West Bengal State Council of Technical & Vocational Education and Skill Development
(Technical Education Division)

Syllabus
of

Diploma in Medical Laboratory Technology [MLT]

Part-II (4th Semester)

Revised 2022

Syllabus of Clinical Biochemistry & Biophysics

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Clinical Biochemistry & Biophysics	Course Code:	MLTPC407
Course Category:	Theory; Program Core	Full Marks & Duration:	100; (15+2) Weeks
Credit:	2	Contact Hr./Week	L-2, T-0, P-0

Course Objective:

Sr. No	Course Objective
1	To know the basic organic & inorganic compound in human body
2	To acquire the basic knowledge of the nutrients and their role in body
3	To know the blood chemistry and their estimation with their clinical significance
4	To acquire the knowledge of Medical Laboratory Techniques & use of instruments.
5	To know the basic biophysics and their physiological significance.

Course Content:

Unit	Topic	Hrs.
1	**Introduction to Biochemistry:** Concept of Biochemistry, Chemical in the body – Organic compounds & inorganic compounds, Overview of body water and Salts, Ion transportation through cell membrane, Concept of blood pH, Basic Knowledge of Nutrients - Carbohydrate, Proteins, Lipids, Minerals, Vitamins, Knowledge of Enzyme, Basic Physiology and biochemistry of the body, Inter-related metabolic process of the body	6
2	**Sample collection and Biochemical Estimation:** Basic clinical biochemistry- chemistry profiles, Types of specimens, Units of Measure, Reference ranges, Collection of blood, Anticoagulants and preservatives for blood, Preparation of serum, Urine collection – timed urine specimen, urine preservatives, and knowledge of others fluids, Separation and Storage of Specimens, Care of sample handling. OD, Basic Principle of Colorimetric, UV-Spectrophotometry, Basic Principle of Biochemical estimation. Estimation & clinical significance of the Followings: Blood sugar (F/PP/R), True glucose, Glucose Tolerance Test, Total Plasma protein, Albumin, Globulin, Cholesterol, Triglyceride, Lipoproteins- LDL, VLDL, HDL, Blood Urea, Uric acid, Creatinine, Bilirubin , SGPT, SGOT, Alkaline Phosphate, Knowledge of LFT, Kidney Function Test, Lipid profile, Cardiac function test	14
3	**Basic Biophysics:** Acidity and alkalinity, pH, Effects of temperature on pH, definition of Buffer, Principles of buffer, determination of pH of buffer, Buffer Mixture, Buffer pair in blood, Buffer of tissue fluids and tissues, Role of Buffer in pH regulation, Bicarbonate buffer, Phosphate buffer, Protein buffer, Diffusion – definition, Experiment, characteristics, Fick's law, Physiological role, Clinical aspects, Osmosis – definition, Experiment, Osmotic Pressure, Physiological important, Surface tension- definition, Explanation only, Viscosity – definition, Factors affecting viscosity, Colloids – definition and colloid terminology only, Concept of Dialysis,	10
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		30
Assessment : **(2**hrs. x 2 Weeks)		04
Total: (2hrs. x 17 Weeks)		**34**

Course Outcomes (COs):

COs	***Students would be able to***
CO1	State the basic organic & inorganic compound in our body and nutrients with their function & sources.
CO2	Demonstrate the sample collection and bio-chemicals estimation with clinical correlation
CO3	Explain the basic biophysics of diffusion, osmosis, dialysis with physiological significance and role of buffers for pH regulation in human body.

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit No	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time
1	**Objective Type:** MCQ/ Fill-in-the blanks/Very short answer	-	All	35	30	1 x 30	30	
2	**Short Answer Type:**	-	All	8	6	2 x 6	12	
3	**Subjective Type:**	M-I	1	3	Any **three** taking at least **One** from each module	6 x 3	18	
		M-II	2	3				
		M-III	3	3				
	Total:						60	Hrs.

Reference Book:

Sr No	Book	Author	Publisher
1	Medical Laboratory technology (Vol. - III)	K L Mukherjee	
2	Medical Laboratory technology	Sood	
3	Fundamentals of Biochemistry	A C Deb	
4	Clinical Biochemistry	D M Vasudevan & Sreekumari	
5	Biochemistry	Debajyoti Das	
6	Practical Pathology	P. Chakraborty & Gargi Chakraborty	
7	Biophysics	Dr. R. N. Roy	
8	Viva & Practical Biochemistry & Biophysics	Dr. R. N. Roy	

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Syllabus of Clinical Biochemistry & Biophysics Lab

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Clinical Biochemistry & Biophysics.	Course Code:	MLTPC407P
Course Category:	Sessional; Program Core	Full Marks & Duration:	100; (15+2) Weeks
Credit:	1	Contact Hr./Week	L-0: T-0: P-2

Course Objective:

Sr. No	Course Objective
1	To perform collection, preparation of blood for biochemical tests.
2	To perform bio-chemistry test for estimation of blood chemistry with clinical interpretation.
3	To perform the Experiments of Biophysics
4	To operate the instrument.

Course Details:

Expt. No	Experiment	Hrs.
1	Collection of venous blood and plasma/serum preparation	
2	Estimation of Blood sugar.	
3	Estimation of Blood Urea	
4	Estimation of Blood Uric acid	
5	Estimation of Blood creatinine	
6	Estimation of Blood Cholesterol	
7	Estimation of Triglyceride	
8	Estimation of Bilirubin (Total, Conjugated, Unconjugated)	
9	Estimation of SGPT	
10	Estimation of SGOT	
11	Estimation of Alkaline Phosphate	
12	Estimation of Plasma protein	
13	Estimation of Albumin, Globulin	
14	Estimation of Electrolytes (Na^+ , K^+ , Cl^-,)	
15	Identification of urinary sugar	
16	Estimation of urinary bile salt & bile pigment	
17	Experiment of Diffusion	
18	Experiment of Osmosis	
19	Measurement of Viscosity	
20	Measurement of pH	
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		30
Assessment : **(**2hrs. x 2 Weeks)		04
Total: (2hrs. x 17 Weeks)		**34**

Course Outcomes (Cos):

COs	***Students would be able to***
CO1	Develop skill of collection, preparation of blood for biochemical tests.
CO2	Perform bio-chemistry tests for estimation of blood chemistry & urine chemistry.
CO3	Interpret the test result of Bio-chemistry test of blood & urine sample.
CO4	Demonstrate the experiment of bio-physic

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Syllabus of Serology & Histopathology

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Serology & Histopathology	Course Code:	MLTPC408
Course Category:	Theory; Program Core	Full Marks & Duration:	100 ; (15+2) Weeks
Credit:	2	Contact Hr./Week	L-2: T-0 : P-0

Course Objective:

Sr. No	Course Objective
1	To be familiar with the basic knowledge of immunity.
2	To know basic principle of serological tests.
3	To study serological test.
4	To introduce histopathology

Course Details:

Unit	Topic	Hrs.
1	**Introduction to Immunology :** Introduction to serology, Immunity, types of immunity, Acquired immunity, active and passive immunity, Introduction to immunity system of the body, Immunization, Primary and secondary antibody response, Diseases involving immune system, Clinical significance of Serodiagnosis,	3
2	**Principle of Serological Tests:** Basic Principle of Immunological tests, Recognition of Antigen-Antibody reaction, sensitivity and Specificity of test procedure, Reporting of Serological Tests – qualitative, Semi quantitative, quantitative, titer. Titer determination, Problems in serological Assays, Principles of Serodiagnostic test – Precipitation, Flocculation, Agglutination, Haemagglutination, Neutralization Reaction, complement fixation, EIA, MIA, fluorescent Antibody (FA) , RIA, ELISA, PCR	7
3	**Laboratory Procedure in Serology:** VDRL, Widal, Latex Agglutination, ASO, CRP, RA factor, HIV, Viral Hepatitis – A, B, C, Dipstick test for Malaria, hCG, T3, T4,TSH, PCR-Swine flu & COVID-19,	12
4	**Overview of Histopathology:** Biopsy, types of biopsy, Factors for selection of types of biopsy, Some common biopsy used in diagnosis, Different steps followed in biopsy specimen preparation – Fixation, Tissue processing, Blocking, Section cutting & fixing on slide, Staining with appropriate stain, Mounting, Observation, Different stain and their use, advantages and disadvantages, Overview of instrument used in histopathology lab	8
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		30
Assessment : **(2** hrs. x 2 Weeks)		04
Total: (2 hrs. x 17 Weeks)		**34**

Course Outcomes (Cos):

COs	***Students would be able to***
CO1	State the different Immunity, immunity system, immunization
CO2	Explain working principle of different serological test, procedure, result and clinical significance.
CO3	Demonstrate different types of biopsy, biopsy sample preservation, biopsy sample preparation, staining and observation.

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit No	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time
1	**Objective Type:** MCQ/ Fill-in-the blanks/Very short answer	-	All	35	30	1 x 30	30	
2	**Short Answer Type:**	-	All	8	6	2 x 6	12	
3	**Subjective Type:**	M-I	1,2	3	Any **three** taking at least **One** from each module	6 x 3	18	
		M-II	3	3				
		M-III	4	3				
	Total:						60	Hrs.

Reference Book:

Sr No	Book	Author	Publisher
1	Hand book of Medical Lab. Technology	V. H. Talib	
2	Medical Laboratory Technology (Vol. - III)	K L Mukherjee	
3	Medical Laboratory Technology	Sood	
4	Fundamentals of Biochemistry	A C Deb	
5	Practical Pathology	P. Chakraborty & Gargi Chakraborty	
6	Viva & Practical Biochemistry & Biophysics	Dr. R. N. Roy	

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Syllabus of Serology & Histopathology Lab.

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Serology & Histopathology Lab.	Course Code:	MLTPC408P
Course Category:	Sessional; Program Core	Full Marks & Duration:	100 ; (15 + 2) Weeks
Credit:	1	Contact Hr./Week	P-2

Course Objective:

Sr. No	Course Objective
1	To handle the instrument use in serology laboratory.
2	To perform serological test and interpret the result
3	To be familiar with biopsy slide preparation and study of biopsy slide.

Course Details:

Expt. No	Experiment/ Job	Hrs.
1	VDRL	
2	WIDAL	
2	ASO	
3	CRP	
4	RA factor	
5	Hepatitis – A, B, C	
6	Malaria (Dipstick)	
7	hCG (Dipstick)	
8	HIV (Dipstick)	
9	Estimation of TSH	
10	Estimation of T3, T4	
11	Collection of nasopharyngeal swab (COVID-19, Swine Flu)	
12	COVID-19 test (Dipstick and PCR)	
13	Swine Flu test (Dipstick and PCR)	
14	Demonstration of different biopsy sample preservation.	
15	Demonstration of different biopsy slide preparation.	
16	Study of Biopsy slide	
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		30
Assessment : **(**2hrs. x 2 Weeks)		04
Total: (2hrs. x 17 Weeks)		**34**

Course Outcomes (COs):

COs	***Students would be able to***
CO1	Perform commonly used serological tests with interpretation.
CO2	Operate the ELISA reader.
CO3	Demonstrate sample collection and testing of COVID-19 & Swine Flu.
CO4	Study the biopsy slides.

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Syllabus of Bio-Medical Instrumentation-II

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Bio-Medical Instrumentation-II	Course Code:	MLTPC409
Course Category:	Theory; Program Core	Full Marks & Duration:	100 ; (15+2) Weeks
Credit:	3	Contact Hr./Week	L-3: T-0 : P-0

Course Objective:

Sr. No	Course Objective
1	To introduce with different analytical and diagnostic instruments/equipment used in medical laboratory technology and biomedical engineering domains.
2	To provide fundamental concepts of different types of Medical instruments/equipment.
3	To introduce with the working principles and applications of different types of Medical instruments/equipment.
4	To apply the knowledge of different analytical and diagnostic instruments/equipment in Biomedical Instrumentation

Course Content:

Unit	Topic	Hrs.
1	**Introduction to analytical Equipment:** Overview of – Binocular microscope, centrifuge, UV-spectrophotometer, Auto-clave	04
2	**Medical Laboratory Instrumentation:** Working principle, construction, basic block diagram, and application of – Bio-chemistry analyzer (Semi & Full Auto), Blood cell counter, Electrolyte analyzer, ELISA reader, RT PCR instrument.	10
3	**Diagnostic Instrument:** Introduction to Sphygmomanometer, stethoscope, Working principle, construction, basic block diagram, application of – Electronic BP (Semi & Full automatic), ECG, EEG, EMG, Computerized Spirometer, Pulse oximeter	12
4	**Therapeutic Instrument:** Working principle, construction (Parts), basic block diagram, and application of – Physio-therapy machine, Cardiac pacemaker, introduction to Radio-therapy	04
5	**ICU Instrument:** Working principle, construction, basic block diagram, application of – Patient monitor, Ventilator, Defibrillator,	06
6	**OT Instrument:** Anesthesia machine, Surgical diathermy machine, Cutting and Coagulation, Safety aspect.	04
7	**Drug Delivery Instrument:** Working principle, construction (Parts), basic block diagram, and application of – Infusion pump, Syringe pump.	02
8	**Life Supporting Instrument:** Working principle, construction (Parts), basic block diagram, and application of - Medical oxygen concentrator, Hemodialysis machine.	03
Total Teaching Hrs. : (3 hrs. x 15 Weeks)		45
Assessment : **(**3hrs. x 2 Weeks)		06
Total: (3hrs. x 17 Weeks)		**51**

Course Outcomes (COs):

COs	*At end of the course, students would be able to*
CO1	Describe the working principle & construction and application of different analytical & medical laboratory instruments.
CO2	Identify the different functional component of few bio-electric potential recording instruments and therapeutic instruments and application.
CO3	Explain the working and parts of some ICU & OT instruments and its use.
CO4	Demonstrate the operation and applications of few drug delivery and life supporting instruments

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit No	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time
1	**Objective Type:** MCQ/ Fill-in-the blanks/Very short answer	-	All	35	30	1 x 30	30	
2	**Short Answer Type:**	-	All	8	6	2 x 6	12	
3	**Subjective Type:**	M-I	1,2	3	Any **three** taking at least **One** from each module	6 x 3	18	
		M-II	3,4	3				
		M-III	5,6,7	3				
	Total:						60	Hrs.

Reference Book:

Sr No	Book	Author	Publisher
1	Handbook of Biomedical Instrumentation	R.S. Khandpur	McGraw Hill Education
2	Biomedical Instrumentation and Measurements	Cromwell	Pearson
3	Handbook of analytical Instrumentation	R.S. Khandpur	McGraw Hill Education
4	A Text Book of Medical Instruments.	S. Ananthi	New Age International Private Limited
5	Medical Instrument	J. G. Webster	

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Syllabus of Bio-Medical Instrumentation-II Lab.

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Bio-Medical Instrumentation-II Lab.	Course Code:	MLTPC409P
Course Category:	Sessional; Program Core	Full Marks & Duration:	100 ; (15+2) Weeks
Credit:	1	Contact Hr./Week	L-0: T-0 : P-2

Course Objective:

Sr. No	Course Objective
1	To be familiar with different types of electrodes used in bio-medical instrument & their application.
2	To study and verify the working principle of transducers & sensors.

Course Content:

Expt. No	Experiment	Hrs.
1	Identification of different part and verification of working principle of Binocular Microscope	
2	Identification of different part and verification of working principle of Centrifuge.	
3	Identification of different part and verification of working principle of Autoclave.	
4	Study of UV-Spectrophotometer	
5	Study of Bio-chemistry analyzer	
6	Study of ELISA Reader and its application.	
7	Study of RT PCR machine.	
8	Identification of different parts of BP Instrument and study of BP instrument.	
9	Study of ECG machine.	
10	Study of EEG machine.	
11	Study of Pulse oximeter.	
12	Study of Spirometer.	
13	Study of Patient monitor.	
14	Study of Syringe pump	
15	Study of Oxygen concentrator.	
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		30
Assessment : **(**2hrs. x 2 Weeks)		04
Total: (2hrs. x 17 Weeks)		**34**

Course Outcomes (COs):

COs	***Students would be able to***
CO1	Identify different analytical and diagnostic instruments/equipment used in medical laboratory technology and biomedical engineering domains.
CO2	Demonstrate working and different constituting parts of few bio-electric signal recording instrument.
CO3	Demonstrate different constituting parts, working, operating of Spirometer and patient monitor
CO4	Demonstrate different constituting parts, working, operating of Oxygen concentrator.

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Syllabus of Diagnostic Techniques

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Diagnostic Techniques	Course Code:	MLTPC410
Course Category:	Theory; Program Core	Full Marks & Duration:	100 ; (15+2) Weeks
Credit:	2	Contact Hr./Week	L-2: T-0 : P-0

Course Objective:

Sr. No	Course Objective
1	To introduce the different diagnostic techniques.
2	To know the measurement procedure, patient preparations and diagnosis.
3	To be familiar with application of the biomedical instruments

Course Content:

Unit	Topic	Hrs.
1	**Basic Clinical Parameters:** ***Body Temperature:*** Introduction to Body temperature, normal range, body temperature measurement- site, working principle of clinical thermometer, procedure, clinical significance, basal body temperature, Fever, Hyperthermia. ***BP:*** Definition of blood pressure, Arterial & Venous BP, arterial BP curve, Systolic, Diastolic, Mean BP, Pulse Pressure. Different method for BP measurement. Arterial BP measurement – different techniques (auscultatory, oscillatory, palpatory), working principle, device, procedure, normal range, Sphygmomanometer, Working of electronic BP instrument. Clinical significance of BP, hypertension, hypotension. ***SpO2:*** Introduction to Spo2, measurement of SpO2 ***Heart Sound:*** Cause of heart sound, characteristic of heart sound – intensity, pitch, location. Overview of different heart sounds –S1, S2, S3 & S4, murmur, Auscultation of heart sound, Introduction to phonocardiography.	8
2	**ECG:** Definition of ECG, Conduction system of the heart, ECG waves and their clinical significance, Leads, Einthoven Law, Einthoven Triangle, ECG paper, Patient preparation, ECG procedure, Measurements, Artifact, Cardiac vector, Reporting	6
3	**EEG:** Definition of EEG, Different brain waves, EEG Recording – Electrode, Electrode positioning (10/20 system), different modes, Montage, Patient preparation, Procedure, Measurement, Artifact, Clinical interpretation, Application, Different sleep pattern,	4
4	**EMG:** Definition of EMG, Overview of muscle, Purpose of EMG, principle of EMG, EMG Recording- Nerve conduction study, latency, nerve conduction velocity, intramuscular EMG, Surface EMG, Electrode, EMG Pattern.	4
5	**ERG:** Definition of ERG, Overview of vision, Purpose of ERG, principle of ERG, ERG Recording, ISCEV guideline, Electrode, ERG wave. Types of ERG,	4
6	**PFT:** Introduction to PFT, Purpose of PFT, Lung volumes & capacities, Spirometry test, FVC, FEV1, EFV1/EVC ration, Volume-time graph, Flow-Volume loop.	4
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		30
Assessment : (**2**hrs. x 2 Weeks)		04
Total: (2hrs. x 17 Weeks)		**34**

Course Outcomes (COs):

COs	***Students would be able to***
CO1	Explain the basic clinical parameters- body temperature, BP, SpO2 & Heart sound and their measurement.
CO2	Demonstrate the recording procedure of bio-electric signal for diagnosis.
CO3	Analysis the ECG, EEG, EMG wave.
CO4	Demonstrate the spirometry test.

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit No	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time
1	**Objective Type:** MCQ/ Fill-in-the blanks/Very short answer	-	All	35	30	1 x 30	30	
2	**Short Answer Type:**	-	All	8	6	2 x 6	12	
3	**Subjective Type:**	M-I	1,2	3	Any **three** taking at least **One** from each module	6 x 3	18	
		M-II	3,4	3				
		M-III	5,6	3				
	Total:						60	Hrs.

Reference Book:

Sr No	Book	Author	Publisher
1	Biomedical Instrumentation	R. S. Khandpur	Tata McGraw-Hill
2	A text book of Medical Instrument	S. Ananthi	
3	Principle hints to clinical Electrocardiography	C R Maiti & N Goswami	
4	Viva & practical Physiology, Biochemistry &biophysics	R N Roy	
5	Human Anatomy & Physiology	E. Merieb	

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Syllabus of Diagnostic Techniques Lab.

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Diagnostic Techniques Lab.	Course Code:	MLTPC410P
Course Category:	Sessional; Program Core	Full Marks & Duration:	100 ; (15+2) Weeks
Credit:	1	Contact Hr./Week	L-0: T-0 : P-2

Course Objective:

Sr. No	Course Objective
1	To be familiar with few diagnostic techniques and patient preparation.
2	To develop skill for use of medical Instruments
3	To measure the basic clinical parameter.
4	To record the bio-electric signal for diagnosis.

Course Details:

Course Content of Biomedical Instrumentation-I Lab		
Expt. No	Experiment	Hrs.
1	Measurement of Body temperature.	
2	Measurement of Blood Pressure	
3	Measurement of SpO2	
4	Auscultation of Heart Sound	
5	Recording of ECG	
6	Recording of EEG	
7	Study of EMG recording	
8	Study of ERG recording	
9	Recording of Spirometry for PFT	
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		30
Assessment : **(**2hrs. x 2 Weeks)		04
Total: (2hrs. x 17 Weeks)		**34**

Course Outcomes (COs):

COs	***Students would be able to***
CO1	Develop the skill for measurement of basic clinical parameters- Body temperature, BP, SpO2
CO2	Auscultate the heart sounds.
CO3	Record the ECG, EEG, Spirometry (PFT)
CO4	Analysis the ECG, EEG, PFT

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Syllabus of Digital Electronics

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Digital Electronics	Course Code:	MLTPC411
Course Category:	Theory; Program Core	Full Marks & Duration:	100; (15+2) Weeks
Credit:	2	Contact Hr./Week	L-2: T-0 : P-0

Course Objective:

Sr. No	Course Objective
1	To acquire the basic knowledge of digital techniques
2	To understand the basic logic to design the digital circuit
3	To be familiar with the Boolean algebra and simplification of Boolean expression
4	To design the digital counter and register

Course Content:

Unit	Topic Details	Hrs.
1	**Number Systems & Boolean Algebra :** Simple arithmetic using positive and negative binary numbers: Addition, Subtraction, Division Different Weighted & Non-weighted codes — Error correcting codes. Definition of Boolean Algebra — Boolean Theorems (with their proofs)	5
2	**Simplification of Logic Expressions** Simplification of Boolean expression or logic expression using — (i) Boolean Algebra and (ii) Karnough Maps	4
3	**Combinational Logic Circuits :** Arithmetic Circuits: Half adder – Full adder – Half subtractor – Full subtractor (truth table, logic expression, equivalent circuit diagram – brief description) — Comparator – Multiplexer – Demultiplexer / Decoder – Code Converter – Encoder – Parity Generator & Checker.	8
4	**Sequential Circuits:** Introduction to sequential circuits — Model of sequential circuits: latch & flip flops – timing parameters of latch & flip flops – conversion of one flip flop to another — COUNTER: Introduction to counter – Binary ripple counter (UP/DOWN) – Module-n-counter – Synchronous & Asynchronous counter — REGISTERS: Shift registers – Serial data – Parallel data – Design of registers & their functional detail	10
5	**Data Converter:** DIGITAL TO ANALOG CONVERTER (DAC): Weighted register ladder, Commercially Available DAC — ANALOG TO DIGITAL CONVERTER (ADC): Different types – Successive approximation – Dual – Slope type – ADC performance – Commercially available ADC	3
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		30
Assessment : (**2**hrs. x 2 Weeks)		04
Total: (2hrs. x 17 Weeks)		**34**

Course Outcomes (Cos):

CO	***At end of the course, students would be able to***
CO1	Solve problems related to number systems and Boolean algebra
CO2	Analyze combinational circuits , synchronous and asynchronous circuits
CO3	Design various Sequential circuits , synchronous and asynchronous circuits
CO4	Explain internal circuitry and logic behind Analog to Digital and Digital to Analog converters

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit No	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time
1	**Objective Type:** MCQ/ Fill-in-the blanks/Very short answer	-	All	35	30	1 x 30	30	
2	**Short Answer Type:**	-	All	8	6	2 x 6	12	
3	**Subjective Type:**	M-I	1,2	3	Any **three** taking at least **One** from each module	6 x 3	18	
		M-II	3,4	3				
		M-III	5	3				
	Total:						60	Hrs.

Reference Book:

Sr No	Book	Author	Publisher
1	Digital Logic & Computer Design	M. Morris Mano	Prentice Hall of India, N. D
2	Digital Principles & Application	Malvino & Leach	Tata McGraw-Hill
3	Digital Logic Design	S.Salivahanan. S. Arivazhagan	Oxford
4	Modern Digital Electronics	R.P. Jain	Tata McGraw-Hill
5	Fundamental of Digital Circuits	A. Anand Kumar	Prentice Hall of India, N. Delhi

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Syllabus of Digital Electronics Lab.

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Digital Electronics Lab.	Course Code:	MLTPC411P
Course Category:	Sessional; Program Core	Full Marks & Duration:	100; (15+2) Weeks
Credit:	1	Contact Hr./Week	L-0: T-0 : P-2

Course Objective:

Sr. No	Course Objective
1	To be familiar with the basic logic gates & their ICs
2	Design of combinational Circuits
3	Design of Counter & Register
4	Study of ADC & DAC Circuits

Course Content:

Expt. No	Experiment	Hrs.

1	Verification of the truth tables for AND, OR, NOT, XOR, XNOR, NAND AND NOR gates.	
2	Realization of basic gates using universal logic gates	
3	Study of Half adder, Half Subtractor, Full Adder, Full Subtractor using basic gates	
4	Study of 4-bit full adder IC chip (7483); Cascading of 7483.	
5	Study of Controlled Inverter, Parity generator and Checker	
6	Study on Word Comparator	
7	Use of commercial multiplexer using IC chips for the design of combinational circuits.	
8	Design simple decoder using discreet logic gates.	
9	Study on RS latch	
10	Study on RS , JK, D and T Flip-Flop	
11	Design Master Slave JK flip-flop.	
12	Design ripple counter.	
13	Design modulus synchronous counter.	
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		
Assessment : **(**2hrs. x 2 Weeks)		
Total: (2hrs. x 17 Weeks)		**34**

Course Outcomes (COs):

COs	***Students would be able to***
CO1	Familiar with digital ICs of logic gates
CO2	Design combinational circuits
CO3	Design Sequential circuits
CO4	Familiar with the application of ADC and DAC circuits

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Elective-I (*Any one course to be selected*)

Sl	**Course Code**	**Program Elective-I Course Name**	**Credit**	**Semester**	**Full Marks**
1	MLTPE411	Biomaterial	2	4th	100
2	MLTPE412	Tissue Engineering	2	4th	100

Code System:

Program (i.e. MLT) _Course Category (i.e. PE) _Semester (i.e. 4) _ Elective Course No (i..e 1)_Course No (i.e. 1, 2,)

Syllabus of Biomaterial

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Biomaterial	Course Code:	MLTPE411
Course Category:	Theory; Program Elective-I	Full Marks & Duration:	100; (15+2) Weeks
Credit:	2	Contact Hr./Week	L-2: T-0 : P-0

Course Objective:

Sr. No	Course Objective
1	To impart adequate knowledge on biomaterials and its application.
2	To know the basic properties of biomaterials
3	To be familiar with biocompatibility
4	To be familiar with the implants and its material.

Course Details:

Unit	Topic	Hrs.
1	**Introduction:** Introduction to Material Science, definition of biomaterials, requirements of biomaterials, Classification of biomaterials, Some common biomaterials and their application	4
2	**Property of Biomaterials:** Surface properties, Physical properties, mechanical properties, of biomaterial, comparison of properties of some common biomaterials, Effect of Physiological fluid on the properties of biomaterials.	5
3	**Different Biomaterials:** Overview of Metallic, Polymer, Ceramic & Composite materials and their uses	4
4	**Biocompatibility :** Definition of biocompatibility, blood compatibility, tissue compatibility, Toxicity test	4
5	**Sterilization of Biomaterials:** Autoclaving, gamma radiation, ETO, Effect of sterilization on materials	2
6	**Metallic Implant Materials:** Introduction to implant, Introduction to Metallic, Polymeric and Biopolymers, Host tissue reaction with biomaterials, Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants, Polymeric implant materials, Polyolefin, polyamides, silicon rubbers.	6
7	**Ceramic and Composite implant materials:** Definition of bio ceramics. Common types of bio ceramics: Aluminum oxides, Carbon based materials. Bio-reabsorbable and bioactive ceramics.	5
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		30
Assessment : **(**2 hrs. x 2 Weeks)		04
Total: (2 hrs. x 17 Weeks)		**34**

Course Outcomes (COs):

COs	***At end of the course, students would be able to***
CO1	Classify the Biomaterials

CO2	Explain the properties of the bio-materials.
CO3	Sate the different metallic, Polymeric, ceramics & composite implants.
CO4	Demonstrate the biocompatibility of the Implement material.

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit No	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time
1	**Objective Type:** MCQ/ Fill-in-the blanks/Very short answer	-	All	35	30	1 x 30	30	
2	**Short Answer Type:**	-	All	8	6	2 x 6	12	
3	**Subjective Type:**	M-I	1,2	3	Any **three** taking at least **One** from each module	6 x 3	18	
		M-II	3,4,5	3				
		M-III	6,7	3				
	Total:						60	Hrs.

Reference Book:

Sr No	Book	Author	Publisher
1	Biomaterials	Sujata Vat	
2	Material Science	Calister	
3			

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Syllabus of Tissue Engineering

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Tissue Engineering	Course Code:	MLTPE412
Course Category:	Theory; Program Elective-I	Full Marks & Duration:	100; (15+2) Weeks
Credit:	2	Contact Hr./Week	L-2: T-0 : P-0

Course Objective:

Sr. No	Course Objective
1	To introduce the organization of cell

2	To acquire the basic knowledge of cell culture
3	To be familiar with the molecular biology aspects
4	To introduce the concept of scaffolds & transplant

Course Details:

Unit	Topic	Hrs.
1	**Introduction:** Basic definition, Structural and organizational of tissues – Epithelial, connective, vascularity and angiogenesis, basic wound healing, cell migration	5
2	**Cell Culture:** Different cell types, progenitor cells, cell differentiations, different kinds of matrix,cell-cell interaction, Aspect of cell culture	5
3	**Molecular Biology Aspect:** Cell signaling molecules, Growth factors, hormones and growth factorssignaling, Growth factors delivery in the tissue engineering, Cell attachment, cell adhesion, receptor ligand binding and cell surface markers	10
4	**Scaffold and Transplant:** Biomaterials in tissue engineering, Degradable materials (collagen, silk and polylactic acid) , porosity, Mechanical Strength, Engineering tissue for replacing bone, cartilage, skin, liver, Basic transplant immunology, stem cell, hematopoiesis	10
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		30
Assessment : **(**2 hrs. x 2 Weeks)		04
Total: (2 hrs. x 17 Weeks)		**34**

Course Outcomes (COs):

COs	*At end of the course, students would be able to*
CO1	Sate organization of cell.
CO2	Demonstrate the cell culture.
CO3	Explain Molecular Biology Aspect
CO4	Sate application of Biomaterial for scaffold and transport.

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit No	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time
1	**Objective Type:** MCQ/ Fill-in-the blanks/Very short answer	-	All	35	30	1 x 30	30	
2	**Short Answer Type:**	-	All	8	6	2 x 6	12	
3	**Subjective Type:**	M-I	1,2	3	Any **three** taking at least **One** from each module	6 x 3	18	
		M-II	3,	3				
		M-III	4	3				
	Total:						60	Hrs.

Reference Book:

Sr No	Book	Author	Publisher

1	Principles of Tissue Engineering	Robert P Lanza, Robert Langer & William L. chick	Academic Press
2	The hand book of Biomedical Engineering	Josep D. Bronzino	CRC Press
3	Tissue Engineering	B. Palsson, J. A. Hubbel, R. Plonsey	CRC- Taylor & Francis
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Evaluation Scheme of Theory Courses:

Examination Scheme					
Course	Internal Assessment (40 Marks)			External Assessment (60 Marks)	Full Marks
	Mid Sem.Test	Quiz / Assignment	Attendance	End Semester Exam (Council)	
Theory	20	10	10	60	100
Pass Marks: Students have to obtain at least 40% marks (pass marks) in both Internal assessment and External separately.					

Evaluation Scheme of Sessional Courses:

Examination Scheme							
Course	Continuous Internal Assessment (60 Marks)					External Assessment (40 Marks)	
	Performance (20)	Assignment (30)			Attendance (10)	Assignment (On day of External sessional)	Viva-Voce (Before Board of Examiners with Lab Report)
		Assignment	Viva-Voce	Lab report			
Sessional	20	10	10	10	10	20	20
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester Assessment separately.							

Note: Course Outcomes may be fixed as per subject teacher of the Institute.