HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

Coimbatore–641032

DEPARTMENT OF BIOMEDICAL ENGINEERING

CURRICULUM
&SYLLABUS
2023-2024

VISION AND MISSION OF THE INSTITUTION

VISION

To become a premier institution by producing professionals with strong technical knowledge, innovative research skills and high ethical values.

MISSION

IM1: To provide academic excellence in technical education through novelteaching methods.
IM2: To empower students with creative skills and leadership qualities.IM3: To produce dedicated professionals with social responsibility.

VISION AND MISSION OF THE DEPARTMENT
VISION

To evolve into a center of excellence in biomedical engineering by nurturing and training interested minds in this diverse technology, thereby striving towards ensuring quality healthcare to the society.

MISSION

M1: To establish the best learning environment that helps the students to face the challenges of Biomedical Engineering field

M2: To inspire the students to drive the next generation innovation to come up with quality solutions to current healthcare needs.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO 1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

I

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

PO 6. **The engineer and society**: Apply reasoning informed by the contextualknowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmentalcontexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports anddesign documentation, make effective presentations, and give and receive clear instructions.

PO11.**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12**. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

PROGRAM SPECIFIC OUTCOMES (PSOs)

Biomedical Engineering Graduates will have ability to:

PSO1: Design and develop biomedical devices to meet the needs of people by applying the Fundamentals of Biomedical Engineering.

PSO2. Understand and implement various software skills for accurate diagnostic and Therapeutic applications.

PSO3. Innovate new ideas and solutions for the healthcare field by integrating various Biomedical Technology.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1. To create a strong foundation in engineering and biology for solving the existing Challenges in the healthcare sector.

PEO2. To acquire knowledge in the cutting edge technologies of Biomedical Engineering field and an ability to identify, analyze and solve problems in the field.

PEO3. To instill ethical values, communicative skills, teamwork and leadership skills necessary to function productively and professionally.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Hindusthan College of Engineering and Technology

(An Autonomous Institution, Affiliated to Anna University, Chennai Approved
by AICTE, New Delhi & Accredited by NAAC with 'A'Grade)
Valley Campus,Pollachi Highway,Coimbatore,TamilNadu.

CBCS PATTERN UNDER GRADUATE PROGRAMMES
B.E. BIOMEDICAL ENGINEERING (UG)
REGULATION-2022
For the students admitted during the academic year 2023-2024 and onwards
SEMESTER I

S.No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
			Theory								
1.	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2.	22ME1201	Engineering Drawing	ESC	1	4	0	3	5	40	60	100
			Theory with Lab Component								
3.	22CY1151	Chemistry For Circuit Engineering	BSC	2	0	2	3	4	50	50	100
4.	22HE1151	English for Engineers	HSC	2	0	2	3	4	50	50	100
5.	22IT1151	Python Programming and practices	ESC	2	0	2	3	4	50	50	100
			EEC Courses(SE/AE)								
6.	22HE1071	Universal Human Values	AEC	2	0	0	2	3	40	60	100
7.	22HE1072	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
			Mandatory Courses								
8.	22MC1091/ 22MC1092	/ /Indian Constitution	MC	2	0	0	0	2	0	0	0
			TOTAL	15	5	6	19	26	370	330	700

REGULATION-2022
For the students admitted during the academic year 2022-2023 and onwards
SEMESTER III

S. No.	Course Code	Course Title	Category	L	T	P	C	CP	CIA	ESE	TOTAL
			Theory								
1.	22BM3201	Signals and Systems	PCC	3	1	0	4	4	40	60	100
2.	22BM3202	Electron Devices and Circuits	PCC	3	0	0	3	3	40	60	100
3.	22BM3203	Medical Biochemistry	PCC	3	0	0	3	3	40	60	100
4.	22BM3204	Human Anatomy and Physiology	PCC	3	0	0	3	3	40	60	100
			Theory with Lab Component								
5.	22MA3151	Statistics and Numerical Methods With R Program	BSC	2	0	2	4	4	50	50	100
6.	22BM3251	Digital Electronics	ESC	2	0	2	3	4	50	50	100
			Practical								
7.	22BM3001	Bio chemistry Lab	PCC	0	0	4	2	4	60	40	100

8.	22BM3002	Electron Devices and Circuits Lab	EEC	0	0	4	2	4	60	40	100
		EEC Courses(SE/AE)									
9.	22HE3071	Soft Skills-2	EEC	1	0	0	1	1	100	0	100
		Mandatory Course(MC)									
10.	22MC3191	Value education-Essence of Indian Traditional Knowledge	MC	2	0	0	0		100	0	100
		TOTAL		19	1	12	25	30	580	420	1000

REGULATION-2019 with amendments

For the students admitted during the academic year 2021-2022 and onwards

SEMESTER V

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
			THEORY							
1	21BM5201	Biocontrol systems	PC	3	1	0	4	25	75	100
2	21BM5202	Biomechanics	PC	3	0	0	3	25	75	100
3	21BM5203	Microprocessors and Microcontrollers	PC	3	0	0	3	25	75	100
4	21BM5204	Biomedical Instrumentation	PC	3	0	0	3	25	75	100
5	21BM53XX	Professional Elective-I	PE	3	0	0	3	25	75	100
			THEORY WITH LAB COMPONENT							
6	21BM5251	Virtual Instrumentation Using Lab VIEW	PC	2	0	2	3	50	50	100
			PRACTICALS							
7	21BM5001	Microprocessors and Microcontrollers Lab	PC	0	0	3	1.5	50	50	100
8	21BM5002	Biomedical Instrumentation Lab	PC	0	0	3	1.5	50	50	100
			MANDATORY COURSES							
9	21HE5071	SoftSkill-I	EEC	1	0	0	1	100	0	100
10	21HE5072	Design Thinking	EEC	1	0	0	1	100	0	100
		Total		21	1	8	**24**	475	475	**1000**

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
			PROFESSIONAL ELECTIVE I							
1	21BM5301	Medical Physics	PE	3	0	0	3	25	75	100
2	21BM5302	Robotics in Medicine	PE	3	0	0	3	25	75	100
3	21BM5303	Total Quality Management	PE	3	0	0	3	25	75	100

2

| 4 | 21BM5304 | Medical Ethics and Standards | PE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 5 | 21BM5305 | Intellectual Property Rights | PE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |

REGULATION-2019

For the students admitted during the academic year 2020-2021 and onwards

SEMESTER VII

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19BM7201	Diagnostic and Therapeutic Equipment-II	PC	3	0	0	3	25	75	100
2	19BM7202	Medical Image Processing	PC	3	0	0	3	25	75	100
3	19BM7203	Hospital Management	PC	3	0	0	3	25	75	100
4	19BM73XX	Professional Elective-III	PE	3	0	0	3	25	75	100
5	19XX74XX	Open Elective II	OE	3	0	0	3	25	75	100
PRACTICALS										
6	19BM7001	Image Processing Laboratory	PC	0	0	3	1.5	50	50	100
7	19BM7002	Diagnostic and Therapeutic Equipment Laboratory	PC	0	0	3	1.5	50	50	100
PROJECT WORK										
8	19BM7901	Project Phase I	EEC	0	0	4	2	50	50	100
			Total	15	0	10	**20**	300	500	**800**
PROFESSIONAL ELECTIVE III										
1	19BM7301	Drug Delivery	PE	3	0	0	3	25	75	100
2	19BM7302	IOT Applications in Healthcare	PE	3	0	0	3	25	75	100
3	19BM7303	Advanced Bio Analytical And Therapeutic Techniques	PE	3	0	0	3	25	75	100
4	19BM7304	Advanced Biosignal Processing	PE	3	0	0	3	25	75	100
5	19BM7305	Ultrasound in Medicine	PE	3	0	0	3	25	75	100

Heads are requested to provide on vertical from their program to offer for other program

students to register for additional courses (18 Credits) to become eligible for the

B.E./B.Tech. Minor Degree. BIOMEDICAL ENGINEERING OFFERING MINOR DEGREE

Note: Each programme should provide verticals for minor degree

Minor Specialization in Biomedical Instrumentation.

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTALCONTACT PERIODS	CREDITS
				L	T	P		
1.	21BM5601	Basics of Anatomy and Physiology	MDC	3	0	0	3	3
2.	21BM6601	Biosensors and Medical Instrumentation	MDC	3	0	0	3	3
3.	21BM6602	Radiological Equipments	MDC	3	0	0	3	3
4.	21BM7601	Biomaterials and Artificial Organs	MDC	3	0	0	3	3
5.	21BM7602	Medical Equipment Calibration and Trouble Shooting	MDC	3	0	0	3	3
6.	21BM8601	Wearable Devices	MDC	3	0	0	3	3

*MDC–Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

VERTICAL I
FINTECHAND BLOCK CHAIN

SL. NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACTPERIODS	CREDITS
				L	T	P		
1.	21CS5602	Financial Management	MDC	3	0	0	3	3
2.	21XXXX	Fundamentals of Investment	MDC	3	0	0	3	3
3.	21 XXXX	Banking ,Financial Services and Insurance	MDC	3	0	0	3	3
4.	21 XXXX	Introduction to Block chain And its Applications	MDC	3	0	0	3	3
5.	21 XXXX	Fintech Personal Finance And Payments	MDC	3	0	0	3	3
6.	21 XXXX	Introduction of Fintech	MDC	3	0	0	3	3

<div align="center">

VERTICAL II

ENTREPRENEURSHIP

</div>

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	**T**	**P**		
1.	21BA5601	Foundation of Entrepreneurship	MDC	3	0	0	3	3
2.	21BA6601	Introduction to Business Venture	MDC	3	0	0	3	3
3.	21BA6602	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
4.	21BA7601	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
5.	21BA7602	Principles of Marketing Management for Business	MDC	3	0	0	3	3
6.	21BA8601	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
7.	21BA8602	Financing New Business Ventures	MDC	3	0	0	3	3

<div align="center">

VERTICAL III

ENVIRONMENT AND SUSTAIN ABILITY

</div>

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	**T**	**P**		
1.	21CEXXXX	Sustain able infrastructure Development	MDC	3	0	0	3	3
2.	21AGXXXX	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3.	21BMXXXX	Sustainable Bio Materials	MDC	3	0	0	3	3
4.	21MEXXXX	Materials for Energy Sustain ability	MDC	3	0	0	3	3
5.	21CEXXXX	Green Technology	MDC	3	0	0	3	3
6.	21CEXXXX	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

<div align="center">

B. Tech (Hons) Biomedical Engineering   With Specialization In Industry 4.0 In Healthcare

</div>

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	**T**	**P**	**C**				
1	21BM5205	Modeling of Physiological Systems	PC	3	0	0	3	3	40	60	100

2	21BM6202	Artificial Intelligence And Machine Learning	PC	3	0	0	3	3	40	60	100
3	21BM6203	Robotics In Medicine	PC	3	0	0	3	3	40	60	100
4	21BM7203	Quality Control &Regulatory Aspects Of Medical Devices	PC	3	0	0	3	3	40	60	100
5	21BM7204	3D Printing	PC	3	0	0	3	3	40	60	100
6	21BM8201	Medical product development and trouble shooting	PC	3	0	0	3	3	40	60	100

B. Tech (Hons) Bio medical Engineering With Specialization In Advanced Healthcare And Devices

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1	21BM5206	Critical Care Equipments	PC	3	0	0	3	3	40	60	100
2	21BM6204	Brain computer interface	PC	3	0	0	3	3	40	60	100
3	21BM6205	Medical Health Technology	PC	3	0	0	3	3	40	60	100
4	21BM7205	Advanced Biomedical Instruments and Data interpretation	PC	3	0	0	3	3	40	60	100
5	21BM7206	Biomedical Laser Instruments	PC	3	0	0	3	3	40	60	100
6	21BM8202	Digital Healthcare Technology	PC	3	0	0	3	3	40	60	100

Note: Each programme should provide verticals for the Honors degree

Credit Distribution R2019 with amendments

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	24	24	20	14	**165**

Credit Distribution R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	19	22	25	23	22	24	20	10	**165**

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	**22MA1101**	**MATRICES AND CALCULUS** (Common to all Branches)	3	1	0	4

Course Objective

The learner should be able to

1. Construct the characteristic polynomial of a matrix and use it to identify eigen values and Eigenvectors
2. Impart the knowledge of sequences and series.
3. Analyseanddiscussthemaximaandminimaofthefunctionsofseveralvariables.
4. Evaluate the multiple integrals and apply in solving problems.
5. Apply vector differential operator for vector function and theorems to solve engineering problems.

Unit	Description	Instructional Hours
I	**Matrices** Eigen values and Eigen vectors – Properties of Eigen values and Eigen vectors (without proof) -Cayley - Hamilton Theorem (excluding proof) - Reduction of a quadratic form to canonical form by orthogonal transformation.	12
II	**Single Variate Calculus** Rolle's Theorem–Lagrange's Mean Value Theorem-Maxima and Minima–Taylor's and Maclaurin's Series.	12
III	**Functions of Several Variables** Partial derivatives-Total derivative, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers	12
IV	**Integral Calculus** Double integrals in Cartesian coordinates–Area enclosed by plane curves (excluding surface area)– Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid , Tetrahedron) using Cartesian co-ordinates.	12
V	**Vector Calculus** Gradient, divergence and curl; Green's theorem, Stoke's and Gauss divergence theorem (statement only) for cubes only.	12
	Total Instructional Hours	**60**

Course Outcome

At the end of the course, the learner will be able to

CO1: Compute Eigen values and Eigen vectors of the given matrix and transform given quadratic form into canonical form.

CO2: Apply the concept of differentiation to identify the maximum and minimum values of curve.

CO3: Compute partial derivatives of function of several variables and write Taylor's series for functions with two variables.

CO4: Evaluate multiple integral and its applications in finding area, volume.

CO5: Apply the concept of vector calculus in two and three dimensional spaces.

TEXTBOOKS:

T1:G.B.ThomasandR.L.Finney,"CalculusandAnalyticalGeometry",9thEditionAddisonWesleyPublishing

Company,2016.

T2:ErwinKreyszig,"AdvancedEngineeringMathematics",JohnWiley&Sons,2019.

T3:K.P.UmaandS.Padma,"EngineeringMathematicsI(MatricesandCalculus) ",PearsonLtd,2022.

REFERENCEBOOKS:

R1-JerroldE.Marsden,AnthonyTromba,"VectorCalculus",W.H.Freeman,2003

R2-StraussM.J,G.L.BradleyandK.J.Smith,"Multivariablecalculus",PrenticeHall,2002.

R3-VeerarajanT,"EngineeringMathematics",McGrawHillEducation(India)PvtLtd,NewDelhi,2016.

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.E/B.Tech	**22CY1151**	**Chemistry for Circuit Engineering** (ECE, EEE, EIE, BME,CSE, IT, AIML)	2	0	2	3

The learner should be able to

Course Objective
1. Acquire knowledge on the concepts of chemistry involved in day today life.
2. Identify the water related problems and water treatment techniques.
3. Enhance the fundamental knowledge on electrochemistry and the mechanism of corrosion and its control.
4. Gain knowledge on the nuclear energy source and batteries.
5. Extend the knowledge on the concepts of spectroscopy and its applications.

Unit	Description	Instructional Hours
I	**CHEMISTRY IN EVERYDAY LIFE** Chemicals in food – Food colors – Artificial sweeteners – Food preservatives. Soaps and Detergents – Soaps – Types of Soap – Detergents – Types of detergents. Drugs – Classification of drugs - Therapeutic Action of Different Classes of Drugs. Chemicals in Cosmetics – Creams – Talcum powders- Deodorants – Perfumes. Plastics – Thermoplastics-Preparation, properties and uses of PVC, Teflon and Thermosetting plastics - Preparation, properties and uses of Polyester and Polyurethane.	6
II	**WATER TECHNOLOGY** Impurities in Water, Hardness of Water, Boiler feed Water – Boiler troubles -Sludge and scale formation, Caustic embrittlement, priming and foaming, boiler corrosion- -Softening Methods (Zeolite & Ion-Exchange Methods)- Desalination of Brackish Water - Reverse Osmosis, Potable water and treatment. **Estimation of total, permanent and temporary hardness of water by EDTA. Determination of Dissolved Oxygen in sewage water by Winkler's method. Estimation of alkalinity of water sample by indicator method.**	6+9
III	**ELECTROCHEMISTRY AND CORROSION** Electrochemical cells – reversible and irreversible cells - EMF- Single electrode potential – Nernst equation (derivation only) – Conductometric titrations. Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types –galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods. **Conductometric titration of strong acid vs strong base (HClvsNaOH). Estimation of Ferrous iron by Potentiometry.**	6+6
IV	**ENERGY SOURCES AND STORAGE DEVICES** Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator- classification of nuclear reactor- light water reactor- breeder reactor. Batteries and fuel cells: Types of batteries- alkaline battery- lead storage battery- lithium ion battery- fuel cell H_2 -O_2 fuel cell applications.	6
V	**SPECTROSCOPY** Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only) - applications – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – Estimation of nickel by atomic absorption spectroscopy.	6

	Total Instructional Hours	**45**

Course Outcome

At the end of the course, the learner will be able to

CO1: List out the chemicals used in food, soaps and detergents, drugs, cosmetics and plastics

CO2: Differentiate hard and soft water and solve the related problems on water purification in domestic as well as in industries.

CO3: Develop knowledge on the basic principles of electrochemistry and understand the causes of corrosion, its consequences to minimize corrosion to improve industrial design

CO4: Develop knowledge about the renewable energy resources and batteries along with the need of new materials to improve energy storage capabilities

CO5: List out the applications of spectroscopic techniques in various engineering fields.

TEXT BOOKS

T1 - P.C.Jain& Monica Jain, "Engineering Chemistry" DhanpatRai Pub, Co., New Delhi (2018).

T2 -O.G.Palanna, "Engineering chemistry" McGraw Hill Education India (2017).

REFERENCES

R1 - ShikhaAgarwal "Engineering Chemistry -Fundamentals and Applications, Cambridge University Press, Delhi, 2019

R2 - S.S.Dara "A Text book of Engineering Chemistry" S.Chand& Co. Ltd., New Delhi (2018).

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

	22HE1151	ENGLISH FOR ENGINEERS (Common to all Branches)	L	T	P	C
			2	0	2	3

Course Objective	**The student should be able** 1. To improve the communicative proficiency of learners. 2. To help learners use language effectively in professional writing. 3. To advance the skills of maintaining the suitable one of communication. 4. To introduce the professional life skills. 5. To impart official communication etiquette.

Unit	Description	Instructional Hours
I	**Language Proficiency:** Types of Sentences, Functional Units, Framing question. **Writing:** process description, Writing Checklist.**Vocabulary –** words on environment. **Practical Component: Listening**- Watching short videos and answer the questions, **Speaking**- Self introduction ,formal & semi-formal,**Reading**- Purpose of Reading - Churning & Assimilation, Interpreting Ideas - Interpreting Graphs in Technical Writing.	7+2
II	**Language Proficiency**: Tenses, Adjectives and adverbs. **Writing:** Formal letters (letters conveying positive and negative news), Formal and informal email writing (using emoticons, abbreviations& acronyms), reading comprehension**. Vocabulary–** words on entertainment. **Practical Component: Listening**-Comprehensions based on TED talks**Speaking-** Narrating a short story or an event happened in their life **Reading** - Skimming – Scanning – Reading: Scientific Texts – Literary Texts .	7+2
III	**Language Proficiency:** Prepositions, phrasal verbs. **Writing:** Formal thanks giving, Congratulating, warning and apologizing letters, cloze test. **Vocabulary –** words on tools.**PracticalComponent:Listening**-Listen to songs and answer the questions**Speaking**-Justaminute**Reading**- Reading feature articles (from newspapers and magazines) -Reading to identify point of view and perspective (opinion pieces, editorials etc.)	5+4
IV	**Language Proficiency:** Subject verb concord, Prefixes & suffixes. **Writing:**Preparing agenda &minutes, writing an event report. **Vocabulary–** words on engineering process. **Practical Component: Listening**-Comprehensions based on Talk of orators or interview shows **Speaking-** Presentation on a general topic with ppt. **Reading**- Reading Comprehension - Techniques for Good Comprehension - - Sequencing of Sentences.	5+4
V	**Language Proficiency:** Modal Auxiliaries, Active & passive voice, **Writing:** Project report (proposal & progress) ,sequencing of sentences **Vocabulary –**words on engineering material**Practical Component: Listening**- Listening- Comprehensions based on Nat Geo/Discovery channel videos **Speaking-** Preparing posters and presenting as a team.**Reading**- Biographies,travelogues,technical blogs.	6+3
	Total Instructional Hours	**45**

Course Outcome	After completion of the course the learner will be able CO1:Tocommunicateinaprofessional forum CO2:Tospeakorwriteacontentintheproficientlanguage CO3: To maintain and use appropriate one of the communication.

CO4:To read ,write and present in a professional way.
CO5:To follow the etiquettes in formal communication.

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	**22ME1201**	**ENGINEERING DRAWING** (AGRI, BME, (CHEM,,AERO, AUTO, CIVIL,MECH, MECT,FT,EEE)	**1**	**4**	**0**	**3**

Course Objective	**The learner should be able** 1. To gain the knowledge of Engineer's language of expressing complete details about objects and construction of conics and special curves. 2. To learn about the orthogonal projections of straight lines and planes. 3. To acquire the knowledge of projections of simple solid objects in plan and elevation. 4. To learn about the projection of sections of solids and development of surfaces. 5. To study the isometric projections of different objects.

Unit	Description	Instructional Hours
I	**PLANE CURVES** Importance of engineering drawing; drafting instruments; drawing sheets – layout and folding; Lettering and dimensioning, BIS standards, scales.Geometrical constructions, Engineering Curves Conic sections –Construction of ellipse, parabolaand hyperbola by eccentricity method. Construction of cycloids and involutes of square and circle – Drawing of tangents and normal to the above curves.	12
II	**PROJECTIONS OF POINTS, LINES AND PLANE SURFACES** Introduction to Orthographic projections- Projection of points. Projection of straight lines inclinedto both the planes, Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the planes by rotating object method (First angle projections only).	12
III	**PROJECTIONS OF SOLIDS** Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular and inclined to one plane by rotating object method.	12
IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES** Sectioning of simple solids with their axis in vertical position when the cutting plane is inclined toone of the principal planes and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinder and cone. Development of lateral surfaces of truncated solids.	12
V	**ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS** Isometric views and projections simple and truncated solids such as - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions.Free hand sketching of multiple views from a pictorial drawing. Basics of drafting using AutoCAD software.	12

Total Instructional Hours   **60**

Course Outcome	At the end of the course, the learner will be able to CO1: Understand and interpret the engineering drawings in order to visualize the objects and draw the conics and special curves. CO2: Draw the orthogonal projections of straight lines and planes. CO3: Interpret the projections of simple solid objects in plan and elevation. CO4: Draw the projections of section of solids and development of surfaces of solids. CO5: Draw the isometric projections and the perspective views of different objects.

TEXT BOOK:
T1. K.Venugopal, V.Prabu Raja, "Engineering Drawing, AutoCAD, Building Drawings", 5thedition New Age International Publishers, New Delhi 2016.
T2. K.V.Natarajan, "A textbook of Engineering Graphics", Dhanlaksmi Publishers, Chennai 2016.
REFERENCES:
R1. BasantAgrawal and C.M.Agrawal, "Engineering Drawing", Tata McGraw Hill Publishing company Limited,

New Delhi,2013.
R2. N.S. Parthasarathy, Vela Murali, "Engineering Drawing", Oxford University PRESS, India 2015.

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	**22IT1151**	**PYTHON PROGRAMMING AND PRACTICES** AGRI, CHEM,FT,AERO, AUTO, CIVIL,MECH, MECT,ECE,BME)	**2**	**0**	**2**	**3**

<table>
<tr><td rowspan="2">Course Objective</td><td colspan="6">The learner should be able
1. To know the basics of algorithmic problem solving
2. To read and write simple Python programs
3. To develop Python programs with conditionals and loops and to define Python functions and call them
4. To use Python data structures –- lists, tuples, dictionaries
5. To do input/output with files in Python</td></tr>
</table>

Unit	Description	Instructional Hours
I	**ALGORITHMIC PROBLEM SOLVING** Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). **Illustrative problems: To find the Greatest Common Divisor (GCD)oftwo numbers, Fahrenheit to Celsius, Perform Matrix addition.**	5+4
II	**DATA, STATEMENTS,CONTROL FLOW** Data Types, Operators and precedence of operators, expressions, statements, comments; Conditionals: Boolean values and operators, conditional (if), alternative (if -else), chained conditional (if –elif-else); Iteration: state, while, for, break, continue, pass; **Simple algorithms and programs: Area of the circle, check the given year is Leap year or not, Factorial of a Number.**	5+4
III	**FUNCTIONS, STRINGS** Functions, parameters and arguments; Fruitful functions: return values, local and global scope, function composition, recursive functions. Strings: string slices, immutability, string functions and methods, string module. **Illustrative programs: Perform Linear Search, Selection sort, Sum of all elements in a List, Pattern Programs**	5+4
IV	**LISTS, TUPLES, DICTIONARIES** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations andmethods; advanced list processing - list comprehension. **Illustrative programs: List Manipulation, Finding Maximum in a List, String processing.**	5+4
V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, modules, packages **Illustrative programs: Reading writing in a file, word count, Handling Exceptions**	9
	Total Instructional Hours	**45**

Course Outcome	At the end of the course, the learner will be able to CO1: Develop algorithmic solutions to simple computational problems CO2: Read, write, execute by hand simple Python programs CO3: Structure simple Python programs for solving problems and Decompose a Python program into functions CO4: Represent compound data using Python lists, tuples, dictionaries CO5: Read and write data from/to files in Python Programs.

TEXT BOOKS:

T1: Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.6.2, Shroff Publishers, First edition (2017).

T2:S. Annadurai, S.Shankar, I.Jasmine, M.Revathi, Fundamentals of Python Programming, Mc-Graw Hill Education (India) Private Ltd, 2019.

REFERENCE BOOKS:

R1:CharlesDierbach, ―Introduction to Computer Science using Python: A Computational Problem- Solving Focus, Wiley India Edition,2013.

R2:Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015

R3:Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ **22HE1071**	**UNIVERSAL HUMAN VALUES** **(COMMON TO ALL BRANCHES)**	2	0	0	2

Thestudentshould bemade

Course Objectives

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. TofacilitatethedevelopmentofaHolisticperspectiveamongstudentstowardslifeandprofession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implication sofsuchaHolisticunderstanding Interms ofethicalhumanconduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Unit	Description	Instructional Hours
I	**Introduction to Value Education** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)-Understanding Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Happiness and Prosperity – Current Scenario - Method to Fulfill the Basic Human Aspirations	6
II	**Harmony in the Human Being and Harmony in the Family** Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - The Body as an Instrument of the Self - Understanding Harmony in the Self- Harmony of the Self with the Body - Programme to ensure self-regulation and Health	6
III	**Harmony in the Family and Society** Harmony in the Family – the Basic Unit of Human Interaction.Values in Human to Human Relationship'Trust' – the Foundational Value in Relationship Values in Human to Human Relationship'Respect' – as the RightEvaluation Understanding Harmony in the Society	6
IV	**Harmony in the Nature / Existence** Understanding Harmony in the Nature.Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature- Understanding Existence as Co-existence of mutually interacting units in all pervasivespace Realizing Existence as Co-existence at All Levels The Holistic Perception of Harmony in Existence. Vision for the Universal Human Order	6
V	**Implications of the Holistic Understanding – a Look at Professional Ethics** Natural Acceptance of Human Values Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical CaseStudiesStrategies for Transition towards Value-based Life and Profession	6

Total Instructional Hours   30

	At the end of the course, the learner will be able
Course Outcome	CO1: To become more aware of holistic vision of life - themselves and their surroundings. CO2: To become more responsible in life, in the Society and in handling problems with sustainable Solutions. CO3: To sensitive towards their commitment towards what they understood towards environment and Socially responsible behavior. CO4: To able to apply what have learnt to their own self in different day-to-day settings in real life and In handling problems with sustainable solutions. CO5: To develop competence and capabilities for maintaining Health and Hygiene.

Reference Books:

R1.A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

R2.Teachers'ManualforAFoundationCourseinHumanValuesandProfessionalEthics,RRGaur, R Asthana,G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-53-2

R3.JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak,1999.

R4.Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22HE1072	ENTREPRENEURSHIP & INNOVATION (Common for all Branches)	1	0	0	1

Course Objectives

The student should be made

1. To acquire the knowledge and skills needed to manage the development of innovation.
2. To recognize and evaluate potential opportunities to monetize these innovations.
3. To plan specific and detailed method to exploit these opportunities.
4. To acquire the resources necessary to implement these plans.
5. To make students understand organizational performance and its importance.

Module	Description
1	**Entrepreneurial Thinking**
2	**Innovation Management**
3	**Design Thinking**
4	**Opportunity Spotting / Opportunity Evaluation**
5	**Industry and Market Research**
6	**Innovation Strategy and Business Models**
7	**Financial Forecasting**
8	**Business Plans/ Business Model Canvas**
9	**Entrepreneurial Finance**
10	**Pitching to Resources Providers / Pitch Deck**
11	**Negotiating Deals**
12	**New Venture Creation**
13	**Lean Start-ups**
14	**Entrepreneurial Ecosystem**
15	**Velocity Venture**

TOTAL INSTRUCTIONAL HOURS   15

Course Outcome

At the end of the course, the learner will be able to

CO1: Understandthenatureofbusinessopportunities,resources,andindustriesincriticalandcreative aspects.

CO2: Understand the processes by which innovation is fostered, managed, and commercialized.

CO3:Remember effectively and efficiently the potential of new business opportunities.

CO4:Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness..

CO5:Developabusiness model for a new venture, including revenue. Margins, operations,

Working capital, and investment

TEXTBOOKS

T1**:**AryaKumar"Entrepreneurship–CreatingandleadinganEntrepreneurialOrganization",Pearson,SecondEdition(2012).
T2:EmrahYayici"DesignThinkingMethodology", Artbiztech,FirstEdition(2016).

REFERENCEBOOKS

R1: Christopher Golis "Enterprise & Venture Capital", Allen &Unwin Publication, Fourth Edition (2007).

R2: ThomasLockWood&EdgerPapke"InnovationbyDesign",Career Press.com,SecondEdition(2017).

R3: Jonathan Wilson "Essentials of Business Research", Sage Publication, FirstEdition(2010).

WEBRESOURCES

W1:https://blof.forgeforward.in/tagged/startup-lessons

W2:https://blof.forgeforward.in/tagged/entrepreurship

W3:https://blof.forgeforward.in/tagged/minimum-viable-product

W4:https://blof.forgeforward.in/tagged/minimum-viable-product

W5:https://blof.forgeforward.in/tagged/innovation

Chairman BoS
BME - HiCET

Chairman

Dean(Academics)
HiCET

Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	22HE1073	**Soft Skills and Aptitude- I**	**0**	**0**	**0**	**1**

Course Objectives:	1. To develop and nurture the soft skills of the students through instruction, knowledge acquisition, demonstration and practice.
	2. To enhance the students ability to deal with numerical and quantitative skills.
	3. To identify the core skills associated with critical thinking.
	4. To develop and integrate the use of English language skills.

Unit	Description	Instructional Hours
I	**Lessons on excellence** Skill introspection, Skill acquisition, consistent practice	2
II	**Logical Reasoning** Problem Solving - Critical Thinking- Lateral Thinking - Coding and Decoding – Series – Analogy - Odd Man Out - Visual Reasoning - Sudoku puzzles **-** Attention to detail	11
III	**Quantitative Aptitude** Addition and Subtraction of bigger numbers - Square and square roots - Cubes and cube roots - Vedic maths techniques - Multiplication Shortcuts - Multiplication of 3 and higher digit numbers – Simplifications - Comparing fractions - Shortcuts to find HCF and LCM - Divisibility tests shortcuts - Algebra and functions	11
IV	**Recruitment Essentials** Resume Building - Impression Management	2
V	**Verbal Ability** Nouns and Pronouns – Verbs - Subject-Verb Agreement - Pronoun-Antecedent – Agreement - Punctuations	4
	Total Instructional Hours	30

Course Outcome:	CO1:	Students will analyze interpersonal communication skills. public speaking skills.
	CO2:	Students will exemplify tautology, contradiction and contingency by logical thinking.
	CO3:	Students will be able to develop an appropriate integral form to solve all sorts of quantitative problems.
	CO4:	Students can produce a resume that describes their education, skills, experiences and measurable achievements with proper grammar, format and brevity.
	CO5:	Students will be developed to acquire the ability to use English language with an error while making optimum use of grammar.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
BE	22BM3202	Electron Devices and Circuits	3	0	0	3

Course Objective	To be familiar with the theory, construction, and operation of Semi conductor diodes To impart knowledge on the configurations and operation of transistors and **amplifiers** To give an insight of the operation of **multistage, differential and feedback amplifiers** To be familiar with the concept of **power supplies and oscillators.** To impart knowledge on fundamentals of communication engineering

Unit	Description	Instructional Hours
I	**SEMICONDUCTOR DIODES** PN junction and Zener diodes – structure, operation and V-I characteristics, Rectifiers - Half and Fu ll Wave, Zener diode as regulator, Display devices – LED and Laser diodes.	9
II	**TRANSISTORS AND AMPLIFIERS** BJT, JFET, MOSFET and IGBT - structure, operation and characteristics. CE amplifier ,Power amplifiers - class A - Class B - Class AB - Class C.	9
III	**MULTI STAGE, DIFFERENTIAL AND FEEDBACK AMPLIFIERS** BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis - Gain and frequency response. Feed back-Positive and Negative, Types-Voltage/current series and shunt feedback amplifiers.	9
IV	**POWER SUPPLIES AND OSCILLATORS** Fixed and Variable power supply, Linear and Switched Mode Power Supply, Regulated power supply, Online and Off line Uninterrupted power supply (Block Diagram Approach only) Oscillators– condition for oscillations, RC Oscillator - Phase shift, LC Oscillators - Hartley oscillators.	9
V	**FUNDAMENTALS OF COMMUNICATION ENGINEERING** Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations – Radar, Modem, Satellite and Optical Fibre communications, 4G,5G (Block Diagram Approach only).	9

	Total Instructional Hours	**45**

Course Outcome	CO1	Ability to explain the theory, construction, and operation of Semiconductor diodes
	CO2	Ability to demonstrate the structure, operation and characteristics of transistors and amplifiers.
	CO3	To understand the working of **multistage, differential and feedback amplifiers**.
	CO4	To understand the working of **power supplies and oscillators**.
	CO5	To understand the fundamentals of communication engineering

TEXT BOOKS:

T1   Gupta J. B. "Electronic Devices and Circuits", Fifth edition, S K Kataria and Sons, 2013 edition.

T2   Sedra and smith, "Microelectronic Circuits", Seventh Edition, Oxford University Press, 2017.

REFERENCE BOOKS:

R1   Floyd, "Electron Devices", 9th edition, Pearson Education India, 2015.

R2   Robert L. Boylestad, "Electronic Devices and Circuit theory", 11th Edition, Pearson Education India, 2015.

R3   Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", 2nd Edition, CRC Press, 2017.

R4   Robert A. Mammano,"Fundamentals of Power Supply Design", 2017.

R5   S.K. Kataria & Sons., "Fundamentals of Communication Engineering 1st Edition, : S.K. Kataria& Sons, 2011

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	22BM3202	MEDICAL BIOCHEMISTRY	3	0	0	3

Course Objective	1. To study the basic fundamentals of biochemistry 2. To study structural and functional properties of carbohydrates 3. To study structural and functional properties of lipids. 4. To study structural and functional properties of proteins ,and nucleic acids 5. To emphasize the role of enzymes in human body.

Unit	Description	Instructional Hours
I	**INTRODUCTIONTOBIOCHEMISTRY** Introduction to Biochemistry, water as a biological solvent,weak acidand bases, pH,buffers,Handerson-Hassel balchequation,physiological buffers in living systems, Energy in living organism .Properties of water and their applications in biological systems. Clinical application of Electrolytes and radioisotopes.	9
II	**METABOLISM OF CARBOHYDRATES** Introduction to meta bolism-Classification of carbohydrates -Digestion and absorption of carbohydrates-Metabolic pathways and bio energetics–Glycolysis, glycol genesis, glycol genolysis and its hormonal regulation. TCA cycle and electron transport chain - Biochemical aspect of Diabetes mellitus and Glycogen storage Disease.	9
III	**METABOLISM OF LIPIDS** Classification of lipids- simple, compound and derived lipids. Nomenclatureof fatty acid, physical and chemical properties of fat. Metabolic pathways:synthesis and degradation of fatty acid (beta oxidation), hormonal regulation offatty acid meta bolism ,ketogenesis, Biosynthesis of Cholesterol .Disorders of lipidmetabolism	9
IV	**NUCLEIC ACID & PROTEIN** Nucleic acid: Biosynthesis of purine and pyrimidines - Disorder of purine and pyrimidines metabolism.Classification structure and properties of proteins, structura lorganization of proteins, classification and properties of amino acids.Separation of protein,In born Meta bolicerror of amino acid metabolism.	9
V	**ENZYME AND ITS CLINICAL APPLICATION** Classification of enzymes,apoenzyme,coenzyme,holoenzyme and co factors.Kinetics of enzymes-Michaelis-Mentenequation.Factors affecting enzymatic activity: temperature, pH, substrate concentration and enzyme concentration.Inhibitors of enzyme action:Competitive,non-competitive,irreversible-Clinical Application of enzyme- ELISA	9
	Total Instructional Hours	**45**

Course Outcome	CO1	Explain the fundamentals of biochemistry
	CO2	Explain structural and functional properties of carbohydrates
	CO3	Explain structural and functional properties of lipids
	CO4	Explain structural and functional properties of proteins, and nucleic acids
	CO5	Discuss the role of enzymes in human body.

TEXT BOOKS:

T1   RAFIMD—Text book of biochemistry for Medical Student, Fourth Edition ,University Press, Orient Blackswan Private Limited , New Delhi, 2021

T2   Peter J. Kennelly, Kathleen M. Botham, Owen McGuinness, Victor W. Rodwell, P. Anthony Weil, Harper's Illustrated Biochemistry, Thirty-Second Edition, MC Graw Hill Lange,2022

REFERENCE BOOKS:

R1   Keith Wilson & John Walker, —Practical Biochemistry - Principles & Techniques‖, Seventh Edition, Oxford University Press, 2010.

R2   David L. Nelson, Michael M. Cox, Aaron A. Hoskins, Lehninger Principles of Biochemistry, Eighth, Edition, 2021

R3   Pamela.C.Champe & Richard.A.Harvey, "Lippincott Biochemistry Lippincott's Illustrated Reviews", Raven publishers,1994

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	22BM3204	HUMAN ANATOMY AND PHYSIOLOGY	3	0	0	3

Course Objective

1. Students would be understand the basic structural and functional elements of human body.
2. Learn about the structure and functions of the skeletal ,muscular and respiratory systems.
3. Students would have knowledge on Skeletal and muscular systems.
4. Students would be able to comprehend circulatory and nervous systems and their components.
5. Students would study importance of digestive and urinary systems in Human body.

Unit	Description	Instructional Hours
I	**CELL AND TISSUE STRUCTURE** Structure of Cell – structure and functions of sub organelles – Cell Membrane –Transport of Across Cell Membrane - Action Potential – Cell to Cell Signaling –Cell Division. Types of Specialized tissues–Functions -The Integumentary System: Structure of the Skin, Accessory Structures of the Skin, Types of Skin, Functions of the Skin Cell Division.	9
II	**SKELETAL, MUSCULAR AND RESPIRATORY SYSTEMS** **Skeletal:**:Types of Bone and function–Physiology of Bone formation– Division of Skeleton – Types of joints and function – Types of cartilage and function .**Muscular:** Parts of Muscle–Movements. **Respiratory:** Parts of Respiratory Systems–Types of respiration-Mechanisms of Breathing– Regulation of Respiration	9
III	**CARDIO VASCULAR AND LYMPHATIC SYSTEMS** **Cardio vascular:** Components of Blood and functions.-Blood Groups and importance – Structure of Heart – Conducting System of Heart – Properties of Cardiac Muscle-Cardiac Cycle–Types of Blood vessel–Regulation of Heart rate and Blood pressure. **Lymphatic:** Parts and Functions of Lymphatic systems –Types of Lymphatic organs and vessels	9
IV	**NERVOUS , ENDOCRINE SYSTEMS AND SENSEORGANS** Nervous system: Types and Structure of Neuron – Mechanism of Nerve Impulse - Structure and Parts of Brain. Sensory organ: Eye and Ear - **Endocrine - Pituitary** and thyroid gland.	9
V	**DIGESTIVE AND URINARY SYSTEMS** Digestive: Organs of Digestive system – Digestion and Absorption. Urinary: Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System–Urinary reflex	9
	Total Instructional Hours	**45**

Course Outcome

CO1	To learn the basic components of formation of systems	
CO2	To understand structure and functions of the various types of systems of human body.	
CO3	To identify all the organelles of an animal cell and their function.	
CO4	To demonstrate their knowledge of importance of anatomical features and physiology of human systems	
CO5	To understand structure and functions of the digestive and	

urinary systems.

TEXT BOOKS:

T1   PrabhjotKaur. Text Book of Anatomy and Physiology. Lotus Publishers. 2014.

T2   Elaine.N. Marieb , "Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi 2007.

REFERENCE BOOKS:

R1   Ross and Wilson, "Anatomy and Physiology ",13th edition,2018

R2   Khurana , "Textbook of Anatomy And Physiology",Cbs Nursing,2020.

R3   PrabhjotKaur ,"Textbook Of Anatomy Physiology 2ed", Lotus Publication, 2019

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.E	22MA3151	**STATISTICS AND NUMERICAL METHODS WITH R PROGRAMMING (BME)**	2	0	2	4

Course Objective

The learner should be able to
1. Illustrate the relation between two random variables by using correlation concepts along with R studio
2. Employ some basic concepts of statistical methods for testing the hypothesis together with R studio.
3. Analyze the design of experiment techniques to solve various engineering problems accompanying with R studio
4. Apply various methods to find the inter mediate values for the given data
5. Explain concepts of numerical differentiation and numerical integration of the unknown functions.

Unit	Description	Instructional Hours
I	**CORRELATION AND REGRESSION** Correlation – Karl Pearson's correlation coefficient – Spearman's Rank Correlation – Regression lines (problems based on Raw data only). **R-Lab : Introduction to R programming, Correlation and Regression**	12
II	**HYPOTHESIS TESTING** Large sample test based on Normal distribution – test of significance for single mean and difference of means - Tests based on t (for single mean and difference of means) - F distribution – for testing difference of variance, Chi – Square test for Contingency table (Test for Independency) – Goodness of fit **R-Lab : t -test, F test , Chi – square test**	12
III	**ANALYSIS OF VARIANCE** Introduction, analysis of variance, completely randomized design, randomized block design, Latin square design. **R-Lab : Completely randomized design, randomized block design**	12
IV	**INTERPOLATION** Interpolation: Newton's forward and backward difference formulae Lagrangian interpolation for unequal intervals – Divided differences- Newton's divided difference formula.	12
V	**NUMERICAL DIFFERENTIATION AND INTEGRATION** Differentiation using interpolation formula – Newton's forward and backward interpolation formulae for equal intervals – Newton's divided difference formula for unequal intervals - Numerical integration by Trapezoidal and Simpson's 1/3 rules.	12
	Total Instructional Hours	60

Course Outcome

At the end of the course, the learner will be able to

CO1: Compute correlation and predict unknown values using regression together with R studio.

CO2: Understand the concepts of statistical methods for testing the hypothesis along with R studio.

CO3: Apply Design of Experiment techniques to solve various engineering problems in addition with R studio.

CO4: Understand the concept of interpolation in both cases of equal and unequal intervals.

CO5: Identify various methods to perform numerical differentiation and integration.

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018.

T2 - Medhi J," stochastic Processes", New Age International Publishers,New Delhi,2014

REFERENCE BOOKS :

R1 - Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers And Scientists", 8th Edition, Pearson Education, Asia, 2007.

R2 - Grewal B.S. and Grewal J.S. "Numerical Methods in Engineering and Science ", 6th Edition , Khanna Publishers, New Delhi 2004.

R3 - S.K.Gupta, Numerical Methods for Engineers", New Age International Pvt.Ltd Publishers, 2015.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	22BM3251	Digital Electronics	2	0	2	3

Course Objective

To understand the number systems and simplification of Boolean functions
To Confer the basic principles combinational circuits
To learn synchronous sequential circuits
To recognize asynchronous sequential circuits
To know about Memory devices and fundamentals of HDL.

Unit	Description	Instructional Hours
I	**NUMBER SYSTEMS AND MINIMIZATION TECHNIQUES** Number systems: Decimal, Binary, Octal, Hexadecimal-Number-Base conversion-Complements of Numbers: 1's and 2's complements- Boolean algebra and laws-De-organ's Theorem-Minimization of Boolean expressions – Midterm – Maxterm – Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization– Don't care conditions (2-variable,3-variable & 4-variable)-Tabulation method	9
II	**COMBINATIONAL CIRCUITS** Adder-Half adder, Full adder; Subtractor- Half subtractor, Full subtractor: Code converters: Binary to Gray, Gray to Binary, BCD to Excess-3 and Excess-3 to BCD; Magnitude comparator- Decoders, Encoders,-Multiplexers, De multiplexers, Experimental **Design and implementation of Adders and Subtractors.** **Experimental Design and implementation of Binary to Gray and Gray to Binary Conversion.** **Experimental Design and implementation of Decoder and Encoder**	9
III	**SYNCHRONOUS SEQUENTIAL CIRCUITS** Flip flops: SR, JK, D, T - Design of synchronous sequential circuits: State diagram - State table, – State minimization - State assignment. Shift registers: SISO, SIPO, PIPO, PISO– Counters: BCD, Up down counter and modulo counter. **Experimental Design and implementation of Shift registers, Synchronous and Asynchronous Counters**	9
IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS** Stable and Unstable states– Cycles and Races-Reduction of state and flow tables – Race-free state assignment – Hazards-Design of Hazard free circuits	9
V	**MEMORY DEVICES AND HDL** ROM-PROM-EPROM-EEPROM-RAM-FPGA-Programmable Logic Devices-Introduction to Hardware Description Language (HDL)- HDL for combinational circuits- Half adder, Full adder, Multiplexer, De-multiplexer, Counters.. **Coding Combinational/Sequential circuits using HDL.**	9

	Total Instructional Hours	**45**

Course Outcome

CO1	Simplify Boolean functions
CO2	Analyze, design and implement combinational logic circuits.
CO3	Evaluate, design and implement Synchronous sequential logic circuits
CO4	Interpret, design and implement Asynchronous sequential logic circuits
CO5	Simulate and implement combinational and sequential circuits using HDL.

TEXT BOOKS:

T1   Morris Mano M. and Michael D. Ciletti, "Digital Design", IV Edition, Pearson Education,2008

T2   S. Salivahanan and S. Arivazhagan, "Digital Circuits and Design", Second Edition, VikasPublishing House Pvt. Ltd, New Delhi, 2010.

REFERENCE BOOKS:

R1   Thomas L. Floyd, "Digital Fundamentals", Pearson Education, Inc, New Delhi, 2013

R2   Kharate G.K "Digital Electronics" Oxford, First edition-2018

R3   Singh B.T "Digital Electronics" Dhanpatrai and Co, First Edition 1987

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	22BM3002	Electron Devices and Circuits Lab	0	0	3	2

Course Objective
To learn the characteristics of PN junction diode.
To understand the characteristics of Zener diode.
To learn the characteristics of Transistors and frequency response of amplifiers.
To learn the working of oscillators.
To learn the basic laws and network reduction theorems.

S. No	Description of the Experiments
1	PN Junction Diode Characteristics
2	Zener Diode Characteristics
3	Common Emitter transistor - Input and Output Characteristics
4	SCR Characteristics
5	Verification of KVL & KCL
6	Verification of Super Position Theorem
7	Verification Of Thevenin's Theorem
8	Verification Of Norton's Theorem
9	RC Phase shift oscillator characteristics
10	Transient analysis of RL and RC circuits

Total Instructional Hours   **45**

Course Outcome
CO1   To understand the characteristics of PN junction diode, Zener diode and transistors.
CO2   To understand the concept of amplifiers and Oscillators.
CO3   Apply the concept of basic laws and network reduction theorems.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	22BM3001	BIOCHEMISTRY LABORATORY	0	0	3	2

Course Objective

1. To learn about Estimation and quantification of bio molecules.
2. To learn about Separation of macromolecules.
3. To learn about Estimation and interpretation of bio chemical parameter.

Description of Experiments

1. General guidelines for working and functional component of biochemistry lab
2. Preparation of solutions: 1) percentage solutions, 2) molar solutions, 3) normal solutions
3. Demonstration of proper use of volume and weight measurement devices.
4. Preparation of buffer-titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates-distinguishing reducing from non-reducing sugras
and keto from aldo sugars
6. Spectros copy: Determination of absorption maxima (λmax) of a given solution
7. Estimation of blood glucose.
8. Estimation of Hemoglobin
9. Estimation of creatinine.
10. Estimation of urea.
11. Estimation of cholesterol.
12. Preparation of serum and plasma from blood.
13. Separation of proteins by SDS electrophoresis(Demo)
14. Separation of amino acids by thin layer chromatography(Demo)

Course Outcome

CO1: Understand the Biochemistry laboratory functional components
CO2: Understand the basics principle of preparation of buffers.
CO3: Understand the qualitative test for different bio molecules
CO4: Understand the basics knowledge of Biochemical parameter
and their inter pretation in Blood sample.
CO5: Understand the separation technology of proteins and amino acids.

Chairman BoS
BME - HiCET

Chairman

Dean(Academics)
HiCET

43

Programme	Course Code	Course Title	L	T	P	C
BE	22HE3071	**Soft Skills and Aptitude- II**	**0**	**0**	**0**	**1**

Course Objectives:
1. Solve Logical Reasoning questions of easy to intermediate level
2. Solve Quantitative Aptitude questions of easy to intermediate level
3. Solve Verbal Ability questions of easy to intermediate level
4. Display good writing skills while dealing with essays

Unit	Description	Instructional Hours
I	**Logical Reasoning** Clocks - Calendars - Direction Sense - Cubes - Data Interpretation: Tables, Pie Chart, Bar Graph - Data Sufficiency	9
II	**Quantitative Aptitude** Time and work: Work with different efficiencies, Pipes and cisterns, Work equivalence, Division of wages - Time, Speed and Distance: Basics of time, speed and distance, Relative speed, Problems based on trains, Problems based on boats and streams, - Profit and loss, Basic terminologies in profit and loss - Averages - Weighted average	12
III	**Verbal Ability** Sentence Correction: Subject-Verb Agreement, Modifiers, Parallelism, Pronoun-Antecedent Agreement, Verb Time Sequences, Comparisons, Prepositions, Determiners - Sentence Completion and Para-jumbles: Pro-active thinking, Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues), Fixed jumbles, Anchored jumbles.	7
IV	**Writing skills for placements** Essay writing: Idea generation for topics, Best practices, Practice and feedback	2
	Total Instructional Hours	30

Course Outcome :

CO1 : Students will avoid the various fallacies that can arise through the misuse of logic.

CO2 : Students would opt for alternate methods to solve the problems rather than conventional methods.

CO3 : Students will heighten their awareness of correct usage of English grammar in writing and speaking

CO4 : Students will be concise and clear, using professional language for placements.

REFERENCE BOOKS:

R1: A New Approach To Reasoning Verbal & Non-Verbal By B.S. Sijwali

R2: How to prepare for data interpretation for CAT by Arun Sharma.

R3: How to Crack TEST OF REASONING in all competitive examinations by Jaikishan and Premkishan.

R4: Quantitative Aptitude for Competitive Examinations -Dr. R.S. Aggarwal, S. Chand

R5: Word Power Made Easy by Norman Lewis

R:6 Six weeks to words of power by Wilfred Funk

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

PROGRAMME	COURSE CODE	NAME OF THE COURSE	L T P C
B.E	22BM3191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2 0 0 0

Course Objective

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

2. To make the students understand the traditional knowledge and analyze it and apply it to their day to day life.

3. To impart basic principles of thought process, Itihas and Dharma Shastra and connecting society and nature.

4. To understand the concept of Intellectual and intellectual property rights with special Reference.

5. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and Indian philosophy.

Unit	Description	Instructional Hours
I	**Introduction to traditional knowledge:** Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vs indigenous knowledge, traditional knowledge vs western knowledge	6
II	**Protection of traditional knowledge:** The need for protecting traditional knowledge, Significance of TK Protection, value of TK in global economy, Role of Government to harness TK	6
III	**Itihas and Dharma-Shastra Itihas:** The Mahabharata - The Puranas - The Ramayana Dharma-Shastra**: Manu Needhi - The Tirukkural – Thiru Arutpa**	6
IV	**Traditional knowledge and intellectual property:** Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge	6
V	**Indian philosophy** Jain – Buddhist – Charvaka – Samkhya - Yoga - Nyaya - Vaisheshika - Saiva Siddhanta	6

Course Outcome

1. Identify the concept of Traditional knowledge and its importance.

2. Explain the need and importance of protecting traditional knowledge.

3. Explain the need and importance of Itihas and Dharma Shastra.

4. Interpret the concepts of Intellectual property to protect the traditional knowledge.

5. Interpret the concepts of indian philosophy to protect the traditional knowledge.

REFERENCES

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
3. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

4. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya
     Bhavan, Mumbai, 5th Edition, 2014.
5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation,
    Velliarnad, Amaku,am.

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.E	21BM5201	BIOCONTROL SYSTEMS	3	1	0	4

Course Objectives

1. To understand the concept behind feedback and continuum in various systems and subsystems.
2. To analyse the systems in time and frequency domain and to understand the concept of stability.
3. To apply mathematical modelling principles in understanding the various fundamental biological systems.
4. To understand biological system models.
5. To analyse biological control systems.

Unit	Description	Instructional Hours
	INTRODUCTION	
I	Open and Closed loop Systems, Block diagram and signal flow graph representation of systems, reduction of block diagram and signal flowgraph.	12
	TIME RESPONSE ANALYSIS	
II	Standard test signals,time response of first order and second order systems, time domain specifications,steady State errors.	12
	FREQUENCY RESPONSE ANALYSIS	
III	Determination of closed loop response from open loop response,Bodeplot, Nichol'schart,Polarplot.	12
	STABILITYANALYSIS	
IV	Characteristic equation,Location of rootsins-plane for stability,Routh Hurwitz criterion,Root locus techniques-Construction,Gain margin and phasemargin,Nyquist stability criterion.	12
	PHYSIOLOGICAL CONTROL SYSTEM ANALYSIS	
V	Difference between engineering and physiological control system-Model development of Cardio vascular system-Heart model-circulatory model - Simplemodels of muscle stretch reflexaction-Stability analysis of Pupillary lightreflex-Regulation of cardiac output,Regulation of ventilation.	12
	Total Instructional Hours	**60**

Course Outcomes

CO1:Understand the need for mathematical modeling of various systems,representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems.
CO2:Analyze the timer esponse of various systems and discuss the concept of systemst ability
CO3:Analyze the frequency response characteristics of various systems using different charts
CO4:Understand the concept of modeling basic physiological systems.
CO5:Comprehend the application aspects of time and frequency response analysis in physiological control systems.

TEXTBOOKS:

T1. I.J. Nagarath and M. Gopal ―Control Systems Engineering", Fifth Edition, AnshanPublishers,2008.(UNIT
T2.MichaelCKKhoo,

―PhysiologicalControlSystems‖,IEEEPress,PrenticeHallofIndia,2005

REFERENCES:

R1.BenjaminC. Kuo,―AutomaticControlSystems‖,PrenticeHallofIndia,1995.

R2. John Enderle Susan Blanchard, Joseph Bronzino ―Introduction to BiomedicalEngineering‖,secondedition,AcademicPress,2005.

R3.RichardC.Dorf, RobertH.Bishop,―Moderncontrolsystems‖, Pearson,2004.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.E	**21BM5202**	**BIOMECHANICS**	3	0	0	3

CourseO bjectives

Up on completion of this course,the students will be familiar with
1. Explain the principles of mechanics.
2. Discuss the mechanics of physiological systems.
3. Explain the mechanics of joints.
4. Illustrate the mathematical models used in the analysis of biomechanical systems.
5. Describe biomechanics of joints.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Scope of mechanics in medicine, mechanics of bone structure, determination ofin- vivoelasticmodulus.Biofluidmechanics,flowpropertiesofblood.Anthropometry.	9
II	**MECHANICSOFPHYSIOLOGICALSYSTEMS** Heartvalves, power developed by the heart,prosthetic valves.Constitutive quations for soft tissues, dynamics of fluid flow in cardiovascular system andeffectofvibration-shearstressesinextra-corporealcircuits..	9
III	**ORTHOPAEDICMECHANICS** Mechanical properties of cartilage, diffusion properties of articular cartilage,mechanical properties of bone,kinetics and kinematics of joints,Lubrication of joints.	9
IV	**MATHEMATICAL MODELS** Introduction to Finite Element Analysis, Mathematical models-pulse wave velocitiesinarteries,determinationofin-vivoelasticityofblood vessel, dynamics offluidfilledcatheters..	9
V	**ORTHOPAEDIC APPLICATIONS** Dynamics and analysis of human locomotion-Gait analysis(determinationof Instantaneous joint reaction analysis),occupant response to vehicular ibration. Mechanics of knee joint during standing and walking..	9

Instructional Hours Total	**45**

Course Outcomes

Upon completion of this course,the students will be able to
CO1: Understand the use of mechanics in medicine.
CO2:Understand the mechanics of physiological systems.
CO3: Distinguish the reason for abnormal patterns.
CO4:Analyze the biomechanical systems using mathematical models.
CO5:Design and develop the models specific to orthopedic applications.

TEXTBOOKS:
1.Y.C.Fung,―Bio-Mechanics,"MechanicalPropertiesofTissues'',Springer-Verilog,1998.
2.C.RossEtherandCraigA.Simmons,
"IntroductoryBiomechanicsfromcellstoorganisms",CambridgeUniversityPres
s,NewDelhi, 2009.

REFERENCE:
1.SusanJHall,"Basics of Biomechanics'',McGraw Hill
Publishing.co.NewYork,5thEdition,2007.
2.DhanjooN.Ghista,"OrthopaedicMechanics",AcademicPress,1999
3.JosephD.Bronzino, "BiomedicalEngineeringFundamentals",Taylor&Francis, 2006.
4.JohnEnderle,Susanblanchard,JosephBronzino,"Introduction to Biomedical
Engineering'',Elsevier,2005

.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	21BM5203	**MICROPROCESSORAND MICROCONTROLLERS**	3	0	0	3

Course Objective

1. Demonstrate the Architecture of 8086 microprocessor.
2. Interpret the system bus structure and Multiprocessor configuration of 8086microprocessor.
3. Apply the design aspects of I/O and Memory Interfacing circuits.
4. Examine theArchitecture of 8051microcontroller.
5. Practice the design aspect of interfacing circuits with 8051microcontroller.

Unit	Description	Instructional Hours
I	**8086 MICROPROCESSOR** Introductionto8086–Microprocessorarchitecture–Addressingmodes-Instruction set– Assemblylanguageprogramming–ModularProgramming-Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interruptserviceroutines.	9
II	**8086 SYSTEM BUS STRUCTURE AND MULTIPROCESSOR CONFIGURATIONS** Basic8086configurations–Systembustiming–BusStandards– Multiprocessorconfigurations– Coprocessor,CloselycoupledandlooselyCoupledconfigurations –Introductiontoadvancedprocessors.	9
III	**PERIPHERAL DEVICES AND THEIR INTERFACING** Addressspace portioning-Memory InterfacingandI/O interfacing-Parallelcommunicationinterface–Serialcommunicationinterface-D/Aand A/DInterface -Timer -Keyboard/displaycontroller –Interruptcontroller –DMAcontroller	9
IV	**8051 MICROCONTROLLER** Over view of 8051 family-Architecture of 8051 –I/O Pins Ports Circuits and I/OPortProgramming - Instruction set- Addressingmodes - Assembly languageprogramming.	9
V	**8051MICROCONTROLLER INTERFACING WITH PERIPHERAL DEVICE** 8051 Timers Programming - Serial Port Programming - Interrupts Programming – LCD&Keyboard Interfacing-ADC,DAC&Sensor Interfacing-ExternalMemory Interface- Interfacing with 8255- Stepper Motor Interfacing, Practical applications-Water level indicator and Zigbee interfacing.	9

Total Instructional Hours   **45**

Course Outcome	**CO1:** Write Assembly Language programs using 8086microprocessor.
	CO2: Pointout System Bus Structure and Multiprocessor Configuration.
	CO3: Analyze the various peripheral devices interfacing with8086microprocessor.
	CO4: Modeland implement8051microcontrollerbasedsystems.
	CO5: Experiment programson8051 microcontroller for interfacing various peripheral devices.

TEXTBOOKS:

T1 Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family -Architecture, Programming and Design",Second Edition, PrenticeHallofIndia,2007.

T2 MohamedAliMazidi,JaniceGillispieMazidi,RolinMcKinlay,"The8051MicrocontrollerandEmbedded Systems: Using Assembly andC",Second Edition,Pearsoneducation,2011

REFERENCEBOOKS:

R1 DoughlasV.Hall,"Microprocessors and Interfacing, Programming and Hardware,TMH,2012

R2 A.K.Ray,K.M.Bhurchandi,"Advanced Microprocessors and Peripherals"3rd edition,Tata McGraw Hill,2012

R3 N.SenthilKumar,M.Saravanan,S.Jeevananthan,"Microprocessors and Microcontrollers",Oxford University Press,2000.

R4 B.Ram,"Microprocessors and Microcontrollers",8th Edition, DhanpatRai Publications Pvt.Ltd.,2015.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	21BM5204	BIOMEDICAL INSTRUMENTATION	3	0	0	3

<table>
<tr><td rowspan="5">Course Objective</td><td>I.</td><td>To Illustrate about the measurement systems.</td></tr>
<tr><td>II.</td><td>To design bio amplifier for various physiological recordings.</td></tr>
<tr><td>III.</td><td>Detection of physiological parameters using impedance techniques.</td></tr>
<tr><td>IV.</td><td>To learn the different measurement techniques form on-physiological parameters.</td></tr>
<tr><td>V.</td><td>To Summarize different patient safety procedures.</td></tr>
</table>

Unit	Description	Instructional Hours
I	**BIOPOTENTIAL ELECTRODES** Origin of biopotential and its propagation.Electrode-electrolyte interface,electrode– skin interface, half-cell potential,impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle andmicro electrodes and their equivalent circuits. Recording problems – measurement with two electrodes.	9
II	**BIOPOTENTIAL MEASUREMENT** Bio signal characteristics– frequency and amplitude ranges. ECG – Einthoven'striangle, standard 12 lead system, block diagram. Measurements of heart sounds -PCG.EEG–10-20electrode system,unipolar,bipolar and averagemode,Functional block diagram. EMG – unipolar and bipolar mode, blockdiagram,EOG and ERG.	9
III	**BIOPOTENTIAL AMPLIFIER** Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier.Bandpass filtering,isolation amplifiers–transformer and opticalisolation-isolated DC amplifier and AC carrier amplifier. Artifacts and removal.	9
IV	**NONELECTRICAL PHYSIOLOGICAL PARAMETER MEASUREMENT** Temperature,respiration rate and pulserate measurements,Plethysmography,Pulse oximetry, Blood Pressure: direct methods - Pressure amplifiers - systolic,diastolic,mean detector circuit,indirect methods-auscultatory method,oscillometric method,ultrasonic method.Bloodflow-Electromagnetic and ultrasound bloodflow measurement.Cardiac output measurement-Indicator dilution, dyedilution and thermodilution method.	9

BIOCHEMICALMEASUREMENT

V   Biochemical sensors - pH, pO2 and pCO2, Ion selective Field Effect Transistor(ISFET), immunologically sensitive FET (IMFET), Blood glucose sensors – Blood gas analyzers, colorimeter,flame photometer,spectro photometer,bloodcell   9

counter,auto analyzer.

Total Instructional Hours   45

CO1:To understand the various concepts of measurement systems.

Course Outcome   CO2: To understand the method of designing bio amplifiers.

CO3:To understand about the Detection of physiological parameters using impedance techniques.

CO4: To understand about measurement of non electric parameter.

CO5:To understand about Patient safety and electromedical equipment.

TEXTBOOKS:

T1-JosephJ.CarrandJohnM. Brown,"Introduction to Biomedical Equipment Technology",Pearson Education India,Delhi,2004

T2-.Cromwell,"Biomedical Instrumentation and Measurements",Prentice Hall of India,New Delhi,2007.

REFERENCE BOOKS: R1- Khandpur .R.S., "Handbook of Biomedical Instrumentation ",Prentice Hall of India, New Delhi,2003.

R2-   Jacobson Band Webster J G Medical and Clinical Engineering–Prentice Hall of India New

R3- John.G.Webster. "Medical Instrumentation, Application and Design "Fourth Edition. Wiley & sons, Inc, New York.2011.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	21BM5251	**VIRTUAL INSTRUMENTATIONUSING LabVIEW**	2	0	2	3

Course Objective	Understand the fundamentals of Virtual Instrumentation. 1. Idea behind the software used inVirtual Instrumentation and its functions 2. To familiarize with the basic programming and working concept in LabVIEW. 3. Acquire biological data and develop applications using LabVIEW.

UNIT	Description	Instructional Hours
I	**INTRODUCTION** Virtual Instrumentation Architecture,Conventional Virtua lInstruments, Distributed Virtual Instruments, Virtual instruments Vs Traditional Instruments,Advantages of VI,Evolution LabVIEW.	9
II	**INTRODUCTION TO LabVIEW AND ITS PROGRAMMING MODES** Front Panel and Block Diagram of LabVIEW, LabVIEW environment and itsMenus,PalletsofLabVIEW,CreatingVIusingLabVIEW,Loops,Arrays,Clusters,Strings,Registers,Structures,Nodes,ControlsandIndicators for clusters and strings, Waveform chart and Graph types and File I/O.**Experiments:** *1. Basic operations,controls and Indicators.* *2. Simple programming structures and Timing Issues.*	6+(3)P
III	**HARDWARE INSTRUMENT CONTROLS** Virtual Instruments Software Architecture (VISA), Digital I/O techniques,Data Acquisition in LabVIEW, DAQ Hardware Installation and configuration, DAQ Hardware Sampling and Grounding Techniques, Analog and DigitalI/O,Counter/Timer,Network data acquisition techniques. **Experiments:** *1.Data Acquisition using Virtual instrumentation from temperature/vibration Transducer.*	6+(3)P
IV	**I TOOLKITS** Biomedical toolkit, Signal Processing Tools-Fourier Transform, Power Spectrum,Correlation,Windowing,Filters,Digital Filter Design Toolkit,	6+(3)P

Control System DesignToolkit, Communication DesignToolkit, Vision And MotionTools,Image processingToolkit.

Experiments:
1. *Computerized data logging of ECG signal and find the heart beat rate using LabVIEW*
2. *Acquisition of PCG,EMG Signal*

V   **BIOMEDICALAPPLICATIONUSINGLabVIEW**   9

Case study: Process Control and Automation Application, Biomedical application,robotics application,IoT application using LabVIEW,Real Time acquisition of ECG,EMG,PCG and EEG signals.

Total Instructional Hours   45

CO1	Analyze Virtual Instruments in Healthcare Domain
CO2	Explain Virtual Instruments process and software.
CO3	Illustrate concepts of LabVIEW in Realtime application.
CO4	Use DAQ for data acquisition and VI Toolkits for analysis.
CO5	Outline various research applications using LabVIEW.

TEXTBOOKS:

1. John Essick,"Hands-On Introduction to LabVIEW for Scientists and Engineers",Oxford University Press,Fourth edition,2018.
2. Sanjay Gupta, Joesph John,"Virtual Instruments using LabVIEW", TATA Mc Graw Hill, New Delhi,2017.

REFERENCES:

1. Ronald W.Larsen,"LabVIEW for Engineers",Pearson,First edition,2010.
2. Robert H.Bishop,"Learning with LabVIEW",Pearson, First edition, 2014.

Chairman   BoS
BME - HiCET

Chairman

Dean(Academics)
HiCET

25

Programme	Course Code	Name of the Course	L	T	P	C
BE	21BM5001	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	0	0	3	1.5

Description of the Experiments

1. Simple arithmetic operations: addition/subtraction/multiplication/division.
2. Programming with control instructions:
(i) Ascending/Descending order, Maximum/Minimum of numbers.
(ii) Programs using Rotate instructions.
(iii) Hex/ASCII/BCD code conversions.
3. Interface Experiments:with8085
(i)A/D Interfacing. & D/A Interfacing.
4. Traffic light controller.
5. I/O Port /Serial communication
6. ProgrammingPracticeswithSimulators/Emulators/opensource
7. Readakey,interface display
8. Demonstration of basic instructions with 8051Microcontroller execution,including:
 (i)Conditional jumps, looping
 (ii)Calling sub routines.
9. Programming I/O Port8051
(i)study on interface with A/D&D/A
(ii)study on interface with DC & AC motor.
  10.   Miniproject development with processors.

Practical Hours:45

	CO1: understand the basic arithmetic operations in8085.
	CO2: Ability to understand and analyze, about 8085microprocessor
Course Outcome	CO3: understanding of various interfacing techniques in microcontrollers
	CO4: understand the basic arithmetic operations in 8051
	CO5: Analyze and demonstrate an mini project using microcontroller.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

26

**BE   21BM5002   BIOMEDICAL INSTRUMENTATION   0 0 3 1.5
LABORATORY**

Description of the Experiments

1. To study the different types of electrodes.

2. To study the Electrocardiogram System.

3. Bedside monitor

4. Evoked Potential Monitoring System(With Auditory,Photic and Electric Stimulus)

5. Measurement of pulse-rate using Photo transducer.

6. Measurement of pH and conductivity.

7. Surgical diathermy.

8. GSR Measurement setup with Software and Accessories(PC based)-Without PC Workstation.

9. Ultrasound DopplerBlood FlowMonitor.

10. TostudyPlethysmographSystem.

11. TostudyPhonocardiographSystem.

12. To study X-ray produced by X-raymachine.

                                                                      Practical Hours:45

Course Outcome	CO1: Identify various Bio-potential and their specifications interms of amplitude and frequency. CO2: Understand principle and working of various Biomedical Instruments for vital parameter monitoring. CO3: Decide the applications of therapeutic instruments for treatment purpose. CO4: Understand applications of imaging instruments and the modalities involved in each technique. CO5: Understand applications of imaging instruments and the modalities involved in each technique.

Chairman   BoS
BME - HiCET

Chairman

Dean(Academics)
HiCET

PROFESSIONAL ELECTIVE I

PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E/B.Tech	21BM5301	MEDICAL PHYSICS	3	0	0	3

Course Objective

1. To apply the basic concept of radiation physics
2. To Know about the genetic effect and Optical radiation principle
3. Students should know about the fundamentals of Radiation saftety.

UNIT	DESCRIPTION	TOTAL INSTRUCTIONAL HOURS
I	**BASICS OF RADIATION PHYSICS** Atomic Structure - Nuclear Transformation - Radioactivity and Interaction;electromagneticradiation,chargedparticlesandneutrons- Radiationattenuation coefficients – Principle of Radiation dosimetric device - cavitytheories Bremsstrahlung effect, Annihilation Interaction of X and Gammaradiation with matter- Compton Scattering , Pair production -Non IonizationmedicalRadiationphysics- Penetrationandpropagationofsignaleffectsin variousvitalorgans.	9
II	**MOLECULAR PHYSICS AND GENETIC EFFECTS** Introduction- Molecular biophysics - Phases of matter – GIBBS law – TheHagen-poiseuillelaw– StrokesLaw–Raoultlaw–Osmoticpressure– Diffusion–Phaseborderphenomena.GeneticEffects-EffectsonDNA damage,embryo,Chromosomaldamage- factorsaffectingfrequencyofradiationinducedmutation- Genecontrolledhereditarydiseases.	9
III	**ACOUSTICS AND OPTICAL RADIATION** Introduction of Acoustics and properties – Doppler effect- Piezo electriceffect-weber-Fechnerslaw–Effectsofultrasoundintissues- Shockwaves – Propagation of light – Light scattering - Photo Medicine –Various types ofopticalradiations- Opticalpropertiesoftissues,applicationsofopticalradiations.	9
IV	**INTERACTION OF NUCLEAR PHYSICS** Principles of Nuclear Physics – Natural radioactivity, Decay series, type of radiation and their properties. Production of artificial isotopes – acceleratorprinciples:Betatron,Cyclotron.fissionandelectronCapturereaction, radionuclideGenerator-Technetiumgenerator–Applicationsofartificial Isotopes and Radio nuclides in Nuclear Medicine and biology.	9

	RADIATIONONCOLOGY&SAFETY	
V	Introduction-exposure-Inversesquarelaw-KERMA-BremsstrahlungradiBragg'scurve-PrinciplesofMPD,ADELandALARA-concept of LD Gammaknife–LINAC–Chemotherapy–Brachytherapy–Dosimeter–RaddetectorandTypes–RadiationsafetyandItsPrinciple	9

TOTAL INSTRCTIONAL HOURS   **45**

CO1: Analyze the physics of Radiation.
CO2: Understand the use of molecular and Genetic Engineering.
CO3: Understand principles of Acoustics and Optical radiation
CO4: analyze the interaction methods of Nuclear Physics.
CO5: understand the basics of radiation Oncology and safety principles.

TEXTBOOKS
1. Daniel Jirak, Frantisek Vitek Basics of Medical Physics.
2. MoumitaMukherjee ,J.K. Mandal, Advance in medical Physics and healthcare Engineering, Springers Singapore,2021.

REFERENCES
1. P.Uma Devi, A.Nagarathnam ,B S Satish Rao,"Introduction to Radiation Biology" B.IChurChillLivingstonepvtLtd,2000.
2. S.Webb" The Physics of Medical Imaging", Taylor and Francis,
2018.3.J.P.Woodcock,Ultrasonic,MedicalPhysicsHandbookseries1, AdamHilger,Bristol.

Chairman BoS
BME - HiCET

Chairman

Dean(Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	21BM5302	Robotics in Medicine	3	0	0	3

Course Objectives:

1. To study the characteristics of robotics.
2. To understand the response of actuators and gripper.
3. To learn about the pneumaticmanipulators
4. To know the compatibility and functioning power source and sensors

UNIT I   INTRODUCTION OF ROBOTICS   9

Introduction to Robotics and his history, Overview of robot subsystems, Degrees of freedom,Configurations-Automation,Mechanisms and movements,Dynamic stabilization-Applicationof robotics in medici

UNIT II   ACTUATORS AND GRIPPERS   9

Pneumatic and hydraulic actuators, stepper motor control circuits, End effectors, Various types of Gripper and methods, Design consideration in vacuum and, PD and PID feedback actuator models.

UNIT III   MANIPULATORS AND BASIC KINEMATICS   9

Constructionof Manipulators,Electronicand pneumaticmanipulator,Forward Kinematic,InverseKinematics.

UNIT IV   POWER SOURCE AND SENSORS   9

Sensors and controllers,Internal and external sensors,position,velocity and acceleration sensors, Proximity sensors, force sensors, laser range finder, LASER – Acoustic , Magneticfibreoptic and Tactilesensor.

UNIT V   ROBOTICS APPLICATION IN MEDICAL FIELD   9

DaVinci Surgical system,Image guided robotic system in USG,Robotic Tele-surgical system .Urologic applications,Cardiac(CABG)surgery,Neurosurgery,Paediatric,and general–Surgery,Gynaecologic Surgery,Laparoscopy,General Surgery and Nanorobotics.

TOTAL: 45 PERIOD

COURSE OUTCOMES:

At the end of the course, the student will able to

CO1: Analyze different types of materials and its application in Robotics

CO2: Choose materials for design of Robotics.

CO3: Evaluate response of robotic in medical field.

CO4: Assess compatibility and functioning of robots

CO5: Design and develop robots for biomedical application.

TEXTBOOKS

1. Nagrath and Mittal, ”Robotics and Control”, Tata Mc Graw-Hill, First edition,2003.
2. Spong and Vidhyasagar, "RobotDynamicsandControl",JohnWiley and Sons,First edition,2008.
3. Fu.K.S. Gonzalaz.R.C., Lee C.S.G," Robotics Control", sensing , Vision and Intelligence, Tata McGrawHillInternational, Firstedition, 2008.

REFERENCES

1. How ie Choset, kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and SebastianThurn,"Priniples of robot motion:Theory,Algorithms,and Implementations",Prentice hall of India,First edition,2005

2. Jacob Rosen, Blake Hannaford & Richard M Satava, " Surgical Robotics: System

   Applications&Visions",Springer2011

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.E	21BM5303	**TOTAL QUALITY MANAGEMENT**	3	0	0	3

Course Objectives	Up on completion of this course, the students will be familiar with 1. To facilitate the understanding of Quality Management framework. 2. Understand TQM principles. 3. Learn TQM Tools and Techniques. 4. Know Quality Function Deployment(QFD),Taguchiquality loss function. 5. Understand Quality Management System.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQMFramework-ContributionsofDeming,JuranandCrosby-BarrierstoTQM-Customer focus-Customer orientation,Customer satisfaction,Customer complaints,Customer retention.	9
II	**TQM PRINCIPLES** Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employeeinvolvement-Motivation,Empowerment,TeamandTeamwork,RecognitionandReward,Performanceappraisal-Continuousprocess improvement-PDCA cycle,5S,Kaizen-Supplierpartnership-Partnering,Supplierselection,SupplierRating.	9
III	**TQM TOOLS AND TECHNIQUES I** The seven traditional tools of quality - Newmanagement tools - Six sigma:Concepts, Methodology, applications to manufacturing, service sector includingIT-Benchmarking-Reasontobenchmark,Benchmarkingprocess-FMEA-Stages,Types.	9
IV	**TQM TOOLS AND TECHNIQUES II** QualityCircles-CostofQuality-QualityFunctionDeployment(QFD)-Taguchiqualitylossfunction-TPM-Concepts,improvementneeds-Performancemeasures.	9
V	**QUALITY MANAGEMENT SYSTEM** Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-SpecificStandards—AS9100,TS16949andTL9000--ISO9001Requirements—Implementation—Documentation—InternalAudits—Registration-ENVIRONMENTALMANAGEMENTSYSTEM:Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO14001—Benefits ofEMS.	9
	Total Instructional Hours	**45**

Course Outcomes	CO1: The student would be able to apply the tools and techniques of quality management to manufacturing and services processes. CO2: Discuss TQM principles. CO3: Able to use TQM Tools and Techniques. CO4: Apply Quality Function Deployment (QFD), Taguchiquality lossfunction. CO5: The student would be able to apply the Quality Management System.

TEXTBOOKS:

T1.DaleH.Besterfiled,CarolB.Michna,GlenH.Besterfield,MaryB.Sacre,HemantUrdhwareshe and RashmiUrdhwareshe, ―Total Quality Management‖, Pearson EducationAsia,RevisedThirdEdition,Indian Reprint,Sixth Impression,2013.

REFERENCES:

R1.JamesR.EvansandWilliamM.Lindsay,"TheManagementandControlofQuality",8thEdition,First IndianEdition,CengageLearning,2012.

R2. Janakiraman.BandGopal.R.K.,"TotalQualityManagement-TextandCases",PrenticeHall(India)Pvt.Ltd.,2006.

R3. Suganthi.LandAnandSamuel,"TotalQualityManagement",PrenticeHall(India)Pvt. Ltd.,2006.

R4. ISO9001-2015standards.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E/B.Tech	21BM5304	MEDICAL ETHICS AND STANDARDS	3	0	0	3

Course Objective
1. Achieve familiarity with some basic ethical framework& understand how theseethical frameworks can help us to think through contemporary questions inmedicalethics.
2.Studentswill be able to know about the legal and ethical principles
3. To apply these principles in health care settings & gain knowledge about the medical standards that to be followed in hospitals.

UNIT	DESCRIPTION	TOTAL INSTRUCTIONAL HOURS
I	**INTRODUCTION TO MEDICAL ETHICS** Definition of Medical ethics, Scope of ethics in medicine, Americanmedical Association code of ethics, CMA code of ethics- FundamentalResponsibilities, The Doctor and The Patient, The Doctor and TheProfession,ProfessionalIndependence,TheDoctorandSociety	9
II	**ETHICAL THEORIES& MORAL PRINCIPLES** Theories-Deontology & Utilitarianism, Casuist theory, Virtue theory,TheRightTheory.PrinciplesNon- Maleficence,Beneficence,Autonomy, Veracity, Justice. Autonomy & Confidentiality issues inmedicalpractice,EthicalIssuesinbiomedicalresearch,BioethicalissuesinHumanGenetics&ReproductiveMedicine	9
III	**HOSPITAL ACCREDITATION AND SAFETY STANDARDS** Accrediation -JCI Accreditation &its Policies. Patient centered tandards, Healthcare Organization management standards.	9
IV	**HOSPITAL SAFETY STANDARDS** Life Safety Standards- Protecting Occupants, Protecting the Hospital from Fire, Smoke, and Heat, Protecting Individuals from Fire and Smoke, Providing and Maintaining Fire Alarm Systems, Systems for Extinguishing Fires Environment of Care Standards-Minimizing ECRisks, Smoking Prohibitions, Managing Hazardous Material and Waste,Maintaining Fire Safety Equipment, Features,Testing,Maintaining,and Inspecting Medical Equipment.	9
V	**MEDICALEQUIPMENTSAFETYSTANDARDS** Fi General requirements for basic safety & essential performance of medical equipment.IEC60601standards,Indian and International standards,ISO standards-Base Standard-general requirement of Electrical medical devices,Collateral Standards-EMC radiation protection	9

&programmable medical device system,Particular Standards-type of medical device.

TOTAL INSTRCTIONAL HOURS   45

Course Outcome	Upon completion of the course, students will be able to CO1:Describe the Social responsibility in healthcare systems CO2:Discuss the Bio ethics and engineers role CO3: Apply Legaland professional guidelines for the hospital accreditation CO4: Understand hospital safety aspects. CO5:Comprehend the medical equipment safety standards and medical device maintenance.
TEXT BOOKS:	T1:DomielA Vallero,Biomedical Ethics for Engineers, ElsevierPub.1stedition,2017 T2:Johnna Fisher,Biomedical Ethics:ACanadianFocus.,Oxford University Press Canada,2019.
REFERENCEBOOKS:	R1: RobertMVeatch,The Basics of BioEthics,3rdEdition.Routledge,2019. R2:PhysicalEnvironmentOnline:AGuidetoTheJointCommission'sSafetyStandardsis published byHCPro,Inc.2020

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	CourseCode	Name of the Course	L	T	P	C
B.TECH	**21BM5305**	**INTELLECTUAL PROPERTY RIGHTS**	**3**	**0**	**0**	**3**

Course Objectives	Uponcompletionofthiscourse,thestudentswillbefamiliarwith 1. To give an idea about IPR,Patents and Copyrights. 2. Understand registration of IPRs. 3. Understand Agreements and Legislations. 4. To know Digital products and Law. 5. Discuss IPRand its enforcement.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents,Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, IndustrialProperty,technologicalResearch,InventionsandInnovations–Important examples ofIPR.	9
II	**REGISTRATIONOFIPRs** Meaningandpracticalaspectsofregistrationof CopyRights,Trademarks,Patents, Geographical Indications, Trade Secrets and Industrial Design registration inIndiaandAbroad.	10
III	**AGREEMENTSANDLEGISLATIONS** InternationalTreatiesandConventionsonIPRs,TRIPSAgreement,PCTAgreement,PatentActofIndia,PatentAmendmentAct,DesignAct,Trademark Act,GeographicalIndicationAct.	10
IV	**DIGITALPRODUCTS ANDLAW** Digital Innovations and Developments as Knowledge Assets – IP Laws, CyberLawandDigitalContentProtection–UnfairCompetition– MeaningandRelationshipbetweenUnfairCompetitionandIPLaws–CaseStudies.	9
V	**ENFORCEMENTOFIPRs** InfringementofIPRs,EnforcementMeasures,Emergingissues–CaseStudies.	7
	Total Instructional Hours	**45**

Up on completion of this course,the students will be able to

Course Outcomes

CO1: Ability to manage Intellectual Property port folio to enhance the value of the firm.
CO2: Discuss registration of IPRs.
CO3: Able to use Agreements and Legislations of IPR.
CO4: Use Digital products and Law.
CO5: Acquire knowledge of IPR and its enforcement.

TEXT BOOKS:
T1.V.ScopleVinod,Managing Intellectual Property, PrenticeHall of IndiapvtLtd,2012
T2.S.V.Satakar,―Intellectual Property Rights and Copy Rights,EssEssPublications,NewDelhi,2002.

REFERENCES:
R1.DeborahE.Bouchoux,―IntellectualProperty:TheLawofTrademarks,Copy rights,Patents andTradeSecrets‖,CengageLearning,ThirdEdition,2012.
R2.Prabuddha Ganguli,‖Intel lectual Property Rights:Unleashing the Knowledge Economy‖,
McGrawHillEducation,2011.
R3.Edited by DerekBosworth and ElizabethWebster,The Management of Intellectual Property,Edward Elgar PublishingLtd.,2013.

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

38

| BE | 21BM5205 | Modeling of Physiological System | 3 | 0 | 0 | 3 |

Course Objective

To provide basic ideas related to modelling techniques of Physiological System.
To provide basic ideas related to modelling techniques of Circulatory System and Bone Modeling.
To provide basic ideas related to modelling techniques of Thermal Regulation System.
To provide basic ideas related to modelling techniques of Ultra-Filtration System.
To provide basic ideas related to modelling techniques of Respiratory System.

Unit	Description	Instructional Hours
I	**BASICS OF PHYSIOLOGICAL SYSTEMS** Systems Analysis, examples of physiological control systems, differences between engineering and physiological control systems. Generalized system properties, mathematical approach, electrical analogs, linear models, lung mechanics, muscle mechanics, distributed parameter versus lumped parameter models, static analysis, regulation of cardiac output, blood glucose regulation, chemical regulation of ventilation, electrical model of neural control mechanism	9
II	**CIRCULATORY SYSTEMS AND BONE MODELLING** Physical, chemical and rheological properties of blood, problems associated with extracorporeal blood flow, dynamics of circulatory system. Properties of bones, modeling of bones, hills model.	9
III	**THERMAL REGULATORY SYSTEM** Parameters involved, Control system model etc. Biochemistry of digestion, types of heat loss from body, models of heat transfer between subsystem of human body like skin core, etc. and systems like within body, body- environment, etc.	9
IV	**ULTRA FILTRATION SYSTEM** Transport through cells and tubules, diffusion, facilitated diffusion and active transport, methods of waste removal, counter current model of urine formation in nephron, Modelling Henle's loop	9
V	**RESPIRATORY SYSTEM** Modelling oxygen uptake by RBC and pulmonary capillaries, Mass balancing by lungs, Gas transport mechanisms of lungs, oxygen and carbon di oxide transport in blood and tissues.	9
	Total Instructional Hours	**45**

Course Outcome

CO1	Explain the application of basic Physiological system
CO2	Understand the concept of Circulatory system and bone modeling
CO3	Familiarize the parameters involved in Thermal regulatory system
CO4	Understand the process of Ultra filtration system
CO5	Enumerate the mechanism of Respiration

TEXT BOOKS:
T1   Khandpur, R.S., "Hand book of Bio-Medical Instrumentation", II ed., Tata McGraw Hill Pub. Co., Ltd., 2003
T2   Patrick Rcully, Electrical Simulation &Electro pathology, Cambridge University press 4. Joseph Bronzino, Biomedical Instrumentation.

REFERENCE BOOKS:
R1   John.G.Webster., "Medical Instrumentation – Application And Design", Ii Ed., John Wiley & Sons, Inc., New York, 2007.
R2   Joseph Dubovy, "Introduction To Biomedical", Mcgraw Hill Co., 1978.
R3   Terry Bahil.A., "Bio-Medical And Clinical Engineering", Prentice Hall Inc.1981.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	21BM5601	Basics of Anatomy and Physiology	3	0	0	3

Course Objective
1. To learn the basic components of formation of systems
2. To identify all the organelles of an animal cell and their function.
3. To understand structure and functions of the various types of systems of human body.
4. To demonstrate their knowledge of importance of anatomical features and physiology of human systems

Unit	Description	Instructional Hours
I	**INTRODUCTION** Level of Organization – Metabolism and Homeostasis – Plan of Body – Body Parts and Areas, Planes and Sections. Elements in the Human Body – Inorganic Compounds and Organic Compounds	9
II	**BASIC STRUCTURE AND FUNCTION OF ANIMAL CELL** Structure of Cell – Structure and Function of Cell Membrane and Sub organelles. Cellular Transport Mechanism – Cell Division – Mitosis and Meiosis	9
III	**TISSUES, MEMBRANE AND SKELETAL SYSTEM** Epithelial tissue – Connective tissue – Muscle tissue – Nerve tissue – Membrane. Types of Bone tissue - Classification of Bones – Functions of the Skeleton system – Skull, Vertebral Column. Joint - Articulation	9
IV	**NERVOUS AND CARDIOVASCULAR SYSTEMS** Nervous system: Types and Structure of Neuron – Mechanism of Nerve Impulse - Structure and Parts of Brain. Sensory organ: Eye and Ear.Cardiovascular: Composition of Blood and functions – Structure of Heart – Conduction system of Heart – Types of Blood vessel – Blood Pressure.	9
V	**DIGESTIVE AND URINARY SYSTEMS** Digestive: Organs of Digestive system – Digestion and Absorption. Urinary: Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System.	9
	Total Instructional Hours	**45**

Course Outcome
CO1 Familiarize with the requirements for formation of systems
CO2 understand the basic structural and functional elements of human body
CO3 Acquire knowledge on Skeletal and muscular systems
CO4 comprehend circulatory and nervous systems and their components
CO5 Understand the importance of digestive and urinary systems in Human body

TEXT BOOKS:

T1   InduKhurana, ArushiKhurana., "Textbook of Anatomy and Physiology",2nd Edition,
      CBS Publishers & Distributors,2022.
T2   Edith Applegate MS .,The Anatomy and Physiology Learning System., 4th Edition .,
      sanders elsevier.,2010.

REFERENCE BOOKS:

R1   Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, Fundamentals of Anatomy
      and Physiology. Tenth Edition, Pearson Publishers, 2014
R2   Guyton & Hall, "Medical Physiology", 13th Edition, Elsevier Saunders, 2015.
R3   Elaine.N. Marieb , "Essential of Human Anatomy and Physiology", Eight Edition,
      Pearson Education, New Delhi 2007

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	21BM5204	Critical Care Equipments	3	0	0	3

Course Objective	To understand the equipment used in Surgeries.	
	To elaboratethe equipment used in Critical Care Equipment.	
	To understand the conceptsof equipment used in Operation Theatre Equipment.	
	To understand the concepts of equipment used in Centralized Systems.	
	To analyzethe concepts of equipment used in Patient Safety.	

Unit	Description	Instructional Hours
I	**ICU EQUIPMENT** Suction apparatus – Different types; Sterilizers – Chemical, Radiation, Steam for small and larger units.Automated drug delivery systems- Infusion pumps, Closed loop control infusion system, Implantableinfusion system.	9
II	**CRITICAL CARE EQUIPMENT** Hemo Dialysis Machine- Different types of Dialyzers, Membranes, Machine controls and measurements.Heart Lung Machine – different types of oxygenators, peristaltic pumps, Incubators.	9
III	**OPERATION THEATRE EQUIPMENT** Surgical diathermy, Instruments for operation. Anesthesia Equipment – Humidification, Sterilization aspects – Boyles apparatus.	9
IV	**CENTRALIZED SYSTEMS** Centralized Oxygen, Nitrogen, Air supply & Suction.Centralized Air – Conditioning, Operation Theatre table & Lighting.	9
V	**PATIENT SAFETY** Patient electrical safety – Types of hazards – Natural protective mechanisms against electricity – Leakagecurrent – Inspection of grounding and patient isolation, Hazards in operation rooms – ICCU and IMCUs –Opto couplers and Pulse transformers.	9
	Total Instructional Hours	**45**

Course Outcome	CO1	Interpret technical aspects of surgical equipment
	CO2	Maintain the performance of life support equipment
	CO3	Identify intensive care equipment for the upkeep and maintenance of ICCU.
	CO4	Understand concepts of centralized systems.
	CO5	Understand concepts of electrical safety in medical equipment

TEXT BOOKS:

T1	Khandpur, R.S., "Hand book of Bio-Medical Instrumentation", II ed., Tata McGraw Hill Pub. Co., Ltd., 2003
T2	Patrick Rcully, Electrical Simulation &Electro pathology, Cambridge University press 4. Joseph Bronzino, Biomedical Instrumentation.

REFERENCE BOOKS:

R1	John.G.Webster., "Medical Instrumentation – Application And Design", Ii Ed., John Wiley & Sons, Inc., New York, 2007.
R2	Joseph Dubovy, "Introduction To Biomedical", McgrawHill Co., 1978.
R3	Terry Bahil.A., "Bio-Medical And Clinical Engineering", Prentice Hall Inc.1981.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	19BM7201	**DIAGNOSTIC AND THERAPEUTIC EQUIPMENT – II**	3	0	0	3

Course Objective	1. Gather basic knowledge about measurements of parameters related to respiratory system. 2. Learn measurement techniques of sensory responses and Hearing Aid Equipments. 3. Understand different types and uses of diathermy units. 4. Know ultrasound imaging technique and its use in diagnosis . 5. Know the importance of patient safety against electrical hazard .

Unit	Description	Instructional Hours
I	**INSTRUMENTS DEALING WITH BONES AND RESPIRATORY CARE** Respiratory care equipments: humidifier, nebulizer, aspirators - Ventilators and types- Capnography -Anesthesia machine - Baby incubator-BMD measurements- Single X-ray Absorptiometry (SXA) -Dual X-ray Absorptiometry (DXA) - Quantitative ultrasound- bone densitometer.	9
II	**SENSORY DIAGNOSIS AND HEARING AID EQUIPMENTS** Mechanism of hearing, sound conduction system - basic audiometer, pure tone audiometer - Speech audiometer, Bekesy audiometer system - Evoked response audiometry system - Hearing aids-cochlear implants - Tonometry - Measurement of basal skin response and galvanic skin response.	9
III	**DIATHERMY** Short wave diathermy -Microwave diathermy -Ultrasonic therapy unit -Electro diagnostic and therapeutic apparatus -Interferential current therapy-Transcutaneous electrical nerve stimulation(TENS)-Spinal cord stimulator-bladder stimulator-deep brain stimulation - Photo therapy unit	9

ULTRASONIC TECHNIQUE

IV	Characteristics of sound- interactions of ultrasound with matter -Ultrasound transducers-ultrasound beam properties-image data acquisition -Modes of image display and storage - Doppler ultrasound-Ultrasound doppler blood flow meter -Ultrasonography in emergency cardiovascular care - Echocardiogram- Echoencephalogram	9

PATIENT SAFETY

V	Physiological effects of electricity – important susceptibility parameters – Macro shock – Micro shock hazards – Patient's electrical environment – Isolated Power system – Conductive surfaces- Electrical safety codes and standards – IEC 60601-1 2005 standard, Basic Approaches to Protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system.	9

Total Instructional Hours   **45**

Course Outcome	**CO1**: Explain about measurements of parameters related to respiratory system. **CO2:** Describe the measurement techniques of sensory responses. **CO3:** Analyze different types and uses of diathermy units. **CO4:** Discuss ultrasound imaging techniques and its usefulness in diagnosis. **CO5:** Outline the importance of patient safety .

TEXT BOOKS:

T1   Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

T2   Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007

REFERENCE BOOKS:

R1   Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

R2   L.A Geddas and L.E.Baker "Principles of Applied Biomedical Instrumentation" 2004.

R3   John G. Webster, "Bioinstrumentation", John Willey and sons, New York, 2004.

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

19

Programme	Course Code	Name of the Course	L	T	P	C
B.E	19BM7202	**MEDICAL IMAGE PROCESSING**	3	0	0	3

Course Objective

6. To become familiar with digital image fundamentals
7. To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
8. To learn concepts of degradation function and restoration techniques.
9. To study the image segmentation and representation techniques.
10. To become familiar with image compression and recognition methods

Unit	Description	Instructional Hours
I	**DIGITAL IMAGE FUNDAMENTALS** Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.	9
II	**IMAGE ENHANCEMENT** Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.	9
III	**IMAGE RESTORATION** Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering	9
IV	**IMAGE SEGMENTATION** Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.	9
V	**IMAGE COMPRESSION AND RECOGNITION** : Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.	9
	Total Instructional Hours	**45**

Course Outcome	CO1: Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

Course Outcome

CO1: Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

CO2: Operate on images using the techniques of smoothing, sharpening and enhancement.

CO3: Understand the restoration concepts and filtering techniques.

CO4: Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

CO5: Able to analyze image compression and recognition methods

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, ‗Digital Image Processing‗, Pearson, Third Edition, 2010.
2. Anil K. Jain, ‗Fundamentals of Digital Image Processing‗, Pearson, 2002.

REFERENCES:

1. Kenneth R. Castleman, ‗Digital Image Processing‗, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, ‗Digital Image Processing using MATLAB‗, Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau, ‗Multidimensional Digital Signal Processing‗, Prentice
    Hall Professional Technical Reference, 1990.
4. William K. Pratt, ‗Digital Image Processing‗, John Wiley, New York, 2002
5. Milan Sonka et al ‗Image processing, analysis and machine vision‗, Brookes/Cole, Vikas
    Publishing House, 2nd edition, 1999

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

21

Course code	**HOSPITAL MANAGEMENT**	L	T	P	C
19BM7203		**3**	**0**	**0**	**3**

Course Objective:

The student should be made to:

To understand the fundamentals of hospital administration and management

To learn the types of codes followed and applications

To explore various information management systems and relative supportive services

Learn the procedures of Clinical Engineering

To learn the quality and safety aspects in hospital

Course Outcomes:

At the end of this course, students will be able to

Explain the principles of Hospital administration.

Classify the types of codes followed and applications

Identify Information management systems and its uses.

Understand procedures of Clinical Engineering

Understand safety procedures followed in hospitals.

UNIT I   Overview of Hospital Administration   9 Hours

Distinction between Hospital and Industry, Challenges in Hospital Administration– Hospital Planning-Equipment Planning – Functional Planning - Current Issues in Hospital Management –Telemedicine - Bio-Medical Waste Management.

UNIT II   Regulatory And Voluntary Guidelines And Health Care Codes 9 Hours

FDA Regulation, Joint Commission of Accreditation for Hospitals, National Fire Protection Association
Standard, ISO, NABL, ISO:13485, ISO:14791, risk management, Environmental regulation.

Case study on risk management.

UNIT III   Hospital Information Systems & Supportive Services   9 Hours

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems ― Medical Transcription, Medical Records Department – Central Sterilization and Supply Department

Pharmacy– Food Services - Laundry Services

UNIT IV   Clinical Engineering   9 Hours

Role to be performed in Hospital, Manpower & Market, Professional Registration, Maintenance ofHospital support system, surveillance network, electric power management, Medical gas production,

waste disposal, inventory control. Case study: RF ID tag for inventory.

UNIT V   Safety Equipment's   9Hours

Operation of safety devices, personnel safety equipment's, Gas mask, Radiation measurements,

equipment safety systems, elements of basic first aid, firefighting, Case study: Safety Awareness.

**   Total Lectures45 Hours**

Text Books

1.   R.C.Goyal, ―Hospital Administration and Human Resource Management‖, PHI –

Fourth Edition,2006.

2.   G.D.Kunders, ―Hospitals – Facilities Planning and Management – TMH, New Delhi –

        FifthReprint 2007
3.   Webster.J.G. and Albert M.Cook, "Clinical Engineering Principles and Practices Prentice Hall

        Inc., Englewood Cliffs, New Jersey, 1979.

Reference Books
1.   Robin Guenther, Gail Vittori, "Sustainable Healthcare Architecture", Wiley, 2013
2.   Sharma D K, R.C.Goyal, "Hospital administration and human Resource Management in Hospital",

        Prentice Hall of India, New Delhi, 2017
3.   Syed Amin Tabish "Hospital and Health services Administration Principles and Practices" Oxford

        Press, New Delhi, 2001

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

BE   19BM7001   IMAGE PROCESSING LABORATORY   0   0   3   1.5

Description of the Experiments

1.   To perform basic operations on images.

2.   To perform histogram equalization.

3.   To perform image filtering in spatial domain.

4.   To perform image filtering in frequency domain.

5.   To perform image restoration.

6.   To perform image compression using DCT / Wavelet transform.

7.   To perform edge detection using various masks.

8.   To perform global and adaptive thresholding.

9.   To apply morphological operators on an image.

10.   To obtain boundary / regional descriptors of an image.

11.   To perform image classification / recognition

Note: It is suggested to carry out the above experiments by Matlab / C programming on diagnostic images such as x-ray / CT / MRI / Ultrasound.

                                              Total Practical Hours: 45

CO1: Develop and implement algorithms for image enhancement and restoration

CO2: Observe filtering in spatial and frequency domain

Course Outcome

CO3: Apply image compression

CO4: Develop programs for image segmentation and classification

CO5: Analyze the different filtering techniques on images.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E	19BM7002	DIAGNOSTIC AND THERAPEUTIC MEDICAL EQUIPMENT LABORATORY	0	0	2	1.5

Course Objective	1: To demonstrate recording and analysis of different Bio potentials.	
	2: To examine different therapeutic modalities.	

Ex.No	DESCRIPTION
1	To study and demonstrate the working of TENS & Ultrasound Therapy Unit.
2	Acquisition of blood flow graph using PC based Vascular Doppler.
3	To study and demonstrate the working of Baby Incubator.
4	To study and demonstrate the working of Radiant heat warmer & Phototherapy.
5	Recording of lung flow, volume and capacities graph using PC based Spirometer.
6	To study and demonstrate the working of Respiratory Ventilator.
7	To study the working of Ultrasound Scanner.
8	To demonstrate the working of Video Endoscopy system.
9	To perform the operation of Drug Delivery Device.
10	To acquire vital parameters from Real time Patient Monitoring System.
11	To perform the sterilization using Autoclave.
12	To demonstrate the Pacemaker System with Patient Simulator

TOTAL INSTRCTIONAL HOURS   45

Course Outcome	**CO1:** Describe design requirements of basic biomedical system used for therapy

CO2: Express the measurement methods available for measuring respiration rate and heart sound.

CO3: Design of ultrasound scanning system and baby incubator system

CO4: Analyze drug delivery systems and visualization of internal organs

CO5: Design real time patient monitoring system and sterilization techniques

CO6: Develop and stimulate the pacemaker system.

TEXTBOOKS

1. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC PRESS, 2012.

2. R.S.Khandpur, "Handbook of Bio-Medical instrumentation", Tata McGraw Hill Publishing Co Ltd, New Delhi, 2015.

REFERENCES

1. Joseph E. Parrillo, "Critical Care Medicine: Principles of Diagnosis and Management in the Adult", Elsevier 4th edition, 2014.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	19BM7301	Drug Delivery	3	0	0	3

Course Objectives:

- To study the characteristics and classification of drug delivey
- To understand the response of materials .
- To learn about the polymeric materials and composites intargeted drug delivery systems.
  To know the compatibility and functioning of implantable delivery systems

UNIT 1 CONTROLLED DRUG DELIVERY SYSTEMS   9

Introduction, terminology/definitions and rationale ,advantage ,disadvantages, Selection of drug candidates, approach to design controlled release formulation based on diffusion, dissolution and ion exchange principles, physiochemical and biological Properties of drug revelent to controlled release formulations

UNIT 2   POLYMERS   9

Introduction, classification, properties, advantages and application of polymer in formulation of controlled release drug delivery systems.

UNIT 3 MICROENCAPSULATION AND MUCOSAL DRUG DELIVERY SYSTEMS   9

Definition, advantages and disadvantages, microspheres, micro particles, microcapsules, method of encapsulation: Transmucosal permeability and formulation considerations of buccal delivery systems

UNIT 4 IMPLANT DRUG DELIVERY SYSTEMS   9

concepts of implant and osmotic pump, inflatable and gastro adhesive systems, nasal and pulmonary routes of drug delivery ,formulation of inhaler,nasal spray, nebulizers, syringe pump, infusion pump, volumetric pump.

UNIT 5 Targeted drug delivery systems 9

Introduction of liposomes, noisome, nanoparticles, monoclonal antibodies, development of intra uterine device and application

COURSEOUTCOMES:

At the end of the course ,the student will able to

> CO1: Analyze different types of materials and its application in drug delivery systems
> CO2: Choose materials for design microencapsulation
> CO3:Evaluateresponseof polymer material
> CO4: Assess compatibility and functioning of implantable drug delivery systems
>
> CO5: Design and develop of targeted drug delivery devices

Textbooks:

1. Textbook Of Drug Delivery Systems (M.Pharm) Sem-I Paperback – 1 January 2020
By Sarode Patil, Gayakwad, Usman (Author)

2. Textbook of Novel Drug Delivery System Prof. (Dr.) RanabirChanda/Prof. (Dr.) Jyotirmoy/Prof. (Dr.) AlugubelliGopi Reddy 1st Edition 2019

Reference books:

1. Drug Delivery: Principles and Applications, Second EditionEditor(s):Binghe Wang, Longqin Hu, Teruna J. SiahaanFirst published:25 March 2016

2. Drug Delivery Systems 1st Edition RakeshTekadeublished Date: 22nd October 2019

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	16BM7302	Internet of Things and Its Medical Applications	3	0	0	3

Course Objective

To understand the basic theory of IoT

⫿ To design embedded systems using IoT

⫿ To study the various IoT Protocols

⫿ To study the various Physical Devices

⫿ To study the various IoT Security

Unit	Description	Instructional Hours
I	**Basics of IoT** Definition and characteristics of IoT, Internet of Things:Vision, Emerging Trends, Economic Significance, Technical Building Blocks, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks, IoT communication models.	9
II	**Embedded IoT** M2M: The internet of devices, RFID: The internet of objects, WSN: The internet of transducer, SCADA: The internet of controllers, DCM: Device, Connect and Manage, Device: Things that talk, Connect: Pervasive Network.	9
III	**IoT Protocols** Protocol Standardization for IoT, M2M and WSN Protocols, SCADA and RFID Protocols, Issues with IoT Standardization, Unified Data Standards, Protocols –IEEE 802.15.4,BACNet Protocol, Modbus, KNX, Zigbee Architecture, Network layer, APS layer.	9
IV	**IoT Physical Devices** IoT Physical Devices and Endpoints: Basic building blocks of and IoT device, Raspberry Pi,Raspberry Pi interfaces, Programming Raspberry Pi with Python, Beagle board and Other IoT Devices	9

| V | **IOT in Medical Field** | 9 |

IoMT-Working,Internet of Things in Hospitals:Collection and Integration of Clinical Data:Benefits of IoT in Healthcare-Future of IoT in Healthcare-IoT-Based Patient Health Monitoring System-Examples of Healthcare IoT-IoT in Healthcare/Medical Projects.

| | **Total Instructional Hours** | **45** |

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

CO1 : Outline the basic concepts of IoT

CO2 : Discuss about Embedded IoT

CO3 : Summarize the IoT protocols

Course Outcome

CO4 : Choose a suitable devices and implement program for stated IoT challenge

CO5 : Explain the fundamentals of security in IoT

TEXT BOOKS:
1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017
2. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach, Universities Press, 2015.
REFERENCES:
1. Jan Ho¨ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.
 2. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols, Wiley, 2012. 5. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things, Springer, 2011.

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	19BM7303	ADVANCED BIO ANALYTICAL AND THERAPEUTIC TECHNIQUES	3	0	0	3

Course Objective	1. Understand the basics of Analytical Techniques . 2. Understand the basics of enzymes as a diagnostic tool. 3. Explore various Radioisotopic Techniques **.** 4. Explore various applications of Gene Therapy. 5. Understanding on basic principles of Nanotherapeutics.

Unit	Description	Instructional Hours
I	**ANALYTICAL TECHNIQUES** Principle- instrumentation and application of electrophoresis- SDS, native gel- UV and IR spectroscopy and its application –Spectrophotometry- fluorimetry- NMR – principle- instrumentation and application in medical sciences.	9
II	**ENZYMES AS A DIAGNOSTIC TOOL** Isoenzymes and their significance in diagnosis-enzyme pattern in health and diseased condition- lipase- amylase- ALP, ACP, SGOT, SGPT, LDH & CPK. - Techniques in screening isoenzymes -Biosensors- enzyme based- antibody based, DNA based -optical biosensor- Blotting techniques-Automation in clinical laboratory.	9
III	**RADIOISOTOPIC TECHNIQUES** Types of radioisotopes- Units of measurements-methods in measuring radioactivity -G.M liquid scintillation counter application in diagnosis (RIA & ELISA) –autoradiography- biological hazards- safety measures in handling isotopes- disposal of labeled compounds and radio dosimetry.	9
IV	**GENE THERAPY** Central concept of gene therapy-basic molecular mechanism of gene transfer- human genome project- prerequisite of human gene therapy- biological basis of gene therapy strategies- vehicles for gene transfer- gene transfer methods- clinical gene therapy studies-gene therapy for hereditary disease- gene therapy for cancer- gene therapy for HIV-Ethical issues in human gene therapy.	9

NANOTHERAPEUTICS

V	Nanoparticles as carriers in drug delivery- design- manufacture and Physiochemical properties- transport across biological barriers- nanotechnology in Cancer therapy-bone treatment- nano particles for oral vaccination and skin disease-Types of nanoparticles-half life-Fate of nano particles.	9

Total Instructional Hours   **45**

Course Outcome

CO1 : Comprehend and appreciate the significance of analytical techniques

CO2 : Demonstrate the knowledge of enzymes as a diagnostic tool

CO3 : Understand the concept and methods of Radio-isotopic techniques

CO4 : Describe the details and ethical issues in human gene therapy

CO5 : Gain knowledge about the concepts of nano-therapeutics in drug delivery

TEXT BOOKS:

T1   Douglas A, ―Principles of Instrumental Analysis, SkoogBrooks Cole publisher 6th edition 2006.

T2   Keith Wilson & John Walker,― Practical Biochemistry , Principles and Techniques. Oxford University Press 7th edition 2010.

REFERENCE BOOKS:

R1   G. Louis Hornyak, John J. Moore, Harry F. Tibbals and Joydeep Dutta, ―Fundamentals of Nanotechnology, CRC press, 1st edition 2008.

R2   Harvey Lodish W. H, ―Molecular Cell Biology, Freeman publisher 7th Edition 2012

R3   Gabor L. Hornyak, Joydeep Dutta, H.F. Tibbals, Anil Rao, ―Introduction to NanoScience, CRC press 2008.

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	19BM7304	ADVANCED BIO SIGNAL PROCESSING	3	0	0	3

Course Objective	1. To familiarize the student with biosignal processing algorithm for automated diagnosis of diseases. 2. To make students familiarize about how to classify biomedical signals 3. To understand about signal processing particularly for cardiovascular applications 4. To understand about various data compression techniques 5. To understand about signal processing particularly for neurological applications

Unit	Description	Instructional Hours
I	**INTRODUCTION TO BIOMEDICAL SIGNALS** Examples of Biomedical signals - ECG, EEG, EMG etc - Tasks in Biomedical Signal Processing - Computer Aided Diagnosis. Origin of bio potentials - Review of linear systems - Fourier Transform and Time Frequency Analysis (Wavelet) of Biomedical signals- Processing of Random & Stochastic signals – spectral estimation – Properties and effects of noise in biomedical instruments - Filtering in biomedical instruments.	9
II	**CONCURRENT, COUPLED AND CORRELATED PROCESSES** llustration with case studies – Adaptive and optimal filtering – Modeling of Biomedical signals - Detection of biomedical signals in noise – removal of artifacts of one signal embedded in another-Maternal-Fetal ECG-Muscle- contraction interference. Event detection - case studies with ECG & EEG – Independent component Analysis - Cocktail party problem applied to EEG signals - Classification of biomedical signals.	9
III	**CARDIO VASCULAR APPLICATIONS** Basic ECG - Electrical Activity of the heart- ECG data acquisition – ECG parameters & their estimation - Use of multiscale analysis for ECG parameters estimation - Noise & Artifacts-ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection - Arrhythmia analysis.	9
IV	**DATA COMPRESSION** Lossless & Lossy- Heart Rate Variability – Time Domain measures – Heart Rhythm representation - Spectral analysis of heart rate variability - interaction with other physiological signals.	9

| V | **NEUROLOGICAL APPLICATIONS**
          The electroencephalogram - EEG rhythms & waveform - categorization of EEG activity - recording techniques - EEG applications- Epilepsy, sleep disorders, brain computer interface. Modeling EEG- linear, stochastic models – Non linear modeling of EEG - artifacts in EEG & their characteristics and processing – Model based spectral analysis - EEG segmentation - Joint Time-Frequency analysis – correlation analysis of EEG channels - coherence analysis of EEG channels. | 9 |

Total Instructional Hours   45

CO1: Understand the basics of signals, systems and spectrum

CO2: Analyze signals in concurrent, coupled and correlated processes.

Course

Outcome

CO3: Construct signaling algorithm for cardiovascular applications.

CO4: Understanding the importance of data compression in signal processing .

CO5: Analyze bio-signals and demonstrate the neurological applications.

TEXT BOOKS:
T1   D.C.Reddy, "Biomedical Signal Processing – Principles and Techniques", TMH,2005.

T2   Wills J. Tompkins, " Biomedical digital signal processing", Prentice Hall of India Pvt. Ltd,2008.

REFERENCE BOOKS:
R1   R. Rangayan, "Biomedical Signal Analysis", Wiley 2002.

R2   Bruce, "Biomedical Signal Processing & Signal Modeling," Wiley, 2001.

R3   Sörnmo,"Bioelectrical Signal Processing in Cardiac & Neurological Applications", Elsevier,2005.

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E/ B.Tech	19BM7305	ULTRASOUND IN MEDICINE	3	0	0	3

Course Objective

7. To apply the basics ultrasound and Echo techniques
8. To find the Imaging modalities and its diagnostic techniques
9. Students should know about the fundamentals of troubleshooting techniques.

UNIT	DESCRIPTION	TOTAL INSTRUCTIONAL HOURS
I	**USG & ECHO** History - Properties of ultrasound – Principle Doppler Effects - Ultrasound Transducers: Piezoelectric Effect- Transducer Beam Characteristics – Scanning Techniques and modes –Biological effects of ultrasound – ECHO principle and Instrumentation – Pulse Echo concept - Pulse generator – Sound waves – Modes of Transducer - Acoustic Properties of Transducer Materials – PLAX and PSAX View – Stress Echocardiogram	9
II	**IMAGING TECHNIQUES** Grey scale and colour Imaging – Panoramic Imaging - Contrast agent and Tissue contrast – 3D & 4D Imaging Techniques – Strain Imaging – Image processing techniques - modalities of Echo – Elasticity Imaging – CT & MRI guided USG	9
III	**DIAGNOSTIC ULTRASOUND** Introduction – Principle and concepts of Intravascular Imaging – Transesophageal Ultrasound – Transabdominal Ultrasound – Transrectal and Vaginal Ultrasound – Fetal monitoring – Soft tissue evaluation of human body organs – Ultrasound Guided biopsy techniques	9
IV	**THERAPEUTIC ULTRASOUND** Thermal and Non-Thermal Ultrasound therapy – Ultrasound Drug delivery – HIFU - Cancer therapy – Phacoemulsification using USG - Lithotripsy – Selerotherapy	9
V	**TROUBLESHOOTING & SAFETY MANAGEMENT** Troubleshooting techniques– Power supply – Calibration of Transducer & Sca – Servicing methodology – USG Licenses – Preventive maintenance precautions of USG during Imaging. USG-ECHO Management system..	9
	TOTAL INSTRCTIONAL HOURS	**45**

CO1: Understand about basic design of USG & Doppler medical devices .
CO2:explain the effect of ultrasound in medical Imaging
CO3: detail about system description of Diagnostic equipments
CO4: detail about system description of therapeutic equipments
CO5: Understand the concept of USG troubleshooting & Safety

TEXT BOOKS

1. K.Shung "Diagnostic Ultrasound: Imaging and Doppler Flow Measurements"Francis & Taylor, CRC Press Boca Raton FL, 2005
2. Szabo. T-Diagnostic Ultrasound Imaging:Inside Out" Elsevier AcademicPress, Amesterdam, 2004.
3. Harald lutz, Elisabetta buscarini , Manual of diagnostic Ultrasound, WHO-2020

REFERENCE

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2018
2. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2009.

Chairman   BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

DEPARTMENT OF BIOMEDICAL ENGINEERING

ACADEMIC YEAR 2023-2024[ODD]

CO'S, PO'S & PSO'S MAPPING

SEMESTER I – R 2022

Course Code &Name :22MA1101/ MATRICES AND CALCULUS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-	-	-	-	2	2	1	1
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2	2	2	1
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	3	1
CO5	3	3	3	3	3	-	-	-	-	-	-	2	1	2	1
AVG	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2	1

Course Code & Name:22IT1151&Python Programming and Practices

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	-	2	-	-	-	-	-	-	2	2	2	1
CO2	2	3	3	-	2	-	-	-	2	-	-	2	2	2	1
CO3	2	3	3	-	2	-	-	-	2	-	-	2	2	2	1
CO4	2	3	3	-	2	-	-	-	2	-	-	2	2	2	2
CO5	2	3	3	-	2	-	-	-	2	-	-	2	2	2	1
Avg	2	3	3	-	2	-	-	-	2	-	-	2	2	2	1

Course Code & Name : 22CY1151/ CHEMISTRY FOR CIRCUIT ENGINEERING

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	1	1	1	1	-	1	-	1	2	-	-	1
CO2	2	3	2	1	1	1	1	-	1	-	1	2	-	-	1
CO3	2	2	2	2	1	1	1	-	1	-	1	2	-	-	2
CO4	2	2	3	1	2	1	1	-	1	-	2	2	-	1	1
CO5	2	3	3	2	2	1	1	-	1	-	1	2	-	-	1
Avg	2	2.6	2.6	1.4	1.4	1	1	-	1	-	1.2	2	-	1	1

Course Code & Name : 22HE1151 / ENGLISH FOR ENGINEERS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	2	2	2	3	1	1	1	2	1
CO2	2	1	-	-	1	1	1	2	2	3	-	2	-	2	1
CO3	2	1	-	-	1	1	2	3	3	3	-	1	1	2	2
CO4	2	1	-	-	-	1	2	2	2	3	1	1	-	-	1
CO5	2	-	-	-	-	1	1	2	3	3	-	1	1	2	2
Avg	2	1	-	-	1	1	1.6	2.2	2.4	3	1	1.2	1	2	1.3

Course Code & Name: 21ME1201 Engineering Drawing

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	-	-	2	1	1	1
CO2	3	3	3	2	2	-	-	-	-	-	-	3	2	2	2
CO3	3	3	3	2	2	-	-	-		-	-	3	3	3	1
CO4	3	3	3	2	2	-	-	-	-	-	-	3	1	1	1
CO5	3	3	3	2	2	-	-	-	-	-	-	3	2	2	2
Avg	3	3	3	2	2	-	-	-	-	-	-	3	2	2	1

Semester – III

Course Code &Name : 22BM3201/ Signals And Systems

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS03
CO1	-	1	1	2	-	-	-	-	-	-	-	1	1	1	2
CO2	-	1	1	2	3	-	1	-	-	-	-	-	1	1	1
CO3	-	1	3	3	-	-	-	-	-	3	1	2	2	3	2
CO4	-	1	1	2	-	-	-	-	-	-	-	-	1	1	1
CO5	-	1	3	3	3	-	2	-	-	3	1	2	2	3	3
AVG	-	1	2	2	1	-	1	-	-	1	0	1	1	2	2

Course Code & Name:22BM3202 Electron Devices and Circuits

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	-	-	-	-	-	-	-	-	1	2	1
CO2	2	2	2	-	-	-	-	-	-	-	-	-	1	2	1
CO3	3	2	3	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	-	2	3	-	-	-	-	-	-	-	-	-	3	1
CO5	2	-			-	-	-	-	-	-	-	-	-	3	1
Avg	2	1	2	1	-	-	-	-	-	-	-	-	0	2	1

Course Code & Name:22BM3203 Medical Biochemistry

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2	2
CO2	3	-	2		-	2	-	-	-	-	-	-	3	2	1
CO3	-	1	2	2	-	-	-	-	-	-	-	-	-	3	1
CO4	3	-	2		-	-	-	-	-	-	-	2	-	3	1
CO5	1	3	3	3	-	-	-	-	-	-	-	2	-	3	2
Avg	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1

Course Code & Name: 22BM3204 Human Anatomy and physiology

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	-	-	-	-	-	-	2	2	1	2
CO2	1	1	1	1	1	-	-	-	-	-	-	1	2	1	1
CO3	1	1	-	1	1	-	-	-	-	-	-	2	2	1	1
CO4	1	1	1	1	1	-	-	-	-	-	-	1	2	1	1
CO5	1	1	-	1	-	-	-	-	-	-	-	2	2	1	2
Avg	1	1	1	1	1	-	-	-	-	-	-	2	2	1	1

Course Code & Name:22MA3151 Statistics and Numerical Methods with R Programming

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	-	-	-	-	-	-	2	3	2	1
CO2	3	3	3	2	1	-	-	-	-	-	-	3	2	2	1
CO3	3	3	3	1	1	-	-	-	-	-	-	2	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	2	1
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	2	1
Avg	3	3	3	2	2	-	-	-	-	-	-	2	2	2	1

Course Code & Name:22BM3251 Digital Electronics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	-	1	-	2	-	2	2	-	2	1
CO2	2	2	2	2	2	-	-	-	-	2	2	2	-	2	2
CO3	2	2	3	2	2	-	2	2	2	-	2	2	-	2	1
CO4	2	2	2	2	2	-	2	2	-	2	2	-	-	2	1
CO5	2	-	2	1	2	-	-	-	-	-	2	1	-	1	2
Avg	2	2	2	2	2	0	1	1	1	1	2	1	0	2	1

Course Code & Name:22BM3001 Electron Devices and Circuits Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	2	-	-	-	-	-	3	-	-	-	-	2	2
CO2	2	2	3	-	-	-	-	-	3	-	-	-	-	2	1
CO3	3	-	-	-	-	-	-	-	3	-	-	-	-	2	1
CO4	3	-	-	-	-	-	-	-	3	-	-	-	-	3	1
CO5	3	-	-	-	-	-	-	-	3	-	-	-	1		1
Avg	3	0	1	-	-	-	-	-	3	-	-	-	1	2	1

Course Code & Name:22BM3002 Biochemistry Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2	1
CO2	3	-	2	-	-	2	-	-	-	-	-	-	3	2	1
CO3	-	1	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	-	2	-	-	-	-	-	-	-	-	2	-	3	1
CO5	1	3	3	3	-	-	-	-	-	-	-	2	-	3	1
Avg	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1

<u>**Semester – V**</u>

Course Code & Name: 21BM5201 Biocontrol systems

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	-	-	-	-	-	-	-	-	-	-	2		1
CO2	3	2	-	2	-	-	-	-	-	-	-	-	2	3	1
CO3	2	3	-	3	-	-	-	-	-	-	-	-	2	3	1
CO4	3	2	-	-	-	-	-	-	-	-	-	-	1	-	1
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Avg	2	2	-	1	-	-	-	-	-	-	-	-	1	1	1

Course Code & Name: 21BM5202 Biomechanics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2	1
CO2	3	-	2	-	-	-	-	-	-	-	-	-	3	2	1
CO3	-	1	2	2	-	2	-	-	-	-	-	-	-	3	1
CO4	3	-	2	-	-	-	-	-	-	-	-	2	-	3	1
CO5	1	3	3	3	-	-	-	-	-	-	-	2	-	3	1
Avg	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1

Course Code & Name:21BM5203 Microprocessors and Microcontrollers

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	-	-	-	-	-	-	-	-	-	-	3	-	1

CO2	1	3	-	-	-	-	-	-	-	-	-	-	2	3	1
CO3	3	-	3	-	2	-	-	-	-	-	-	-	-	3	1
CO4	2	-	3	-	3	-	-	-	-	-	-	-	-	2	1
CO5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Avg	2	1	1		1	-	-	-	-	-	-	-	2	2	1

Course Code & Name:21BM5204 Biomedical Instrumentation

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	1	1	-	-	-	-	-	-	-	-	-	-	2	1	1
CO2	1	1	-	-	-	-	-	-	-	-	-	-	2	1	2
CO3	1	1	1	1	-	1	-	-	-	-	-	-	2	2	1
CO4	0	0	1	1	-	1	-	-	-	-	-	-	2	2	1
CO5	0	0	-	-	-	-	-	-	-	-	-	-	2	1	1
Avg	1	1	0	0	-	0	-	-	-	-	-	-	2	1	1

Course Code & Name: 21BM5251 Virtual Instrumentation using Lab VIEW

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	-	-	-	-	-	-	-	-	-	2	2	1	2
CO2	1	1	-	-	-	-	-	-	-	-	-	2	2	1	1
CO3	1	1	1	1		1	-	-	-	-	-	2	2	2	1
CO4	0	0	1	1		1	-	-	-	-	-	1	2	2	1
CO5	0	0	-	-	-	-	-	-	-	-	-	2	2	1	2
Avg	1	1	0	0		0	-	-	-	-	-	2	2	1	1

Course Code & Name:19BM5001 Microprocessors and Microcontrollers Lab

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	3	-	-	2	-	3	1
CO2	2	-	2	-	-	-	-	-	3	-	-	2	-	3	2
CO3	3	-	3	2	-	-	-	-	3	-	-	-	-	3	1
CO4	3	-	-		2	-	-	-	3	-	-	-	-	2	2
CO5	3	-	-	2	-	-	-	-	3	-	-	2	3	3	1
Avg	3	0	1	1	0	-	-		3	-	-	1	1	3	1

Course Code & Name:21BM5002 Biomedical Instrumentation Lab

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	3	-	-	2	-	3	1
CO2	2	-	2	-	-	-		-	3	-	-	2	-	3	1
CO3	3	-	3	2	-	-	-	-	3	-	-	-	-	3	1
CO4	3	-	-	-	2	-	-	-	3	-	-	-	-	2	1
CO5	3			2	-	-	-	-	3	-	-	2	3	3	1
Avg	3	0	1	1	0	-	-	-	3	-	-	1	1	3	1

Course Code & Name:19BM7201 Diagnostic and Therapeutic Equipment-II

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2	1
CO2	3	-	2	-	-	2	-	-	-	-	-	-	3	2	1
CO3	-	1	2	2	-	-	-	-	-	-	-	-	-	3	1
CO4	3		2	-	-	-	-	-	-	-	-	2	-	3	1
CO5	1	3	3	3	-	-	-	-	-	-	-	2	-	3	1
Avg	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1

Course Code & Name:19BM7202 Medical Image Processing

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	-	1	-	2		2	2	2	1	1
CO2	2	2	2	2	2	-	-	-	-	2	2	2	2	1	1
CO3	2	2	3	2	2	-	2	2	2	-	2	2	2	1	1
CO4	2	2	2	2	2	-	2	2	-	2	2	-	2	1	1
CO5	2	-	2	1	2	-	-	-	-	-	2	1	2	1	1
Avg	2	1	2	2	2	-	1	1	1	1	2	2	2	1	1

Course Code & Name:19BM7251 Hospital Management

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	1	1	1	-	-	-	-	-	-	2	2	1	1
CO2	1	1	1	1	1	-	-	-	-	-	-	1	2	1	1
CO3	1	1	-	1	1	-	-	-	-	-	-	2	2	1	1
CO4	1	1	1	1	1	-	-	-	-	-	-	1	2	1	1
CO5	1	1	-	1	-	-	-	-	-	-	-	2	2	1	1
Avg	1	1	1	1	1	-	-	-	-	-	-	1	1	1	1

Course Code & Name: 19BM7001 Image Processing Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	2	-	2	-	-	-	2	-	-	-	-	-	1
CO2	1	1	2	-	2	-	-	-	2	-	-	-	-	-	1
CO3	1	1	2	-	2	-	-	-	2	-	-	-	-	-	1
CO4	1	1	2	-	2	-	-	-	2	-	-	-	-	-	1
CO5	1	1	2	-	2	-	-	-	2	-	-	-	-	-	1
Avg	1	1	2	-	2	-	-	-	2	-	-	-	-	-	1

Course Code & Name:19BM7002 Diagnostic and TherapeuticEquipment Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	2	-	-	-	-	3	-	-	2	3	3
CO2	2	-	2	-	2	-	-	-	3	-	-	2		3
Avg	3	1	1	1	1	-	-	-	3	-	-	2	2	3

Course Code & Name: 19BM7901 Project Phase I

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	-	-	3	-	3	-	-	-	1
CO2	-	-	-	-	-	-	-	-	3	-	3	-	-	-	1
CO3	-	-	-	-	-	-	-	-	3	-	3	-	-	-	1
CO4	-	-	-	-	-	-	-	-	3	-	3	-	-	-	1
CO5	-	-	-	-	-	-	-	-	3	-	3	-	-	-	1
Avg	-	-	-	-	-	-	-	-	3	-	3	-	-	-	1

PROFESSIONAL ELECTIVE I

Course Code & Name:21BM5301 Medical Physics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	1	-	-	3	2	2	1	-	2	2	1	1
CO2	2	2	2	1	-	-	3	2	-	1	-	2	2	1	1
CO3	2	2	3	1	-	-	3	2	2	1	-	2	2	1	1
CO4	2	2	2	1	-	-	3	2	-	1	-	2	2	1	1
CO5	2	2	2	1	-	-	3	2	-	1	-	2	2	1	1
Avg	2	2	2	1	-	-	3	2	1	1	-	2	2	1	1

Course Code & Name:21BM5302 Robotics in Medicine

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	3	-	-	1
CO3	-	1	2	2	-	2	-	-	-	-	-	-	-	-	1
CO4	3	-	2	-	-	-	-	-	-	-	-	-	-	-	1
CO5	1	3	2	3	-	-	-	-	-	-	-	-	-	-	1
Avg	2	1	3	1	-	0	-	-	-	-	-	1	-	-	1

Course Code & Name:21BM5303 Total Quality Management

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	-	3	-	-	-	-	-	-	-	-	-	-	2	-	1
CO3	-	3		-	-	-	-	-	-	-	-	-	2	-	1
CO4	-	-	3	-	2	-	-	-	-	-	-	-	2	-	1
CO5	-	-	3	-	2	-	-	-	-	-	-	-	2	-	1
Avg	-	2	1	-	1	-	-	-	-	-	-	-	1	-	1

Course Code & Name:21BM5304 Medical Ethics and Standards

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	3	-	2	-	-	-	-	-	-	-	1	-	1
CO2	1	-	3	-	-	-	-	-	-	2	-	-	2	-	1
CO3	1	-	3	-	-	-	-	-	-	2	-	-	3	-	1
CO4	1	-	2	-	3	-	-	-	-	2	-	-	-	-	1
CO5	1	-	2	-	-	-	-	-	-	2	-	-	-	-	1
Avg	1	-	3	-	1	-	-	-	-	2	-	-	1	-	1

Course Code & Name:21BM5305 Intellectual Property Rights

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	1	1	-	-	-	-	1	-	-	-	-	-	1
CO2	-	2	1	2	-	-	-	-	1	2	-	-	-	-	1
CO3	-	2	1	1	-	-	-	-	1	-	-	2	-	-	1
CO4	-	2	1	1	-	-	-	-	1	-	-	2	-	-	1
CO5	-	2	1	2	-	-	-	-	1	-	-	2	-	-	1
Avg	-	2	1	2	-	-	-	-	1	0	-	2	-	-	1

PROFESSIONAL ELECTIVE III

Course Code & Name: 19BM7301 Drug Delivery

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	2	1	-	-	2	-	-	2	-	-	-	2	1
CO2	2	-	2	1	-	-	2	-	-	3	-	-	-	2	1
CO3	3	-	2	-	-	-	-	-	-	3	-	-	-	2	1
CO4	2	-	2	-	-	-	-	-	-	3	-	-	-	2	1
CO5	-	-	1	-	-	-	-	-	-	3	-	-	-	2	1
Avg	2	-	2	0	-	-	1	-	-	3	-	-	-	2	1

Course Code & Name:19BM7302 IOT Applications in Healthcare

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	1	-	2	-	2	-	-	2	-	-	-	-	-	1
CO2	-	1	-	3	-	2	-	-	2	-	-	-	1	-	1

PO&PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO3	-	1	-	3	-	3	-	-	2	-	-	-	-	-	1
CO4	-	1	-	3	-	3	-	-	-	-	-	-	-	-	1
CO5	-	1	-	3	-	3	-	-	-	-	-	-	1	-	1
Avg	-	1	-	3	-	3	-	-	1	-	-	-	0	-	1

Course Code & Name:19BM7303 Advanced Bio Analytical And Therapeutic Techniques

PO&PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	1	2	-	-	-	-	-	-	-	1	1	1	1
CO2	-	1	1	2	3	-	1	-	-	-	-	-	1	1	1
CO3	-	1	3	3	-	-	-	-	-	3	1	2	2	3	3
CO4	-	1	1	2	-	-	-	-	-	-	-	-	1	1	1
CO5	-	1	3	3	3	-	2	-	-	3	1	2	2	3	3
Avg	-	1	2	2	1	-	1	-	-	1	0	1	1	2	2

Course Code & Name:19BM7305 Ultrasound in Medicine

PO&PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1
CO2	-	-	1	3	-	-	1	-	3	-	-	-	1	-	1
CO3	-	-	2	-	-	-	1	-	3	-	-	-	2	-	1
CO4	-	-	2	2	-	-	1	-	3	-	-	-	1	1	1
CO5	-	-	2	-	-	-	1	-	-	-	-	-	-	-	1
Avg	-	-	2	1	-	-	1	-	2	-	-	-	1	0	1

Mapping of Course Outcome and Programme Outcome:

Ye ar	Se m	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
I	I	22MA1101/ Matrices And Calculus	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2	1
		22IT1151& Python Programming and Practices	2	3	3	-	2	-	-	-	2	-	-	2	2	2	1
		22CY1151/ Chemistry For Circuit Engineering	2	2.6	2.6	1.4	1.4	1	1	-	1	-	1.2	2	-	1	1
		22HE1151 / ENGLISH FOR ENGINEERS	2	1	-	-	1	1	1.6	2.2	2.4	3	1	1.2	1	2	1.3
		21ME1201 Engineering Drawing	3	3	3	2	2	-	-	-	-	-	-	3	2	2	1
II	III	22BM3201 Signals And Systems															
		22BM3202 Electron Devices and Circuits	2	1	2	1	-	-	-	-	-	-	-	-	0	2	1
		22BM3203 Medical Biochemistry	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1
		22BM3204 Human Anatomy and physiology	1	1	1	1	1	-	-	-	-	-	-	2	2	1	1
		22MA3151 Statistics and Numerical Methods with R programming	3	3	3	2	2	-	-	-	-	-	-	2	2	2	1
		22BM3251 Digital	2	2	2	2	2	0	1	1	1	1	2	1	0	2	1

Year	Sem	Course														
		Electronics														
		22BM3001 Electron Devices and Circuits Laboratory	3	0	1	-	-	-	-	-	3	-	-	-	1	2	1
		22BM3002 Biochemistry Laboratory	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1
III	V	21BM5201 Biocontrol systems	2	2	-	1	-	-	-	-	-	-	-	-	1	1	1
		21BM5202 Biomechanics	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1
		21BM5203 Microprocessors and Microcontrollers	2	1	1		1	-	-	-	-	-	-	-	2	2	1
		21BM5204 Biomedical Instrumentation	1	1	0	0	-	0	-	-	-	-	-	-	2	1	1
		21BM5251 Virtual Instrumentation using LabVIEW	1	1	0	0		0	-	-	-	-	-	2	2	1	1
		21BM5001 Microprocessors and Microcontrollers Lab	3	0	1	1	0	-	-		3	-	-	1	1	3	1
		21BM5002 Biomedical Instrumentation Lab	3	0	1	1	0	-	-	-	3	-	-	1	1	3	1
IV	VII	19BM7201 Diagnostic and TherapeuticEquipment-II	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1
		19BM7202 Medical Image Processing	2	1	2	2	2	-	1	1	1	1	2	2	2	1	1
		19BM7001 Image Processing Laboratory	1	1	2	-	2	-	-	-	2	-	-	-	-	-	1

Category	Course															
	19BM7002 Diagnostic and Therapeutic Equipment Laboratory	3	1	1	1	1	-	-	-	3	-	-	2	2	3	
PE 3	19BM7301 Drug Delivery	2	-	2	0	-	-	1	-	-	3	-	-	-	2	1
	19BM7302 IOT Applications in Healthcare	-	1	-	3	-	3	-	-	1	-	-	-	0	-	1
	19BM7303 Advanced Bio Analytical And Therapeutic Techniques	-	1	2	2	1	-	1	-	-	1	0	1	1	2	2
	19BM7304 Advanced Biosignal Processing	-	-	2	1	-	-	1	-	2	-	-	-	1	0	1
	19BM7305 Ultrasound in Medicine	-	-	2	1	-	-	1	-	2	-	-	-	1	0	1
OE 2	19BM7401 First Aid In Emergency Care	1	1	1	1	1	-	-	-	-	-	-	2	2	1	1

CHAIRMAN-BOS   **DEAN ACADEMICS**