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

Syllabus
of

Diploma in Medical Laboratory Technology [MLT]

Part-III (5th Semester)

Revised 2022

Curriculum Structure for Part-III, (3rd Year) of the Full Time Diploma in MLT

Program: Medical Laboratory Technology **Program Code:** MLT
Program Level: Diploma in Engineering & Technology **Duration:** 3 Years

SEMESTER – 5th													
Sr No	Course Code	Course Name	Credit	Contact Hr./Week			Evaluation / Assessment Scheme						Full Marks
							Internal				External		
				L	T	P	CA	TA	MST	P	P	ESE	
Theoretical													
1	MLTPC512	Clinical Microbiology & Parasitology	3	3	-	-	10	10	20	-	-	60	100
2	MLTPC513	Medical Imaging	2	2	-	-	10	10	20	-	-	60	100
3	MLTPC514	Advanced Bio-Medical Engineering	3	2	1	-	10	10	20	-	-	60	100
4	MLTPC515	Microprocessor & Microcontroller	3	2	1	-	10	10	20	-	-	60	100
5	MLTPE52#	Elective-II:	2	2	-	-	10	10	20	-	-	60	100
6	MLTPE53#	Elective-III:	2	2	-	-	10	10	20	-	-	60	100
Sessional													
7	MLTPC512P	Clinical Microbiology & Parasitology Lab	1		-	2	-	-	-	60	40	-	100
8	MLTPC513P	Medical Imaging Lab	1		-	2	-	-	-	60	40	-	100
9	MLTPC514P	Advanced Bio-Medical Engineering Lab	1		-	2	-	-	-	60	40	-	100
10	MLTPC515P	Microprocessor & Microcontroller Lab	1		-	2	-	-	-	60	40	-	100
11	*PR502	Major Project	-		-	2	-	-	-	-	-	-	-
12	*I502	Internship-II	1	-	-	-	-	-	-	60	40	-	100
		TOTAL:	20										

SEMESTER – 6th													
Sr No	Course Code	Course Name	Credit	Contact Hr./Week			Evaluation / Assessment Scheme						Full Marks
							Internal				External		
				L	T	P	CA	TA	MST	P	P	ESE	
Theoretical													
1	MLTPC616	Installation & Maintenance of Medical Equipment	3	2	1	-	10	10	20	-	-	60	100
2	MLTPE64#	Elective-IV:	2	2	-	-	10	10	20	-	-	60	100
3	*OE611	Open Elective-I:	3	3	-	-	10	10	20	-	-	60	100
4	*OE62#	Open Elective-II :	3	3	-	-	10	10	20	-	-	60	100
5	*HS604	Entrepreneurship and Start-ups	4	3	1	-	10	10	20	-	-	60	100
Sessional													
6	MLTPC616P	Installation & Maintenance of Medical Equipment Lab.	1	-	-	2	-	-	-	60	40	-	100
7	*PR603	Major Project	4		-	6	-	-	-	60	40	-	100
8	*SE601	Seminar	1	-	-	-	-	-	-	60	40	-	100
		TOTAL:	21										

Code System:

Program (i.e. MLT) _Course Category (i.e. PC) _Semester (i.e. 3/ 4/5/6) _ Course No (i.e. 01, 02, …)
Program (i.e. MLT) _Course Category (i.e. PC) _Semester (i.e. 3/ 4/5/6) _ Course No (i.e. 01, 02, …) _ P (for Practical)

Program Elective (PE) Course								
Sr No	Course Code	Course Name	Semester	Credit	Contact Hr./Week			Full Marks
					L	T	P	
1. Elective-I (*Any one course to be selected***)**			4th	2	2	-	-	100
1.1	MLTPE411	Biomaterial						
1.2	MLTPE412	Tissue Engineering						
2. Elective-II (*Any one course to be selected***)**			5th	2	2	-	-	100
2.1	MLTPE521	Artificial Organs & Rehabilitation Engineering						
2.2	MLTPE522	Biotechnology						
3. Elective-III (*Any one course to be selected*)			6th	2	2	-	-	100
3.1	MLTPE631	Hospital Engineering & Management						
3.2	MLTPE632	Digital Image Processing						
4. Elective-IV (*Any one course to be selected***)**			6th	2	2	-	-	100
4.1	MLTPE641	Power & Control System						
4.2	MLTPE642	Micro-Electro Mechanical System						

Code System:
Program (i.e. MLT) _Course Category (i.e. PE) _Semester (i.e. 4/5/6) _ Elective No (i.e. 1/2/3/4) _ Course No (i.e. 1, 2, …)

Open Elective (OE) Course								
Sr No	Course Code	Course Name	Semester	Credit	Contact Hr./Week			Full Marks
					L	T	P	
1	***OE61#**	**Open Elective-I**	6th	3	3	0	0	100
1.1	*OE611	Engineering Economics & Project Management						
2	***OE62#**	**Open Elective-II** (*Any one course to be selected***)**	6th	3	3	0	0	100
2.1	*OE621	Environmental Engineering & Science						
2.2	*OE622	Artificial Intelligence						
2.3	*OE623	Industrial Management						

Code System:
Program (All i.e. *) _Course Category (i.e. OE) _Semester (6th) _Open Elective No (i.e. 1 or 2) _Course No (i.e. 1, 2, …)

Examination Scheme											
Course	**Internal Assessment**						**External**				Full Marks
	MST	Quiz/ Assignment	Practical	Attendance	Viva-Voce	**Total**	ESE	Assignment / Practical	Viva-Voce	**Total**	
Theory	20	10	-	10	-	**40**	60	-	-	**60**	100
Sessional	-	-	30	10	20	**60**	-	20	20	**40**	100
Pass Marks: Students have to obtain at least 40% marks (pass marks) in both Internal assessment and External separately.											

CA: Class Attendance
TA: Teacher's Assessment is based on Average Marks obtained in Assignments/ quiz/ Viva-Voce on each Unit.
MST: **Best of two** MST, if marks obtained >50% in both MST or **Average** if marks obtained < 50 % in one or both MST.
ESE: End Semester Exam
I: Internship may be duration of 2- 4 weeks at Hospital/Diagnostic Centre/Industry.

Syllabus of Clinical Microbiology & Parasitology

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Clinical Microbiology & Parasitology	Course Code:	MLTPC 512
Course Category:	Theory; Program Core	Full Marks & Duration:	100; (15+2) Weeks
Credit:	3	Contact Hr./Week	L-3, T-0

Course Objective:

Sr. No	Course Objective
1	To acquire the basic knowledge of the bacteria, virus, parasites & helminthes
2	To be familiar with different culture media and their use.
3	To know different staining procedure
4	To know the microbiology test for diagnosis

Course Content:

Unit	Topic	Hrs.
1	**General Bacteriology:** Introduction to microbiology, bacteria, Morphology of bacteria, Classification of bacteria, bacterial anatomy, Structure of cell wall, Gram negative and gram positive cell wall, difference between Gram negative and gram positive cell wall, spores. Growth requirements – Nutritional, gas, moisture, accessory nutritional requirement, Growth curve, factors influencing growth, Bacterial reproduction, Different Culture Media for bacterial growth, culture techniques.	7
2	**Sterilization and disinfection:** Introduction to sterilization, disinfection, antiseptic, bacteriocidal agents, bacteriostatic agents; Different methods of sterilization-Physical, Chemical, dry heat, moist heat, Filtration, Radiation, Autoclave, types of autoclave, Commonly employed sterilization method for different clinical article , Uses of disinfectant; Infection, classification of infection, Source of infection in man, Method of transmission of infection, Pathogenecity and Virulence	3
3	**General Virology:** Morphology of virus – size, shape, structure, Reaction to physical and chemical agents, Viral Multiplication, classification of viruses, Overview of oncogenic viruses, DNA viruses, RNA Viruses	5
4	**Mycology:** Fungi and yeasts, classification of Fungi, Superficial Mycosis, Microsporum, Trichophyton, Epidermophytom, Subcutaneous Mycosis.	4
5	**Parasitology:** Introduction, Classification of parasite, host, Mechanism of disease production by parasites, classification of the pathogenic Protozoa, overview of Entamoeba histolytica, Giardia lamblia, Leishmania donovani Malaria parasite, Balantidium coli, kala-azar	8
6	**Helminthology:** Habitat, morphology, lifecycle of Roundworm, Hookworm, Threadworm, Wuchereria Bancrofti Taenia saginata, Taenia Solium	6
7	**Diagnostic Microbiology:** Specimen collection and handling, Containers, Transportation of specimen, Disposal of specimen after laboratory use, Microscopic Examination , Gram staining, Acid-fast staining, albert staining, Sopre straining, Laboratory Culture – culture media, preparation of culture media, pH adjustment of culture media, Making of culture	12

	plates, Drug Sensitivity test, Classification and identification of bacteria, collection of blood for culture, Laboratory diagnosis of Throat swab, Sputum Specimens, purulent exudates, Tuberculosis, Faecal specimen, Vibrio infections and cholera, Gonorrhea, Leprosy, Dengue, Flue, Covid-19	
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	Explain the morphology, structure, classification and characteristics of bacteria, virus, fugi, parasites & helminthes.
CO2	Explain the sample collection, handling, transportation with maintaining sterility & asceptic measures in microbiology laboratory.
CO3	State the different culture and staining of bacteria & fungi
CO4	Demonstrate the different microbiological testing with interpretation.

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time (Hrs.)
A	**Objective Type:** MCQ/ Fill-in-the blanks	-	All	25	20	1 x 20	20	
B	**Short Answer Type:**	-	All	12	10	1 x 10	10	
C	**Subjective Type:**	C-1	1,2,3	3	Any **Five** taking at least **One** from each group	6 x 5	30	
		C-2	4,5,6	3				
		C-3	7	3				
	Total (A+B+C) :						**60**	

Reference Book:

Sr No	Book	Author	Publisher
1	Medical Microbiology	Satish Gupta	
2	Practical Microbiology Protozoology and Parasitological	N C Dey, T K Dey	
3	Medical Microbiology	N C Dey, H L E Grueber, T K Dey	
4	Medical Parasitology & clinical Pathology	S K Sarkar	
5	Microbiology	Michael J Pelezar	
6	Medical Laboratory technology	K L Mukherjee	
7	Medical Laboratory technology	Sood	
8	Practical Pathology	P. Chakraborty & Gargi Chakraborty	

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Syllabus of Clinical Microbiology & Parasitology Lab

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Clinical Microbiology & Parasitology Lab.	Course Code:	MLTPC 512P
Course Category:	Sessional; Program Core	Full Marks & Duration:	100; (15+2) Weeks
Credit:	1	Contact Hr./Week	T-0: P-2

Course Objective:

Sr. No	Course Objective
1	To be familiar with the clinical microbiology test for diagnosis of microbial infection
2	To hands on practice for sample collection & testing.
3	To prepare culture media and perform culture, staining
4	To perform laboratory test for clinical diagnosis of diseases.

Course Details:

Expt. No	Experiment	Hrs.
1	Verification of working principle of autoclave, hot-air oven, bio-safety cabinet and incubator.	
2	Swab sticks preparation & sterilization.	
3	Preparation culture media – nutrient broth, nutrient agar, blood agar, RCM, VTM	
4	Identification of bacteria by Gram's staining	
5	Collection of sputum & diagnosis of tuberculosis by AFB staining	
6	Collection of throat/nasal swab & diagnosis of diphtheria by Albert's staining.	
7	Bacterial spore staining.	
8	Urine culture & sensitivity for UTI	
9	Blood culture & sensitivity.	
10	Sputum/ Puss/stool culture & sensitivity	
11	Microscopic examination of stool for ova, parasites	
12	Laboratory diagnosis of Gonorrhea	
13	Laboratory diagnosis of Leprosy	
14	Laboratory diagnosis of Dengue	
15	Laboratory diagnosis of Flue	
16	Laboratory diagnosis of Covid-19	
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	***At end of the course, students would be able to***
CO1	Develop skill for collection, preparation of blood for biochemical tests.
CO2	Perform bio-chemistry test 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 Medical Imaging

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Medical Imaging	Course Code:	MLTPC 513
Course Category:	Theory; Program Core	Full Marks & Duration:	100 ; (15+2) Weeks
Credit:	2	Contact Hr./Week	L-2: T-0

Course Objective:

Sr. No	Course Objective
1	To be familiar with the different medical imaging modalities.
2	To acquire the basic knowledge of different medical imaging procedure.
3	To know the basic working principle of medical imaging system.
4	To know the Patient care during the above procedure

Course Details:

Unit	Topic	Hrs.
1	**X-ray Imaging:** Introduction to medical image, Different medical imaging modalities Radiography, Electromagnetic spectrum, Introduction to X-ray, Properties of X-ray, Production of X-ray, Bremsstrahlung radiation, Characteristic radiation, Factor affecting X-ray Intensity, Classification of X-ray, Principle of X-ray image, Latent image, X-ray film, dark room processing, radiographic densities. Characteristic of X-ray film – film density, Speed, Latitude, Image contrast, Application of X-ray image. Radiation hazards & safety, Instrumentation of X-ray System: Different functional Parts of X-ray machine, Basic block diagram of diagnostic X-ray machine. Working of X-ray machine with Circuit diagram. Accessories- Grid, Cassette, Bucky, Automatic Film processor, Working principle of CR system, Devices of CR System, Working of DR system	9
2	**Computed Tomography (CT):** Limitation of Radiography, Tomography, Different tomographic modalities, Definition of CT, History of CT, Basic principle of CT, CT number, Image reconstruction technique, Contrast medium enhancement, Generation of CT scan system. Instrumentation of CT system: Working Principle of CT system, Different Parts -	7

	Gantry, Patient table, work station. Spiral/ helical CT scanning, Interpolation. Radiation protection in CT.	
3	**Ultrasonography:** Introduction to ultrasound, Production of ultrasound, Definition of Ultrasonography, Acoustic Impedance or Characteristic Impedance of different tissues, echo, Interaction of ultrasound with tissue, Working principle of Ultrasonography- Piezoelectric effect & Pulse-echo principle. Different Modes of Ultrasonography- A, B & M modes, Working of Ultrasound machine with Block diagram. Different types of USG Probe, Introduction to Doppler Ultrasound, Color Doppler, Duplex Scanner, Overview of Echocardiography. Introduction to Obstetric Ultrasound Scanning.	8
4	**MRI:** Definition of MRI, Introduction to NMR, Working principle of MRI, precession, Larmor frequency, RF excitation, resonance, Relaxation – T1 & T2, Instrumentation of MRI system- Block diagram, Function of Magnet, super conductor, Shim coil, RF coil, Receiver coil, Gradient coil, Introduction to DICOM, PAC	5
5	**Introduction to Molecular Imaging:** Overview of PET CT, SPECT	1
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	State the principle of x-ray production, x-ray imaging, X-ray systems and Radiation hazards & Safety.
CO2	Explain working principle of CT scan, CT image formation & CT instrumentation.
CO3	Describe principle of Ultrasound imaging, application of ultrasound and ultrasound system.
CO4	Demonstrate the principle of MRI and MRI instrumentation.

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time (Hrs.)
A	**Objective Type:** MCQ/ Fill-in-the blanks	-	All	25	20	1 x 20	20	
B	**Short Answer Type:**	-	All	12	10	1 x 10	10	
C	**Subjective Type:**	C-1	1	3	Any **Five** taking at least **One** from each group	6 x 5	30	
		C-2	2	3				
		C-3	3,4,5	3				
	Total (A+B+C) :						**60**	

Reference Book:

Sr No	Book	Author	Publisher
1	Diagnostic radiography	Bryan	
2	Text book of Radiology for Residents and Technician	Prof. Satish Kr. Bhargava	

3	Biomedical Instrumentation	R. S. Khandpur	
4	Medical Instrumentation application & design	John G. Webster	
5	A text book of Medical Instrument	Cromwell	
6	Medical Instrument	S. Ananthi	
7	Introduction to Biomedical instrumentation technology	Joseph J. Carr and John M. Brown	

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Syllabus of Medical Imaging Lab.

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Medical Imaging Lab.	Course Code:	MLTPC 513P
Course Category:	Sessional; Program Core	Full Marks & Duration:	100 ; (15 + 2) Weeks
Credit:	1	Contact Hr./Week	T-0 : P-2

Course Objective:

Sr. No	Course Objective
1	To identify parts of the different medical imaging instrument.
2	To verify principle of medical imaging.
3	To develop skill of radiography & it instrumentation.
4	To demonstrate imaging procedure.

Course Details:

Expt. No	Experiment/ Job	Hrs.
1	Identification of different parts of diagnostic x-ray machine and accessories.	
2	Verification of working principle of Computed Radiography (CR) system.	
2	X-ray for chest	
3	X-ray for arms/wrist joint	
4	X-ray for KUV	
5	X-ray for skull	
6	Identification of different parts of CT system.	
7	Study of CT scan.	
8	Identification of different parts of ultrasound machine.	
9	USG for upper/lower /whole abdomen.	
10	Demonstration of echocardiography	
11	Identification of different parts of MRI instrumentation	
12	Demonstration of MRI.	
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	***At end of the course, students would be able to***
CO1	Develop skill on CR system for radiography.
CO2	Identify the parts of the CT system with their function
CO3	Develop skill on USG system
CO4	Demonstrate working principle of MRI and MRI instrumentation

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Syllabus of Advanced Biomedical Engineering

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Advanced Biomedical Engineering	Course Code:	MLTPC 514
Course Category:	Theory; Program Core	Full Marks & Duration:	100 ; (15+2) Weeks
Credit:	3	Contact Hr./Week	L-2: T-1

Course Objective:

Sr. No	Course Objective
1	Familiarization with Telemetry system and Lasers for medical applications
2	Imparting the Design concept of Bio-amplifiers, electronic filters and bio-signal processing
3	Familiarization with medical robotics and IoT & wearable devices in biomedical applications
4	Understand the computer applications in medical instruments

Course Content:

Unit	Topic	Hrs.
1	**Biotelemetry:** Introduction to telemetry – Overview of Wire & Wireless telemetry system, Modulation, Demodulation, TDM, FDM Biotelemetry, need of Biotelemetry, Single channel biotelemetry, multi-channel biotelemetry system	10
2	**LASER:** Principle of operation of LASER, Overview of Nd-YAG, pulsed Ruby, CO_2, Lasers and their medical applications., Medical application of Thulium lasers & Femtosecond lasers	9
3	**Design of Bio-amplifier and bio-signal processing:** Design of ECG amplifier, QRS detection, EMG amplifier, design concept of filters (LPF, HPF, BPF, Notch) Basic idea of bio-signal processing – Block description and applications	9
4	**Introduction to Medical Robotics:** Basic Concept-Classification, Advantages, Applications in medical domain	4
5	**Introduction to IoT and Wearable Devices:** Basic characteristics of IoT and Wearable devices, Applications	3
6	**Application of Computer in Biomedical Engineering:** Microcomputer in Medical Instrument, Overview of computer interfacing with the medical Instruments, Overview of HIS, PAC, RIS, DICOM format & applications	10
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	Demonstrate biotelemetry & its applications
CO2	Identify the characteristics of different LASERs & their medical applications
CO3	Understand medical robotics, IoT & Wearable Devices in medical applications
CO4	Explain the application of computer & computer network-based systems in medical instrumentation systems

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time (Hrs.)
A	**Objective Type:** MCQ/ Fill-in-the blanks	-	All	25	20	1 x 20	20	
B	**Short Answer Type:**	-	All	12	10	1 x 10	10	
C	**Subjective Type:**	C-1	1, 2	3	Any **Five** taking at least **One** from each group	6 x 5	30	
		C-2	3, 4	3				
		C-3	5, 6	3				
	Total (A+B+C) :						**60**	

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	Introduction to Biomedical Equipment Technology	Carr and Brown	Wiley
4	Medical Instrumentation- Application and Design	John G. Webster	Wiley
5	Fundamentals of IoT and Wearable Technology Design	Haider Raad	Wiley
6	Control Theory in Biomedical Engineering	Olfa Boubaker	Academic Press
7	Medical Robotics	Jocelyne Troccaz	Wiley

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Syllabus of Advanced Biomedical Engineering Lab.

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	4th
Course Title:	Advanced Biomedical Engineering Lab.	Course Code:	MLTPC 514P
Course Category:	Sessional; Program Core	Full Marks & Duration:	100 ; (15+2) Weeks
Credit:	1	Contact Hr./Week	T-0 : P-2

Course Objective:

Sr. No	Course Objective
1	To familiarize with the components of Biotelemetry system
2	To design Bio-amplifier and active filters of bio-signals
3	To familiarize with the human-computer interface and smart watch
4	To familiarize with the medical robots and computer network based medical software application modalities

Course Content:

Expt. No	Experiment	Hrs.
1	Study of Biotelemetry system	
2	Study of Bio-amplifier	
3	Study of active filter for bio-signal	
4	Interfacing of bio-signal with computer	
5	Study of smart watch	
6	Study of medical robot	
7	Study of HIS	
8	Study of PAC	
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	***At end of the course, students would be able to***
CO1	Demonstrate the components &function of biotelemetry system
CO2	Design Bio-amplifier and active filters of bio-signals
CO3	Demonstrate the human-computer interface system and smart watch
CO4	Demonstrate the medical robots and computer network based medical software application modalities

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Syllabus of Microprocessor & Microcontroller

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Microprocessor & Microcontroller	Course Code:	MLTPC 515
Course Category:	Theory; Program Core	Full Marks & Duration:	100 ; (15+2) Weeks
Credit:	3	Contact Hr./Week	L-2: T-1 : P-0

Course Objective:

Sr. No	Course Objective
1	To study about the architecture of 8085 IC.
2	To study about the architecture of 8086 IC.
3	To develop the knowledge of assembly language programming for 8085 & 8086
4	To study about the interfacings of 8085 & their applications
5	To be familiar with open source microcontroller board using Arduino

Course Content:

Unit	Topic	Hrs.
1	**Introduction to Microprocessors :** Evolution of microprocessors; Specific features of microprocessors; Application of microprocessors	3
2	**Architecture of Microprocessors :** Explanation of each Functional Block Diagram and Internal Architecture of 8085,8086 – ALU, Registers, Control unit, Clocks, Bus Structure; Address, Data and Control Bus of 8085, 8086; pin Details of 8085, 8086, Introduction to PC range of Microprocessors	5
3	**Programming of Microprocessors:** Different Addressing modes of 8085,8086; Instruction Cycle of 8085,8086 (including subroutine calls, jumping, comparing, string instructions of 8086); Timing Diagram of different parts of Instruction Cycles; Solving basic problems of Assembly Language Programming using 8085 Trainer Kit and Using any 8086 Assembler or DOS Debug Program.	15
4	**Interfacing of Memory and I/O Ports:** Address Space; Memory mapped I/O, I/O mapped I/O; address Decoding and Interfacing of Memory; DMA Description with sequence of steps and control flow, Structure of a generic DMA controller; programmer's model of 8251, Programmer's model of 8255 with its Interfacing; Interrupts – Hardware and Software interrupts, A brief overview of BIOS Interrupts, An introduction to (i) Disk Access Interrupts (ii) CRT/Graphics Interrupts	10
5	**Single Chip Microcontroller:** Programming model of 8051: CPU – Address bus – Data bus – Control bus – Register – Internal RAM and ROM – Ports (serial and parallel) – Timers – Interrupts. ADDRESS MODES: Immediate – Register – Direct – Indirect – Indexed. INSTRUCTION TYPES: Arithmetic – Logical – Data Transfer (Internal/External) – Boolean. Control Transfer and Special Function Register	6
6	**Open source Microcontroller Board:** ARDUINO prototype platform- description- prerequisites-outline of instructions- Introduction- I/O functions-time-display-sensors-secondary integration-communications-Arduino projects	6
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	Discuss the Architecture of 8085 and 8086 microprocessor
CO2	Develop assembly language programs for simple arithmetic and various real life

	applications
CO3	Interface external peripheral devices with 8085 microprocessor
CO4	Develop the knowledge on single chip micro-controller
CO5	Concept on open-source microcontroller board

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time (Hrs.)
A	**Objective Type:** MCQ/ Fill-in-the blanks	-	All	25	20	1 x 20	20	
B	**Short Answer Type:**	-	All	12	10	1 x 10	10	
C	**Subjective Type:**	C-1		3	Any **Five** taking at least **One** from each group	6 x 5	30	
		C-2		3				
		C-3		3				
	Total (A+B+C) :						**60**	

Reference Book:

Sr No	Book	Author	Publisher
1	Microprocessor	R.S.Gaonkar	
2	Microprocessor and Its applications	B.Ram	
3	Microprocessor & Digital System	D.V. Hall	
4	The 8051 Microcontroller & Embeded System using Assembly and C (2nd Ed.)	Muhammad Ali Mazidi	
5	8051 Microntroller Architecture Programming and application.	M. Mahalakshmi	

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Syllabus of Microprocessor & Microcontroller Lab.

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Microprocessor & Microcontroller Lab.	Course Code:	MLTPC 515P
Course Category:	Sessional; Program Core	Full Marks & Duration:	100 ; (15+2) Weeks
Credit:	1	Contact Hr./Week	T-0 : P-2

Course Objective:

Sr. No	Course Objective
1	To be familiar with the microprocessor & microcontroller
2	To acquire the basic Microprocessor programming knowledge.
3	To be familiar with assembly language programming & execution.
4	To practice open source microcontroller board using Arduino

Course Details:

Expt. No	Experiment/job	Hrs.
1	To be familiar with 8085-system development kit	
2	To write, test and debug (if necessary) assembly and machine language programs using instruction set of 8085.	
3	To write programs to execute the following:	
	a) Display digits through seven-segment display using 8255. b) Rolling display-using 8255. c) Display hexadecimal digits using 8279. d) Development of a counter by 8255 and 8253. e) Developments of waveforms using 8255 and 8253. f) Receive on-line data through ADC and display. g) Develop interfacing program using DAC	
4	To practice assembly language programming with 8086	
5	To practice programming with 8051SDK.	
6	To practice open source microcontroller board using Arduino	
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	***At end of the course, students would be able to***
CO1	Develop common assembly language programmes using 8085 and 8086 microprocessor kit
CO2	Develop application based program with hardware interface using 8085 kit
CO3	Develop basic programmes of microcontroller 8051
CO4	Develop basic knowledge on open source microcontroller board application

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

Sl	**Course Code**	**Program Elective-II:** Course Name	**Credit**	**Semester**	**Full Marks**
1	MLTPE 521	Artificial Organs & Rehabilitation Engineering	2	5th	100
2	MLTPE 522	Biotechnology	2	5th	100

Code System:

Program (i.e. MLT) _Course Category (i.e. PE) _Semester (i.e. 5) _ Elective Course No (i..e 2)_Course No (i.e. 1, 2,)

Syllabus of Artificial Organ & Rehabilitation Engineering

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Artificial Organs & Rehabilitation Engineering	Course Code:	MLTPE 521
Course Category:	Theory; Program Elective-II	Full Marks & Duration:	100; (15+2) Weeks
Credit:	2	Contact Hr./Week	L-2: T-0

Course Objective:

Sr. No	Course Objective
1	To introduce artificial organs and their application.
2	To acquire the knowledge of the biomaterial used for artificial organ and rehabilitation engineering.
3	To know the working of artificial organs.
4	To be familiar with the rehabilitation engineering.

Course Details:

Unit	Topic	Hrs.
1	**Introduction:** Introduction to artificial organs and prostheses, Biomaterials used, Tissue response- Inflammation, rejection, correction, Rheological properties of blood,	6
2	**Artificial Kidney:** Function of kidney, Brief of kidney filtration, Principle of hemodialysis, Artificial waste removal, Dialyzer, Overview of different types of hemodialysers – plate, coil, hollow fibre type.	5
3	**Artificial Heart-lung Machine:** Function of heart & lungs, Operation of Artificial heart-lung device, Oxygenator,	3
4	**Artificial Pancreas:** Basic principle of artificial pancreas, Introduction to artificial blood	3
5	**Audiometry:** Hearing mechanism, Basic principle of hearing aids,	3
6	**Rehabilitation Engineering:** Impairments, disabilities, handicaps, aids for blind, Rehabs for locomotion, Gait study, Artificial limbs and hand, prosthetic heart valves, Basic principle of Myoelectric controlled hand and arm prostheses, Dental Prostheses	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	State the material used for artificial organs & their tissue response and Rheological properties of blood
CO2	Explain the functions of artificial kidney, heart lung machine, artificial Pancreas.
CO3	Describe hearing mechanism and working principle of hearing aids
CO4	Demonstrate gait study, artificial limb, heart valve and dental prostheses.

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time (Hrs.)
A	**Objective Type:** MCQ/ Fill-in-the blanks	-	All	25	20	1 x 20	20	
B	**Short Answer Type:**	-	All	12	10	1 x 10	10	
C	**Subjective Type:**	C-1	1, 2	3	Any **Five** taking at least **One** from each group	6 x 5	30	
		C-2	3, 4	3				
		C-3	5, 6	3				
	Total (A+B+C) :						**60**	

Reference Book:

Sr No	Book	Author	Publisher
1	Biomedical Instrumentation	R. S. Khandpur	Tata Mc
2	Biomaterial	Sujata Vat	
3	Material Science	Calister	
4	The hand book of Biomedical Engineering	Josep D. Bronzino	CRC Press
5	Rehabilitation Engineering	Robbinson C. J.	CRC press
6	Rehabilitation Engineering	Ballabio Betal	IOS press

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Syllabus of Biotechnology

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Biotechnology	Course Code:	MLTPE 522
Course Category:	Theory; Program Elective-II	Full Marks & Duration:	100; (15+2) Weeks
Credit:	2	Contact Hr./Week	L-2: T-0

Course Objective:

Sr. No	Course Objective
1	Introduce to biotechnology.
2	To know the basic principle of biotechnology.
3	To be familiar with Tools and process of recombinant DNA technology.
4	To be familiar with applications of biotechnology

Course Details:

Unit	Topic	Hrs.
1	**Molecular Biology:** Introduction to Biotechnology, Structure, Function and Replication of DNA, Gene expression, the structure and function of the gene, Structure, function and Biochemical properties of RNA	4
2	**Principles of Biotechnology:** Scope of biotechnology, Principles of bio-technology, introduction to Genetic engineering & Bioprocess engineering	4
3	**Tools of Genetic Engineering:** Basic tools, Restriction enzyme, Cloning vectors & its features, Competent host (for Transformation with Recombinant DNA), micro-injection, biolistic.	5
4	**Process of Recombinant DNA Technology:** Isolation of the genetic material (DNA), Cutting of DNA at Specific location, Amplification of Gene of interest using PCR, Insertion of Recombinant DNA into host cell/organism, Obtaining the foreign Gene product, Bioreactor, Downstream processing.	6
5	**Application of Biotechnology in Agriculture:** Critical research area, overview of agro-chemical based agriculture, Organic agriculture, Genetically engineered crop-based agriculture, Genetically modified organisms (GMO), Bt Cotton, Pest Resistant Plant.	3
6	**Application of Biotechnology in Medicine:** Introduction, Genetically engineered insulin, Gene therapy, Molecular Diagnosis,	5
7	**Transgenic Animals:** Introduction, Purpose of transgenic animal – Normal physiology & development, Study of disease, Biological product, Vaccine safety, Chemical safety testing, Ethical issues.	3
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	State the molecular biology aspect
CO2	Explain the principle of biotechnology and tools of recombinant DNA technology
CO3	Demonstrate the process of recombinant DNA technology
CO4	State the application of biotechnology in agriculture, medicine etc.

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time (Hrs.)
A	**Objective Type:** MCQ/ Fill-in-the blanks	-	All	25	20	1 x 20	20	
B	**Short Answer Type:**	-	All	12	10	1 x 10	10	
C	**Subjective Type:**	C-1	1	3	Any **Five** taking at least **One** from each group	6 x 5	30	
		C-2	2, 3, 4	3				
		C-3	5, 6, 7	3				
	Total (A+B+C) :						**60**	

Reference Book:

Sr No	Book	Author	Publisher
1	Biotechnology	R. C. Dubey	S. Chand
2	Molecular biotechnology	Bernard R. Glick	
3	Biotechnology	David P. Clark	
4	Biotechnology	U. Satyanarayana	
5	Principles of Tissue Engineering	Robert P Lanza, Robert Langer & William L. chick	Academic Press
6	Tissue Engineering	B. Palsson, J. A. Hubbel, R. Plonsey	CRC- Taylor & Francis

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

Sl	Course Code	Program Elective-III: Course Name	Credit	Semester	Full Marks
1	MLTPE 531	Hospital Engineering & Management	2	5th	100
2	MLTPE 532	Medical Image Processing	2	5th	100

Code System:
Program (i.e. MLT) _Course Category (i.e. PE) _Semester (i.e. 5) _ Elective Course No (i..e 3)_Course No (i.e. 1, 2,)

Syllabus of Hospital Engineering & Management

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Hospital Engineering & Management	Course Code:	MLTPE 531
Course Category:	Theory; Program Elective-III	Full Marks & Duration:	100; (15+2) Weeks
Credit:	2	Contact Hr./Week	L-2: T-0

Course Objective:

Sr. No	Course Objective
1	To acquire the basic knowledge of Different types of hospital & hospital services
2	To be familiar with hospital engineering & role of Biomedical Engineer in hospital,
3	To know biomedical waste management system.
4	To be familiar with the hazards in hospital and protection system for safety.
5	To acquire the concept of quality management in hospital.

Course Details:

Unit	Topic	Hrs.

1	**Hospital Aspect:** Hospital, Classification of hospital, Administration of a hospital, Aspect of Hospital services - IPD, OPD, Emergency, Pharmacy, Diagnostic, blood bank, Departments of a hospital, Location, Environment of hospital	5
2	**Hospital Engineering:** Department of Bio-Medical Engineering, Role of a Biomedical Engineer, Procurement & maintenance of medical equipment, Medical gas and its necessity, Centralised Gas supply system, color code for gas conduit pipes. General maintenances-electrical, civil, plumbing, carpentry, Principle of production of liquid oxygen, Oxygen plant.	7
3	**Hospital Waste Management:** Different hospital waste, Biomedical waste, categories of biomedical waste, color code for biomedical waste, WHO classification of biomedical waste, Purpose of biomedical waste management, Collection and Disposal system of different categories of Biomedical waste.	7
4	**Safety:** Sources of radiation hazard, Protection of radiation hazard, Cause of fire, Fire prevention, Fire protection system in hospital, Fire fighting equipment, electrical safety in hospital.	6
5	**Quality Control:** Definition of quality, Quality control, quality assurance, quality improve, concept of TQM, Importance of ISO certificate	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	State the different types of hospital and aspect of hospital services.
CO2	Explain function biomedical engineering department in hospital, centralize gas supply system in hospital, production of oxygen.
CO3	Describe biomedical waste collection and disposal system.
CO4	Demonstrate the safety aspect in hospital and quality assurance.

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time (Hrs.)
A	**Objective Type:** MCQ/ Fill-in-the blanks	-	All	25	20	1 x 20	20	
B	**Short Answer Type:**	-	All	12	10	1 x 10	10	
C	**Subjective Type:**	C-1	1, 2	3	Any **Five** taking at least **One** from each group	6 x 5	30	
		C-2	3	3				
		C-3	4, 5	3				
	Total (A+B+C) :						**60**	

Reference Book:

Sr No	Book	Author	Publisher

1	Hospital Management Engineering	Harold E.Smalley	HPI
2	Clinical Engineering	C. A. Caccras	
3	Hospital & Healthcare Facilities	L.C. Redstone	
4	Industrial Management (Vol-1)	L.C. Jhamb	EHP

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Syllabus of Medical Image Processing

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Medical Image Processing	Course Code:	MLTPE 532
Course Category:	Theory; Program Elective-III	Full Marks & Duration:	100; (15+2) Weeks
Credit:	2	Contact Hr./Week	L-2: T-0

Course Objective:

Sr. No	Course Objective
1	To be familiar with different medical imaging modalities.
2	To acquire the basic knowledge of digital image and fundamental of digital image processing
3	To be familiar with the image acquisition, image quality improvement, display

Course Details:

Unit	Topic	Hrs.
1	**Principle of Medical Images:** Different medical imaging modalities, Introduction to Radiography, Principle of x-ray image, Tomography, Principle of CT, CT image formation, Principle of Ultrasound image, Modes of USG, Principle of NMR/MRI, Image acquisition, T1, T2.	6
2	**Introduction to Digital Image:** Concept of Image, Digital image, Pixel, Dimension of Image, Types of digital image – Binary image, Gray scale image, RGB image, RGBA, Image matrix, Sources of digital image. Basic principle of digital image formation, Image formation in human eye, Image brightness, contrast.	2
3	**Fundamental of Digital Image Processing:** Concept of digital Image processing, Types of digital image processing, Image acquisition, storage, processing, display of Image, Different image sensor. Component of digital image processing system. Fundamental steps of digital image processing- Image Acquisition, Image Enhancement, Image Restoration, Wavelets and Multi-resolution Processing, Compression, Morphological Processing, Representation and Description, Recognition, Knowledge Base.	6
4	**Sampling and Quantization:** Image Sensing and Acquisition, Image Acquisition using a Sensor Arrays, Image sampling and Quantization.	4
5	**Image Enhancement:** Image enhancement, approaches. Spatial domain methods, Overview of Basic Gray level transformations, Histogram processing, Histogram equalization, Image enhancement by frequency domain- Blurring/Noise Reduction, Low Pass Filter (LPF), Image	8

	sharpening using frequency domain filter, High-Pass Filter (HPF)	
6	**Overview of Image Presentation & Recognition:** Introduction of Image Degradation / Restoration Process. Techniques to reduce the noise effect. Image Segmentation, edge detection, Basic Concept of Seed Points with example. Overview of image compression, presentation & recognition.	4
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	State the different medical imaging modalities and their principle of medical image formation.
CO2	Explain fundamental of digital image processing steps, image acquisition, image sampling & quantization.
CO3	Describe digital image enhancement technique
CO4	Describe image segmentation, edge detection technique

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time (Hrs.)
A	**Objective Type:** MCQ/ Fill-in-the blanks	-	All	25	20	1 x 20	20	
B	**Short Answer Type:**	-	All	12	10	1 x 10	10	
C	**Subjective Type:**	C-1	1, 2	3	Any **Five** taking at least **One** from each group	6 x 5	30	
		C-2	3, 4	3				
		C-3	5, 6	3				
	Total (A+B+C) :						**60**	

Reference Book:

Sr No	Book	Author	Publisher
1	Digital Image Processing	R. C. Gonsalez, R.E. Woods, Steven L. Eddins	Dorling Kindersley Pvt Ltd
2	Fundamental of Image Processing	Anil Kr. Jain	Prentice Hall
3	Digital Image Processing	.William K. Pratt	John Wiley, NJ
4	Medical Imaging systems	Albert Macouski	Prentice Hall, New Jersey

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Major Project

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Major Project	Course Code:	* PR 502
Course Category:	Sessional; Project Work	Full Marks & Duration:	100; (15+) Weeks
Credit:	-	Contact Hr./Week	L-0: T-0: P-2

Course Objective:

Sr. No	Course Objective
1	To build up the creativity & innovation.
2	To enhance the decision making capability
3	To face the problems and solution
4	To allow to do a job as their choice/interest.

Course Details:

Unit	Topic	Hrs.
1.	Project work on Bio-medical instrumentation/MLT/ Electronics device (hardware/software) may be done by individual or in group under the project guide. 1. Selection of Project work 2. Preparation of Synopsis 3. Job for project work.	
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		30
Assessment : ()		-
Total: (2 hrs. x 15 Weeks)		**30**

Internship-II

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	5th
Course Title:	Internship-II	Course Code:	* I 502
Course Category:	Sessional; Internship	Full Marks & Duration:	100; (15+2) Weeks
Credit:	1	Contact Hr./Week	L-0: T-0: P-0

Course Objective:

Sr. No	Course Objective
1	To build up the practical experience.
2	To be familiar with the hands on training in Institute/industry.
3	Entrepreneurship Development.

Course Details:

Unit	Topic	Hrs.
1.	**Note: Internship-II** I: Internship may be duration of 2- 4 weeks at Hospital/Diagnostic Centre/Industry. 1) 60% (Internal) will be assessed by the Institute, based on Internship Report, Assignment and Viva-Voce. 2) 40% marks (External), will be assessed during internship by the concern authority of the Institute/ hospital/ Industry etc. where students will go for their Internship based on performance, attendance, report etc.	

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)					External Assessment (40)		Full Marks (100)
	Performance (30)			Viva-Voce (20)	Attendance (10)	Assignment (On day of External sessional)	Viva-Voce (Before Board of Examiners with Lab Report)	
	Job/ Expt.	Assignment	Lab report	VV	ATT			
Sessional	20	5	5	20	10	20	20	100
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.