focusing, Capillary Electrophoresis, 2DE, Immuno-Electrophoresis. Blotting Techniques -Southern, Northern, and Western blotting.

Module VI: - Cell Biology Tools

Primary & Secondary Cell Lines, Monolayer & Suspension cultures, Fluorescence-Activated Cell Sorting (FACS), Different methods of cell lysis/ breakage and isolation and purification of various cell organelles - Cell Surface Structures, Cell Envelopes, Plasma Membranes, Peptidoglycan, Outer membrane, Ribosomes, Protoplasts, Vesicles, Spheroplast, DNA, RNA

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attendance	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Williams, B. L., Wilson, K. 1982. A Biologists Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold, London.
2. Wilson, K., Walkar, J. 2008. Principles and Techniques of Biochemistry and Molecular Biology. 6th Edition. Cambridge Uni. Press, N. Delhi.
3. Upadhyay, A., Upadhyay, K. Nath, N. 2010. Biophysical Chemistry (Principles and Techniques) by Himalya Publishing House Pvt. Ltd., Mumbai.
4. Ghatak, K. L. 2011. Techniques and Methods. PHI Learning Pvt. Ltd., N. Delhi.

Marine Microbiology

Course Code: MMC 312

Credit Units: 03

Course Objective:-

The aim of this course is to aware students about the world's oceans & seas and its microflora. It will also explain the role of microbes in ocean processes.

Module I: - Marine Environment

World's oceans & Seas, Physico – Chemical properties of marine water, marine microbial habitat: water column, sediments, coastal ecosystems, mangroves salt marshes. Bio-films & Microbial mats. Microbial life at the surface of living & non-living systems and microbial interactions. Quorum sensing in marine microbes and significance. Metabolic diversity and importance of microbial communities, Photo trophy & primary productivity.

Module II: - Methods in Marine Microbiology

Sampling methods of the different habitats of oceans and screening by CLSM & FCM. Importance of Culturable & non Culturable microorganisms. Molecular tools to study marine diversity. Limitations of analysis of nucleic acid directly from the marine environment.

Module III: - Role of Microbes in ocean processes

Bio-Energetics, Carbon & Nitrogen cycling in ocean, Photosynthesis and Primary productivity. Eutrophication of coastal areas. Microbial loop in the ocean food web. Microbial processes and climate change. Bio-fouling & biodeterioration, indicator organisms and pollution control.

Symbiosis of microalgae with animals: Chemoautotrophic prokaryotes with animals. Symbionts of sponges, mixotrophy in protists. Metabolic consortia and mutualism between prokaryotes.

Module IV: - Marine Microbes

Bacterial and viral disease of freshwater, seawater, aquaculture: fish, bivalve mollusks, crustaceans, corals. Diagnosis methods. Control of diseases.

Biodegradation and Bioremediation of marine pollutants (oil, Organic comp. etc.).

Module V: - Recent trends in Marine Microbiology

Recently identified microorganisms of the marine ecosystem, their applications in present and future industries.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attendance	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Munn, C. 2011. Marine Microbiology: Ecology and Applications. GS Publications. PP- 648
2. Sekwon Kim. 2013. Marine Microbiology: Bioactive compounds and Biotechnological applications. Wiley VCH.
3. Paul, J. 2001. Marine Microbiology. Academic Press. PP-666.

Cellular Microbiology

Course Code: MMC 313

Credit Units: 03

Course Objective:-

Module I: - Introduction

Introduction and emergence of cellular microbiology, cellular biology underlying prokaryotic and eukaryotic interactions: ultrastructure, genome expression

Module II: - Prokaryotic and Eukaryotic Systems

Prokaryotic system: Pathogenicity Islands, Bacterial Protein secretion systems (sec dependent pathway, Type I, II, III protein secretion pathway), Bacterial cell cycle.

Eukaryotic system: Ultra structure-plasma membrane, cytoplasm, nucleus, mitochondria and chloroplasts, ribosomes, endoplasmic reticulum, Golgi apparatus, lysosome, peroxisomes, vacuoles, cytoskeleton, flagella, cilia, pseudopodia; Vesicular transport pathways- Exocytosis and Endocytosis; cell cycle and Apoptosis.

Module III: - Prokaryotic – eukaryotic interactions in infection

Bacterial adhesion to host cells: Basic principles of microbial adhesion, Molecular mechanisms of adhesion, Bacterial structures involved in adhesion, the effect of adhesion on host cells. Bacterial invasion to host cells (a) Invasion of epithelial cells - actin rearrangements (eg *Salmonella*), microtubules (eg *Klebsiella pneumonia*), paracytosis, (b) Invasion of endothelial cells (eg *E.coli*, *Streptococcus pneumonia*), (c) Invasion of macrophages (eg. *Bordetella pertusis*, *Mycobacterium*). The consequence of invasion – Effect on host cell, Effect on bacteria Survival after invasion - (a) Intracellular lifestyle- Survival in phagolysosomes, survival of remodeled vacuole, Survival in the cytoplasm of the host cell. (b) Extracellular lifestyle

Module IV: - Prokaryotic and eukaryotic signaling mechanisms

Prokaryotic cell to cell signaling: quorum sensing and bacterial pheromones. Overview of extracellular signaling; types of hormones; major classes of receptors, secondary messengers, common intracellular signaling proteins-

GTPase switch proteins, protein kinases, adapter proteins; G-protein coupled receptors and their effectors; Receptor tyrosine kinases and Ras, MAP kinase pathways, signaling pathways leading to activation of transcription factors and modulation of gene expression.

Module V: - Applied Aspects

Comparative and functional genomics, Phylogenetic analysis, Virulence genes, tools for identifying virulence gene by mutation, differential expression, and by use of comparative genomics. Genome evolution in microbes Genomic processes in bacterial pathogen evolution, the role of horizontal gene transfer in prokaryotic genome evolution. Future approach for discovery of novel therapeutics.

Examination Scheme:

Components	C T	Assignment	Project	Case Study	Attendance	EE
Weightage (%)	15	10	10	10	5	50

Suggested Readings

1. Fredrirch Marks et al (2009), Cellular signaling processing, Garland Science Taylor & Francis Group.
2. Henderson et al.,(2000), Cellular microbiology, John Wiley & sons Ltd.
3. Jacquelyn G.Black, (2008), Microbiology Principles and explorations, JohnWiley& sons Ltd
4. Lehninger(2010), Principles of Biochemistry, Worth Publishers,Inc.
5. Lodish, Berk, Baltimore 4th Edition (2000) Molecular biology, W.H Freeman and Company.
6. Nester et al, 2004, Microbiology a human perspective, Mac Graw Hill Higher education.
7. Prescott, Harley & Klein’s,(2008), Microbiology, Mac Graw Hill Higher education.
8. Stalley, Jerome, Microbial life 2nd edition (2007), Sinauer Associates inc, Massachusetts

Term Paper (Evaluation)

Course Code: MMC 330

Credit Units: 03

Course objectives

A term (or research) paper is primarily a record of intelligent reading in several sources on a particular subject.

The students will choose the topic at the beginning of the session in consultation with the faculty assigned. The progress of the paper will be monitored regularly by the faculty. At the end of the semester the detailed paper on the topic will be submitted to the faculty assigned. The evaluation will be done by Board of examiners comprising of the faculties.

GUIDELINES FOR TERM PAPER

The procedure for writing a term paper may consist of the following steps:

1. Choosing a subject
2. Finding sources of materials
3. Collecting the notes
4. Outlining the paper
5. Writing the first draft
6. Editing & preparing the final paper

1. Choosing a Subject

The subject chosen should not be too general.

2. Finding Sources of materials

- a) The material sources should be not more than 10 years old unless the nature of the paper is such that it involves examining older writings from a historical point of view.
- b) Begin by making a list of subject-headings under which you might expect the subject to be listed.
- c) The sources could be books and magazine articles, news stories, periodicals, scientific journals etc.

3. Collecting the notes

Skim through sources, locating the useful material, then make good notes of it, including quotes and information for footnotes.

- a) Get facts, not just opinions. Compare the facts with author's conclusion.
- b) In research studies, notice the methods and procedures, results & conclusions.
- c) Check cross references.

4. Outlining the paper

- a) Review notes to find main sub-divisions of the subject.
- b) Sort the collected material again under each main division to find sub-sections for outline so that it begins to look more coherent and takes on a definite structure. If it does not, try going back and sorting again for main divisions, to see if another general pattern is possible.

5. Writing the first draft

Write the paper around the outline, being sure that you indicate in the first part of the paper what its purpose is. You may follow the following:

- a) statement of purpose
- b) main body of the paper
- c) statement of summary and conclusion

Avoid short, bumpy sentences and long straggling sentences with more than one main idea.

6. Editing & preparing the final Paper

- a) Before writing a term paper, you should ensure you have a question which you attempt to answer in your paper. This question should be kept in mind throughout the paper. Include only information/ details/ analyses of relevance to the question at hand. Sometimes, the relevance of a particular section may be clear to you but not to your readers. To avoid this, ensure you briefly explain the relevance of every section.
- b) Read the paper to ensure that the language is not awkward, and that it "flows" properly.
- c) Check for proper spelling, phrasing and sentence construction.
- d) Check for proper form on footnotes, quotes, and punctuation.
- e) Check to see that quotations serve one of the following purposes:
 - (i) Show evidence of what an author has said.
 - (ii) Avoid misrepresentation through restatement.
 - (iii) Save unnecessary writing when ideas have been well expressed by the original author.
- f) Check for proper form on tables and graphs. Be certain that any table or graph is self-explanatory.

Term papers should be composed of the following sections:

- 1) [Title page](#)
- 2) [Table of contents](#)
- 3) [Introduction](#)
- 4) Review
- 5) [Discussion](#) & [Conclusion](#)
- 6) [References](#)
- 7) [Appendix](#)

Generally, the introduction, discussion, conclusion and bibliography part should account for a third of the paper and the review part should be two thirds of the paper.

Discussion

The discussion section either follows the results or may alternatively be integrated in the results section. The section should consist of a discussion of the results of the study focusing on the question posed in the research paper.

Conclusion

The conclusion is often thought of as the easiest part of the paper but should by no means be disregarded. There are a number of key components which should not be omitted. These include:

1. summary of question posed
2. summary of findings
3. summary of main limitations of the study at hand
4. details of possibilities for related future research

References

From the very beginning of a research project, you should be careful to note all details of articles gathered.

The bibliography should contain ALL references included in the paper. References not included in the text in any form should NOT be included in the bibliography.

The key to a good bibliography is consistency. Choose a particular convention and stick to this.

Conventions

Monographs

Crystal, D. (2001), *Language and the internet*. Cambridge: Cambridge University Press.

Edited volumes

Gass, S./ Neu, J. (eds.) (1996), *Speech acts across cultures. Challenges to communication in a second language*. Berlin/ NY: Mouton de Gruyter. [(eds.) is used when there is more than one editor; and (ed.) where there is only one editor. In German the abbreviation used is (Hrsg.) for Herausgeber].

Edited articles

Schmidt, R./Shimura, A./Wang, Z./Jeong, H. (1996), *Suggestions to buy: Television commercials from the U.S., Japan, China, and Korea*. In: Gass, S./Neu, J. (eds.) (1996), *Speech acts across cultures. Challenges to communication in a second language*. Berlin/ NY: Mouton de Gruyter: 285-316.

Journal articles

McQuarrie, E.F./Mick, D.G. (1992), *On resonance: A critical pluralistic inquiry into advertising rhetoric*. *Journal of consumer research* 19, 180-197.

Electronic book

Chandler, D. (1994), *Semiotics for beginners* [HTML document]. Retrieved [5.10.'01] from the World Wide Web, <http://www.aber.ac.uk/media/Documents/S4B/>.

Electronic journal articles

Watts, S. (2000) *Teaching talk: Should students learn 'real German'?* [HTML document]. *German as a Foreign Language Journal* [online] 1. Retrieved [12.09.'00] from the World Wide Web, <http://www.gfl-journal.com/>.

Other websites

Verterhus, S.A. (n.y.), *Anglicisms in German car advertising. The problem of gender assignment* [HTML document]. Retrieved [13.10.'01] from the World Wide Web, <http://olaf.hiof.no/~sverrev/eng.html>.

Unpublished papers

Takahashi, S./DuFon, M.A. (1989), *Cross-linguistic influence in indirectness: The case of English directives performed by native Japanese speakers*. Unpublished paper, Department of English as a Second Language, University of Hawai'i at Manoa, Honolulu.

Unpublished theses/ dissertations

Möhl, S. (1996), *Alltagssituationen im interkulturellen Vergleich: Realisierung von Kritik und Ablehnung im Deutschen und Englischen*. Unpublished MA thesis, University of Hamburg.

Walsh, R. (1995), Language development and the year abroad: A study of oral grammatical accuracy amongst adult learners of German as a foreign language. Unpublished PhD dissertation, University College Dublin.

Appendix

The appendix should be used for data collected (e.g. questionnaires, transcripts, ...) and for tables and graphs not included in the main text due to their subsidiary nature or to space constraints in the main text.

Assessment Scheme:

Continuous Evaluation **40%**

(Based on abstract writing, interim draft, general approach, research orientation, readings undertaken etc.)

Final Evaluation **60%**

(Based on the organization of the paper, objectives/ problem profile/ issue outlining, comprehensiveness of the research, flow of the idea/ ideas, relevance of material used/ presented, outcomes vs. objectives, presentation/ viva etc.)

COMMUNICATION SKILLS - III

Course Code:BCS 311

Credit Units: 01

Course Objective:

To initiate the learners with the basic mechanics of writing skills and facilitate them with the core skills required for communication in the professional world.

Course Contents:

Module I:Mechanics and Semantics of Sentences

Writing effective sentences
Style and Structure

Module II: Developing writing skills

Inter - office communication: Business Letter; E mails; Netiquette
Intra – office communication: Memos, Notices, Circulars, Minutes
Report Writing

Module III: Business Presentations

Planning, design and layout of presentation
Information Packaging
Audience analysis
Audio visual aids
Speaking with confidence
Case Studies

CAF – Communication Assessment File
GD – Group Discussion
GP – Group Presentation

Text & References:

- Krishnaswamy, N, Creative English for Communication, Macmillan
- Raman Prakash, Business Communication, Oxford.

**BEHAVIOURAL SCIENCE - III
(LEADING THROUGH TEAMS)**

Course Code: BSS 311

Credit Units: 01

Course Objective:

This course aims to enable students to:
Understand the concept and building of teams
Manage conflict and stress within team
Facilitate better team management and organizational effectiveness through universal human values.

Course Contents:

Module I: Teams: An Overview

Team Design Features: team vs. group
Effective Team Mission and Vision
Life Cycle of a Project Team
Rationale of a Team, Goal Analysis and Team Roles

Module II: Team & Sociometry

Patterns of Interaction in a Team
Sociometry: Method of studying attractions and repulsions in groups
Construction of sociogram for studying interpersonal relations in a Team

Module III: Team Building

Types and Development of Team Building
Stages of team growth
Team performance curve
Profiling your Team: Internal & External Dynamics
Team Strategies for organizational vision
Team communication

Module IV: Team Leadership & Conflict Management

Leadership styles in organizations
Self Authorized team leadership
Causes of team conflict
Conflict management strategies
Stress and Coping in teams

Module V: Global Teams and Universal Values

Management by values
Pragmatic spirituality in life and organization
Building global teams through universal human values
Learning based on project work on Scriptures like Ramayana, Mahabharata, Gita etc.

Module VI: End-of-Semester Appraisal

Viva based on personal journal

Assessment of Behavioural change as a result of training
Exit Level Rating by Self and Observer

Text & References:

- Organizational Behaviour, Davis, K.
- Hoover, Judhith D. Effective Small Group and Team Communication, 2002, Harcourt College Publishers
- LaFasto and Larson: When Teams Work Best, 2001, Response Books (Sage), New Delhi
- Dick, Mc Cann & Margerison, Charles: Team Management, 1992 Edition, viva books
- J William Pfeiffer (ed.) Theories and Models in Applied Behavioural Science, Vol 2, Group (1996); Pfeiffer & Company
- Smither Robert D.; The Psychology of Work and Human Performance, 1994, Harper Collins College Publishers

FRENCH - III

Course Code:FLT 311

Credit Units: 02

Course Objective:

To provide the students with the know-how

- To master the current social communication skills in oral and in written.
- To enrich the formulations, the linguistic tools and vary the sentence construction without repetition.

Course Contents:

Module B: pp. 76 – 88 Unité 6

Module C: pp. 89 to103 Unité 7

Contenu lexical: Unité 6:se faire plaisir

1. acheter : exprimer ses choix, décrire un objet (forme, dimension, poids et matières) payer
2. parler de la nourriture, deux façons d'exprimer la quantité, commander un repas au restaurant
3. parler des différentes occasions de faire la fête

Unité 7: Cultiver ses relations

1. maîtriser les actes de la communication sociale courante (Salutations, présentations, invitations, remerciements)
2. annoncer un événement, exprimer un souhait, remercier, s'excuser par écrit.
3. caractériser une personne (aspect physique et caractère)

Contenu grammatical:

1. accord des adjectifs qualificatifs
2. articles partitifs
3. Négations avec de, ne...rien/personne/plus
4. Questions avec combien, quel...
5. expressions de la quantité
6. ne...plus/toujours - encore
7. pronoms compléments directs et indirects
8. accord du participe passé (auxiliaire « avoir ») avec l'objet direct
9. Impératif avec un pronom complément direct ou indirect
10. construction avec « que » - Je crois que/ Je pense que/ Je sais que

C – Project + Presentation

I – Interaction/Conversation Practice

Text & References:

- le livre à suivre : Campus: Tome 1

GERMAN - III

Course Code:FLG 311

Credit Units: 02

Course Objective:

To enable the students to converse, read and write in the language with the help of the basic rules of grammar, which will later help them to strengthen their language.

To give the students an insight into the culture, geography, political situation and economic opportunities available in Germany

Course Contents:

Module I: Modal verbs

Modal verbs with conjugations and usage
Imparting the finer nuances of the language

Module II: Information about Germany (ongoing)

Information about Germany in the form of presentations or “Referat”- neighbors, states and capitals, important cities and towns and characteristic features of the same, and also a few other topics related to Germany.

Module III: Dative case

Dative case, comparison with accusative case
Dative case with the relevant articles
Introduction to 3 different kinds of sentences – nominative, accusative and dative

Module IV: Dative personal pronouns

Nominative, accusative and dative pronouns in comparison

Module V: Dative prepositions

Dative preposition with their usage both theoretical and figurative use

Module VI: Dialogues

In the Restaurant,
At the Tourist Information Office,
A telephone conversation

Module VII: Directions

Names of the directions
Asking and telling the directions with the help of a roadmap

Module VIII: Conjunctions

To assimilate the knowledge of the conjunctions learnt indirectly so far

C – Project +Presentation

I – Interaction/Conversation Practice

Text & References:

- Wolfgang Hieber, Lernziel Deutsch
- Hans-Heinrich Wangler, Sprachkurs Deutsch
- Schulz Griesbach, Deutsche Sprachlehre für Ausländer

- P.L Aneja, Deutsch Interessant- 1, 2 & 3
- Rosa-Maria Dallapiazza et al, Tangram Aktuell A1/1,2
- Braun, Nieder, Schmoe, Deutsch als Fremdsprache 1A, Grundkurs

SPANISH – III

Course Code:FLS 311

Credit Units: 02

Course Objective:

To enable students acquire knowledge of the Set/definite expressions (idiomatic expressions) in Spanish language and to handle some Spanish situations with ease.

Course Contents:

Module I

Revision of earlier semester modules

Set expressions (idiomatic expressions) with the verb *Tener, Poner, Ir...*

Weather

Module II

Introduction to *Gustar...*and all its forms. Revision of *Gustar* and usage of it

Module III

Translation of Spanish-English; English-Spanish. Practice sentences.

How to ask for directions (using *estar*)

Introduction to IR + A + INFINITIVE FORM OF A VERB

Module IV

Simple conversation with help of texts and vocabulary

En el restaurante

En el instituto

En el aeropuerto

Module V

Reflexives

C – Project +Presentation

I – Interaction/Conversation Practice

Text & References:

- Español, En Directo I A
- Español Sin Fronteras -Nivel Elemental

CHINESE – III

Course Code:FLC 311

Credit Units: 02

Course Objective:

Foreign words are usually imported by translating the concept into Chinese, the emphasis is on the meaning rather than the sound. But the system runs into a problem because the underlying name of personal name is often obscure so they are almost always transcribed according to their pronunciation alone. The course aims at familiarizing the student with the basic aspects of speaking ability of Mandarin, the language of Mainland China. The course aims at training students in practical skills and nurturing them to interact with a Chinese person.

Course Contents:

Module I

Drills

Dialogue practice

Observe picture and answer the question.

Introduction of written characters.

Practice reading aloud

Practice using the language both by speaking and by taking notes.

Character writing and stroke order

Module II

Measure words

Position words e.g. inside, outside, middle, in front, behind, top, bottom, side, left, right, straight.

Directional words – beibian, xibian, nanbian, dongbian, zhongjian.

Our school and its different building locations.

What game do you like?

Difference between “hui” and “neng”, “keyi”.

Module III

Changing affirmative sentences to negative ones and vice versa

Human body parts.

Not feeling well words e.g. ; fever, cold, stomach ache, head ache.

Use of the modal particle “le”

Making a telephone call

Use of “jiu” and “cai” (Grammar portion)

Automobiles e.g. Bus, train, boat, car, bike etc.

Traveling, by train, by airplane, by bus, on the bike, by boat.. etc.

Module IV

The ordinal number “di”

“Mei” the demonstrative pronoun e.g. mei tian, mei nian etc.

use of to enter to exit

Structural particle “de” (Compliment of degree).

Going to the Park.

Description about class schedule during a week in school.

Grammar use of “li” and “cong”.

Comprehension reading followed by questions.

Module V

Persuasion-Please don't smoke.

Please speak slowly

Praise – This pictorial is very beautiful

Opposites e.g. Clean-Dirty, Little-More, Old-New, Young-Old, Easy-Difficult,

Boy-Girl, Black-White, Big-Small, Slow-Fast ... etc.

Talking about studies and classmates

Use of “it doesn't matter”

Enquiring about a student, description about study method.

Grammar: Negation of a sentence with a verbal predicate.

C – Project +Presentation

I – Interaction/Conversation Practice

Text & References:

- “Elementary Chinese Reader Part I, Part-2” Lesson 21-30



AMITY UNIVERSITY

— R A J A S T H A N —

AMITY INSTITUTE OF MICROBIAL TECHNOLOGY (AIMT)

Program Name: M.Sc. -INDUSTRIAL MICROBIOLOGY FOURTH SEMESTER

Course Code	Course Title	Lectures(L) Hours per week	Tutorial (T) Hours per week	Practical (P) Hours per week	Total Credits
MMC 460	Research Project & Dissertation	-	-	-	25
	TOTAL	-	-	-	25

RESEARCH PROJECT AND DISSERTATION

Course Code: MMC 460

Credit Units: 25

Course Contents:

- Fourth Semester of the M.Sc. Curriculum is devoted to research dissertation work.
- Students, with the help of their mentor and faculty colleagues will identify a lab in India & abroad for the research work.
- The student should stay for a minimum prescribed Semester period at the place of work.
- Students not staying for the prescribed period will be marked absent as per the University rules
- At the end of their research the students shall submit the dissertation as per the Guidelines prescribed below.

The Aims of the Dissertation

The aim of the dissertation is to provide the students with an opportunity to further their intellectual and personal development in the chosen field by undertaking a significant practical unit of activity, having an educational value at a level commensurate with the award a M.Sc. Degree.

Objectives

- To provide the students an opportunity to demonstrate the ability to devise, select and use a range of methodologies appropriate to the chosen topic of research.
- To allow students to show the application of skills of data collection, critical analysis and concept synthesis necessary for formation of defensible conclusions and/or recommendations.
- To allow students the opportunity to demonstrate ability to draw appropriate conclusions argued from the evidence presented. [Should the research produce negative or inconclusive results, the conclusions should be critically examined to ascertain the reasons].
- To provide a forum to demonstrate the skills of structuring and present a balanced informed, complete, clear and concise written argument.

Dissertation Guidelines

The Dissertation Topic

It is important to distinguish here between 'dissertation topic' and 'dissertation title'. The topic is the specific area that you wish to investigate. The title may not be decided until the dissertation has been written so as to reflect its content properly.

Few restrictions are placed on the choice of the topic. Normally the topic is expected to be:

- relevant to Microbial Sciences;
- related to one or more of the subjects or areas of study within the core program and specialisation stream;
- clearly focused so as to facilitate an in-depth approach, subject to the availability of adequate sources of information and to the knowledge of students;
- of value and interest to the students and their personal and professional development.

Dissertation format

All students must follow the following rules in submitting their dissertation.

- **Front page** should provide title, name of the student, name of degree and the date of submission.
- **Second page** should contain the certificate received from the organization/University from where the student has completed his/her project work.
- **The next page** should be the table of contents giving page references for each chapter and section.
- **The next page** should be the table of graphs, figures and tables giving legends and page numbers.
- Next to follow should be following in the sequence given below:
- **Abbreviations used (if any)**
- **Introduction**
- **State-of-Art**
- **Material & Methods**
- **Results**
- **Discussion**
- **Summary (approximately 500 words)**
- **Conclusion**
- **Future Prospects**
- **References:**After this concluding chapter, students should give a list of all the references they have used. These should be cross - references with the text. For articles from journals, the following details are required e.g.
Schloter M, Assmus B and Hartmann A (1995) the use of immunological methods to detect and identify bacteria in the environment. Biotech Adv 13: 75-90

For books, the following details are required

Bahera BK and Varma A (2003) Green Energy from Waste Biomass, Capital Book Company, New Delhi, India

For book chapter

Mukherji KG, Mandeep and Varma A (1998) Mycorrhizosphere microorganisms: screening and evaluation. (Ed) Varma A. In: Mycorrhiza Manual. Springer-Verlag, Germany, pp 85-97

- Finally, you should give any appendices. These should only include relevant statistical data or material that cannot be fitted into the above categories.
- List of Publications (if any) by the students should be attached in the end.

Guidelines for the assessment of the dissertation

While evaluating the dissertation, faculty guide will consider the following aspects:

1. Has the student made a clear statement of the objective or objective(s).
2. If there is more than one objective, do these constitute parts of a whole?
3. Has the student developed an appropriate analytical framework for addressing the problem at hand.
4. Is this based on up-to-date developments in the topic area?
5. Has the student collected information / data suitable to the frameworks?
6. Are the materials & methods employed by the student to analyse the data / information appropriate and relevant?
7. Has the student succeeded in drawing conclusion form the analysis?
8. Do the conclusions relate well to the objectives of the project?