

Diploma
in
Medical Laboratory Technology (MLT)

Curriculum Structure
(III to VI Semester)

Semester III

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/Week	Credit
				L	T	P		
1	Programme core course-1	MLPC-301	Biochemistry & Biophysics	3	0	0	3	3
2	Programme core course-2	MLPC-302	Physiology	3	0	0	3	3
3	Programme core course-3	MLPC-303	Anatomy	2	0	0	2	2
4	Programme core course-4	MLPC-304	Hospital Management	1	0	0	1	1
5	Programme core course-5	MLPC-305	Biomedical Instrumentation	2	0	0	2	2
6	Programme core course-6	MLPC-306	Biochemistry Lab	0	0	4	4	2
7	Programme core course-7	MLPC-307	Biophysics Lab	0	0	4	4	2
8	Programme core course-8	MLPC-308	Physiology Lab	0	0	4	4	2
9	Programme core course-9	MLPC-309	Anatomy Lab	0	0	2	2	1
10	Summer Internship-I (4 weeks) after Semester II	MLSI-310	Summer Internship-I	0	0	0	0	2
Total				11	0	14	25	20

Semester IV

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/Week	Credit
				L	T	P		
1	Programme core course-10	MLPC-401	Clinical Biochemistry	2	0	0	2	2
2	Programme core course-11	MLPC-402	Medical Microbiology	2	0	0	2	2
3	Programme core course-12	MLPC-403	Cytology & Histology	1	1	0	2	2
4	Programme core course-13	MLPC-404	Cell Biology & Genetics	1	1	0	2	2
5	Programme core course-14	MLPC-405	Clinical Biochemistry Lab	0	0	4	4	2
6	Programme core course-15	MLPC-406	Medical Microbiology Lab	0	0	4	4	2
7	Programme elective course-1 (Any one to be opted)	MLPE-407/A	Analytical Techniques	2	1	0	3	3
		MLPE-407/B	Microbial Technology					
8	Humanities & Social Science-4	HS-408	Professional Skill Development	2	1	0	3	3
9	Minor Project	MLPR-409	Minor Project	0	0	4	4	2
10	Mandatory Course-1	AU-410	Essence of Indian Knowledge and Tradition	2	0	0	2	0
Total				12	4	12	28	20

Semester V

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/ Week	Credit
				L	T	P		
1	Programme core course-16	MLPC-501	Haematology	2	0	0	2	2
2	Programme core course-17	MLPC-502	Immunology & Immunotechnology	2	0	0	2	2
3	Programme core course-18	MLPC-503	Molecular Biology & Genetic Engineering	2	0	0	2	2
4	Programme core course-19	MLPC-504	Immunotechnology Lab	0	0	4	4	2
5	Programme core course-20	MLPC-505	Haematology Lab	0	0	2	2	1
6	Programme elective course-2 (Any one to be opted)	MLPE-506/A	Biomedical Devices	3	0	0	3	3
		MLPE-506/B	Drug Discovery					
7	Programme elective course-3 (Any one to be opted)	MLPE-507/A	Fundamental Biotechnology	2	1	0	3	3
		MLPE-507/B	Animal Cell Culture Technology					
8	Open elective-1	(Any one to be opted from Annexure-I)		3	0	0	3	3
9	Summer Internship-II (6 weeks) after Semester IV	MLSI-509	Summer Internship-II	0	0	0	0	2
10	Major Project-I	MLPR-510	Major Project	0	0	4	4	2
Total				14	1	10	25	22

Semester VI

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/ Week	Credit
				L	T	P		
1	Programme core course-21	MLPC-601	Medical Diagnostics & Animal Care	2	1	0	3	3
2	Programme core course-22	MLPC-602	Protein Technology	1	1	0	2	2
3	Programme elective course-4 (Any one to be opted)	MLPE-603/A	Quality Control	3	0	0	3	3
		MLPE-603/B	Public Health Informatics					
4	Humanities and Social Science-5	HS-604	Entrepreneurship and Start-up's	3	1	0	4	4
5	Open elective-2	(Any one to be opted from Annexure-II)		4	0	0	4	4
6	Mandatory Course-2	AU-606	Indian Constitution	2	0	0	2	0
7	Major Project-II	MLPR-607	Major Project	0	0	6	6	3
8	Seminar	MLSE-608	Seminar	2	0	0	2	1
Total				17	3	6	26	20

Medical Laboratory Technology (MLT) Syllabus

Semester III

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				L	T	P		
1	Programme core course-1	MLPC-301	Biochemistry & Biophysics	3	0	0	3	3
2	Programme core course-2	MLPC-302	Physiology	3	0	0	3	3
3	Programme core course-3	MLPC-303	Anatomy	2	0	0	2	2
4	Programme core course-4	MLPC-304	Hospital Management	1	0	0	1	1
5	Programme core course-5	MLPC-305	Biomedical Instrumentation	2	0	0	2	2
6	Programme core course-6	MLPC-306	Biochemistry Lab	0	0	4	4	2
7	Programme core course-7	MLPC-307	Biophysics Lab	0	0	4	4	2
8	Programme core course-8	MLPC-308	Physiology Lab	0	0	4	4	2
9	Programme core course-9	MLPC-309	Anatomy Lab	0	0	2	2	1
10	Summer Internship-I (4 weeks) after Semester II	MLSI-310	Summer Internship-I	0	0	0	0	2
Total				11	0	14	25	20

BIOCHEMISTRY & BIOPHYSICS

Course Code	MLPC-301
Course Title	Biochemistry & Biophysics
Number of Credits	3 (L:3, T:0, P:0)
Prerequisites	Basic knowledge of Chemistry & atomic structure
Course Category	Programme Core Course

Course Outcomes: -

1. Students will be able to understand basic principles & be able to analyse various problems of biophysics.
2. Students will be able to evaluate problems & results involving Acid-base and pH chemistry , Atomic structure , Solution & Dialysis and transport across biological membrane.
3. Students will be able to understand Biochemistry of Carbohydrates , Lipids & Amino Acids and their significance.
4. Students will be able to understand clinical & biochemical role of Proteins , Minerals & Vitamins.
5. Students will be able to evaluate principles of Biochemistry of Enzymes.

Course Content:-

Module- 1: Principles of biophysics & Acid-base and pH chemistry

Number of class hours: 04

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of biophysics.
- 2) Students will be able to analyse various problems related to biophysical principle.
- 3) Students will be able to evaluate results involving biophysical principles.
- 4) Students will be able to understand basic principle of acid-base chemistry.
- 5) Students will be able to analyse various problems related to pH.
- 6) Students will be able to evaluate results involving pH.

Detailed content of the unit:-

- a) Osmosis & osmotic pressure , Surface tension , Colloid & colloidal system, Diffusion, viscosity , Endocytosis, phagocytosis and pinocytosis
- b) Study of Acid, Base, Buffers, pH, and Handerson-Hasselbalch equation. , Significance of pH in our body , Acidosis and alkalosis

Module- II: Atomic structure, Solutions & Dialysis and membrane transport.

Number of class hours: 04

Suggestive Learning Outcomes:

- 1) Students will be able to know application related to isotope.
- 2) Students will be able to analyse various problems related to various types of solutions & will be able to prepare various types of solutions.
- 3) Students will be able to understand basic principle of dialysis & will be able to understand various types of dialysis.
- 4) Students will be able to analyse various types of transport across biological membrane.

Detailed content of the unit:-

- a) Isotopes & radio-isotopes , Application of isotopes in medical practice
- b) Normal solution, molar solution , Isotonic, hypertonic, hypotonic solution , W/V and % solution.
- c) Cell & cell organelle, structure of cell membrane Dialysis, haemodialysis, electro dialysis , Semi permeable membrane.
- d) Simple diffusion , Active transport , Passive transport , Voltage gated and ligand gated channel.

Module- III: Biochemistry of Carbohydrates, Lipids & Amino Acids.

Number of class hours: 06

Suggestive Learning Outcomes:

- 1) Students will be able to understand biochemical principles of Carbohydrates.
- 2) Students will be able to analyse various aspects of Carbohydrates & able to determine qualitative and quantitative aspects of Carbohydrates.
- 3) Students will be able to understand biochemical principles & synthesis of Lipids to analyse clinical role of various lipids.
- 4) Students will be able to understand biochemical principles & clinical role of various amino acids.

Detailed content of the unit: -

- 1. Definition, Function & Classification of Carbohydrates, Concept of Asymmetric Carbon , Empirical formula and structures of Carbohydrates.**
- 2. Types of Isomerism / Optical Isomerism of monosaccharide with their structures & examples, Properties of Disaccharides & Polysaccharides with their structures, Principles of Qualitative & Semi-quantitative Clinical diagnosis related to Carbohydrate chemistry.**
- 3. Definition, function & classification of Lipids. Esterification & Synthesis of fats. Essential Fatty acids – concepts , structure & IUPAC Nomenclature, PUFA,MUFA.**

4. Isomerism and properties of fatty acids. Quantitative estimation of unsaturation through Iodine number , Saponification number. Clinical Significance of Fats , Atherosclerosis , CBAG. Clinical significance of HDL, LDL, VLDL, TG etc.

5. Amino acids & their structures, classification, isomerism, properties. Concept of Zwitter ion & effect of pH on charge , Iso-electric pH.

Module- IV: Biochemistry of Proteins , Minerals & Vitamins

Number of class hours: 04

Suggestive Learning Outcomes:

- 1) Students will be able to understand biochemical properties of Proteins..
- 2) Students will be able to analyse the clinical role of various Proteins.
- 3) Students will be able to analyse the role of various minerals & vitamins in biochemical pathways.

Detailed content of the unit:-

- 1. Definition, function and properties of proteins. Principles of qualitative identification of proteins.**
- 2. Concepts of structural hierarchy of proteins, denaturation, salting out & solubility of proteins.**
- 3. Clinical significance of proteins, Proteinuria & related clinical concepts. Physiological aspects of functional & structural proteins.**
- 4. Definition, Classification and clinical importance, Pro-vitamins.**
- 5. Physiological role of Water soluble Vitamins as co-enzymes for Redox, Group transfer etc.**
- 6. Importance of Water balance.**
- 7. Role of Electrolytes, Macro & Micro elements.**

Module- V: Biochemistry of Enzymes

Number of class hours: 06

Suggestive Learning Outcomes:

- 1) Students will be able to understand biochemical properties of Enzymes.
- 2) Students will be able to enumerate details of factors effecting enzyme activity.
- 3) Students will be able to understand concepts of turnover number & able to analyse various enzyme inhibitions.

Detailed content of the unit:-

- 1. Definition and classification of enzymes.**
- 2. Kinetics of enzyme, Concepts of K_m & V_{max} .**
- 3. Mechanism of action & Concept of activation energy and enzyme substrate complex , Models of enzyme action , Concepts of active site , allosterism.**
- 4. Factors affecting enzyme activity & graphical representation.**
- 5. Concepts of co-enzyme, co-factor & prosthetic groups.**
- 6. Mechalis Menten Equation, Reciprocal curve.**

- 7. Enzyme inhibition – Competitive, non-competitive & un-competitive , Feed back inhibition , Introduction to drug design.**
- 8. Clinical importance of Enzymes & Isozymes in Diagnostics & Therapeutics.**

References:

1. Viva & Practical Biochemistry & Biophysics – Dr R. N. Roy
2. A Text book of Biophysics – Dr. R. N. Roy
3. Biophysics & Biophysical Chemistry- Debajyoti Das
4. Medical Biophysics- R. N. Roy
5. Text book of Biochemistry – U. Satyanarayan
6. Harper's Illustrated Biochemistry by V.Rodwell et al.

PHYSIOLOGY

Course Code	MLPC-302
Course Title	Physiology
Number of Credits	3 (L:3, T:0, P:0)
Prerequisites	Basic knowledge on fundamental biology
Course Category	Programme Core Course

Course Outcomes: -

1. Students will be able to understand basic of physiology.
2. Students will be able to analyse various problems related to physiology.
3. Students will be able to evaluate results involving physiological principles.
4. Students will get overview of Nervous system & Special senses.
5. Students will gain knowledge on Reproductive Systems , Excretory System & Endocrine system.

Course Content:-

Module- 1: Nervous system

Number of class hours: 06

Suggestive Learning Outcomes:

Students will be able to learn

- 1) different type of nervous system and their function.
- 2) transmission of signal across the nerve.
- 3) Depolarisation and repolarisation of nerve.

Detailed content of the unit: -.

- a) Structure of nerve.-velocity of impulse through nerve—Depolarisation—Repolarisation of nerve-Neuron—Neuroglia.
- b) Sketch diagram of central Nervous system---Autonomic Nervous system---Cranial nerves (origin, distribution, nature & termination)
- c) CNS: Cross section of spinal cord & Reflex Arc—Function of cerebrum & cerebellum—cerebrum spinal fluid.
- d) ANS : Sympathetic and Parasympathetic—Chemical transmitter--Functions

Module- 2: Special senses

Number of class hours: 04

Suggestive Learning Outcomes:

Students will be able to learn

- 1) Sense organ and their function.
- 2) Error of refraction and disorder of eye.

Detailed content of the unit: -.

- a) Structure of Eyeball—Mode of rotation of eyeball—Physiology of vision—error of Refraction.
- b) Different parts of Ear—Mechanism of test sensation.
- c) Test Bud- Mechanism of Test sensation-- Olfaction

Module-3: Reproductive Systems

Number of class hours: 05

Suggestive Learning outcomes:

Students will be able to learn

- 1) Different reproductive system and their physiological function.
- 2) Physiological changes during placental development and ovulation.
- 3) Screening of pregnancy.

Detailed content of the unit: -.

- a) Sketch and diagram of male and female reproductive system—structure and function.
- b) Process of fertilisation and ovulation—placenta & its function
- c) Physiological changes during pregnancy—primary and secondary sex organ—character—puberty- menopause—pregnancy test.

Module- 4: Excretory System

Number of class hours: 05

Suggestive Learning outcomes:

Students will be able to learn

- 1) Structure of kidney.
- 2) formation of urine.
- 3) renal filtration.
- 4) filling up urine in urinary system.
- 5) elimination of urine .
- 6) normal and abnormal composition of urine.

Detailed content of the unit:

- a) Macro & Micro-scopical structure kidney—Function of kidney-- Mechanism of urine formation—function of renal tubules.
- b) Mechanism of filling of urinary bladder---evacuation of urine—Normal & abnormal
- c) Composition of urine.

Module- 5: Endocrine system**Number of class hours: 05****Suggestive Learning outcomes:** Students will be able to

- 1) location of different endocrines.
- 2) hormones secreted different endocrine organs and roles of the hormones in our body.
- 3) hormones secreted from adrenal gland and its roles.

Detailed content of the unit:-

- a) Different endocrines, location with sketch diagram.
- b) Hypothalamus as an endocrine organ – Hormones of pituitary & Thyroid and their functions – pancreas & its hormones.
- c) Adrenal Gland—Hormones of Adrenal Cortex & Adrenal Medulla And their function.

References: -

- 1) Physiology / Best & Taylor
- 2) Physiology / Guyton

ANATOMY

Course Code	MLPC-303
Course Title	Anatomy
Number of Credits	2 (L:2, T:0, P:0)
Prerequisites	Knowledge of structure of human body
Course Category	Programme Core Course

Course Outcomes: -

Upon completion of this course, students will be able to -

1. integrate anatomy with other medical science to build up clinical aspects.
2. gain an interest to cultivate information to apply in clinical disciplines.
3. gain knowledge actual features of an organ in the body parts.
4. apply accurate surface measurement and location of an organ in radiological technics.
5. Students will get an overview of Human skeleton , Surface Anatomy & Macroscopical structure of viscera.

Course Content:-

Module- 1: Human skeleton

Number of class hours:05

Suggestive Learning Outcomes: Students will be able to-

- 1) learn human skeleton that corresponds the land marks of every organs and systems in the body.
- 2) learn different structure of bone.
- 3) identify male and female skeleton.

Detailed content of the unit: -

- a) Introduction of skeleton and bones.
- b) Name and numbers of bones.
- c) Different structure of bones (upper extrimities, lower extrimities, head and neck, abdomen, thorax).

Module- 2: Macro and Micro structure of bones

Number of class hours: 05

Suggestive Learning Outcomes: Students will be able to-

- 1) learn formation and development of bone.
- 2) learn different structure of bone .

Detailed content of the unit: -

- a) Osteology
- b) Macro structure of bone—different parts of bones
- c) Micro structure of bones.

Module-3: Joints

Number of class hours: 05

Suggestive Learning Outcomes: Students will be able

- 1) to learn possible movement of body.
- 2) to know joints of the body.

Detailed content of the unit:

- a) joints of articulating bones.
- b) Movement directions of joints.

Module-4: Surface Anatomy

Number of class hours: 10

Suggestive Learning Outcomes:

1. Students will be able to learn surface lands of internal organs of systems.
2. students will be able to know the structure and function of different organ in the systems.

Detailed content of the unit:

Heart (structure and function of Cardio vascular system –Alimentary system – Urinary system – Reproductive system), lungs , liver, gall bladder, stomach, spleen, kidney and appendix.

Module -5: Macroscopical structure of viscera

Number of class hours: 05

Suggestive Learning Outcomes: Students will be able to learn gross structure of visceral organ.

Detailed course content:

Shape, border , covering layer, adjacent structure, position, blood supply, nerve supply.

References: -

1. Gray's Anatomy.
 2. Anatomy – Samar Mitra
 3. Anatomy and physiology | Ross and Willson.
 4. Anatomy | B. D Chowrasia
 5. Osteology| Frazer
 6. Human Anatomy |A K Datta
 7. Dissection Anatomy| Curninggham.
 8. Anatomy| Sahanuiza| Central Book Agency
- (In the reference you may also suggest any Online Swayam Moocs Courses.)

HOSPITAL MANAGEMENT

Course Code	MLPC-304
Course Title	Hospital Management
Number of Credits	1 (L:1, T:0, P:0)
Prerequisites	NIL
Course Category	Programme Core Course

Course Outcomes: - Upon completion of this course, students will be able

1. To learn about health care system of Hospital Organisation.
2. To gain knowledge to build up resources.
3. To learn services and facilities available in Hospital.
4. To learn Health awareness, safety measures of hazards and waste management.
5. To gain knowledge of modern health care systems towards the advancement of biomedical field.

Course Content:-

Module- 1: Introduction of hospital organisation

Number of class hours: 04

Suggestive Learning Outcomes: Students will be able

- 1) to gain Knowledge of Hospital and its services.
- 2) to learn healthcare system for benefited social health.
- 3) to know about facilities and services provided in various division of hospital for improvement of healthcare.

Detailed content of the unit: -

- a) Hospital – Introduction, beginning of Hospital, aims and objectives, responsibilities, effective of Hospital Administrator.
- b) Health centres—PHC, SHC, Health fair.
- c) Hospital Division, Services and Health Institution.
- d) Medical records.

Module- 2: Hospital planning

Number of class hours: 03

Suggestive Learning Outcomes: Students will be able

- 1) to know the activity of the engineers in healthcare systems.
- 2) to know importance of planning and design of Hospital as an effective healthcare.

Detailed content of the unit: -

- a) Hospital Engineering.

- b) Design of a Hospital.
- c) Biomedical Engineering division

Module-3: Healthcare services in Hospital

Numbers of the class hours: 03

Suggestive Learning Outcomes: Students will be able

- 1) to learn outdoor services for patients.
- 2) to learn indoor services for patients.
- 3) to know Hospital diet is a part to improve patient recovery.

Detailed content of the unit:

- a) Outdoor service and management.
- b) Indoor service and management.
- c) Hospital Diets.

Module-4: Health awareness Programme

Numbers of the class hour: 03

Suggestive Learning Outcomes: Students will be able

- 1) to gain knowledge about awareness programme achieved to strategic improvement in social health.
- 2) to learn safety management in laboratory.
- 3) to learn eco-friendly waste treatment and disposal.

Detailed content of unit:

- a) Health awareness—blind control and birth control.
- b) Lab safety measures and hazards.
- c) Biomedical waste management.

Module- 5:

Number of class hours: 03

Suggestive Learning Outcomes: Students will be able to know

- 1) Application of biomedical field.
- 2) The activities of medical person and industries person.
- 3) Importance in interdisciplinary field in healthcare system.

Detailed content of unit:

- a) Xenobiotics.
- b) Biomedical field in Hospital.
- c) Difference between Hospital management and industrial management.
- d) Role of medical person and biomedical person.

References: -

- 1. Hospital administration—C M. Francis & Mario De Souza.
- 2. Principles of Hospital Administration and planning- B.M.Sakarkar
- 3. Hospital Administration . – DC Joshi & Mamta Joshi.

(In the reference you may also suggest any Online Swayam Moocs Courses.)

BIOMEDICAL INSTRUMENTATION

Course Code	MLPC-305
Course Title	Biomedical Instrumentation
Number of Credits	2 (L:2, T:0, P:0)
Prerequisites	Basic knowledge on biophysical principles and fundamental electronics
Course Category	Programme Core Course

Course Outcomes: -

1. Students will be able to understand basic principle of biomedical instrumentation.
2. Students will be able to know various types of biomedical instruments of clinical lab.
3. Students will be able to understand hazards of biomedical instruments.
4. Students will be able to know and understand mechanism of respiratory measurement.
5. Students will be able to know and understand X-ray machine and its operation.

Course Content:-

Module- 1: Introduction

Number of class hours: 02

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of biomedical instrumentation.
- 2) Students will be able to know application of various types of biomedical instruments.

Detailed content of the unit: -

- a) General introduction including in measurement of physiological parameters.
- b) Sources of bio-electric potentials, introduction of bio-potential electrodes, its necessity and its problems.
- c) Transducers for biomedical applications.

Module- 2: Instrumentation of clinical lab

Number of class hours: 4 hrs

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of biomedical instruments of clinical lab.
- 2) Students will be able to know various types of biomedical instruments of clinical lab.
- 3) Students will be able to evaluate results observed in various types of biomedical instruments.

Detailed content of the unit: -

- a) Temperature measurement
- b) pH measurement
- c) Blood gas analysis (pCO₂, pO₂)
- d) Blood cell counters (conductivity method)

Module- 3: Hazards and electrical safety of medical equipment

Number of class hours: 2 hrs

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of electrical safety of medical equipment.
- 2) Students will be able to know various types hazards that may occur in clinical lab and hospitals.
- 3) Students will be able to evaluate extent of hazards and electrical safety of medical equipment.

Detailed content of the unit: -

- a) Physiological effect of electrical current
- b) Shock hazards of electrical equipments
- c) Methods of accident prevention
- d) Gasses and irritants
- e) Earthing and grounding

Module- 4: Respiratory measurement

Number of class hours: 2 hrs

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of respiratory measurements.
- 2) Students will be able to know various types respiratory parameters.
- 3) Students will be able to evaluate extent of respiratory measurements.

Detailed content of the unit: -

- a) Measurement of pulmonary volumes and capacities
- b) Spirometry
- c) Breathing reserve
- d) Body plethysmography

Module- 5: X-Ray machine

Number of class hours: 2 hrs

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of X-ray machine.
- 2) Students will be able to know various components of X-ray machine.
- 3) Students will be able to know application of X-ray machine..

Detailed content of the unit: -

Properties of X-Ray.

- a) Photo electric effect
- b) X- ray tube- Stationary & rotating anode
- c) Typical X-Ray machine
- d) Visualization of X-rays

References: -

1. Hand Book of Biomedical Instrumentation – R S Khandpur
2. Biomedical Instruments – R S Khandpur
3. Radiographic Imagins – DN & MO Chesney.
4. X-Ray equipment fastudents Radiographics – DN & MO Chesney
5. Medical Electronics – S Sarkar
6. Principle of Medical Electronics & Biomedical Instrumentation- C Raja Rao & S K Guha
7. Biomedical instruments & Measurements – Croamwell
8. Medical Electronics – D Jemice

BIOCHEMISTRY LAB

Course Code	MLPC-306
Course Title	Biochemistry Lab
Number of Credits	2 (L:0, T:0, P:4)
Prerequisites	Knowledge on basic biochemistry
Course Category	Programme Core Course

Course Outcomes: -

1. Students will be able to examine various samples by performing qualitative tests.
2. Students will be able to perform semi-quantitative estimation of bio-molecules.
3. Students will be able to evaluate diagnostic & clinical role of the biochemical tests.
4. Students will be able to analyse the data of the biochemical tests results..
5. Students will be able to interpret the observations of the biochemical tests.

Course Content:-

Module- 1: Overview of Qualitative & Semi-quantitative Reactions for identification of Carbohydrates .

Number of class hours: 2 hrs

Suggestive Learning Outcomes:

- 1) Students will be able to examine various samples & perform qualitative tests of Carbohydrates.
- 2) Students will be able to evaluate test results & data .
- 3) Students will be able to analyse & interpret diagnostic & clinical role of the biochemical tests of Carbohydrates.

Detailed content of the unit: -

- a) **Clinical Diagnosis of Glycosuria: Identification of Reducing Sugar in a Given sample.**
- b) **Semi-Quantitative Estimation of Reducing Sugar in a Given sample.**
- c) **To classify various reducing sugars by Osazone Crystal Test.**
- d) **Qualitative identification of Polysaccharides present in a given sample.**
- e) **Qualitative identification of Carbohydrates by Molish's Test.**
- f) **To determine Ketone functional groups in Carbohydrates by Sheliwanoff's Test.**
- g) **To determine reducing property of Carbohydrates using Fehlings Test.**

Module- 2: Overview of experimental Characterization of Proteins , Enzymes & Fats.

Number of class hours: 24hrs

Suggestive Learning Outcomes:

- 1) Students will be able to examine various samples & perform qualitative tests of Proteins , fats & enzymes.
- 2) Students will be able to evaluate the test results & data .

- 3) Students will be able to analyse & interpret diagnostic & clinical role of the biochemical tests of Proteins , fats & enzymes.

Detailed content of the unit: -

- a) **Experiment on Protein Structure unfolding : Role of Polar & non-polar environment.**
- b) **To determine protein denaturation & its role on Protein function.**
- c) **To differentiate Fractions of various Proteins using using Di-valent ions.**
- d) **Activity assays for various Proteins & enzymes from body fluids.**

References: -

- 1. Practical Clinical Biochemistry by Ranjana Cawla.
- 2. Practical Text Book of Biochemistry by Vasudevan & S.K.Das.
- 3. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox.
- 4. Harper's Illustrated Biochemistry by V.Rodwell et al.

BIOPHYSICS LAB

Course Code	MLPC-307
Course Title	Biophysics Lab
Number of Credits	2 (L:0, T:0, P:4)
Prerequisites	Understanding of biophysics theory
Course Category	Programme Core Course

Course Outcomes: -

1. Students will be able to understand basics of biophysical principles.
2. Students will be able to know to design experiments on biophysical principles.
3. Students will be able to evaluate/analyse observations of biophysical experiments.
4. Students will be able to evaluate/analyse observations of acid-base chemistry.
5. Students will be able to evaluate/analyse observations of osmosis and diffusion.

Course Content:-

Module- 1: List of experiments.

Number of class hours: 48 hrs

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of biophysical principles.
- 2) Students will be able to design experiments on biophysical principles.
- 3) Students will be able to evaluate/analyse observations of biophysical experiments.

Detailed content of the unit: -

1. Cleaning & drying techniques of different glass ware & plastics.
2. Preparation of solution of different strength and their standardization.
3. Preparation of buffers.
4. Detection & setting of pH of different solutions.
5. Preparation of colloidal dispersion system.
6. Separation of molecules by dialysis.
7. Purification of compounds by passing through semi-permeable membrane.
8. Performing experiments on diffusion.
9. Performing experiment on osmosis.
10. Performing experiments on viscosity.

Reference:-

1. Viva & Practical Biochemistry & Biophysics – Dr R N Roy
2. A Text book of Biophysics – Dr. R N Roy

3. Biophysics & Biophysical Chemistry- Debajyoti Das
4. Medical Biophysics- R.N.Roy
5. Text book of Biochemistry – U. Satyanarayan

PHYSIOLOGY LAB

Course Code	MLPC-308
Course Title	Physiology Lab
Number of Credits	2 (L:0, T:0, P:4)
Prerequisites	Basic knowledge on physiology theory
Course Category	PC

Course Outcomes: -

Upon completion of this course, Students will be able

1. To attained clinical aspects with correlate study of physiology of human body.
2. To identify different components of human blood.
3. To study different parameters associated with human blood.
4. Students will be able to evaluate clinical test results in physiology.
5. Students will be able to analyse clinical observations.

Course Content:-

Module- 1: Blood Examination:

Suggestive Learning Outcome: Students will be able to learn-

- 1) Collection of blood.
- 2) Identification of different components of blood.
- 3) Analysis of different blood parameters.
 1. To identify blood cells.
 2. To determine Total count and different count of a given sample of blood.
 3. To estimate the Haemoglobin Percentage in a given sample of blood.
 4. To determine the erythrocyte sedimentation rate of a given sample
 5. To determine the bleeding time and clotting time of a given sample of blood.
 6. To determine the Haematocrite value of a given sample of blood.
 7. To determine the packed cell volume, Mean corpuscular volume, Mean corpuscular Heamoglobin concentration and Colour Index of a given sample of blood.

ANATOMY LAB

Course Code	MLPC- 309
Course Title	Anatomy Lab.
Number of Credits	1 (L:0, T:0, P:2)
Prerequisites	Basic knowledge on anatomy theory
Course Category	Programme Core Course

Course Outcomes: - Upon completion of this course, students will be able

1. to attained clinical aspects with correlate study of bones.
2. to identify different parts of bones.
3. to study digestive system, Excretory system and Excretory system.
4. to identify different part of organs.
5. Students will be able to enumerate details of anatomical structures.

Course Content:-

Module- 1: Osteology

Number of class hours: 10

Suggestive Learning Outcomes: Students will be able to learn

- 1) Surface Anatomical plane and position of body.
- 2) Skeleton system and its number and name of bone.
- 3) To identified bones with their features.

Detailed content of the unit: -

- a) To determine the Anatomical position and plane, elementary anatomy of different system using skeleton
- b) To identify: Skull- Cranium-Face-Hyoid- Vertebral column- Vertebra- sternum- Ribs Scapula- Humerus- Radius- Ulna- Carpals- Metacarpal- Pelvicgirdles-femur- Tibia- Fibula- Tarsal- Metarsals- Phalanges.

Module- 2: Systemic Anatomy

Number of class hours: 05

Suggestive Learning Outcomes: Students will be able to learn

- 1) Digestive system.
- 2) Respiratory system.
- 3) Hear.
- 4) Reproductive and excretory system.

Detailed content of the unit:-

- a) To dissect digestive system in toad.
- b) To identify different parts of brain.
- c) To identify different parts of heart in Toad.
- d) To identify different parts of reproductive and excretory system in toad.

Summer Internship-I

Course Code	MLSI-310
Course Title	Summer Internship-I
Number of Credits	2 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Internship

Internships may be full-time or part-time; they are full-time in the summer vacation and part-time during the academic session.

Sl. no.	Schedule	Duration	Activities	Credits	Hours of Work
1	Summer Vacation after 2 nd Semester	3-4 Weeks	Inter/ Intra Institutional Activities **	2	80 Hours

(** Students are required to be involved in Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective Institutions; contribution at incubation/ innovation /entrepreneurship cell of the Institute; participation in conferences/ workshops/ competitions etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working for consultancy/ research project within the Institutes and Participation in all the activities of Institute's Innovation Council for e.g.: IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.)

Benefits to Students:

1. An opportunity to get hired by the Industry/ organization.
2. Practical experience in an organizational setting.
3. Excellent opportunity to see how the theoretical aspects learned in classes are integrated into the practical world. On-floor experience provides much more professional experience which is often worth more than classroom teaching.
4. Helps them decide if the industry and the profession is the best career option to pursue.
5. Opportunity to learn new skills and supplement knowledge.
6. Opportunity to practice communication and teamwork skills.
7. Opportunity to learn strategies like time management, multi-tasking etc. in an industrial setup.
8. Opportunity to meet new people and learn networking skills.
9. Makes a valuable addition to their resume.
10. Enhances their candidacy for higher education.
11. Creating network and social circle and developing relationships with industry people.
12. Provides opportunity to evaluate the organization before committing to a full-time position.

Course Outcome:-

After completion of the course, students will be able to:

C.O.1: Explain the real life organizational and industrial environment situations (K2).

C.O.2: Develop organizational dynamics in terms of organizational behaviour, culture and professional ethics (K1).

C.O.3: Understand the importance of Team work (K2).

C.O.4: Explain invaluable knowledge and networking experience (K2).

C.O.5: Develop skill to build a relationship with a prospective employer (K3).

Course Content:-

Internships are educational and career development opportunities, providing practical experience in a field or discipline. The Summer Internship-I is a student centric activity that would expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectives and the activities of the internship program are clearly defined and understood. Following are the intended objectives of internship training:

1. Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
2. Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
3. Exposure to the current technological developments relevant to the subject area of training.
4. Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions.
5. Create conditions conducive to quest for knowledge and its applicability on the job.
6. Learn to apply the Technical knowledge in real industrial situations.
7. Gain experience in writing Technical reports/projects.
8. Expose students to the engineer's responsibilities and ethics.
9. Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
10. Promote academic, professional and/or personal development.
11. Expose the students to future employers.
12. Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
13. Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

Overall compilation of Internship Activities / Credit Framework:

Major Head of Activity	Credit	Schedule	Total Duration	Sub Activity Head	Proposed Document as Evidence	Evaluated by	Performance appraisal/ Maximum points/ activity
Inter/ Intra Institutional Activities	2	Summer Vacation after 2 nd Semester	3-4 Weeks	Inter/ Intra Institutional Workshop/ Training	Certificate	Programme Head	Satisfactory/ Good/ Excellent
				Working for consultancy/ research project	Certificate	Programme Head	Satisfactory/ Good/ Excellent
				Festival (Technical / Business / Others) Events	Certificate	Programme Head	Satisfactory/ Good/ Excellent
				Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation Council	Certificate	Cell In-charge	Satisfactory/ Good/ Excellent
				Learning at Departmental Lab/Tinkering Lab/ Institutional workshop	Certificate	Cell In-charge	Satisfactory/ Good/ Excellent

STUDENT'S DIARY/ DAILY LOG

The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students.

The daily training diary should be signed at the end of each day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and get ratified on the day of his visit.

Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the

Institute immediately after the completion of the training. It will be evaluated on the basis of the following criteria:

- a) Regularity in maintenance of the diary.
- b) Adequacy & quality of information recorded.
- c) Drawings, sketches and data recorded.
- d) Thought process and recording techniques used.
- e) Organization of the information.

INTERNSHIP REPORT

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact Industrial Supervisor/ Faculty Mentor/TPO for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, TPO and Faculty Mentor. The Internship report will be evaluated on the basis of following criteria:

- a) Originality.
- b) Adequacy and purposeful write-up.
- c) Organization, format, drawings, sketches, style, language etc.
- d) Variety and relevance of learning experience.
- e) Practical applications, relationships with basic theory and concepts taught in the course.

Medical Laboratory Technology (MLT) Syllabus

Semester IV

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/Week	Credit
				L	T	P		
1	Programme core course-10	MLPC-401	Clinical Biochemistry	2	0	0	2	2
2	Programme core course-11	MLPC-402	Medical Microbiology	2	0	0	2	2
3	Programme core course-12	MLPC-403	Cytology & Histology	1	1	0	2	2
4	Programme core course-13	MLPC-404	Cell Biology & Genetics	1	1	0	2	2
5	Programme core course-14	MLPC-405	Clinical Biochemistry Lab	0	0	4	4	2
6	Programme core course-15	MLPC-406	Medical Microbiology Lab	0	0	4	4	2
7	Programme elective course-1 (Any one to be opted)	MLPE-407/A	Analytical Techniques	2	1	0	3	3
		MLPE-407/B	Microbial Technology					
8	Humanities & Social Science-4	HS-408	Professional Skill Development	2	1	0	3	3
9	Minor Project	MLPR-409	Minor Project	0	0	4	4	2
10	Mandatory Course-1	AU-410	Essence of Indian Knowledge and Tradition	2	0	0	2	0
Total				12	4	12	28	20

CLINICAL BIOCHEMISTRY

Course Code	MLPC-401
Course Title	Clinical Biochemistry
Number of Credits	2 (L:2, T:0, P:0)
Prerequisites	Knowledge of basic biochemistry & biophysics
Course Category	Programme Core Course

Course Outcomes: -

1. Students will be able to understand concepts & principles of Clinical Biochemistry.
2. Students will be able to enumerate the background details of various clinical tests regarding Clinical Biochemistry.
3. Students will be able to evaluate problems on Clinical Biochemistry.
4. Students will be able to understand Clinical Biochemistry of Blood Sugar , Diabetes , Blood Proteins, Serology & Hepato-renal functions.
5. Students will be able to gain knowledge on Clinical Biochemistry of Cardiac function and tumour markers & Endocrine Profiling and apply them.

Course Content:-

Module- 1: Clinical Biochemistry of Blood Sugar & Diabetes

Number of class hours: 04

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of and principles of Clinical Biochemistry.
- 2) Students will be able to enumerate various tests for diagnosis of glucose metabolism..
- 3) Students will be able to enumerate the observation and results of various tests.

Detailed content of the unit: - Clinical Biochemistry of Blood Sugar & Diabetes . Types of Diabetes & Differential diagnosis through Blood Sugar estimation -(PP), (F), (R), OGTT- Oral Glucose Tolerance Test , OGTT Curves & Interpretation of Results , Glycosylated Hemoglobin, Micro vascular complication.

Module- 2: Clinical Biochemistry of Blood Proteins, Serology

Number of class hours: 04

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of and principles of Blood Proteins.
- 2) Students will be able to analyse the significance of blood proteins.
- 3) Students will be able to enumerate the tests for blood proteins.
- 4) Students will be able to understand the basics of some serological tests.
- 5) Students will be able to enumerate the tests.
- 6) Students will be able to analyse the significance of these tests.

Detailed content of the unit: -Serum Protein, Serum Albumin, Serum Globulin, A:G Ratio , Clinical significance of Ceruloplasmin , Transferrin , Ferritin, Laboratory Detection of ASO RA, ASO , C- Reactive Proteins (CRP). Clinical significance of the serological tests.

Module-3: Clinical Biochemistry of Hepato-renal function

Number of class hours: 12

Suggestive Learning Outcomes:

- 1) Students will be able to understand the basics of tests done for the analysis of Hepato-renal Function.
- 2) Students will be able to enumerate various tests for Hepato-renal Function .
- 3) Students will be able to analyse significance of the tests.
- 4) Students will be able to understand the basics of Urine, Stool & Sputum Examinations.
- 5) Students will be able to enumerate the tests done for each type of clinical samples.
- 6) Students will be able to analyse the significance of these tests.

Detailed content of the unit: -Overview on metabolism of Blood urea, Uric Acid, Creatinine, BUN , Non protein Nitrogen , Bilirubin (fractions) , SGPT, SGOT, Serum Alkaline Phosphatase. GGTP (Gamma Glutamyl Transpeptidase) , EPO (Erythropoietin) , Vitamin D3 , Estimation of GFR, Urea & Creatinine Clearance test ,Advances in Hepato-Renal Evaluations.

Urine Routine tests, Urine Culture & Antibiotic Sensitivity, 24 hrs. urine collection and analysis. Abnormal constituents of urine, 17 Keto steroids, Urine micro albumin, Bence Jones Protein.

Stool tests– Principle, Method , clinical Significance of Stool –RE – Physical , Microscopic , Biochemical Examination ,Differential diagnosis of Gastrointestinal bleeding , Occult blood test . Sputum examination Routine & Culture , Collection , Handling ,Antibiotic sensitivity.

Module-4: Clinical Biochemistry of Cardiac function and tumour markers

Number of class hours: 08

Suggestive Learning Outcomes:

- 1) Students will be able to understand the basics of tests done for the analysis of Cardiac Function.
- 2) Students will be able to analyse the significance of various tests.
- 3) Students will be able to enumerate various tests for Cardiac Function.
- 4) Students will be able to understand the basics of tests done for Tumor markers.
- 5) Students will be able to enumerate various tests for these markers.
- 6) Students will be able to analyse the significance of these tests.

Detailed content of the unit: -Cholesterol, Tri-glycerides, VDL, HDL, VLDL, LDL, Electrolytes (Na^+ , Cl^- , HCO_3^- , Ca^{+2}) , Lactate Dehydrogenase , Troponin

Definition, type and clinical importance of Cancer markers.Laboratory Detection & Clinical Significance,Alpha Feto protein (AFP) , Carcino Embryonic Antigen (CEA), Prostate Specific Antigen (PSA).

Module- 5: Endocrine Profiling:

Number of class hours: 08

Suggestive Learning Outcomes:

- 1) Students will be able to understand the basics of tests done for Endocrine profiling.
- 2) Students will be able to analyse the significance of various tests.
- 3) Students will be able to enumerate various tests for Endocrine profiling.

Detailed content of the unit: - Role of Iodine in Thyroid hormone, Clinical significance & Laboratory detection of FT3,FT4 & total T3 - T4, TSH, LH, FSH, Serum Insulin, Human Chorionic Gonadotropin (HCG), Androgen, Estrogen, Progesterone, Aldosterones ,Hormone regulation of GI Secretion , Mucus , CCK , Hormone regulation of HCl , Enzymes , Use of Ryleis tube, Defination Clinical significance of Exophthalmic Goitre, Detection of Graves Disease and its Management.

References: -

1. Biochemistry – Harper
2. Biochemistry – Leninger
3. Viva & Practical Biochemistry & Biophysics – Dr R N Roy
4. Practical Biochemistry- D,M Vasudevan.
5. Biochemistry- Satyanarayan
6. Biochemistry - Ranjana Chawla.
7. Medical Laboratory Technology - Kolhatkar
8. Medical Laboratory Technology -Ramnik Sood

MEDICAL MICROBIOLOGY

Course Code	MLPC-402
Course Title	Medical Microbiology
Number of Credits	2 (L:2, T:0, P:0)
Prerequisites	Fundamental knowledge on biology
Course Category	Programme Core Course

Course Outcomes: -

- 1) Students will be able to understand basics of background and principles of microbiology.
- 2) Students will be able to apply tools of microbiology like sterilisation, media preparation.
- 3) Students will be able to understand/analyse extent of bacterial infection.
- 4) Students will be able to understand extent of viral infection.
- 5) Students will be able to understand extent of fungal infection.

Course Content:-

Module- 1: Introduction of microbiology

Number of class hours: **3 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of microbiology.
- 2) Students will be able to understand various types of microbes.
- 3) Students will be able to understand significance of microbiology.

Detailed content of the unit: -

History and Scope- Role of Microbes in agriculture, public health, medicine and industry,

Organization of Prokaryotic and Eukaryotic Cell Structure and Function, Types and Classification of microbes.

Module- II: Bacteriology

Number of class hours: **5 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background of bacteriology.
- 2) Students will be able to understand various types of bacteria.
- 3) Students will be able to understand significance of bacteria.

Detailed content of the unit: -

a. Introduction

b. Morphology

c. Nutritional requirements, metabolism and growth

d. Classification and identification of bacteria.

Module- III: Culture media & Sterilization technique

Number of class hours: **6 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background of culture media.
- 2) Students will be able to understand various types of culture media.
- 3) Students will be able to understand significance of culture media.
- 4) Students will be able to understand basics of background and principles of sterilization.
- 5) Students will be able to understand various types of sterilization techniques.
- 6) Students will be able to understand significance of sterilization.

Detailed content of the unit: -

a. Composition

b. Preparation of different media

c. Procedure of isolation of bacteria

d. Culture of bacteria

Sterilisation

a. Different sterilization methods

b. Autoclave

c. Laminar air flow system.

Module- IV: Virology

Number of class hours: **4 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background of virology.
- 2) Students will be able to understand various types of virology.
- 3) Students will be able to understand significance of virology.

Detailed content of the unit: -

a. Definition and Classification of virus

b. Nature or Characteristics of virus

c. Mode of infection of virus

d. Virus producing diseases

Module- V: Mycology and study of following organisms

Number of class hours: **3 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background of mycology.
- 2) Students will be able to understand various types of mycology.
- 3) Students will be able to understand significance of mycology.
- 4) Students will be able to understand basics of background of misc organisms.
- 5) Students will be able to understand various types of misc organisms.

6) Students will be able to understand significance of misc organisms.

Detailed content of the unit: -

- a. Definition and classification**
- b. Characteristics of fungus**
- c. Mode of infection**
- d. Manifestation of fungal infection.**

Organism:

- a. Staphylococci**
- b. Streptococci**
- c. Neisseria**
- d. *E. coli***
- e. Mycobacterium**
- f. *Corynebacterium diphtheriae***
- g. Hepatitis virus**
- h. HIV**

Reference:

1. Text Book of Microbiology- Ananthanarayan & Paniker
2. Medical Microbiology- R.Panjarathinam
3. Microbiology for the Health Sciences- G.R.W.Buston & P.G.Engelkirk
4. Microbiology- A Introduction- Tortora, Funke & Case
5. Prescott's Microbiology by Willey, Sherwood and Woolverton.
6. Brock Biology of Microorganisms by Madigan, Martinko, Stahl and Clark.
7. General Microbiology by Stanier, Ingraham, Wheelis and Painter.
8. Text book of Microbiology- P. Chakraborty

CYTOLOGY & HISTOLOGY

Course Code	MLPC-403
Course Title	Cytology & Histology
Number of Credits	2
Prerequisites	Basic knowledge of Anatomy , Physiology & pathology
Course Category	Programme Core Course

Course Outcomes: -

- 1) Students will be able to understand basic principle of cytology & histology.
- 2) Students will be able to understand and analyse various problems related to tissue processing.
- 3) Students will be able to understand histological section cutting.
- 4) Students will be able to understand staining of histological samples.
- 5) Students will be able to understand specialised techniques of histology.

Course Content:-

Module- 1: Introduction

Number of class hours: **4 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of histology.
- 2) Students will be able to understand cytology.
- 3) Students will be able to know different components of histology and cytology.

Detailed content of the unit:-

- a. The cell, metabolism of cell
- b. Cell division
- c. Outline of tissue examination

Module- 2: Tissue processing

Number of class hours: **6 hrs**

Suggestive Learning Outcomes:

1. Students will be able to learn various types of fixative and decalcifying agent.
2. Students will be able to learn roles of fixative and decalcifying agent.
3. Students will be able to know effective fixative and decalcifying agent.
4. Students will be able to learn the technique of fixation and decalcification.
5. Dehydration and dehydrating agent.

6. Clearing agent
7. Impregnation and embedding process.
8. Effectiveness of Gelatin and Plastic embedding.

Detailed content of the unit:-

- a. Fixation and different types of fixatives
- b. Fixation of smears and specimens
- c. Secondary fixation
- d. Decalcification
- e. Dehydration and cleaning
- f. Impregnation and embedding
- g. Gelatin embedding & plastic embedding

Module- 3: Section cutting and staining

Number of class hours: **5 hrs**

Suggestive Learning Outcomes:

Students will be able to learn

- a. Various types of microtome
- b. Advantages and disadvantages of microtomes
- c. Selection of suitable section.
- d. Urgent tissue section and ribbon section.
- e. Type of staining
- f. Procedure of staining
- g. Affinity of dye and its properties.
- h. Effect of Haematoxylin staining solution .

Detailed content of the unit:-

- a. Microtome in detail
- b. Section cutting
- c. Chemistry and classification of dye
- d. Natural dye, synthetic dye, basic dye, acidic dye and neutral dye.
- e. Staining properties of dyes
- f. Methodology of staining
- g. Haematoxylin staining solution

Module- 4: Staining of various samples

Number of class hours: **2 hrs**

Suggestive Learning Outcomes:

Students will be able to know a. various types of staining on tissue substance and sample.

Detailed content of the unit:-

- a. Staining of carbohydrates, lipids, CNS and tissues
- b. Staining of different body fluids
- c. Staining of various tissue samples

Module- 5: Specialised cytopathology

Number of class hours: **6 hrs**

Suggestive Learning Outcomes:

Students will be able to learn

- a. Preparation and analysis of PAP smear.
- b. Preparation and analysis of endometrial aspiration.
- c. Preparation and analysis of ovarian cyst aspiration.
- d. Technique of FNAC
- e. Analysis of Immunochemistry.
- f. Different type of needle gauge and its use.
- g. Various types of biopsy
- h. Process of lumbar puncture.

Detailed content of the unit:-

- a. Gynecological cytopathology – preparation and analysis of PAP smear, endometrial and ovarian cyst aspirations
- b. Bronchial cytopathology – bronchial fluid, bronchial wash, bronchoalveolar lavage, AFB, GMS, PAS, MGG, Gram stain etc.
- c. Urine cytopathology – identification of infection, non-neoplastic lesion and malignancy
- d. FNAC
- e. Immunohistochemistry (IHC)
- f. Different types of needle gauge.
- g. Biopsy, Lumbar puncture.

References:

1. Previous years question papers for Superspeciality Pathology Examinations 2020, Author: Dr. Ranjan Agrawal.
2. Manual of Histological Techniques Author: Dr. Santosh Kumar Mondal.
3. Text book of Pathology by Harsh Mohan
4. Pathology Practicals, Publisher:- CBS Publication, Author:- Dr. Santosh Kumar Mondal

Cell Biology & Genetics

Course Code	MLPC-404
Course Title	Cell Biology & Genetics
Number of Credits	2
Prerequisites	Basic understanding of biochemistry and physiology
Course Category	Programme core course-13 (L+T)

- Course Outcomes:** -
- 1) Students will be able to understand various concepts & principles of Cell biology and genetics.
 - 2) Students will be able to enumerate the background of Cellular and Gnomonic organizations.
 - 3) Students will be able to evaluate problems on Cell biology and Genetics.
 - 4) Students will have understanding of Cell division and clinical significance of mutations and Cancer.
 - 5) Students will be able to understand and analyse principles of human genetics , clinical genetics and introductory Genomics.

Course Content:-

Module- 1: Cellular Organization, Genome organization & Genetic material

Number of class hours: **8 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Cell biology.
 - 2) Students will be able to enumerate various types of cell organelles and their structures.
 - 3) Students will be able to analyse significance of cell biology.
- Students will be able to understand basics of Genome organization.
- 4) Students will be able to enumerate various types of Chromatin materials with their structures.
 - 5) Students will be able to analyse significance of experimental cell biology and their principle.

Detailed content of the unit: -

Ultra structure of Eukaryotic cell & its organelle, Microscopy for Cell biology & different kinds of microscopes & their applications for visualizing cells and tissues ,Outline of Cell to Tissue , Cell-Cell junctions , Metamorphosis, Role of apoptosis in organ development , Stem cells, Pluripotency and iPS cells , Embryonic development & role of placenta.

Organization of Prokaryotic and Eukaryotic genome; Fine structure of the Gene: Cistron, muton, and recon, Organization of Chromatin material- Chromosome ,Centromere based Classification, Lampbrush & Polytene Chromosome , Nucleosome model, Transposons, Sex chromatin , Barr Body & its significance , Discovery of DNA as genetic material, Experiments of Griffith; Avery, McCleod and; McCarthy, and Harshey and Chase.

Module- 2: Cell Cycle & Cell Division:

Number of class hours: **4 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of Cell cycle.
- 2) Students will be able to enumerate basics of Cell division.
- 3) Students will be able to analyse role of various factors in regulation of cell cycle.

Detailed content of the unit: -

Cell cycle phases & regulation , Role of CDK and associated factors , Cell cycle check points & Proto -oncogenes , Stages of Mitosis & Meiosis , Nuclear pore complex, Synaptonemal complex , Molecular basis of Crossing over & Recombination ,

Module- 3: Cellular & Molecular basis of Mutations, Metastasis and Cancer:

Number of class hours: **4 hrs**

Suggestive Learning Outcomes:

1. Students will be able to understand basics of Mutagenesis & its types.
2. Students will be able to enumerate various types of inducers.
3. Students will be able to evaluate significance of various chemotherapeutic factors & molecular diagnosis.
4. Students will be able to understand some basics of Cancer.
5. Students will be able to enumerate significance of some types of Cancer & will be able to explain role of various chemotherapeutic factors & molecular diagnosis..

Detailed content of the unit: -

Mutagenesis & Types (Base substitution, Frame-shift & so on), Experimental induction of mutation , Biochemical basis of mutation - Chemical & Physical inducers , Experimental detection of carcinogens by AMES test , Metabolic blockage of Arginine pathway in *Nurospora* , Gene silencing , RNA interference , Terminator gene technology.

Cellular transformation & Cancer, Classification on the basis of tissue types , Characteristics , Role of nucleotide analogs as chemotherapeutic agents , Advances in Molecular diagnosis & therapy.

Module- 4: Mendelian Genetics, Microbial Genetics, Human Genetics & Epigenetics:

Number of class hours: **12 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of Genetics.
- 2) Students will be able to understand principles of microbial Genetics.
- 3) Students will be able to evaluate various factors in microbial Genetics. & Human Genetics.
- 4) Students will be able to enumerate various concepts of Human Genetics & genetic diseases.

Detailed content of the unit: -

Independent Assortment & Segregation , Linkage & its types , Cytoplasmic Inheritance , Concept of Allels & Multiple Allelism , Sex determination in Human.

Transformation , Transduction and Conjugation, Role of F factor, Hfr and F-duction , Making competent *E. coli* cells using chemical methods , Transformation of *E. coli* and calculation of competence.

Molecular basis & Diagnosis of Genetic traits, Genetics of ABO & Rh Blood group inheritance , Erythroblastosis foetalis, Congenital Chromosomal abnormalities - Down's Syndrome , Klinefelter's & Turner Syndrome , Mode of inheritance of Autosomal & Sex linked genes with respect to albinism , Colour blindness , Hemophilia , Thalassemia , Mitochondrial disorders & Inborn errors of Metabolism , Megdel Syndrome , Barth Syndrome, Amino acid metabolism disorders - Phenyl ketonuria , Alkaptonuria , Sickle cell anemia , Regulation of Gene expression , Operon concept , Catabolite repression, Role of Histone , Histone deacetylase based Epigenetic regulation.

Module- 5: Clinical Genetics & Introductory Genomics:

Number of class hours: **4 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand principles of Clinical Genetics.
- 2) Students will be able to enumerate various concepts of Introductory Genomics.
- 3) Students will be able to evaluate significance in Clinical Genetics & Genomics.

Detailed content of the unit: -

Differential staining & mounting of human cell & tissue, Method of Karyotyping , Method of Linkage mapping , Pedigree analysis of common human traits , DNA Fingerprinting , Fluorescent In-situ Hybridization , Flowcytometry , Chromosome banding & Chromosome walking , Minisatellite & Micro-satellite based Fingerprinting for Forensic applications , Genetic tests for tissue typing - Donor recipient cross matching , Variants of PCR , Blotting of Nucleic acids & Proteins , Probe design & labeling , Whole Genome Sequencing , Shotgun sequencing , NGS- Next Generation Sequencing , Visualization of NGS data , Database handling ,

REFERENCES:

1. Lewin's GENES XII by Jocelyn E. Krebs Elliott S. Goldstein and Stephen T. Kilpatrick Martin .
2. Textbook on Molecular Genetics by D. N. Bharadwaj (2009); Kalyani Publisher.
3. Genetics by P.K. Gupta.
4. Molecular Genetics by Primrose.
5. Molecular Biology of the Gene -II , by Watson et al.
6. Molecular Biology of the Gene -IV , by Watson et al.
7. Principles of Gene Manipulation & Genomics , by Primrose & Twyman.
8. "Introductory Structural Biology" -NPTEL Course By Dr. Saugata Hazra , Department of Biotechnology , Indian Institute of Technology Roorkee (IITR).
Link of the course: https://onlinecourses.nptel.ac.in/noc21_bt14/preview

CLINICAL BIOCHEMISTRY LAB

Course Code	MLPC-405
Course Title	Clinical Biochemistry Lab
Number of Credits	2
Prerequisites	Theoretical exposure to Clinical Biochemistry.
Course Category	Programme core course-14(P)

Course Outcomes: -

- 1) Students will be able to examine various samples by performing clinical tests.
- 2) Students will be able to perform some clinical estimation of metabolites.
- 3) Students will be able to evaluate diagnostic role of some clinical tests.
- 4) Students will be able to analyse the data of the clinical tests results.
- 5) Students will be able to interpret the observations of these tests and apply them.

Course Content:-

Module- 1: List of Experiments

Number of class hours: **68 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of Clinical Biochemistry Laboratory Practices.
- 2) Students will be able to design experiments on Clinical Biochemistry Laboratory.
- 3) Students will be able to evaluate/analyse observations of Clinical Biochemistry Laboratory experiments.

Detailed content of the unit: -

- 1. Clinical Biochemistry Laboratory Safety , disposal of biodegradable wastes & Hazard Analysis.**
- 2. Laboratory diagnosis of Diabetes & Hyperglycaemia by Fasting & Random Blood Sugar estimation.**
- 3. Estimation of Post Prandial Blood sugar & the Concept of OGTT.**
- 4. Clinical Biochemistry of Blood Proteins -Albumin .**
- 5. Laboratory Detection of Globulins & Analysis of A: G with Clinical significance.**
- 6. Clinical Biochemistry evaluation of Hepato-renal function by detection of Bilirubin (fractions).**
- 7. Laboratory analysis of SGPT .**
- 8. Laboratory analysis of SGOT.**
- 9. Detection of Renal function through estimation of Urea.**
- 10. Laboratory detection of Creatinine.**
- 11. Laboratory analysis of Uric acid.**

- 12. Clinical Biochemistry evaluation of Lipids for Cardiac & related function – LDL , HDL , VLDL.**
- 13. Clinical Biochemistry analysis of total Cholesterol.**
- 14. Clinical Biochemistry evaluation of endocrine functions.**
- 15. Clinical examination of Body fluids – Urine Examination (RE , ME , Strip Test , Proteinuria).**
- 16. Laboratory procedures for Sputum Analysis.**
- 17. Clinical examination of Stool.**

References: -

- 1) Biochemistry – Harper
- 2) Biochemistry – Leninger
- 3) Viva & Practical Biochemistry & Biophysics – Dr R N Roy
- 4) Practical Biochemistry- D,M Vasudevan
- 5) Biochemistry- Satyanarayan
- 6) Biochemistry - Ranjana Chawla.
- 7) Medical Laboratory Technology - Kolhatkar
- 8) Medical Laboratory Technology -Ramnik Sood.

MEDICAL MICROBIOLOGY LAB

Course Code	MLPC-406
Course Title	Medical Microbiology Lab
Number of Credits	4
Prerequisites	Basic understanding of microbiology theory
Course Category	Programme Core Course

Course Outcomes: -

- 1) Students will be able to understand basics of microbiology.
- 2) Students will be able to design experiments on microbiology.
- 3) Students will be able to perform experiments on sterilisation.
- 4) Students will be able to perform experiments on media preparation.
- 5) Students will be able to evaluate/analyse observations of microbiological experiments.

Course Content:-

Module- 1: List of experiments

Number of class hours: **48 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of microbiology.
- 2) Students will be able to design experiments on microbiology.
- 3) Students will be able to evaluate/analyse observations of microbiological experiments.

Detailed content of the unit: -

- 18. Microbial Good Lab Practices and Biosafety**
- 19. Preparation of different culture media (solid media and liquid media).**
- 20. Sterilization of different culture media and sterility testing.**
- 21. Culturing different bacterial strains on culture media.**
- 22. Microbial Growth Curve Determination**
- 23. Isolation of bacteria from the infected area such as throat swab, urethral smear, vaginal smear, tear, wounds, septic focus.**
- 24. Collection of sputum for 24 hours & identification Acid fast bacilli (Concentration method).**
- 25. Collection of urine for 24 hours & different test of it (Qualitative, culture, microscopical etc.)**
- 26. Composition of different stain & Procedure of staining such as Gram's stain, Zeil Nelson stain etc.**
- 27. Identification of gram positive and gram negative bacteria by staining.**
- 28. Biochemical tests for microbial identification**
- 29. Antibiotic Sensitivity of Microorganisms**

ANALYTICAL TECHNIQUES

Course Code	MLPE-407/A
Course Title	Analytical Techniques
Number of Credits	3
Prerequisites	Understanding of calculations and analysis
Course Category	Programme Elective Course

Course Outcomes: -

- 1) Students will be able to understand basics of titration and analytical techniques.
- 2) Students will be able to principle and application UV-Visible Spectrophotometer.
- 3) Students will be able to principle and application pH meter and chromatography.
- 4) Students will be able to principle and application flame photometer.
- 5) Students will be able to principle and application auto-analyser.

Course Content:-

Module- 1: Basics of clinical analysis, Oxidation-reduction reaction and Optimization techniques

Number of class hours: **12 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of clinical analysis.
- 2) Students will be able to know applications of clinical analysis.
- 1) Students will be able to understand basics of clinical optimization techniques.
- 2) Students will be able to know applications of clinical optimization techniques.
- 1) Students will be able to understand basics of oxidation reduction reaction.
- 2) Students will be able to know applications of oxidation reduction reaction.
- 3) Students will be able to evaluate/analyse problems of oxidation reduction reaction.

Detailed content of the unit: -

Calculations for dilution, preparation of different types of solution (O/W, W/O), Suspension, proof spirit, rectified spirit etc.

Oxidation-reduction reactions, Titration (acid-base & non-aqueous, indicators used).

Process optimization, optimization of titration and chemical reactions, solution preparation optimization.

Module- 2: UV-Vis spectrophotometric analysis

Number of class hours: **6 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of UV-Vis spectrophotometer.
- 2) Students will be able to know applications of UV-Vis spectrophotometer.

3) Students will be able to evaluate/analyse problems of UV-Vis spectrophotometer.

Detailed content of the unit: -

- a. Principle**
- b. Lambert-Beer law, combined law**
- c. λ_{max} , calibration curve**
- d. Instrumentation and application**
- e. Colorimetric analysis**

Module- 3: pH meter and Chromatography

Number of class hours: **4 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of pH meter.
- 2) Students will be able to know applications of pH meter.
- 3) Students will be able to evaluate/analyse problems of pH meter.
- 1) Students will be able to understand basics of chromatography.
- 2) Students will be able to know applications of chromatography.
- 3) Students will be able to evaluate/analyse problems of chromatography.

Detailed content of the unit: -

- a. Principle**
- b. Electrodes**
- c. Instrumentation**
- d. Application**

Chromatography-

- a. Principle and different types of chromatography**
- b. Solid phase & liquid phase.**
- c. Different parameters of qualitative and quantitative analysis**
- d. Details of thin layer chromatography**
- e. Details of paper chromatography**

Module- 4: Flame photometric analysis

Number of class hours: **3 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of flame photometer.
- 2) Students will be able to know applications of flame photometer.
- 3) Students will be able to evaluate/analyse problems of flame photometer.

Detailed content of the unit: -

- a. Principle**
- b. Instrumentation**
- c. Analysis of ions**
- d. Clinical application**

Module- 5: Autoanalyser

Number of class hours: **2 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of autoanalyser.
- 2) Students will be able to know applications of autoanalyser.
- 3) Students will be able to evaluate/analyse problems of autoanalyser.

Detailed content of the unit: -

a. Types and characteristics

b. Instrumentation

c. Limitation

d. Application

References:

1. Chemical Analysis and Material Characterisation, Author L Bhim Prasad Kafle, Elsevier.
2. Spectrophotometry by Thomas Germer Joanne Zwinkels Benjamin Tsai
3. Chromatography: Concepts and Contrasts, Book by James M Miller

MICROBIAL TECHNOLOGY

Course Code	MLPE-407/B
Course Title	Microbial Technology
Number of Credits	3
Prerequisites	Basic understanding of microbiology
Course Category	Programme Elective Course

Course Outcomes: -

- 1) Students will be able to understand basics of microbial technology and fermentation.
- 2) Students will be able to understand and apply sterilisation in microbial technology.
- 3) Students will be able to understand process development in microbial technology.
- 4) Students will be able to understand purification techniques in microbial technology.
- 5) Students will be able to understand antisense and other techniques in microbial technology.

Course Content:-

Module- 1: Brief history of fermentation, Types of fermentations

Number of class hours: **8 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of fermentation technology.
- 2) Students will be able to know applications of fermentation technology.
- 3) Students will be able to evaluate/analyse problems of fermentation technology.
- 1) Students will be able to understand types of fermentation technology.
- 2) Students will be able to know applications of fermentation technology.
- 3) Students will be able to evaluate/analyse problems of fermentation technology.

Detailed content of the unit: -

Fermentation- general concepts, Applications of fermentation; Range of fermentation process- Microbial biomass, enzymes, metabolites, recombinant products, transformation process; Component parts of a fermentation process.

Aerobic and anaerobic fermentation, Submerged and solid state fermentation; Factors affecting submerged and solid state fermentation; Substrates used in SSF and its advantages; Culture media- types, components and formulations. Sterilization: Batch and continuous sterilization.

Module- II: Process development, Aeration, agitation

Number of class hours: **8 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of bio-process technology.
- 2) Students will be able to know applications of bio-process technology.

- 3) Students will be able to evaluate/analyse problems of bio-process technology.
Students will be able to understand basics of aeration and agitation in bio-process technology.
- 2) Students will be able to know applications of aeration and agitation in bio-process technology.
- 3) Students will be able to evaluate/analyse problems related to aeration and agitation in bio-process technology.

Detailed content of the unit: -

Optimization of a process, Classical and statistical methods of optimization, Immobilization: different matrices, whole cell and enzyme immobilization; Scale up of bioprocess General concept of a fermenter- Batch, fed-batch and continuous fermentation.

Effect of aeration and agitation on fermentation, Oxygen requirement and oxygen supply, Oxygen transfer kinetics; Determination of K_{La} value; Effect of agitation and microbial biomass on K_{La} value; Newtonian and non-Newtonian fluids; Foam and antifoams, their effect on oxygen transfer; Fermentation economics.

Module- III: Sterilisation

Number of class hours: **4 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of sterilization in bio-process technology.
- 2) Students will be able to understand significance of sterilization in bio-process technology.
- 3) Students will be able to evaluate/analyse problems related to sterilization in bio-process technology.

Detailed content of the unit: -

Pure cultures and aseptic techniques; Nutritional Types; Bacterial growth curve, Metagenomics for the isolation of genes for novel enzymes; Types of PCR, Light microscopy.

Module- IV: Purification of microbial protein

Number of class hours: **7 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of purification of microbial protein.
- 2) Students will be able to understand significance of purification of microbial protein.
- 3) Students will be able to evaluate/analyse problems related to purification of microbial protein.

Detailed content of the unit: -

Electrophoretic separation of protein; Characterization using- PAGE/ gel filtration method, native and SDS-PAGE; 2D-PAGE; capillary electrophoresis; IEF; Differential centrifugation and purification by density gradient centrifugation; Chromatographic methods of separation; Principles and applications of Paper; Thin layer; Gas-liquid;

HPLC and FPLC; Spectrophotometry- Principles and applications UV-Visible, Mass Spectrometry, MALDI-TOF, Atomic Absorption Spectrometer.

Module- V: Antisense and RNAi technology and Tracer techniques in biology

Number of class hours: **8 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of antisense and RNAi technology.
- 2) Students will be able to understand significance of antisense and RNAi technology.
- 3) Students will be able to know application of antisense and RNAi technology.
- 1) Students will be able to understand basics of tracer techniques in biology.
- 2) Students will be able to understand significance of tracer techniques in biology.
- 3) Students will be able to know application of tracer techniques in biology.

Detailed content of the unit: -

Protein and DNA sequencing techniques- Maxam–Gilbert sequencing, Chain-termination methods, Massively Parallel Signature Sequencing (MPSS), Pyrosequencing, Illumina (Solexa) sequencing, Solid sequencing; Genomic and cDNA library preparation; RFLP; RAPD and AFLP techniques.

Concept of radioactivity; radioactivity counting methods with principles of different types of counters; Concept of α , β and γ emitters, scintillation counters; γ -ray spectrometers; autoradiography; applications of radioactive tracers in biology, FACS.

References

1. Stanbury, P. F., Whitaker and Hall, A. S. J., Principles of Fermentation Technology. Butterworth-Heinemann
2. Shuler, M.L. and Karg, I F., Bioprocess Engineering Basic Concepts , Prentice Hall.
3. Vogel, H.C. Todaro, C.L. and Todaro C.C., Fermentation and Biochemical Engineering
4. Handbook: Principles, Process Design, and Equipment, Noyes Data Corporation/ Noyes
5. Publications.
6. Crueger W. and Crueger, A., Biotechnology. A Textbook of Industrial Microbiology, Sinauer Associates.
7. Friefelder. D. (1982) Physical Biochemistry, Application to Biochemistry and Molecular Biology, 2 nd ed. W.H. Freeman and Company, San Fransisco.
8. William, B.L. and Wilson, K. (1986). A Biologist Guide to Principles and Techniques
9. Practical Biochemistry, 3 rd ed., Edward Arnold Publisher, Baltimore, Maryland (USA).
10. Reed, G., Prescott and Dunn's Industrial Microbiology, AVI publication
11. Casida L. E. J. R., Industrial Microbiology, New Age (1968)

Professional Skill Development

Course Code	:	HS 408
Course Title	:	Professional Skill Development (Theory)
Number of Credits	:	3 (L: 2, T: 1, P:0)
Prerequisites	:	NIL
Course Category	:	HS

Course Outcomes:

After successful completion of this course, students would be able to:

CO1: Understand the importance of soft skills and personality in a person's career growth. K2

CO2: Communicate uprightly while looking for a job. K3

CO3: Learn and utilize the key skills while facing job interview. K2 & K3

CO4: Demonstrate effective writing skills for professional excellence. K2

CO5: Explore ways to make oral communications interesting and captivating. K3

Unit – 1 Soft Skills & Personality Development

Number of Class Hours: 06

Marks: 08

Learning Outcomes:

- 1) Get acquainted with the details of soft skills and the importance of personality K1
- 2) Understand the importance of communication skills in developing one's personality. K2
- 3) Understand the importance of soft skills and personality in a person's career growth K2

Detailed Content:

1. **Soft skills - Demand of Every Employer:** How soft skills complement hard skills, Soft skills as competitive weapon, Classification of soft skills into personal and

interpersonal traits, Soft skills needed for career growth- Time management, Leadership traits, Communication and networking skills, Teamwork and Interpersonal skills, Empathy and Listening skills, Responsibility, Attitude, Ethics, Integrity, Values and Trust.

2. **Personality Development – A must for career Growth:** Grooming one's personality as a signal that others read, mapping different personality types – Perfectionists, Helpers, Achievers, Romantics, Observers, Questioners, Enthusiasts or adventurers, Bosses or asserters, Mediators or peacemakers.

Unit – 2 Looking for a Job

Number of Class Hours: 05

Marks: 08

Learning Outcomes:

- 1) Learn to write Job Applications, Cover Letter, Resume, Curriculum Vitae, bio data
K2
- 2) Develop interpersonal skills/ soft skills through Group Discussion. K3

Detailed Content

1. Job Application : Job Application Letters in response to advertisements, Self-application letters for Jobs
2. Curriculum Vitae/Resume: Formats of Resume and CV for a fresher and for someone with experience, Differences between Resume, CV, Bio-data, and choice of referees.
3. Group Discussion : A test of soft skills

Unit – 3 Job Interviews

Number of Class Hours: 05

Marks: 08

Learning Outcomes:

- 1) Understand the importance of Job interviews in the selection procedure K2
- 2) Comprehend and Adapt to various types, stages and processes of job interviews
K1&K3
- 3) Demonstrate appropriate body language in interviews K3

Detailed Content

1. Job Interviews: Definition, processes of Interviews, Types of Interviews
2. Stages in Job interviews: Before interview stage, On D' Day, After interview stage.

3. Importance of Body language in Interviews: : Facing an interview, Using proper verbal and non- verbal cues, the perfect handshake ,Exhibiting confidence, the business etiquettes to maintain, body language ,and dress code - what to speak, how to speak in an interview and answer interview questions, negative body language, handling an awkward situation in an interview.
4. Probable interview questions and answers.
5. Mock interviews to be conducted by mock interview boards.

Unit – 4 Enhancing Writing skills

Number of Class Hours: 12

Marks: 08

Learning Outcomes:

- 1) Write dialogues on given topics / situations K3
- 2) Express facts & ideas effectively in written form K3
- 3) Learn to write formal and informal letters & emails. K2

Detailed Content

- 1) **Art of Condensation:** Principles to increase clarity of written communication.
- 2) **Dialogue Writing:** Meeting and Parting, Introducing and Influencing, Requests, Agreeing and Disagreeing, Inquiries and Information.
- 3) **Letter Writing:** Placing an order, Letter to Inquiry, Letter of Complaint, Letter seeking permission.
- 4) **E- mail writing:** writing the perfect e-mail, steps to the perfect e-mail, formal and informal greetings, requests through an e-mail, writing an apology, complaint and seeking help and information in an e-mail, informing about a file attached in an email, writing the formal ending of an e-mail.

Unit – 5 Conversations, Panel Discussion and Public Speaking

Number of Class Hours: 12

Marks: 08

Learning Outcomes:

1. Speak persuasively on a given topic fluently and clearly. K3
2. Participate in formal and informal conversations. K3
3. Express ideas and views on given topics. K3

Detailed Content

1) Conversation & Dialogue Practice:

- a) Introducing oneself
- b) Introduction about family

- c) Discussion about the weather
- d) Seeking Permission to do something
- e) Seeking Information at Railway Station/ Airport
- f) Taking Appointments from superiors and industry personnel
- g) Conversation with the Cashier- College/ bank
- h) Discussing holiday plans
- i) Asking about products in a shopping mall
- j) Talking over the Telephone

2) **Panel Discussion:** Act of a moderator - ways to respond to audience questions.
Suggested topics: Current Affairs

3) **Public Speaking:** Art of Persuasion, Making speeches interesting, Delivering different types of speeches: Ceremonial, Demonstrative, Informative, Persuasive.

List of Software/Learning Websites

1. <http://www.free-english-study.com/>
2. <http://www.english-online.org.uk/course.htm>
3. <http://www.english-online.org.uk/>
4. <http://www.talkenglish.com/>
5. <http://www.learnenglish.de/>

Reference Books:

(Name of Authors/ Title of the Book /Edition /Name of the Publisher)

- 1) Sanjay Kumar & PushpLata Communications Skills , 2nd Edition, Oxford University Press
- 2) Meenakshi Raman & Sangeeta Sharma Technical Communication: Principles & Practice Oxford University Press
- 3) M. Raman & S. Sharma Technical Communication Oxford University Press
- 4) Barun Kumar Mitra, Personality Development and Soft Skills Oxford University Press

Minor Project

Course Code	CEPR-409
Course Title	Minor Project
Number of Credits	2 (L: 0, T: 0, P: 4)
Prerequisites	Nil
Course Category	Project Work (PR)

Course Outcome:-

After completion of the course, students will be able to:

C.O.1: Demonstrate a thorough and systematic understanding of project contents (K2).

C.O. 2: Identify the methodologies and professional way of documentation and communication (K3).

C.O. 3: Illustrate the key stages in development of the project (K2).

C.O. 4: Develop the skill of working in a Team (K3).

C.O. 5: Apply the idea of mini project for developing systematic work plan in major project (K3).

Course Content:-

The minor project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

- 1) Perform detailed study about various components of a project.
- 2) Study about methodologies and professional way of documentation and communication related to project work.
- 3) Develop idea about problem formulation.
- 4) Knowledge of how to organize, scope, plan, do and act within a project thesis.
- 5) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
- 6) Demonstrate the implementation of a minor project work.

ESSENCE OF INDIAN KNOWLEDGE AND TRADITION

Course Code	AU 410
Course Title	Essence of Indian Knowledge and Tradition
Number of Credits	0
Prerequisites	NA
Course Category	Audit

Course Outcomes: -

After completion of the course the students will be able to-

CO 1: Understand the essence of Indian tradition and the importance of carrying them forward. (K₂)

CO 2: Understand the Vedic literature and important ideas discussed in the Vedas. (K₂)

CO 3: Describe scientific heritage of ancient India along with comprehending its relevance and application in various modern scientific disciplines. (K₁)

CO 4: Relate the theoretical and practical sides of the science of Yoga and Aurveda with modern knowledge systems. (K₁)

CO 5: Explain the worth of Indian intellectual heritage, traditional practices and Indian lifestyle from scientific lenses. (K₄)

Module- 1

Name of the Module: Introduction to Vedic Literature

Number of class hours: **05**

Content:

- General structure of Vedic Literature,
- Different theories on the age of the Vedas,
- Educational system in the Vedic times
- subject-matter of R̥gveda-samhitā, Sāmaveda -Samhitā, Yajurveda-Samhitā, Atharvaveda-Samhitā, Brāhmaṇa and Āraṇyaka literature, Upaveda

Learning outcomes of the Module

1	Describe the Vedic literature (K1)
2	Outline the heritage of ancient India specially the scientific knowledge that is embedded in the Vedas will be shown through this module (K2)

Module- 2

Name of the Unit: Fundamental doctrines of the *Upaniṣads*

Number of class hours:**05**

Content:

- General introduction of Upaniṣadic literature
- Philosophical ideas and ethics in Upaniṣadas

Learning outcomes of the Module

1.	Understand Upaniṣads and its significance as the perennial source Indian philosophy (K2)
2.	Explain the scientific temperament, knowledge and methods of scientific enquiry that is embedded in the Upaniṣadas (K2)

Module- 3

Name of the Unit: *Vedāṅgas*, Purāṇas and Dharmaśāstra Literature

Number of class hours:**05**

Content:

- Introduction to Vedāṅga Literature
- History of Sanskrit Grammar
- An Overview of Purāṇic literature
- History of Dharmaśāstra

Learning outcomes of the Module

1.	Describe various scientific and academic disciplines of ancient India along with scientific knowledge that is rooted in the Puranic literature (K1)
2.	Remember ancient system of Law and Governance in a nutshell especially the principles and philosophy behind the ancient constitutions (K1)

Module- 4

Name of the Module: Introduction to Indian Philosophical Systems, Scientific aspects of Indian knowledge systems

Number of class hours:**05**

Content:

- General introduction to Indian Philosophical systems, i.e. Orthodox and Heterodox
- Glimpse of ancient Indian Science and technology.

Learning outcomes of the Module

1.	Describe the Indian Philosophical systems and their relevance and application in modern scientific enquiry (K1)
2.	Remember the various scientific methods, means and validity of knowledge as discussed in these systems, methods of discussion, debate and systemic learning as structured in ancient Indian knowledge literature (K1)

Module- 5

Name of the Unit: Introduction to Yoga & Āyurveda

Number of class hours:**05**

Content:

- General ideas about Yoga,
- Origin and Development of Pātañjala Yoga,
- Origin and Development of Āyurveda and its relevance

Learning outcomes of the Module

1.	Understand about principles and philosophy of Yogic sciences and Āyurveda. (K2)
2.	Identify various ancient texts, practices of Yoga and Āyurveda along with gaining basic practical and theoretical knowledge which they will be able to relate with modern healthcare systems (K4)

References: -

- 1) Capra, Fritjof. *The Tao of Physics*. New York: Harpercollins, 2007.
- 2) Capra, Fritjof. *The Web of Life*. London: Harpar Collins Publishers, 1996.
- 3) Dasgupta, Surendranath & De, Sushil Kumar. *A History of Sanskrit Literature*. Delhi: Motilal Banarsidass, 2017.
- 4) Dasgupta, Surendranath. *A History of Indian Philosophy*. Delhi: Motilal Banarsidass, 1991.

- 5) Gonda, Jan. *A History of Vedic Literature*. Delhi: Monohar Publishers and Distributors, 2020.
- 6) Jha, R.N. *Science and Consciousness Psychotherapy and Yoga Practices*. Delhi: Vidyanidhi Prakashan, 2016.
- 7) Kane. P.V. *History of Dharmasastra*, Poona: Bhandarkar Oriental Research Institute, 1930.
- 8) Max Muller. *Ancient Sanskrit Literature*, London: Spottiswoode and Co., 1859.
- 9) *Pride of India*, New Delhi: Samskrita Bharati, 2006.
- 10) Shastri, Gourinath. *A History of Vedic Literature*, Kolkata: Sanskrit Pustak Bhandar, 2006.
- 11) Sinha, Jadunath. *Indian Philosophy*. Delhi: Motilal Banarsidass, 1938.
- 12) Wujastyk, Dominik. *The Roots of Ayurveda*. India: Penguin India, 2000.

Medical Laboratory Technology (MLT) Syllabus

Semester V

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/ Week	Credit
				L	T	P		
1	Programme core course-16	MLPC-501	Haematology	2	0	0	2	2
2	Programme core course-17	MLPC-502	Immunology & Immunotechnology	2	0	0	2	2
3	Programme core course-18	MLPC-503	Molecular Biology & Genetic Engineering	2	0	0	2	2
4	Programme core course-19	MLPC-504	Immunotechnology Lab	0	0	4	4	2
5	Programme core course-20	MLPC-505	Haematology Lab	0	0	2	2	1
6	Programme elective course-2 (Any one to be opted)	MLPE-506/A	Biomedical Devices	3	0	0	3	3
		MLPE-506/B	Drug Discovery					
7	Programme elective course-3 (Any one to be opted)	MLPE-507/A	Fundamental Biotechnology	2	1	0	3	3
		MLPE-507/B	Animal Cell Culture Technology					
8	Open elective-1	(Any one to be opted from Annexure-I)		3	0	0	3	3
9	Summer Internship-II (6 weeks) after Semester IV	MLSI-509	Summer Internship-II	0	0	0	0	2
10	Major Project	MLPR-510	Major Project	0	0	4	4	2
Total				14	1	10	25	22

HAEMATOLOGY

Course Code	MLPC-501
Course Title	Haematology
Number of Credits	2
Prerequisites	Basic understanding of physiology
Course Category	Programme Core Course

Course Outcomes: -

- 1) Students will be able to understand basic studies of Haematology
- 2) Students will be able to analyse various problems related to blood.
- 3) Students will be able to evaluate results involving abnormalities of blood.
- 4) Students will be able to understand basics of Count of blood cells.
- 5) Students will be able to understand various methods of Collection and separation of blood and Blood Bank.

Course Content:-

Module- 1: Basic concept of blood

Number of class hours:**4hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic concept to f blood.
- 2) Students will be able to analyse various problems of blood related diseases..

Detailed content of the unit:-

- a. Introduction ,composition , definition of blood.**
- b. Function of blood.**
- c. Haematopoiesis and series of different blood cells.**
- d. Roles of the blood cells in the body.**
- e. Features of each blood cells and abnormalities.**

Module- 1I: Count of blood cells

Number of class hours:**2hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle blood concept.
- 2) Students will be able to analyse various problems related blood count.
- 3) Students will be able to evaluate results of blood count.

Detailed content of the unit:-

- a. Total count of R.B.Cs , W.B.Cs, and Platelets and its significance
- b. Differential count of WBC and significance.

Module- III: Hb ,RED cell indices and Anemia

Number of class hours:**3hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of Hb determination
- 2) Students will be able to know RED cell indices.
- 3) Students will be able to know causes of Anemia

Detailed content of the unit:-

- a. Hb- synthesis, degradation and function.**
- b. determination of Hb and its significance**
- c. RED cell indices – its determination . PCV,MCV,MCH and MCHC and Each significance.**
- d. Anemia and its type and cause of anemia.**

Module- IV: ESR and CT ,BT and prothombin time

Number of class hours:**2hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of determination of ESR..
- 2) Students will be able to analyse various problems related to various types Clotting disorders.

Detailed content of the unit:-

- ESR determination and its significance.**
- Mechanism of coagulation and coagulation disorders.**
- Determination of CT and BT and prothombin time.**

Module- V: Collection and separation of blood and Blood Bank

Number of class hours: **4hr**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle. Collection of blood
- 2) Students will be able to understand seperation of blood cells.
- 3) Students will be able to understand basic principle blood storage.
- 4) Students will be able to analyse various types of storage of blood.
- 5) Students will be able to know application of transport of blood..

Detailed content of the unit:-

- Collection of blood – type, sight and process of collection**
- Seperation of blood cells, plasma and serum.**

- a. Blood Bank, Storage mechanism of whole blod packed cell volume.**

Reference Books:

1. Haematology by Devidson
2. Clinical Haematology in Medical Practice by Frkin ,Chestorman, Peninston and Rush.
3. Viva in pretical Haematology by Parkash
4. Medical laboratory Technology -Kolhatkar
5. Medical Laboratory Technology- Ramnik
6. Text Book Of Pathology- HarshMohan
7. Recent advances in pathology_ K.P.Deodhar and Ulwagholikar.

IMMUNOLOGY & IMMUNOTECHNOLOGY

Course Code	MLPC-502
Course Title	Immunology & Immunotechnology
Number of Credits	2
Prerequisites	Basic understanding of biology and analytical techniques
Course Category	Programme core course

Course Outcomes: -

1. Students will be able to understand core principles of Immunology & Immunotechnology.
2. Students will be able to enumerate details of Cells & organs of immuno system.
3. Students will be able to understand principles of antigens and Immunoglobulins.
4. Students will be able to enumerate various Ab-Ag reactions and apply them in lab.
5. Students will be able to understand principles of Immunization and apply them in real life situations.

Course Content:-

Module- 1: Fundamentals of Immunology, Cells & organs of immuno system:

Number of class hours: **8hr**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of Immunology.
- 2) Students will be able to know applications of Immunology.

3) Students will be able to understand basic principle of Cells & organs of immuno system.

Detailed content of the unit:-

Mechanism of Inflammation , Nonspecific immune responses, Central role of TH Cells in immune response , Cellular lineages of Immune Cells , Innate immunity , Adaptive immunity , Cell mediated immunity , Bone marrow- stem cells, granulocytic cells , Lymphoid organs- B lymphocytes & T lymphocytes.

Module- II: Recognition of antigen:

Number of class hours:**4hr**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of Recognition of antigen.
- 2) Students will be able to understand various concepts of Recognition of antigen.
- 3) Students will be able to know applications regarding Recognition of antigen.

Detailed content of the unit:-

HLA Typing methods , Molecular method based tissue typing , DNA Finger printing,Self Non Self Recognition , Tissue Incompatibility concepts , Experimental demonstration of role of APCs , B Cells & T- Cells restrictions , ADCC , Complement fixation , Generation and Structural variations of immunoglobulin , Immuno response mechanism-I , Immuno response mechanism-II , Cytokines

Module- III:Immunoglobulin:

Number of class hours:**4hr**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of Immunoglobulin.
- 2) Students will be able to understand various types of Immunoglobulin.
- 3) Students will be able to know applications of Immunoglobulin

Detailed content of the unit:-

Enzymatic & Chemical cleavage analysis of IG Structure , Role of MHCs , Membrane bound & Secreted antibody concepts, Antibody Class Switching. Structural analysis of immunoglobulin , Study of immunoglobins- IgG, IgM, IgE, IgA, IgD , Importance of immunoglobulin , Genetics of antibody diversity.

Module- IV: Study of Ab-Ag reaction mechanism, Allergy and hypersensitivity reaction

Number of class hours: **6hr**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of Ab-Ag reaction.
- 2) Students will be able to understand basic principle of allergy and hypersensitive reaction.
- 3) Students will be able to analyse various types of hypersensitive reaction.
- 4) Students will be able to know significance of hypersensitive reaction.

Detailed content of the unit:-

Humanization of MoAB , Hybridoma technology , Role of HAT Selection , Herceptin & Rituximab Clinical Role , Targeted Immuno therapy Concepts , Cytokine mediated immunotherapy , IgE mediated reaction mechanisms , In-vivo Ab-Ag reaction , Monoclonal and polyclonal antibody , detection and application of Ab-Ag reaction ,

Anaphylactic reaction , Antibody dependent cytotoxic hypersensitivity , Different hypersensitive reactions.

Module- V: Immunization, Study of disorders of immunity and Immunological techniques

Number of class hours: **6 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of immunization.
- 2) Students will be able to understand basic principle of disorders of immunity.
- 3) Students will be able to know application of immunization.
- 4) Students will be able to understand basic principle of immune techniques.

Detailed content of the unit:-

Plasma therapy , Vaccine design concepts , Clinical trials for Vaccine Development & its Phases , Active immunization and Passive immunization , Toxoids, Sera and vaccines , Medical application of immunization , B- Cell cancer, AIDS, infectious diseases like COVID-19 , Autoimmunodisorders- e.g. Autoimmuno Anemia, Thyroiditis. , Systemic immuno disorders- e.g. Multiple Sclerosis, Rheumatoid Arthritis , SLE. , Immuno-diffusion assay , ELISA and ELISPOT assay , Immuno-Histochemistry , Flow Cytometry and FACS sorting , Immuno-precipitation

References:

1. Immunology: Introductory Text Book- Nandini Shetty
2. Immunology- Kuby
3. Immunology- A Short Text Book- Md. AkramHossain
4. Immunodiagnostics- S.C.Rastogi

MOLECULAR BIOLOGY & GENETIC ENGINEERING

Course Code	MLPC - 503
Course Title	Molecular Biology & Genetic Engineering
Number of Credits	2
Prerequisites	Basic understanding of biochemistry and Genetics
Course Category	Programme core course-18 (L)

Course Outcomes: -1) Students will be able to enumerate the background of Molecular Biology & Genetic Engineering.

2) Students will be able to understand various concepts & principles of Molecular Biology & Genetic Engineering.

3) Students will be able to evaluate problems on Molecular Biology & Genetic Engineering and its applications.

4) Students will be able to understand various concepts & principles of Molecular enzymes.

5) Students will be able to gain knowledge on the principles of Modification of Nucleic Acids .

Course Content:-

Module 1 - Nucleic Acids:

Number of class hours: **4hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Nucleic Acids.
- 2) Students will be able to analyse significance of Nucleic Acids.
- 3) Students will be able to enumerate various concepts of Nucleic Acids.

Detailed content of the unit: -

Study of DNA ,DNA Replication , Mechanism of replication , Replication fork , Experiments on Semiconservative replication , Initiation & Elongation of Replication, DNA Polymerase Enzyme structure & Mechanism , Proof reading activity , DNA Repair mechanisms, Study of RNA and transcription , Rho dependent & Independent transcription termination , Types of RNA Polymerase & types of RNA. Types of Splicing, Mechanism of Splicing , Differential splicing of RNA. Concept of Promoter, DNA – Protein Interaction analysis.

Module 2- Stability analysis of nucleic acids:

Number of class hours: **4hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Stability analysis of nucleic acids.
- 2) Students will be able to analyse significance of Stability analysis of nucleic acids.
- 3) Students will be able to enumerate various concepts on Stability analysis of nucleic acids.

Detailed content of the unit: -

Isolation of DNA and its stability analysis, Isolation of RNA and its stability analysis , Study of proteins and amino acids in connection with DNA & RNA. Nano drop method , A260/A280 analysis , Role of Histones in DNA stability , RNase inhibitors , Nucleic Acid blottings and Gel based analysis.

Module 3- Molecular enzymes and their role in r-DNA Technology:

Number of class hours: **4hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Molecular enzymes and their role in r-DNA Technology.
- 2) Students will be able to analyse significance of Molecular enzymes and their role in r-DNA Technology.
- 3) Students will be able to enumerate various concepts on Molecular enzymes and their role in r-DNA Technology.

Detailed content of the unit: -

DNA modifying enzymes, RNA modifying enzymes, Their function and role in r-DNA Technology. Mechanism of DNA Ligase , DNA Methylase , Exo & Endonucleases & Nomenclature , Terminal transferase , Phosphatases , Helicases , Topo isomerases , Restriction mapping , Vector DNA biology , Expression vectors , Genetic transformations & methods. Antisense RNA Technology, CRISPR

Module 4- Molecular, Genetic events and Modification of Nucleic Acids:

Number of class hours: **8hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of various Molecular & Genetic events.
- 2) Students will be able to analyse significance of Molecular & Genetic events.
- 3) Students will be able to enumerate various concepts on Molecular & Genetic events.

Detailed content of the unit: -

Eukaryotic cell cycle ,DNA repair, RNA transcription, Reverse transcription, Translation , Genetic code , Viral vector mediated transgene integration , Reporter gene concepts , B-Gal system for analysis of genetic transformation , Concepts of Cloning , Cloning of mammals , Agrobacterium mediated genetic transformations , Ligation

,Restriction digestion , Polymerization , Mutation , Recombinant DNA technology applications in health care and biomedicine.

Module 5- Identification of Nucleic Acids, Biomedical application and allied concepts:

Number of class hours: **8hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Identification of Nucleic Acids.
- 2) Students will be able to analyse significance of Identification of Nucleic Acids.
- 3) Students will be able to enumerate various concepts on Identification of Nucleic Acids.

Detailed content of the unit: -

PCR ,DNA sequencing-Sanger method.Study in brief about DNA vaccines ,Study in brief about RNA vaccines , Study of Gene therapy in brief with application. Case study in SCID.

References:

1. Cell and Molecular Biology- S.C.Rastogi
2. Biochemistry- Debajyoti Das
3. Immunology: Introductory Text Book- NandiniShetty
4. Human Physiology: Vol-1- Dr.C.C.Chatterjee
5. Immunology- Kuby
6. Lehninger's Principles of Biochemistry-Fourth Edition
7. Harper's Illustrated Biochemistry, 26th Edition
8. Modern Concept of Biotechnology- H.D.Kumar

IMMUNOTECHNOLOGY LAB

Course Code	ML P C - 504
Course Title	Immunotechnology Lab
Number of Credits	2
Prerequisites	Basic understanding of immunology and analytical techniques
Course Category	Programme core course-(P)

Course Outcomes: -

- 1) Students will be able to understand basics of Immuno-technology Lab.
- 2) Students will be able to know to design experiments on Immuno-technology principles.
- 3) Students will be able to evaluate/analyse observations of Immuno-technology experiments.
- 4) Students will be able to understand inference of experiments in immunotechnology.
- 5) Students will be able perform tests in Immunotechnology.

Course Content:-

LIST OF EXPERIMENTS

Number of class hours:**48hrs**

1. Laboratory Detection of antibody by agglutination assays : Inference and differential diagnosis through Qualitative test –Example , ASO .
2. Laboratory Detection of antibody by agglutination assays : Quantitative validation of results – Serial dilution based observation.
3. Detection of antigen –antibody complex of RA and its differential diagnosis.
4. Immuno chromatography& laboratory detection of HbSAg.
5. Rapid test antigen detection of an infective agent – Bacteria –*H.pylori*.
6. Separation of Immunoglobulin from serum - Inference and differential observation.
7. Identification of Immune cells from blood and identification of cell surface antigens from various blood cells.
8. Simulation and hands-on analysis of Population coverage of HLA classes and analysis of immunogenic epitope of a viral spike protein.

References:

1. Kuby Immunology by Thomas J. Kindt, Barbara A. Osborne, Richard Goldsby.
2. Principles of Microbiology and Immunology by Harper and Row.
3. Introduction to Medical Immunology by Gabriel Virella.
4. Immunology: Introductory Text Book- Nandini Shetty

Haematology Lab

Course Code	MLPC-505
Course Title	Haematology Lab
Number of Credits	1
Prerequisites	Basic understanding of haematology theory
Course Category	Programme core course

Course Outcomes: -

- 1) Students will be able to understand basic studies of collection of blood.
- 2) Students will be able to analyse various problems related to blood.
- 3) Students will be able to evaluate results involving abnormalities of blood.
- 4) Students will be able to understand methodologies of blood related experiments.
- 5) Students will be able to evaluate results involving blood related experiments.

Course Content:-

Module- 1: Blood

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic concept to f blood.
- 2) Students will be able to analyse various problems of blood related diseases..

Detailed content of the unit:-

- 1. Collection of blood**
- 2. Separation of Whole blood plasma and cells by centrifugation.**
- 3. Preparation serum in clotting blood**
- 4. Haematocrit value.**
- 5. Separation of RBC and plasma and their ratio by wintrobe tube with the help of centrifuge.**
- 6. Preparation of blood film and staining for DC**
- 7. Determinations of erythrocyte-sedimentation-rate (ESR)**
- 8. Haemoglobin estimation by shalis method and colorimetric method.**
- 9. Study of RBC, WBC and Platelet.**

Module- II: Application of stain

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle staining agent
- 2) Students will be able to application of stain.

Detailed content of the unit:-Haematoxyline, eosin,lishman,Gramsstain,Metheline blue stain.

REFERENCES: As on Theory Subjects.

BIOMEDICAL DEVICES

Course Code	MLPE-506/A
Course Title	Biomedical Devices
Number of Credits	3
Prerequisites	Basic understanding of biomedical instrumentation
Course Category	Programme elective course

Course Outcomes: -

- 1) Students will be able to understand technology and significance of haemodialyser.
- 2) Students will be able to understand technology and significance of cardiac measurement.
- 3) Students will be able to understand technology and significance of ICU, CCU.
- 4) Students will be able to understand technology and significance of EEG.
- 5) Students will be able to understand technology and significance of biotelemetry.

Course Content:-

Module- 1: Haemodialysis machine

Number of class hours:**2 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of haemodialysis machine.
- 2) Students will be able to know application of haemodialysis machine.

Detailed content of the unit: -

- a. Definition of dialysis and different types haemodialysis machine
- b. Different dialysis membrane
- c. Performance analysis
- d. Clinical application

Module- 2: Cardiac Measurement

Number of class hours:**4 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of cardiac measurement.

- 2) Students will be able to know various components of cardiac measurement.
- 3) Students will be able to know application of cardiac measurement.

Detailed content of the unit: -

- Engineering Analog of heart, model of heart
- Characteristics of blood flow
- Types and causes of heart sound
- Electrocardiograph and its features- electrode & its placement
- Measurement of blood flow and cardiac output
- Noises and interference's in the measurement and its solution
- Plethysmography
- Blood pressure measuring instruments- invasive & non-invasive, manual, semi-automatic & automatic type (detail of sphygmomanometer).
- Pacemaker and its use
- Defibrillators

Module- 3: EEG

Number of class hours:**2 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of EEG.
- 2) Students will be able to know various components of EEG.
- 3) Students will be able to know applications of EEG.

Detailed content of the unit: -

- 3.1 Wave form
- 3.2 Machine block diagram & discussion
- 3.3 Electrodes of EEG in brief
- 3.4 Application

Module- 4: ICU/CCU System

Number of class hours:**2 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of ICU/CCU.
- 2) Students will be able to know various components of ICU/CCU.
- 3) Students will be able to know application of ICU/CCU.

Detailed content of the unit: -

- 4.1 Introduction
- 4.2 Recording instruments
- 4.3 Alarm Modules
- 4.4 Display
- 4.5 Information
- 4.6 Strip chart recorder
- 4.7 Electronic recorder
- 4.8 Adjustment and typical faults

Module- 5: Study with principle, block diagram, properties and application and BIO TELEMETRY

Number of class hours: **6 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basic principle of biotelemetry.
- 2) Students will be able to know various components of biotelemetry.
- 3) Students will be able to know application of biotelemetry.
- 1) Students will be able to understand basic principle of different machines.
- 2) Students will be able to know various components of biomedical machines.
- 3) Students will be able to know application of biomedical machines.

Detailed content of the unit: -

- 5.1 Introduction of bio telemetry
- 5.2 Physical parameters adaptable to bio telemetry
- 5.3 Components of bio telemetry
- 5.4 Multi-patient telemetry.

- 6.1 C.T.Scan.
- 6.2 Ultra Sonography (USG) machine
- 6.3 EMG
- 6.4 ERG
- 6.5 Defibrillator
- 6.6 ECG
- 6.7 Foetal Monitoring

References: -

9. Hand Book of Biomedical Instrumentation – R S Khandpur
10. Biomedical Instruments – R S Khandpur
11. Radiographic Imagins – DN & MO Chesney.
12. X-Ray equipment fastudentsRadiographics – DN & MO Chesney
13. Medical Electronics – S Sarkar
14. Principle of Medical Electronics & Biomedical Instrumentation- C Raja Rao& S K Guha
15. Biomedical instruments & Measurements – Croamwell
16. Medical Electronics – D Jemice

DRUG DISCOVERY

Course Code	ML P E - 5 06/B
Course Title	Drug Discovery
Number of Credits	3
Prerequisites	Basic understanding of biochemistry & biotechnology.
Course Category	Programme elective course-2- -3(L)

- Course Outcomes:**
- 1) Students will be able to understand various concepts & principles of Rational Drug Discovery.
 - 2) Students will be able to enumerate the background of Big Data Analytics and its significance.
 - 3) Students will be able to evaluate problems on Rational Drug Discovery and its applications.
 - 4) Students will be able to gain knowledge on Thermodynamics for Rational Drug Design.
 - 5) Students will be able to understand & apply Hands-on Simulations for Rational Drug Design

Course Content:-

Module 1 - Big Data analytics & Rational Drug Discovery:

Number of class hours: **4hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Rational Drug Discovery.
- 2) Students will be able to analyse significance of Rational Drug Discovery.
- 3) Students will be able to enumerate various methods in Rational Drug Discovery.

Detailed content of the unit: -

Basics of Pharmaceutical formulation, Drug metabolism- pharmacokinetics, pharmacodynamics, Chemistry of drug action, Role of Data science in Rational Drug Design and discovery, Mechanism of action of drugs relevant to recent global scenario - anti COVID therapy, QSAR Analysis, Drug ability of small molecules, Ligand design & Pharmacophore design. Concept of grid computer and GUI, Classifications and clustering of Biological data, Handling of large volume of biomedical data, File formats and databases relevant to biotechnology, Implementation of feature selection & classification in biotechnology applications, Pattern recognition in high throughput biomedical data, Bootstrapping and analysis of biomedical data for different applications, Cloud platform and its implementation of biotechnology, Python based tools for visualizing biomedical data for biotechnology applications. Regression analysis,

Scatter plot, histogram, hypothesis testing, significance of p-value, chi-square, T-test, ANOVA and Bayesian Probability for biomedical and biotechnology applications.

Module 2- Structural Biology for Rational Drug Design:

Number of class hours: 4hrs

Suggestive Learning Outcomes:

- 1) Students will be able to analyse significance of Structural Biology for Rational Drug Design.
- 2) Students will be able to enumerate various methods in Structural Biology for Rational Drug Design..
- 3) Students will be able to understand basics of background and principles of Structural Biology for Rational Drug Design.

Detailed content of the unit: -

Polypeptide stereochemistry, Hierarchy in protein folds , Structural basis of amino acids on protein structure , Chaperones and HSPs , Characteristics of membrane protein , Amyloid bodies and their clinical role, Structural analysis of Protein, Principles of solubility, purification, separation and crystallization , Steps in X-Ray Crystallography and refinement , DNA and RNA secondary structures, Glycobiology and Lipidomics.

Module 3- Quantum mechanics and Thermodynamics for Rational Drug Design:

Number of class hours: 8hrs

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Quantum mechanics and Thermodynamics for Rational Drug Design for Rational Drug Design.
- 2) Students will be able to analyse significance of Quantum mechanics and Thermodynamics for Rational Drug Design.
- 3) Students will be able to enumerate various methods in Quantum mechanics and Thermodynamics for Rational Drug Design for Rational Drug Design..

Detailed content of the unit: -

Energy concept and its importance in drug action, Concepts , interactive visualization & rational of thermodynamic stability of a receptor model, Geometric and mechanical torsion , clash and outlier concepts of a modelled active site in a protein, Features of molecular mechanics force fields, Bond structures and interactions of electrostatic, van der Waals and non – bonded forms, Hydrogen bonding in molecular mechanics , Derivatives of molecular mechanics energy function; Application of energy minimization, Gaussian principles relevant to peptide receptors and drug targets , Hands on for Molecular dynamics simulations of enzyme –substrate complex, Brownian dynamics, Calculation of R2 , RMSD , RMSF and their rational for drug-receptor interaction , Concept of solvents , boundary , time scale analysis , Implementation of GROMACS , CHARM ,NMA , OPLS.

Module 4- Hands-on Simulations for Rational Drug Design:

Number of class hours: **8hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Hands-on Simulations for Rational Drug Design.
- 2) Students will be able to enumerate various methods in Hands-on Simulations for Rational Drug Design..
- 3) Students will be able to analyse significance of Hands-on Simulations for Rational Drug Design.

Detailed content of the unit: -

In-silico data mining, retrieval, analysis & interpretation. Molecular Drawing and interactive visualization , Building molecules on a computer, Molecular modelling&structural modeling tools, *In silico* tools for medicinal and drug chemistry , Analysis of molecular interaction , Scoring, analysis and inference , Analysis of drug likeliness and its logic, Lipinski Rule and analysis, Ligand design methods, Target & lead identification, optimization and validation, Structure and ligand based drug design , Conformational changes from molecular dynamics simulation and application in drug design, Molecular phylogenetics and active site analysis , Protein regulatory networks and analysis , Dynamics of Protein-RNA complexes.

Module 5- Rational Protein Engineering & Peptide design:

Number of class hours: **8hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to analyse significance of Hands-on Simulations for Rational Drug Design.
- 2) Students will be able to enumerate various methods in Hands-on Simulations for Rational Drug Design..
- 3) Students will be able to understand basics of background and principles of Hands-on Simulations for Rational Drug Design.

Detailed content of the unit: -

Protein design and modelling by template based and ab-initio protocols, Generating mutant library of proteins and analysis of biophysical property, Application of Ala- scanning and disulphide bridges , Incorporation of desired phenotype in proteins , Analysis of active site dimensions in wild type and mutant proteins , Application of protein engineering for catalytic proteins , therapeutic growth factors , anti-infective agents and small peptides, Analysis and alterations of IpH , Solvent accessible surface , energy landscape and vacuum electrostatics of therapeutic proteins , Implementation of motif finding algorithms and application in peptide design , *In-silico* and *in-vitro* analysis of bioactive peptides , Programming of MCH binding and vaccine candidate identification against common infectious agents , 3D analysis of the effects of mis-sense mutations on antibiotic resistance and in -born errors of metabolisms (Genetic diseases).

Sample Tutorial :

1. *In-silico* and *in-vitro* analysis of bioactive peptides.
2. Programming of MCH binding and vaccine candidate identification against common infectious agents using GUI.
3. Geometric and mechanical torsion, clash and outlier concepts of a modelled active site in a protein.
4. Hands on for Molecular dynamics simulations of enzyme –substrate complex.

REFERENCES:

1. Bioinformatics: methods and applications, S. C. Rastogi, PHI learning; 4th edition, 2013.
2. The Dictionary of Genomics, Transcriptomics and Proteomics, Günter Kahl, Willey VCH, 2015.
3. Bajorath, Jurgen. Chemoinformatics for Drug Discovery. John Wiley & Sons, 2013.
4. Medicinal Chemistry by Ashutosh Kar.
5. Singh, V and P.K. Dhar. (2015). Systems and Synthetic Biology. Springer publishing, Netherlands.
6. Essential Bioinformatics, Jin Xiong, Cambridge University Press; 1st edition 2006.
7. A Practical Approach to Microarray Data Analysis (Hardcover) by Daniel P. Berrar(Editor), Werner Dubitzky (Editor), Martin Granzow (Editor).
8. Biotechnology for Waste mass Utilization, Sarangi et al , Eds , CRC Press, Taylor & Francis , UK , 2022 , ISBN:978-1-77463-995-5.

FUNDAMENTAL BIOTECHNOLOGY

Course Code	MLPE-507/A
Course Title	Fundamental Biotechnology
Number of Credits	3
Prerequisites	Understanding of microbiology, immunology, biochemistry and analytical techniques
Course Category	Programme elective course-3(L+T)

Course Outcomes: -

- 1) Students will be able to understand various concepts & principles of Biotechnology.
- 2) Students will be able to enumerate the background of Biotechnology and its significance.
- 3) Students will be able to evaluate problems on Biotechnology and its applications.
- 4) Students will be able to understand relationship of Data Science & Biotechnology.
- 5) Students will be able to understand & apply the concepts of Genomics & Proteomics.

Course Content:-

Module 1 - Medical Biotechnology:

Number of class hours: **8hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to analyse significance of Medical Biotechnology.
- 2) Students will be able to enumerate various types of methods used in Medical Biotechnology.
- 3) Students will be able to understand basics of background and principles of Medical Biotechnology.

Detailed content of the unit: -

Novel drug delivery methods, Clinical trials of novel therapeutics– Types and set-up , Inborn errors of metabolism & rare diseases ,SNP and DNA Finger printing, Gene therapy , SCID , Knock-out mice and its applications ,Gene silencing and RNA Interference (RNAi) , Tissue transplantation and Xenograft, HLA Typing , Production of Recombinant proteins , Bioseparation and purification of therapeutic proteins by Ion-Exchange, Affinity, Hydrophobic, Size exclusion, Chromatography, HPLC , Bioactive peptides & their Characterization through Protein in Gel and Protein in membrane techniques. Humanization of Monoclonal Antibodies, Mechanism of action of RituxiMAb , Herceptin , Biomaterials for medical applications , Reverse vaccinology and Vaccine design , Immuno diagnostics- RIA , Immuno-Electrophoresis , Immuno and allied therapy in cancer.

Module 2 - Synthetic & Systems Biology

Number of class hours: **4hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of the background of Synthetic & Systems Biology.
- 2) Students will be able to enumerate various types of methods in Synthetic & Systems Biology.
- 3) Students will be able to analyse the significance of Synthetic & Systems Biology.

Detailed content of the unit: -

Gene Regulatory Mechanisms - Promoters, Terminators, Enhancers, Inducers, Repressors, Transcription Factors, Co-factors, Transcriptional and post-transcriptional regulation, Post transcriptional modifications, Genomic DNA & c-DNA Library, Post-translational modifications, Choices for microbial hosts for industrial applications- bacteria, yeast, insect. Gene editing methods – CRISPR/ Cas, Metabolic pathways and networks.

Module 3 - Genomics and Proteomics

Number of class hours: **8hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to analyse significance of Genomics and Proteomics.
- 2) Students will be able to understand basics of Genomics and Proteomics.
- 3) Students will be able to enumerate various factors of Genomics and Proteomics.

Detailed content of the unit: -

DNA and RNA sequencing for genomics, PCR for transcriptomics, Real time PCR, RAPD, Hotstart, Inverse and other variants, Human Genome project, Cancer genomics, Different types of genetic and nongenetic variations, Genetic screening and diagnosis, Prenatal carrier testing and new born screening for Mendelian diseases, Pharmacogenomics testing for drug selection, dosing and predicting adverse effects of commonly prescribed drugs, Protein sequencing platforms, Electrophoresis, Solution- and solid-state NMR spectroscopy, X-ray crystallography, Mass spectroscopy-MALDI, Biomarker identification and validation of a disease state, Microarray analysis. ELISA and its variants, FACS, FACS, Genome-wide association studies of human diseases, Genome editing tools and applications to human diseases

Overview of recombinant protein expression vectors, Primer design for specific use, Nick translation, Use of adapters, Use of transgenic animals. History, safety and ethics of transgenic animals. Methods for creation of transgenic animals-DNA microinjection, Embryonic stem cell-mediated gene transfer, Retrovirus-mediated gene transfer. Use of transgenic animals in medical research and toxicology.

Module 4 - Data Science and Biotechnology

Number of class hours: **16hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to analyse significance of Data Science in Biotechnology.
- 2) Students will be able to enumerate various concepts of Data Science in Biotechnology.
- 3) Students will be able to understand basics of Data Science in Biotechnology.

Detailed content of the unit: -

Machine learning and artificial intelligence for Biomedical Research. Analysis of High throughput Sequence Data , Database Concept and handling , File formats and conversion of data types for biomedical applications, Data visualization , Primary , Secondary and tertiary transcripts , Pattern recognition and its application in Biotechnology , Hidden Markov Model (HMM) and its application for handling Biomedical data , Naïve bayes classification concepts for application in Biotechnology ,

Module 5 - Bioprocess Technology and Environmental Bio-Technology

Number of class hours: **10hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of Bioprocess Technology.
- 2) Students will be able to enumerate various topics of Environmental Bio-Technology.
- 3) Students will be able to analyse significance of Environmental Bio-Technology.

Detailed content of the unit: -

Microbial growth kinetics, Substrate utilization, Principles of enzyme catalysis, Enzyme kinetics, Immobilized enzymes, Enzyme inhibition and application in Drug discovery, Bioreactors, Solid state Fermentation, Bioprocesses for the production of antibiotics, proteins, Instrumentation and monitoring, Sterilization, Downstream processing, Plant/mammalian cell culture reactors, Examples of industrial bioprocesses, Management of oil spills , Bioremediation by coupled approach , Biomass Recovery process – Centrifugation ,Filtration, Genetic engineering for biomass recovery , Petroleum metabolizing genomes , Chloroplast transformation and cloning , Auto flocculation and co-culture for biomass recovery , Green fuel , Engineered nanomaterial of relevance to environment & human health.

Sample Tutorial :

1. Microbial growth kinetics and estimation of cell mass through spectral studies.
2. High throughput data analysis and application of Pattern recognition algorithms.
3. Primary processing of X-Crystallographic Proteome data.
4. Presumptive Isolation of Genomic DNA.

REFERENCES:

1. Bioinformatics: methods and applications, S. C. Rastogi, PHI learning; 4th edition, 2013.
2. Principles of Gene Manipulation and Genomics, Primrose & Twyman.
3. Principles of Biochemistry by David L. Nelson and Michael M. Cox.
4. Biotechnology for Waste mass Utilization, Sarangi et al , Eds , CRC Press, Taylor & Francis , UK , 2022 , ISBN:978-1-77463-995-5.
5. Kuby Immunology by Thomas J. Kindt, Barbara A. Osborne, Richard Goldsby.
6. The Role of Microalgae in Wastewater Treatment, Sukla et al , *Eds.*, Springer Nature Singapore Pte Ltd. 2019, ISBN:978-981-13-1585-5.
7. Colin Ratledge, Bjorn Kristiansen, Basic Biotechnology, 2nd Edition, Cambridge University Press, 2001.
8. Basic Biotechnology ,R.C.Dubey , S.Chand Publisher ,Recent Edition.

ANIMAL CELL CULTURE TECHNOLOGY

Course Code	MLPE-507/B
Course Title	Animal Cell Culture Technology
Number of Credits	3
Prerequisites	Basic understanding of microbiology
Course Category	Programme elective course

Course Outcomes: -

- 1) Students will be able to understand basics of animal cell culture technology.
- 2) Students will be able to understand and apply cell culture media and its preparation.
- 3) Students will be able to understand basics of animal cell culture maintenance.
- 4) Students will be able to understand basics of transformation in animal cell culture technology.
- 5) Students will be able to understand basics of hybridoma technology.

Course Content:-

Module- I: Introduction

Number of class hours:**2hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of cell culture.
- 2) Students will be able to understand basics of metabolism.
- 3) Students will be able to understand basics of nutritional requirements.

Detailed content of the unit: -

- 1.1 History of Animal Cell Culture,
- 1.2 Characteristics of animal cell,
- 1.3 Metabolism and regulation
- 1.4 Nutritional requirements

Module- II: Culture Media

Number of class hours:**2hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of culture media.
- 2) Students will be able to know role of culture media.
- 3) Students will be able to know significance of culture media.

Detailed content of the unit: -

- 2.1 Culture Media
- 2.2 Types and composition
- 2.3 Growth Conditions

Module- III: Maintenance of cell culture

Number of class hours:**2hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of maintenance of cell culture.
- 2) Students will be able to know types of cell culture.
- 3) Students will be able to know preservation of cell culture.

Detailed content of the unit: -

- 3.1 Development of Primary Culture and Cell Lines
- 3.2 Suspension Culture
- 3.3 Characterization and maintenance of cell lines
- 3.4 Cryopreservation
- 3.5 Common Cell Culture Contaminants

Module- IV: Transformation

Number of class hours:**2hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of transfection.
- 2) Students will be able to understand basics of transformation.
- 3) Students will be able to know application of transformation.

Detailed content of the unit: -

- 4.1 Marker Gene and its characterization
- 4.2 Transfection
- 4.3 Transformation of Cells

Module- V: Hybridoma Technology and Cell Culture Reactors

Number of class hours:**6hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of hybridoma technology.
- 2) Students will be able to know various aspects of hybridoma technology.
- 3) Students will be able to know applications of hybridoma technology.
- 1) Students will be able to understand basics of cell reactors.
- 2) Students will be able to know cell growth monitoring system.
- 3) Students will be able to understand application of reactors.

Detailed content of the unit: -

- 5.1 Need for scaling-up of cells for vaccine or antigen or pharmaceutical protein production
- 5.2 Hybridoma Technology

-Principles

-Components

-Application

6.1 Cell culture reactors

6.2 Scale-Up in suspension and monolayer cultures

6.3 Factors affecting cell growth

6.4 Growth Monitoring

6.5 Mass Transfer

6.6 Application

Reference:

1. Culture of Animal Cells by R.I. Freshney.

2. Animal Cell Biotechnology 2007, Humana Press by Portner R.

3. Basic Cell Culture Second Edition, Oxford University Press by Davis, J.M.

4. Biochemistry & Molecular Biology of Plants. Bob Buchanan, Wilhelm Gruissem, Russell Jones. John Wiley & Sons, 2002.

Summer Internship-II

Course Code	SI-509
Course Title	Summer Internship-II
Number of Credits	3 (L: 0, T: 0, P: 0)
Prerequisites	Fundamental and basic practical skills of relevant discipline/programme
Course Category	Internship

Internships may be full-time or part-time; they are full-time in the summer vacation and part-time during the academic session.

Sl. no.	Schedule	Duration	Activities	Credits	Hours of Work
1	Summer Vacation after 4 th Semester	6 Weeks	Industrial/Govt./NGO/MSME/ Rural Internship/Innovation / Entrepreneurship ^{##}	3	120 Hours

(^{##}During the summer vacation after 4th Semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship /Innovation /Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry. In case a student want to pursue his/herfamily business and don't want to undergo internship, a declaration by a parent may be submitted directly to the TPO.)

Course Outcome: -

After completion of the course, students will be able to:

- C.O.1: Describe a better understanding of the engineering / technological workplace(K2).
- C.O.2: Develop and demonstrate workplace competencies necessary for professional and academic success (K2).
- C.O.3: Classify career preferences and professional goals (K3).
- C.O.4: Develop preliminary portfolio including work samples from the internship (K2).
- C.O.5: Increase competitiveness for full-time engineering employment / start-up (K3).

Course Content:-

Internships are educational and career development opportunities, providing practical experience in a field or discipline. The Summer Internship-II is a student centric activity that would expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectives and the activities of the internship program are clearly defined and understood. Following are the intended objectives of internship training:

1. Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
2. Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
3. Exposure to the current technological developments relevant to the subject area of training.
4. Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions.
5. Create conditions conducive to quest for knowledge and its applicability on the job.
6. Learn to apply the Technical knowledge in real industrial situations.
7. Gain experience in writing Technical reports/projects.
8. Expose students to the engineer's responsibilities and ethics.
9. Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
10. Promote academic, professional and/or personal development.
11. Expose the students to future employers.
12. Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
13. Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

Overall compilation of Internship Activities / Credit Framework:

Major Head of Activity	Credit	Schedule	Total Duration	Sub Activity Head	Proposed Document as Evidence	Evaluated by	Performance appraisal/ Maximum points/ activity
Innovation / IPR / Entrepreneurship	3	Summer Vacation after 4 th Semester	6 Weeks	Participation in innovation related completions for eg. Hackathons	Certificate	Faculty Mentor	Satisfactory/ Good/ Excellent

				etc.			
				Development of new product/ Business Plan/ registration of start-up	Certificate	Programme Head	Satisfactory/ Good/ Excellent
				Participation in all the activities of Institute's Innovation Council for eg: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.	Certificate	President/ Convener of ICC	Satisfactory/ Good/ Excellent
				Work experience at family business	Declaration by Parent	TPO	Satisfactory/ Good/ Excellent
Internship	3	Summer Vacation after 4 th Semester	6 Weeks	(Internship with Industry/ Govt. / NGO/ PSU/ Any Micro/ Small/ Medium enterprise/ Online Internship	Evaluating Report	Faculty Mentor/ TPO/ Industry supervisor	Satisfactory/ Good/ Excellent
Rural Internship	3	Summer Vacation after 4 th	6 Weeks	Long Term goals under rural	Evaluating Report	Faculty Mentor/ TPO/ NSS/	Satisfactory/ Good/ Excellent

		Semester		Internship		NCC head	
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STUDENT’S DIARY/ DAILY LOG

The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students’ thought process and reasoning abilities. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students.

The daily training diary should be signed at the end of each day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and get ratified on the day of his visit.

Student’s Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. It will be evaluated on the basis of the following criteria:

- a) Regularity in maintenance of the diary.
- b) Adequacy & quality of information recorded.
- c) Drawings, sketches and data recorded.
- d) Thought process and recording techniques used.
- e) Organization of the information.

INTERNSHIP REPORT

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact Industrial Supervisor/ Faculty Mentor/TPO for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, TPO and Faculty Mentor. The Internship report will be evaluated on the basis of following criteria:

- a) Originality.
- b) Adequacy and purposeful write-up.
- c) Organization, format, drawings, sketches, style, language etc.
- d) Variety and relevance of learning experience.
- e) Practical applications, relationships with basic theory and concepts taught in the course.

Major Project - I

Course Code	CEPR-510
Course Title	Minor Project
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Nil
Course Category	Project Work (PR)

Course Outcome:-

After completion of the course, students will be able to:

C.O. 1: Demonstrate a sound technical knowledge of their selected project topic and the knowledge, skills and attitudes of a professional engineer (K2).

C.O. 2: Develop the skill of working in a Team (K3).

C.O. 3: Design engineering solutions to complex problems utilising a systems approach (K6).

C.O. 4: Design the solution of an engineering project involving latest tools and techniques (K6).

C.O. 5: Develop the skill of effective communication with engineers and the community at large in written and oral forms. (K3)

Course Content:-

The major project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

- 1) Develop sound knowledge about the domain of the project work.
- 2) Perform detailed study about various components of a project.
- 3) Learn to be an important member of a team for successful execution of a project work.
- 4) Study about methodologies and professional way of documentation and communication related to project work.
- 5) Develop idea about problem formulation, finding the solution of a complex engineering problem.
- 6) Develop project report as per the suggested format to communicate the findings of the project work.

- 7) Acquire the skill of effective oral communication to the fellow engineers and people in the society at large.
- 8) Knowledge of how to organize, scope, plan, do and act within a project thesis.
- 9) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
- 10) Demonstrate the implementation of a major project work.

Semester VI

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/ Week	Credit
				L	T	P		
1	Programme core course-21	MLPC-601	Medical Diagnostics & Animal Care	2	1	0	3	3
2	Programme core course-22	MLPC-602	Protein Technology	1	1	0	2	2
3	Programme elective course-4 (Any one to be opted)	MLPE-603/A	Quality Control	3	0	0	3	3
		MLPE-603/B	Public Health Informatics					
4	Humanities and Social Science-5	HS-604	Entrepreneurship and Start-up's	3	1	0	4	4
5	Open elective-2	(Any one to be opted from Annexure-II)		4	0	0	4	4
6	Mandatory Course-2	AU-606	Indian Constitution	2	0	0	2	0
7	Major Project-II	MLPR-607	Major Project	0	0	6	6	3
8	Seminar	MLSE-608	Seminar	2	0	0	2	1
Total				17	3	6	26	20

MEDICAL DIAGNOSTICS & ANIMAL CARE

Course Code	MLPC-601
Course Title	Medical Diagnostics & Animal Care
Number of Credits	3
Prerequisites	Basic understanding of immunology and laboratory analysis
Course Category	Programme core course

Course Outcomes: -

- 1) Students will be able to understand and apply PCR in medical diagnostics.
- 2) Students will be able to understand and apply SDS-PAGE in medical diagnostics.
- 3) Students will be able to understand and apply agarose gel electrophoresis, DNA finger printing in medical diagnostics.
- 4) Students will be able to understand and apply Western Blotting and FNAC in medical diagnostics.
- 5) Students will be able to understand and apply Fluorescence Spectroscopy and Animal Care in medical diagnostics and animal care.

Course Content:-

Module- 1: PCR

Number of class hours:**3hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of PCR.
- 2) Students will be able to understand various components of PCR.
- 3) Students will be able to understand significance of PCR.

Detailed content of the unit: -

- 1.1 Amplification of DNA by PCR
- 1.2 Different type of PCR
- 1.3 Performing PCR
- 1.4 Application

Module- II: SDS-PAGE

Number of class hours:**5hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of SDS-PAGE.
- 2) Students will be able to understand various components of SDS-PAGE.

3) Students will be able to understand significance of SDS-PAGE.

Detailed content of the unit: -

- 2.1 Separation of protein by SDS-PAGE
- 2.2 Block diagram
- 2.3 Performing SDS-PAGE
- 2.4 Application of SDS-PAGE
- 2.5 Other Acrylamide Gel Electrophoresis

Module- III: Agarose Gel Electrophoresis and DNA fingerprinting

Number of class hours: **2 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of agarose gel electrophoresis.
- 2) Students will be able to understand various components of agarose gel electrophoresis.
- 3) Students will be able to understand significance of agarose gel electrophoresis.
- 1) Students will be able to understand basics of DNA fingerprinting.
- 2) Students will be able to understand various components of DNA fingerprinting.
- 3) Students will be able to understand significance of DNA fingerprinting.

Detailed content of the unit: -

- 3.1 Separation of DNA/RNA by electrophoresis
- 3.2 Block diagram
- 3.3 Performing Agarose gel electrophoresis
- 2.4 Application of agarose gel electrophoresis
- 4.1 Basic technology of DNA fingerprinting
- 4.2 Identification of fingerprint
- 4.3 Block diagram
- 4.4 Application

Module- IV: Western Blotting and FNAC

Number of class hours: **6 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of western blotting.
- 2) Students will be able to understand various components of western blotting.
- 3) Students will be able to understand significance of western blotting.
- 1) Students will be able to understand basics of FNAC.
- 2) Students will be able to understand various components of FNAC.
- 3) Students will be able to understand significance of FNAC.

Detailed content of the unit: -

- 4.1 Basic technology of Western blotting
- 4.2 Identification of protein by western blotting
- 4.3 Block diagram

4.4 Application

6.1 Basics of cytology

6.2 FNAC technology in brief

6.3 Application

Module- V: Fluorescence Spectroscopy and Animal Care

Number of class hours: **8hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of fluorescence spectroscopy.
- 2) Students will be able to understand various components of fluorescence spectroscopy.
- 3) Students will be able to understand significance of fluorescence spectroscopy.
- 1) Students will be able to understand basics of animal care.
- 2) Students will be able to understand various aspects of animal care.
- 3) Students will be able to understand significance of animal care.

Detailed content of the unit: -

7.1 Basics of spectroscopy

7.2 Basics of fluorescence

7.3 Application

8.1 Common laboratory animal

8.2 General knowledge about their food, housing, breeding, handling.

Reference:

1. Cell and Molecular Biology- S.C.Rastogi
2. Biochemistry- Debajyoti Das
3. Immunology: Introductory Text Book- NandiniShetty
4. Human Physiology: Vol-1- Dr.C.C.Chatterjee
5. Immunology- Kuby
6. Lehninger's Principles of Biochemistry-Fourth Edition
7. Harper's Illustrated Biochemistry, 26th Edition
8. Modern Concept of Biotechnology- H.D.Kumar

PROTEIN TECHNOLOGY

Course Code	ML P C - 602
Course Title	Protein Technology
Number of Credits	2
Prerequisites	Basic understanding of biochemistry and cell biology
Course Category	Program Core Course (L+T)

Course Outcomes: -1) Students will be able to understand various concepts & principles of Protein Technology.
2) Students will be able to enumerate the background of Protein Technology and its significance.
3) Students will be able to evaluate problems on Protein Technology and its applications.
4) Students will be able to understand and apply Analytical methods in Protein Technology and Extraction of proteins.
5) Students will be able to understand & evaluate Basic Proteomics and Protein Design

Course Content:-

Module 1 - Structures of protein:

Number of class hours: **4hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Structures of protein.
- 2) Students will be able to analyse significance of Structures of protein.
- 3) Students will be able to enumerate various concepts in Structures of protein.

Detailed content of the unit: -

Study of structures of proteins, Protein folding, Protein stability, Storage of proteins, and Different parameters in X-ray crystal structure of Protein. 3 –D Co-ordinates of Proteins in PDB.

Module 2- Proteins as therapeutic and diagnostic tools:

Number of class hours: **4hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Proteins as therapeutic and diagnostic tools.
- 2) Students will be able to analyse significance of Proteins as therapeutic and diagnostic tools.

- 3) Students will be able to enumerate various concepts of Proteins as therapeutic and diagnostic tools.

Detailed content of the unit: -

Development of monoclonal and polyclonal antibody, Purification and storage of these antibodies, Therapeutic application of monoclonal and polyclonal antibody, Enzyme and fluorescent tags on antibodies, Interferon's and Growth factors as therapeutic agents, Visualization of secondary structural motifs of a therapeutic protein.

Module 3- Analytical methods in Protein Technology and Extraction of proteins:

Number of class hours: **8hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Analytical methods in Protein Technology.
- 2) Students will be able to analyse significance of the Analytical methods in Protein Technology.
- 3) Students will be able to enumerate various concepts of Analytical methods in Protein Technology.

Detailed content of the unit: -

SDS-PAGE , IEF , 2D – GE , Immunodiffusion , Western blotting , Protein sequencing , Cleavage of Di-sulphide bonds , Site specific cleavage and proteolysis. Precipitation, Cell destruction (Physical– Bead mill ,Ultrasonicator , Chemical- detergents , EDTA & bio-catalytic) , Salt extraction , Solvent extraction.

Module 4- Purification of proteins and Protein Therapeutics

Number of class hours: **8hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Purification of proteins.
- 2) Students will be able to analyse significance of the Purification of proteins.
- 3) Students will be able to understand basics of background and principles of Protein Therapeutics.

Detailed content of the unit: -

Gel filtration chromatography, Affinity chromatography, Dialysis, HPLC ,Ion Exchange Chromatography , Column chromatography basics , Void volume and related concepts. Blood products ,Therapeutic antibody , Therapeutic enzymes , Hormones & growth factors.

Module 5- Basic Proteomics and Protein Design

Number of class hours: **8hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of background and principles of Basic Proteomics and Protein Design.
- 2) Students will be able to analyse significance of Basic Proteomics and Protein Design.

- 3) Students will be able to enumerate various concepts of Basic Proteomics and Protein Design.

Detailed content of the unit: -

Classification and parameters of protein crystal structures , Algorithms and packages for structural analysis of proteins , Tutorial on protein solubility , Composition analysis of – Cys , Tyr , Trp etc , Characteristics of Peptide bond and its analysis , Protein motif identification and protein folding , Simulation of Protease activity using computational tool, biophysical analysis of protein structure , Analysis of the impact of pH and Temperature on protein stability , Free energy analysis of protein interaction and binding landscape , Molecular modelling of a therapeutic protein.

References:

- 1) Harper's Illustrated Biochemistry, 26th Edition.
- 2) Basic separation Techniques in Biochemistry- R.O.Okotore.
- 3) Lehninger's Principles of Biochemistry-Fourth Edition.
- 4) Immunology- Kuby.
- 5) Basic Biotechnology ,R.C.Dubey , S.Chand Publisher ,Recent Edition.
- 6) The Dictionary of Genomics, Transcriptomics and Proteomics, Günter Kahl, Willey VCH, 2015.
- 7) Biochemistry- Debajyoti Das.

QUALITY CONTROL

Course Code	MLPE-603/A
Course Title	Quality Control
Number of Credits	3
Prerequisites	Basic understanding of laboratory analysis and process biotechnology
Course Category	Programme elective course

Course Outcomes: -

- 1) Students will be able to understand basics of quality control of biopharmaceuticals.
- 2) Students will be able to understand and apply statistics in quality control of biopharmaceuticals.
- 3) Students will be able to know about different tools used as analytical techniques in quality control of biopharmaceuticals.
- 4) Students will be able to understand significance of separation techniques used in quality control of biopharmaceuticals.
- 5) Students will be able to understand significance of regulatory affairs used in quality control of biopharmaceuticals.

Course Content:-

Module – 1: Data analysis

Number of Class hours: 5

Learning Outcomes:

1. Students will develop the ability to build and assess data-based models.
2. Students will demonstrate proficiency with statistical analysis of data.

Detailed content of the unit:

Frequency Distribution, Diagrammatic representation of Frequency Distribution, Mean, Median and Mode – properties and related problems, Standard Deviation – properties and related problems.

Module – 2: Correlation and Regression

Number of Class hours: 3

Learning Outcomes:

1. Calculate and interpret the correlation between two variables.
2. Calculate the simple linear regression equation for a set of data.

Detailed content of the unit:

Bivariate frequency distribution, Correlation, Covariance, Correlation Coefficient – properties and related problems, Regression- Lines of regression, equation of lines of regression- properties and related problems.

Module – 3: Curve Fitting, Method of Least Squares and Probability Distribution

Number of Class hours: 4

Learning Outcomes:

1. Understand the Least Squares Method.
2. Be able to curve fit data using several types of curves.
3. Explain the concept of a random variable and the probability distributions.
4. Calculate the expected value and the moments.
5. Explain major distributions of random variables.

Detailed content of the unit:

Method of Least squares, Fitting Straight line, Fitting Parabola, Fitting Exponential and Geometrical Curves.

Random Variable, Discrete Probability Distribution, Binomial Distribution – properties and related problems, Continuous Probability Distribution, Normal Distribution – properties and related problems.

Module- 4: Biopharmaceuticals, diagnostics and Analytical Techniques

Number of class hours: **10hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of biopharmaceuticals & diagnostics.
- 2) Students will be able to know classification of of biopharmaceuticals & diagnostics.
- 3) Students will be able to understand application of of biopharmaceuticals & diagnostics.
- 1) Students will be able to understand basics of analytical techniques.
- 2) Students will be able to know types of analytical techniques.
- 3) Students will be able to know significance of analytical techniques.

Detailed content of the unit:-

Introduction to biotechnology and biopharmaceuticals, historical perspective of pharmaceutical biotechnology, process of transforming new molecular entities into drugs, current trends in drug development, biotechnology industry perspective on drug development. Quality control of protein therapeutics & diagnostics.

Analytical techniques used for quality control of protein therapeutics & diagnostics

(All basic preliminary studies only can be carried over in these topics)-

- a. Spectroscopy
- b. SDS-PAGE
- c. Agarose gel electrophoresis

d. Chromatography-
ELISA v. TLC
i. Gelfiltration ii. Affinity iii. HPLC iv.

Module- 5: Quality assurance, quality control, Production facilities and Regulatory bodies

Number of class hours:**8 hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to understand basics of QC and QA.
- 2) Students will be able to know various aspects of QC and QA.
- 3) Students will be able to understand significance of QC and QA.
- 1) Students will be able to understand basics of production facilities.
- 2) Students will be able to understand basics of regulatory bodies.
- 3) Students will be able to know significance of production facilities and regulatory bodies.

Detailed content of the unit: -

Four lectures Fundamental of quality assurance, benefits, structure of quality management, documentation, audits, quality assurance in manufacturing, measures to cross contamination and product confusion, equipment qualification, process validation, product release, product recall.

GMP, compliant design, zoning concept, single and multiple product plants, clean rooms, clean and plant utilities, water for injection, waste management.

Field of pharmaceutical laws, authorities, institutions and their regulation, drug approval steps and processes, FDA, EMEA, German, Japanese and Indian regulatory bodies.

References:

1. Statistical methods by N. G. Das
2. Quality Control by A.K. Bewoor V.A. Kulkarni (Author)
3. Biotechnology Quality Assurance and Validation *Edited By Kenneth E. Avis, Carmen M. Wagner, Vincent L. Wu*

PUBLIC HEALTH INFORMATICS

Course Code	MLPE-603/B
Course Title	Public Health Informatics
Number of Credits	3
Prerequisites	Basic understanding of hospital management
Course Category	Programme elective course-4(L)

- Course Outcomes:**
- 1) Students will be able to understand various concepts & principles of Public Health Informatics.
 - 2) Students will be able to enumerate the background of Public Health Informatics and its significance.
 - 3) Students will be able to evaluate problems on Public Health Informatics and its applications.
 - 4) Students will be able to understand Hospital Management
 - 5) Students will be able to understand how to make Clinical decision.

Course Content:-

Module 1 - Hospital Information System

Number of class hours: **12hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to analyse significance of Hospital Information System.
- 2) Students will be able to enumerate various types of methods used in Computer based patient records.
- 3) Students will be able to understand basics of background and principles of Informatics and clinical imaging.

Detailed content of the unit: -

– their function and state ,Hospital Engineering , Management of Hospital out door & Indoor division. Birth Control Program ,Blind Control Program Computer based patient records Informatics and clinical imaging

Module 2 - Hospital Management

Number of class hours: **8hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to analyse significance of Biomedical Engineering and Medical Person.

- 2) Students will be able to enumerate Hospital Management and Industrial Management.
- 3) Students will be able to understand basics of background and principles of Public Health Informatics.

Detailed content of the unit: -

Hospital Management Basics , Relation between Biomedical Engineering and Medical Person. Difference between Hospital Management and Industrial Management.

Module 3 -

Number of class hours: **4hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to analyse significance of health awareness.
- 2) Students will be able to understand lab safety and hazard.
- 3) Students will be able to understand basics of xenobiotics.

Detailed content of the unit: -

Health awareness, Xenobiotics and lab safety measures & hazards ,

Module 4 - Health Care Informatics

Number of class hours: **8hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to analyse significance of Computer networks in Health Care.
- 2) Students will be able to enumerate Overview of standards related to the emerging health care information infrastructure.
- 3) Students will be able to understand basics of Design issue in developing clinical decision support and monitoring system.

Detailed content of the unit: -

Computer networks in Health Care ,Overview of standards related to the emerging health care information infrastructure ,

Module 5 - Clinical decision support

Number of class hours: **4hrs**

Suggestive Learning Outcomes:

- 1) Students will be able to analyse significance of Computer networks in Health Care.
- 2) Students will be able to enumerate Overview of standards related to the emerging health care information design.
- 3) Students will be able to understand basics of medical informatics.

Detailed content of the unit: -

Non-A1 Decision maker , Design issue in developing clinical decision support and monitoring system.

REFERENCES

1. Hospital Administration – C.M.Francis& Mario C De Souza
2. Principles of Hospital Administration and Planning- B.M.Sakharkar

ENTREPRENEURSHIP AND START-UPS

Course Code	:	HS 604
Course Title	:	Entrepreneurship and Start-ups
Number of Credits	:	4
Prerequisites (Course code)	:	None
Course Category	:	HS

- CO1 Understand the basic concepts of Entrepreneurship and Startups.
- CO2 Illustrate skills of discovering business ideas, visualizing and planning a business.
- CO3 Analyze market and business risk for strategy development.
- CO4 Demonstrate skills of organizational management.
- CO5 Exhibit knowledge of financing methods, institutions and skills for communication of ideas.

Course Content:**Unit1-Introduction and Basics of Entrepreneurship and Start-Ups****Suggestive Learning Outcomes:**

- (1) Describe the Basic Elements of Entrepreneur and Entrepreneurship
- (2) Distinguish between Entrepreneur, Manager and Intrapreneur

Content:

- Definitions, Traits of an entrepreneur, Factors influencing entrepreneurship, Types and Functions of Entrepreneurs, Need for promotion of entrepreneurship, Intrapreneur, Motivation
- Role of Entrepreneurs in Economic Development

- Similarities/differences between - Entrepreneur and Manager, Entrepreneur and Intrapreneur.

Unit2–Business Ideas and their implementation

Suggestive Learning Outcomes:

- (1) Illustrate different Types of Business Planning and Business Structure
- (2) Select specific Institutions Assisting Entrepreneur

Content:

- Discovering ideas
- Visualizing the business
- Business Plan, - Types of planning, Importance of planning, Steps in planning
- Types of Business Structures
- Institutions assisting entrepreneur

Unit3–Idea to Start-up

Suggestive Learning Outcomes:

- (1) Identify Steps for Starting a SSI
- (2) Predict the Target Market and Associated Risk

Content:

- Market analysis – Identifying the target market
- Competition evaluation and Strategy Development
- Steps for starting a small enterprise
- Risk analysis

Unit4–Management of Enterprise

Suggestive Learning Outcomes:

- (1) Apply the Basic Accounting Concepts in Business
- (2) Demonstrate Knowledge of Pricing, Positioning and Advertising of Products

Content:

- Recruitment and management of talent.
- Determinants of Price, Pricing methods in practice.
- Market Positioning, Advertising and Sales Promotion
- Accounting - Understanding basics of Transaction, Journal, Ledger,

Cashbook, Trial Balance, Cost Sheet and Final Accounts through simple problems

Unit5-Financing and Communication of Ideas

Suggestive Learning Outcomes:

- (1) Exhibit Knowledge of various Financial Institutions and Financing Methods
- (2) Illustrate Business Ideas through Communication Skills

Content:

- Financial Institutions
- Financing methods available for start-ups in India
- Communication of Ideas to potential investors–Investor Pitch

SUGGESTED LEARNING RESOURCES:

S.No.	Title of Book	Author	Publication
1.	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf	K & S Ranch ISBN-978-0984999392
2.	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Penguin UK ISBN-978-0670921607
3.	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber	Headline Book Publishing ISBN-978-0755388974
4.	Entrepreneurship	Alpana Trehan	Dreamtech Press ISBN: 978-93-5004-026-3
5	Marketing and Sales Management	D C Kapoor	S Chand and Company Ltd. ISBN: 81-219-2430-8
S.No.	Title of Book	Author	Publication
6	Business Economics	H L Ahuja	S Chand and Company Ltd. ISBN: 81-219-1791-3

7	Financial Accounting (Principles and Practice)	Jawahar Lal & Seema Srivastava	S Chand Publishing
8	Accounting for Management	N.P. Srinivasan & Sakthivel Murugan	S Chand Publishing
9	Marketing	Harsh V Verma and Ekta Duggal	Oxford University Press ISBN: 0-19-945910-X
10	Marketing (Asian Edition)	Paul Baines, Chris Fill, Kelly Page and Piyush K. Sinha	Oxford University Press
11	Entrepreneurship	Rajeev Roy	Oxford University Press ISBN: 0-19-807263-5
12	Entrepreneurship Development	Kumar S Anil	New Age Publishers
13	Human Resource Management	Uday Kumar Haldar and Juthika Sarkar	Oxford University Press
14	Fundamentals of Entrepreneurship	S K Mohanty	Prentice Hall of India Private Limited ISBN: 81-203-2867-1
15	Entrepreneurship Development	S S khanka	S Chand and Company Ltd. ISBN: 81-219-1801-4

SUGGESTED SOFTWARE/LEARNINGWEBSITES:

- a. <https://www.fundable.com/learn/resources/guides/startup>
- b. <https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate-structure/>
- c. <https://www.finder.com/small-business-finance-tips>
- d. <https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/>

INDIAN CONSTITUTION

Course Code	:	AU302
Course Title	:	Indian Constitution
Number of Credits	:	0 (L: 2, T:0; P:0)
Prerequisites (Course code)	:	None
Course Category	:	AU

Course Outcomes:

CO1. Illustrate Preamble, Basic Structure, Fundamental Rights and Duties of Indian Constitution(K3).

CO2. Discuss the Structure of The Indian Union Government(K2).

CO3. Memorize the Role and Power of Governor, Chief Minister and Council of Ministers and explain the role of State Secretariat (K2).

CO4. Describe the role of Local Administration (K2).

CO5. Explain the Role and Functioning of Election Commission (K2).

Detailed Course Content:

Unit 1 – The Constitution – Introduction

Number of Class hours:06

Learning Outcomes:

1. Describe the History of the Making of the Indian Constitution (K2)
2. Illustrate Preamble and the Basic Structure of Indian Constitution (K3)
3. Illustrate the Fundamental Rights and Duties set by Indian Constitution(K3)

Detailed content of the unit:

1. The History of the Making of the Indian Constitution
2. Preamble and the Basic Structure, and its interpretation
3. Fundamental Rights and Duties and their interpretation
4. State Policy Principles

Unit 2 – Union Government

Number of Class hours:06

Learning Outcomes:

1. Discuss the Structure of the Indian Union Government (K2).
2. Memorize the Role and Power of President, Prime Minister and Council of

Ministers of India (K1)

3. Explain the role of Lok Sabha and Rajya Sabha (K2)

Detailed content of the unit:

1. Structure of the Indian Union
2. President – Role and Power
3. Prime Minister and Council of Ministers
4. Lok Sabha and Rajya Sabha

Unit 3 – State Government

Number of Class hours:06

Learning Outcomes:

1. Memorize the Role and Power of Governor, Chief Minister and Council of Ministers of a state (K1)
2. Explain the role of State Secretariat (K2)

Detailed content of the unit:

1. Governor – Role and Power
2. Chief Minister and Council of Ministers
3. State Secretariat

Unit 4 – Local Administration

Number of Class hours:06

Learning Outcomes:

1. Describe the role of District Administration (K2)
2. Explain the role of Municipal Corporation (K2)
3. Discuss the role of Zila Panchayat (K2)

Detailed content of the unit:

1. District Administration
2. Municipal Corporation
3. Zila Panchayat

Unit 5 – Election Commission

Number of Class hours:06

Learning Outcomes:

1. Explain the Role and Functioning of Election Commission (K2)
2. Classify the role and functioning of Chief Election Commissioner and State Election Commissioner (K2).

Detailed content of the unit:

1. Role and Functioning of Election commission
2. Chief Election Commissioner
3. State Election Commission

Suggested Learning Resources:

S. No.	Title of Book	Author	Publication
1.	Ethics and Politics of the Indian Constitution	Rajeev Bhargava	Oxford University Press, New Delhi, 2008
2.	The Constitution of India	B.L. Fadia	Sahitya Bhawan; New edition (2017)
3.	Introduction to the Constitution of India	DD Basu	Lexis Nexis; Twenty-Third 2018 edition

Suggested Software/Learning Websites:

- a. <https://www.constitution.org/cons/india/const.html>
- b. <http://www.legislative.gov.in/constitution-of-india>
- c. <https://www.sci.gov.in/constitution>
- d. <https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/>

Major Project - II

Course Code	CEPR-607
Course Title	Major Project
Number of Credits	3 (L: 0, T: 0, P: 6)
Prerequisites	Nil
Course Category	Project Work (PR)

Course Outcome:-

After completion of the course, students will be able to:

C.O. 1: Demonstrate a sound technical knowledge of their selected project topic and the knowledge, skills and attitudes of a professional engineer (K2).

C.O. 2: Develop the skill of working in a Team (K3).

C.O. 3: Design engineering solutions to complex problems utilising a systems approach (K6).

C.O. 4: Design the solution of an engineering project involving latest tools and techniques (K6).

C.O. 5: Develop the skill of effective communication with engineers and the community at large in written and oral forms (K3).

Course Content:-

The major project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should provide the scope to develop the following by the students-

- 1) Develop sound knowledge about the domain of the project work.
- 2) Perform detailed study about various components of a project.
- 3) Learn to be an important member of a team for successful execution of a project work.
- 4) Study about methodologies and professional way of documentation and communication related to project work.
- 5) Develop idea about problem formulation, finding the solution of a complex engineering problem.
- 6) Develop project report as per the suggested format to communicate the findings of the project work.
- 7) Acquire the skill of effective oral communication to the fellow engineers and people in the society at large.
- 8) Knowledge of how to organize, scope, plan, do and act within a project thesis.

- 9) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
- 10) Demonstrate the implementation of a major project work.

Seminar

Course Code	AR SE608
Course Title	Seminar
Number of Credits	1 (L: 0, T: 0, P: 1)
Prerequisites	Nil
Course Category	Seminar presentation

Course Outcome:-

After completion of the course, students will be able to:

C.O.1: Demonstrate a thorough and systematic understanding of a seminar topic (K2).

C.O. 2: Identify the methodologies and professional way of documentation and communication (K3).

C.O.3: Demonstrate the ability to construct a report consistent with expectations of the topic, including an appropriate organization, style, voice, and tone (K3).

C.O.4: Develop the ability to follow discussions, oral arguments, and presentations, noting main points or evidence and tracking through different comments given by the audience (K3).

C.O.5: Develop the communication skill as a speaker (K3).

Course Content:-

The seminar topics may be any aspect of the science and technology, entrepreneurship or any contemporary social issues to be solved by specific branch of engineering and technology (For example, Water logging problems in a particular city may be a seminar topic for Civil Engineering Students) must be approved by the instructor in advance.

The course should have the following-

- 1) Practice speaking in front of a scientific audience.
- 2) Explore topics in detail.
- 3) Research topics and organize presentations.
- 4) To improve as speakers, each student will receive feedback from the fellow students and the instructor.
- 5) PowerPoint, Key Note or overheads are acceptable media for Visual aids. Visual aids should look professional and be readable in the entire room; use spell check and proofread for typographical errors.

- 6) Students have to submit a hard copy contains detailed outline (4-5 pages) of their presentation and also a brief abstract (one or two paragraphs; **250 words max.**) describing their presentation.
- 7) Each student will give 20-minute presentations followed by 3 minutes of question-answer session.

Proposal Seminar Format for Students:

- Introduce yourself.
- Give an introduction and background information on your topic. What relevant research has been performed previously?
- State the problem(s) that remain unanswered.
- Clearly state your objectives and give the specific hypotheses you wish to test.
- Describe the methodology you will use to test your hypotheses. Be sure you fully understand your chosen methods. Give reasons why you chose these methods over other approaches.
- Present any data you have collected thus far.
- Describe what remains to be done, and what you expect to find.

Explain the significance of your findings (or potential future findings).
