HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

Coimbatore–641032

DEPARTMENT OF BIOMEDICAL ENGINEERING

CURRICULUM&
SYLLABUS
2022-2023

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.

Chairman BoS
BME - HiCET

Chairman

Dean (Academics)
HiCET

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.

PO 5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6. **The engineer and society**: Apply reasoning informed by the contextual knowledge 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 environmental contexts, 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 and design 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.

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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.

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DETAILS OF CHANGES CARRIED OUT IN CURRICUUM & SYLLABUS

CBCS PATTERN UNDER GRADUATE PROGRAMMES
B.E. BIOMEDICAL ENGINEERING (UG)
REGULATION- 2022
For the students admitted during the academic year 2022-2023 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	தமிழரும்தொழில்நுட்பமும்/ /Indian Constitution	MC	2	0	0	0	2	0	0	0
	TOTAL			15	5	6	19	26	370	330	700

SEMESTER II

S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
Theory											
1.	**22MA2105**	Fourier Analysis and Transforms	BSC	3	1	0	4	4	40	60	100
2.	22CY2101	Environmental Studies	ESC	3	0	0	2	3	40	60	100
3.	22PH2101	Basics of Material Science	BSC	2	0	0	2	3	40	60	100

		Theory with Lab Component									
4.	22CS2154	Essentials of C & C++ Programming	PCC	2	0	2	3	4	50	50	100
5.	22PH2151	Physics For Circuit Engineering	BSC	2	0	2	3	4	50	50	100
6.	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
Practical											
7.	22ME2001	Engineering Practices	ESC	0	0	4	2	2	60	40	100
EEC Courses(SE/AE)											
8.	22HE2071	Design Thinking	AEC	2	0	0	2	2	100	0	100
9.	22HE2072	Soft Skills-1	AEC	0	0	0	1	1	100	0	100
Mandatory Courses											
22MC2093		NCC*/NSS/YRC/Sports/Clubs /Society Service-Enrollment	MC	All students shall enroll, on admission, in anyone of the personality and character development programmers and undergo Training for about 80 hours							
2MC2091/ 2MC2092		தமிழர்மரபு/ **Heritage of Tamils**	MC	2	0	0	0	2	100	0	100
			TOTAL	**17**	**1**	**12**	**22**	**30**	**520**	**380**	**900**

REGULATION- 2019
For the students admitted during the academic year 2021-2022 and Onwards

SEMESTER III

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21MA3102	Fourier Analysis and Transforms	BS	3	1	0	4	40	60	100
2	21BM3201	Electron Devices and Circuits	PC	3	1	0	4	40	60	100
3	21BM3202	Medical Biochemistry	PC	3	0	0	3	40	60	100
4	21BM3203	Human Anatomy and Physiology	PC	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
5	21BM3251	Digital Electronics	PC	2	0	2	3	50	50	100
6	21HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
PRACTICAL										
7	21BM3001	Electron Devices and Circuits Laboratory	PC	0	0	3	1.5	50	50	100
8	21BM3002	Biochemistry Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9	21MC3191	Indian Constitution	AC	2	0	0	0	100	0	100

10	21HE3072	Career Guidance-Level III	EEC	2	0	0	0	100	0	100
11	21HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
			Total	20	2	8	**20**	610	390	**1100**

SEMESTER IV

S.No	CourseCode	CourseTitle	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21BM4201	Linear Integrated Circuits	PC	3	0	0	3	40	60	100
2	21BM4202	Bio MEMS and Nanotechnology	PC	3	1	0	4	40	60	100
3	21BM4203	Pathology and Microbiology	PC	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
4	21MA4152	Statisticsand Numerical Methods	BS	3	0	2	4	50	50	100
5	21BM4251(R)	Sensors and Measurement(R)	PC	3	0	2	4	50	50	100
PRACTICAL										
7	21BM4001	IntegratedCircuits lab	PC	0	0	3	1.5	50	50	100
8	21BM4002	Human Physiology Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9	21MC4191	Value education -Essence of Indian Traditional Knowledge	AC	2	0	0	0	100	0	100
10	21HE4072	Career Guidance –Level IV	EEC	2	0	0	0	100	0	100
11	21HE4073	Ideation Skills	EEC	2	0	0	0	100	0	100
			Total	21	2	10	**21**	620	380	**1000**

REGULATION- 2019
For the students admitted during the academic year 2020-2021 and Onwards
SEMESTER V

S.No.	Course Code	CourseTitle	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19BM5201	Biocontrol systems	PC	3	1	0	4	25	75	100
2	19BM5202	Biomechanics	PC	3	0	0	3	25	75	100
3	19BM5203	Microprocessors and Microcontrollers	PC	3	0	0	3	25	75	100

4	19BM5204	Biomedical Instrumentation	PC	3	0	0	3	25	75	100
5	19BM53XX	Professional Elective-I	PE	3	0	0	3	25	75	100
THEORYWITHLABCOMPONENT										
6	19BM5251	Virtual Instrumentation Using Lab VIEW	PC	2	0	2	3	50	50	100
PRACTICALS										
7	19BM5001	Microprocessors and Microcontrollers Lab	PC	0	0	3	1.5	50	50	100
8	19BM5002	Biomedical Instrumentation Lab	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9	19HE5071	SoftSkill-I	EEC	1	0	0	1	100	0	100
10	19HE5072	DesignThinking	EEC	1	0	0	1	100	0	100
Total				19	1	8	**24**	475	475	**1000**

SEMESTERVI

S.No.	Course Code	CourseTitle	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19BM6201(R)	Biosignal Processing(R)	PC	3	1	0	4	25	75	100
2	19BM6202	Radiological Equipmentsand nuclearMedicine	PC	3	0	0	3	25	75	100
3	19BM63XX	Professional Elective-II	PE	3	0	0	3	25	75	100
4	19XX64XX	OpenElective-I	OE	3	0	0	3	25	75	100
5	19BM6203	EntrepreneurshipDevelopment	HS	3	0	0	3	25	75	100
THEORYWITHLABCOMPONENTS										
6	19BM6251	Diagnostic andTherapeutic Equipment-I	PC	3	0	2	3.5	50	50	100
PRACTICALS										
7	19BM6001	BiosignalProcessing Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8	19BM6701	IndustrialTraining*	EEC	0	0	0	1	100	100	100
9	19HE6071	SoftSkill-II	EEC	1	0	0	1	100	0	100
10	19HE6072	IntellectualProperty Rights	EEC	1	0	0	1	100	0	100
Total				**18**	**1**	**5**	**24**	**225**	**475**	**1000**

LIST OF PROFESSIONAL ELECTIVES

S. No.	Course Code	CourseTitle	Category	L	T	P	C	CIA	ESE	TOTAL
PROFESSIONALELECTIVEI										
1	19BM5301	MedicalPhysics	PE	3	0	0	3	25	75	100
2	19BM5302	RoboticsinMedicine	PE	3	0	0	3	25	75	100
3	19BM5303	Total QualityManagement	PE	3	0	0	3	25	75	100
4	19BM5304	Medical Ethics andStandards	PE	3	0	0	3	25	75	100
5	19BM5305	IntellectualProperty Rights	PE	3	0	0	3	25	75	100
PROFESSIONALELECTIVEII										
1	19BM6301	Biomaterial andArtificialOrgans	PE	3	0	0	3	25	75	100
2	19BM6302	EmbeddedSystemsin Medical Devices	PE	3	0	0	3	25	75	100
3	19BM6303	BiomedicalWaste Management	PE	3	0	0	3	25	75	100
4	19BM6304	Physiological Modeling	PE	3	0	0	3	25	75	100
5	19BM6305	ArtificialNeural Networks	PE	3	0	0	3	25	75	100

REGULATION- 2019
For the students admitted during the academic year 2019-2020 and Onwards
SEMESTERVII

S.No.	Course Code	CourseTitle	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	19BM73XX	ProfessionalElective-III	PE	3	0	0	3	25	75	100
4	19XX74XX	OpenElectiveII	OE	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENTS										

5	19BM7251	Hospital Management	PC	2	0	2	3	50	50	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	ProjectPhaseI	EEC	0	0	4	2	50	50	100
		Total		14	0	12	**20**	300	500	**800**

SEMESTER VIII

S.No.	Course Code	CourseTitle	Category	L	T	P	C	CIA	ESE	TOTAL
		THEORY								
1	19CH83XX	Professiona l Elective–IV	PE	3	0	0	3	25	75	100
2	19CH83XX	Professional Elective- V	PE	3	0	0	3	25	75	100
		PROJECT WORK								
3	19CH8901	ProjectWork–PhaseII	EEC	0	0	16	8	100	100	200
		Total		**6**	**0**	**16**	**14**	**150**	**250**	**400**
		PROFESSIONAL ELECTIVE III								
1	19BM7301	Drug Delivery	PE	3	0	0	3	25	75	100
2	19BM7302	IOTApplications in Healthcare	PE	3	0	0	3	25	75	100
3	19BM7303	Advanced BioAnalytical And Therapeutic Techniques	PE	3	0	0	3	25	75	100
4	19BM7304	Advanced Bio-signal Processing	PE	3	0	0	3	25	75	100
5	19BM7305	Ultrasound in Medicine	PE	3	0	0	3	25	75	100
		PROFESSIONAL ELECTIVE IV								
1	19BM8301	Biofluids and Dynamics	PE	3	0	0	3	25	75	100
2	19BM8302	Artificial Intelligence in Healthcare	PE	3	0	0	3	25	75	100
3	19BM8303	Medical Informatics	PE	3	0	0	3	25	75	100
4	19BM8304	Wearable Medical Devices	PE	3	0	0	3	25	75	100
5	19BM8305	Cardiovasular Engineering	PE	3	0	0	3	25	75	100

		PROFESSIONAL ELECTIVE V									
S.No.	Course Code	CourseTitle	Category	L	T	P	C	CIA	ESE	TOTAL
1	19BM8306	Rehabilitation Engineering	PE	3	0	0	3	25	75	100
2	19BM8307	Virtual Reality inMedicine	PE	3	0	0	3	25	75	100
3	19BM8308	Biophotonics	PE	3	0	0	3	25	75	100
4	19BM8309	Telemedicine	PE	3	0	0	3	25	75	100
5	19BM8310	BiometricSystems	PE	3	0	0	3	25	75	100

LIST OF OPEN ELECTIVES

BIOMEDICAL ENGINEERING

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	19BM6401	Applications of Biomedical Engineering	OE	3	0	0	3	25	75	100

BIOMEDICAL ENGINEERING

2	19BM7401	First Aid In EmergencyCare	OE	3	0	0	3	25	75	100

LIFE SKILL COURSES

3	19LSZ401	General Studies for Competitive Examinations	OE	3	0	0	3	25	75	100
4	19LSZ402	Human Rights, Women's Rights and Gender Equality	OE	3	0	0	3	25	75	100
5	19LSZ403	Indian Ethos and HumanValues	OE	3	0	0	3	25	75	100
6	19LSZ404	Indian Constitution and PoliticalSystem	OE	3	0	0	3	25	75	100
7	19LSZ405	Yoga for HumanExcellence	OE	3	0	0	3	25	75	100

CREDIT DISTRIBUTION R19

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

CREDIT DISTRIBUTION R22

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

Chairman
Board of Studies

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BME - HiCET

Dean
Academics

Dean (Academics)
HiCET

Principal
PRINCIPAL
Hindusthan College of Engineering & Technology
COIMBATORE - 641 032

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

The learner should be able to

Course Objective

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. Analyse anddiscuss the maxima and minima of the functions of several variables.
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

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

Course Outcome

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.

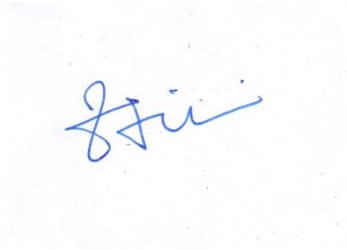T2:ErwinKreyszig,"AdvancedEngineeringMathematics",JohnWiley&Sons,2019.

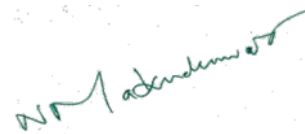T3:K.P.UmaandS.Padma,"EngineeringMathematicsI(MatricesandCalculus) ",PearsonLtd,2022.

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   **DEAN ACADEMICS**

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	**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
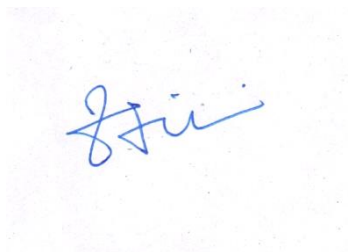
T1 - P.C.Jain& Monica Jain, "Engineering Chemistry" DhanpatRai Pub, Co., New Delhi (2018).

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   **DEAN ACADEMICS**

B.E.	**22HE1151**	**ENGLISH FOR ENGINEERS** (Common to all Branches)	L2	T0	P2	C3

The student should be able

Course Objective

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.
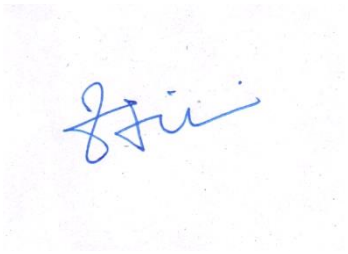5. To impart official communication etiquette.

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

1

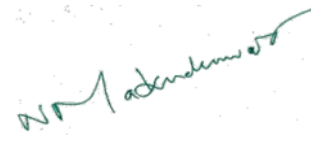| Course Outcome	After completion of the course the learner will be able

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   **DEAN ACADEMICS**

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.
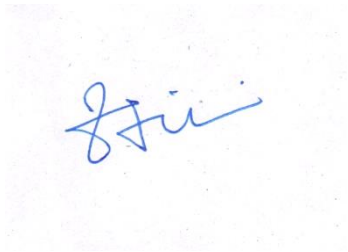
TEXT BOOK:

T1. K.Venugopal, V.Prabu Raja, "Engineering Drawing, AutoCAD, Building Drawings", 5thedition New Age International
Publishers, New Delhi 2016.
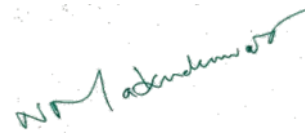T2. K.V.Natarajan, "A textbook of Engineering Graphics", Dhanlaksmi Publishers, Chennai 2016.

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   **DEAN ACADEMICS**

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

Course Objective	**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

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**

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

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   **DEAN ACADEMICS**

Programme	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

The student should be made

<table>
<tr><td rowspan="3">Course Objectives</td><td>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.</td></tr>
<tr><td>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.</td></tr>
<tr><td>3. To highlight plausible implication of such a Holistic understanding In terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.</td></tr>
</table>

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 Case	6

Studies Strategies for Transition towards Value-based Life and Profession

Total Instructional Hours   30

Course Outcome	At the end of the course, the learner will be able
	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   **DEAN ACADEMICS**

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	22HE1072	ENTREPRENEURSHIP & INNOVATION	1	0	0	1

(Common for all Branches)

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

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

Course Outcome

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–Creatingandleadingand EntrepreneurialOrganization",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
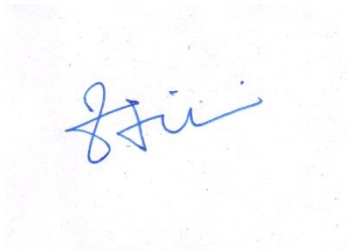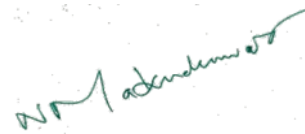
CHAIRMAN-BOS   **DEAN ACADEMICS**

திட்டம்/செம்	பாடநெறி குறியீடு	பாடத்தின் பெயர்	L	T	P	C
பி.இ/ க	22MC1091	தமிழரும்தொழில்நுட்பமும் (முதலாம் ஆண்டு பி.இ பொது பாடப்பிரிவு)	2	0	0	0

பாடத்தின் நோக்கம்

கற்றவர்இயலவேண்டும்
சங்க காலத்தில் தொழில்துறை பற்றிய அறிவைப் பெறுதல்.
சங்க காலத்தில் வீட்டின் பொருள் ,சிற்பங்கள் மற்றும் கோவில்கள் வடிவமைப்பு பற்றி கூட்டு கற்றல்
வரலாறு மற்றும் தொல்லியல் சான்றுகளின் ஆதாரமாக உலோகவியல் ஆய்வுகளில் அறிவை வளர்த்துக் கொள்ளுங்கள்.
வேளாண்மை மற்றும் வேளாண் செயலாக்கத்தில் பயன்படுத்தப்படும் பண்டைய நுட்பங்களைப் பற்றிய அறிவைப் பெறுதல்.
தமிழ் மொழியின் மென்பொருள் பற்றி அறிதல்

அலகு	விளக்கம்	பயிற்சிநேரம்
I	**நெசவுமற்றும்பானைத்தொழில்நுட்பம்** சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம்-கருப்பு சிவப்பு பாண்டங்கள் -பாண்டங்களில் கீறல் குறியீடுகள்.	3
II	**வடிவமைப்புமற்றும்கட்டிடத்தொழில்நுட்பம்** சங்க இலக்கியத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் மற்றும்சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும்-சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிப்பாடுத் தளங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டி நாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோச்செனிக் கட்டிடக் கலை.	3
III	உற்பத்தி தொழில்நுட்பம் கப்பல் கட்டும் கலை- உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருகுதல் எஃகு - வரலாற்றுசாலை சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள் , கண்ணாடிமணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின்வகைகள்.	3
IV	**வேளாண்மைமற்றும்நீர்பாசனத்தொழில்நுட்பம்** அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின்	3

முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்க பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

	அறிவியல்தமிழ்மற்றும்கணித்தமிழ் அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணைய கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.	
V		3

மொத்தபயிற்றுவிக்கும்நேரம்   15

பாடநெறியின்முடிவில்கற்றவர்கற்றபின்

பா மு1: பண்டைய தொழில்நுப்பதை அடையாளம் கொள்ள தெரியும்

பா மு2: சங்க கால கட்டுமானப் பொருட்கள்- சிற்ப வகைகளை வேறுபடுத்த முடியும்

பாடத்தின்முடிவு

பா மு3: வரலாறு மற்றும் தொல்லியல் சான்றுகளின் ஆதாரமாக உலோகவியல் ஆய்வுகளில் பட்டியலிட்டு அடையாளம் காண முடியும்

பா மு4: விவசாயம் மற்றும் வேளாண் செயலாக்கத்தில் பயன்படுத்தப்படும் பழங்கால நுட்பங்களைப் பற்றி விளக்கத்துடன் நிரூபிக்க முடியும்

பா மு5: தமிழ் மொழியின் புதிய மென்பொருள் பற்றி உருவாக்கக் கூடிய திறன் மேம்படுத்துதல்.

உரைபுத்தகங்கள்

உ1- தமிழக வரலாறு - மக்களும் பண்பாடும் - கே .கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

உ2- எஸ்.கே. சிங், இடைக்கால இந்தியாவின் வரலாறு. புது தில்லி: ஆக்சிஸ் புக்ஸ் பிரைவேட் லிமிடெட், 2013.

குறிப்புகள்

கு1- கணிதத்தமிழ் -முனைவர் இல. சுந்தரம் .(விகடன் பிரசுரம்)

கு2- கீழடி வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	CourseCode	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22MC1091	**INDIAN CONSTITUTION** **(Common for all Branches)**	2	0	0	0

Course Objectives

The student should be made to
1. Sensitization towards self, family (relationship),society and nature
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals
3. Strengthening of self-reflection
4. Development of commitment and courage to act

Unit	Description	Instructional Hours
I	**BASIC FEATURES AND FUNDAMENTAL PRINCIPLES** Meaning of the constitution law and constitutionalism–Historical perspective of the constitution of India– salient features and characteristic of the constitution of India.	6
II	**FUNDAMENTAL RIGHTS** Scheme of the fundamental rights–fundamental duties and its legislative status–The directive principles of state policy–its importance and implementation-Federal structure and distribution Of legislative and financial powers between the union and states.	6
III	**PARLIAMENTARY FORM OF GOVERNMENT** The constitution powers and the status of the president in India.–Amendment of the constitutional Powers and procedures–The historical perspective of the constitutional amendment of India–Emergency provisions: National emergency, President rule, Financial emergency.	6
IV	**LOCALGOVERNANCE** Local self-government-Rural Local Government-Panchayath Raj, Elections of Panchayat-State Election Commission- Urban Local Government-Amendment Act, Urban Local Government Structures in India -	6
V	**INDIANSOCIETY** ConstitutionalRemediesforcitizens–PoliticalPartiesandPressureGroups;Right of Women,Childrenand Scheduled Castes and Scheduled Tribes and other Weaker Sections.	6
	Total Instructional Hours	**30**

Course Outcome

At the end of the course, the learner will be able to
CO1:Understand the functions of the Indian government.
CO2:Understand and abide the rules of the Indian Constitution

TEXTBOOKS:
T1: DurgaDasBasu,"IntroductiontotheConstitutionofIndia",PrenticeHallofIndia,NewDelhi,1997.
T2: Agarwal R C.,"Indian Political System", S.Chand and Company, NewDelhi,1997.
T3: MaciverandPage,"Society:AnIntroductionAnalysis",MacMilanIndiaLtd.,NewDelhi.
T4: Sharma K L., "Social Stratification in India: Issues and Themes ",Jawaharlal NehruUniversity,NewDelhi,1997.
REFERENCEBOOKS:
R1-Sharma,Brij Kishore,"Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
R2-GahaiUR.,"IndianPoliticalSystem",NewAcademicPublishingHouse, Jalaendhar.
R3-Sharma R N., "Indian Social Problems",Media Promoters and Publishers Pvt. Ltd.

Programme/ sem	Course Code	Name of the Course	L	T	P	C
B.E/ II	22MA2105	**PARTIAL DIFFERENTIAL EQUATIONS , FOURIER SERIES AND TRANSFORMS (BME, CIVIL & FT)**	3	1	0	4

The learner should be able to

Course Objective
1. Compute the solution of first order partial differential equations.
2. Analyze Fourier series which is central to many applications in engineering.
3. Apply the effective tools for the solutions of one dimensional boundary value problems.
4. Apply Fourier transform techniques in various situations.
5. Analyze Z transform techniques for discrete time systems.

Unit	Description	Instructional Hours
I	**PARTIAL DIFFERENTIAL EQUATIONS** Formation of partial differential equations by eliminating arbitrary constants and functions – Solution of first order partial differential equations of the form f(p,q)=0, Clairaut's equation – Lagrange's equation.	12
II	**FOURIER SERIES** Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Change of Interval - Parseval's Identity - Harmonic analysis.	12
III	**BOUNDARY VALUE PROBLEMS** Classification of PDE - Solutions of one dimensional wave equation-One dimensional equation of heat conduction (excluding insulated edges).	12
IV	**FOURIER TRANSFORMS** Fourier Transform Pair - Fourier sine and cosine transforms Pair – Properties- Transforms of Simple functions – Convolution Theorem (Statement only).	12
V	**Z - TRANSFORMS** Z- Transforms - Elementary properties – Inverse Z - transform (using partial fraction only) –Solution of difference equations using Z – transform.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Compute the solution of first order partial differential equations.

CO2: Understand the principles of Fourier series which helps them to solve physical problems of engineering.

CO3: Employ Fourier series in solving the boundary value problems

CO4: Apply Fourier transform techniques which extend its applications .

CO5: Compute the solution of difference equations using Z – transform.

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018
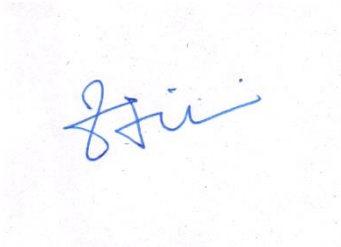
T2 - Bali. N.P and Manish Goyal & Watkins, "Advanced Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007

REFERENCE BOOKS :

R1 - Veerarajan. T.,"Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Second reprint, New Delhi, 2012.

R2 - Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi,2018.

R3 - Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E/ II	22CY2101	**ENVIRONMENTAL STUDIES** **(common to all branches except CSE,IT & AIML)**	3	0	0	2

Course Objective

The learner should be able to
1. Grasp the importance and issues related to ecosystem and biodiversity and their protection.
2. Acquire knowledge about environmental pollution – sources, effects and control measures of environmental pollution.
3. Identify the various natural resources, exploitation and its conservation
4. Gain knowledge on the scientific, technological, economic and political solutions to environmental problems.
5. Become aware on the national and international concern for environment and its protection

Unit	Description	Instructional Hours
I	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY** Main objectives and scope of environmental studies-Importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – food chain, food web and ecological pyramids - energy flow in the ecosystem – ecological succession processes - Introduction, types, characteristic features, structure and function of the forest and ponds ecosystem – Introduction to biodiversity definition: types and value of biodiversity – hot-spots of biodiversity – threats to biodiversity– endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.	9
II	**NATURAL RESOURCES** Renewable and Non renewable resources - Forest resources: Use and over-exploitation, deforestation, timber extraction, mining, dams and their effects on forests and tribal people - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture – Energy resources: Renewable and non renewable energy sources – Solar energy and wind energy - role of an individual in conservation of natural resources.	9
III	**ENVIRONMENTAL POLLUTION** Definition – causes, effects and control measures of: Air pollution- Water pollution – Water quality parameters- Soil pollution - Noise pollution- Nuclear hazards – role of an individual in prevention of pollution.	9
IV	**SOCIAL ISSUES AND THE ENVIRONMENT** From unsustainable to sustainable development – urban problems related to energy- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- Municipal solid waste management. Global issues – Climatic change, acid rain, greenhouse effect and ozone layer depletion – Disaster Management – Tsunami and cyclones.	9
V	**HUMAN POPULATION AND THE ENVIRONMENT** Population growth, variation among nations – population explosion – family welfare programme – environment and human health – effect of heavy metals – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- GIS-remote sensing-role of information technology in environment and human health.	9
	Total Instructional Hours	**45**

Course Outcome

At the end of the course, the learner will be able to
CO1: Discuss the importance of ecosystem and biodiversity for maintaining ecological balance.
CO2: Identify the causes of environmental pollution and hazards due to manmade activities.
CO3: Develop an understanding of different natural resources including renewable resources.
CO4: Demonstrate an appreciation for need for sustainable development and understand the various social issues and solutions to solve the issues.
CO5: Describe about the importance of women and child education, existing technology to protect environment.

TEXT BOOKS:

T1 – S.Annadurai and P.N. Magudeswaran, "Environmental studies", Cengage Learning India Pvt.Ltd, Delhi, 2020

T2 - Anubha Kaushik and C. P. Kaushik, "Perspectives in Environmental studies", Sixth edition, New Age International Publishers, New Delhi, 2019.

REFERENCE BOOKS:

R1 - Erach Bharucha, "Textbook of environmental studies" University Press (I) Pvt.ltd, Hyderabad, 2015

R2 - G.Tyler Miller, Jr and Scott E. Spoolman"Environmental Science" Thirteenth Edition, Cengage Learning, 2010.

R3 – Gilbert M. Masters and Wendell P. Ela "Introduction to Environmental Engineering and Science", 3rd edition, Pearson Education, 2013.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem BE/B.Tech	Course Code	Name of the Course	L	T	P	C
II	22PH2101	**BASICS OF MATERIAL SCIENCE** (Common to all branches except MCT)	2	0	0	2

Course Objective

The student should be able to
1.Gain knowledge about Crystal systems and crystal structures
2. Understand the knowledge about electrical properties of materials
3. Enhance the fundamental knowledge in semiconducting materials.
4. Gain knowledge about magnetic materials
5. Acquire fundamental knowledge new engineering materials which is related to the engineering program

Unit	Description	Instructional Hours
I	**CRYSTAL PHYSICS** Crystal systems - Bravais lattice - Lattice planes - Miller indices – Inter planar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures.	6
II	**ELECTRICAL PROPERTIES OF MATERIALS** Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression – Widemann - Franz law – Success and failures –– Fermi- Dirac statistics – Density of energy states .	6
III	**SEMICONDUCTING MATERIALS** Introduction – Compound and elemental semiconductor - direct and indirect band gap of semiconductors. Intrinsic semiconductor — electrical conductivity – band gap determination. - Extrinsic semiconductor – n type and p type semiconductor –Light Emitting Diode.	6
IV	**MAGNETIC MATERIALS** Origin of magnetic moment – Bohr magnetron – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti ferromagnetic materials – Ferrites and its applications.	6
V	**NEW ENGINEERING MATERIALS** Metallic glasses: melt spinning process, Preparation and applications - shape memory alloys: phases, shape memory effect - Characteristics of SMA : Pseudoelastic effect, Super elasticity and Hystersis. Applications of SMA. Nanomaterials preparation (bottom up and top down approaches) – various techniques - pulsed laser deposition - Chemical vapor deposition	6
	Total Instructional Hours	30

After completion of the course the learner will be able to

Course Outcome	CO1: Understand the Crystal systems and crystal structures in the field of Engineering
	CO2: Illustrate the fundamental of electrical properties of materials
	CO3: Discuss concept of acceptor or donor levels and the band gap of a semiconducting materials
	CO4: Develop the technology of the magnetic materials and its applications in engineering field
	CO5: Understand the advanced technology of new engineering materials in the field of Engineering

TEXT BOOKS:

T1 - Rajendran V, "Materials Science", Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.

T2- M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi 2022

REFERENCE BOOKS:

R1 – Charles Kittel "Introduction to Solid State Physics". Wiley., New Delhi 2017

R2 - Dr. M.Arumugam "Materials Science " Anuradha publications., 2019

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E. / II	22CS2154	**ESSENTIALS OF C AND C++ PROGRAMMING (BME)**	2	0	2	3

Course Objective	**The student should be able to**
	1. Learn and develop basics of C programming.
	2. understand Object Oriented Programming concepts and basic characteristics of C++.
	3. Be familiar with the constructors and operator overloading.
	4. understand the concepts of inheritance, polymorphism and virtual function.
	5. learn and define concept of templates and exception handling.

Unit	Description	Instructional Hours
I	**BASICS OF 'C' PROGRAMMING** Fundamentals of ' C' programming – Structure of a 'C' program – Constants - Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations- Branching and Looping - Arrays – One dimensional and Two dimensional arrays. **Programs: 1. Write a C program to calculate sum of individual digits of a given number.** **2. Write a C program to count no. of positive numbers, negative numbers and zeros in the array. 3. Write a C program to find sum of two numbers using functions with arguments and without return type**.	3+6
II	**BASICS OF 'C++' PROGRAMMING** Introduction to C++ – structures and unions- Object oriented programming concepts–Defining a Class – creating objects - access specifiers – Function in C++ - function and data members default arguments – function overloading – Inline functions - friend functions – constant with class – static member of a class – nested classes – local classes. **Program: Write a C++ program to accept the student detail such as name and 3 differentmarks by get_data() method and display the name and average of marks using display() method. Define a friend class for calculating the average of marks using the method mark_avg().**	6+3
III	**CONSTRUCTOR AND OPERATOR OVERLOADING** Constructors - Default, Copy, Parameterized, Dynamic constructors, Default argument – Destructor. - Function overloading- Operator overloading-Unary, Binary - Binary operators using friend function. **Program: Write a C++ program to calculate the volume of different geometric shapes like cube, cylinder and sphere and hence implement the concept of Function Overloading.**	7+2
IV	**INHERITANCE AND POLYMORPHISM** Inheritance – Public, Private and Protected derivations– Single– Multiple– Multilevel– Hybrid– Hierarchical - Virtual base class – abstract class – composite objects- Runtime polymorphism – virtual functions – pure virtual functions. **Program: Demonstrate Simple Inheritance concept by creating a base class FATHER with data members SurName and BankBalance and creating a derived class SON, which inherits SurName and BankBalance feature from base class but provides its own feature FirstName and DOB. Create and initialize F1 andS1 objects with appropriate constructors and display the Father & Son details. (Hint : While creating S1 object, call Father base class parameterized constructor through derived class by sending values).**	7+2
V	**TEMPLATES AND EXCEPTION HANDLING** Function and class templates - Exception handling – try-catch-throw paradigm – exception specification – terminate and Unexpected functions – Uncaught exception. **Program: Write a C++ program to create a template function for Bubble Sort and demonstrate sorting of integers and doubles.**	7+2
	TOTAL INSTRUCTIONAL HOURS	**45**

Course Outcome	At the end of the course, the learner will be able to
	CO1:Develop simple applications in C using basic constructs.
	CO2:Apply solutions to real world problems using basic characteristics of C++.
	CO3:Write object-oriented programs using operator overloading, constructors and destructors.
	CO4:Develop programs with the concepts of inheritance and polymorphism.
	CO5:Understand and define solutions with C++ advanced features such as templates and exception handling.

TEXT BOOKS:
T1 - E.Balagurusamy, "Programming in ANSI C", 7th Edition, McGraw Hill Publication, 2016.
T2 - E.Balagurusamy, "Object Oriented Programming with C++", 7th Edition, McGraw Hill Publication, 2017.
REFERENCE BOOKS:
R1 - Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.
R2 - RohitKhurana, "Object Oriented Programming with C++", Vikas Publishing, 2nd Edition, 2016.
R3 - B. Trivedi, "Programming with ANSI C++", Oxford University Press, 2007.
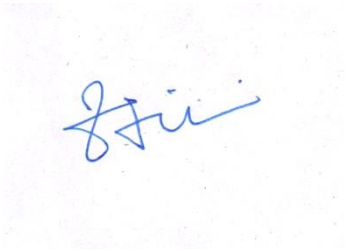
CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ II	22HE2151	**EFFECTIVE TECHNICAL COMMUNICATION** (Common to all Branches)	2	0	2	3

Course Objective

The learner should be able
1. To improve essential business communication skills.
2. To enrich employability knowledge.
3. To acquire the crucial organizing ability in official forum.
4. To impart important business writings.
5. To make effective presentation with essential etiquette.

Unit	Description	Instructional Hours
I	Language Proficiency: Types of sentences in English according to structure Writing: writing definitions, Describing product, work place and service (purpose, appearance, function) Vocabulary – words on nature **Practical Component: Listening- Watching and interpreting advertisements/short films Speaking- Extempore speech**	9
II	Language Proficiency: Direct and Indirect speech. Writing: Formal memos, Job application and resume preparation Vocabulary - words on offense and ethics**Practical Component: Listening- Comprehensions based on telephonic conversation Speaking- Vote of thanks& welcome address**	9
III	Language Proficiency: Homophones and Homonyms, Writing: Preparing a detail plan for an official visit, schedule and Itinerary, reading comprehension, Vocabulary– words on society **Practical Component: Listening- Listening- paraphrasing the listened content Speaking- Group Discussion with preparation**	9
IV	Language Proficiency: Idioms Writing: Report writing (marketing, investigating) Vocabulary-words involved in business **Practical Component: Listening- Watching technical discussions and preparing MoM Speaking- On the spot Group Discussion**	9
V	Language Proficiency: spotting errors Writing: making /interpreting chart, sequencing of sentences Vocabulary- words involved in finance **Practical Component: Listening- Comprehensions based on announcements Speaking- Presentation on a technical topic with ppt.**	9
	Total Instructional Hours	**45**

At the end of the course, learners will be able

Course Outcome	CO1: To the business procedure and promotion skills. CO2: To make oral and written presentation in corporate forum. CO3: To schedule official events and participate in official discussions without reluctance. CO4: To take an effective role and manage in an organizational sector. CO5:To prepare and demonstrate a professional presentation

TEXT BOOKS:

T1 - Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate",Cambridge University Press, 2016.

T2- Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2015.

REFERENCE BOOKS :

R1 -Michael Mc Carthy, "Grammar for Business", Cambridge University Press, 2009.

R2- Bill Mascull, "Business Vocabulary in use: Advanced 2nd Edition", Cambridge University Press, 2009.

R3-Frederick T. Wood, "Remedial English Grammar For Foreign Students", Macmillan publishers, 2001.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
BE/B.Tech/ II	22PH2151	**PHYSICS FOR CIRCUIT ENGINEERING PROGRAMME (AIML,CSE,ECE,EEE,EIE,IT & BME)**	2	0	2	3

Course Objective	The student should be able to 1. Gain knowledge about laser, their applications , become conversant with principles of optical fiber and its applications 2. Enhance his fundamental knowledge about properties of matter 3. Understand the concept of wave optics 4. Gain knowledge about quantum mechanics to explore the behavior of sub atomic particles 5. Acquire fundamental knowledge of Ultrasonics and their applications.

Unit	Description	Instructional Theory Hours
I	**LASER AND FIBER OPTICS** Spontaneous emission and stimulated emission –Type of lasers – Nd:YAG laser - Laser Applications – Holography – Construction and reconstruction of images. Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index and modes) – Fiber optical communication link. **Determination of Wavelength and particle size using Laser**	6
II	**PROPERTIES OF MATTER** Elasticity – Hooke's law – Poisson's ratio – Bending moment – Depression of a cantilever – Determination of Young's modulus of the material of the beam by Uniform bending theory and experiment. Twisting couple - torsion pendulum: theory and experiment **Determination of Young's modulus by uniform bending method** **Determination of Rigidity modulus – Torsion pendulum**	6
III	**WAVE OPTICS** Interference of light – air wedge –Thickness of thin paper(Testing of thickness of surface) - Michelson interferometer - Diffraction of light –Fraunhofer diffraction at single slit – Diffraction grating - Plane Diffraction grating – Rayleigh's criterion of resolution power - resolving power of grating. **Determination of wavelength of mercury spectrum – spectrometer grating** **Determination of thickness of a thin wire – Air wedge method**	6
IV	**QUANTUM PHYSICS** Black body radiation –Compton effect: theory and experimental verification – wave particle duality –concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box .	6
V	**ULTRASONICS** Production – Piezoelectric generator – Properties of Ultrasonic waves. Determination of velocity using acoustic grating – Cavitation. Industrial applications – Drilling and welding – Non destructive testing (pulse echo system). Medical applications – Ultrasound Scanner – A – mode – B- mode and C –mode.	6
	Total Instructional Hours	30
	Total Lab Instructional Hours	30

Course Outcome

After completion of the course the learner will be able to

CO1: Understand the advanced technology of LASER and optical communication in the field of engineering

CO2: Illustrate the fundamental properties of matter

CO3: Discuss the Oscillatory motions of particles

CO4: Understand the dual nature of matter and the Necessity of quantum mechanics.

CO5: Develop the Ultrasonics technology and its applications in NDT.

TEXT BOOKS:

T1 - Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.

T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

R1 - M.N Avadhanulu and PG Kshirsagar"A Text Book of Engineering physics"S.Chand and Company ltd., NewDelhi 2016

R2 - Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2021

CHAIRMAN-BOS   **DEAN ACADEMICS**

S	Programme	Course Code	Name of the Course	L	T	P	C
E				**0**	**0**	**4**	**2**
M	B.E/B.Tech	**22ME2001**	**Engineering Practices** (Common to all branches)				
E							

Course Objective	To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical and Electrical Engineering.

Unit	Description of the Experiments

GROUP A (CIVIL AND MECHANICAL)

1	Preparation of Single pipe line and Double pipe line connection by using valves, taps, couplings, unions, reducers and elbows.
2	Arrangement of bricks using English Bond for one brick thick wall for right angle corner junction and T- junction
3	Arrangement of bricks using English Bond for one and a half brick thick wall for right angle corner and T- junction
4	Preparation of arc welding of Butt joints, Lap joints and Tee joints.
5	Practice on sheet metal Models– Trays and funnels
6	Hands-on-exercise in wood work, joints by sawing, planning and cutting.
7	Practice on simple step turning, taper turning and drilling.
8	Demonstration on Smithy operation.
9	Demonstration on Foundry operation.
10	Demonstration on Power tools.

GROUP B (ELECTRICAL ENGINEERING)

1	Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2	Fluorescent lamp wiring.
3	Stair case wiring.
4	Measurement of Electrical quantities – voltage, current, power & power factor in single phase circuits.
5	Measurement of energy using single phase energy meter.
6	Soldering practice using general purpose PCB.
7	Measurement of Time, Frequency and Peak Value of an Alternating Quantity using CRO and Function Generator.
8	Study of Energy Efficient Equipment's and Measuring Instruments.

Total Instructional Hours   45

Course Outcome	• Fabricate wooden components and pipe connections including plumbing works. • Fabricate simple weld joints. • Fabricate different electrical wiring circuits and understand the AC Circuits.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22MC2092	HERITAGE OF TAMIL	2	0	0	0

Course Objective	**The learner should be able to** 1. Introduce students to the great History of Tamil literature. 2. Establish the heritage of various forms of Rock art and Sculpture art. 3. To study and understand the various folk and Martial arts of Tamil culture 4. Introduce students to Ancient Tamil concepts to understand the richness of Tamil literature. 5. To learn about the various influences or impacts of Tamil language in Indian culture.

Unit	Description	Instructional Hours
I	**Language and Literature** Language families in India – Dravidian Languages – Tamil as a classical language – Classical Literature in Tamil- Secular nature of Sangam Literature – Distributive justice in Sangam Literature – Management principles in Thirukural – Tamil epics and impacts of Buddhism & Jainism in Tamil and Bakthi literature of Azhwars and Nayanmars – Forms of minor poetry _ Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidasan.	6
II	**Heritage _ Rock Art Paintings to Modern Art – Sculpture** Hero Stone to Modern Sculpture – Bronze icons – Tribes and their handcrafts - Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar statue at Kanyakumari, Making of musical instruments – Mridangam, Parai, Yazh and Nadhaswaram - Role of Temples in social and economic life of Tamils.	6
III	**Folk and Martial Arts** Therukoothu, Karagattem, Villupattu, Kaniyan koothu, Oyilattam, Leather puppertry, Silambattam., Valari Tiger dance – Sports and Games of Tamils.	6
IV	**Thinai Concept of Tamils** Flora and Fauna of Tamils – Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram concept of Tamils – Education and Literacy during Sangam Age - Ancient cities and ports of Sangam age – Exporot and Import during Sangam age – Overseas conquest of Cholas.	6
V	**Contribution of Tamils to Indian National Movement and Indian Culture** Contribution of Tamils to Indian freedom struggle – The cultural influence of Tamils over the other parts of India – Self respect movement – Role of Siddha Medicine in indigenous systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil books**.**	6
	Total Instructional Hours	**30**

Course Outcome	**At the end of the course, the learner will be able to** CO1: Learn about the works pertaining to Sangam age CO2: Aware of our Heritage in art from Stone sculpture to Modern Sculpture. CO3Appreciate the role of Folk arts in preserving, sustaining and evolution of Tamil culture. CO4: Appreciate the intricacies of Tamil literature that had existed in the past. CO5: Understand the contribution of Tamil Literature to Indian Culture
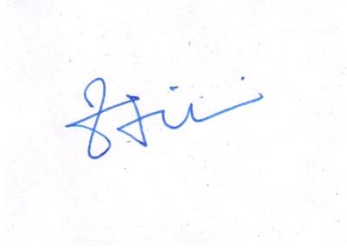
TEXTBOOKS:
T1: Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
T2: Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
 T3: Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).
REFERENCEBOOKS:
R1-The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)

R2- Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu TextBookand Educational Services Corporation, Tamil Nadu)
R3-Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – ReferenceBook.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
BE/B.TECH II	22HE2072	**SOFT SKILLS AND APPTITUDE I**	0	0	0	1

The student should be able to

Course Objective

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	4
V	**Verbal Ability** Nouns and Pronouns – Verbs - Subject-Verb Agreement - Pronoun-Antecedent – Agreement - Punctuations	4

Total Instructional Hours	**30**

After completion of the course the learner will be able to

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

REFERENCE BOOKS:

 R1 - Quantitative Aptitude – Dr. R S Agarwal
 R2 -Speed Mathematics: Secret Skills for Quick Calculation - Bill Handley
 R3 -Verbal and Non – Verbal Reasoning – Dr. R S Agarwal
 R4- Objective General Enlish – S.P.Bakshi

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
BE/B.TECH II	22HE2071	**DESIGN THINKING**	2	0	0	2

Course Objective

The student should be able to
1. To expose students to the design process
2. To develop and test innovative ideas through a rapid iteration cycle.
3. To provide an authentic opportunity for students to develop teamwork and leadership skills

Unit	Description	Instructional Hours
I	**DESIGN ABILITY** Asking Designers about what they Do – Deconstructing what Designers Do – Watching what Designers Do – Thinking about what Designers Do – The Natural Intelligence of Design Sources	6
II	**DESIGNING TO WIN** Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	5
III	**DESIGN TO PLEASE AND DESIGNING TOGETHER** Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	6
IV	**DESIGN EXPERTISE** Design Process – Creative Design - Design Intelligence – Development of Expertise – Novice to Expert. Critical Thinking – Case studies: Brief history of Albert Einstein, Isaac Newton and Nikola Tesla	6
V	**DESIGN THINKING TOOLS AND METHODS** Purposeful Use of Tools and Alignment with Process - Journey Mapping - Value Chain Analysis - Mind Mapping – Brainstorming - Design Thinking Application: Design Thinking Applied to Product Development	7
	Total Instructional Hours	30

Course Outcome

After completion of the course the learner will be able to
CO1: Develop a strong understanding of the Design Process
CO2: Learn to develop and test innovative ideas through a rapid iteration cycle.
CO3: Develop teamwork and leadership skills

TEXT BOOKS:
T1 - 1. Nigel Cross, "Design Thinking", Kindle Edition.
REFERENCE BOOKS:
R1 - Tom Kelley, "Creative Confidence", 2013.
R2 - 3. Tim Brown, "Change by Design", 2009.

CHAIRMAN-BOS   **DEAN ACADEMICS**

GE3152 தமிழர் மரபு **L T P C**
1 0 0 1

அலகு I மொழி மற்றும் இலக்கியம்: 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/III	19MA3102	FOURIER ANALYSIS AND TRANSFORMS	3	1	0	4

Course Objective	1. Analyze Fourier series which is central to many applications in engineering.
	2. Apply the effective tools for the solutions of one dimensional boundary value problems.
	3. Apply the effective tools for the solutions of two dimensional heat equations.
	4. Apply Fourier transform techniques in various situations.
	5. Analyze Z transform techniques for discrete time systems.

Unit	Description	Instructional Hours
I	**FOURIER SERIES** Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Half range sine and cosine series – Change of Interval - Parseval's Identity - Harmonic analysis.	12
II	**BOUNDARY VALUE PROBLEMS** Classification of PDE - Solutions of one dimensional wave equation - Onedimensional equation of heat conduction (excluding insulated edges).	12
III	**TWO DIMENSIONAL HEAT EQUATIONS** Steady state solution of two dimensional equation of heat conduction in infiniteplate and semi circular plate.	12
IV	**FOURIER TRANSFORMS** Fourier Transform Pairs - Fourier sine and cosine transforms – Properties - Transforms of Simple functions – Convolution Theorem (Statement only) – Parseval's identity(Statement only).	12
V	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS** Z- Transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem(excluding proof)– Solution of difference equations using Z – transform.	12
	Total Instructional Hours	**60**

Course Outcome	CO1: Understand the principles of Fourier series which helps them to solve physical problemsof engineering.
	CO2: Employ Fourier series in solving the boundary value problems.
	CO3: Understand Fourier series in solving the two dimensional heat equations.
	CO4: Apply Fourier transform techniques which extend its applications.
	CO5: Illustrate the Z- transforms for analyzing discrete-time signals and systems.

TEXT BOOKS:

T1 - Veerarajan. T.,"Transforms and Partial Differential Equations", Tata McGraw HillEducation Pvt. Ltd.,Second reprint, New Delhi, 2012.

T2 - Bali. N.P and Manish Goyal & Watkins, "Advanced Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007 .

REFERENCE BOOKS :

R1 - C.Roy Wylie " Advance Engineering Mathematics" Louis C. Barret, 6th Edition, Mc GrawHill Education India Private Limited, New Delhi 2003.

R2 - Kandasamy P., Thilagavathy K. and Gunavathy K.,"Engineering Mathematics Volume III",S.Chand & Company Ltd., New Delhi, 1996.

R3 - Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers,Delhi,2018.

R4- Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill PublishingCompany

Limited, New Delhi, 2018.

CHAIRMAN-BOS   **DEAN ACADEMICS**

PROGRAMME/SEM	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E./B.TECH/ III	21BM3201	ELECTRON DEVICES AND CIRCUITS	3	1	0	4

Course **Objective**	1. To be familiar with the theory, construction, and operation of semiconductor diodes. 2. To impart knowledge on the configurations and operation of transistors. 3. To give an insight of the operation of amplifiers. 4. To be familiar with the concept of multistage amplifiers and differential amplifiers. 5. To impart knowledge on feedback amplifiers and oscillators.

Unit	Description	InstructionalHours
I	**PN JUNCTION** PN junction diode –structure, operation and V-I characteristics, diffusion and transient capacitance – Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes- Zener diode- characteristics-Zener Reverse characteristics – Zener as regulator	12
II	**TRANSISTORS** BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristor and IGBT – Structure and characteristics	12
III	**AMPLIFIERS** BJT small signal model – Analysis of CE amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency Model	12
IV	**DIFFERENTIAL AMPLIFIER AND POWER AMPLIFIER** BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).	12
V	**FEEDBACK AMPLIFIERS AND OSCILLATORS** Advantages of negative feedback – voltage / current, series , Shunt feedback –positive feedback – Condition for oscillations, phase shift –Wien bridge, Hartley, Colpitts and Crystal oscillators	12

Total Instruction hours 60

Course Outcome	CO1: Ability to explain the theory, construction, and operation of PN junction diodes. CO2: Ability to demonstrate the theory, construction, and operation of transistors. CO3: To understand the working of amplifiers. CO4: To understand the working multistage amplifiers and differential Amplifiers. CO5: To differentiate different types of feedback amplifiers and oscillators.

TEXT BOOKS:

1. David A. Bell ,"Electronic Devices and Circuits", Fifth edition, Prentice Hall of India,2008.
2. Sedra and smith, "Microelectronic Circuits", Seventh Edition, Oxford University Press,2017.

REFERENCES:

1. Floyd, "Electron Devices" Pearson Education India, 9th Edition, 2015.
2. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rdEdition, 2006.
3. Robert L.Boylestad, "Electronic Devices and Circuit theory", 11th Edition, PearsonEducation India , 2015.
4. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits toBiomedical Instrumentation", 2nd Edition, CRC Press, 2017

CHAIRMAN-BOS   **DEAN ACADEMICS**

PROGRAMME/SEM	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E./B.TECH/ III	19BM3202	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	InstructionalHours
I	**INTRODUCTION TO BIOCHEMISTRY** Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson - Hasselbalch equation, physiological buffers in living systems, Energy in living organism. Properties of water and their applications in biological systems. Introduction to Biomolecules, Biological membrane, Clinical application of Electrolytes and radioisotopes	9
II	**CARBOHYDRATES** Classification of carbohydrates - mono, di, oligo and polysaccharides. Structure, physical and chemical properties of carbohydrates Isomerism, racemisation and mutarotation. Digestion and absorption of carbohydrates. Metabolic pathways and bioenergetics – Glycolysis, glycogenesis, glycogenolysis and its hormonal regulation. TCA cycle and electron transport chain. Oxidative phosphorylation. Biochemical aspect of Diabetes mellitus and Glycogen storage Disease.	9
III	**LIPIDS** Classification of lipids- simple, compound and derived lipids. Nomenclature of fatty acid, physical and chemical properties of fat..Metabolic pathways: synthesis and degradation of fatty acid (beta oxidation), hormonal regulation of fatty acid metabolism, ketogenesis, Biosynthesis of Cholesterol. Disorders of lipid metabolism	9
IV	**NUCLEIC ACID & PROTEIN** Structure of purines and pyrimidines, nucleoside, nucleotide, DNA act as agenetic material, chargoffs rule. Watson and crick model of DNA. Structure of RNA and its type. Metabolism and Disorder of purines and pyrimidines nucleotide Classification, structure and properties of proteins, structural organization of proteins, classification and properties of amino acids. Separation of protein, Inborn Metabolic error of amino acid metabolism.	9
V	**ENZYME AND ITS CLINICAL APPLICATION** Classification of enzymes, apoenzyme, coenzyme, holoenzyme and cofactors. Kinetics of enzymes - Michaelis-Menten equation.Factors affecting enzymatic activity: temperature, pH, substrate concentration and enzyme concentration. Inhibitors of enzyme action: Competitive, non- competitive, irreversible.	9

Total Instructional Hours 45

Course Outcome

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

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:

1.RAFI MD —Text book of biochemistry for Medical Student‖ Second Edition, University Press, 2014

2.Victor. W.Rodwell, David A Bender et al —Harper's Illustrated Biochemistry, 31st edition, LANGEMedical Publications,2018

REFERENCES:

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

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

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/III	21BM3251	DIGITAL ELECTRONICS	2	0	2	3

Course Objective	
	1. To understand different methods used for the simplification of Boolean functions.
	2. To study combinational circuits.
	3. To learn synchronous sequential circuits.
	4. To understand asynchronous sequential circuits.
	5. To study the fundamentals of HDL.

Unit	Description	Instructional Hours
I	**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- Morgan's Theorem-Principle of Duality-Minimization of Boolean expressions – Minterm – Maxterm– Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don't care conditions (2variable,3variable&4-variable)-Tabulation method.	6
II	**COMBINATIONAL CIRCUITS** Circuits for arithmetic operations: adder: Half adder, Full adder, subtractor: Half subtractor, Full subtractor-BCD adder-Magnitude comparator-Encoders, Decoders-Multiplexers, Demultiplexers, Code converters: Binary to Gray, Gray to Binary 1.Experimental Design and implementation of Half Adder & Half Subtractor. 2. Experimental Design and implementation of Binary to Gray and Gray to BinaryConversion. 3. Experimental Design and implementation of Multiplexers and Demultiplexers	9+6(P)
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. **1.Experimental Design and implementation of Synchronous and Asynchronous Counters**	6+3(P)
IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS** Analysis and design of asynchronous sequential circuits-Reduction of state and flow tables– Race-free state assignment–Hazards.	6
V	**MEMORY DEVICES AND HDL** ROM-PROM-EPROM-EEPROM-RAM-FPGA-Programmable Logic Device-Introduction toHardware Description Language (HDL)- HDL for combinational circuits- Half adder, Full adder, Multiplexer, De-multiplexer, Counters **1.Coding Combinational/Sequential circuits using HDL**	6+3(P)
	Total Instructional Hours	**45**

Course Outcome

CO1: Simplify Boolean functions using different methods.
CO2: Analyze, design and implement combinational logic circuits.
CO3: Analyze, design and implement Synchronous sequential logiccircuits.
CO4: Analyze, design and implement Asynchronous sequential logiccircuits
CO5: Simulate and implement combinational and sequential circuits usingHDL.

TEXT BOOKS:

T1 Morris Mano M. and Michael D. Ciletti, "Digital Design with an Introduction to theVerilog HDL", V

Edition, Pearson Education, 2013.ISBN-13: 978-0-13-277420-8

REFERENCE BOOKS :

R1-.S. Salivahanan and S. Arivazhagan, "Digital Circuits and Design",FourthEdition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012.ISBN: 978-93-259-6041-1

R2-.Thomas L. Floyd, "Digital Fundamentals", Pearson Education, Inc, New Delhi, 2013 ISBN:978-1-292-07598-

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L T P C
B.E./B.Tech/III	21BM3001	**Electron Devices and Circuits Laboratory**	0 0 3 1.5

Course Objective	1. To learn the characteristics of PN junction diode. 2. To understand the characteristics of Zener diode. 3. To learn the characteristics of Transistors and frequency response of amplifiers. 4. To learn the basic laws and network reduction theorems. 5. To learn the working of oscillators.

S.No	Description Of The Experiments
1	PN Junction Diode Characteristics
2	Zener Diode Characteristics
3	Common Emitter transistor, Input-Output Characteristics
4	JFET Characteristics
5	Frequency Response analysis of CE amplifier
6	RC Phase shift oscillator
7	Verification Of Thevenin's and Norton's Theorem
8	Verification of KVL & KCL
9	Verification of Super Position Theorem
10	Verification of Maximum Power Transfer

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   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/III	21BM3002	**BIOCHEMISTRY LABORATORY**	0	0	3	1.5

Description of Experiments

1. General guidelines for working and functional component of biochemistry lab

2. Units of volume, weight, density and concentration measurements ad their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.

3. Preparation of buffer-titration of a weak acid and a weak base..

4. Qualitative tests for carbohydrates-distinguishing reducing from non-reducing sugras andketo from aldo sugars

5. Spectroscopy: Determination of absorption maxima (λmax) of a given solution

6. Estimation of blood glucose.

7. Estimation of Haemoglobin

8. Estimation of creatinine.

9. Estimation of urea.

10. Estimation of cholesterol.

11. Preparation of serum and plasma from blood.

12. Separation of proteins by SDS electrophoresis(Demo)

13. Separation of amino acids by thin layer chromatography (Demo).

Course Outcome	CO1: Understand the Biochemistry laboratory functional components
	CO2: Understand the basics knowledge of Biochemical parameter andtheir interpretation in Blood sample.
	CO3: Understand the basics principle of preparation of buffers

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course
B.E. / B.Tech./III	21MC3191	INDIAN CONSTITUTION

COURSE OBJECTIVES

1. Sensitization of student towards self, family (relationship), society and nature.
2. Understanding (or developing clarity) of nature, society and larger systems, on the basisof human relationships and resolved individuals.
   3. Strengthening of self reflection.
   4. .Development of commitment and courage to act.

UNIT   DESCRIPTION   INSTRUCTIONAL HOURS

UNIT I : BASIC FEATURES AND FUNDAMENTALE PRINCIPLES

Meaning of the constitution law and constitutionalism – Historical perspective of the constitution of India – salient features and characteristics of the constitution of India.

UNIT II : FUNDAMENTAL RIGHTS

Scheme of the fundamental rights – fundamental duties and its legislative status – The directive principles of state policy – its importance and implementation - Federal structure and distribution of legislative and financial powers between the union and states.

UNIT III : PARLIAMENTARY FORM OF GOVERNMENT

The constitution powers and the status of the president in India. – Amendement of the constitutional powers and procedures – The historical perspective of the constitutional amendment of India – Emergency provisions : National emergency, President rule, Financial emergency.

UNIT IV: LOCAL GOVERNANCE

Local self government -constitutional scheme of India – Scheme of fundamental right to equality – scheme of fundamental right to certain freedom under article19 – scope of the right to life and personal liberty under article 21.

UNIT V : INDIAN SOCIETY

Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

Total instructional hours : 20

COURSE OUTCOMES:

Upon completion of the course, students will be able to:
1. Understand the functions of the Indian government
2. Understand and abide the rules of the Indian constitution.

TEXT BOOKS:

1. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of

   India, NewDelhi.

T2. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.

T3. Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.

T4. K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal

REFERENCE BOOKS:

R1. Sharma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.

R2. U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.

R3. R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd

CHAIRMAN-BOS   **DEAN ACADEMICS**

SEMESTER IV

Programme/Sem	CourseCode	Name of the Course	L	T	P	C
BE/IV	**21MA4152**	**STATISTICS & NUMERICAL METHODS**	3	0	2	4

Course

Objective

1. Illustrate the relation between two random variables byusing 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 f ind the inter mediate values for the given data
5. Explain concepts of numerical differentiation and numerica l integration of the unknown functions.

Unit	Description	Instructional Hours
I	**CORRELATIONANDREGRESSION** Correlation–Karl Pearson's correlation coefficient–Spearman's RankCorrelation– Regression lines (problems based on Rawdataonly). **Introduction to R programming, Applications of Correlation and Regression**	9+3
II	**HYPOTHESISTESTING** Tests based on t (for single mean and difference of means) -F distribution – for testing difference of variance, Chi – Square test for Contingency table(TestforIndependency)–Goodnessoffit **Application ofFtest,Application of Chi –squaretest**	9+6
III	**ANALYSIS OFVARIANCE** Introduction,analysis of variance,completely randomized design,randomized blockdesign,Latin square design.**ANOVA– completely randomized design ANOVA–randomized block design**	9+6
IV	**INTERPOLATION** Interpolation:Newton'sforwardandbackwarddifferenceformulaeLagrangian Interpolation for unequalintervals–Divided differences-Newton'sdivided difference formula.	9
	NUMERICAL DIFFERENTIATION AND INTEGRATION Differentiation using interpolation formula – Newton's forward and	9

V	backwardinterpolationformulaeforequalintervals–Newton'sdivided differenceformulafor unequalintervals-Numerical integrationby Trapezoidaland Simpson's1/3rules.

Total Instructional Hours 45+15=60

Course Outcome	CO1: Compute correlation and predict unknown values using regression together with Rstudio. 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 inadditionwithR studio. CO4:Understand the concept ofi nterpolationinbothcases ofequalandunequalintervals. CO5:Identify various methods to perform numerical differentiation and integration.

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India

PrivateLtd.,NewDelhi,2018.

 T2- MedhiJ,"stochasticProcesses",NewAgeInternationalPublishers,NewDelhi,2014

REFERENCE BOOKS:

R1- Walpole.R.E.,Myers. R.H.,Myers. S.L.,andYe. K.,"ProbabilityandStatisticsforEngineers
    andScientists",8thEdition, PearsonEducation, Asia,2007.

R2-
GrewalB.S.andGrewalJ.S."NumericalMethodsinEngineeringandScience",6thEdition,Khan
na
     publishers,NewDelhi2004.

R3- S.K.Gupta,Numerical MethodsforEngineers", NewAgeInternationalPvt.LtdPublishers,2015.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	CourseCode	NameoftheCourse	L	T	P	C
BE	**21BM4201**	**LINEAR INTEGRATED CIRCUITS**	3	0	0	3

Course Objective

CO1.To introduce the basic concepts of OPAMP.
CO2.To impart knowledge on various applications of OPAMP.
CO3.To understand the workingofcomparators and waveform generators.
CO4.To learnthe design concepts of ADCand DAC.
CO5.To understand the working of PLL and voltage regulators.

Unit	Description	Instructional Hours
	BASICS OF OPERATIONAL AMPLIFIERS	
I	Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages ,DC and AC performance characteristics, slewrate,Open and closed loopconfigurations.	12
	APPLICATIONS OF OPERATIONAL AMPLIFIERS	12
II	Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I andI-to-Vconverters,adder,subtractor,Instrumentationamplifier,Integrator,Differentiator,Logarithmicamplifier,Antilogarithmicamplifier,Precisionrectifier,peakdetector, Clipper and clamper, Low-pass,high-passandband-passButterworthfilters..	
	COMPARATORSAND WAVE FORM GENERATORS	12
III	Comparators, Schmitt trigger, Sine-wave generators, Multivibrators , Triangularwave generator, Saw-tooth wave generator, Frequency to Voltage and Voltage toFrequencyconverters.	
	ANALOGTO DIGITAL AND DIGITALTO ANALOG CONVERTERS	12
IV	Analog and Digital Data Conversions, D/A converter – specifications - weightedresistor type, R-2R Ladder type, Voltage Mode and Current-Mode -R - 2RLadder types -switches for D/A converters, high speed sample and hold circuits,A/D Converters –specifications - Flash type - Successive Approximation type -SingleSlopetype–DualSlopetype.	
	SPECIALISED ICs AND APPLICATIONS	12
V	IC regulators - 723 (block diagram, typical low voltage regulator circuit), 78XX,79XX, 317 - applications. Timers - 555 – Functional block diagram-Astable andmonostable multivibrators using 555 - applications. VCO – 566. PLL - Blockdiagram and derivation of capture range, lock range and pull in time capture andlockrange-565–applications.	

Total Instructional Hours

60

Course	CO1. To analyse the characteristics of opamp.
Outcome	CO2. To design various applications of opamp.
	CO3. To design various wave generating and shaping circuits.
	CO4. To select ADC and DAC for various applications.
	CO5. To design PLL and voltage regulators.

TEXTBOOKS:

T1 - D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", 4th Edition ,New AgeInternationalPvt.Ltd., 2010.

T2 - Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Pearson Education,2015.

REFERENCEBOOKS:
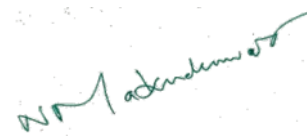
R1-S.Salivahanan&V.S.KanchanaBhaskaran, "LinearIntegratedCircuits",2ndeditionMcGrawHill,2014.

R2- SergioFranco,"DesignwithOperationalAmplifiersandAnalogIntegratedCircuits",3rdEdition,TataMc Graw-Hill, 2007.

R3-RobertF.Coughlin,Frederick F.Driscoll,"OperationalAmplifiersandLinearIntegratedCircuits",SixthEdition,2001

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	CourseCode	NameoftheCourse	L	T	P	C
		BioMEMSANDNANOTECHNOLOGY				
B.E	21BM4202		3	1	0	4

Course Objectives

1. LearnaboutMEMSandNanotechnology.
2. LearnvariousMEMSandNanotechnologyfabricationtechniques.
3. Understand different types of sensors and actuators and their principles ofoperation.
4. LearnaboutMicrofluidicsystems.
5. Know the application of MEMS and Nanotechnology in different field ofmedicine.

Unit Description	Instructional Hours
I INTRODUCTIONTOMEMS&NANOTECHNOLOGY	**9**

Introduction to BioMEMS and Nanotechnology, Development of MEMS technology-Comparison ofmicrosystems and microelectronics - Materials for MEMS-Smart Materials and Structures- Applicationsof MEMS

IIMICROANDNANOFABRICATIONTECHNIQUES	**9**

Nanotechnology, Bottom up and top down methods of synthesis- Self-assembly- lithography techniques,etching-Ionimplantation,surfacemicromachining-LIGAprocess-CVDtechnique

IIIMEMSSENSORSANDACTUATORS	**9**

Sensing and Actuation- Piezoresistive and Capacitive sensing -Electrostatic actuation -Pressure sensors -Accelerometers, Gyroscopes- Interfacing with Sensors and Actuators-Nanoporesensors-magneticsensors,
Thermalsensorsandactuators

IVMICRO-OPTOELECTROMECHANICALSYSTEMS&MICROFLUIDICS	**9**

Fundamental principle of MOEMS Technology - Light Modulators, Beam splitter ,
Micro-lens, Micro-mirrors - Digital Micro-mirror Device, Light detectors - Important
Consideration on Micro-scale fluid,Properties of fluid - Fluid Actuation Methods ,
Micro-pumps - Typical Micro-fluidic Channel, Micro-fluidDispenser

VAPPLICATIONSOFMEMSANDNANOTECHNOLOGYINMEDICINE	**9**

Biochip-Micro Total Analysis Systems detection and measurement methods-DNA sensor-Drug deliverysystem, Ampero-metric Biosensor - Multi-analyte measurement, Micro-dialysis - Monitoring of Glucose& Lactate with amicro-dialysis probe , AmmoniaMonitoring - Electronic Nose, Biomolecularsensingfor cancer diagnostics using carbon nanotubes, Carbon nanotube biosensors, Magnetic nanoparticles forMRImaging,Nano-devicesinbiomedicalapplications

Total Instructional Hours	**45**

CourseOutcomes:

CO1 : Understandthefundamentalsofmicroandnanotechnology

CO2 : Explainfabricationtechniquesofmicroandnanotechnology

CO3 : LearnaboutdifferenttypesofMEMSsensorandactuators

CO4 : DiscussabouttheMicro-OptoElectromechanicalSystems&Microfluidics

CO5 : DescribetherecentapplicationsofMEMSandNanotechnologyinMedicine

TEXTBOOKS:
T1. Tai Ran Hsu,―MEMSandMicrosystemsDesign andManufacture‖, Tata McGrawHillPublishingCompany,New Delhi,2002.(UnitI,II,III&IV).

T2.WanjunWang,StephenA.Soper,‖BioMEMS:TechnologiesandApplications‖,CRC Press,NewYork,2007.(UnitV).

REFERENCES:
R1.MarcJ.Madou―FundamentalsofMicrofabrication:theScienceofMiniaturization‖,CRCPress, 2002.

R2.NadimMaluf,KirtWilliams.―Anintroduction to Microelectro Mechancial Systems Engineering‖,

Second Edition,Artech HouseInc, MA, 2004.

R3.ChangLiu,'Foundations of MEMS',Pearson Education International,NewJersey,USA,2006

R4. Nitaigour Premchand Mahalik, ―MEMS‖, Tata McGraw Hill Publishing Company, NewDelhi,2007

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	CourseCode	NameoftheCourse	L	T	P	C
BE/IV	**21BM4203**	**PATHOLOGYANDMICROBIOLOGY**	3	0	0	3

Course Objective	1. Gainaknowledgeonthestructuralandfunctional aspectsoflivingorganisms. 2. Knowtheetiologyandremedyintreatingthepathologicaldiseases. 3. Tostudythestructureofdiseasecausingorganisms. 4. Tostudyabouttheworkingofmicroscope. 5. Empower theimportanceofpublichealth.

Unit	Description	Instructio nalHours
I	**CELLDEGENERATION, REPAIRANDNEOPLASIA** Cell injury - Reversible cell injury and Irreversible cell injury and Necrosis,Apoptosis, Intracellular accumulations, Pathological calcification-DystrophicandMetastatic.cellularadaptationsofgrowthanddifferentiation,Inflam mation and Repair including fracture healing, Neoplasia, Classification,Benign and Malignant tumours, carcinogenesis, spread of tumours Autopsyandbiopsy.	9
II	**FLUIDANDHEMODYNAMICDERANGEMENTS** Edema,Hyperemia/Ischemia,normalhemostasis, thrombosis,disseminatedintravascularcoagulation,embolism,infarction,shock,C hronicvenouscongestion.Hematologicaldisorders-Bleedingdisorders,Leukaemias,LymphomasHaemorrhage..	9
III	**MICROBIOLOGY** Structure of Bacteria and Virus. Routes of infection and spread; endogenousand exogenous infections, Morphological features and structural organizationofbacteriaandvirus,growthcurve,identificationofbacteria,cultureme dia and its types , culture techniques and observation of culture.Disease causedbybacteria,fungi,protozoal,virusandhelminthes	9

6

	MICROSCOPES	
IV	Light microscope – bright field, dark field, phase contrast, fluorescence, Electronmicroscope (TEM & SEM). Preparation of samples for electron microscope. Stainingmethods–simple,gramstainingandAFBstaining.	9

	IMMUNOPATHOLOGY	
V	Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediatedtissueinjury:opsonization,phagocytosis,inflammation,Secondaryimm unodeficiency including HIV infection. Auto-immune disorders: Basic conceptsandclassification,SLE.Antibodiesanditstypes,antigenand antibody reactions,immunologicaltechniques:immunediffusion,immunoelectrophoresis, RIAandELISA,monoclonalantibodies	9

TotalInstructionalHours   45

Course Outcome	CO1:Analyzestructuralandfunctionalaspectsoflivingorganisms.CO2: Analyze the structureofdiseasecausingorganism. CO3: Describe methods involved in treating the pathological diseases.CO4:Explainthefunctionofmicroscope CO5:Discusstheimportanceofpublichealth.

TEXTBOOKS:

1. RamziSCotran,VinayKumar&StanleyLRobbins,―PathologicBasisofDiseases,7thedition,WB Saunders Co.2005.
2. Ananthanarayanan&Panicker, ―Microbiology‖Orientblackswan,201710thedition

REFERENCES:

1. UnderwoodJCE:GeneralandSystematicPathologyChurchillLivingstone,3rdedition,2000.
2. DubeyRCandMaheswariDK.―ATextBookofMicrobiology‖Chand&CompanyLtd,2007
3. Prescott,HarleyandKlein,―Microbiology‖,10thedition, McGrawHill,2017

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	CourseCode	NameoftheCourse	L	T	P	C
BE	21BM4251	**SENSORS AND MEASUREMENT**	3	0	2	4

Thestudent shouldbeconversant with

Course Objective	1. Understandthepurposeofmeasurement,the methodsofmeasurements,errorsassociatedwithmeasurements. 2. Know the principle of transduction, classifications and the characteristics ofdifferenttransducers 3. Knowthedifferentbridgesformeasurement. 4. Knowthedifferentdisplayandrecordingdevices.

Unit	Description	InstructionalHours
I	**SCIENCE OF MEASUREMENT** MeasurementSystem–Instrumentation-ClassificationandCharacteristicsofTransducers - Static and Dynamic - Errors in Measurements and their statisticalanalysis–Calibration-Primaryandsecondarystandards.	9
II	**DISPLACEMENT,PRESSURE,TEMPERATURESENSORS** Strain Gauge: Gauge factor, sensing elements, configuration, and unbounded straingage. Capacitive transducer - various arrangements, Inductive transducer, LVDT,Passivetypes:RTDmaterials&range,relativeresistancevs.temperaturecharacteristics,thermistorcharacteristics,Activetype:Thermocouple-characteristics. **Experiments:** *1. Characteristicsofvarioustemperaturesensors–RTD,ThermistorandThermocouple* *2. DisplacementmeasurementusingLVDT.*	6+(3)P
III	**PHOTO ELECTRIC AND PIEZOELECTRIC SENSORS** Phototube, scintillation counter, photo multiplier tube (PMT), photovoltaic, photoconductivecells,photodiodes,phototransistor,comparisonofphotoelectrictransducers. Optical displacement sensors and optical encoders. Piezoelectric activetransducer-Equivalentcircuitanditscharacteristics. **Experiments:***Characteristicsofvariouslightsensors–LDR,Photodiodeand Phototransistor*	6+(3)P
		6+(3)P

IV	**SIGNAL CONDITIONING CIRCUITS** Functions of signal conditioning circuits, Preamplifiers, Concepts of passive filters,Impedance matching circuits, AC and DC Bridges - wheat stone bridge, Kelvin,Maxwell,Hay, Schering**Experiments:** *1. MeasurementofresistanceusingDCbridges* *2. Measurementof inductanceusingMaxwellbridge* *3. MeasurementofcapacitanceusingScheringbridge*	

DISPLAY AND RECORDING DEVICES

V	Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical &horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servorecorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermalrecorder.	9

TotalInstructionalHours   45

After the completion of the course,the learner will be able to

- ❑ Measurevariouselectricalparameterswithaccuracy,precision, resolution.
- ❑ Selectappropriatepassiveoractivetransducers
- ❑ formeasurementofphysicalphenomenon.Selectappropriatelightsensorsfor measurementof physicalphenomenon.
- ❑ UseACandDCbridgesforrelevantparametermeasurement.
- ❑ EmployMultimeter,CROanddifferenttypesofrecordersforappropriatemeasurement.

TEXTBOOKS:

1. A.K.Sawhney,―Electrical&ElectronicsMeasurementandInstrumentation,10thedition,DhanpatRai&Co,New Delhi,21thRevisededition2011,Reprint2014.
2. JohnG.Webster,―MedicalInstrumentationApplicationandDesign,4thedition,WileyIndia PvtLtd,NewDelhi,2015.

REFERENCES:

1. Ernest O Doebelin and Dhanesh N Manik, Measurement systems, Application and design, 6thedition,McGraw-Hill,2012.
2. KhandpurR.S,―HandbookofBiomedicalInstrumentation‖,3rdedition,TataMcGraw-Hill,New Delhi,2014.
3. Leslie Cromwell, ―Biomedical Instrumentation and measurement‖, 2nd edition, Prentice hallofIndia,NewDelhi,2015.
4. AlbertD.HelfrickandWilliam D.Cooper.Modern ElectronicInstrumentationandMeasurementTechniques‖,PrenticeHallofIndia,1stedition,2016.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E. / B.Tech./IV	21MC4191	VALUE EDUCATION-ESSENCE OF INDIAN TRADITIONAL KNOWLEDEGE	2	0	0	0

Course Objectives:

1. The course aims at imparting basic principles of thought process, reasoning and inferencing.
2. Sustainability is at the core of Indian Traditional Knowledge Systems connecting societyand nature.
3. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
4. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view, basic principles of Yoga and holistic health care system, Indian philosophical traditions,Indian linguistic tradition and Indian artistic tradition.

UNIT HOURS	DESCRIPTION	INSTRUCTIONAL
UNIT I :	Basic Structure of Indian Knowledge System	4
UNIT II :	Modern Science and Indian Knowledge System	4
UNIT III :	Yoga and Holistic Health care	4
UNIT IV :	Philosophical tradition	4
UNIT V :	Indian linguistic tradition (Phonology, Morphology, Syntax and semantics), Indian artistic tradition and Case Studies	4

.

TOTAL INSTRUCTIONAL HOURS : 20
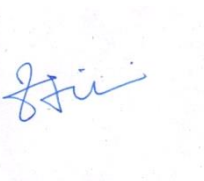
Course Outcomes:

CO1: Abilityto understand the structure of Indian system of life.

CO2: Connect up and explain basics of Indian Traditional knowledge in modern scientificperspective.

Reference Books:

R1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya VidyaBhavan,

Mumbai, 5th Edition, 2014

R2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya BhavanR3. Fritzof Capra, Tao of Physics

R4. Fritzof Capra, The wave of Life.

R5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation,Velliarnad,Amakuam

R6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta.

R7. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, VidyanidhiPrakasham, Delhi,2016.

R8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, VidyanidhiPrakasham, Delhi,2016.

R9. P R Sharma (English translation), Shodashang Hridayam.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E. / B.Tech./IV	21BM4001	**INTEGRATED CIRCUITS LABORATORY**	0	0	3	1.5

Description of the Experiments

1 .Design and Testing of Voltage Follower, Inverting & Non inverting amplifiers using741 op-amp.

2 .Design and Testing of Active low-pass, High-pass and band-pass filters using 741 opamp.

3 .Design and Testing of Astable multivibrator , Monostable multivibrator and Schmitt Trigger using 741 op-amp.

4 .Design and Testing of Phase shift and Wien bridge oscillators using 741 op-amp.

5 . Design and Testing of Astable and Monostable multivibrators using NE555 Timer.

6 .Design Function Generator using ICL8038.

7 .Simulate Integrator and Differentiator using SPICE.

8 .Simulate Astable & Monostable multivibrators with NE555 Timer using SPICE.

9 .Simulate Phase shift and Wien bridge oscillators with op-amp using SPICE.

10 .Simulate D/A and A/D converters using SPICE.

Total Practical Hours: 45

Course Outcome

CO1: Design oscillators using operational amplifiers.
CO2: Design amplifiers using operational amplifiers.
CO3: Design filters using Op-amp and plot frequency response.
CO4: Analyse the performance of oscillators using SPICE.
CO5: Analyse the performance of multivibrators using SPICE

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E. / B.Tech./IV	21BM4002	HUMAN PHYSIOLOGY LABORATORY	0	0	3	1.5

Description of Experiments

i. Study of parts of compound microscope
ii. Peripheral smear study
iii. Estimation of RBC count.
iv. Estimation of WBC count.
v. Estimation of ESR.
vi. Hemoglobin estimation.
vii. Blood grouping.
viii. Bleeding time/ clotting time.
ix. Hearing test using Audiometer.
x. Respiratory parameter measurement.
xi. Manual paraffin tissue processing and section cutting (demonstration)
xii. Cryo processing of tissue and cryosectioning (demonstration)

Total Practical Hours: 45

REFERENCES:

1. Ghai C L, ―Textbook of Practical Physiology, Eight edition, Jaypee Brothers, Medical Publisher's Pvt. Ltd., New York, 2013.
2. Stuart Ira Fox, ―Laboratory Guide to Human Physiology, Tata McGraw Hill, 2002.
3. Richard G P Flanzer, ―Experimental and Applied Physiology Laboratory Manual, Tata McGraw Hill, Columbus, 2005.

CO1: Identification and enumeration of blood cells

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E. / B.Tech./V	19BM5201	**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	InstructionalHours
I	**INTRODUCTION** Open and Closed loop Systems, Block diagram and signal flow graph representation of systems, reduction of block diagram and signal flow graph.	12
II	**TIME RESPONSE ANALYSIS** Standard test signals, time response of first order and second order systems, time domain specifications, steady State errors.	12
III	**FREQUENCY RESPONSE ANALYSIS** Determination of closed loop response from open loop response, Bode plot, Nichol's chart, Polar plot.	12
IV	**STABILITY ANALYSIS** Characteristic equation, Location of roots in s-plane for stability, Routh Hurwitz criterion, Root locus techniques - Construction, Gain margin and phase margin, Nyquist stability criterion.	12
V	**PHYSIOLOGICAL CONTROL SYSTEM ANALYSIS** Difference between engineering and physiological control system- Model development of Cardiovascular system- Heart model-circulatory model - Simple models of muscle stretch reflex action- Stability analysis of Pupillary light reflex -Regulation of cardiac output, Regulation of ventilation.	12
	TotalInstructional 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 time response of various systems and discuss the concept of system stability
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.

TEXT BOOKS:
T1. I.J. Nagarath and M. Gopal ―Control Systems Engineering", Fifth Edition, Anshan Publishers, 2008.(UNIT)
T2. Michael C K Khoo, ―Physiological Control Systems‖, IEEE Press, Prentice Hall of India,2005

REFERENCES:

R1. Benjamin C. Kuo, ―Automatic Control Systems‖, Prentice Hall of India, 1995.
R2. John Enderle Susan Blanchard, Joseph Bronzino ―Introduction to Biomedical Engineering‖, second edition, Academic Press, 2005.
R3. Richard C. Dorf, Robert H. Bishop, ―Modern control systems‖, Pearson, 2004.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L T P C
B.E. / B.Tech./V	19BM5202	BIOMECHANICS	3 0 0 3

Course Objectives

Upon completion of this course, the students will be familiar with

Explain the principles of mechanics.

Discuss the mechanics of physiological systems.

Explain the mechanics of joints.
Illustrate the mathematical models used in the analysis of biomechanical systems.

Describe biomechanics of joints

Unit	Description	InstructionalHours
I	**INTRODUCTION** Scope of mechanics in medicine, mechanics of bone structure, determination of in-vivo elastic modulus. Bio fluid mechanics, flow properties of blood. Anthropometry.	9
II	**MECHANICS OF PHYSIOLOGICAL SYSTEMS** Heart valves, power developed by the heart, prosthetic valves. Constitutive equations for soft tissues, dynamics of fluid flow in cardiovascular system and effect of vibration - shear stresses in extra-corporeal circuits..	9
III	**ORTHOPAEDIC MECHANICS** 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 velocities in arteries, determination of in-vivo elasticity of blood vessel, dynamics of fluid filled catheters..	9
V	**ORTHOPAEDICAPPLICATIONS** Dynamics and analysis of human locomotion - Gait analysis (determination of instantaneous joint reaction analysis), occupant response to vehicular vibration. Mechanics of knee joint during standing and walking..	9
	Total	**45**

Instructional Hours

Course Outcomes

Upon completion of this course, the students will be able toCO1: 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.

TEXT BOOKS:

1. Y.C.Fung,―Bio-Mechanics, "Mechanical Properties ofTissues'',Springer-Verilog,1998.

2. C. Ross Ether and Craig A.Simmons, "Introductory Biomechanics from cells to organisms",Cambridge University Press, New Delhi, 2009

REFERENCES:

1. Susan J Hall, "Basics of Biomechanics'', Mc Graw Hill Publishing.co. New York, 5thEdition, 2007.

2. Dhanjoo N.Ghista, "Orthopaedic Mechanics", Academic Press, 1990.

3. .Joseph D.Bronzino, "Biomedical Engineering Fundamentals", Taylor& Francis, 2006.
4. John Enderle, Susanblanchard, Joseph Bronzino, "Introduction to Biomedical Engineering'',Elsevier, 2005.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E. / B.Tech./V	19BM5203	**MICROPROCESSOR AND MICROCONTROLLERS**	3	0	0	3

Course Objective	Demonstrate the Architecture of 8086 microprocessor.
	Interpret the system bus structure and Multi processor configuration of 8086microprocessor.
	Apply the design aspects of I/O and Memory Interfacing circuits.
	Examine the Architecture of 8051 microcontroller
	Practice the design aspect of interfacing circuits with 8051 microcontroller

Unit	Description	InstructionalHours
I	**8086 MICROPROCESSOR** Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines.	9
II	**8086 SYSTEM BUS STRUCTURE AND MULTIPROCESSORCONFIGURATIONS** Basic 8086 configurations – System bus timing –Bus Standards – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.	9
III	**PERIPHERAL DEVICES AND THEIR INTERFACING** Address space portioning-Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface -D/A and A/D Interface - Timer - Keyboard /display controller – Interrupt controller – DMA controller	9
IV	**8051 MICROCONTROLLER** Over view of 8051 family-Architecture of 8051 –I/O Pins Ports Circuits and I/O Port Programming - Instruction set - Addressing modes - Assembly language programming.	9
V	**8051 MICROCONTROLLER INTERFACING WITH PERIPHERALDEVICE** 8051 Timers Programming - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface-Interfacing with 8255- Stepper Motor Interfacing, Practical applications-Water level indicator and Zigbee interfacing.	9 9
	Total Instructional Hours	**45**

Course Outcome	CO1:	Write Assembly Language programs using 8086 microprocessor.
	CO2:	Point out System Bus Structure and Multiprocessor Configuration.
	CO3:	Analyze the various peripheral devices interfacing with 8086 microprocessor.
	CO4:	Model and implement 8051 microcontroller based systems.
	CO5:	Experiment programs on 8051 microcontroller for interfacing various peripheraldevices

TEXT BOOKS:

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

T2   Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller andEmbedded Systems: Using Assembly and C", Second Edition, Pearson education,2011

REFERENCE BOOKS:

R1Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware,TMH,2012

R2A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd edition, Tata McGrawHill,2012

R3N. Senthil Kumar, M. Saravanan, S. Jeevananthan, "Microprocessors and Microcontrollers" ,OxfordUniversity Press,2000.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E. / B.Tech./V	19BM5204	**BIOMEDICAL INSTRUMENTATION**	3	0	0	3

Course Objective	1. To Illustrate about the measurement systems. 2. To design bio amplifier for various physiological recordings 3. Detection of physiological parameters using impedance techniques 4. To learn the different measurement techniques for non-physiological parameters 5. To Summarize different patient safety procedures.

Unit	Description	nstructionalHours
I	**BIOPOTENTIAL ELECTRODEs** Origin of bio potential 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 and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.	9
II	**BIOPOTENTIAL MEASUREMENT** Bio signal characteristics– frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system, block diagram. Measurements of heart sounds - PCG. EEG – 10-20 electrode system, unipolar, bipolar and average mode, Functional block diagram. EMG – unipolar and bipolar mode, block diagram, EOG and ERG.	9
III	**BIOPOTENTIAL AMPLIFIER** Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier –right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier.Artifacts and removal.	9
IV	**NON ELECTRICAL PHYSIOLOGICAL PARAMETER MEASUREMENT** Temperature, respiration rate and pulse rate measurements, Plethysmography,Pulse oximetry, Blood Pressure: direct methods - Pressure amplifiers - systolic, diastolic, mean detector circuit, indirect methods - auscultatory method, oscillometric method, ultrasonic method. Blood flow - Electromagnetic and ultrasound blood flow measurement. Cardiac output measurement- Indicator dilution, dye dilution and thermodilution method.	9
V	**BIOCHEMICAL MEASUREMENT** Biochemical sensors - pH, pO_2 and pCO_2, Ion selective Field Effect Transistor (ISFET), immunologically sensitive FET (IMFET), Blood glucose sensors - Bloodgas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.	9
	Total Instructional Hours	45

Course Outcome	CO1: To understand the various concepts of measurement systems .CO2: To understand the method of of designing bioamplifiers. CO3: To understand about the Detection of physiological parameters using impedancetechniques. CO4: To understand about measurement of non electric parameter. CO5: To understand about Patient safety and electromedical equipment.

TEXT BOOKS:

T1 - Joseph J. Carr and John M. Brown, "Introduction to Biomedical EquipmentTechnology",Pearson Education India, Delhi, 2004

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

REFERENCE BOOKS:

R1-Khandpur. R. S., "Handbook of Biomedical Instrumentation", Prentice Hall of India, NewDelhi, 2003.

R2 - Jacobson B and Webster J G Medical and Clinical Engineering – Prentice Hall of IndiaNew

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

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./V	19BM5251	**VIRTUAL INSTRUMENTATION USING LabVIEW**	2	0	2	3

| **Course Objective** | 1.Understand the fundamentals of Virtual Instrumentation.
2.Idea behind the software used in VirtualInstrumentation
3.To familiarize with the basic programming and working concepts in LabVIEW.
4. Acquire biological data and develop applications using LabVIEW. | |

	Description	**Instructional Hours**
I	**INTRODUCTION** Virtual Instrumentation Architecture, Conventional Virtual Instruments, 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 , Pallets of LabVIEW, Creating VI using LabVIEW, Loops, Arrays,Clusters, Strings, Registers, Structures, Nodes, Controls and Indicators forclusters 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 Digital I/O, Counter/ Timer, Network data acquisition techniques. **Experiments:** *1. Data Acquisition using Virtual instrumentation from temperature / vibration Transducer.*	6+(3)P
IV	**TOOLKITS** Biomedical toolkit, Signal Processing Tools-Fourier Transform, Power Spectrum, Correlation, Windowing, Filters, Digital Filter Design Toolkit,	6+(3)P

Control System Design Toolkit, Communication Design Toolkit, Vision AndMotion Tools, Image processing Toolkit.

Experiments:

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

BIOMEDICAL APPLICATION USING LabVIEW

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

9

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

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

TEXT BOOKS:

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 McGraw Hill, NewDelhi, 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   **DEAN ACADEMICS**

Programme/Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./V	19BM5001	**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: with 8085
(i) A/D Interfacing. & D/A Interfacing.
4. Traffic light controller.
5. I/O Port / Serial communication
6. Programming Practices with Simulators/Emulators/open source
7. Read a key ,interface display
8. Demonstration of basic instructions with 8051 Micro controller execution, including:
 (i) Conditional jumps, looping (ii) Calling subroutines.
9. Programming I/O Port 8051
(i) study on interface with A/D & D/A (ii) study on interface with DC & AC motor.
10. Mini project development with processors.

Practical Hours: 45

	CO1: understand the basic arithmetic operations in 8085
	CO2: Ability to understand and analyze, about 8085 microprocessor
Course Outcome	CO3: understanding of various interfacing techniques in microcontrollersCO4:
	understand the basic arithmetic operations in 8051
	CO5: Analyze and demonstrate an mini project using microcontroller.

48

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./V	19BM5002	**BIOMEDICAL INSTRUMENTATION LABORATORY**	0	0	3	1.5

Description of the Experiments

1. To study the different types of electrodes.
2. To study the Electrocardiogram System.
3. Bed side 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. SR Measurement setup with Software and Accessories(PC based) - Without PC Workstation
9. Ultrasound Doppler Blood Flow Monitor
10. To study Plethysmograph System.
11. To study Phonocardiograph System.
12. To study X-ray produced by X-ray machine.

Practical Hours: 45

Course Outcome

CO1: Identify various Bio-potential and their specifications in terms 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   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Course Title	L	T	P	C
B.E./B.Tech./V	19HE5071	Soft Skills - I	1	0	0	1

Course Objectives:
1. To employ soft skills to enhance employability and ensure workplace and career success.
2. To enrich students' numerical ability of an individual and is available in technical flavor.
3. To interpret things objectively, to be able to perceive and interpret trends to make generalizations and be able to analyze assumptions behind an argument/statement.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO SOFT SKILLS** Introduction- Objective -Hard vs Soft Skills - Measuring Soft Skills- Structure of the Soft Skills -Self Management-Critical Thinking-Reflective thinking and writing- p2p Interaction	3
II	**ART OF COMMUNICATION** Verbal Communication - Effective Communication - Active listening –Paraphrasing - Feedback - Non-Verbal Communication – Roles-Types- How nonverbal communication can go wrong- How to Improve nonverbal Communication - Importance of feelings in communication - dealing with feelings in communication.	4
III	**WORLD OF TEAMS** Self Enhancement - importance of developing assertive skills- developing self-confidence – developing emotional intelligence - Importance of Team work – Team vs. Group - Attributes of a successful team – Barriers involved - Working with Groups – Dealing with People- Group Decision Making.	3
IV	**QUANTITATIVE APTITUDE** Averages - Profit and loss - Partnerships - Time and work - Time, Speed and Distance - Problems based on trains - Problems based on boats and streams	3
V	**LOGICAL REASONING** Clocks - Calendars - Direction Sense - Data Interpretation: Tables, Pie Chart, Bar Graph - Data Sufficiency	2

Course Outcome:

CO1:	Students will have clarity on their career exploration process and to match their skills and interests with a chosen career path.
CO2:	Students will develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others
CO3:	Students will understand how teamwork can support leadership skills
CO4:	Students will be able to make sense of problems, develop strategies to find solutions, and persevere in solving them.
CO5:	Students will demonstrate an enhanced ability to draw logical conclusions and implications to solve logical problems.

REFERENCE BOOKS:
R1:   Soft Skills Training: A Workbook to Develop Skills for Employment - Frederick H. Wentz
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:   A New Approach To Reasoning Verbal & Non-Verbal By B.S. Sijwali
R5:   Quantitative Aptitude for Competitive Examinations - Dr. R.S. Aggarwal, S. Chand

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./V	19HE5072	**Design Thinking**	1	0	0	1

Course Objective	- To expose students to the design process - To develop and test innovative ideas through a rapid iteration cycle. - To provide an authentic opportunity for students to develop teamwork and leadership skills

Unit	Description	Instructional Hours
I	**DESIGN ABILITY** Asking Designers about what they Do – Deconstructing what Designers Do – Watching what Designers Do – Thinking about what Designers Do – The Natural Intelligence of Design Sources	4
II	**DESIGNING TO WIN** Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	4
III	**DESIGN TO PLEASE AND DESIGNING TOGETHER** Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	4
IV	**DESIGN EXPERTISE** Design Process – Creative Design - Design Intelligence – Development of Expertise – Novice to Expert. Critical Thinking – Case studies: Brief history of Albert Einstein, Isaac Newton and Nikola Tesla	3
	Total Instructional Hours	15

Course Outcome	Upon completion of the course, students will be able to CO1: Develop a strong understanding of the Design Process CO2: Learn to develop and test innovative ideas through a rapid iteration cycle. CO3: Develop teamwork and leadership skills

TEXT BOOKS:
T1 - 1. Nigel Cross, "Design Thinking", Kindle Edition.

REFERENCE BOOKS:
R1 - Tom Kelley, "Creative Confidence", 2013.
R2 - 3. Tim Brown, "Change by Design", 2009.

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CHAIRMAN-BOS

DEAN ACADEMICS

Programme	Course Code	Name of the Course	L	T	P	C
BE	19BM6201R	BIOSIGNAL PROCESSING (R)	3	1	0	4

Course Objective	1. To introduce the concept of analyzing discrete time signals and systems in the time and frequency domain through mathematical representation. 2. To study various time to frequency domain transformation techniques 3. To Understand the implementation of the DFT in terms of the FFT, as well as some of its applications (computation of convolution sums, spectral analysis). 4. To learn the basic design and structure of FIR and IIR filters with desired frequency responses and design digital filters. 5. To learn ECG and EEG signal processing.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO DIGITAL SIGNAL PROCESSING** Classification of signals - Basic concepts of digital signal processing - Digital signal processing applications - Representation of discrete-time signals - Elementary discrete-time signals - Classifications of discrete-time signals - Basic operations on signals - Classification of discrete-time systems: static - causal - linear - time-invariant - Review of sampling and reconstruction – Anti-aliasing filtering.	9
II	**Z-TRANSFORM** Definition - Properties of the Z-Transform - Inverse Z-Transform - Partial Fraction Expansion - Difference Equations using Z-Transform	9
III	**DISCRETE AND FAST FOURIER TRANSFORMS** Discrete Fourier Transforms (DFT) - Properties of DFT - Linear Convolution of Sequences using DFT - Computation of DFT - Over-lap Add Method - Over-lap Save Method. Fast Fourier Transforms (FFT) - Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms.	9
IV	**IIR AND FIR DIGITAL FILTERS** IIR Digital Filters: Analog Filter Approximations - Butterworth and Chebyshev - Design of IIR Digital filters from Analog Filters - Bilinear Transformation Method. FIR Digital Filters: Design of FIR Filters using Window Techniques - Comparison of IIR & FIR filters.	9
V	**CARDIOLOGICAL AND NEUROLOGICAL SIGNAL PROCESSING** Cardiological signal processing: ECG signal characteristics (parameters and their estimation) - Analog filters - ECG amplifier - and QRS detector - Portable arrhythmia monitor. Neurological signal processing: EEG signal and its characteristics (EEG rhythms, waves, and transients) – Correlation - Analysis of EEG channels - Detection of EEG rhythms.	9
	Total Instructional Hours	**45**

Course Outcome	CO1	Ability to understand signals and systems by their mathematical representation.
	CO2	Ability to do system representation using transforms.

52

CO3   Understand the significance of various filter structures and effects of rounding errors.
CO4   Design a digital filter for a given specification.
CO5   Understand the ECG and EEG signal processing.

TEXT BOOKS:
T1   D. C Reddy, "Biomedical Signal Processing, Principles and Techniques", Tata McGraw Hill Publishing Company Limited, First Edition, 2005
T2   John G Proakis & Dimitris G Manolakis: Digital Signal Processing – Principles, Algorithms and Applications, Prentice Hall of India, 2005.

REFERENCE BOOKS:
R1   Andreas Antonion: Digital Filters Analysis & Design, Prentice Hall of India, 2002.
R2   P. Ramesh Babu: Digital Signal Processing, Scitech Publications,India 2004.
R3   Alan V. Oppenheim & Ronald W Schafer: Digital Signal Processing, Prentice Hall of India, 2004.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem B.E./B.Tech./VI	Course Code	Name of the Course	L	T	P	C
	16BM6202	RADIOLOGICAL EQUIPMENTS AND NUCLEAR MEDICINE	3	0	0	3

Course Objective

Understand generation of x-rays and its uses in imaging.

Learn different types of radio diagnostic techniques.

Know techniques used for visualizing different sections of the body.

Understanding about different nuclear imaging techniques.

Learn radiation therapy methodologies and the radiation safety.

Unit	Description	Instructional Hours
I	**MEDICAL X-RAY EQUIPMENT** Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography- discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.	9
II	**COMPUTED TOMOGRAPHY** Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors-Viewing systems- spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques- back projection and iterative method.	9
III	**MAGNETIC RESONANCE IMAGING** Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system- system magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.	9
IV	**NUCLEAR MEDICINE SYSTEM** Radio Isotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GMcounter and scintillation Detectors, Gamma camera- Principle of operation, collimator, photo multiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET.	9
V	**RADIATION THERAPY AND RADIATION SAFETY** Radiation therapy – linear accelerator, Telegamma Machine. SRS –SRT,-Recent Techniques in radiation therapy - 3DCRT – IMRT – IGRT and Cyber knife- radiation measuring instruments-Dosimeter, film badges, Thermo Luminescentdosimeters- electronic dosimeter- Radiation protection in medicine- radiation protection principles	9
	Total Instructional Hours	45

Course Outcome

CO1: Explain theory underlying machine learning.

CO2: Construct algorithms to Learn ANN.

CO3: Implement single layer feed forward networks.

CO4: Construct Algorithms To learn multi- layer feed forward networks.

CO5: Apply associative memories learning techniques for real life problems

TEXT BOOKS:

T1   Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia, 2008 (Units I, II, III &IV).

T2   R.Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, Wiley-Liss,2002.

REFERENCE BOOKS:

R1 Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine"- Third edition Springer, 2006.
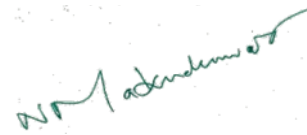
R2 B.H.Brown, PV Lawford, R H Small wood , D R Hose, D C Barber, "Medical physics and biomedicalEngineering", - CRC Press, 1999.

R3 Myer Kutz, "Standard handbook of Biomedical Engineering and design", McGraw Hill, 2003.

R4 P.Ragunathan, "Magnetic Resonance Imaging and Spectroscopy in Medicine

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	Course Code	Name of the Course	L	T	PC
B.E./B.Tech./VI	19HE6203	ENTREPRENEURSHIP DEVELOPMENT	3	0	0 3

Course Objective	To become familiar entrepreneurship development
	To learn concepts of creativity and innovation.
	To learn steps in developing business model.
	To study about appraisal of projects.
	To become familiar different forms of business organisations

Unit	Description	·uctionalHours
I	**INTRODUCTION TO ENTREPRENEURSHIP** Definition – Characteristics and Functions of an Entrepreneur – Common mythsabout entrepreneurs – Importance or Entrepreneurship. Seminar in R5 & R6.	6
II	**CREATIVITY AND INNOVATION:** The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process.	6
III	**DEVELOPING AN EFFECTIVE BUSINESS MODEL:** The Importance of a Business Model – Starting a small scale industry -Components of an Effective Business Model.	6
IV	**APPRAISAL OF PROJECTS:** Importance of Evaluating Various options and future investments- Entrepreneurship incentives and subsidies – Appraisal Techniques.	6
V	**FORMS OF BUSINESS ORGANIZATION:**: Sole Proprietorship – Partnership – Limited liability partnership - Joint StockCompanies and Cooperatives..	6
	Total Instructional Hours	**45**

Course Outcome	CO1: Know and understand the basics of entrepreneurship development.CO2: Understand the role of creativity in entrepreneurship development.CO3: Understand the concepts of developing an effective business model.CO4: Learn the basics of appraisal of projects. CO5: Understand the different forms of business organisations

TEXT BOOKS:

1. Donald F.Kuratko and Richard M. Hodgetts, ―Entrepreneurship‖, South-Western.
2. Vasant Desai, ―The Dynamics of Entrepreneurial Development and Management‖, HimalayaPublishing House, 2010.

REFERENCES:

1. Gupta S.L., Arun Mittal, ―Entrepreneurship Development‖, International Book House, 2012.
2. Sudha G. S., ―Management and Entrepreneurship Development‖, Indus Valley Publication,2009.
3. Badi V., Badi N. V., ―Business Ethics‖, R. Vrinda Publication (P) Ltd., 2012.
4. Prasanna Chandra, ―Projects- Planning, Analysis, Financing, Implementation and review‖,TATA McGraw Hill, 2012.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./VI	BE	19BM6251	**DIAGNOSTIC AND THERAPEUTIC EQUIPMENT – I**	3	0	2	3.5

Course Objective	1. Gather basic knowledge about measurements of parameters related to patient monitoring. 2. Learn techniques of blood gas analyzers and oximeters. 3. Understand blood rheology parameters. 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	**PATIENT MONITORING SYSTEMS** System concepts- Cardiac monitor- selection of system parameters-Bedside monitors-Central monitors- Heart rate meter- Pulse rate meter- Holter monitor andCardiac stress test- Cardiac cauterization instrumentation- Organization and equipments used in ICCU & ITU. **Experiments:** *Measurement of various biological signals using bedside monitors.* *Analysis of ECG, EEG and EMG signals.*	9

II	**BLOOD GAS ANALYZERS AND OXIMETERS**
	  Blood pH measurement, Blood $pCO2$ measurement, Blood $pO2$ measurement, a complete blood gas analyzer-Fiber optic based blood gas sensors, Oximetry- Principles of oximetric measurements-Ear oximeter- Pulse oximeter- Intravascular oximeter.
	 Experiments:
	  Recording of Audiogram. Measurement of pH and conductivity.
		9

III	**EXTRA CORPOREAL DEVICES AND SPECIAL DIAGNOSTIC TECHNIQUES** Need for heart lung machine, Functioning of bubble, Disc type and membrane type oxygenators, finger pump, roller pump. Hemodialyser unit, Peritoneal dialyser unit, Thermography – Recording Principle and clinical application. **Experiments:** *To study the working of heart lung machine.To study the working of Hemodialysis unit.*	9

	CORONARY CARE EQUIPMENTS	
IV	Cardiac pacemakers: different modes of operation- external and implantable pacemakers- pacemaker standard codes -Defibrillator: AC and DC defibrillator - Implantable defibrillator and automated external defibrillator(AED) - Pacer- cardioverter defibrillator- defibrillator analysers - Heart lung machine (HLM) and types of oxygenators. **Experiments:** *Study the working of Defibrillator and pacemakers.* *Study of heart lung machine model.*	9
V	**SURGICAL AND THERAPEUTIC EQUIPMENTS** Surgical diathermy unit - Endoscopy basic components and types – Laparoscope- gastro scope- bronchoscope - Cryogenic techniques and application - Operating microscope- arthroscopy - Modern lithotripter system- laser lithotripsy. **Experiments:** *Analyze the working of ESU – cutting and coagulation modes.Study of hemodialysis* *model*	9

Total Instructional Hours   45

Course Outcome	**CO1**: Explain about measurements of parameters related to Patient Monitoring Systems. **CO2:** Describe the measurement techniques of Blood gas analyzers and Oximeters. **CO3:** Analyze different types and uses of Blood cell counters and Blood Flow meters .**CO4:** Discuss about the various coronary care equipments used in hospitals. **CO5:** Outline the different surgical and therapeutic equipments used in hospitals .

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, NewDelhi, 2007

REFERENCE BOOKS:

R1   Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", PearsonEducation, 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   **DEAN ACADEMICS**

Programme/Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./V	19BM6001	**BIOSIGNAL PROCESSING LABORATORY**	0	0	3	1.5

Description of Experiments

1. MATLAB familiarization

2. Acquisition of biosignals to the system

3. Implementation of filters.

4. Processing of ECG signals for acquiring parameters like heart rate, QRS complex, P wave etc

5. Arrhythmia analysis.

6. Analysis of plethysmographic signal.

7. Automated detection of systolic and diastolic pressure from cuff pressure and peripheral pulse.

8. Signal Classification using neural networks.

9. 50 Hz interference rejection in ECG signals.

10. Event detection in EEG signals

11. Spectral analysis of EEG, EMG signals.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Course Title	L	T	P	C
B.E./B.Tech./VI	19HE6071	Soft Skills-II	1	0	0	1
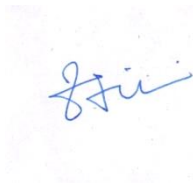
Course Objectives:
1. To make the students aware of the importance, the role and the content of soft skills through instruction, knowledge acquisition, demonstration and practice.
2. To learn everything from equations to probability with a completely different approach.
3. To make the students learn on an increased ability to explain the problem comprehensively.

Unit	Description	Instructional Hours
I	**GROUP DISCUSSION & PRESENTATION SKILLS** GD skills – Understanding the objective and skills tested in a GD – General types of GDs – Roles in a GD – Do's & Don'ts – Mock GD & Feedback. - Presentation Skills – Stages involved in an effective presentation – selection of topic, content, aids – Engaging the audience – Time management – Mock Presentations & Feedback	4
II	**INTERVIEW SKILLS AND PERSONALITY SKILLS** Interview handling Skills – Self preparation checklist – Grooming tips: do's & don'ts – mock interview & feedback - Interpersonal skills-creative thinking-problem solving-analytical skills	3
III	**BUSINESS ETIQUETTE & ETHICS** Etiquette – Telephone & E-mail etiquette – Dining etiquette – do's & Don'ts in a formal setting – how to impress. Ethics – Importance of Ethics and Values – Choices and Dilemmas faced – Discussions from news headlines.	3
IV	**QUANTITATIVE APTITUDE** Permutation, Combination - Probability - Logarithm - Quadratic Equations - Algebra - Progression - Geometry - Mensuration.	3
V	**LOGICAL REASONING** Logical Connectives - Syllogisms - Venn Diagrams – Cubes - Coded inequalities - Conditions and Grouping	2

Course Outcome:

CO1:	Students will have learnt to keep going according to plan, coping with the unfamiliar, managing disappointment and dealing with conflict.
CO2:	Students will Actively participate meetings, Group Discussions / interviews and prepare & deliver presentations
CO3:	Students will define professional behavior and suggest standards for appearance, actions and attitude in a Business environment
CO4:	Students will be able to apply quantitative reasoning and mathematical analysis methodologies to understand and solve problems.
CO5:	Students will excel in complex reasoning.

REFERENCE BOOKS:

R1: Bridging the Soft Skills Gap: How to Teach the Missing Basics to Todays Young Talent- Bruce Tulgan
R2: Quantitative Aptitude for Competitive Examinations (5th Edition) - Abhjit Guha
R3: How to crack test of Reasoning - Jaikishan and Premkishan
R4: The hand on guide to Analytical Reasoning and Logical Reasoning - Peeyush Bhardwaj

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	Course Code	Course Title	L	T	P	C
B.E./B.Tech./VI	19HE6072	Intellectual Property Rights (IPR)	1	0	0	1

Course Objectives:
1. To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
2. To disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
3. To disseminate knowledge on copyrights and its related rights and registration aspects.
4. To disseminate knowledge on trademarks and registration aspects.
5. To disseminate knowledge on Design, Geographical Indication (GI) and their registration aspects.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO INTELLECTUAL PROPERTY** Introduction, Types of Intellectual Property, International Organizations, Agencies and Treaties, Importance of Intellectual Property Rights.	3
II	**PATENTS** Patents -Elements of Patentability: Novelty, Non-Obviousness (Inventive Steps), Industrial Application -Non -Patentable Subject Matter -Registration Procedure, Rights and Duties of Patentee, Assignment and license.	3
III	**COPYRIGHTS** Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.	3
IV	**TRADEMARKS** Concept of Trademarks -Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) -Non-Registrable Trademarks - Registration of Trademarks.	3
V	**DESIGN AND GEOGRAPHICAL INDICATION** Design: meaning and concept of novel and original -Procedure for registration. Geographical indication: meaning, and difference between GI and trademarks -Procedure for registration.	3

Course Outcome:

CO1: Identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP.

CO2: Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development.

CO3: Identify, apply and assess ownership rights and marketing protection under intellectual property law as applicable to information, ideas, new products and product marketing.

CO4: Identify different types of trademarks and procedure for registration

CO5: Recognize the concept of design, geographical indication and procedure for registration

TEXT BOOKS:
T1- Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
T2- V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt. Ltd, 2012.

REFERENCE BOOKS:
R1- Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
R2- Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

CHAIRMAN-BOS   **DEAN ACADEMICS**

PROFESSIONAL ELECTIVE I

Programme/Sem	COURSECODE	NAME OF THE COURSE	L	T	P	C
B.E./B.Tech./V	19BM5301	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 safety.

UNIT	DESCRIPTION	TOTAL INSTRUCTIONAL HOURS
I	**BASICS OF RADIATION PHYSICS** Atomic Structure - Nuclear Transformation - Radioactivity and Interaction; electromagnetic radiation, charged particles and neutrons - Radiation attenuation coefficients – Principle of Radiation dosimetric device - cavity theories Bremsstrahlung effect, Annihilation Interaction of X and Gamma radiation with matter- Compton Scattering , Pair production -Non Ionization medical Radiation physics - Penetration and propagation of signal effects in various vital organs.	9
II	**MOLECULAR PHYSICS AND GENETIC EFFECTS** Introduction- Molecular biophysics - Phases of matter – GIBBS law – TheHagen-poiseuille law – Strokes Law – Raoult law – Osmotic pressure –Diffusion – Phase border phenomena . Genetic Effects- Effects on DNA damage, embryo, Chromosomal damage - factors affecting frequency of radiation induced mutation - Gene controlled hereditary diseases.	9
III	**ACOUSTICS AND OPTICAL RADIATION** Introduction of Acoustics and properties – Doppler effect - Piezo electric effect - weber-Fechners law – Effects of ultrasound in tissues - Shock waves – Propagation of light – Light scattering - Photo Medicine –Various types of optical radiations - Optical properties of tissues, applications of optical radiations.	9
IV	**INTERACTION OF NUCLEAR PHYSICS** Principles of Nuclear Physics – Natural radioactivity, Decay series, type of radiation and their properties. Production of artificial isotopes – accelerator principles: Betatron, Cyclotron . fission and electron Capture reaction, radionuclide Generator-Technetium generator – Applications of artificial isotopes and Radio nuclides in Nuclear Medicine and biology.	9
V	**RADIATION ONCOLOGY & SAFETY** Introduction -exposure- Inverse square law-KERMA- Bremsstrahlung radi Bragg's curve- Principles of MPD, ADEL and ALARA - concept of LD Gamma knife – LINAC – Chemotherapy – Brachytherapy – Dosimeter – Raddetector and Types – Radiation safety and Its Principle	**9**
		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.

TEXT BOOKS

.
1. Daniel Jirak, Frantisek Vitek Basics of Medical Physics.
2. Moumita Mukherjee, J.K. Mandal , Advance in medical Physics and healthcareEngineering, Springers Singapore , 2021

REFERENCES

1.P.Uma Devi, A.Nagarathnam , B S SatishRao , "Introduction to Radiation Biology" B.IChur Chill Livingstone pvt Ltd, 2000.

2.S.Webb" The Physics of Medical Imaging", Taylor and Francis, 2018.
3.J.P.Woodcock, Ultrasonic,Medical Physics H   andbook series 1, Adam Hilger, Bristol

TOTAL INSTRCTIONAL HOURS 45

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./V	BE	19BM5302	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 pneumatic manipulators
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- Application of 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

Construction of Manipulators, Electronic and pneumatic manipulator, Forward Kinematic, Inverse Kinematics.

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 , Magnetic fibre optic and Tactile sensor.

UNIT V   ROBOTICS APPLICATION IN MEDICAL FIELD   9

Da Vinci 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 Nano robotics.

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.

TEXT BOOKS

1. Nagrath and Mittal," Robotics and Control", Tata McGraw-Hill , First edition,2003.
2. Spong and Vidhyasagar," Robot Dynamics and Control", John Wileyand Sons, First edition , 2008.
3. Fu.K.S. Gonzalaz.R.C., Lee C.S.G," Robotics Control", sensing , Vision and Intelligence, Tata McGrawHill International, First edition, 2008.

REFERENCES

1. Howie Choset, kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thurn,"Priniples of robot motion:Theory, Algorithms, and Implementations", Prentice hall ofIndia, First edition, 2005
2. Jacob Rosen, Blake Hannaford & Richard M Satava, " Surgical Robotics: System Applications

   &Visions",Springer 2011

3.

CHAIRMAN-BOS   **DEAN ACADEMICS**

    4.

65

Programme/Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./V	19BM5303	**TOTAL QUALITY MANAGEMENT**	3	0	0	3

Course Objectives

Upon completion of this course, the students will be familiar with
1. To facilitate the understanding of Quality Management frame work.
2. Understand TQM principles.
    3. Learn TQM Tools and Techniques.
4. Know Quality Function Deployment (QFD), Taguchi quality 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 - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.	9
II	**TQM PRINCIPLES** Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.	9
III	**TQM TOOLS AND TECHNIQUES I** The seven traditional tools of quality - New management tools - Six sigma:Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA -Stages, Types.	9
IV	**TQM TOOLS AND TECHNIQUES II** Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.	9
V	**QUALITY MANAGEMENT SYSTEM** Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards— Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation— Documentation—Internal Audits— Registration- ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction— ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.	9

TotalInstructional Hours   **45**

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

TEXT BOOKS:

T1 B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, ―
Total Quality Management‖, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

R1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8thEdition, First Indian Edition, Cengage Learning, 2012.

R2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", PrenticeHall (India) Pvt. Ltd., 2006.

R3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.R4. ISO9001-2015 standards.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E./B.Tech./V	19BM5304	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 in medical ethics.
2. Students will 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, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and The Patient, The Doctor and The Profession, Professional Independence, The Doctor and Society	9
II	**ETHICAL THEORIES & MORAL PRINCIPLES** Theories-Deontology & Utilitarianism, Casuist theory, Virtue theory, The Right Theory. Principles Non- Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice, Ethical Issues in biomedical research, Bioethical issues in Human Genetics & Reproductive Medicine	9
III	**HOSPITAL ACCREDITATION AND SAFETY STANDARDS** Accrediation- JCI Accreditation & its Policies. Patient centeredstandards, 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 EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste, Maintaining Fire Safety Equipment, Features, Testing, Maintaining, and Inspecting Medical Equipment.	9

	MEDICAL EQUIPMENT SAFETY STANDARDS	
V	Fi General requirements for basic safety & essential performance of medical equipment. IEC 60601 standards, Indian and Internationalstandards, ISO standards - Base Standard-general requirement of electrical medical devices, Collateral Standards- EMC radiation protection &programmable medical device system, Particular Standards-type of medical device.	9

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 Bioethics and engineers role CO3 :Apply Legal and professional guidelines for the hospital accreditation CO4: Understand hospital safety aspects CO5 :Comprehend the medical equipment safety standards and medical devicemaintenance.

TEXT BOOKS:

T1:Domiel A Vallero, Biomedical Ethics for Engineers, Elsevier Pub.1st edition, 2017

T2: Johnna Fisher, Biomedical Ethics: A Canadian Focus., Oxford University Press Canada,2019.

REFERENCE BOOKS:

R1:Robert M Veatch, The Basics of Bio Ethics, 3 rd Edition. Routledge, 2019.

R2:Physical Environment Online: A Guide to The Joint Commission's Safety Standards ispublished by HCPro, Inc. 2020

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./V	19BM5305	**INTELLECTUAL PROPERTY RIGHTS**	3	0	0	3

Upon completion of this course, the students will be familiar with

<table>
<tr><td rowspan="5">Course Objectives</td><td>1.</td><td>To give an idea about IPR, Patents and Copyrights.</td></tr>
<tr><td>2.</td><td>Understand registration of IPRs.</td></tr>
<tr><td>3.</td><td>Understand Agreements and Legislations.</td></tr>
<tr><td>4.</td><td>To know Digital products and Law.</td></tr>
<tr><td>5.</td><td>Discuss IPR and its enforcement.</td></tr>
</table>

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, Industrial Property, technological Research, Inventions and Innovations – Importantexamples of IPR.	9
II	**REGISTRATION OF IPRs** Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.	10
III	**AGREEMENTS AND LEGISLATIONS** International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, TrademarkAct, Geographical Indication Act.	10
IV	**DIGITAL PRODUCTS AND LAW** Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.	9
V	**ENFORCEMENT OF IPRs** Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.	7
	Instructional Hours Total	45

Course Outcomes	Upon completion of this course, the students will be able to CO1: Ability to manage Intellectual Property portfolio to enhance the value ofthe 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. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012

T2. S. V. Satakar, ―Intellectual Property Rights and Copy Rights, Ess Ess Publications, NewDelhi, 2002.

<div align="center">REFERENCES:</div>

R1. Deborah E. Bouchoux, ―Intellectual Property: The Law of Trademarks, Copyrights,Patents and Trade Secrets‖, Cengage Learning, Third Edition, 2012.

R2. Prabuddha Ganguli,‖Intellectual Property Rights: Unleashing the Knowledge Economy‖,McGraw Hill Education, 2011.

R3. Edited by Derek Bosworth and Elizabeth Webster, The Management of IntellectualProperty, Edward Elgar Publishing Ltd., 2013.

CHAIRMAN-BOS   **DEAN ACADEMICS**

PROFESSIONAL ELECTIVE II

Programme/Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./VI	19BM6301	Biomaterials and Artificial Organs	3	0	0	3

Course Objectives:

- To study the characteristics and classification of biomaterials.
- To understand the response of biomaterials in living system.
- To learn about the polymeric materials and composites in tissue replacements.
- To know the compatibility and functioning of artificial organs inside the living system.

UNIT I STRUCTURE OF BIO-MATERIALS AND BIO- COMPATIBILITY

Definition and classification of bio-materials, mechanical properties, viscoelasticity ,wound   Healing process, body response to implants, blood   compatibility, HLA compatibility.

UNIT II IMPLANTMATERIALS 9

Metallic implant materials, stainless steels, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite, glass ceramics, carbons, medical applications case study on bone replacement

UNITIII POLYMERIC IMPLANTMATERIALS 9

Polymerization, polyamides, Acryrilic polymers, Hydrogels, rubbers, high strength, thermoplastics, medical applications. Bio polymers: collagen and elastin. Medical Textiles:silica,chitosan, PLA, composites ,Sutures, wound dressings .Materials for ophthalmology:

contactlens, Intra ocularlens. Membranes for plasma separation and blood oxygenation.

UNITIV TISSUE REPLACEMENTIMPLANTS 9

Small intestinal submucosa and other decellularized matrix biomaterials for tissue repair.
Soft- tissue replacements, types of transplant by stem cell,sutures, surgicaltapes ,Tissue adhesive/ glue. Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts,har dtissue replacement Implants, joint replacements, Pancreas replacement case study ontissue replacement.

UNITV ARTIFICIALORGANS 9

Artificial Blood, Artificial Skin, Artificial Heart,Prosthetic Cardiac valves, Artificial Lung(Oxy genator), Artificial Kidney(Dialyzer Membrane),   Dental Implants, Retinal Implantscase study on dental and heart valve

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze different types of materials and its applicationin biomedical field.

CO2: Choose materials for design of implants in tissue replacement.

CO3:Evaluate response of biomaterials inliving system.

CO4: Assess compatibility and functioning of artificial organs inside the living system.

CO5: Design and develop biomaterial based scaffold for biomedical application.

TEXTBOOKS

1. SujataV.Bhatt,"Biomaterials",Narosa PublishingHouse, 7thEdition,2005.
2. JoonB.ParkJosephD.Bronzino,"Biomaterials-PrinciplesandApplications",CRCpress,2003.

REFERENCES:

1. H.H.Willard,D.L.Merrit,"InstrumentalMethodsof Analysis",CBSPublishers,1992.
2. ParkJ.B.,"BiomaterialsScienceandEngineering'',PlenumPress,1984.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./VI	19BM6302	ᴐDED SYSTEMS IN MEDICALDEVICES	3	0	0	3

Course Objective	
	1. Understand overview of Processors and hardware units.
	2. Understand Intel MCS51 Architecture.
	3. Learn PIC Microcontroller.
	4. Understand Embedded system evolution trends.
	5. Discuss applications of embedded system.

Unit	Description	Instructional Hours
I	**Introduction to embedded systems** Definition and Classification – Overview of Processors and hardware units in an embedded system – Software Embedded into the System – Complex System Design and the various Processors - Concept of Design Process in Embedded Systems - Design Examples – Classifications in Embedded Systems and Skills required for an Embedded Systems Designer	9
II	**Interfacing with 8051 and Introduction to Arduino UNO R3** Introduction to 16 bit Microcontroller. Interfacing of 8051 with ADC, sensors, stepper motor, key board, & DAC - Introduction to Arduino UNO R3 Hardware setup – I/O functions – Real time Application	9
III	**Introduction to PIC Microcontroller** PIC Microcontroller - Introduction, CPU architecture, registers, instruction sets addressing modes Loop timing, timers, Interrupts, Interrupt timing, I/o Expansion,I 2C Bus Operation Serial EEPROM, Analog to digital converter, UART-Baud Rate- Data Handling, Special Features	9
IV	**Real time Operating system Concepts** Recursion, Debugging strategies, Simulators. Task and Task States, tasks and data, semaphores and shared Data Operating system Services-Message queues- Timer Function- Events-Memory Management, Interrupt Routines in an RTOSenvironment, basic design Using RTOS	9
V	**Embedded systems application in Medical devices** Embedded medical applications: Ophthalmology - Glaucoma screening device, Medical Imaging Acquisition User Interface, Drug delivery systems, Patient monitoring Systems.	9
	Total Instructional Hours	45

CO1: Explain overview of Processors and hardware units.

CO2: Apply Intel MCS51 Architecture.

CO3: Describe PIC Microcontroller.

CO4: Explain Embedded system evolution trends.
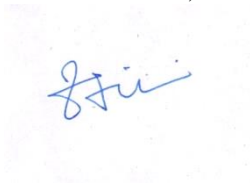
Course Outcome CO5:Apply applications of embedded system.

TEXT BOOKS:
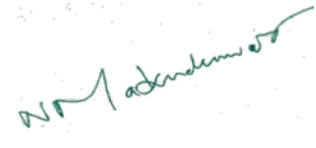
1. Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, First reprint Oct. 2003

2. M A Mazidi & Mazidi, The 8051 micro controllers, Pearson Education, 2005

REFERENCES:

1. Tim Wilmshusrst, Designing Embedded Systems with PIC, Newnes publishing, 2007
2. Steve Heath, Embedded Systems Design, Second Edition-2003, Newnes,
   David E. Simon, An Embedded Software Primer, Pearson Education Asia, First IndianReprint 2000.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./VI	19BM6303	**BIOMEDICAL WASTE MANAGEMENT**	3	0	0	3

Course Objective	
	1.Understand hazard control
	2.Understand the hazardous materials used in hospital and its impact on health
	3.Understand various waste disposal procedures and management.
	4.Learn safety of hospital
	5.Understand infection control, prevention and patient safety

Unit	Description	Instructional Hours
I	**HEALTHCARE HAZARD CONTROL AND UNDERSTANDINGACCIDENTS** Healthcare Hazard Control : Introduction, Hazard Control, Hazard Control Management, Hazard Control Responsibilities, Addressing Behaviors, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Hazard Control and Correction, Personal Protective Equipment, Hazard Control Committees, Hazard Control Evaluation, Hazards, System Safety, Ergonomics. Understanding Accidents: Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis, Organizational Functions That Support Accident Prevention, Workers' Compensation, Orientation, Education, and Training.	9
II	HOSPITAL **WASTE MANAGEMENT** Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization,waste segregation and labeling, waste handling, collection, storage andtransportation, treatment and disposal	9
III	**HAZARDOUS MATERIALS** Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations andEmergency Response Standard, Respiratory Protection.	9
IV	**FACILITY SAFETY** Facility Safety : Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating,and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.	9
V	**INFECTION CONTROL, PREVENTION AND PATIENT SAFETY** Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events, Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare-Associated Infections, Medication Safety.	9
	Total Instructional Hours	**45**

Course Outcome	
	CO1: Analyse various hazards, accidents and its control
	CO2: Design waste disposal procedures for different biowastes
	CO3: Categorise different biowastes based on its properties
	CO4: Design different safety facility in hospitals
	CO5: Propose various regulations and safetynorms

TEXT BOOKS:

1. James T., Healthcare hazard control and safety management-CRCPress_Taylor and Francis (2014).
2. Sukhjit Kaur, Biomedical Waste Disposal, Jaypee BrothersMedical Publishers (P) Ltd (2012).

REFERENCES:

1.C.Goyal ―Hospital Administration and Human Resource Management‖, PHI –Fourth Edition, 2006
2. J. Landrum, ―Medical Waste Management and disposal‖, Elsevier, 1991

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./VI	**19BM6304**	**PHYSIOLOGICAL MODELLING**	**3**	**0**	**0**	**3**

Course Objective

1. To understand the concepts of physiological modelling
2. To learn the different approaches used in modeling of physiological systems.
3. To learn the concepts of modeling human thermal regulatory system.
4. To learn the concepts of modeling human respiratory system.
5. To study about the electrical properties of neuron and to model them.

Unit	Description	Instructional Hours
I	**Introduction to physiological modelling** Physiological complexity and the need for models: Complexity , Feedback and Control in Physiological Systems Models and the modeling process: Model Formulation , Identification Validation and Simulation.	9
II	**Different approaches of modeling physiological systems** Linear Modeling Distributed Modeling Nonlinear Modeling Time-varying Modeling Mathematical approach, electrical analogues, etc. Introduction to various process controls like cardiac rate, blood pressure, respiratory rate. Blood - Glucose regulation. Pharmacokinetic modeling-compartmental models, blood-tissue models.	9
III	**Modeling of human thermal regulatory system** Parameters involved, control system model etc. Biochemistry of digestion, Loss of heat to the environment, Heat transfer within the body, Models describing heat transfer between core and skin, heat distribution in extremities.	9
IV	**Modeling of Respiratory system** Human Lungs: Anatomy and physiology of the respiratory system, mass balance in lungs, oxygen and carbon dioxide transport in blood Modelingoxygen uptake by RBC and pulmonary capillaries .	
V	**Neuron Models** Electrical properties of Neurons, Single compartment models, voltage dependent conductances, Hodgkin Huxley model, Integrate fire neuron model, conductance based models, Cable equation, multi compartment models. Fitzhugh Nagumo models.	9
	Total Instructional Hours	**45**

Course Outcome

CO1	Gain adequate knowledge about the modeling of physiological systems
CO2	Have an in depth idea about different approaches in modeling physiological systems
CO3	Design and develop the physiological model of human thermal regulatory system.
CO4	Design and develop the physiological model of human respiratory system
CO5	Gain in-depth knowledge about different types of neuron models and its electrical properties

TEXT BOOKS:

1. Arthur C Guyton, Text Book of Medical physiology, PRISM Books India, 2000
2. David Cooney, Biomedical Engineering Principles, Marcel Decker Publications, 2001.

REFERENCE BOOKS:

1. Peter Dayan, Theoretical Neuroscience: Computational and Mathematical modeling of Neuralsystems MIT Press

2. Vasilis Z Marmarelis, Nonlinear Dynamic Modeling of Physiological systems IEEE Press series inBiomedical Engineering,

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/Sem	Course Code	Name of the Course	LT	P	C
B.E./B.Tech./V	19BM6305	**ARTIFICIAL NEURALNETWORKS**	**30**	**0**	**3**

Course Objective	To understand the need for machine learning for various problem solving To study the various supervised, semi-supervised and unsupervised learningalgorithms in machine learning To learn the new approaches in machine learning To design appropriate machine learning algorithms for problem solving To understand about the basic concepts of associative memories.

Unit	Description	InstructionalHours
I	**INTRODUCTION TO NEURAL NETWORKS** Introduction-Humans and Computers- Organization of the Brain- Biological Neuron-Biological and Artificial Neuron Models-Characteristics of ANN- McCulloch Pitts Model- Historical Developments- Potential Applications of ANN.	9
II	**ESSENTIALS OF ARTIFICIAL NEURAL NETWORKS** Artificial Neuron Model- Operations of Artificial Neuron- Types of Neuron Activation Function- ANN Architectures- Classification Taxonomy of ANN – Connectivity- Learning Strategy- Supervised, Unsupervised, Reinforcement-Learning Rules.	9
III	**SINGLE LAYER FEED FORWARD NETWORKS** Introduction-Perceptron Models: Discrete, Continuous and Multi-Category- Training Algorithms: Discrete and Continuous Perceptron Networks- Limitations of the Perceptron Model.	9
IV	**MULTI- LAYER FEED FORWARD NETWORKS** Credit Assignment Problem- Generalized Delta Rule- Derivation of Backpropagation (BP) Training,-Summary of Backpropagation Algorithm- Kolmogorov Theorem- Learning Difficulties and Improvements.	9
V	**ASSOCIATIVE MEMORIES** Paradigms of Associative Memory-Pattern Mathematics-Hebbian Learning- General Concepts of Associative Memory- Bidirectional Associative Memory (BAM) Architecture- BAM Training Algorithms-Storage and Recall Algorithm- BAM Energy Function-Architecture of Hopfield Network: Discrete and Continuous versions-Storage and Recall Algorithm,-Stability Analysis- Neural network applications: Process identification, control, fault diagnosis.	9
	Total Instructional Hours	**45**

Course Outcome	**CO1:** Explain theory underlying machine learning. **CO2:** Construct algorithms to Learn ANN. **CO3:** Implement single layer feed forward networks. **CO4:** Construct Algorithms To learn multi- layer feed forward networks. **CO5:** Applyassociative memories learning techniques for real life problems

TEXT BOOKS:

T1   LaureneFausett, "Fundamentals of Neural Networks" , Pearson Education,2014.

T2   Simon Haykin, "Neural Networks- A comprehensive foundation", Pearson Education, 2013.

REFERENCE BOOKS:

R1   S.N.Sivanandam, S.Sumathi,S. N. Deepa "Introduction to Neural Networks using MATLAB 6.0", TATAMcGraw Hill, 2016.

R2   S. Rajasekharan and G. A. Vijayalakshmipai, "Neural Networks, Fuzzy logic, Genetic algorithms:synthesis and applications", PHI Publication, 2014.

R3   Timothy J. Ross, " Fuzzy Logic With Engineering Applications", Tata McGraw-Hill Inc. 2010.

CHAIRMAN-BOS

DEAN ACADEMICS

SEMESTER VII

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

Course Objective	1.	To become familiar with digital image fundamentals
	2.	To get exposed to simple image enhancement techniques in Spatial and Frequencydomain.
	3.	To learn concepts of degradation function and restoration techniques.
	4.	To study the image segmentation and representation techniques.
	5.	To become familiar with image compression and recognition methods

Unit	Description	
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 IN MEDICAL IMAGES**: 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.

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

CO3: Understand the restoration concepts and filtering techniques.

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

CO5: Able to analyze image compression and recognition methods

TEXT BOOKS:
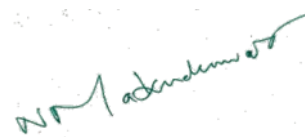
1. Rafael C. Gonzalez, Richard E. Woods, _Digital Image Processing', Pearson, ThirdEdition, 2010.
2. Anil K. Jain, _Fundamentals of Digital Image Processing', Pearson, 2002.

REFERENCES:

1. Kenneth R. Castleman, _Digital Image Processing', Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, _Digital Image Processing usingMATLAB', 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   **DEAN ACADEMICS**

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 Equipment's.
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
IV	**ULTRASONIC TECHNIQUE** 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
V	**PATIENT SAFETY** 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 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, NewDelhi, 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   **DEAN ACADEMICS**

Programme	Course Code	Name of the Course	L	T	P	C
BE	19BM7251	HOSPITAL MANAGEMENT	2	0	2	3

Course Objective	1. Identify various areas of hospitals and Discuss about effective hospital management. 2. Develop knowledge of hospital building maintenance, equipment and systems for health care. 3. Develop knowledge regarding plant operations, clinical engineering, biomedical engineering, safety technology and hospital information system. 4. Maintain various medical records and information management system. 5. Students shall be well trained to solve the rising challenges and specific necessities of modern day hospitals.

Unit	Description	Instructional Hours
I	**HEALTHCARE SYSTEM** Health organization of the country-health technology and challenges in maintaining normal health, Indian hospitals- challenges and strategies, modern techniques of hospital management. ***Experiment:*** *1. Presentations on modern hospital architecture* *2. Presentations on space distribution in hospital*	9
II	**HOSPITAL ORGANIZATION** Classification of hospital, Hospital- social system, location of hospital, site selection of new hospital, Line services, Supportive services and Auxiliary services of hospital. ***Experiment:*** *1. Presentations on electrical distribution in hospital* *2. Presentations on De-odourisation and disinfections and dehumidification in hospital*	9
III	**ENGINEERING SERVICES OF HOSPITAL** Biomedical engineer's role in hospital, Maintenance department, MRO, Clinical engineering preventive maintenance of equipment, Electrical system, Power supply system, Electrical safety, Centralized gas supply system, Air conditioning system, Hospital waste management system, Fire safety and threat alarm system. ***Experiment:*** *1. Presentations on centralized gas supply system* *2. Presentations on hospital waste management.*	9

IV	**HOSPITAL MANAGEMENT AND INFORMATION SYSTEM** Role of HMIS, Functional areas, Modules forming HMIS, HMIS and Internet, Centralized data record system, computerized patient record system, Health information system. *Experiment:* *1. Presentations on sterilization system in hospital* *2. Presentations on design of operation theatre in hospital*	9
V	**REGULATION AND PLANNING OF NEW HOSPITAL** FDA regulation, ISO certification, Fire protection standard, Planning and designing of new hospital. *Experiment:* *1.Presentations on planning and designing of new hospital*	9

Total Instructional Hours   45

Course Outcome	CO1: Develop an understanding of criteria regarding assessment, management,administration and regulation of healthcare technology. CO2: Improve the clinical effectiveness, efficiency and safety of technology use,considering the importance and impact of various services on patient care. CO3: To gain knowledge about the role of a biomedical engineer in hospitals and variousservices at large. CO4: to understand about the various hospital management and information systems inhospitals CO5: Students shall be well trained to solve the rising challenges and specific necessities of modern day hospitals.

TEXT BOOKS:

1. R.C. Goyal, Handbook of Hospital Personal Management, Prentice Hall of India, 2003
2. Hans Pfeiff, Vera Dammann (Ed.), Hospital Engineering in Developing Countries, Z report Eschbom, 2006

REFERENCE BOOKS:

1. Cesar A. Caceres and Albert Zara, The practice of clinical engineering, Academic Press, 1977.
2. Webster, J. G and Albert M. Cook, Clinical Engineering Principles and Practices, Prentice Hall Inc. Englewood Cliffs, 1979
3. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press, San Diego 1988

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./ VII	19BM7001	MEDICAL IMAGE PROCESSING LABORATORY	0	0	4	2

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. To

9. apply morphological operators on an image.

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

11. perform image classification / recognition

12. To perform basic operations on images.

13. To perform histogram equalization.

14. To perform image filtering in spatial domain.

15. To perform image filtering in frequency domain.

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

Total Practical Hours: 45

CHAIRMAN-BOS   **DEAN ACADEMICS**

DIAGNOSTICANDTHERAPEUTIC

| B.E | 19BM7002 | **EQUIPMENTLABORATORY** | 0 | 0 | 3 | 1.5 |

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

Ex.No   **DESCRIPTION**

1   To study and demonstrate the working of TENS & Ultrasound Therapy Unit.

2   Acquisition of bloodflow graphusing PC based VascularDoppler.

3   Tostudyanddemonstrate the working of BabyIncubator.

4   To study and demonstrate theworking of Radiant heatwarmer & Phototherapy.

5   Recording of lungflow,volume and capacities graphusing PC based Spiro meter.

6   Tostudy and demonstratethe workingof 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 usingAutoclave.

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 form Measuring respirationrate and heartsound.
	CO3: Design of ultrasound scanning system and baby incubator system
	CO4: Analyze drug delivery systems and visualizationof internal organs
	CO5: Design realtime patient monitoring system and sterilization techniques
	CO6: Develop and stimulate the pacemaker system.

TEXTBOOKS

1. RobertB.Northrop,"Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation",CRC PRESS,2012.
2. R.S.Khandpur,"Handbook of Bio-Medical instrumentation",TataMcGraw Hill Publishing CoLtd,NewDelhi,2015.

REFERENCES

1. JosephE.Parrillo,"Critical Care Medicine:Principles of Diagnosisand Management in the Adult",Elsevier

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	CourseCode	NameoftheCourse	L	T	P	C
BE	19BM7301	DrugDelivery	3	0	0	3

CourseObjectives:

- To study the characteristics and classification of drug delivey
- To understand the response of materials.
- Tolearn about the polymeric materials and composites in targeted drugdelivery systems.
- Toknowthecompatibilityandfunctioningofimplantabledeliverysystems

UNIT 1 CONTROLLED DRUG DELIVERYSYSTEMS 9

Introduction, terminology/definitions and rationale ,advantage ,disadvantages, Selection of drugcandidates, approach todesign controlled release formulationbased on diffusion, dissolutionandionexchangeprinciples,physiochemicalandbiological Propertiesof drugrevelenttocontrolledreleaseformulations

UNIT2 POLYMERS 9

Introduction, classification, properties, advantages and application of polymer in formulation ofcontrolledreleasedrugdeliverysystems.

UNIT3 MICROENCAPSULATION AND MUCOSAL DRUG DELIVERY SYSTEMS 9

Definition, advantages and disadvantages, microspheres, micro particles, microcapsules, methodof encapsulation: Transmucosal permeability and formulation considerations of buccal deliverysystems

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 intrauterine device and application

COURSE OUTCOMES:
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 micro
encapsulation

CO3:Evaluate response of 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 2020BySarodePatil,Gayakwad,Usman(Author)

2. Textbook of Novel Drug Delivery System Prof.(Dr.) Ranabir Chanda/Prof.(Dr.)Jyotirmoy/Prof.(Dr.) Alugubelli Gopi Reddy 1st Edition2019

Referencebooks:

1. Drug Delivery:Principles and Applications,Second Edition Editor(s): Binghe Wang,LongqinHu,Teruna J.Siahaan First published:25 March 2016

2. Drug Delivery Systems 1st Edition Rakesh Teka deublished Date:22nd October 2019

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/ Sem	Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./ VII	BE	19BM7302	**INTERNET OF THINGS AND ITS MEDICAL APPLICATIONS**	3	0	0	3

Course Objective	1. To understand the basic theory of IoT 2. To study the various IoT Protocols 3. To study the various Physical Devices 4. To design embedded systems using IoT 5. 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** IoMT-Working, Internet of Things in Hospitals: Collection and Integration of ClinicalData: 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.	9

Course outcome

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

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   **DEAN ACADEMICS**

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech./ VI	19BM7303	ADVANCED BIO ANALYTICAL AND THERAPEUTIC TECHNIQUES	3	0	0	3

Course Objective	3. Understand the basics of Analytical Techniques . 4. 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 press2008.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	CourseCode	NameoftheCourse	L	T	P	C
BE	19BM7304	ADVANCED BIOSIGNAL 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 cardio vascular applications
4. To understandabout various data compression techniques
5. To understand about signal processing particularly for neurological applications

Unit	Description	InstructionalHours
I	**INTRODUCTIONTOBIOMEDICALSIGNALS** Examples of Biomedical signals- ECG, EEG, EMG etc - Tasks in Biomedical Signal Processing-Computer Aided Diagnosis.Origin of biopotentials-Review of Linear systems -FourierTransformand 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 linstruments.	9
II	**CONCURRENT,COUPLED AND CORRELATED PROCESSES** llustration with case studies – Adaptive and optimal filtering – Modeling of Biomedicalsignals - 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** BasicECG-ElectricalActivityoftheheart-ECGdataacquisition–ECGparameters & their estimation - Use of multiscale analysis for ECG parameters estimation - Noise & Artifacts-ECG Signal Processing: Baseline Wandering, Power line interference,Muscle noise filtering–QRSdetection-Arrhythmiaanalysis.	9
IV	**DATACOMPRESSION** Lossless & Lossy- Heart Rate Variability – Time Domain measures – Heart Rhythmrepresentation-Spectralanalysisofheartratevariability-interactionwithother	9

physiologicalsignals.

	NEUROLOGICALAPPLICATIONS	
V	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 ofEEG - artifactsin EEG &theircharacteristicsandprocessing– Model based spectra lanalysis - EEG segmentation - Joint Time-Frequency analysis – correlation analysis of EEGchannels-coherenceanalysisofEEGchannels.	9

Total Instructional Hours   **45**

Course Outcome

CO1:Understand the basics of signals,systemsandspectrum

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

CO3: Construct signaling algorithm for cardiovascular applications.

CO4: Understanding the importance of datacompression in signal processing.

CO5: Analyz ebio-signals and demonstrate the neurological applications.

TEXT BOOKS:

T1   D.C.Reddy,"Biomedical Signal Processing–PrinciplesandTechniques",TMH,2005.

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

REFERENCE BOOKS:

R1   R.Rangayan,"Biomedical Signal Analysis",Wiley2002.

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

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

CHAIRMAN-BOS   **DEAN ACADEMICS**

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

Course Objective	1.To apply the basics ultrasound and Echo techniques 2.Tofind theImaging modalities and itsdiagnostic techniques 3.Students should know about the fundamentals of troubleshooting techniques.

UNIT	DESCRIPTION	TOTAL INSTRUCTIONAL HOURS
I	**USG&ECHO** History - Properties of ultrasound – Principle Doppler Effects - UltrasoundTransducers:PiezoelectricEffect-TransducerBeamCharacteristics– Scanning Techniques and modes –Biological effects of ultrasound – ECHOprinciple andInstrumentation –Pulse Echoconcept-Pulsegenerator– Sound waves – Modes of Transducer - Acoustic Properties of TransducerMaterials –PLAX andPSAXView–Stress Echocardiogram	9
II	**IMAGINGTECHNIQUES** Grey scale and colour Imaging – Panoramic Imaging - Contrast agent andTissue contrast – 3D & 4D Imaging Techniques – Strain Imaging – Imageprocessing techniques - modalities of Echo – Elasticity Imaging – CT & MRIguidedUSG	9
III	**DIAGNOSTICULTRASOUND** Introduction–PrincipleandconceptsofIntravascularImaging–Transesophageal Ultrasound – Transabdominal Ultrasound – Transrectal andVaginal Ultrasound– Fetal monitoring – Soft tissue evaluation of humanbodyorgans– UltrasoundGuidedbiopsytechniques	9
IV	**THERAPEUTICULTRASOUND** Thermal and Non-Thermal Ultrasound therapy – Ultrasound Drug delivery – HIFU - Cancer therapy – Phacoemulsification using USG- Lithotripsy – Selerotherapy	9
V	**TROUBLESHOOTING&SAFETYMANAGEMENT** Troubleshooting techniques– Powersupply– Calibration of Transducer& Sca –Servicing methodology–USGLicenses–Preventive maintenance precautions of USG during Imaging.USG-ECHO Management system..	9
		45

TOTAL INSTRCTIONAL HOURS

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: Understandthe conceptof USG troubleshooting & Safety

TEXTBOOKS
1. K.Shung "Diagnostic Ultrasound: Imaging and Doppler Flow Measurements"Francis&Taylor,CRC Press BocaRaton FL,2005
2.Szabo.T-Diagnostic Ultrasound Imaging:Inside Out"Elsevier Academic Press,Amesterdam,2004.
3.Haraldlutz,Elisabettabuscarini,Manual of diagnostic Ultrasound,WHO-2020

REFERENCE

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill,New Delhi,2018
2.   JohnG.Webster,"Medical InstrumentationApplication and Design",JohnWiley and sons,NewYork,2009.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	CourseCode	NameoftheCourse	L	T	P	C
BE	19BM8301	**BIOFLUIDS AND DYNAMICS**	3	0	0	3

Course Objective	1. An understanding on the physiology and anatomy of studied systems, 2. A capability to analyze the flow properties of blood. 3. To analyze cellular,ocular,cardio vascular and respiratory fluid mechanics 4. To understand the basics of soft tissue mechanics, 5. To understand mathematical modeling of fluid biological systems.

Unit	Description	Instructional Hours
I	**BIO-FLUIDMECHANICS** Newtons laws, Stress, Strain, Elasticity- Hooks-law-viscosity- Newtonian fluid-Non-Newtonianfluid-Viscoelasticfluids-vasculartree-Relationship between diameter-velocity and pressure of blood flow-Resistance against flow-Bioviscoelastic fluid:Viscoelasticity-Viscoelastic models,Maxwell,Voigt and Kelvin Models, Response to Harmonic variation- Use of viscoelastic models- Bio-Viscoelasticfluids: Protoplasm-Mucus-Saliva-Synovialfluids.	9
II	**FLOW PROPERTIESOFBLOOD** Physical- Chemical and Rheological properties of blood-Apparent and relativeviscosity- Blood viscosity variation- Effect of shear rate- hematocrit-temperature-protein contents of blood-Casson'sequation-Problems associated with extracorporeal bloodflow-Rheology of Blood In Microvessels-Fahraeus-Lindquist effect and inverse effect- distribution of suspended particles in a narrowrigid tube-Nature of red blood cells in tightly fitting tubes-hematocrit in very narrow tube.	9
III	**CARDIACMECHANICS** Cardiovascularsystem-Mechanical properties of blood vessels:arteries,arterioles, capillaries and veins- Blood flow: Laminar and Turbulent- Physics of cardiovascular diseases-Prosthetic heartvalves and replacements-Respiratory Mechanics-Alveoli mechanics- Interaction of Blood and Lung P-V curve of Lung-Breathing mechanism-Airway resistance-Physics of Lung diseases.	9

SOFTTISSUEMECHANICS

| IV | Pseudoelasticity-non-linearstress-strain relationship-Viscoelasticity-Structure-function and mechanical properties of skin-ligaments andtendons. | 9 |

ORTHOPEDICMECHANICS

| V | Mechanical properties of cartilage- diffusion properties of Articular cartilage- mechanical properties of bone- kinetics and kinematics of joints- lubrication ofjoints. | 9 |

Total Instructional Hours   **45**

| **Course Outcome** | **CO1:**Understand the principles of biofluid mechanics
CO2: Outline theflow propertiesof blood.
CO3: Discusson Cardiovascularand   pulmanory system in human body
CO4: Explain blood properties speciallythe anatomy and physiologyof soft tissues.
CO5: Understanding theconceptsofor the pedicmechanics. |

TEXTBOOKS:

T1   Y.CFung,"Biomechanics-Mechanicalpropertiesofliving tissues",2ndEdition,Springer-Verlag,2003.

T2   DavidA.Rubenstein,Weiyin,MaryD.Frame,"BiofluidMechanics-An Introduction to fluid Mechanics,Macrocirculation and Microcirculation",Springer,2013.

REFERENCE BOOKS:

R1   DhanjooN.Ghista.(2008).AppliedBiomedicalEngineeringMechanics.CRCPress.

R2   SilverFrederickH. Biomaterials,MedicalDevices&Tissue Engineering:Chapman&Hall,London,1994

R3   Nihanthozkai,D.AMcDonald,"Biomechanics,Bloodflowinarteries", Edward Arnoldltd,1998.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	CourseCode	NameoftheCourse	L	T	P	C
BE	**19BM8302**	**AI In Healthcare**	**3**	**0**	**0**	**3**

Course Objective

1. To understand the need for machine learning for various sproblemsolving
2. To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
3. To learn the new approaches in machine learning
4. Todesign appropriate machine learning algorithms for problemsolving
5. To understand about the basic conceptsof associative memories.

Unit	Description	InstructionalHours
I	**INTRODUCTION & SEARCH STRATEGIES** Intelligence: history, the state of the art - Intelligent agents: structure, environment.Breadth-first search,uniform costsearch,depth-firstsearch,depth-limitedsearch,iterative deepening search, bidirectional search, heuristic search techniques, comparingsearchstrategies..	9
II	**KNOWLEDGE AND REASONING** Representation,logic: propositional logic,using predicatelogic,usingrules,forward and backwardchaining,strong and weakslotfillers.	9
III	**PLANNING & UNCERTAINTY** Overview,components,goalstack planning,non-linear planning,hierarchical planning,reactivesystems.Non-monotonicreasoning,logics,implementation, Probability and Bayes theorem,certain factors-Bayesian networks,dempster-Shafertheory.	9
IV	**MACHINE LEARNING IN HEALTHCARE** Introduction–Machine learning models–Categories–Tools–Patient centric machine learning model – Healthcare dataset – Supervised and Unsupervised technique-Introduction to Deep learning.	9
V	**HEALTHCARE APPLICATIONS** Disease detection system –methodology,case diagram –for cancer detection–Brain convolution–Smart Health record-Virtual Nursing assistance-Surgical Assistance.	9
	Total Instructional Hours	**45**

Course Outcome	**CO1:**Explain theory underlying machine learning. **CO2:**Construct algorithms toLearnANN. **CO3:**Implement single layerfeedforwardnetworks. **CO4:**Construct AlgorithmsTolearn multi-layerfeed forward networks. **CO5:**Apply associative memories learning techniques for real life problems

TEXT BOOKS:

T1 StuartRussell,"Artificial Intelligence:A ModernApproach",4thEdition,Pearson,2020

T2 ArvinAgah,"MedicalApplicationsofArtificialIntelligence",CRCPress,2017

REFERENCE BOOKS:

R1 JamesV Stone,"Artificial Intelligence Engines:ATutorial Introduction to the Mathematics of Deep Learning,"2019

R2 Robert Scoble & ShelIsrael,"The Fourth Transformation:How Augmented Reality &Artificial Intelligence Will Change Everything",Patrick Brewster Press;1st edition,2016

R3 S. Rajasekharan and G. A. Vijayalakshmi pai, "Neural Networks, Fuzzy logic, Genetic algorithms:synthesis and applications",PHI Publication,2004.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	CourseCode	NameoftheCourse	L	T	P	C
BE	19BM8303	**MEDICAL INFORMATICS**	3	0	0	3

Course Objective

1. To study about the evolution of medical informatics and its applicationin healthcare field.
2. To understand the various standards and terminologies used in medical informatics
3. Togain knowledge about the theories such as E health,human factors involved in Medicalinformatics.
4. Tolearn about statistical computation in bioinformatics.
5. To understand the implementation and visualization of medical data.

Unit	Description	Instructional Hours
I	**INTRODUCTION:** Definition-evolution of medical informatics–screening, diagnosisandprognosis - applications:clinical informatics,nursing informatics,public health informatics - principles of bioethics-Indian and International health agencies-featuresof modern persona lcomputers and peripherals.	9
II	**STANDARDS AND TERMINOLOGY:** MeSH,UMLS,ICD,SNOMED,LOINC- CCHIT,HL7,HIE,HIMSS,DICOM, and HIPAA-networking medical data:PACS,cloudsand web-Hospital InformationSystem(HIS):characteristics,functional online and offline modules –introduction to RIS and LIS.	9
III	**THEORIES OF MEDICAL INFORMATICS:** Definition and six levels of interfacing–E-health-Evidencebasedmedicine–Quality of Care-work flow analysis-usabilityandhumanfactors–User Interface design– challenges and limitationsof technological solutions..	9
IV	**MEDICAL INFORMATICS TOOLS:** Introduction to statistical computing:statistical analysis and characterization of healthcare data,descriptive statistics–logistic and linear regression -introduction To data mining:variable typesand terminology,supervised learning and function approximation..	9
V	**IMPLEMENTATIONAND VISUALIZATION:** Electronic medical records: components and functionality, development tools,computerized prescription-telemedicine:technologies and applications- multimedia applications in medicine: visualization of medical data, virtual reality,VRML	9

Total Instructional Hours   45

Course Outcome

CO1	Understand the evolutionof medica linformatics and itsapplication in healthcare field
CO2	Understand the various standards and terminologies used in medical informatics
CO3	Understand knowledge about the theories such as Ehealth,human factors involved in Medical informatics.
CO4	Understand about statistical computation in bioinformatics.
CO5	Understand the implementation and visualization of medical data

TEXTBOOKS:
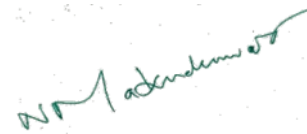
1. Ramachandra Lele, ―Computers in Medicine: Progress in Medical Informatics‖, TataMcGraw Hill,New Delhi,2005.

2.Hastie Tibshirani and Friedman, ―The Elements of Statistical Learning‖, SpringerSeriesinStatistics,2013.

REFERENCEBOOKS:

1.Mohan BansalMS,―Medical Informatics‖,TataMcGraw Hill,NewDelhi,2002.

2.Edwa rd H.Shortliffe and JamesJ.Cimino,―Biomedical Informatics:ComputerApplications in Health Care and Biomedicine‖,Springer,2006.

3.HM Dietel,P JDietel,―Internetand WorldWideWeb:HowtoProgram‖,PearsonEducation,New Delhi,2011.

4. Joseph Tan, ―Medical Informatics: Concepts, Methodologies, Tools, and Applications‖, Medical InformationScience Reference,2 008.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	CourseCode	NameoftheCourse	L	T	P	C
BE	19BM8304	WEARABLE MEDICAL DEVICES	3	0	0	3

Course Objective

1. To understand wearable health monitoring systems and the electrodes usedfor the acquisition of biological signals.
2. To determine the multi functional sensor systems for health monitoring and their energy harvesting methodology under the self poweredcategory
3. To apply the various wireless communication modalities for healthcare devicesand understand the designing of wireless health platforms.
4. To understand the sensors kinsused for healthcare monitoring and nanomaterial based skin Electronics.
5. To apply the concept of wearable electronics to medical diagnostics and monitoring.

Unit	Description	InstructionalHours
I	**INTRODUCTION** Sensors for wearable systems, optical electrodes, Multifunctional Epiderma lSensor Systems with Ultra thin Encapsulation-Packaging for Health Monitoring,sensing of biological signals-Device requirements, data acquisition, systemintegration.	9
II	**ENERGY HARVESTING** Energy Harvesting for Self-powered wearable devices, wireless communicationtechnologies,Designofwireless healthplatforms.	9
III	**LOW POWER HEALTH MONITORING SYSTEMS** Semiconductors in flexible electronics, Low power analog and digital circuitdesign for bio potential acquisition – architecture and practical considerations.Intelligent patches.	9
IV	**SENSOR SKINS** Sensor Skins: An Overview, Nanomaterials-Based Skin-Like Electronics for theUnconscious and Continuous Monitoring of Body Status - detection mechanisms,fabrication.	9

MEDICALTEXTILES

V	Textile engineering for wearable sensing devices, Sensory application of textiles- EMG and ECGmonitoring,Respiratorymonitoring.ActiveTextiles for therapeutic applications- Textile electrodes for electrical muscle stimulation,textileinteractivemedicalagent(depotsanddisposingsystems),Heatablete xtiles.Passive textile for therapeutic applications- Reusable 3- D knitted elastic shorttractionbandages.	9

Total Instructional Hours   **45**

	CO1	DevelopapplicationsinCusingpointersandstructures.
	CO2	Acquire knowledge the most common abstractions for data collections(e.g.,stacks,queues,lists).
Course Outcome	CO3	Usenon lineardatastructuressuchastreestosolveproblems..
	CO4	ApplyGraphalgorithmstofindtheshortestpathcost
	CO5	ApplyAlgorithmsforsolvingproblemslikesortingandsearching.

TEXT BOOKS:

1.BonfiglioA ,DeRossi.D,"WearablemonitoringSystems",Springer,2011.

2.RogersJ.A, Ghaffari.R,Kim.D,"Stretchable Bioelectronics for Medical Devices and Systems",Springer,2016.

REFERENCE BOOKS:

1. Roger Narayan, "Medical Biosensors for Point of Care, (POC) Applications", 1st Edition,Wood head publishing,2016.
2. WenZhong,"An IntroductiontoHealthcare and Medical Textiles",DE Stechpublication,Inc, 2013.
3. BartelsV.T,"Hand book of MedicalTextiles",WoodHeadpublishing,2011.
4. Subhas Chandra Mukhopadhyay, "Intelligent Sensing, Instruments and Measurement- Wireless Sensors and Sensor Networks",1st edition,Springer Berlin Heidelberg,2013.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme/sem	CourseCode	NameoftheCourse	L	T	P	C
B.E	19BM8305	**CARDIOVASCULARENGINEERING**	3	0	0	3

Course Objective	1. Understanding the common anatomy of heart and vascular structure in depth
	2. Understanding the electrical activityof heart throughECG,
	3. Knowing moreaboutthecommoncardiovascularstates such as coronary artery disease, hypertension, dysrhythmias, and valvular heartdisease.
	4. Gain the knowledge mechanisms of blood flow.
	5. Knowing more about the cardiovascular diseases.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO CARDIOVASCULAR SYSTEM** Introduction,Blood vessels-ArteriesandArterioles,Veins and Venules,capillaries, control of blood vessel diameter, blood supply- internal respiration,and cell nutrition.Heart-position,structure pericardium,myocardium, endocardium,interior oftheheart.	12
II	**CARDIO CIRCULATORY SYSTEM** Flow of blood through the heart, blood supply to heart, conducting system oftheheart,factorsaffectingheartrate,thecardiaccycle,cardiacoutput,excitation contraction coupling,electrophysiology,congenital heartdefects,blood pressure, control of blood pressure, pulse and factors affecting the pulserate.Circulationoftheblood-pulmonarycirculation,systemiccirculation-aorta(differentpartsofaorta&theirbloodsupply,inbrief).	12
III	**CARDIAC EQUIPMENT** ECG;continuousmonitoringsystemsforpulserate,temperature,B.P.Respiration, Arrhythmia monitor; B.P. monitor, Blood flow and cardiac output,Measurement, Plethysmography, Oximetry, Tread mill (Stress ECG), Externaland implantable pacemakers, Programmable pacemakers, Power sources, Designof encapsulationandleads,Pacingsystemanalyzers.CardiacDefibrillators,BasicprinciplesandcomparisonofdifferentDefibrillators,Energyrequirements, Synchronousoperation,Implantable Defibrillators,Defibrillatoranalyzers.	12

	MECHANISM OF BLOODFLOW	
IV	Biofluidics:Biofluidmechanics,Flowpropertiesofblood,Rheologyofbloodin microvessels,Mechanicalpropertiesofbloodvessels:arteries,arterioles,capillaries,veins,Cardiovascularregenerativeengineering	12
	CARDIOVASCULAR DISEASES	
V	PericardialDisease,AtheroscleroticDisease,IschemicDisease,PeripheralVascularDisease,HeartFailure,Arrhythmias,ValvularDisease,Pulmonary Vascular Disease	12

	TotalInstructionalHours	**60**

Course Outcome	CO1: Understanding detailed anatomy of the cardiovascular regions
	CO2: Understanding various cardiac circulatory system
	CO3:Understanding cardiac electrical activity with various equipment's used for heart analysis.
	CO4:Understanding the mechanism behind bloodflow
	CO5:Understanding cardiovascular diseases and it Recovery.

TEXTBOOKS:

T1-ArchillesJ.Pappano,WithrowGilWier,"CardiovascularPhysiology: MosbyPhysiologySeries",Elsevier;11thedition, September6, 2018.

T2-MichelR.Labrosse,"CardiovascularMechanics", 2019,CRCPRESS TaylorandFrancis.

REFERENCEBOOKS:

R1-

ElaineN.Marie,"Essentialofhumananatomyandphysiology",11[th]edition,PearsonEducation,NewDelhi,2019.

R2- Braunwald,Eugene.(2012)HeartDisease:ATextbookofCardiovascularMedicine.9thEd. W.B.SaundersCompany.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	Course Code	Name of the Course	L	T	P	C
BE	19BM8306	REHABILITATION ENGINEERING	3	0	0	3

Course Objective	1. To understand the rehabilitation concepts and Rehabilitation team members for future development and applications 2. To understand the Principles of Rehabilitation Engineering. 3. To understand the different types of Therapeutic Exercise Technique. 4. To understand the the tests to assess the hearing loss, development of electronic devices to compensate for the loss and various assist devices for visually and auditory impaired 5. To understand the concepts of orthotic devices and prosthetic devices to overcome orthopedic problems.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO REHABILITATION** What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Psychiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Rehabilitation team Classification of members, The Role of Psychiatrist, Occupational therapist, Physical therapist, Recreation therapist, Prosthetist - Orthotist, Speech pathologist, Rehabilitation nurse, Social worker, Corrective therapist.	9
II	**PRINCIPLES OF REHABILITATION** Introduction, The Human Component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles - Practice of Rehabilitation and Assistive Technology	9
III	**THERAPEUTIC EXERCISE TECHNIQUE** Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction, Mobilisation exercises, Endurance exercises	9
IV	**MANAGEMENT OF COMMUNICATION & VIRTUAL REALITY** Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids. Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation	9

General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO. Prosthetic devices: Hand and arm replacement, Body powered prosthetics, Myoelectric controlled prosthetics and Externally powered limb prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS)..

9

ORTHOTIC, PROSTHETIC DEVICES & RESTORATION TECHNIQUES

Total Instructional Hours   **45**

	CO1	Gain adequate knowledge about the needs of rehabilitations and its future development
	CO2	Have an in depth idea about Engineering Concepts in Sensory & Motor rehabilitation.
Course	CO3	Apply the different types of Therapeutic Exercise Technique to benefit the society.
Outcome	CO4	Design and apply different types Hearing aids, visual aids and their application in biomedical field and hence the benefit of the society.
	CO5	Gain in-depth knowledge about different types of models of Hand and arm replacement.

TEXT BOOKS:

1 Sunder 'Textbook of Rehabilitation', Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007 2. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third edition-3 volume set, Taylor & Francis, 2006

1 Sunder 'Textbook of Rehabilitation', Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007 2. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third edition-3 volume set, Taylor & Francis, 2006

REFERENCE BOOKS:

1. Horia- Nocholai Teodorecu, L.C.Jain ,Intelligent systems and technologies in rehabilitation Engineering; CRC; December 2000.
2. Keswick. J., What is Rehabilitation Engineering, Annual Reviews of Rehabilitation- Springer- Verlag, New York, 1982.

DEAN ACADEMICS

RMAN-BOS

PROGRAMME	COURSE CODE	NAMEOF THE COURSE	L	T	P	C
B.E/B.Tech	19BM8307	**VIRTUALREALITYINMEDICINE**	**3**	**0**	**0**	**3**

Course Objective	1. To applythebasicVirtualrealitytechniques 2. Tofindthevirtualmodelingtechniquesanditsrepresentation 3. Studentsshouldknowaboutthefundamentalsofclinicalapplication.

UNIT	DESCRIPTION	TOTAL INSTRUCTIONAL HOURS
I	**INTRODUCTION** DefiningVirtualReality,HistoryofVR-HumanPhysiologyandPerception - Key Elements of Virtual Reality Experience - Virtual Reality System – Interface to the VirtualWorld-Input & output-Visual,Aural&Haptic Displays,Applications & representation of VirtualReality-Study about unity3D–UE4.–3DxMax&Maya–Skecthup	9
II	**BASICSOFMODELLING&REPRESENTATION** Geometric modeling - kinematics modeling - physical modeling - behaviormodeling – model management. Representation of the Virtual World - VisualRepresentation in VR -Aural Representation in VR - Haptic RepresentationinVR.	9
III	**HUMANFACTORS** Introduction-Changing Position and Orientation,Axis-Angle Representations of Rotation,ViewingTransformations-ChainingtheTransformations - Human Eye - eye movements & implications for VR –Interaction: Motor Programs and Remapping, Locomotion, Manipulation,Social Interaction. Audio -The Physics of Sound, The Physiology of Human Hearing,Auditory Perception,Auditory Rendering.	9
IV	**MOTION TRACKING** Motion in Real and Virtual Worlds-Velocities and Accelerations,The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection.Tracking-Tracking2D&3DOrientation,TrackingPositionand Orientation,Tracking Attached Bodies.	9

| V | **CLINICALAPPLICATIONS**
Medical and Surgical training–Pain Management–Physical Therapy management– Health Educations–Image guided surgery–Pre&Postope planning–3D modelling-Diagnostic Applications | 9 |

TOTAL INSTRCTIONAL HOURS **45**

CO1: understand about basics of Virtual reality

CO2:Understand the design and implementation of the modeling & Implementation.

CO3:Understand the system of human vision

CO4:Explain theconcepts of motion and tracking in VR systems.

CO5:detail about system description of Medical Applications

TEXT BOOKS

1. M. LaValle,"Virtua l Reality, Steven",CambridgeUniversityPress,2016

2. William R Sherman and Alan B Craig, " Understanding Virtual Reality", Interface,Application and Design, , (The Morgan Kaufmann Series in Computer Graphics)".MorganKaufmannPublishers,SanFrancisco,CA,2002

3. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications:Foundations of Effective Design",MorganKaufmann,2009.

REFERENCE

1. Surgical Scene GenerationForVirtual Reality-BasedTraining In Medicine Edition2008 by HardersM,SPRINGER

2. **Riener**,Robert,**Harders**,Matthias,Virtual reality in medicine,2015

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	CourseCode	NameoftheCourse	L	T	P	C
B.E/B.Tech	19BM8308	**BIOPHOTONICS**	3	0	0	3

CourseO bjective

1. Understand Optics principle.
2. Understand Light-matter interactions.
3. Learn Optical Imaging
4. Learn Optical Imaging in biomedical.
5. Understand various applicatons of optical biosensors.

Unit	Description	Instructional Hours
I	**IntroductoryOptics.** Geometric,Wave,EM and QuantumPicture of Light.Concept of phase, Polarization and coherence.Diffraction and Interference	9
II	**Light-matterinteractions.** Energy level picture of materials.Photons, Photoelectric effect, Interaction of photons with materials.Phosphorescence and fluorescence.Stimulatedemissionof photons.Principle of laser action.Laser types and applications (CW, Pulsed,Ultra-fast,Solidstate,Gas,Dye …). Spectroscopy:Types and applications (UV-Vis, Infrared, Raman, FTIR…).	9
III	**OpticalImaging I.** Basic imagingtheory,concept of diffraction limit.Optical microscope.Methodsforcontrast-generation(Dark-field,Phasecontrast,DIC,Polarization).Fluorescence microscopy.Fluorescence techniques (FRET, FLIM,FRAP, FCS …). Nanoparticle fluorescence.3D sectioning: Confocal and multi-photon imaging. Advanced Topics.Nanoparticle fluorescence. Super-resolutiontechniques (STED, STEM, STORM, PALM …).Super-resolution imagereconstructionmethods.	9
IV	**OpticalImagingII.** Biomedical(PhysiologicalImaging).Light Scatteringphenomena.Tomographic techniques:OCT.Image reconstruction techniques	9
V	**Other applications.** Optical biosensors.Optical manipulation of biological materials.Optical tweezers.Laser dissection and surgery.Neural excitation.	9
	TotalInstructionalHours	**45**

CO1:Discuss Optics principle.

Course CO2:Describe Light-matterinteractions.

Outcome CO3:Analyze Optical Imaging

CO4:Apply Optical Imaging in biomedical.

CO5:Apply new applications of optical biosensors

TEXTBOOKS:

1.BahaaSaleh and MalvinTeich,*Fundamentals of Photonics*,Wiley&Sons(2002).

2.Paras N .Prasad ,*Introduction to Biophotonics,*Wiley&Sons(2003).

REFERENCES:

P.N.Prasad,IntroductiontoBiophotonics,Wiley,2003

J.R.Lakowicz,Principles of fluorescence spectroscopy,3rd edition,Springer,2006

J.Mertz,Introduction to optical microscopy,Roberts&Co.Publishers,2009.

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DEAN ACADEMICS

Programme	Course Code	Name of the Course	L	T	P	C
BE	19BM8309	**TELEMEDICINE**	3	0	0	3

Course Objective
1. To study about telemedicine and telehealth and telecare techniques.
2. To understand the different type of information and standards used in telemedicine.
3. To understand the applications in the field of telemedicine.
4. To understand the use of internet in telemedicine.
5. To understand the ethical and legal aspects in telemedicine.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Definitions of telemedicine telehealth and telecare. History of telemedicine: Main phases of telemedicine Pre electronic telemedicine Electronic telemedicine Technical Requirements.	9
II	**TYPE OF INFORMATION AND STANDARDS** Type of information and standards, audio, data, Fax, Video Types of communications and networking- networking architecture, POTS, ISDN, ATM Other Fixed networks, Air/aireless communications.- RF,Microwaves, Satellite, GSM, CDPD (Cellular Digital Packet Data) Acquisition/ displays: Acquisition systems Cameras, Scanners, Other medical specialized acquisition system	9
III	**APPLICATIONS** Telemedicine applications- Basic parts of a teleradiography system- Telepathology- Telecytology- Telecardiology- Teleoncology- Teledermatology- Telesurgery, telepsychiatry	9
IV	**INTERNET IN TELEMEDICINE** Internet in telemedicine 1) The internet 2) Basic concepts 3) Security – secure socket layer – Firewalls – proxies. Personal Communication , Medical data sharing needs for telemedicine- -Internet problems Distant training, teleworking and telecasting.	9
V	**ETHICAL AND LEGAL ASPECTS** Ethical and legal aspects of telemedicine-confidentiality, patient rights and consent-ehtical and legal aspects of internet-telemedical malpractice. Constraints for the wide spread use of telemedicine-constraints linked to economy, social	9

acceptance Strategic planning for telemedicine implementation

Total Instructional Hours   45

	CO1	Understand the concepts of telemedicine, telehealth and telecare.
	CO2	Acquire knowledge in different types of information and standards used in telemedicine.
Course		
Outcome	CO3	Understand the applications of telemedicine.
	CO4	Explain the use of internet in telemedicine
	CO5	Learn the ethical and legal aspects in telemedicine.

TEXT BOOKS:

1. Olga (EDT), Ferrer – Roca, M. Sosa (EDT), Marcelo C, *Handbook of telemedicine*, IOS Press 2003.

2. A. C. Norris *Essentials of Telemedicine and Telecare*, John Wiley & Sons 2002.

REFERENCE BOOKS:

1. Ling Guan, *Multimedia image and video processing*, CRC Press 2000

2. Thorsten M Buzug, Heinz Handels, Dietrich Holz, *Telemedicine: Medicine and Communication*", Springer Verlag 2001

3. Douglas V.Goldstein, " *E Healthcare: Harness the power of Internet, e-commerce and e-care"*, Jones and Barlett Publishers

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	Course Code	Name of the Course	L	T	P	C
BE	19BM8310	BIOMETRIC SYSTEMS	3	0	0	3

Course Objective

1. To understand the technologies of fingerprint, iris, face and speech recognition
2. To understand the general principles of design of biometric systems and the underlying trade-offs.
3. To recognize personal privacy and security implications of biometrics based identification technology.
4. To identify issues in the realistic evaluation of biometrics based systems.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO BIOMETRICS** Introduction and back ground – biometric technologies – passive biometrics – active biometrics - Biometrics Vs traditional techniques – Benefits of biometrics - Operation of a biometric system– Key biometric processes: verification, identification and biometric matching – Performance measures in biometric systems: FAR, FRR, FTE rate, FTA rate and rate- Need for strong authentication – Protecting privacy and biometrics and policy – Biometric applications	9
II	**FINGERPRINT IDENTIFICATION TECHNOLOGY** Fingerprint Patterns, Fingerprint Features, Fingerprint Image, width between two ridges - Fingerprint Image Processing - Minutiae Determination - Fingerprint Matching: Fingerprint Classification, Matching policies.	9
III	**FACE RECOGNITION** Introduction, components, Facial Scan Technologies, Face Detection, Face Recognition, Representation and Classification, Kernel- based Methods and 3D Models, Learning the Face Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition.	9
IV	**VOICE SCAN** Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NIST Speaker Recognition Evaluation Program, Biometric System Integration.	9
V	**FUSION IN BIOMETRICS** Introduction to Multibiometric - Information Fusion in Biometrics - Issues in Designing a Multibiometric System - Sources of Multiple Evidence - Levels of Fusion in Biometrics - Sensor level, Feature level, Rank level, Decision level fusion - Score level Fusion. Examples – biopotential and gait based biometric systems.	9
	Total Instructional Hours	**45**

Course Outcome		
	CO1	Understand the basic technologies used in biometric systems
	CO2	Acquire knowledge the most common abstractions for data collections

(e.g., stacks, queues, lists).

CO3   Use non linear data structures such as trees to solve problems. .

CO4   Apply Graph algorithms to find the shortest path cost

CO5   Apply Algorithms for solving problems like sorting and searching.

TEXT BOOKS:

1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, ―Biometric Systems, Technology Design and Performance Evaluation‖, Springer, 2005.

2. David D. Zhang, ―Automated Biometrics: Technologies and Systems‖, Kluwer Academic Publishers, New Delhi, 2000.

REFERENCE BOOKS:

1. Paul Reid, ―Biometrics for Network Security‖, Pearson Education, 2004.
2. Nalini K Ratha, Ruud Bolle, ―Automatic fingerprint Recognition System‖, Springer, 2003
3. L C Jain, I Hayashi, S B Lee, U Halici, ―Intelligent Biometric Techniques in Fingerprint and Face Recognition‖ CRC Press, 1999.
4. John Chirillo, Scott Blaul, ―Implementing Biometric Security‖, John Wiley, 2003.

TEXTBOOKS:

1. JamesWayman, AnilJain, DavideMaltoni, DarioMaio, ―BiometricSystems,TechnologyDesignandPerformanceEvaluation‖,Springer,2005.

2. DavidD.Zhang,―AutomatedBiometrics:TechnologiesandSystems‖,Kluwer AcademicPublishers, NewDelhi,2000.

REFERENCEBOOKS:

1. PaulReid, ―BiometricsforNetworkSecurity‖, PearsonEducation, 2004.
2. NaliniKRatha,RuudBolle, ―AutomaticfingerprintRecognitionSystem‖, Springer, 2003
3. LCJain, IHayashi, S BLee, UHalici, ―IntelligentBiometricTechniquesinFingerprintandFaceRecognition‖CRCPress,1999.
4. JohnChirillo,ScottBlaul, ―ImplementingBiometricSecurity‖,JohnWiley,2003.

CHAIRMAN-BOS   **DEAN ACADEMICS**

OPEN ELECTIVES

Programme	Course Code	Name of the Course	L	T	P	C
BE	19BM6401	**APPLICATIONS OF BIOMEDICAL ENGINEERING**	3	0	0	3

Course Objective	9. To elucidate the recent advancements in the fields of biomedical computing. 10. To gain knowledge about fiber optics and lasers application in biomedical application 11. Knowing how IoT and Biometrics is important in Healthcare. 12. Knowing about the use of robotics in Healthcare.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO BIOMEDICAL ENGINEERING** Introduction to biomedical engineering, Role of biomedical engineers, Major players in biomedical engineering equipment's	9
II	**BIOMEDICAL INSTRUMENTS** Diagnostic and therapeutic devices like ECG,EEG,EMG, Patient monitoring, Ventilator	6+(3)P
III	**FIBER OPTICS AND LASER INSTRUMENTATION** Fiber optic sensors, fiber optic communication and instrument system, Biomedical applications of optical sensor, Types of lasers, Lasers and tissue interaction, Laser instruments for micro surgery, removal of tumors of vocal cords, plastic surgery, dermatology.	6+(3)P
IV	**IoT and BIOMETRICS in healthcare** Applications of IoT in healthcare, Various recognition systems and its applications in healthcare.	6+(3)P

	ROBOTICS IN HEALTHCARE	
V	Robots in surgeries, Augmenting human abilities, Nano bots inside body, Future healthcare and Robots.	9

Total Instructional Hours   45

CO1	Understand the various perspectives of biomedical engineering.
CO2	Understand the concept of medical instruments in healthcare
CO3	Understandingfiber optics and laser used in the field of health care
CO4	Understand the concepts of IoT and Biometrics in healthcare
CO5	Understand the concepts of Robotics in healthcare.

TEXT BOOKS:
1. Nagrath and Mittal, "Robotics and Control", Tata McGraw Hill, 2018.
2. John G. Webster, ―Medical Instrumentation Application and Design, 5th edition, Wiley India Pvt Ltd,New Delhi, 2020.
3. Joseph D. Bronzino, Donald R. Peterson, "The Biomedical Engineering Handbook", 4th edition, CRC Press, 2015.
4. Kirill Lazarev, "Internet of things for Personal Healthcare.studies of application, motivation and audience of e-health secor", Smart wearable design, December 2016.
5. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, ―Biometric Systems, Technology Design and Performance Evaluation‖, Springer, 2015.

REFERENCES:
1. Khandpur R.S, ―Handbook of Biomedical Instrumentation‖, 3rdedition,Tata McGraw-Hill, New Delhi, 2014.
2. Leslie Cromwell, ―Biomedical Instrumentation and measurement‖, 2nd edition, Prentice hall of India, New Delhi, 2015.
3. Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques‖, Prentice Hall of India, 1stedition, 2016.

CHAIRMAN-BOS   **DEAN ACADEMICS**

Programme	Course Code	Name of the Course	L	T	P	C
BE	19BM7401	**FIRST AID IN EMERGENCY CARE**	3	0	0	3

Course Objective

1. To study about introduction of first aid
2. To understand about emergency first aid
3. To gain a knowledge in First Aid Techniques
4. To learn about emergency equipment
5. To study about healthcare technologies

Unit	Description	Instructional Hours
I	**INTRODUCTION TO FIRST AID** First aider - First aid priorities- Managing incident - Traffic accident – Fires – Clothing on Fire - Electrical Incidents-low and high Voltage current – Lighting- Water Incidents- Water recue	9
II	E**MERGENCY FIRST AID** Action in an Emergency-Chest compression only CPR- CPR for adult - CPR for child- CPR for infant- Heart attack- Stroke – Asthma – Head Injuries.	9
III	**FIRST AID TECHNIQUES** Removing head gear- First aid Material – Dressing – Types of Dressing – Principles of Bandaging – Roller bandages – Hand Bandages – Hand and Foot cover –Arm Sling	9
IV	**EMERGENCY EQUIPMENT** Patient Monitor – Sphygmomanometer – Pulse oximeter- Heart rate monitor- Defibrillators – Ventilator – ECG.	9
V	**HEALTHCARE TECHNOLOGIES** Introduction to mhealth – heathcare 3.0 – IoT in health care – Medical IoT devices – Remote Patient Monitoring – Depression Monitoring.	9

Total Instructional Hours   **45**

Course Outcome	**CO1:** Explain the Introduction to First aid.
	CO2: Familiar with emergency First aid.
	CO3: Discuss about First aid technologies.
	CO4: Explain the emergency equipment.
	CO5: Discuss about the various healthcare technologies.

TEXT BOOKS:

T1 The authorized manual of St. John Ambulance, St. Andrew's Ambulance association and the British red cross society, First Aid manual, 9th edition, Dorling Kindersley, London
T2 American college of emergency physicians, First Aid manual, 5th edition, Dorling Kindersley, London

REFERENCE BOOKS:

R1 Clement Text book on First Aid & Emergency Nursing, First edition, JP brothers, 2012

R2 Philip Jevon, Emergency care and First Aid for Nurses, A practical guide, Churchill Living Stone, 2007

R3 Mahadevan, Swaminatha V., and Gus M. Garmel. An introduction to clinical emergency medicine: guide for practitioners in the emergency department. Cambridge University Press, 2005

CHAIRMAN-BOS   **DEAN ACADEMICS**

DEPARTMENT OF BIOMEDICAL ENGINEERING

ACADEMIC YEAR 2022-2023

REGULATION 2022

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	PS03
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 : 22PH1151/PHYSICS FOR NON CIRCUIT ENGINEERING

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	1	1	-	1	-	2	3	3	2	1
CO2	3	3	2	2	1	1	1	-	1	-	2	2	3	1	1
CO3	3	3	2	2	2	1	1	-	1	-	1	2	2	2	2
CO4	3	2	3	1	3	1	1	-	1	-	1	2	2	1	1
CO5	3	2	3	1	2	1	1	-	1	-	2	2	2	1	1
Avg	3	2.6	2.6	1.6	2.2	1	1	-	1	-	1.6	2.2	2.4	1.4	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	1
Avg	2	1	-	-	1	1	1.6	2.2	2.4	3	1	1.2	1	2	1

Semester – II

Course Code & Name: 22MA2103-Fourier Analysis and Z Transforms

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

Course Code & Name: 22CY2101 Environmental Studies

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

Course Code & Name: 22PH2101 Basics of Material Science

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

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

Course Code & Name: 22CS2154 Essentials of C&C++ Programming

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

Course Code & Name: 22PH2151 Physics For Circuit Engineering

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

Course Code & Name: 22ME2001 Engineering Practices

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

Semester – III

Course Code & Name: 21MA3102 Fourier Analysis and Transforms

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	3	3	2	-	-	-	-	-	-	2	2	2	1

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

Course Code & Name:21BM3201 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:21BM3202 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: 21BM3203 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:21BM3251 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:21BM3001 Electron Devices and Circuits Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO	PSO	PSO3

PO& PSO												1	2	
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:21BM3002 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

Semester – IV

Course Code & Name:21BM4201 Linear Integrated Circuits

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	2	1	1	-	-	-	-	-	-	2	2	1	1
CO4	1	1	1	1	1	-	-	-	-	-	-	1	2	1	1
CO5	1	1	2	1	-	-	-	-	-	-	-	2	2	1	2
Avg	1	1	1	1	1	-	-	-	-	-	-	2	2	1	1

Course Code & Name:21BM4202 Bio MEMS and Nanotechnology

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

Course Code & Name:21BM4203 Pathology and Microbiology

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	-	-	-	-	-	-	-	1	1	1	2	2
CO2	1	1	2	3		1	-	-	-	-		1	1	1	1
CO3	1	3	3	-	-	-	-	-	3	1	2	2	3	2	1
CO4	1	1	2	-	-	-	-	-	-	-	-	1	1	1	1
CO5	1	3	3	3		2	-	-	3	1	2	2	3	3	1
Avg	1	2	2	1		1	-	-	1	0	1	1	2	2	1

Course Code & Name:21MA4152 Statistics and Numerical Methods

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	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: 21BM4251 Sensors and Measurement

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	-	-	-	-	-	1	1	1	-	1	1	1	1
CO2	3	-	-	-	-	-	-	1	1	1	-	1	1	1	1
CO3	3	-	-	-	-	-	-	1	1	1	-	1	1	1	1
CO4	3	-	-	-	-	-	-	1	1	1	-	1	1	1	1
CO5	3	-	-	-	-	-	-	1	1	1	-	1			1
Avg	3	0	-	-	-	-	-	1	1	1	-	1	1	1	1

Course Code & Name: 21BM4001 Integrated Circuits lab

PO& PSO	PO1	PO2	PO 3	PO 4	PO 5	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	1	3	1
Avg	3	0	1	1	0	-	-	-	3	-	-	1	0	3	1

Course Code & Name: 21BM4002   Human Physiology 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	-	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: 19BM5201 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: 19BM5202 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:19BM5203 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:19BM5204 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: 19BM5251 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

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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	PO10	PO11	PO12	PSO1	PSO2	PSO3
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:19BM5002 Biomedical Instrumentation Lab

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

SEMESTER VI

Course Code & Name:19BM6201 Biosignal Processing

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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: 19BM6202 Radiological Equipment's and nuclear Medicine

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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	3	1

Course Code & Name: 19BM6203 Entrepreneurship Development

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

Course Code & Name:19BM6251 Diagnostic   and Therapeutic Equipment-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	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	-	-	-	-	-	-	-	-	-	3	1
Avg	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1

Course Code & Name:19BM6001 Biosignal 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	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	-	-	-	-	-	-	-	2	3	3	1
Avg	3	0	1	1	0	-	-	-	3	-	-	1	1	3	1

SEMESTER VII

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 Therapeutic Equipment 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

Course Code & Name:19BM8901 Project Work – Phase 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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Avg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1

PROFESSIONAL ELECTIVE I

Course Code & Name: 19BM5301 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:19BM5302 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:19BM5303 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: 19BM5304 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: 19BM5305 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 II

Course Code & Name: 19BM6301 Biomaterial and Artificial Organs

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:19BM6302 Embedded Systems in Medical Devices

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	-	1	1	-	-	-	3	-	3	-	-	-	-	1
CO2	2	-	3	-	-	-	-	3	-	1	-	1	-	-	1
CO3	2	-	3	-	-	-	-	3	-	1	-	1	-	-	1
CO4	2	-	3	-	-	-	-	3	-	1	-	-	-	-	1
CO5	-	-	3	-	-	-	-	1	-	1	-	-	-	-	1
Avg	2	-	3	0	-	-	-	3	-	1	-	1	-	-	1

Course Code & Name:19BM6303 Biomedical Waste 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	2	1	-	-	-	-	-	-	3	-	-	-	-	1
CO2	1	2	3	-	-	-	-	-	-	1	-	1	-	-	1
CO3	1	2	3	-	-	-	-	-	-	1	-	1	-	-	1

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO4	2	1	3	-	-	-	-	-	-	1	-	-	-	-	1
CO5	1	1	3	-	-	-	-	-	-	1	-	-	-	-	1
Avg	1	2	2	-	-	-	-	-	-	1	-	1	-	-	1

Course Code & Name: 19BM6304 Physiological Modelling

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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	2	-	-	-	-	-	-	2	-	-	2
CO3	2	1	-	-	0	-	-	1	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO5	-	-	-	-	-	-	-	1	-	-	-	1	-	-	2
Avg	2	1	-	-	0	-	-	1	-	-	-	1	-	-	1

Course Code & Name:19BM6305 Artificial Neural Networks

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	1
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	1
Avg	1	1	0	0	-	0	-	-	-	-	-	2	2	1	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
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	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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

PROFESSIONAL ELECTIVE IV

Course Code & Name: 19BM8301 Biofluids and Dynamics

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

Course Code & Name:19BM8302 Artificial Intelligence 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	3	1	-	-	-	-	-	-	-	-	1	-	-	-	1
CO2	3	2	3	-	-	-	1	-	-	-	1	-	3	-	1
CO3	3	2	3	-	-	-	3	-	-	-	1	-	3	-	1
CO4	3	-	2	-	-	-	2	-	-	-	3	-	2	-	1
CO5	3	-	-	-	-	-	-	-	-	-	3	-	-	-	1
Avg	3	1	2	-	-	-	1	-	-	-	2	-	2	-	1

Course Code & Name:19BM8303 Medical Informatics

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	-	1	-	3	-	1
CO2	-	1	-	3	-	1	-	-	2	-	2	-	3	-	1
CO3	-	-	-	3	-	-	-	-	3	-	1	-	3	-	1
CO4	-	1	-	3	-	1	-	-	2	-	-	-	3	-	1
CO5	-	1	-	3	-	-	-	-	-	-	-	-	1	-	1
Avg	-	1	-	3	-	0	-	-	2	-	1	-	3	-	1

Course Code & Name:19BM8304 Wearable Medical Devices

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

Course Code & Name:19BM8305 Cardiovasular Engineering

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	-	2	-	-	3	-	-	2	-	2	-	1
CO2	-	-	3	-	2	-	-	3	-	-		-	-	-	1
CO3	2	-	3	-	2	-	-	3	-	-	1	-	-	-	1
CO4	2	-	1	-	2	-	-	-	-	-		-	-	-	1
CO5	-	-	-	-	2	-	-	1	-	-	2	-	-	-	1
Avg	1	-	2	-	2	-	-	2	-	-	1	-	0	-	1

<div align="center">

PROFESSIONAL ELECTIVE V

</div>

Course Code & Name:19BM8306 Rehabilitation Engineering

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

Course Code & Name:19BM8307 Virtual Reality in Medicine

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

Course Code & Name:19BM8308 Biophotonics

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

Course Code & Name:19BM8309 Telemedicine

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	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	-	-	-	-	-	-	-	-	-	-	-
Avg	1	1	1	1	1	-	-	-	-	-	-	1	2	1	1

Course Code & Name:19BM8310 Biometric Systems

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

OPEN ELECTIVES

Course Code & Name: 19BM6401 Applications of Biomedical Engineering

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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	2	1

Course Code & Name:19BM7401 First Aid In Emergency Care

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS03
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	-	-	-	-	-	-	2	2	1	1

Mapping of Course Outcome and Programme Outcome:

Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	I	22MA1101 & Matrices And Calculus	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2	
		22PH1151 & Physics For Non Circuit Engineering	3	2.6	2.6	1.6	2.2	1	1	-	1	-	1.6	2.2	2.4	1.4	1
		22CY1151& Chemistry For Circuit Engineering	2	2.6	2.6	1.4	1.4	1	1	-	1	-	1.2	2	-	1	1

	Sem	Course															
		22HE1151 & English For Engineers	2	1	-	-	1	1	1.6	2.2	2.4	3	1	1.2	1	2	1
	II	22MA2103 & Fourier Analysis and Z Transforms	3	3	3	3	3	-	-	-	-	-	-	2	2	1	1
		22CY2101 & Environmental Studies	2	1	2	-	-	1	2	3	2	-	-	2	-	-	1
		22PH2101 Basics of Material Science	3	2	1	2	2	1	2	-	-	-	-	-	2	1	1
		22CS2154 Essentials of C&C++ Programming	3	1	1	-	-	-	-	-	3	-	-	-	-	2	-
		22PH2151 Physics For Circuit Engineering	3	2	3	2	3	-	2	-	-	-	-	-	1	1	1
		22ME2001 Engineering Practices	3	-	3	-	3	-	-	-	1	-	-	-	1	2	1
	III	21MA3102 Fourier Analysis and Transforms	3	3	3	3	3	-	-	-	-	-	-	2	2	1	1
		21BM3201 Electron Devices and Circuits	2	1	2	1	-	-	-	-	-	-	-	-	0	2	1
		21BM3202 Medical Biochemistry	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1
		21BM3203 Human Anatomy and physiology	1	1	1	1	1	-	-	-	-	-	-	2	2	1	1
		21BM3251 Digital Electronics	2	2	2	2	2	0	1	1	1	1	2	1	0	2	1
		21BM3001 Electron Devices and Circuits Laboratory	3	0	1	-	-	-	-	-	3	-	-	-	1	2	1
		21BM3002 Biochemistry Laboratory	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1
	IV	21BM4201	1	1	1	1	1	-	-	-	-	-	-	2	2	1	1

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Linear Integrated Circuits															
	21BM4202 Bio MEMS and Nanotechnology	2	2	2	-	-	-	-	-	-	-	-	-	2	2	1
	21BM4203 Pathology and Microbiology	1	2	2	1		1	-	-	1	0	1	1	2	2	1
	21MA4152 Statistics and Numerical Methods	3	3	3	2	2							2	2	2	1
	21BM4251 Sensors and Measurement	3	3	3	2	2	-	-	-	-	-	-	2	2	2	1
	21BM4001 Integrated Circuits lab	3	0	1	1	0	-	-	-	3	-	-	1	0	3	1
	21BM4002 Human Physiology Laboratory	3	0	1	1	0	-	-	-	3	-	-	1	1	3	1
V	19BM5201Biocontrol systems	2	2	-	1	-	-	-	-	-	-	-	-	1	1	1
	19BM5202Biomechanics	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1
	19BM5203Microprocessors and Microcontrollers	2	1	1		1	-	-	-	-	-	-	-	2	2	1
	19BM5204Biomedical Instrumentation	1	1	0	0	-	0	-	-	-	-	-	-	2	1	1
	19BM5251Virtual Instrumentation using LabVIEW	1	1	0	0		0	-	-	-	-	-	2	2	1	1
	19BM5001Microprocessors and Microcontrollers Lab	3	0	1	1	0	-	-		3	-	-	1	1	3	1
	19BM5002Biomedical Instrumentation Lab	3	0	1	1	0	-	-	-	3	-	-	1	1	3	1
	19BM6201Biosignal Processing	-	1	2	2	1	-	1	-	-	1	0	1	1	2	2
VI	19BM6202Radiological Equipments and nuclear Medicine	2	1	2	1	-	0	-	-	-	-	-	-	1	3	1
	19BM6203Entrep	-	-	-	-	1	1	-	-	2	2	3	-	-	-	1

		Course															
		reneurship Development															
		19BM6251Diagnostic and TherapeuticEquipment-I	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1
		19BM6001Biosignal Processing Laboratory	3	0	1	1	0	-	-	-	3	-	-	1	1	3	1
	VII	19BM7201Diagnostic and TherapeuticEquipment-II	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1
		19BM7202Medical Image Processing	2	1	2	2	2	-	1	1	1	1	2	2	2	1	1
		19BM7001Image Processing Laboratory	1	1	2	-	2	-	-	-	2	-	-	-	-	-	1
		19BM7002Diagnostic and Therapeutic Equipment Laboratory	3	1	1	1	1	-	-	-	3	-	-	2	2	3	**1**
	PEI	19BM5301Medical Physics	2	2	2	1	-	-	3	2	1	1	-	2	2	1	1
		19BM5302Robotics in Medicine	2	1	3	1	-	0	-	-	-	-	-	1	-	-	1
		19BM5303Total Quality Managements	-	2	1	-	1	-	-	-	-	-	-	-	1	-	1
		19BM5304 Medical Ethics and Standards	1	-	3	-	1	-	-	-	-	2	-	-	1	-	1
		19BM5305 Intellectual Property Right	-	2	1	2	-	-	-	-	1	0	-	2	-	-	1
	PE 2	19BM6301 Biomaterial and Artificial Organs	2	1	2	1	-	0	-	-	-	-	-	1	1	3	1
		19BM6302 Embedded Systems in Medical Devices	2	-	3	0	-	-	-	3	-	1	-	1	-	-	1
		19BM6303 Biomedical Waste Management	1	2	2	-	-	-	-	-	-	1	-	1	-	-	1

		19BM6304 Physiological Modelling	2	1	-	-	0	-	-	1	-	-	-	1	-	-	1
		19BM6305 Artificial Neural Networks	1	1	0	0	-	0	-	-	-	-	-	2	2	1	1
	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
	PE 4	19BM8301 Biofluids and Dynamics	1	-	2	2	-	-	1	-	2	-	-	2	-	1	1
		19BM8302 Artificial Intelligence in Healthcare	3	1	2	-	-	-	1	-	-	-	2	-	2	-	1
		19BM8303Medical Informatics	-	1	-	3	-	0	-	-	2	-	1	-	3	-	1
		19BM8304Wearable Medical Devices	1	-	1	-	-	2	1	-	-	1	-	-	-	-	2
		19BM8305 Cardiovasular Engineering	1	-	2	-	2	-	-	2	-	-	1	-	0	-	1
	PE 5	19BM8306 Rehabilitation Engineering	1	1	1	1	1	-	-	-	-	-	1	2	1	1	1
		19BM8307 Virtual Reality in Medicine	1	1	1	1	1	-	-	-	-	-	1	2	1	1	1
		19BM8308 Biophotonics	-	-	-	-	1	1	-	2	2	3	-	-	-	1	1
		19BM8309	1	1	1	1	1	-	-	-	-	-	-	1	2	1	1

		Telemedicine															
		19BM8310 Biometric Systems	2	1	2	-	-	-	-	-	-	-	-	1	2	1	1
OE I	19BM6401 Applications of Biomedical Engineering	2	1	2	1	-	0	-	-	-	-	-	1	1	2	1
OE 2	19BM7401 First Aid In Emergency Care	1	1	1	1	1	-	-	-	-	-	-	2	2	1	1

CHAIRMAN-BOS   **DEAN ACADEMICS**