

STATEMENT OF MODIFICATIONS IN THE REVISED CURRICULUM AND SYLLABUS

M.Sc. Biomedical Instrumentation with effect from 2026

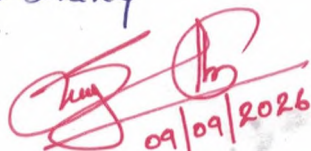
Sl. No.	Particulars	Old Syllabus	Revised Syllabus – Modifications Incorporated
1	Vision and Mission	Not included	Vision and Mission have been incorporated. [page no.2]
2	Programme Objectives	Existing objectives	Objectives have been revised and consolidated into five objectives. [page no.2]
3	Programme Outcomes	Not included	Ten Programme Outcomes have been incorporated. [page no.3]
4	Regulations	Existing arrangement	Regulations have been revised and rearranged. [page no.4 and 5]
5	Programme Structure	Structure of P.G programme	Research-oriented practical activities (instead of seminars) and Viva-Voce have been incorporated as a distinct component of the programme structure, along with Core Subjects, Practical/Laboratory Work, Project Work, Hospital/Industry Training. [page no.4]
6	Pass Mark Table	Existing table	Revised to include BMI 205, Research-Oriented Practical Activities, and revised Hospital/Industry Training. [page no.6]
7	Programme Structure/ Curriculum Framework	Not included	The Programme Structure/Curriculum Framework has been incorporated, followed by the semester-wise listing of courses for Semesters I, II, III and IV. [page no.7 and 8]
8	Staff Requirement	Not included	Staff requirements have been incorporated. [page no.9]

9	Power to Modify	Existing provision	Corrections have been incorporated in the teaching hours of specified courses, and the abbreviations L, T, and P and corresponding credits have been included. [page no.10 and 11]
10	Scheme of Examination	Existing scheme	The Scheme of Examination has been revised with necessary corrections in teaching hours and corresponding examination components, and the Semester II, III and IV course nomenclature and codes have been revised in accordance with the updated programme structure. [page no.12 and 13]
11	Semester II	BMI 2P3 Seminar-I	BMI 205 was introduced as an internal theory subject, and BMI 2P3 Seminar-I was removed.
12	Hospital/Industry Training	Existing training components	Contents, training duration, training log, report, presentation, and viva-voce requirements revised.
13	Hospital/Industry Training	BMI 2P4 in Semester II	Course code revised from BMI 2P4 to BMI 2P3 .
14	Research Component	Seminar components	Research-oriented practical activities have been introduced in Semesters III and IV.
15	Research-Oriented Practical Activities I and II	Not included	New research-oriented components introduced with revised contents, report, presentation, and assessment requirements.
16	Semester III	BMI 3P3 Seminar-II	Renamed to BMI 3P3 Research-Oriented Practical Activity-I – Biomedical Research and Literature Review.
17	Semester IV	BMI 4P2 Seminar-III	Renamed to BMI 4P2 Research-Oriented Practical Activity-II – Biomedical Device Design and Development Proposal.
18	Viva-Voce	Existing viva voce	Content and assessment revised to cover theoretical, practical, research, and project components.
19	Project Work	Existing project component	Project content revised with emphasis on research, innovation, design, development, testing, and performance evaluation.

20	Individual Course Format	Existing course format	Hours per week have been incorporated in the course-wise structure, along with corresponding L, T, P, and Credit details.
21	CIE and ESE	Existing arrangement	The Continuous Internal Evaluation (CIE) and End Semester Examination (ESE) components have been rearranged and revised wherever applicable.
22	Course Contents	Existing syllabus contents	Individual course contents reviewed, reorganized, updated; relevant topics added and redundant/outdated topics removed.
23	Recent Developments	Limited coverage	Recent trends and emerging technologies incorporated in relevant courses.
24	Model Question Papers	Existing Model Question Papers	Model Question Papers have been revised.

The above modifications in the revised curriculum and syllabus are kindly recommended for approval.

Yours Sincerely



SANGEETHA K. CHINNAN
Asst. Professor, Dept. of BMI,
Member, Expert Committee Panel.



**REGULATIONS, CURRICULUM, SCHEME OF
EXAMINATION AND SYLLABUS
FOR
MASTER OF SCIENCE IN
BIOMEDICAL INSTRUMENTATION
(M.Sc. BMI)**

(Under Credit and Semester System -CSS)

(W.E.F. 2026)

School of Medical Education

Centre for Professional and Advanced Studies, Gandhinagar, Kottayam

Affiliated to

MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

PROGRAMME VISION AND MISSION

VISION

To develop competent, innovative, and ethical biomedical instrumentation professionals for advancing healthcare, medical technology, and biomedical research.

MISSION

The programme aims to:

1. Provide quality education in biomedical instrumentation and healthcare technologies.
2. Develop practical and technical skills in biomedical equipment.
3. Promote innovation in biomedical device design and development.
4. Foster research, critical thinking, and problem-solving skills.
5. Develop ethical and competent professionals for clinical, industrial and research environments.

OBJECTIVES OF THE PROGRAMME

After completion of the programme, the candidate should be able to:

1. Develop a strong understanding of biomedical instrumentation, biomedical equipment and healthcare technologies.
2. Acquire practical and technical skills in the operation, calibration, testing, maintenance and safe use of biomedical equipment.
3. Apply biomedical technologies such as biosensors, medical imaging, nanotechnology and medical informatics to address healthcare needs.
4. Develop skills in problem-solving, research, innovation, and the design and development of biomedical devices and instrumentation systems.
5. Demonstrate professional, multidisciplinary competence and pursue continuous learning, research, and professional development.

PROGRAMME OUTCOMES

After successful completion of the M.Sc. Biomedical Instrumentation programme, the graduate will be able to:

PO1. Knowledge and Understanding: Demonstrate knowledge of biomedical instrumentation, equipment, and healthcare technologies.

PO2. Technical and Practical Skills: Apply skills in the operation, calibration, testing, maintenance and safe use of biomedical equipment.

PO3. Clinical Understanding: Apply knowledge of human physiology to diagnostic, therapeutic and patient-monitoring applications.

PO4. Problem Solving: Analyse and solve biomedical and clinical problems using appropriate scientific and engineering principles.

PO5. Design and Innovation: Design and develop innovative biomedical devices and instrumentation systems.

PO6. Research and Critical Thinking: Analyse scientific literature, identify research gaps and apply appropriate research methods.

PO7. Technology Integration: Integrate emerging technologies to address healthcare challenges.

PO8. Professional Practice: Demonstrate ethical and professional practices with emphasis on patient safety and regulatory requirements.

PO9. Communication and Teamwork: Communicate effectively and work independently or collaboratively in multidisciplinary environments.

PO10. Lifelong Learning: Adapt to emerging technologies and pursue continuous learning, research and professional development.

REGULATIONS

1. NAME OF THE POSTGRADUATE PROGRAMME

The name of the Master's degree programme shall be “**Master of Science in Biomedical Instrumentation**” and shall be abbreviated as **M.Sc (BMI)**.

2. DURATION OF THE PROGRAMME

The programme shall last **two academic years**, consisting of **four semesters**. University examinations shall be conducted at the end of each semester as prescribed by the University.

3. MEDIUM OF INSTRUCTION

The Medium of Instruction, examinations, and Project reports will be in **English**

4. ELIGIBILITY FOR ADMISSION

Candidates for admission to the First semester of the Master of Science in Biomedical Instrumentation Degree programme shall be required to have passed the Bachelor degree examinations with **Electronics, Instrumentation, B Voc Software Development, B Voc Industrial Instrumentation & Automation, Computer Science, Computer Application, B.Tech Electronics/Computer Science Engineering Physics or Mathematics as main or subsidiary** from any of the **University in Kerala or Universities recognized by Mahatma Gandhi University** as equivalent there to are eligible to apply for the course provided they have secured minimum of 50% marks for the optional subjects with usual relaxations allowed for Scheduled Castes, Scheduled Tribes and other Backward Classes. **A weightage of 20% of the total score will be given to the students with B.Sc. Electronics/ B.Sc. Instrumentation Degree** while calculating the merit marks for admission to the course.

5. PROGRAMME STRUCTURE

The P.G. programme will consist of

- i. Core subjects
- ii. Practicals / Laboratory work
- iii. Project work
- iv. Research-oriented Practical Activities
- v. Hospital/Industry training as specified in the curriculum.
- vi. Viva-Voce

6. ATTENDANCE

A candidate who has attendance less than 80% will not be permitted to sit for the End Semester Examination in the subject / Laboratory work in which the shortfall exists.

7. SESSIONAL EXAMINATIONS / CONTINUOUS INTERNAL EVALUATION (CIE)

In each **core subject**, the Sessional Examinations may be a combination of Attendance, Periodical tests, Assignments and Seminars conducted internally by the Department. In case of **practicals/Laboratory work**, Sessional Examinations are a combination of Attendance, Performance and Examinations conducted internally by the corresponding Department. **Project work / Research-oriented Practical Activities** will be evaluated based on the Report, Presentation and Viva- Voce Examinations conducted internally.

At the end of each **Hospital/Industry Training**, the candidate shall submit a Training Report along with a certificate from the Organization where he/she has undergone training. The evaluation will be based on the Attendance, Training Report, Presentation and Viva-Voce Examination conducted internally. If a student is not securing the separate minimum for the Sessional examination, he /she shall be given a single redo chance before the commencement of the university examination, provided he/she has the minimum required attendance and the criteria for determining the Sessional assessment remain the same.

8. UNIVERSITY EXAMINATIONS / END SEMESTER EXAMINATION (ESE)

There shall be one end-semester examination of 3 hours' duration in each **core subject**, conducted by the University. **In case of practicals**, an end-semester examination will be conducted by the University. **A Viva-Voce** examination will be conducted by the University at the end of the Final (4th) semester.

9. PROJECT WORK

A candidate may, however, in certain cases, be permitted to work on the **Project** in an Industry/ Hospital/ Research Organization on the recommendation of the Head of the Department/ Director. In such cases, the project work shall be supervised jointly by a member of the Department of Biomedical Instrumentation Teaching faculty and an Engineer / Scientist from that organization.

10. HOSPITAL/INDUSTRY TRAINING

The Hospital/Industry Training specified in the curriculum shall be of **10 days' duration** at the end of the **first semester**, **15 days at the end of the second semester**, and **one month's duration** at the end of the **third semester** of the course.

11. MINIMUM REQUIREMENT FOR SUCCESSFUL COMPLETION

PASS MARK

The curriculum should be drawn up so that the minimum pass marks for successful completion of M. Sc (BMI) satisfy the following:

	University examinations		Sessional examinations		Total	
	Minim.	Max.	Minim.	Max.	Minim.	Max.
Core Subject	45	100	20	50	75	150
Practical/Laboratory Work	45	100	20	50	75	150
Viva-Voce (BMI 4P1)	75	150	-	-	75	150
Subject-Sessional (BMI-105) and (BMI-205)	-	-	25	50	25	50
Practical (BMI-3P2)	-	-	50	100	50	100
Research-oriented practical activity- I (BMI 3P3)	-	-	25	50	25	50
Research-oriented practical activity- II (BMI 4P2)			50	100	50	100
Hospital Training (BMI-1P3,2P3)	-	-	25	50	25	50
Hospital Training (BMI-3P4)	-	-	50	100	50	100
Project Work (BMI-4P3)	-	-	75	150	75	150

12. CLASSIFICATION FOR THE AWARD OF MASTER OF SCIENCE IN BIOMEDICAL INSTRUMENTATION

- A candidate who completes the programme of study and secures a minimum pass mark in all subjects as specified will be declared to be qualified for the award of the degree.
- A candidate who secures not less than **60%** of Marks in the aggregate of all examinations in four semesters will be classified as having passed in **First class**.
- A candidate who secures not less than **75%** of Marks in the aggregate in all four semesters will be declared to have passed in **First class with Distinction**.
- A candidate who secures **50%** marks or above, but below **60%** of marks in aggregate of all examinations in four semesters will be classified to have passed in **Second Class**.

PROGRAMME STRUCTURE / CURRICULUM FRAMEWORK

The M.Sc. Biomedical Instrumentation programme is a two-year, four-semester postgraduate programme designed to provide a balanced combination of theoretical knowledge, practical training, research-oriented activities, professional exposure and project-based learning.

The curriculum comprises core theory courses, practical/laboratory courses, research-oriented practical activities, hospital/industry training, project work, and viva-voce. The programme is structured to progressively develop students' knowledge, technical skills, research aptitude, clinical understanding, and ability to design and develop biomedical instrumentation systems.

SEMESTER –I

BMI - 101 Engineering Mathematics

BMI - 102 Introduction to Anatomy, Physiology and Biomedical Instrumentation

BMI - 103 Electrical Technology

BMI - 104 Electronic Devices & Circuits

BMI - 105 Communication and Soft Skills Development

BMI - 1P1 Electronic Circuit Laboratory

BMI - 1P2 Computer Applications Laboratory- I

BMI - 1P3 Hospital/Industry Training

SEMESTER –II

BMI - 201 Biomedical Equipment – I

BMI - 202 Digital Electronics and Integrated Circuits

BMI - 203 Python Programming

BMI - 204 Biophotonics and Non-Radiating Medical Imaging Techniques

BMI - 205 Research Methodology

BMI - 2P1 Digital and Analog Circuits Laboratory

BMI - 2P2 Computer Applications Laboratory II

BMI - 2P3 Hospital/Industry Training

SEMESTER –III

- BMI - 301 Biomedical Equipment – II
- BMI - 302 Medical Imaging Systems Using Ionizing Radiations
- BMI - 303 Biosensors and Medical Image Processing
- BMI - 304 8051 & Arduino Based Embedded Systems
- BMI - 3PI Microcontroller Laboratory
- BMI - 3P2 Biomedical Instrumentation Laboratory
- BMI - 3P3 Research-oriented practical activity- I
- BMI – 3P4 Hospital/Industry Training

SEMESTER –IV

- BMI - 401 Biosignal Processing
- BMI - 402 Medical Informatics
- BMI - 403 Automation and Quality Control in Biomedical Engineering
- BMI -404 Hospital Management Science or Nanomaterials for Biomedical Applications
- BMI - 4P1 Viva-Voce
- BMI - 4P2 Research-oriented practical activity- II
- BMI - 4P3 Project Work

STAFF REQUIREMENT FOR M.Sc. BIOMEDICAL INSTRUMENTATION COURSE

Sl no	Designation	No.of post	Qualifications	Experience Required
1	Professor and HOD	1	M. App. Sc / M.Sc. Biomedical Instrumentation	Ph.D with five years of postgraduate teaching experience or 10 years of teaching experience at the postgraduate level
2	Associate Professor	1	M. App. Sc / M.Sc. Biomedical Instrumentation	8 years of teaching experience at the postgraduate level
3	Asst. Professor	1	M. App. Sc / M.Sc. Biomedical Instrumentation	3 years of teaching experience at the postgraduate level
4	Lecturer	1	M. App. Sc / M.Sc. Biomedical Instrumentation / M.Sc.Electronics	2 years of teaching experience at the postgraduate level
5	External/Visiting Faculties	4	M.Sc Medical Anatomy, M.Sc Medical Physiology, M.Sc.(Statistics/Mathematics), MCA, M.Tech Computer Science	2 years of teaching experience at the postgraduate level
6	Technical Assistant	1	B.Tech / Diploma in Biomedical Engineering.	1 year as a technical lab assistant

POWER TO MODIFY

Notwithstanding all that has been stated above, the academic council has the right to modify any of the regulations from time to time.

Semester	Course code	Course name	Types of the course	Teaching Hours / Week	L	T	P	Credit	Total Credit
I st	BMI 101	Engineering mathematics	Core	5	3	2	0	3	21
	BMI 102	Introduction to Anatomy, Physiology & Biomedical Instrumentation	Core	6	3	3	0	4	
	BMI 103	Electrical Technology	Core	5	3	2	0	3	
	BMI 104	Electronic Devices & Circuits	Core	6	3	3	0	4	
	BMI 105	Communication and Soft Skill Development	Core	3	2	1	0	1	
	BMI 1P1	Electronic Circuit Laboratory-I	Core	6	0	0	6	3	
	BMI –1P2	Computer Application Laboratory-I	Core	4	0	0	4	2	
	BMI-1P3	Hospital/Industrial Training	Core	1	0	0	1	1	
II nd	BMI-201	Biomedical Equipments-I	Core	6	3	3	0	4	21
	BMI-202	Digital Electronics and Integrated Circuits	Core	6	3	3	0	4	
	BMI -203	Python programming	Core	4	2	2	0	2	
	BMI-204	Biophotonics & Non-Radiating Medical Imaging Technique	Core	6	3	3	0	4	
	BMI-205	Research Methodology	Core	3	2	1	0	1	
	BMI-2P1	Digital & Analog Circuit Laboratory	Core	6	0	0	6	3	
	BMI-2P2	Computer Application Laboratory-II	Core	4	0	0	4	2	
	BMI-2P3	Hospital/Industry Training	Core	1	0	0	1	1	

III rd	BMI-301	Biomedical Equipments-II	Core	6	3	3	0	4	23
	BMI-302	Medical Imaging Systems Using Ionizing Radiations	Core	6	3	3	0	4	
	BMI-303	Biosensors and Medical Image Processing	Core	6	3	3	0	4	
	BMI-304	8051 Arduino-Based Embedded System	Core	6	3	3	0	4	
	BMI-3P1	Microcontroller Laboratory	Core	4	0	0	4	2	
	BMI-3P2	Biomedical Instrumentation Laboratory	Core	6	0	0	6	3	
	BMI-3P3	Research-oriented practical activity- I	Core	1	0	1	0	1	
	BMI3P4	Hospital/Industry Training	Core	1	0	0	1	1	
IV th	BMI –401	Biosignal Processing	Core	6	3	3	0	4	22
	BMI –402	Medical Informatics	Core	6	3	3	0	4	
	BMI –403	Automation and quality control in biomedical engineering	Core	6	3	3	0	4	
	BMI –404	Hospital Management / Nanomaterials for Biomedical Applications	Elective	6	3	3	0	4	
	BMI –4P1	Viva-Voce	Core	3	0	3	0	1	
	BMI –4P2	Research-oriented practical activity- II	Core	3	0	3	0	1	
	BMI –4P3	Project Work	Core	6	0	0	6	4	

Total credits =87

L - Lecture: Classroom-based theoretical teaching and instruction.

T - Tutorial: Guided discussion, problem-solving, revision, and interactive learning sessions.

P - Practical: Laboratory, experimental, demonstration, and hands-on training sessions.

Credit: Academic credit assigned to the course based on the prescribed teaching and learning hours.

SCHEME OF EXAMINATION

SEMESTER -I					
Subject Code	Subject	Marks		Hours/ week	Total Hours
		University Exams	Sessional Exams		
BMI-101	Engineering Mathematics	100	50	5	100
BMI-102	Introduction to Anatomy, Physiology and Biomedical Instrumentation	100	50	6	120
BMI-103	Electrical Technology	100	50	5	100
BMI-104	Electronic Devices& Circuits	100	50	6	120
BMI-105	Communication and Soft Skills Development	-	50	3	60
BMI-1P1	Electronic Circuit Laboratory	100	50	6	120
BMI-IP2	Computer Applications Laboratory-I	100	50	4	80
BMI-1P3	Hospital/Industry Training (10 days)	-	50	1	20
	Grand Total	1000		36	720
SEMESTER -II					
BMI-201	Biomedical Equipment –I	100	50	6	120
BMI-202	Digital Electronics and Integrated Circuits	100	50	6	120
BMI-203	Python Programming	100	50	4	80
BMI-204	Biophotonics and Non-Radiating Medical Imaging Techniques	100	50	6	120
BMI-205	Research Methodology	-	50	3	60
BMI-2P1	Digital and Analog Circuits Laboratory	100	50	6	120
BMI-2P2	Computer Applications Laboratory-II	100	50	4	80
BMI-2P3	Hospital/Industry Training (15 Days)	-	50	1	20
	Grand Total	1000		36	720

SEMESTER -III					
Subject Code	Subject	Marks		Hours/ week	Total Hours
		University Exams	Sessional Exams		
BMI-301	Biomedical Equipment–II	100	50	6	120
BMI-302	Medical Imaging Systems Using Ionizing Radiations	100	50	6	120
BMI-303	Biosensors and Medical Image Processing	100	50	6	120
BMI-304	8051&Arduino Based Embedded Systems	100	50	6	120
BMI-3P1	Microcontroller Laboratory	100	50	4	80
BMI-3P2	Biomedical Instrumentation Laboratory	-	100	6	120
BMI-3P3	Research-oriented practical activity- I	-	50	1	20
BMI-3P4	Hospital/Industry Training (30 Days/1 Month)	-	100	1	20
	Grand Total	1000		36	720
SEMESTER -IV					
BMI-401	Biosignal Processing	100	50	6	120
BMI-402	Medical Informatics	100	50	6	120
BMI –403	Automation and Quality Control in Biomedical Engineering	100	50	6	120
BMI-404	Hospital Management Science or Nano materials for Biomedical Applications	100	50	6	120
BMI-4P1	Viva-Voce	150	-	3	60
BMI-4P2	Research-oriented practical activity- II	-	100	3	60
BMI-4P3	Project Work	-	150	6	120
	Grand Total	1000		36	720

BMI101	ENGINEERING MATHEMATICS	CATEGORY	L	T	P	HOURS/ WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	2	0	5	3	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI – 101 ENGINEERING MATHEMATICS

Total hours:100

This paper enables students to understand different transformations in the Engineering field and the details of Probability and Statistics. It also includes Linear Programming.

MODULE – I

Laplace Transforms: Laplace Transforms, Properties, transforms of periodic functions, Laplace transform of derivatives and integrals, inverse transforms- method of partial fractions, Convolution theorem, Application to differential equations, Unit step function.

MODULE – II

Fourier Series and Integrals and Special Functions: Fourier Series, Functions having points of discontinuity, Change of interval, Even and odd functions, Half-range series.

MODULE – III

Fourier Transforms: Properties of Fourier Transforms, Sine and Cosine Transform, Convolution theorem for Fourier Transform.

Basics of Z-Transforms, Properties of Z-Transform, Inverse Z-Transform, Long division method, Residue method, Partial fraction method.

MODULE – IV

Probability and Statistics: Measures of central tendency- Mean, Median, and Mode; Measures of dispersion; Correlation; Regression, Probability, Discrete and continuous probability distribution, Expectation, Binomial Distribution, Poisson Distribution, Normal Distribution.

MODULE – V

Linear programming- Mathematical Formulation of LPP, graphical solution, Simplex method, Big M method, Duality concept, Transportation problem, Assignment problem

Reference :

1. “*Higher Engineering Mathematics*”, Dr.B.S. Grewal, Khanna Publishers, 41st Edition, 2011.
2. “Digital Signal Processing”, Ramesh Babu, Fourth Edition.
3. “*A Textbook of Engineering Mathematics*”, N.P.Bali & Dr.Manish Goyal, Laxmi Publishers Ltd, 8th Edition, 2011.
4. “*Advanced Engineering Mathematics*”, M.C. Potter & J.L. Goldberg, Oxford University Press.
5. “*Advanced Engineering Mathematics*”, R.K. Jain, S.R.K Iyengar, Narosa Publishers, 1991.
6. “*Advanced Engineering Mathematics*”, C.R. Wilie & L.C. Barrett, MGH Co.

University Examination Question pattern:

12 questions of 10 marks from Module I to Module V, with a choice to answer any ten.
--

BMI 102	INTRODUCTION TO ANATOMY, PHYSIOLOGY AND BIOMEDICAL INSTRUMENTATION	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

**BMI – 102 INTRODUCTION TO ANATOMY, PHYSIOLOGY AND
BIOMEDICAL INSTRUMENTATION**

Total Hours: 120

Part A (Introduction to Anatomy) and Part B (Introduction to Physiology) provide general awareness of the overall structure and function of systems (detailed study not required). The objective of the course is to understand the different parts of the body in relation to various biomedical equipment.

CIE	ESE	TOTAL MARKS	ESE Duration
12.5	25	37.5	45 minutes

PART-A INTRODUCTION TO ANATOMY

Total hours: 30

Respiratory System: Structure of trachea, lungs.

Digestive system: Parts, general features of oesophagus, stomach, small intestine, large intestine, rectum and anal canal, liver, spleen, pancreas.

Cardiovascular system: Structure of heart.

Nervous system: Structure of cerebrum, cerebellum, pons, medulla oblongata and spinal cord.

Excretory system: Parts, structure of kidney, ureter, urinary bladder and urethra.

Reproductive system: Structure of ovary and testis.

Endocrine system: Structure of thyroid, parathyroid, and pituitary gland.

Basics of cells, Chromosomes, DNA, Genes, and Chromosomal abnormalities.

CIE	ESE	TOTAL MARKS	ESE Duration
12.5	25	37.5	45 minutes

PART-B INTRODUCTION TO PHYSIOLOGY

Total hours: 30

Respiratory System: Transport of gases, Regulation of breathing, hypoxia, lung volume and capacity.

Digestive system: Functions of stomach, pancreas, liver. Composition of digestive fluids, peristaltic movement, function of mouth, small intestine and large intestine.

Circulatory system: Blood, composition and functions of blood cells (RBC, WBC and platelets). Function of heart –Hormonal and long-term regulation of BP, cardiac cycle, cardiac output, regulation of arterial BP

Nervous system: Functions of Cerebrum, cerebellum, and hypothalamus; functions of Autonomous Nervous System (Sympathetic & Parasympathetic).

Excretory system: Physiology of urine formation, Nephron.

Reproductive system: Function of ovary and testis.

Endocrine system: functions and applied aspects of various endocrine glands

CIE	ESE	TOTAL MARKS	ESE Duration
25	50	75	1 ½ hours

PART-C INTRODUCTION TO BIOMEDICAL INSTRUMENTATION

Total Hours: 60

This course will enable the students to understand the fundamental principles of bioelectric signals and their physiological origin. Additionally, it provides an overview of the electrodes, amplifiers, and measurement systems used in the medical field.

MODULE I

Introduction to Biomedical Instrumentation (BMI): Definition, scope, and interdisciplinary nature of biomedical instrumentation, Role of biomedical engineers in healthcare, Basic components of a biomedical measurement system.

Bioelectricity and Excitable Cells: Structure and basic physiological properties of excitable cells – neurons and muscle cells; cell membrane, ion channels and ionic gradients involving Na^+ , K^+ , Cl^- and Ca^{2+} ; electrochemical equilibrium and Nernst potential. **Resting and Action Potentials:** Resting membrane potential and polarization; threshold potential; phases of action potential – depolarization, repolarization; Refractory periods (absolute and relative) - propagation of Nerve Impulses: factors affecting conduction velocity.

MODULE II

Biopotentials: Origin and characteristics of bioelectric signals

Electrocardiogram (ECG): electrical activity of the heart; cardiac conduction system; ECG waveform; basic clinical significance; ECG abnormalities- heart blocks, premature contractions, flutter, and fibrillation; ECG artifacts. **Electroencephalogram (EEG):** Electrical activity of the brain; EEG waveforms; EEG patterns during sleep; EEG changes in epilepsy; EEG artifacts. **Electromyogram (EMG):** Electrical activity of muscles; Neuromuscular junction and motor unit; Motor unit action potentials (MUAPs); EMG artifacts; PCG principle and applications.

MODULE III

Electrodes: Fundamentals of electrode–tissue and electrode–electrolyte interfaces, electrolyte–skin interfaces, skin–electrode impedance; types of electrodes used for ECG, EEG and EMG; introduction to dry/gel-free electrodes. **Amplifiers:** Need for amplification of biopotential signals; instrumentation amplifiers; isolation amplifiers.

Measurement, Display and Recording Systems: Basic biomedical measurement system, Signal acquisition and conditioning, Digital Storage Oscilloscope (DSO), Display systems: LCD and OLED, Recording systems: digital recorders and basic conventional recording systems, Introduction to cloud storage.

Reference:

1. “*Textbook of Human Anatomy*”, S.Chand & Co. Ltd., 1996.
2. “*Textbook of Medical Physiology*”, Arthur C. Guyton, Prism Book (P) Ltd, 1996.
3. *Handbook of Biomedical Instrumentation*, R.S. Khandpur, 3rd Edition, Tata McGraw-Hill, 2021.
4. *Medical Instrumentation: Application and Design*, John G. Webster, 5th Edition, Wiley, 2020.
5. *Biomedical Instrumentation and Measurements*, Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 2nd Edition, Pearson, 2019.
6. *Wearable Sensors: Fundamentals, Implementation and Applications*, Paolo Bonato, Elsevier, 2019.
7. *The Biomedical Engineering Handbook*, J.G. Webster & J. Bronzino, 4th Edition, CRC Press, 2020.
8. *Recent Journals: IEEE Transactions on Biomedical Engineering (2022–2025), Nature Biomedical Engineering.*
9. “*Elements of Electronic Instrumentation and Measurement*”, Joseph J Carr, Pearson Education, Third Edition.

University Examination Question pattern: (Part A, Part B & Part C in separate main sheet)

Part A (Introduction to Anatomy) Max marks: 25 marks

6 questions of 5 marks, with a choice to answer any five.

Part B (Introduction to Physiology) Max marks: 25 marks

6 short-type questions of 5 marks, with a choice to answer any five.

Part C (Introduction to Biomedical Instrumentation) Max marks: 50marks

I - 4 questions of 10 marks from Module I to Module III with a choice to answer any three.

II - 5 questions of 5 marks from Module I to Module III with a choice to answer any four.

BMI	ELECTRICAL	CATEGORY	L	T	P	HOURS	CREDIT	YEAR OF
103	TECHNOLOGY	M.Sc.	3	2	0	/WEEK 5	3	INTRODUCTION 2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI – 103 ELECTRICAL TECHNOLOGY

Total hours: 100

The objective of this paper is to understand the electrical circuits and theorems in the Biomedical field. Also, it enables the students to get an idea about the basic electrical equipment.

MODULE – I

DC Circuits: Kirchhoff's Laws, Node and Mesh analysis, Voltage and Current source transformations, Star and Delta transformations, Superposition, Thevenin, Norton, Maximum power transfer and Compensation theorems.

MODULE – II

AC Circuits: Series and parallel AC circuits, RL – RC and RLC circuits, phasor diagram, Active power, Reactive power and apparent power, Series and parallel resonance circuits, Bandwidth and selectivity of resonant circuits. Self and Mutual Inductances.

MODULE – III

Three-Phase Circuits: Three-phase circuits, Balanced circuits, Star and Delta connected loads, Unbalanced circuits, Power measurements by two-wattmeter method.

Transformers: Transformer theory, current and voltage relations in primary and secondary windings, e. m. f. equations, Vector diagrams, Losses and efficiency, open-circuit and short-circuit tests.

MODULE – IV

DC Machines: DC Generators–Shunt, Series and compound generators, EMF equation, Losses and efficiency, Commutation, Armature reactions, DC Motors, Back EMF, Losses and efficiency.

MODULE – V

AC Machines: Ac Generators, Rotor and stator windings, emf equations, Frequency, Synchronous speed, Losses and efficiency. Synchronous motors, Vector diagram for varying excitations, V Curves. Induction Motor–Basic principle, squirrel and slip ring motors–synchronous speed, slip, Torque Characteristics, losses and Efficiency, star-delta starter, Types of single-phase induction motors–Universal Motors.

MODULE – VI

Special Machines and Measuring Instruments: Tacho generators, AC and DC servo motor, stepper motor, Circuit Breakers – MCBs and ELCBs, Current and Potential Transformers, Protective systems – Fuses –Isolators and switches, Earthing, Surge protectors. Analog Ammeters, Voltmeters, Multimeters, Wattmeter, Energy meter, Megger. Extension of ranges. Voltage stabilizers and UPS (Offline and Online).

Reference:

1. “*Electric Circuits & Electronic Devices*”, A.Milton, S.Caroline.
2. “*Industrial Instrumentation*”, W.Prabhakararao.
3. “*Textbook of Electrical Technology in S.I. system of units: volume 2: AC and DC machines*”, B.L. Theraja, S. Chand & Company Ltd, 1997.
4. “*Electrical Technology*”, Edward Hughes, Addison Wesley Publication.
5. “*Electrical Machines*”, Nagarath & Kothari, Tata McGraw Hill, 1999.

University Examination Question pattern:

Part A - 6 questions of 10 marks from Module I to Module V, with a choice to answer any five. Part B- 12 questions of 5 marks from Module I to Module V, with a choice to answer any ten.
--

BMI 104	ELECTRONIC DEVICES& CIRCUITS	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI -104 ELECTRONIC DEVICES& CIRCUITS

Total hours:120

This paper introduces an idea about basic electronic devices, which include passive and active devices. It also helps to understand the basic electronic circuits such as wave shaping circuits, wave generating circuits, etc.

MODULE -I

Junction Diodes: VI characteristics of Diodes, Rectifiers – Expression for ripple factor and efficiency. Filters– capacitor, inductor, LC and CLC filters– Expression for ripple factor. Zener and avalanche diodes–Zener diode as a voltage regulator.

Special Diodes: Principles and operation–Tunnel, PIN, Varactor, Photodiodes, LED, LVD, LDR and Thermistor. Thyristors– Classification & Constructional Details. **Transistors:** Fundamentals of BJT operation, Transistor configurations, Current application factors –Relations between alpha & beta comparison. Field-effect transistors –JFET, MOSFET, General characteristics–enhancement and depletion modes. UJT, SCR, TRIAC and DIAC–principles, characteristics, and Applications.

MODULE –II

Amplifier circuits: Biasing techniques of BJT, stabilization of operating point, concept of load lines, Analysis and design of BJT amplifier circuits in common emitter, common collector and common base configurations, Frequency response of RC coupled amplifier. FET and MOSFET amplifiers, Multistage amplifiers (RC coupled and Transformer coupled).

Negative feedback: Effect of negative feedback on amplifier performance, Voltage series, current series, Voltage shunt, feedback arrangements, design of feedback amplifiers, Darlington connection.

MODULE –III

Power amplifiers: class A, B, AB and C power amplifiers, efficiency, push-pull and complementary symmetry power amplifier –Harmonic distortion – Thermal runaway and heat sinks.

MODULE – IV

Oscillators: Positive Feedback, Principle of Sinusoidal Oscillators, Barkhausen Criteria, RC Oscillator, Phase shift, Wien Bridge, LC Oscillators, Hartley, Colpitts, Clapp Oscillator and Crystal Oscillator.

Multivibrators– Astable, Monostable and Bistable circuits using BJTs–Applications. Pulse shaping using RC circuits –Differentiating and integrating circuits. Clipping and Clamping circuits using Diodes, voltage multipliers.

Reference:

1. “Electronic Devices & Circuit Theory”, J.B.Gupta, Third Edition, S.K.Kataria & Sons, 2009.
2. “Electronic Devices & Circuit Theory”,Boylestead & Neshelsky, Prentice Hall of India, 2003.
3. “Electronic Devices & Circuits”, Allan Mottorshed, Prentice Hall of India, New Delhi, 2003.
4. “Electronic Devices & Circuits”, Theodore F. Bogart, Universal Book Stall, New Delhi

University Examination Question pattern:

Part A - 6 questions of 10 marks from module I to module V, with a choice to answer any five. Part B- 12 questions of 5 marks from Module I to Module V, with a choice to answer any ten.
--

BMI	COMMUNICATION AND SOFT SKILLS DEVELOPMENT	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
105		M.Sc.	2	1	0	3	1	2025

CIE	TOTAL MARKS
50	50

BMI – 105 COMMUNICATION AND SOFT SKILLS DEVELOPMENT

Total hours:60

MODULE I Communication

Communication in management process – effectiveness – Communication opportunities – Choice of media – Formal – Informal – Types – techniques.

Group communication –Methods – Problems – Solutions – Meetings

Speeches – Structure of speech – Drafting of speech – Speeches for different occasions,

Interview – Listening and observation skills – Body language.

MODULE II Reports

Report writing – Types of report – Structure – Methods of collecting and preparing material- Drafting of report.

Business correspondence – Drafting of letters – Circulars – Answering letters.

Office orders – Office circulars – Office notes – Suggestions – Complaints – Office memorandums.

Meeting documentation

MODULE III Group Process lab:

Workshop – Seminar – Media and advertising lab- Self-development and assessment – Self-assessment- self-awareness – perception and attitudes – values and belief system – personal goal setting – career planning – self-esteem – building self-confidence- group discussion and oral presentations.

MODULE IV Time Management

Managing time, improving personal memory –complex problem solving – creativity.

Team Building, Stress Management, Setting skills.

MODULE V Career Skills

Curriculum Vitae and Cover Letters, Facing an interview, Presentation Skills, Persuasion Skills.

Reference:

1. Dalmer Fisher: Communication in Organizations, Jaico Publishing Co., Bombay
2. Krishna Mohan & Meera Banerji, Developing Business Communication, Mc Millan Education Ltd.
3. Rajendra Pai & Bhatnagar OP: Education and Communication for Department
4. Raymond V Lesikar, John D. Pettit Jr & Lakshman C Arya: Business Communication, All India Traveller Book Seller, New Delhi.
5. Essentials of Business Communication, Rajendra Pal, JS Korlahhi: Sultan Chand & Sons, New Delhi.
6. Basic Communication Skills for Technology, Andre J. Rutherford: Pearson Education Asia, Patparganj, New Delhi 92
7. Advanced Communication Skills, V. Prasad, Atma Ram Publications, New Delhi.

BMI 1P1	ELECTRONIC CIRCUIT LABORATORY	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	0	0	6	6	3	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI – 1P1 ELECTRONIC CIRCUIT LABORATORY

Total hours:120

1. Familiarization of Electronic Components and Electrical Equipment.
2. Characteristics of Active devices.
 - i) Forward characteristics of a Diode
 - ii) Forward and reverse characteristics of a Zener Diode
 - iii) Characteristics of a Transistor
 - iv) Characteristics of an FET
3. Clipping and Clamping circuits using Diodes.
4. Differentiating circuits and Integrating circuits.
5. Rectifying circuits.
 - i) Half-wave rectifier
 - ii) Full Wave Rectifier
 - iii) Full-wave bridge rectifier
 - iv) Filter circuits - Capacitor filter, Inductor filter, LC filter and Pi section filter (Measurement of ripple factor)
6. Biasing of BJT.
7. Amplifiers.
8. Oscillators and Multivibrators.

BMI 1P2	COMPUTER APPLICATIONS LABORATORY-I	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	0	0	4	4	2	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI- 1P2 COMPUTER APPLICATIONS LABORATORY-I

Total hours:80

1. Computer fundamentals, Computer Organization, etc.
2. MS OFFICE
3. Programming in C.
 - 3.1 Simple C programs
 - 3.2 Program to illustrate control statements, Switch statement
 - 3.3 Program to illustrate looping statements
 - 3.4 Program to illustrate arrays
 - 3.5 Program to illustrate functions and user-defined functions

Reference:

1. Kernighan et. al., “The C Programming Language”, Prentice Hall of India, Ltd.
2. Huthivision. R., “Programming in C”, McGraw Hill, New York.
3. Gottfried. S. B., “Theory and Problems of Programming with C”, Tata McGraw Hill Pub

BMI 1P3	HOSPITAL/ INDUSTRY TRAINING	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	0	0	1	1	1	2025

CIE	TOTAL MARKS
50	50

BMI- 1P3 HOSPITAL/INDUSTRY TRAINING

Total Hours: 20

Students shall undergo **ten days** of supervised practical training in a hospital or biomedical industry to gain basic exposure to the clinical and technical environment. The training shall familiarize students with commonly used biomedical equipment, their basic functions, applications and safe handling practices. Students shall observe the basic operation and use of biomedical equipment relevant to the topics covered in the curriculum. Students shall maintain a structured training log and submit a training report. **An internal assessment of approximately 20 minutes shall include presentation and viva-voce based on the training experience, training log and report.**

BMI 201	BIOMEDICAL EQUIPMENT-1	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 201 BIOMEDICAL EQUIPMENTS– I

Total hours:120

This subject is to provide an overview of biomedical equipment used for laboratory analysis, diagnosis, patient monitoring, and healthcare applications. It provides an overview of modern developments in biomedical instrumentation.

MODULE I

Classification of Biomedical Equipment: Different types and applications of Analytical equipment, Diagnostic equipment, Therapeutic equipment, and surgical equipment; **patient monitoring and patient care equipment;** **Calibration, safety, and Maintenance:** Importance of accuracy and reliability, Calibration standards and procedures, Quality assurance and preventive maintenance; Electrical safety in biomedical equipment

MODULE II

Analytical and Laboratory Equipment

Basic Analytical Instruments: Flame photometers- principle and applications; spectrophotometers (UV–Vis)-principle and applications; **Clinical Laboratory Equipment:** Blood gas analyzers- principle and measurement of pH, pO₂, pCO₂; Hematology analyzers- basic principle and blood cell counting. **Sterilization Techniques:** Autoclave (steam sterilization)-principle and applications; Sterrad (low-temperature plasma sterilization)-principle and applications; Chromatography-Gas & Liquid; Lab-on-chip systems - principle and biomedical applications.

MODULE III

Diagnostic and Audiological Equipment.

Cardiac Diagnostic Equipment: Electrocardiography (ECG)- electrodes and lead systems, ECG Machine and recording systems, clinical applications, cardiac stress testing: principle & applications. **Neurological and Neuromuscular Diagnostic Equipment:** Electroencephalography (EEG)- principle, electrodes and lead systems, EEG recording systems,

clinical applications, evoked potentials- visual evoked potential (VEP), Auditory evoked potential (AEP), somatosensory evoked potential (SSEP); Magnetoencephalography (MEG) - principle & applications, SQUIDs system; Electromyography (EMG)- principle and applications; Electroneurography (ENG) and Nerve conduction velocity (NCV)-principle and applications; AI-assisted diagnostic systems. **Endoscopic Equipment:** Fiber-optics principle; Endoscopy – principle and major applications: Laparoscopy, Bronchoscopy, Robotic and capsule endoscopy. **Audiological Equipment:** Pure-tone and speech audiometers; digital audiometers; hearing assistive devices: analog and digital hearing aids; cochlear implants; ear moulds; Auracast.

MODULE IV

Patient Monitoring Systems: Principles of patient monitoring; bedside multiparameter monitors (ECG, SpO₂, BP, respiration, temperature); Holter monitoring; AI-integrated cloud-based healthcare monitoring system. **Patient Care Equipment:** Infusion pumps, Syringe pumps, Infant incubators, and Infant warmers; IoT-connected patient care equipment.

Reference:

1. *Handbook of Biomedical Instrumentation*, R.S. Khandpur, 3rd Edition, Tata McGraw-Hill, 2021.
2. *Medical Instrumentation: Application and Design*, John G. Webster, 5th Edition, Wiley, 2020.
3. *Introduction to Biomedical Engineering*, John D. Enderle and Joseph Bronzino, 3rd Edition, Academic Press/Elsevier, 2020.
4. *Principles of Biomedical Instrumentation*, D. Patranabis, 2nd Edition, PHI Learning, 2019.
5. *Wearable Sensors: Fundamentals, Implementation and Applications*, Paolo Bonato, Elsevier, 2019.
6. *“Biomedical Instrumentation”*, Shakthi Chatterjee & Aubert Miller, CENGAGE Learning, 2010.

University Examination Question pattern:

Part A	- 6 questions of 10 marks from Module I to Module V with a choice to answer any five.
Part B	- 12 questions of 5 marks from Module I to Module V with a choice to answer any ten.

BMI 202	DIGITAL ELECTRONICS AND INTEGRATED CIRCUITS	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 202 DIGITAL ELECTRONICS AND INTEGRATED CIRCUITS

Total hours:120

The aim of the paper is to learn the basic digital circuits and their uses. This paper also enables the student to understand the circuits using op-amps which have wide applications in the field of medicine.

MODULE -I

Number System and Codes: Binary, Octal, and Hexadecimal number systems, Binary Coded Decimal, Excess - 3 code, Gray Code. Binary arithmetic and Complement of numbers, Addition and subtraction with BCD. Boolean algebra –De-Morgan’s Theorem. Minimization of Boolean function using Boolean Theorems, Karnaugh map, and Quine – McCluskey methods. Realization of logic function using NAND, NOR. **Combinational Circuits:** Multiplexer, Demultiplexer, Decoder. **Arithmetic Circuits:** Half adder, Full adder, Serial and parallel addition – Carry look-ahead adder, Subtractor.

MODULE –II

Sequential Circuits: Flip-flops – RS, JK, JKMS, T & D flip-flops, Shift registers, Counters –Asynchronous and synchronous counters, Up-Down counter, Shift register counters, Decade counter, Ring counter, Johnson counter. Sequence generators –state tables and diagrams. Logic Families: DCL, RTL, DTL, TTL, ECL, CMOS, Tri-state logic – specification and transfer characteristics of basic TTL –Current and voltage parameters –fan-in and fan-out – Propagation delay, noise consideration, Comparison.

MODULE –III

Introduction to Operational Amplifiers: Internal block schematic of op amp –Op-amp parameters–Slew rate, Input bias current, offset current, CMRR, SVRR, unity-gain bandwidth,

Input and output impedance. Ideal characteristics of op amp–open-loop gain, frequency response. Open-loop and Closed loop Op-Amp Configurations: Feedback configurations – Voltage series feedback and voltage shunt feedback –concept of virtual ground –voltage follower. Inverting and non-inverting amplifier, summer, subtractor, average, Integrator and differentiator, voltage-to-current and current-to-voltage converter, voltage-to-frequency converter, clipper, clamper, Log and Antilog amplifiers. Sample-and-hold circuit, Precision rectifiers.

MODULE – IV

Comparator: Applications of comparator, zero-crossing detector, regenerative comparators (Schmitt trigger). Multivibrators: Astable and monostable –Design, working. Wave generators: Triangular and sawtooth, RC phase shift and Wien bridge oscillators.

MODULE – V

Specialized ICs and applications: IC regulators –723 (block diagram, typical low-voltage regulator circuit). Timers –555 – Functional block diagram–Astable and monostable multivibrators using 555 –applications. Voltage-controlled oscillators – 566. Phase-locked loop (PLL) –Block diagram – application

Reference:

1. “Digital Fundamentals”, Floyd & Jain, Pearson Education, 8 th Edition.
2. ”Digital Principles and Applications”, Malvino and Leach, McGraw Hill, 5 th Edition.
3. ”Fundamentals of Logic Design”, Charles H.Roth, Thomson Learning, 5 th Edition.
4. “Op-Amp and Linear Integrated Circuits”, Ramakant A. Gayakwad, Pearson Education Asia,4 th Edition.
5. “Op-Amps and Linear Integrated Circuits”, Coughlin & Driscoll, Pearson Education

University Examination Question pattern:

Part A	- 6 questions of 10 marks from module I to module V with a choice to answer any five.
Part B	- 12 questions of 5 marks from module I to module V with a choice to answer any ten.

BMI 203	PYTHON PROGRAMMING	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	2	2	0	4	2	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 203 PYTHON PROGRAMMING

Total hours:80

This paper is designed to understand the basic object oriented programming languages. It emphasizes the Python programming language with programming examples.

MODULE-I

Object-oriented programming principles, Definition and motivation of object-oriented programming languages, Features of object-oriented programming languages. Introduction to Python programming-Python features, identifiers, keywords, statements and expressions, variables, operators, precedence and associativity. Datatypes-numbers, Boolean, Strings, None; indentation, Comments, Reading Input, Print Output, Type conversions.

MODULE –II

Datatypes in Python: built-in datatypes, None type, Numeric types, Explicit conversion of datatypes, Sequences in Python, str, bytes, bytearray, List, Tuple, range, Sets, set datatype, frozenset, mapping types, determining the data type of a variable, Identifiers and reserved words, Naming conventions in Python. Operators, I/O and control statements, Membership operators, Identity operators, Output statements, Input statements, command-line arguments, A word on Indentation, the if-elif-else statement, Infinite loops, Nested Loops, the else Suite, break, continue, pass, assert, and return statements.

MODULE –III

List, Tuples and Dictionaries: Exploring lists, creating lists, Basic list operations. List() function, Indexing and slicing, Built-in –functions, updating the elements of the list, Concatenation of two lists. Tuples: creating and accessing Tuple elements, Basic operations on Tuples, Functions to

process tuples, built-in functions on Tuples, Tuple methods, zip() function. Dictionaries: Introduction to Dictionaries, Operations on Dictionaries, Dictionary methods, del statement.

MODULE- IV

Functions: Built-in functions, user-defined functions, Function calls, the return statement, and void functions

Reference:

1. Charles Dierbach, “Introduction to Computer Science using Python - A Computational Problem-Solving Focus”, Wiley India Edition, 2015.
2. Mark Lutz, “Learning Python: Powerful Object-Oriented Programming”, O’reilly Media, 2018, 5th Edition.
3. Timothy A. Budd, “Exploring Python”, Tata McGraw-Hill Education Private Limited, 2011, 1st Edition.
4. Allen Downey, Jeffrey Elkner, Chris Meyers, “How to think like a computer scientist: learning with Python”, 2012.
5. Sheetal Taneja & Naveen Kumar, “Python Programming: A Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications”, Pearson, 2017.
6. Ch Satyanarayana M Radhika Mani, B N Jagadesh, “Python programming”, Universities Press, 2018.

WEB REFERENCES

<http://interactivepython.org/courselib/static/pythonds>,

<http://www.ibiblio.org/g2swap/byteofpython/read>,

<http://www.diveintopython3.net>, <http://greenteapress.com/wp/think-python>

University Examination Question pattern:

Part A - 6 questions of 10 marks from Module I to Module IV, with a choice to answer any five. Part B - 12 questions of 5 marks from Module I to Module IV, with a choice to answer any ten.

BMI 204	BIOPHOTONICS AND NON- RADIATING MEDICAL IMAGING TECHNIQUES	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 204 BIOPHOTONICS AND NON-RADIATING MEDICAL IMAGING TECHNIQUES

Total hours:120

The objective of this paper is to understand the uses of lasers in the medical field and holographic imaging techniques. Also, it helps to learn the principles and applications of ultrasound. The principles and applications of MRI are also included in this paper.

MODULE –I

Laser: Laser physics, Characteristics of laser radiation – Coherence of light, Principles of laser action – Population inversion – Optical pumping – Metastable states – Conditions for laser action, Different types of lasers and their applications – Solid, Liquid and Semiconductor lasers, Applications of Laser in Biology – Dentistry, Dermatology, Medicine, Surgery, Angioplasty and Endoscopy, Laser safety management, Personnel safety.

MODULE –II

Holography: Introduction, Recording and Reconstruction of holograms, Holographic Recording media, Holographic memory, Holographic Interferometry, Motion-induced contrast images, Holographic computer, Holographic application in medicine, Correlation filtering, Fourier optics.

MODULE –III

Medical ultrasound: Physics of ultrasonic waves, Interactions with body matter, Generation and detection, single-element transducer construction, Linear and sector scanning Transducer arrays, Different modes of display, Modes of transmission of ultrasound, Colour Doppler, Ultrasonic diagnosis in Abdomen, Breast, Heart, Chest, Eye, Kidney, Skull, Pulsatile motion, Pregnant and Non-Pregnant uterus.

Ultrasound pulse echo imaging system, Design of scan converters, Design of frame grabbers, 2D scanners. Diagnostic Ultrasound Imaging: A-mode, B-mode and M-mode, Principle of B-Mode Image formation, B-mode formats, Transducers and Beam forming, B-Mode Instrumentation, B-mode image properties, limitations and artifacts, B-Mode Measurements

MODULE –IV

Magnetic Resonance Imaging: Principles of image formation – MRI instrumentation – magnets – Gradient system – RF coils, receiver system, Pulse sequence – Image acquisition and reconstruction techniques, Application of MRI, NMR Spectroscopy. Magnetic resonance imaging: Physics of the Dynamics of the Spin (Review Only). MRI -Principle-Magnetisation-Excitation-Relaxation-T1 and T2 phase relaxation and relaxation curves – Acquisition-Bloch Equations. MRI Instrumentation and Block Diagram – Main Magnet, Gradient System, Shim System, RF System, Console, MRI Suite, Encoding, Phase Encoding, Frequency Encoding, slice thickness, 2D and 3D imaging

Reference:

1. “*Lasers in Medicine*”, Leon Goldman, Springer-Verlag.
2. “*Introduction to Biomedical Photonics*”, Paras N.Prasad, John Wiley, 2003.
3. “*The Physics of Diagnostic Ultrasound*”, Peter Fish, John Wiley & Sons, England, 1990.
4. “*Ultrasound Physics & Instrumentation*”, D.L. Hykes, W.R. Hedrick & D.E. Starchman, Churchill Livingstone, Melbourne, 1985.
5. “*The Physics of Medical Imaging*”, S. Webb, IOP Publishing Ltd., 1988.

University Examination Question pattern:

Part A - 6 questions of 10 marks from Module I to Module IV with a choice to answer any five.
Part B - 12 questions of 5 marks from Module I to Module IV with a choice to answer any ten.

BMI 205	RESEARCH METHODOLOGY	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	2	1	0	3	1	2025

CIE	TOTAL MARKS
50	50

BMI – 205 RESEARCH METHODOLOGY

Total hours:60

MODULE I

Fundamentals of research

Introduction to Research: Meaning, objectives and types of research; research process; identification and formulation of research problems; research questions, hypothesis and objectives; basic research designs; variables and experimental planning.

MODULE II

Literature review and research methods

Literature Review: Purpose and importance of literature review; literature search using scientific databases; selection of relevant research papers; critical reading and analysis of research papers; citation and referencing; identification of research gaps. Research Methods: Quantitative and qualitative approaches; experimental and observational methods; sampling and data collection techniques.

MODULE III

Data analysis and scientific writing

Data Analysis: Basic statistical concepts; descriptive statistics; graphical representation and interpretation of data; basic statistical analysis. Scientific Writing: Structure of scientific reports; scientific writing; citation and referencing; plagiarism and research ethics.

MODULE IV

Research proposal development

Research Proposal: Components of a research proposal; formulation of research problem, objectives and methodology; research planning; preparation and presentation of a research proposal.

Reference:

1. Kothari, C. R., & Garg, G. (2024). *Research methodology: Methods and techniques* (5th ed.). New Age International.
2. Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE Publications.
3. Hulley, S. B., Cummings, S. R., Browner, W. S., Grady, D. G., & Newman, T. B. (2013). *Designing clinical research* (4th ed.). Lippincott Williams & Wilkins.
4. Kumar, R. (2019). *Research methodology: A step-by-step guide for beginners* (5th ed.). SAGE Publications.
5. Day, R. A., Gastel, B., & Sakaduski, N. (2016). *How to write and publish a scientific paper* (8th ed.). Greenwood.

BMI 2P1	DIGITAL AND ANALOG CIRCUITS LABORATORY	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.SC.	0	0	6	6	3	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI- 2PI DIGITAL AND ANALOG CIRCUITS LABORATORY

Total hours:120

1. Study of Logic circuits –AND, OR, NOT, NAND, EX-OR, etc.
2. Design of half adder and full adder using NAND and NOR gates.
3. Design of half subtractor and full subtractor using NAND and NOR gates.
4. Set up RS, T, D, JK & JKMS flip flops using NAND Gates.
5. Sequential Logic circuits, Counters, Registers etc.,
6. Study of IC counters.
7. Study of op amps and basic circuits using op amp.
(Comparator circuits, arithmetic circuits, simple amplifier circuits)
8. Precision rectifiers (half-wave and full-wave).
9. Sample-and-hold circuit
10. Study of 555 IC and its applications (Astable and Monostable Multivibrators).

BMI 2P2	COMPUTER APPLICATIONS LABORATORY-II	CATEGORY	L	T	P	HOUR /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	0	0	4	4	2	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI- 2P2 COMPUTER APPLICATIONS LABORATORY-II

Total hours:80

Python Programming.

1. Basic programs in Python: Display the use of variables and basic expressions; demonstrate arithmetic operators and data type conversions; create a Python script that involves working with numbers, floats, and string operations.
2. Programs Using Control Structures: Logical operators and control flow using if-else statements, while and for loops in Python.
3. Programs Using Data Structures: Manipulate lists, tuples, dictionaries, and sets-programs demonstrating different data structure methods.
4. Programs using functions: Python script incorporating basic built-in functions and demonstrating their usage. Implementation of user-defined functions, function calls, and parameterized function calls.

BMI 2P3	HOSPITAL/ INDUSTRY TRAINING	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	0	0	1		1	2025

CIE	TOTAL MARKS
50	50

BMI- 2P3 HOSPITAL/INDUSTRY TRAINING

Total Hours: 20

Students shall undergo **fifteen days** of supervised practical training in a hospital or biomedical industry to gain practical exposure to the operation, maintenance and management of biomedical equipment. The training shall focus on equipment operation, basic calibration, preventive maintenance, troubleshooting, safety practices and performance monitoring. Students shall develop an understanding of biomedical equipment management in clinical and technical environments. Students shall maintain a structured training log and submit a comprehensive training report. **An internal assessment of approximately 20 minutes shall include presentation and viva-voce based on the training experience, training log and report.**

BMI 301	BIOMEDICAL EQUIPMENTS– II	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 301 BIOMEDICAL EQUIPMENTS– II

Total Hours: 120

This paper will enable the students to learn the principles and operations of therapeutic and surgical instruments. Also, it gives an idea of the Hospital gas supply system and details about electrical safety. Recent advances in the Biomedical field are also summarized in this paper.

MODULE I

Cardiac and respiratory equipment

Cardiac Equipment: Cardiac pacemakers – principle, types (synchronous and asynchronous) and applications; Leadless and remote-monitoring pacemakers; cardiac defibrillators – principle, types (external and internal) and applications; Automated External Defibrillator (AED); wearable and automated defibrillation technologies.

Respiratory Equipment: Mechanical ventilators – principle, working, classification and basic parameters; volume- and pressure-controlled ventilation, pressure support, PEEP and SIMV; non-invasive ventilation – CPAP and BiPAP; advanced modes – APRV, PAV, NAVA and ASV; AI-assisted and IoT-enabled ventilation systems.

MODULE II

Extracorporeal, physiotherapy and electrotherapy equipment

Extracorporeal Equipment: Dialysis – haemodialysis and peritoneal dialysis; heart-lung machine and oxygenators; ECMO; cardiac assist devices – artificial heart and IABP; Lithotripsy: ESWL – principle and applications; **Physiotherapy and Electrotherapy:** Shortwave and microwave diathermy; TENS and IFT – principles and applications; Portable and wearable therapeutic systems.

MODULE III

Operation Theatre and Surgical Equipments

Operation Theatre Essentials: Surgical lights, operating tables, C-arm, surgical microscopes and aspirators. **Electrosurgical Systems:** ESU – principle and operating modes; Robotic and AI-Powered Surgery. **Anesthesia Systems:** Anesthesia machines and modern workstations; medical gases and delivery systems.

MODULE IV

Hospital Gas Systems and Electrical Safety

Centralized Medical Gas Supply: Oxygen, medical air, nitrous oxide, carbon dioxide, nitrogen, and vacuum systems; MGPS – principles, components, and safety features; alarm systems and automated gas distribution; Smart gas monitoring.

Electrical Safety: Microshock and macroshock; patient protection and protective circuits; GFCI; leakage current monitoring.

Reference :

1. *Handbook of Biomedical Instrumentation*, R.S. Khandpur, 3rd Edition, Tata McGraw-Hill, 2021.
2. *Medical Instrumentation: Application and Design*, John G. Webster, 5th Edition, Wiley, 2020.
3. *Biomedical Device Technology: Principles and Design*, Anthony Y. K. Chan, 3rd Edition, Charles C. Thomas, 2016.
4. *Clinical Engineering Handbook*, Ernesto Iadanza, 2nd Edition, Academic Press, 2020.
5. *Principles of Biomedical Instrumentation*, D. Patranabis, 2nd Edition, PHI Learning, 2019.
6. *“Biomedical Instrumentation”*, Shakthi Chatterjee & Aubert Miller, CENGAGE Learning, 2010.
7. *“Handbook of Biomedical Instrumentation”*, Chanderlekha Goswami, Manglam Publications, 2010.

University Examination Question pattern:

Part A - 6 questions of 10 marks from Module I to Module V, with a choice to answer any five.
Part B - 12 questions of 5 marks from Module I to Module V, with a choice to answer any ten.

BMI 302	MEDICAL IMAGING SYSTEMS USING IONIZING RADIATIONS	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 302 MEDICAL IMAGING SYSTEMS USING IONIZING RADIATIONS

Total Hours:120

The objective of this paper is to understand the underlying physics of the medical imaging systems and to give an overview of major modern diagnostic imaging technologies. Also, it supports more in-depth investigations into radiography and nuclear medicine imaging modalities.

MODULE –I

X-rays: Principle and production of X-rays, Bremsstrahlung radiation, Interaction of X-rays with matter. Properties of X-ray films and screens, Characteristics of imaging systems by image modulation transfer functions,

Radiography: Various components of Radiography systems – Exposure switching and control of exposure time – Types of timer circuits, Filament circuit and KV– mA controls – HT units – X-ray tubes for various medical applications – fixed anode, rotating anode, X-ray tubes for specialized applications – collimators – grids, X-Ray processing methods-Manual, CR and DR, Mamography. Cath Lab Description

MODULE –II

Fluoroscopy systems – characteristics of image-intensifying television for fluoroscopy – TV systems – Fundamentals, monochrome/colour – scanning principles, Basics of digital radiography, charge-coupled devices, basics of digital angiography – Digital subtraction angiographic techniques. Components of digital fluoroscopy imaging system, Dynamic Flat panel detector units. Dental Radiology-Intraoral radiology, Panoramic Radiography

MODULE –III

CT principles – Principles of sectional imaging, generations – CT image formation, conversion of X-ray data into scan image – mathematical details of various algorithms–Principles of 3D

imaging. Types of CT scanners – spiral CT, multi-slice CT. Radiation safety – safety precautions – Hazardous effects of radiation– Allowed level protection methods.

MODULE –IV

Nuclear Medicine – Physics of radioisotope imaging – Radioisotopes in medical use – Radionuclide production – Cyclotron – Radiopharmaceuticals – Radiation Detectors – Scintillation Detector – Photomultiplier Tube – Pulse Height Analyzer – Rectilinear scanners – Gamma camera – Emission computed tomography – PET scanner– SPECT – Linear accelerator – Construction, Operation and Applications – Betatron, Cobalt and Caesium therapy – Automatic treatment planning. Types of Radiation therapy(EBRT or XRT) or Teletherapy, Brachytherapy.

Reference :

1. “*Fundamental Physics of Radiology*”, W.J. Meredith & J.B. Massey, Varghese Publishing House, Bombay, 1992.
2. “*A Manual of Radiographic Equipment*”, Sybil M.Stockley, Churchill Livingstone, New York, 1986.
3. “*Radiographic Imaging*”, D.N. & M.O. Chesney, CBS Publishers, 1990.
4. “*The Physics of Medical Imaging*”, S. Webb, IOP Publishing Ltd., 1988.

University Examination Question pattern:

Part A - 6 questions of 10 marks from Module I to Module V with a choice to answer any five.
Part B - 12 questions of 5 marks from Module I to Module V with a choice to answer any ten.

BMI 303	BIOSENSORS AND MEDICAL IMAGE PROCESSING	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 303 BIOSENSORS AND MEDICAL IMAGE PROCESSING

Total Hours: 120

This paper introduces an idea about various biological sensors present in the human body. It also provides an overview of different transducers and biosensors in the Medical field and introduces the applications of BioMEMS. This paper also helps to understand the techniques of image processing.

MODULE I

Biological Sensors and Receptors: Concept of biological sensors and natural receptors as biosensors; classification of sensory receptors – mechanoreceptors, chemoreceptors, photoreceptors, thermoreceptors and nociceptors; representative biological receptors and their physiological functions, including touch and pressure receptors, taste and olfactory receptors, auditory hair cells, rods and cones, baroreceptors and osmoreceptors.

MODULE II

Biomedical Transducers: Basic principles of biomedical transducers; transducer characteristics: sensitivity, accuracy, linearity and response time; temperature transducers: thermistors and thermocouples – applications in body temperature measurement; force and displacement transducers: strain gauges, capacitive and piezoelectric transducers – biomedical applications; smart sensors and IoT-enabled healthcare systems; AI-enhanced and virtual sensing.

MODULE III

Biosensors and BioMEMS: Basic principle and components of biosensors; types and applications of biosensors including ion-selective electrode, enzyme-based, ISFET and fibre-optic biosensors; Introduction to MEMS and BioMEMS; basic principles and materials of BioMEMS; applications of BioMEMS in lab-on-chip systems, microfluidic devices, implantable sensors and drug delivery, Surgical applications (minimally invasive tools, micro-needles).

MODULE IV

Data Acquisition, Recording and Wireless Monitoring: Basic signal conditioning and data acquisition systems; digital recording, storage and real-time monitoring of biosensor signals; principles of wireless data transmission; Bluetooth and Wi-Fi-based monitoring; applications in remote and wearable biosensor systems.

MODULE V

Medical Image Processing:

Medical Image Acquisition: Fundamentals of digital medical images; image acquisition; **Image Pre-processing:** Noise reduction and basic filtering; smoothing and image restoration. **Image Enhancement:** Contrast enhancement; histogram-based enhancement; sharpening techniques; **Image Segmentation:** Basic segmentation techniques – thresholding, region-based methods and edge detection; **Feature Extraction:** Extraction of shape, texture, intensity and spatial features. **Image Compression:** Fundamentals of image compression; lossless and lossy compression for medical images. **Image Storage and Retrieval:** Basic concepts of medical image storage, databases, and retrieval systems. **Medical Image Communication and Management:** DICOM standards; PACS architecture and workflow; medical image communication and management in healthcare systems.

Reference :

1. *Biosensors and Bioelectronics*, Brian R. Eggins, 2nd Edition, Wiley, 2018.
2. *Fundamentals of Biosensors: From Sensors to Biosensing Systems*, Jeong-Yeol Yoon, Springer, 2019.
3. *Biomedical Signal and Image Processing*, Kayvan Najarian & Robert Splinter, 2nd Edition, CRC Press, 2018.
4. *Medical Image Processing, Reconstruction and Analysis*, Jiri Jan, 2nd Edition, CRC Press, 2019.
5. *Biomedical Image Analysis*, Rangaraj M. Rangayyan, 2nd Edition, CRC Press, 2015.
6. “*Essentials of Medical Physiology*”, Mahapathra.
7. “*Fundamentals of BioMEMS and Medical Micro Devices*”, Steven S. Saliterman, SPIE Press Monograph, 2006.

University Examination Question pattern:

Part A - 6 questions of 10 marks from Module I to Module V, with a choice to answer any five. Part B - 12 questions of 5 marks from Module I to Module V, with a choice to answer any ten.

BMI 304	8051 & ARDUINO- BASED EMBEDDED SYSTEMS	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 304 8051 & ARDUINO BASED EMBEDDED SYSTEMS

Total hours:120

This subject is to provide an overview of microcontrollers. It includes the introduction and architecture of 8051 and Arduino. It also includes assembly language programming and Embedded C with 8051 and Arduino.

MODULE –I

Introduction to Embedded Systems: Embedded systems, Historical background, Difference between Embedded Systems and General Computing Systems, Classification of Embedded Systems based on generation, complexity and performance.

Introduction to 8051: Overview and block diagram of 8051, Architecture of 8051, program counter and memory organization, Data types and directives, PSW, register banks and stack, pin diagram of 8051, Interrupts and timers, addressing modes of 8051, Instruction set of 8051, Arithmetic, Logical, Simple bit, Jump, loop, and call instructions and their usage.

MODULE –II

Assembly Language Programming: Time delay and calculation, Timer/Counter programming, Basics of serial communication, 8051 connections to RS232, 8051 serial port programming in assembly language. Interfacing: LCD interfacing, Keyboard interfacing, ADC, DAC and sensor interfacing

MODULE –III

Introduction to Arduino: Arduino history and development, Arduino board vs microcontroller, Advantages and limitations, Types of Arduino- Arduino UNO, Nano, Mega, Leonardo, Due. Arduino UNO: ATmega328P, Arduino UNO, Overview, Pin Diagram, Board description, Program structure – Elements of programming, Interfacing sensors – LMR, PIR sensor, Motor control – PWM.

MODULE –IV

Embedded C & Arduino programming: Introduction to Embedded C for Arduino, Basics of Embedded C programming – Data types and variables, Operators and Expressions, Control statements, Functions in Embedded C, Arduino libraries and header files, Digital and Analog I/O in Arduino, Interrupts and timers, Communication protocols – UART, I2C, SPI, Memory management and optimization – Flash, SRAM, EEPROM.

MODULE V

Applications of Embedded Systems: General discussion on the design and working of washing machine, refrigerator, microwave oven, automobiles, mobile phones, hearing aid device, electrocardiogram(ECG), AC or TV remote control system, smart watch, digital camera and laser printers.

Reference:

1. “The 8051 Microcontroller & Embedded Systems”, Muhammed Ali Mazidi & Janice
2. Gillispie Mazide.
3. “The 8051 Microcontroller Architecture, Programming & Applications”, by Kenneth J.
4. Ayala, West Publishing Company (St. Paul, New York, Los Angeles, San Francisco)
5. “Arduino Programming: Step-by-Step Guide to Master Arduino Hardware & Software”, second edition, ISBN – 13: 978-1976097713 BY Mark Torvalds.
7. “Arduino Programming From Beginning To Advanced”, by Muhammed Ali Mazidi,
8. Shujen Chen, Eshragh Ghaemi

University Examination Question pattern:

Part A - 6 questions of 10 marks from Module I to Module IV, with a choice to answer any five.
Part B - 12 questions of 5 marks from Module I to Module V, with a choice to answer any ten.

BMI 3P1	MICROCONTROLLER LABORATORY	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	0	0	4	4	2	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI- 3P1 MICROCONTROLLER LABORATORY

Total hours:80

1. Study of a typical 8051 microcontroller trainer kit and its operation.
2. Simple programming examples using 8051 instruction set to understand the use of various instructions and addressing modes.
 - (a) Arithmetic operations / Logical operations.
 - (b) Bit manipulation.
 - (c) Data format conversion.
 - (d) Sorting an array.
 - (e) Finding the largest / smallest elements in an array.
 - (f) Data sequence generation.
 - (g) Interfacing 8051 – stepper motor/ DC motor.
 - (h) Interfacing 8051 – DAC/ADC.
 - (i) LED interfacing and delay programming.
3. Introduction to Arduino entry level board && Arduino IDE && simple programs.
 - (a) LED blinking.
 - (b) LED fade-in and fade-out.
 - (c) LED circling.
 - (d) Blinking of even and odd states of LED.
 - (e) Design a simple transmitter and receiver circuit using an IR LED and a detector, and use it for obstacle detection.
 - (f) Interface a DC motor to Arduino UNO and rotate it clockwise and anti- clockwise.
 - (g) Interface a servo motor to Arduino UNO and rotate it clockwise and anti-clockwise for a given angle.
 - (h) Design an alarm system using an ultrasonic sensor.

- (i) Design a motion sensor alarm using IR LED and detector.
- (j) Design a circuit to control ON/OFF of LED using LDR.
- (k) Control the speed of DC motor using LDR.

References for Laboratory work:

1. Arduino Programming: 3 books in 1 - The Ultimate Beginner, Intermediate, and Expert Guide to Master Arduino Programming, R. Turner
2. Arduino: Getting Started With Arduino and Basic Programming with Projects, E. Leclerc
3. Basic Electronics: A Text Lab Manual, P. B. Zbar, A. P. Malvino, M. A. Miller, 1994, McGraw-Hill
4. Electronic Devices and Circuit Theory, R. L. Boylestad and L. B. Nashelsky, 2009, Pearson
5. Electronics: Fundamentals and Applications, J. D. Ryder, 2004, Prentice Hall.
6. Modern Electronic Instrumentation and Measurement Tech., Helfrick and Cooper, 1990, PHI Learning.

BMI 3P2	BIOMEDICAL INSTRUMENTATION LABORATORY	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	0	0	6	6	3	2025

CIE	TOTAL MARKS
100	100

BMI – 3P2 BIOMEDICAL INSTRUMENTATION LABORATORY

Total hours:120

1. ESU waveform generator
2. Power amplifier for stylus movement
3. Study of medical equipment: -
ECG, PCG, EEG, EMG, Monitor, Spirometer, Sphygmomanometer, Fetal monitor, Plethysmograph, Defibrillator, Oxygenator, Infusion pump, Syringe pump, Analytical equipment such as colorimeter, pH meter, Hb meter.
4. Design and test the bio-potential amplifier for ECG, EEG, or EMG
5. Design and test a notch filter for 50Hz and 60Hz
6. Testing and analysis of the following hardware circuits/simulation
 - i. DC defibrillator
 - ii. Pacemaker
7. Acquisition of ECG: (1) Single lead, (2) three-lead, (3) 12-lead. Analysis of the acquired ECG in the amplitude, time, and frequency domains.
8. Acquisition and analysis (time and frequency) of EEG
9. Earth leakage current circuit

BMI 3P3	RESEARCH ORIENTED PRACTICAL ACTIVITY- I	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	0	1	0	1	1	2025

CIE	TOTAL MARKS
50	50

BMI -3P3 RESEARCH ORIENTED PRACTICAL ACTIVITY- I

Biomedical research and literature review

Total hours: 20

This subject provides practical training in the systematic review and critical analysis of recent biomedical research literature, with emphasis on Biomedical Instrumentation and healthcare technologies. Each student shall select a recent and relevant research problem, technology or biomedical application in consultation with the faculty supervisor and review a **minimum of 15 recent peer-reviewed research papers**, giving priority to the most recent publications.

The work shall include literature search, critical evaluation of existing technologies and methodologies, comparative analysis, identification of limitations and research gaps, and formulation of a potential area for further investigation. The identified research gap shall be discussed with the faculty supervisor.

Each student shall individually prepare and submit a structured literature review report. **An internal assessment of approximately 20 minutes shall include a presentation and viva voce based on the reviewed topic.** Evaluation shall consider the relevance and recency of literature, critical analysis, identification of research gaps, technical understanding, references, and quality of presentation.

BMI 3P4	HOSPITAL/ INDUSTRY TRAINING	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	0	0	1	1	1	2025

CIE	TOTAL MARKS
100	100

BMI- 3P4 HOSPITAL/ INDUSTRY TRAINING

Total Hours: 20

Students shall undergo **one month** of supervised practical training in a hospital or biomedical industry to gain advanced professional exposure to biomedical equipment and instrumentation, including installation, operation, calibration, servicing, troubleshooting, performance evaluation, preventive maintenance and safety inspection. The training shall also provide exposure to equipment management, technical documentation, safety practices and professional responsibilities of biomedical engineers.

Students shall maintain a structured training log and submit a comprehensive training report. **An internal assessment of approximately 30 minutes shall include presentation and viva-voce based on the training experience, log and report.**

BMI 401	BIOSIGNAL PROCESSING	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 401 BIOSIGNAL PROCESSING

Total hours:120

This paper introduces fundamental concepts of signal processing. It gives an overview of various Biological signals and applications of signal processing in them.

MODULE –I

Discrete Time Systems: Signals – Introduction to biomedical signals – nature – examples – ECG, EMG, EEG, PCG – Discrete time signals – Frequency Domain Representation of Discrete Time Systems and Signals – Sampling Theorem – Properties of Discrete Time Signals – stability and causality– Linear Time Invariant systems – convolution. Z-transform – Z transform theorems and properties – Inverse Z-transform – Transfer function.

MODULE –II

The Discrete Fourier Transform: Introduction – Frequency Domain Analysis of discrete-time signals – The Discrete Fourier Series – Properties of the discrete Fourier series – Discrete Fourier Transforms – Properties of Discrete Fourier Transforms – Linear Convolution, Circular Convolution and Block Convolution. Fast Fourier Transform – Decimation in Time and Decimation in Frequency FFT Algorithms –Features.

MODULE –III

Digital Filter Design Techniques: Introduction – Filters – IIR Digital Filter Realizations – Direct, Cascade, Parallel forms. Analog filter approximations – Butterworth Approximation – Design of IIR Digital Filters from Analog filters – Frequency transformation techniques – The method of mapping of impulse transformation and Bilinear transformation.

FIR Digital Filters Realizations – direct, cascade, lattice forms. FIR filter design using Fourier series - use of window functions like rectangular, Hanning, Hamming, Triangular - frequency sampling design. A comparison of IIR and FIR digital filters.

MODULE –IV

Application in Biological Signals: IIR and FIR techniques applied in processing of various signals like ECG, EEG, PCG, Evoked potentials.

Reference:

1. “*Biomedical signal processing*”, D C Reddy, Tata McGraw-Hill, New Delhi, 2005.
2. “*Digital Signal Processing*”, P. Ramesh Babu, Fourth Edition, Scitech Publications (India) Pvt. Ltd., 2007.
3. “*Digital Signal Processing*”, Sanjit K.Mithra, Tata McGraw-Hill, Third Edition.
4. “*Designing digital filters*”, Charles S.Williams, Prentice-Hall India Ltd, 1986.

University Examination Question pattern:

- | |
|--|
| <ol style="list-style-type: none">1. 12 questions of 5 marks from Module I to Module IV, with a choice to answer any ten2. 6 questions of 10 marks from Module I to Module IV, with a choice to answer any five |
|--|

BMI 402	MEDICAL INFORMATICS	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 402 MEDICAL INFORMATICS

Total hours:120

This subject is to provide an overview of informatics. It emphasizes computer-assisted medical decision-making and also highlights recent trends.

MODULE- I

Medical Informatics: Definition, scope and applications of Medical Informatics, Health Informatics and Bioinformatics, Role of computers and information technology in healthcare, Internet and healthcare, Computer-based medical information retrieval, Security and privacy of medical information

Hospital Information Systems: Introduction to Hospital Information Systems (HIS), Clinical and administrative information systems, E-health services.

MODULE -II

Computerized Patient Record: Introduction to Computerized/Electronic Patient Records, Components and functionality of CPR, Computerized history taking and clinical data entry, Computerized prescription systems, Clinical Information Systems, Patient records in diagnostic departments, Intranet and healthcare information sharing. Security and confidentiality of patient information.

MODULE -III

Healthcare Databases: Basics of databases, Types of databases: relational and distributed databases, Database Management Systems (DBMS), Basic database operations, Integrity and security of healthcare databases, Applications of databases in healthcare.

Data Communication and Computer Networks: Basics of data communication, Communication modes, Computer networks, Types of networks, Network topologies, Applications of computer networks in healthcare.

MODULE- IV

Computer Applications in Clinical Laboratory: Computerized clinical laboratory systems, Laboratory Information System (LIS), Intelligent Laboratory Information Systems – introduction.

Computerized Physiological Signal Analysis: Computerized ECG, EEG, EMG, Basic signal acquisition, processing, and analysis

Computer-Assisted Medical Imaging: Computer-assisted medical imaging – basic concepts, Computerized X-ray imaging and CT, Ultrasound imaging, Nuclear medicine imaging: SPECT and PET, Magnetic Resonance Imaging (MRI), Computer applications in radiation therapy and treatment planning.

MODULE- V

Computer-Assisted Medical Decision-Making: Introduction to Computerized Clinical Decision Support Systems (CDSS), Artificial Neural Networks and their medical applications, Computer-assisted diagnosis. **Computer-Assisted Surgery:** Computer-assisted surgery, Surgical simulation, Basic concepts of telesurgery.

Telemedicine and Emerging Technologies: Principles and applications of telemedicine, Virtual reality applications in medicine, Computer-assisted patient and medical education, Assistive computer technologies for persons with disabilities.

Reference :

1. R.D. Lele, “*Computers in medicine: progress in medical informatics*”, Tata McGraw Hill Publishing Company Ltd, 2005, New Delhi.
2. Mohan Bansal, “*Medical informatics*”, Tata McGraw Hill Publishing Company Ltd, 2003, New Delhi.

University examination question pattern:

Part A - 6 questions of 10 marks from Module I to Module VI with a choice to answer any five.
Part B - 12 questions of 5 marks from Module I to Module VI with a choice to answer any ten

BMI 403	AUTOMATION AND QUALITY CONTROL IN BIOMEDICAL ENGINEERING	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 403 AUTOMATION AND QUALITY CONTROL IN BIOMEDICAL ENGINEERING

Total hours:120

This paper is designed to understand the concept of automation and apply the same in the field of medicine. It lays emphasis on specialized robotic systems and critical surgeries performed by them. Also, it attempts to make better understanding of Quality standards and management methodologies in Biomedical Engineering.

MODULE –I

Robotic Surgery: Surgical Robots – Types, Advances and Applications. Technologies involved in Robotic Surgery – Sensors, Actuators, Communication control, Virtual Reality and Artificial Intelligence. Application of Intelligent tools for Robotic systems design, Integration of Electronics and Communication systems with the human nerve network. **Mobile Robotics:** Architecture of Advanced Mobile Robotics, Actuator design, Navigation, Obstacle avoidance, Sensors and Vision systems. Legged Robotic devices, Control of Mobile Robots in semi-structured environments.

MODULE –II

Advanced Robotics: Control, Instrumentation – Navigation – Route planning – Autonomous operation – Haptic interface – Haptic feedback in systems design – System Architecture – Data fusion – System integration, Advances in Micro mechatronics. **Robotic systems:** Robotic Radio surgery system, computer-assisted surgery and Rehabilitation Robotics in Virtual environment.

MODULE –III

Biomedical Applications of Medical Robotics: Nerve cell repair using micro-mechatronics, Micro and Nano devices for targeted delivery of medicines to tumour sites and diagnosis using navigable biosensors, Surgeries performed using robotic systems – Mitral valve Surgery and

minimally invasive surgeries, Surgical procedures in General surgery, Neurology, Urology, Gastroenterology, Cardiology, Orthopedics, pediatrics, and Radio surgery. Characterization of gestures to the design of robots- Design methodologies- Technological choices - Security. Professional and medical ethics; Robo ethics - social and ethical implications

MODULE –IV

Automation in Quality Control: Automated testing systems, computerized calibration, Automated monitoring & alarms, AI-based quality monitoring, preventive maintenance.

MODULE –V

Need for Standardization: Regional, National, International Standardization, Methods for Testing Standardization, Maintenance of Standardization & Recalibration, Food and Drug Administration Regulations.

Reference :

1. *“Advanced Robotics and Intelligent Machines”*, J.O.Roy, Darwin G.Caldwell, D.G.Campbell, Institution of Electrical Engineers, 1996.
2. *“Computer Vision, Virtual Reality and Robotics in Medicine”*, Nicholas Ayache, Springer-Verlag, 1993.
3. *“Robotics Research”*, Raymond A.Jarvis, Alexander Zelinsky, Springer, 2003.
4. *“Sensor-Based Intelligent Robots”*, Gregory D.Hager, H.I.Christensen, Horst Bunke, Rolf Klein, Springer, 2002.
5. *“Primer of Robotic and Telerobotic Surgery”*, Garth H.Ballantyne, Jacques Marescaux, Pier Cristoforo Giulianotti, Williams & Wilkins, 2004.
6. *“Total Quality Management”*, Rose. J.E, Kogan Page Ltd., 1993.
7. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, *“Robot Modeling and Control”*, Wiley Publishers, 2006.
8. Paula Gomes, *“Medical robotics: Minimally Invasive surgery”*, Woodhead, 2012.
9. Mikell and Groover, *Industrial Robotics – Technology, Programming and Applications*, McGraw Hill, 2012.
10. Saeed B. Niku, *Introduction to Robotics. Analysis and control, applications-* Wiley student edition, 2010.

University examination question pattern:

Part A	- 6 questions of 10 marks from Module I to Module V, with a choice to answer any five.
Part B	- 12 questions of 5 marks from Module I to Module V, with a choice to answer any ten.

BMI 404	HOSPITAL MANAGEMENT SCIENCE OR NANOMATERIALS FOR BIOMEDICAL APPLICATIONS (Elective)	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	3	3	0	6	4	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 404 HOSPITAL MANAGEMENT SCIENCE

Total hours:120

This paper provides an overview of planning, purchasing, and maintenance of hospital equipment. It also supports understanding of hospital management and accreditation of hospitals.

MODULE – 1

Hospital Organization and Management: Hospital as an Organization – Types of hospitals – Introduction to Clinical, Supportive, and Ancillary Services. Planning of Bio-Medical Department.

MODULE – II

General Management: Management Concepts. Planning and Decision Making: Steps and need for planning. Organizing: Span of control – delegation and decentralization – line and staff authority. Co-ordination and control: Control process – types of control.

Hospital Information System: Role of information system in decision making at various managerial levels.

MODULE – III

Personnel Management: Manpower planning – Recruitment – Selection – Training and Development – Performance appraisal. Collective Bargaining. Motivation. Industrial Safety: Safety and accident prevention – Accident records. Ergonomics: Work environment Design. Environment-related factors: Fatigue, lighting, ventilation, Temperature, noise, vibration.

MODULE – IV

Purchase Management: Importance - Purchase function – sources of purchase – purchase procedure – Tender procedures. Store: Storekeeping. Inventory control methods – ABC – VED Analysis– Advantages. Managerial Economics: Cost control – Break-even analysis. Financial Management in hospitals – budgetary control – depreciation.

MODULE – V

Marketing Management: Objectives and functions of marketing management – Market planning – Sales promotion – Advertising – Market Research – Sales forecasting.

MODULE – VI

Total Quality Management: Quality Control Methods-Quality Circles-Hospital Infection Control-Medical, Clinical and Nursing Audits-Kaizen-JIT-Statistical quality control-Six sigma-Cost and Effect diagram-Pareto analysis. Accreditation: ISO-NABH-JCI

Reference

1. Kunders, G.D(2004)-Facilities Planning and Arrangement in Healthcare, Prism Books Pvt Ltd, Bangalore.
2. T.R.Banga, S.C Sharma & N.K. Agarwal: Industrial Engineering and Management Science, Khanna Publishers, Delhi 110006
3. Tripathi P.C and Reddy P.N: Principles of Management.
4. England W.B.& Leenders M.R. Purchasing& Materials Management Tarapore Vala & Sons.
5. S.K.Joshi-Quality Management in Hospitals, Jaypee Brothers.
6. Rose J.E.: Total Quality Management, Kogan Page Ltd,1993.
7. Kunders, G.D(2002)-Designing for Total Quality in Healthcare, Prism Books Pvt Ltd, Bangalore.
8. Kotler, Philip: Marketing Management-Analysis, Planning, Implementation and Control.

University examination question pattern:

Part A - 6 questions of 20 marks from Module I to Module VI, with a choice to answer any four. Part B - 6 questions of 5 marks from Module I to Module VI, with a choice to answer any four
--

CE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 404 NANOMATERIALS FOR BIOMEDICAL APPLICATIONS

Total hours:120

This paper provides students with fundamental knowledge and a practical understanding of nanomaterials and their applications in biomedical engineering, focusing on diagnostics, therapeutics, implants, and hospital/industrial healthcare solutions.

MODULE I

Introduction to Nanomaterials: Introduction to nanotechnology and nanomaterials; Classification of nanomaterials based on dimensions and dimensionality of nanomaterials; Size, shape, and surface area-to-volume ratio; Basic properties of nanomaterials: Optical, electrical, magnetic, mechanical, and thermal properties; Size-dependent properties; Types of nanomaterials: Nanoparticles, Nanotubes, Nanowires, Nanofibers, Nanocomposites; Biomedical importance of nanomaterials.

MODULE II

Synthesis of Nanomaterials: Principles of nanomaterial synthesis; top-down and bottom-up approaches; physical and chemical methods of synthesis; sol-gel method; chemical reduction method; green synthesis of nanomaterials; Factors affecting nanoparticle synthesis: pH, temperature, concentration, and reaction time.

Characterization of Nanomaterials: Importance of characterization of nanomaterials; UV-Visible spectroscopy; Fourier Transform Infrared Spectroscopy (FTIR); X-ray Diffraction (XRD); Scanning Electron Microscopy (SEM); Transmission Electron Microscopy (TEM); Dynamic Light Scattering (DLS); Zeta potential analysis; Particle size, morphology, and surface characteristics.

MODULE III

Biomedical Applications:

Diagnostics & Imaging: Nanomaterials in biosensors and medical diagnosis; Cancer detection and medical imaging; Nanoparticles as contrast agents; Applications in early disease detection.

Therapeutics & Drug Delivery: Nanomaterials in drug delivery; Nanoparticles in cancer therapy; Antimicrobial applications of nanomaterials.

Implants & Regenerative Medicine: Nanomaterials in biomedical implants; regenerative medicine; Bone and dental applications; Nanomaterials in wound healing.

Hospital Equipment Applications: Nanomaterials in biomedical devices- applications in wearable and implantable biomedical devices; Nanomaterials for infection control.

MODULE IV

Safety and emerging trends

Safety & Regulatory Aspects: Safety protocols for handling nanomaterials in laboratories and hospitals; biocompatibility evaluation; Regulatory guidelines for nanomaterials.

Emerging Trends: Theranostics: combined diagnosis and therapy; Nanorobotics in medicine; advanced nano-biosensors.

Reference:

1. Santra, T. S. and Mohan, L. (Eds.), *Nanomaterials and Their Biomedical Applications*, Springer, 2021.
2. Liu, H. H., Shokuhfar, T. and Ghosh, S. (Eds.), *Nanotechnology in Medicine and Biology*, Elsevier, 2021.
3. Sarkar, B. and Sonawane, A. (Eds.), *Biological Applications of Nanoparticles*, Springer, 2023.
4. Javed, R., Chen, J.-T. and Khalil, A. T. (Eds.), *Nanomaterials for Biomedical and Bioengineering Applications*, Springer, 2024.
5. Thakur, A., Thakur, P. and Khurana, S. M. P. (Eds.), *Synthesis and Applications of Nanoparticles*, Springer, 2022.

University examination question pattern

Part A - 6 questions of 10 marks from Module I to Module IV with a choice to answer any five.
Part B - 12 questions of 5 marks from Module I to Module IV with a choice to answer any ten

BMI 4P1	VIVA – VOCE	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	0	3	0	3	1	2025

CIE	ESE	TOTAL MARKS	ESE Duration
50	100	150	3 hours

BMI 4P1 VIVA – VOCE

Total hours: 60

A comprehensive University Viva-Voce examination covering the theoretical, practical, research-oriented and project components of the M.Sc. Biomedical Instrumentation programme shall be conducted. Students shall produce their hospital/industry training reports, research-oriented practical activity reports, and project report, duly certified by the institutional authorities, before the examiners.

The Viva-Voce shall assess the candidate's conceptual understanding, practical competence, technical knowledge, analytical and problem-solving abilities, research aptitude, and application of biomedical instrumentation principles to clinical and professional contexts. The assessment shall also include the candidate's understanding of biomedical equipment, professional practices, research activities, and project development in the field of Biomedical Instrumentation.

BMI 4P2	RESEARCH ORIENTED PRACTICAL ACTIVITY - II	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	0	0	3	3	1	2025

CIE	TOTAL MARKS
100	100

BMI 4P2 RESEARCH ORIENTED PRACTICAL ACTIVITY - II

Biomedical device design and development proposal

Total hours:60

This subject provides practical training in the formulation of a research and development proposal for an innovative biomedical device or instrumentation system based on a research gap, technological challenge, or healthcare need identified through the previous semester's literature review.

Each student shall continue the selected research area under faculty supervision. The work shall include problem definition, objectives and design specifications, system conceptualization, selection of suitable technologies and components, methodology development, feasibility analysis, and planning of testing and performance evaluation.

Each student shall prepare and submit a structured research and development proposal. **An internal assessment of approximately 30 minutes shall include a presentation and viva voce.** Evaluation shall consider problem relevance, innovation, technical merit, feasibility, biomedical significance, expected performance, and presentation. **The candidate shall proceed with the project work only after approval of the proposal by the competent authority.**

BMI 4P3	PROJECT WORK	CATEGORY	L	T	P	HOURS /WEEK	CREDIT	YEAR OF INTRODUCTION
		M.Sc.	0	0	6	6	4	2025

CIE	TOTAL MARKS
150	150

BMI 4P3 PROJECT WORK

Total hours:120

The project shall involve a research-oriented and innovation-driven design, development, and validation of a biomedical device or instrumentation system addressing an identified healthcare need. The work shall include problem definition, system design, component integration, development, testing, and performance evaluation under faculty supervision.

The project may be carried out in the Biomedical Instrumentation Department, hospital, research institution, or biomedical industry, either individually or as a group. Each student shall be assessed individually based on technical knowledge, understanding, and contribution. Each student shall submit a project report.

The project work shall be carried out over a period of **15 days** under faculty supervision. **An internal examination of approximately 45 minutes shall include project presentation, system demonstration, and viva-voce.** Evaluation shall consider innovation, technical merit, functionality, performance, biomedical relevance, and individual contribution.

MODEL QUESTION PAPERS
M.SC (BIOMEDICAL INSTRUMENTATION)

M.Sc (Biomedical Instrumentation) FIRST SEMESTER
Model Question Paper - ENGINEERING MATHEMATICS [BMI-101]

Time: 3 Hrs

Max marks : 100

Answer any ten questions (10× 10 = 100marks)

1. (a) Find the Laplace transform of $t^2 e^{at} \sin 3t$ (5)

(b) Find the inverse Laplace transform of $\log(s+1/s-1)$ (5)

2. (a) Solve the differential equation

$$d^2y/dx^2 - 4dy/dx + 8y = 0, \text{ given } y(0)=0, dy/dx \text{ at } x=0=-2 \quad (6)$$

(b) Find the Laplace form of the unit step function (4)

3. (a) Find the Laplace transform of the square wave with period a defined by

$$f(t) = \begin{cases} 1 & \text{for } 0 < t < a/2 \\ -1 & \text{for } a/2 < t < a \end{cases} \quad (6)$$

(b) Show that $\Gamma_{1/2} = \sqrt{\pi}$ (4)

4. Find the Fourier series of $f(x) = x^2, -\pi \leq x \leq \pi$ (10)

5. Find the Fourier transform of (10)

$$f(x) = \begin{cases} 1 & \text{for } |x| \leq 1 \\ 0 & \text{for } |x| > 1 \end{cases} \text{ and hence evaluate } \int_0^\infty \frac{1 - \cos \pi \lambda}{\lambda} \sin x \lambda d\lambda$$

6. (a) Derive the Poisson distribution as the limiting form of the binomial distribution (5)

(b) If X is normally distributed with mean 12 and SD 4, determine $P(X \geq 20)$ (5)

7. (a) Fit a binomial distribution to the following data (10)

x:	0	1	2	3	4
f:	30	62	46	10	2

Also find the theoretical frequencies.

8. A set of fine similar coins is tossed 320 times, and the result is (10)

Number of heads: 0 1 2 3 4 5

Frequency: 6 27 72 112 71 32

Test the hypothesis that the data follow a binomial distribution. Given the degrees of freedom $\nu=5$,

$$\chi^2_{0.05}=11.07$$

9. Using the graphical method, solve the LPP (10)

Maximize $Z=5x_1+7x_2$

Subject to $x_1+x_2 \leq 4$

$5x_1+8x_2 \leq 24$

$10x_1+7x_2 \leq 35$

$x_1, x_2 \geq 0$

10. Using the simplex method to solve the LPP (10)

Maximize $Z= 5x_1+3x_2$

Subject to $x_1+x_2 \leq 2$

$5x_1+2x_2 \leq 10$

$3x_1+8x_2 \leq 12$

$x_1, x_2 \geq 0$

11. Solve the transportation problem (10)

		Destination				Availability
		A	B	C	D	
Source	1	2	3	11	7	6
	2	1	0	6	1	2
	3	5	8	15	9	10
Requirements		7	5	3	2	

12. (a) Write the dual of the problem

$$\text{Max: } Z=3x_1+16x_2+7x_3$$

$$\text{Subject to } x_1-x_2+x_3 \geq 3$$

$$-3x_1+2x_3 \leq 1$$

$$2x_1+x_2-x_3=4$$

$$x_1, x_2, x_3 \geq 0$$

(5)

(b) Find the Fourier sine integral of

$$f(x) = \begin{cases} 1 & \text{for } 0 \leq x \leq \pi \\ 0 & \text{for } x > \pi \end{cases} \quad (5)$$

M.Sc (Biomedical Instrumentation) FIRST SEMESTER

**Model Question Paper -INTRODUCTION TO ANATOMY, PHYSIOLOGY AND
BIOMEDICAL INSTRUMENTATION [BMI-102]**

Answer Part A, Part B, and Part C in separate answer books

Time:3 Hours

Maximum:100 Marks

PART A

INTRODUCTION TO ANATOMY

Answer any five questions; each question carries 5 marks (5× 5 = 25marks)

1. Describe the structure of the kidney and urinary bladder.
2. Discuss the main parts of the digestive system with special emphasis on the stomach.
3. Describe the structure of male and female reproductive organs
4. Write briefly on the respiratory system
5. Write briefly on the structure of the liver under the following headings
 - a. Lobes
 - b. Ligaments
 - c. Structure
6. Describe the structure of the heart.

PART B

INTRODUCTION TO PHYSIOLOGY

Answer any five questions; each question carries 5 marks (5× 5 = 25marks)

1. Define Nephron? Explain the physiology of Urine formation.
2. Write the composition of blood. Explain the functions of each blood cell (RBC, WBC, Platelets).
3. Name the hormones produced by the pituitary gland. Discuss the functions of each
4. What is Hypoxia? Explain the different types of hypoxia.
5. Explain the functions of the hypothalamus
6. Ovarian hormones.

PART C
INTRODUCTION TO BIOMEDICAL INSTRUMENTATION

Part I

*(Answer any three questions; each question carries 10 marks) (3*10=30marks)*

1. With neat diagrams, explain the phases of an action potential and describe the refractory periods in detail.
2. Draw and explain the typical ECG waveform. Discuss the clinical significance.
3. Describe the electrode–tissue interface and explain different types of electrodes used for ECG, EEG, and EMG measurements.
4. Explain the principle and working of an instrumentation amplifier.

Part II

*(Answer any four questions; each question carries 5 marks) (4*5=20 marks)*

1. Define resting membrane potential and state its physiological importance.
2. Differentiate between the absolute refractory period and the relative refractory period.
3. What are EEG waveforms? Mention their clinical applications.
4. Write a short note on dry electrodes.
5. What is the role of a digital storage oscilloscope (DSO) in biomedical instrumentation?

M.Sc (Biomedical Instrumentation) FIRST SEMESTER

Model Question Paper -ELECTRICAL TECHNOLOGY [BMI-103]

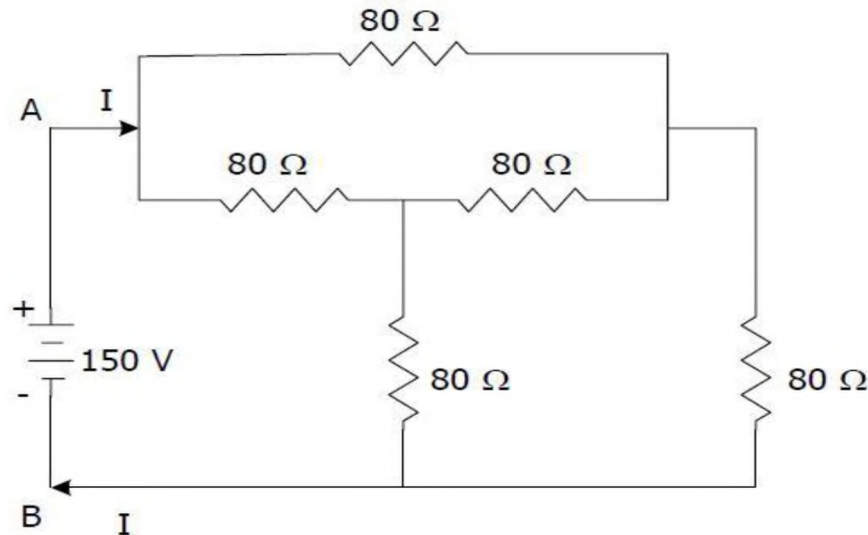
Time: 3 Hours

Maximum: 100 Marks

Part A

(10 marks each) Answer any Five Questions ($5 \times 10 = 50$ marks)

- 1 (a) “In parallel combination, the equivalent resistance is less than the least among the resistors”. Justify the statement with an example.
2. In Fig. 150 volts are applied to the terminal AB. Determine
 - i) The resistance between the terminals A and B
 - ii) The current I



3. (a) State advantages of a balanced load in a three-phase system.
(b) For a balanced three phase, three wire system with star connected load, for which the line voltage is 230V and the per-phase resistance and reactance are 6 ohms and 8 ohms, respectively. Calculate the line current and power absorbed by each phase.
4. An alternating current of frequency 50 Hz has a maximum value of 100 A. Calculate:
 - i) The instantaneous value after $1/360$ second and
 - ii) The time taken to reach 80 A for the first time
5. (a) A coil takes a current of 6 A when connected to a 24 V d.c. supply. To obtain the same current with a 50 Hz a.c. supply, the voltage required was 30 V. Calculate:
 - i) The inductance of the coil and

- ii) The power factor of the coil
- (b) Define voltage regulation and efficiency of a single-phase transformer.
- 6. Draw a phasor diagram for an R-C series circuit. Write the voltage and current equations for it.

Part B (5 marks each) Answer any ten (5× 10 = 50 marks)

1. State Kirchhoff's Current Law.
2. State the difference between EMF and Potential Difference.
3. Give the classification of Fuses.
4. State any one application of a universal motor.
5. Define the following related to A.C.
 - i) Frequency ii) Cycle
6. Define the following terms.
 - i) Active Power
 - ii) Reactive Power
7. State Faraday's laws of electromagnetic induction.
8. Distinguish between statically induced EMF and dynamically induced EMF.
9. Give the expression for star-to-delta conversion of resistances.
10. State two advantages of three-phase circuits over single-phase circuits.
11. Draw A.C. waveforms showing the following:
 - i. Phase difference
 - ii. In phase
12. State and explain Thevenin's theorem.

M.Sc (Biomedical Instrumentation) FIRST SEMESTER

Model Question Paper-ELECTRONIC DEVICES AND CIRCUITS [BMI-104]

Time: 3 Hours

Maximum: 100 Marks

Part A (Answer any 5 of the following) (5×10=50 Marks)

1. Explain the characteristics of TRIAC. Compare TRIAC with SCR.
2. Explain, with diagrams, the working of colpitts oscillator. Derive an expression for its frequency of oscillation.
3. Explain the three main transistor configurations and compare their performances.
4. Explain, with circuit diagram the principles of operation of a push-pull amplifier. What are its advantages?
5. Explain, with a circuit diagram, the working of a Wien-bridge oscillator.
6. Explain, with diagrams, the principle of operation, characteristics, and applications of a MOSFET.

Part B (Answer any 10 of the following) (10×5=50 Marks)

1. Explain thermal runaway?
2. State and explain Barkhausen criteria?
3. Explain the principle of a thermistor?
4. What is meant by clamping? Draw a clamping circuit to clamp a sinusoidal signal of 10V_{pp} to -2V level?
5. Explain the need for biasing. Compare various biasing circuits.
6. Write a note on multivibrators.
7. What are the characteristics of a Darlington pair?
8. What are the effects of negative feedback?
9. Explain the principle of crystal oscillators.
10. Explain the working of a Zener diode as a voltage regulator.
11. Write a note on a class AB amplifier.
12. Explain differentiating circuits?

M.Sc (Biomedical Instrumentation) SECOND SEMESTER

Model Question Paper-BIOMEDICAL EQUIPMENTS-I [BMI-201]

Time: 3 Hours

Maximum: 100 Marks

Part A (Answer any 5 of the following) (5×10=50 Marks)

1. Explain the classification of biomedical equipment.
2. Describe the principle and biomedical applications of a UV-Vis spectrophotometer.
3. With a neat diagram, explain the block diagram of an ECG machine.
4. Explain the working principle of a multiparameter patient monitoring system used in ICUs.
5. Describe the types of Audiometers and their clinical applications.
6. Discuss the principle of fiber optic imaging and applications in biomedical diagnostics.

Part B (Answer any 10 of the following) (10×5=50 Marks)

1. Explain ENG.
2. Write short notes on blood gas analyzers.
3. What are the common artifacts in ECG recording?
4. Differentiate between Holter monitoring and Bedside monitoring.
5. Explain an infusion pump.
6. Explain the Beer–Lambert law.
7. What is a Holter monitor? Mention its applications.
8. Define Electromyography (EMG) and list its diagnostic uses.
9. Write short notes on Autoclave.
10. What are Neonatal incubators?
11. Differentiate between Analog and Digital hearing aids.
12. What is meant by evoked potential?.

M.Sc (Biomedical Instrumentation) SECOND SEMESTER

Model Question Paper-DIGITAL ELECTRONICS AND INTEGRATED CIRCUITS [BMI-202]

Time: 3 Hours

Maximum: 100 Marks

Part A (Answer any 5 of the following) (5×10=50 Marks)

1. With diagrams, explain the working of a three-input TTL NAND gate.
2. Show how a 555 timer can be used as a monostable multivibrator.
3. Design a 4-bit binary-to-gray converter.
4. Minimize the following function using a K-map:-
$$f(A, B, C, D) = \sum m(1, 2, 5, 7, 11, 13, 15) + \sum d(0, 4, 8, 12)$$
 Realize the function using logic gates.
5. Draw the circuit diagram of an op-amp integrator. Derive the equation for the output voltage. Discuss the frequency response of the integrator.
6. Write a short note about MUX and De-MUX.

Part B (Answer any 10 of the following) (10×5=50 Marks)

1. Convert the following
 - (i) $470E_B$ to BCD.
 - (ii) 34621_8 to excess-3 code.
2. State and explain De Morgan's theorem with an example.
3. Explain the Johnson counter.
4. List the ideal parameters of op-amps.
5. What is meant by the race-around condition? Explain how it can be avoided.
6. Realize the following gates using NAND gates:
(i) NOR (ii) OR (iii) EX-OR (iv) EX-NOR
7. Define synchronous and asynchronous counters. What are the advantages of synchronous counters?
8. Draw the basic block diagram of an op-amp.
9. Explain the parameters of a PLL?
10. Explain the operation of a Schmitt trigger?
11. Explain the concept of a VCO, mention its applications.
12. With an internal diagram explain the function of IC 723?

M.Sc (Biomedical Instrumentation) SECOND SEMESTER

Model Question Paper-PYTHON PROGRAMMING [BMI-203]

Time: 3 Hours

Maximum: 100 Marks

Answer any five, each carrying 10 marks

1. What are the key features of Python?
2. Explain data types in python?
3. Explain functions in Python?
4. Explain control structures in Python.
5. What are the basic list operations that can be performed in Python?
Explain each operation with its syntax and example.
6. What is a dictionary? Explain Python dictionaries in detail, discussing their operations and methods?

Answer any ten, each carrying 5 marks

1. What is the difference between tuples and lists in Python?
2. What is the Python continue statement?
3. Mention five benefits of using Python?
4. Briefly explain function prototypes?
5. Explain the purpose of loop structure in a programming language?
6. Explain how to create a dictionary in Python?
7. What is the difference between tuples and lists in Python?
8. Explain the values and items methods used in a dictionary with an example.
9. What are the built-in functions that are used in tuples?
10. How to open a new file in Python?
11. What are tuples in Python?
12. What are the advantages of a tuple over a list?

M.Sc (Biomedical Instrumentation) SECOND SEMESTER

**Model Question Paper-BIOPHOTONICS AND NON-RADIATING MEDICAL IMAGING
TECHNIQUES [BMI-204]**

Time: 3 Hours

Maximum: 100 Marks

Section A (Answer any 5 questions)(5×10=50 Marks)

1. With a neat diagram, explain the working of any one type of laser.
2. What are the applications of lasers in endoscopy?
3. Explain the holographic applications in medicine.
4. Explain how diagnosis can be done on different body parts using ultrasonics?
5. Describe the working of an ultrasound pulse echo imaging system.
6. Explain, with a neat diagram, the principle of magnetic resonance imaging?

Section B (Answer any 10 questions) (10×5=50 Marks)

1. What are the safety measures for using lasers?
2. Explain the properties of laser radiation briefly?
3. Write a short note on lasing medium.
4. Explain the basic principle of a holographic computer?
5. Write a note on motion-induced contrast?
6. Compare the performance of A-scan and B-scan.
7. Describe the design of scan converters.
8. What is Fourier optics?
9. Discuss the interactions of ultrasound with body matter.
10. Explain image acquisition in MRI?
11. Compare the spin echo technique and gradient echo technique used in MRI.
12. Explain semiconductor lasers?

M.Sc (Biomedical Instrumentation) THIRD SEMESTER

Model Question Paper-BIOMEDICAL EQUIPMENTS –II [BMI 301]

Time: 3 Hours

Maximum: 100 Marks

Part A (Answer any 5 of the following) (5×10=50 Marks)

1. Explain the classification of cardiac Defibrillators.
2. Explain the principle and operation of a ventilator.
3. Describe Hemodialysis and peritoneal dialysis. Compare their clinical applications.
4. Explain the principles of ESWL and applications in medicine
5. Discuss the working of an Anesthesia machine.
6. Describe modern electrical safety measures and explain hospital electrical safety standards.

Part B (Answer any 10 of the following) (10×5=50 Marks)

1. Differentiate between synchronous and asynchronous pacemakers.
2. Write short notes on Automated External Defibrillators (AED).
3. What is ECMO? Mention its applications.
4. Define pulse oximetry.
5. Write short notes on artificial heart.
6. Mention two types of Diathermy and their applications.
7. What is IABP?
8. Define surgical aspirator and its role in OT.
9. Write a short note on C-Arm imaging systems.
10. Explain anesthesia gas delivery systems.
11. Differentiate between Microshock and Macroshock.
12. Write short notes on ground-fault circuit interrupter (GFCI) used in hospital electrical safety.

M.Sc (Biomedical Instrumentation) THIRD SEMESTER

Model Question Paper-MEDICAL IMAGING SYSTEMS USING IONIZING RADIATIONS

[BMI-302]

Time: 3 Hours

Maximum: 100 Marks

Section A (Answer any 5 questions) (5×10=50 Marks)

1. With the help of a neat sketch, explain a rotating anode X-ray tube.
2. Explain the working principle of an X-ray image intensifier system.
3. Describe the principle and working of the digital subtraction angiographic technique.
4. Briefly explain the blocks of a CT scanner.
5. With the help of a diagram, explain the working of a gamma camera.
6. With necessary diagrams, explain how a Betatron works?

Section B (Answer any 10 questions) (10×5=50 Marks)

1. Describe dental radiography.
2. What is a collimator? Compare its performance with a grid.
3. What are the advantages of radiography?
4. Explain the Cath lab?
5. What is radiation safety? Explain the precautions to be taken while giving radiation treatment to a patient.
6. Explain the PET Scanner?
7. List various radioisotopes used for medical applications? Explain about anyone.
8. What is multisliced scanning in CT?
9. Write a note on charge-coupled devices.
10. What do you mean by a cyclotron?
11. Explain an image-intensifying TV for fluoroscopy.
12. Explain how automatic treatment planning is employed?

M.Sc (Biomedical Instrumentation) THIRD SEMESTER

Model Question Paper- BIOSENSORS AND MEDICAL IMAGE PROCESSING-[BMI 303]

Time: 3 Hours

Maximum: 100 Marks

Section A (Answer any 5 questions) (5×10=50 Marks)

1. Explain the classification of sensory receptors in humans. Discuss the role of rods and cones in vision.
2. Describe the working principle of Pressure transducers, and explain biomedical applications
3. With suitable examples, explain enzyme-based biosensors.
4. Describe the applications of BioMEMS in diagnostics.
5. Explain various Image Enhancement techniques.
6. Discuss Image Segmentation.

Section B (Answer any 10 questions) (10×5=50 Marks)

1. Define mechanoreceptors and give two examples.
2. What are osmoreceptors? Mention their physiological importance.
3. Explain force and displacement transducers.
4. Write short notes on thermistors and their applications in biomedicine.
5. What are baroreceptors?
6. Explain materials used in BioMEMS.
7. Define signal conditioning.
8. Explain BioMEMS in lab-on-chip systems.
9. What are microneedles? Give one biomedical use.
10. Write short notes on DICOM standards.
11. What is image compression? State its importance in medical imaging.
12. Explain a fiber-optic biosensor.

M.Sc (Biomedical Instrumentation) THIRD SEMESTER

Model Question Paper- 8051 AND ARDUINO-BASED EMBEDDED SYSTEMS [BMI 304]

Time: 3 Hours

Maximum: 100 Marks

PART A

(Answer any five questions. Each question carries 10 marks).

1. Draw and explain the block diagram of 8051.
2. Explain the different modes of addressing used in 8051 with examples.
3. Describe the serial port programming of the 8051 microcontroller. How is RS232 interfaced with the 8051?
4. Explain the program elements in Arduino with suitable examples.
5. Explain serial communication in Arduino using the UART protocol.
6. Explain the working of an embedded system-based ECG device. Describe the signal acquisition, signal processing and display/recording stages with a suitable block diagram. (5 x 10 = 50)

PART B

(Answer any ten questions. Each question carries 5 marks).

1. Explain small-scale, medium-scale, and sophisticated/large-scale embedded systems with suitable examples.
2. Describe LCD interfacing in 8051.
3. Write an 8051 assembly language program for time delay and calculation.
4. Describe the concept of stack memory in 8051.
5. Explain the interrupt system in the 8051 microcontroller with priority levels.
6. Describe the ADC interfacing with the 8051 microcontroller and write a simple program.
7. Explain how the Arduino system can be used in a typical motor control application.
8. Explain the different data types and variables used in Arduino.
9. Write an Arduino program to blink an LED connected to pin 13 with a delay of 1 second.
10. Explain the interfacing of a PIR sensor with Arduino to detect motion.
11. Explain how control statements (if, else, for, while) are used in Embedded C for Arduino?
12. Explain memory management in Arduino programming? (10 x 5 = 50)

M.Sc (Biomedical Instrumentation) FOURTH SEMESTER

Model Question Paper- BIO-SIGNAL PROCESSING [BMI-401]

Time: 3 Hours

Maximum: 100 Marks

PART A

Answer any 10 questions (10×5=50 marks)

1. What is a causal system? Give an example
2. What is an LTI system?
3. State the sampling theorem. What is the aliasing effect?
4. Compute the linear convolution of

$$x(n) = \left\{ \begin{matrix} 1, 0, 2, 3, 4 \\ \uparrow \end{matrix} \right\}; h(n) = \left\{ \begin{matrix} 1, -1, 1, -1 \\ \uparrow \end{matrix} \right\}$$

5. Explain impulse response and convolution sum?
6. Define the Z-transform and region of convergence.
7. Find the DFT of a sequence

$$x(n) = \left\{ \begin{matrix} 1, 1, 0, 0 \\ \end{matrix} \right\}$$

8. Find the circular convolution of

$$x_1(n) = \left\{ \begin{matrix} 1, -1, -2, 3, -1 \\ \end{matrix} \right\}; x_2(n) = \left\{ \begin{matrix} 1, 2, 3 \\ \end{matrix} \right\}$$

9. List the differences and similarities between DIT & DIF algorithms.
10. What are the advantages of digital filters over analog filters?
11. What is meant by quantization error?
12. Draw the characteristics of an ECG signal and define its parameters.

PART B

Answer any 5 questions (5×10=50 marks)

1. Find the Z transform $x(n) = r^n \cos(n\theta) u(n)$.
2. State and prove any four properties of DFT.
3. Find the DFT of a sequence $x(n) = 1, 2, 3, 4, 4, 3, 2, 1$ using DIT FFT algorithm

4. Obtain the direct form II and cascade realization for the system

$$y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2)$$

5. With a block diagram, explain an EEG signal processing system
6. Design an ideal high-pass filter with a frequency response

$$H_d(e^{j\omega}) = 1 \text{ for } \pi/4 \leq |\omega| \leq \pi$$

$$= 0 \text{ for } |\omega| \leq \pi/4$$

using a Hamming window of length $N=11$

M.Sc (Biomedical Instrumentation) FOURTH SEMESTER

Model Question Paper-MEDICAL INFORMATICS [BMI-402]

Time: 3 Hours

Maximum: 100 Marks

Section A

Answer any 5 Questions; each question carries 10 marks. (5× 10 = 50marks)

1. Explain clinical and administrative information systems.
2. Explain the components and functionalities of CPR.
3. Explain computer-assisted medical imaging.
4. Explain the applications of Artificial Neural Networks.
5. Explain computer-assisted patient education.
6. Explain DBMS.

Section B

Answer any 10 questions; each question carries 5 marks. (10× 5 = 50marks)

1. Write short notes on computer-based medical information retrieval.
2. Explain E- health services.
3. What is an intranet?
4. Write a short note on virtual reality applications in medicine.
5. Explain security and confidentiality of patient information.
6. Write a short note on Nuclear Magnetic Resonance.
7. Explain the laboratory information system.
8. Explain the application of databases in healthcare.
9. Write a short note on surgical simulation.
10. Briefly explain a relational database.
11. Write a short note on computerized ECG.
12. Explain different network topologies.

M.Sc (Biomedical Instrumentation) FOURTH SEMESTER

**Model Question Paper- AUTOMATION AND QUALITY CONTROL IN BIOMEDICAL
ENGINEERING [BMI-403]**

Time: 3 Hours

Maximum: 100 Marks

Part A

(Answer any five) 10 marks each (5×10=50 Marks)

1. Explain the different technologies involved in robotic surgery.
2. Explain the architecture of a robotic radio surgery system.
3. Explain the procedure of nerve cell repair using micro-mechatronics.
4. Explain how pediatric surgery is performed using robotic systems.
5. Explain automated testing systems and computerized calibration.
6. Explain different methods used for testing standardization.

Part B (Answer any ten), 5 marks each (10 ×5=50 Marks)

1. Write short notes on virtual reality and artificial intelligence.
2. What are the applications of intelligent tools in robotics system design?
3. What is the use of actuators in mobile robotics?
4. Briefly explain autonomous operation of advanced robotics.
5. What is a haptic interface? Explain its importance.
6. Briefly explain surgical procedures in general robotic surgery.
7. Write a short note on computer-assisted surgery.
8. Explain the use of navigable biosensors.
9. Explain automated monitoring and alarms.
10. Write a short note on AI-based quality monitoring.
11. What is the need for standardization in biomedical engineering?
12. Write short notes on food and drug administration regulations.

M.Sc (Biomedical Instrumentation) FOURTH SEMESTER

Model Question Paper-HOSPITAL MANAGEMENT SCIENCE [BMI-404]

(Elective)

Time: 3hrs

Maximum: 100 Marks

Part A

(Answer Any Four) (20x4=80Marks)

1. Write notes on Clinical, supporting, and Ancillary services of a Hospital.
2. What are the functions of Management? Explain each of them with respect to the Management of a Hospital.
3. Explain the objectives of Training. Give various types of Training.
4. What is meant by Break-Even Point? Explain 'Margin of Safety' and 'Contribution' in connection with BEA.
5. What are the objectives of Marketing Management? How can they be achieved?
6. Total Quality Management is a never-ending process. Explain with reference to Healthcare.

Part B

(Answer Any Four) (4x5=20Marks)

1. Manpower Planning
2. Span of Control
3. Motivation
4. Storekeeping
5. Market Research
6. Quality Circles

M.Sc (Biomedical Instrumentation) FOURTH SEMESTER

**Model Question Paper -NANOMATERIALS FOR BIOMEDICAL APPLICATIONS [BMI 404]
(Elective)**

Time: 3 Hours

Maximum: 100 Marks

Part A

(Answer any five questions; each question carries 10 marks) (5*10=50 marks)

1. Explain the differences between top-down and bottom-up approaches for nanoparticle synthesis with examples.
2. Describe the unique properties of nanomaterials at the nanoscale.
3. Compare and explain at least three characterization techniques used for nanomaterials.
4. Discuss factors affecting nanoparticle synthesis.
5. Explain how nanomaterials are utilized in hospital biomedical equipment.
6. Discuss the regulatory and safety considerations of using nanomaterials in biomedical applications.

Part B

(Answer any ten questions; each question carries 5 marks) (10*5=50 marks)

1. Define Nanocomposites.
2. Explain scanning electron microscopy.
3. What is zeta potential?
4. Describe the role of FTIR in characterizing nanomaterials.
5. Explain the importance of biocompatibility testing for biomedical nanomaterials.
6. Give an example of a nanoparticle used in cancer imaging and describe its working principle.
7. Give any five types of nanomaterials.
8. Describe Antimicrobial applications of nanomaterials.
9. Define Nanomaterials in wound healing.
10. Explain nanoparticles as contrast agents.
11. Explain Hospital safety protocols when handling nanomaterials.
12. Explain Nanorobotics.