KPRIET
Learn Beyond

I. Vision and Mission of the Institute

Vision

To become a premier institute of academic excellence by imparting technical, intellectual and professional skills to students for meeting the diverse needs of the industry, society, the nation and the world at large.

Mission

- Commitment to offer value-based education and enhancement of practical skills
- Continuous assessment of teaching and learning process through scholarly activities
- Enriching research and innovative activities in collaboration with industry and institute of repute
- Ensuring the academic process to uphold culture, ethics and social responsibility

II. Vision and Mission of the Department

Vision

Be at the forefront in providing multidisciplinary education in engineering, technology and biological sciences, thereby providing our students, the future engineering professionals with the skills required to develop avant-garde devices and technologies to assist medical professionals in providing exceptional healthcare.

Mission

The Mission of the Department is to

- Establish new teaching paradigms to converge biomedical engineering education to unveil creativity and innovation in clinical health care.
- Build an integrated team of biomedical engineering community to nurture cutting-edge technologies through research and development.
- Collaborate and promote partnership with healthcare industry to enrich employability skills and be in phase with their progress.
- Impart moral values, inculcate ethical behaviors and practice life-learning.

III. Program Educational Objectives (PEOs)

The Program Educational Objectives (PEOs) of the Biomedical Engineering (BM) represent major accomplishments that the graduates are expected to achieve after three to five years of graduation.

PEO1: To enable the graduates to demonstrate their skills in solving challenges in their chosen field through the core foundation and knowledge acquired in engineering and biology.

PEO2: To enable the graduates to exhibit leadership, make decisions with societal and ethical responsibilities, function and communicate effectively in multidisciplinary settings.

PEO3: To ensure that graduates will recognize the need for sustaining and expanding their technical competence and engage in learning opportunities throughout their career.

IV. Program Outcomes (POs)

Graduates of Biomedical Engineering will be able to

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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PO 2 Problem analysis: Identify, formulate, review research literature, and analyze complex Biomedical 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 Biomedical 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 Biomedical engineering activities with an understanding of the limitations.

PO 6 The engineer and society: Apply reasoning informed by the contextual knowledge to access 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.

PO 10 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.

PO 11 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.

PO 12 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.

V. Program Specific Outcomes (PSOs)

Graduates of Biomedical Engineering will be able to

PSO 1: Design and develop diagnostic and therapeutic devices that reducephysician burnout and enhance the quality of life for the end user by applying fundamentals of Biomedical Engineering.

PSO 2: Equip with software skills in developing algorithms for solving healthcare related problems in various fields of medical sector.

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VI. PEO/PO Mapping

Following three levels of correlation should be used:

1: Low

2: Medium

3: High

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	3	3	3	2	2	2	2	2	3	3	2
PEO2	3	3	3	3	3	2	1	2	2	3	3	3
PEO3	3	3	3	3	3	2	2	2	1	3	3	3

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B.E. – BM – R2019 – CBCS

VII. Mapping of Course Outcomes with Program Outcomes

SEM	Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
SEM I	Language Elective I*	-	-	-	-	-	✓	✓	-	✓	✓	-	-	-	-
	Calculus and Differential Equations	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-
	Engineering Physics	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-	-
	Engineering Chemistry I	✓	✓	-	-	-	-	✓	-	✓	✓	-	✓	-	-
	Problem Solving using Python Programming	✓	✓	✓	-	-	-	-	✓	✓	✓	-	✓	-	-
	Engineering Graphics	✓	✓	-	-	✓	-	-	-	-	✓	-	✓	-	-
	Workshop (BME)	✓	✓	-	-	-	✓	-	✓	✓	✓	-	✓	-	-
SEM II	Language Elective II**	-	-	-	-	-	✓	✓	✓	✓	✓	-	✓	-	-
	Complex Variables and Partial Differential Equations	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
	Medical Physics	✓	✓	-	-	✓	✓	-	-	-	✓	-	✓	-	-
	Fundamentals of Biochemistry	✓	✓	-	-	-	-	✓	-	✓	✓	-	✓	-	-
	Computational Thinking	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓	-	-
	Electronic Devices and Circuits	✓	✓	-	-	✓	-	-	✓	✓	✓	-	✓	-	-
	Circuit Theory	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	-	-
SEM III	Transforms and its Applications	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-
	Biomedical Sensors and Measurements	✓	✓	✓	-	✓	✓	-	-	-	-	-	✓	✓	-
	Human Anatomy and Physiology	✓	✓	-	-	-	✓	-	-	-	-	-	✓	✓	-
	Signals and Systems	✓	✓	✓	✓	✓	-	-	✓	✓	✓	-	✓	-	✓
	Linear Integrated Circuits	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	✓	-
	Data Structures	✓	✓	✓	✓	-	-	-	✓	✓	✓	-	-	-	-
	Human Anatomy and Physiology Laboratory	✓	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓	✓	-
	Sensors and Transducers Laboratory	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓
	Linear Integrated Circuits Laboratory	✓	✓	✓	-	✓	-	-	✓	✓	✓	✓	✓	✓	✓

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SEM IV	Probability and Statistics	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	-	-
	Digital Logic Design	✓	✓	✓	-	-	-	-	✓	✓	✓	-	-	✓	-
	Microbiology and Pathology	✓	✓	-	-	-	✓	-	-	-	-	-	✓	✓	-
	Biomedical Instrumentation	✓	✓	✓	✓	✓	✓	-	✓	-	-	-	✓	✓	✓
	Object Oriented Programming and Advanced Data Structures	✓	✓	✓	✓	-	-	-	✓	✓	✓	-	-	-	-
	Microbiology and Pathology Laboratory	✓	✓	✓	-	-	✓	-	✓	✓	✓	✓	✓	✓	-
	Biomedical Instrumentation Laboratory	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓	✓	-
SEM V	Biocontrol Systems	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	✓
	Microprocessor and RISC Architecture	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓	✓	✓
	Biomaterials	✓	✓	✓	-	-	✓	✓	✓	-	-	-	✓	✓	-
	Biosignal Processing	✓	✓	✓	-	✓	✓	-	-	-	-	-	✓	-	✓
	Microprocessor and Microcontroller Laboratory	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓
	Biosignal Processing Laboratory	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓	-	✓
	Technical Seminar	✓	✓	✓	✓	-	✓	-	✓	✓	✓	-	✓	-	-
SEM VI	Diagnostic and Therapeutic Equipment	✓	✓	✓	-	✓	✓	-	-	-	-	-	✓	✓	-
	Biomechanics	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	✓	✓
	Healthcare Management	✓	✓	✓	-	-	✓	✓	✓	-	-	-	-	✓	-
	Diagnostic and Therapeutic Equipment Laboratory	✓	✓	✓	-	-	-	✓	✓	✓	✓	✓	-	✓	-
	Mini Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SEM VII	Radiological Equipment	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓	-
	Medical Image Processing	✓	✓	✓	✓	✓	-	-	✓	-	-	-	✓	-	✓
	Project Management and Entrepreneurship	✓	✓	✓	-	-	✓	✓	✓	✓	-	✓	✓	-	-
	Medical Image Processing Laboratory	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓	-	✓

TRACK I	AI and Machine Learning	✓	✓	✓	-	✓	-	-	-	-	-	-	-	-	-
	Data Mining and Pattern Recognition	✓	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓
	Healthcare Data Analytics	✓	✓	✓	-	✓	-	-	-	-	-	-	-	-	-
	Big Data in Healthcare	✓	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓
	Virtual Reality	✓	✓	✓	-	✓	✓	-	-	-	-	-	-	✓	✓
	Bioinformatics	✓	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓
	Medical Informatics	✓	✓	✓	-	-	✓	-	✓	-	-	-	-	-	-
	Health Telematics & Telemedicine	✓	✓	✓	-	✓	✓	-	✓	-	-	-	-	✓	-
TRACK II	Internet of Medical Things	✓	✓	✓	-	✓	-	-	-	-	-	-	-	-	-
	Robotics in Medicine	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-
	Embedded Systems for Biomedical Engineers	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
	Wearable Technology	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-
	Biophotonics	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
	Electrical Safety and Quality Assurance	✓	✓	✓	-	-	✓	✓	-	-	-	-	-	✓	-
	Comprehension – I	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-
	Comprehension – II	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
TRACK III	Biosensors	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓	-
	Biotechnology for Biomedical Engineers	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
	Ergonomics	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-
	Rehabilitation Engineering	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
	Advanced Biomaterials	✓	✓	✓	-	-	✓	-	-	-	-	-	-	✓	-
	Clinical Research	✓	✓	-	-	-	✓	✓	✓	-	✓	-	-	✓	-
	Medical Textiles	✓	✓	✓	-	-	✓	-	-	-	-	-	-	✓	-
	BioMEMS	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-

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REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR I – VIII SEMESTERS

SEMESTER I

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1		Language Elective I*	HSM	1	0	2	2
2	U19MA101	Calculus and Differential Equations	BS	3	1	0	4
3	U19PH101	Engineering Physics	BS	2	0	2	3
4	U19CY101	Engineering Chemistry I	BS	2	0	2	3
5	U19CSG01	Problem Solving using Python Programming	ES	2	0	2	3
6	U19MEG01	Engineering Graphics	ES	1	0	4	3
PRACTICAL							
7	U19BM101	Workshop (BME)	ES	0	0	4	2
			TOTAL	11	1	16	20

*** U19LE101 - Basic English / U19LE102 - Communicative English**

SEMESTER II

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1		Language Elective II**	HSM	1	0	2	2
2	U19MA202	Complex Variables and Partial Differential Equations	BS	3	1	0	4
3	U19PH201	Medical Physics	BS	3	0	0	3
4	U19CY201	Fundamentals of Biochemistry	BS	2	0	2	3
5	U19CSG02	Computational Thinking	ES	2	0	2	3
6	U19BM201	Electronic Devices and Circuits	ES	2	0	2	3
7	U19BM202	Circuit Theory	ES	2	1	0	3
			TOTAL	15	2	8	21

**** U19LE201 - Advanced Communicative English / U19LE20* - Other languages**

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SEMESTER III

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	U19MA301	Transforms and its Applications	BS	3	1	0	4
2	U19BM301	Biomedical Sensors and Measurements	PC	3	0	0	3
3	U19BM302	Human Anatomy and Physiology	PC	3	0	0	3
4	U19BM303	Signals and Systems	PC	2	0	2	3
5	U19BM304	Linear Integrated Circuits	PC	3	0	0	3
6	U19EC305	Data Structures	ES	2	0	2	3
PRACTICALS							
7	U19BM305	Human Anatomy and Physiology Laboratory	PC	0	0	2	1
8	U19BM306	Sensors and Transducers Laboratory	PC	0	0	2	1
9	U19BM307	Linear Integrated Circuits Laboratory	PC	0	0	4	2
			TOTAL	16	1	12	23

SEMESTER IV

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	U19MA401	Probability and Statistics	BS	3	0	0	3
2	U19BM401	Digital Logic Design	PC	2	0	2	3
3	U19BM402	Microbiology and Pathology	PC	3	0	0	3
4	U19BM403	Biomedical Instrumentation	PC	3	0	0	3
5	U19EC405	Object Oriented Programming and Advanced Data Structures	ES	2	0	2	3
6	U19CA001	Numerical Aptitude and Verbal Ability I	EEC	1	0	0	1
PRACTICALS							
7	U19BM404	Microbiology and Pathology Laboratory	PC	0	0	4	2
8	U19BM405	Biomedical Instrumentation Laboratory	PC	0	0	2	1
			TOTAL	14	0	10	19

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SEMESTER V

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1	U19BM501	Biocontrol Systems	PC	3	0	0	3
2	U19BM502	Microprocessor and RISC Architecture	PC	3	0	0	3
3	U19BM503	Biomaterials	PC	3	0	0	3
4	U19BM504	Biosignal Processing	PC	3	0	0	3
5	-	Professional Elective I	PE	3	0	0	3
6	-	Open Elective I	OE	3	0	0	3
7	U19CA002	Numerical Aptitude and Verbal Ability II	EEC	1	0	0	1
		PRACTICALS					
8	U19BM505	Microprocessor and Microcontroller Laboratory	PC	0	0	4	2
9	U19BM506	Biosignal Processing Laboratory	PC	0	0	2	1
10	U19BM507	Technical Seminar	EEC	0	0	2	1
			TOTAL	19	0	8	23

SEMESTER VI

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1	U19BM601	Diagnostic and Therapeutic Equipment	PC	3	0	0	3
2	U19BM602	Biomechanics	PC	3	0	0	3
3	U19BM603	Healthcare Management	HSM	3	0	0	3
4	-	Professional Elective II	PE	3	0	0	3
5	-	Professional Elective III	PE	3	0	0	3
6	-	Open Elective II	OE	3	0	0	3
		PRACTICALS					
7	U19BM604	Diagnostic and Therapeutic Equipment Laboratory	PC	0	0	4	2
8	U19BM605	Mini Project	EEC	0	0	2	1
			TOTAL	18	0	6	21

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SEMESTER VII

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	U19BM701	Radiological Equipment	PC	3	0	0	3
2	U19BM702	Medical Image Processing	PC	3	0	0	3
3	U19BM703	Project Management and Entrepreneurship	HSM	3	0	0	3
4	-	Professional Elective IV	PE	3	0	0	3
5	-	Open Elective III	OE	3	0	0	3
6	-	Open Elective IV	OE	3	0	0	3
PRACTICAL							
7	U19BM704	Medical Image Processing Laboratory	PC	0	0	4	2
			TOTAL	18	0	4	20

SEMESTER VIII

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	-	Professional Elective V	PE	3	0	0	3
2	-	Professional Elective VI	PE	3	0	0	3
PRACTICAL(S)							
3	U19BM801	Project Work	EEC	0	0	20	10
			TOTAL	6	0	20	16

INDUSTRIAL INTERNSHIP

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19BMI01	Industrial Training / Internship* (4 Weeks)	EEC	0	0	0	2
			TOTAL	0	0	0	2

*Four Weeks during any semester vacation from III to VI Semester

TOTAL CREDITS: 165

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PROFESSIONAL ELECTIVES (PE)

TRACK – I

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19BMP01	AI and Machine Learning	PE	3	0	0	3
2	U19BMP02	Data Mining and Pattern Recognition	PE	3	0	0	3
3	U19BMP03	Healthcare Data Analytics	PE	3	0	0	3
4	U19BMP04	Big Data in Healthcare	PE	3	0	0	3
5	U19BMP05	Virtual Reality	PE	3	0	0	3
6	U19BMP06	Bioinformatics	PE	3	0	0	3
7	U19BMP07	Medical Informatics	PE	3	0	0	3
8	U19BMP08	Health Telematics and Telemedicine	PE	3	0	0	3

TRACK – II

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
9	U19BMP09	Internet of Medical Things	PE	3	0	0	3
10	U19BMP10	Robotics in Medicine	PE	3	0	0	3
11	U19BMP11	Embedded Systems for Biomedical Engineers	PE	3	0	0	3
12	U19BMP12	Wearable Technology	PE	3	0	0	3
13	U19BMP13	Biophotonics	PE	3	0	0	3
14	U19BMP14	Electrical Safety and Quality Assurance	PE	3	0	0	3
COMPREHENSIVE COURSE							
15	U19BMP15	Comprehension I	PE	3	0	0	3
16	U19BMP16	Comprehension II	PE	3	0	0	3

TRACK – III

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
17	U19BMP17	Biosensors	PE	3	0	0	3
18	U19BMP18	Biotechnology for Biomedical Engineers	PE	3	0	0	3
19	U19BMP19	Ergonomics	PE	3	0	0	3
20	U19BMP20	Rehabilitation Engineering	PE	3	0	0	3
21	U19BMP21	Advanced Biomaterials	PE	3	0	0	3
22	U19BMP22	Clinical Research	PE	3	0	0	3
23	U19BMP23	Medical Textiles	PE	3	0	0	3
24	U19BMP24	BioMEMS	PE	3	0	0	3

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HUMANITIES AND SCIENCES (HSM)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19LE101	Basic English	HSM	1	0	2	2
2	U19LE102	Communicative English	HSM	1	0	2	2
3	U19LE201	Advanced Communicative English	HSM	1	0	2	2
4	U19BM603	Healthcare Management	HSM	3	0	0	3
5	U19BM703	Project Management and Entrepreneurship	HSM	3	0	0	3

BASIC SCIENCES (BS)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19MA101	Calculus and Differential Equations	BS	3	1	0	4
2	U19PH101	Engineering Physics	BS	2	0	2	3
3	U19CY101	Engineering Chemistry I	BS	2	0	2	3
4	U19MA202	Complex Variables and Partial Differential Equations	BS	3	1	0	4
5	U19PH201	Advanced Physics	BS	3	0	0	3
6	U19CY201	Fundamentals of Biochemistry	BS	2	0	2	3
7	U19MA301	Transforms and its applications	BS	3	1	0	4
8	U19MA401	Probability and Statistics	BS	3	0	0	3

ENGINEERING SCIENCES (ES)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19MEG01	Engineering Graphics	ES	1	0	4	3
2	U19CSG01	Problem Solving using Python Programming	ES	2	0	2	3
3	U19BM101	Workshop (BME)	ES	0	0	4	2
4	U19CSG02	Computational Thinking	ES	2	0	2	3
5	U19BM201	Electronic Devices and Circuits	ES	2	0	2	3
6	U19BM202	Circuit Theory	ES	2	1	0	3
7	U19EC305	Data Structures	ES	2	0	2	3
8	U19EC405	Object Oriented Programming and Advanced Data Structures	ES	2	0	2	3

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PROFESSIONAL CORE (PC)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19BM301	Biomedical Sensors and Measurements	PC	3	0	0	3
2	U19BM302	Human Anatomy and Physiology	PC	3	0	0	3
3	U19BM303	Signals and Systems	PC	2	0	2	3
4	U19BM304	Linear Integrated Circuits	PC	3	0	0	3
5	U19BM305	Human Anatomy and Physiology Laboratory	PC	0	0	2	1
6	U19BM306	Sensors and Transducers Laboratory	PC	0	0	2	1
7	U19BM307	Linear Integrated Circuits Laboratory	PC	0	0	4	2
8	U19BM401	Digital Logic Design	PC	2	0	2	3
9	U19BM402	Microbiology and Pathology	PC	3	0	0	3
10	U19BM403	Biomedical Instrumentation	PC	3	0	0	3
11	U19BM404	Microbiology and Pathology Laboratory	PC	0	0	4	2
12	U19BM405	Biomedical Instrumentation Laboratory	PC	0	0	2	1
13	U19BM501	Biocontrol Systems	PC	3	0	0	3
14	U19BM502	Microprocessor and RISC Architecture	PC	3	0	0	3
15	U19BM503	Biomaterials	PC	3	0	0	3
16	U19BM504	Biosignal Processing	PC	3	0	0	3
17	U19BM505	Microprocessor and Microcontroller Laboratory	PC	0	0	4	2
18	U19BM506	Biosignal Processing Laboratory	PC	0	0	2	1
19	U19BM601	Diagnostic and Therapeutic Equipment	PC	3	0	0	3
20	U19BM602	Biomechanics	PC	3	0	0	3
21	U19BM604	Diagnostic and Therapeutic Equipment Laboratory	PC	0	0	4	2
22	U19BM701	Radiological Equipment	PC	3	0	0	3
23	U19BM702	Medical Image Processing	PC	3	0	0	3
24	U19BM704	Medical Image Processing Laboratory	PC	0	0	4	2

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PROFESSIONAL ELECTIVES (PE)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
PROFESSIONAL ELECTIVES I							
1	U19BMP01	AI and Machine Learning	PE	3	0	0	3
2	U19BMP17	Biosensors	PE	3	0	0	3
3	U19BMP24	BioMEMS	PE	3	0	0	3
4	U19BMP15	Comprehension I	PE	3	0	0	3
PROFESSIONAL ELECTIVES II							
1	U19BMP02	Data Mining and Pattern Recognition	PE	3	0	0	3
2	U19BMP09	Internet of Medical Things	PE	3	0	0	3
3	U19BMP13	Biophotonics	PE	3	0	0	3
4	U19BMP18	Biotechnology for Biomedical Engineers	PE	3	0	0	3
PROFESSIONAL ELECTIVES III							
1	U19BMP03	Healthcare Data Analytics	PE	3	0	0	3
2	U19BMP05	Virtual Reality	PE	3	0	0	3
3	U19BMP11	Embedded systems for Biomedical Engineers	PE	3	0	0	3
4	U19BMP21	Advanced Biomaterials	PE	3	0	0	3
PROFESSIONAL ELECTIVES IV							
1	U19BMP04	Big Data in Healthcare	PE	3	0	0	3
2	U19BMP20	Rehabilitation Engineering	PE	3	0	0	3
3	U19BMP23	Medical Textiles	PE	3	0	0	3
4	U19BMP16	Comprehension II	PE	3	0	0	3
PROFESSIONAL ELECTIVES V							
1	U19BMP07	Medical Informatics	PE	3	0	0	3
2	U19BMP10	Robotics in Medicine	PE	3	0	0	3
3	U19BMP12	Wearable Technology	PE	3	0	0	3
4	U19BMP19	Ergonomics	PE	3	0	0	3
PROFESSIONAL ELECTIVES VI							
1	U19BMP06	Bioinformatics	PE	3	0	0	3
2	U19BMP08	Health telematics and Telemedicine	PE	3	0	0	3
3	U19BMP14	Electrical Safety and Quality Assurance	PE	3	0	0	3
4	U19BMP22	Clinical Research	PE	3	0	0	3

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EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19CA001	Numerical Aptitude and Verbal Ability I	EEC	1	0	0	1
2	U19BM507	Technical Seminar	EEC	0	0	2	1
3	U19CA002	Numerical Aptitude and Verbal Ability II	EEC	1	0	0	1
4	U19BM606	Mini project	EEC	0	0	2	1
5	U19BM801	Project	EEC	0	0	20	10
6	U19BMI01	Industrial Training / Internship (4 Weeks)	EEC	0	0	0	2

VIII. Scheme of Credit distribution – Summary

Sl.No.	Subject Area	Credits as Per Semester								Credits Total	Percentage	Suggested by AICTE
		I	II	III	IV	V	VI	VII	VIII			
1	Humanities and Social Sciences including Management (HSM)	2	2	-	-	-	3	3	-	10	6%	12
2	Basic Sciences (BS)	10	10	4	3					27	16%	25
3	Engineering Sciences (ES)	8	9	3	3					23	14%	24
4	Professional Core (PC)			16	12	15	8	8		59	36%	48
5	Professional Elective (PE)					3	6	3	6	18	11%	18
6	Open Electives (OE)					3	3	6		12	7%	18
7	Employability Enhancement Courses (EEC)				1	2	1		10	14	9%	15
8	Industrial Training/ Internship	-	-	-	-	-	-	-	-	2		
9	Mandatory Non-Credit Course (MNC)	-	-	-	-	-	-	-	-	-	-	-
	Total	**20**	**21**	**23**	**19**	**23**	**21**	**20**	**16**	**165**	**100%**	**165**

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SEMESTER I

U19LE101	BASIC ENGLISH	Category: HSM			
		L	T	P	C
		1	0	2	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To read the text, understand and write the meaning under Technical, Business, Social and Academic contexts.
- To listen and comprehend monologues, dialogues and discussions.
- To speak effectively with appropriate use of words and participate in discussions.

UNIT I BASICS FOR COMMUNICATION 9

Regular & Irregular Verbs – Modal Verbs – Prepositions – Tenses – Subject Verb Agreement – Spotting Errors – Homonyms & Homophones – Phrasal Verbs – Single word substitute – Word formation – Reported Speech

UNIT II LISTENING 9

Listening for specific Information – Listening to short texts – Listening to product description and process – Listening to formal and informal Conversations – Listening to announcements – Listening Comprehension

UNIT III SPEAKING 9

Introducing oneself – Seeking and sharing information – JAM – Enquiry – Asking for clarification – Describing a place, person, process, product and experience – Current affairs – Making presentations

UNIT IV READING 9

Reading for information – Skimming – Scanning – Predicting the content – Reading comprehension – Reading short texts – Proof reading(editing)

UNIT V WRITING 9

Memo – Email – Letter writing (formal and informal) – Dialogue writing – Descriptive writing – Instructions – Filling forms of application - Paraphrasing

LIST OF EXPERIMENTS

1. Listening for information
2. Listening to announcements
3. Listening to stories
4. Song based listening
5. Listening to conversations
6. Self-Introduction
7. Just a Minute
8. Story narration
9. Picture description
10. Movie review

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Contact Periods:

Lecture: 15 Periods Tutorial: – Periods Practical: 30 Periods Total: 45 Periods

TEXT BOOKS:

1. Mindscapes: "English for Technologist and Engineers", Orient BlackSwan, 2014
2. Sudharshana N P and Savitha C, "English for Technical Communication", Cambridge University Press, 2016

REFERENCES:

1. Murphy, Raymond, "Intermediate English Grammar", Cambridge University Press, 2009
2. Means, Thomas L, "English and Communication for Colleges", Cengage 2017
3. "Using English: A Coursebook for Undergraduate Engineers and Technologists" Orient BlackSwan, 2017

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Use appropriate vocabulary required for spoken and written communication	Remember
CO2	Comprehend and answer questions and take part in conversations	Understand
CO3	Participate in discussions and presentations	Apply
CO4	Understand the meaning of the content present in letters, reports and newspaper	Understand
CO5	Draft letters, e-mails and make notes with appropriate use of words	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO2	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO3	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO4	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO5	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO	-	-	-	-	-	2	1	-	3	3	-	-	-	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER I

U19LE102	COMMUNICATIVE ENGLISH	Category: HSM			
		L	T	P	C
		1	0	2	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop the ability to read, write and comprehend various texts.
- To enhance the listening skills to understand conversations and deliberations on diverse contexts.
- To make effective presentations and demonstrate concepts within a team.

UNIT I BASICS FOR COMMUNICATION 9

Active and Passive – Conditionals – Reported speech – Degrees of comparison – Phrases and clauses – Idioms – Kinds of sentences – Connectives and Discourse markers – Purpose statements

UNIT II LISTENING 9

Listening to TED talks – Listening to product description – Listening to orations – Listening to news – Radio based listening

UNIT III SPEAKING 9

Group discussion – Extempore – Technical seminar – Product and process description – Role play – Conversation and etiquettes – Short group conversation – Narrating a story – Formal and informal discussions

UNIT IV READING 9

Pre-reading and Post-reading – Intensive reading – Extensive reading – Newspaper reading – Reading longer texts – Reviewing company profile – Reading strategies – Interpreting visual graphics

UNIT V WRITING 9

Interpreting charts and graphs – Recommendations – Minutes of meeting – Job application and cover letter – Report writing – Drafting circulars (Business contexts)

LIST OF EXPERIMENTS

1. Listening to TED talks
2. Listening to product description
3. Listening to news
4. Radio based listening
5. Listening to oration
6. Self-Introduction
7. Role play
8. Extempore
9. Presentation
10. Group discussion

Contact Periods:

Lecture: 15 Periods Tutorial: – Periods Practical: 30 Periods Total: 45 Periods

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TEXT BOOKS:

1. Mindscapes: English for Technologist and Engineers", Orient BlackSwan, 2014
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REFERENCES:

1. Murphy, Raymond, "Intermediate English Grammar", Cambridge University Press, 2009
2. Means, Thomas L, "English and Communication for Colleges", Cengage 2017
3. "Using English: A Coursebook for Undergraduate Engineers and Technologists" Orient BlackSwan, 2017

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Make use of relevant vocabulary in formal and informal contexts	Apply
CO2	Infer and exhibit the ability to listen various professional interactions	Understand
CO3	Express views and perceptions in a technical forum	Understand
CO4	Interpret a given text and relate the content effectively	Understand
CO5	Frame coherent and cohesive sentences in select contexts	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO2	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO3	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO4	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO5	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO	-	-	-	-	-	2	1	-	3	3	-	-	-	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

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SEMESTER I

U19MA101	CALCULUS AND DIFFERENTIAL EQUATIONS (Common to all Branches)	Category: BS			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of matrices and calculus which will enable them to model and analyze physical phenomena involving continuous changes of variables
- To apply and summarize the methodologies involved in solving problems related tofundamental principles of calculus
- To develop confidence to model mathematical pattern and give appropriate solutions

UNIT I MATRICES 9+3

Eigenvalues and Eigenvectors – Properties (without proof) – Cayley Hamilton theorem (without proof) – Diagonalization using orthogonal transformation – Applications – Elastic membrane

UNIT II DIFFERENTIAL CALCULUS 9+3

Curvature – Radius of curvature (cartesian form only) – Centre of curvature – Circle of curvature – Evolute and envelope of plane curves

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+3

Partial derivatives – Total derivative – Jacobians – Taylor's series expansion – Extreme values of functions of two variables – Lagrange multipliers method

UNIT IV INTEGRAL CALCULUS 9+3

Evolution of definite and improper integrals – Applications of definite integrals – Surface areas – Volume of revolutions

UNIT V ORDINARY DIFFERENTIAL EQUATIONS 9+3

Second and higher order linear differential equations with constant coefficients – Variable coefficients – Euler cauchy equation – Legendre equation – Method of variation of parameters – Applications

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Total: 60 Periods

TEXT BOOKS:

1. Erwin Kreyszing, "Advanced Engineering Mathematics", Wiley India Pvt Ltd, New Delhi, 2018
2. Grewal BS, "Higher Engineering Mathematics", 44th edition, Khanna Publishers, 2017

REFERENCES:

1. Bali N.P and Manish Govel, "A textbook of Engineering Mathematics", 12th edition, Lakshmi Publications, 2016
2. Thomas G.B and Finney R.L, "Calculus and Analytic Geometry", 14th edition, Pearson Education, India, 2018
3. Maurice D Weir, Joel Hass and Christopher Heil, "Thomas Calculus", Pearson Education, Uttar Pradesh, 2018
4. James Stewart, "Calculus: Early Transcendental", 7th edition, Cengage Learning, New Delhi, 2015

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply the knowledge of matrices with the concepts of eigen values to study their problems in core areas	Apply
CO2	Study the behavior of a function at infinity, knowledge on curvature with its properties in cartesian form	Apply
CO3	Develop competency in applying the idea of Lagrange multipliers to find extreme of functions with constraints	Apply
CO4	Compute area and volume using definite and improper integrals	Apply
CO5	Model the problems, when the particle changes with respect to its velocity, acceleration using higher order differential equations	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO	3	2	-	-	-	-	-	-	-	-	-	1	-	-
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)						3: Substantial (High)					

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SEMESTER I

U19PH101	ENGINEERING PHYSICS	Category: BS			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of surface tension, flow of liquids, heat transfer and thermal conductivity of materials practically
- To acquire the knowledge of ultrasonic waves and its production methods with its industrial and medical applications
- To understand the fundamental principles of laser and fiber fs with their applications

UNIT I PROPERTIES OF LIQUIDS 6

Surface tension – Determination of surface tension by jaeger's method – Effect of temperature on surface tension – Viscosity – Coefficient of viscosity – Streamline and turbulent flow – Stokes law and terminal velocity – Poiseuille's equation for flow of a liquid through a capillary tube and experimental determination

UNIT II HEAT 6

Modes of heat transfer – Thermal properties (solids and liquids) – Specific heat capacity – thermal capacity – thermal diffusivity and coefficient of linear thermal expansion – Lee's disk apparatus for determination of thermal conductivity – Heat conduction through compound media (series and parallel) – Solar water heater

UNIT III ULTRASONICS 6

Properties of ultrasonic waves – Production of ultrasonic waves – Magnetostrictive generator – Piezoelectric generator – Acoustic grating – Applications – SONAR – Cavitation – Drilling and welding – Non destructive testing (flaw detection) – Medical applications (fetal heart movement)

UNIT IV LASER 6

Laser characteristics – Spatial and temporal coherence – Einstein coefficient and its importance – Population inversion – Optical resonator – Pumping methods – Nd-YAG laser – CO_2 laser – Material processing (drilling, welding) – Medical applications in ophthalmology

UNIT V FIBER OPTICS 6

Fiber optic cable feature – Total internal reflection – Numerical aperture and acceptance angle – Classification of optical fibers based on refractive index – Models and materials – Fiber optical communication – Medical endoscopy

LIST OF EXPERIMENTS

1. Determination of viscosity of the given liquid using Poiseuille's flow method
2. Determination of thermal conductivity of a bad conductor using Lee's disc method
3. Determination of velocity of sound and compressibility of liquid using ultrasonic interferometer
4. Determination of particle size of lycopodium powder using laser light
5. Determination of wavelength of a given laser source
6. Determination of acceptance angle and numerical aperture in an optical fiber using laser source
7. Determination of dispersive power of prism using spectrometer
8. Determination of refractive index of a liquid using spectrometer

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Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Total: 60 Periods

TEXT BOOKS:

1. Bhattacharya D.K and Poonam Tandon T, "Engineering Physics", Oxford University Press, 2016
2. Pandey B.K and Chaturvedi S, "Engineering Physics", Cengage Learning India, 2018

REFERENCES:

1. Arumugam M, "Engineering Physics", Anuradha Publishers, 2014
2. Murugeshan R, "Properties of matter", Chand S and Company Ltd, 2010
3. Gaur R,K, Gupta S.L, "Engineering Physics", Dhanpat Rai Publishers, 2016
4. https://nptel.ac.in/downloads/104104085/ (LASER)
5. https://nptel.ac.in/courses/122107035/8 (ultrasonic)

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the concept of surface tension and viscosity of liquids	Understand
CO2	Interpret the thermal properties of materials and apply to the field of engineering	Understand
CO3	Illustrate the production methods of ultrasonic waves and use it for the field of engineering and medicine	Understand
CO4	Demonstrate the types of laser for various industrial and medical applications	Understand
CO5	Classify fiber optic cable and study its engineering applications	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO	3	2	1	-	-	-	-	-	-	-	-	1	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER I

U19CY101	ENGINEERING CHEMISTRY I	Category: BS			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To inculcate the fundamentals of water technology and electrochemistry
- To gain basic knowledge of corrosion of metals and change of phases in alloys
- To acquire knowledge about the preparation, properties and applications of nanomaterials

UNIT I WATER 6

Hardness of water – Types – Problems in hardness calculations – Estimation of hardness by EDTA – Boiler feed water – Boiler trouble (scale, sludge, priming, foaming and caustic embrittlement) – Softening methods – Internal treatment (phosphate and calgon) – External treatment (deionization process) – Desalination of water – Reverse osmosis

UNIT II ELECTROCHEMISTRY 6

Electrochemical cells – Types – Galvanic cells – Redox reactions – EMF – Concept of electrode potential – Electrodes (Standard Hydrogen and Calomel electrode) – Nernst equation (derivation only) – Electrochemical series and its applications – Estimation of iron by potentiometry – Determination of pH by pH metry

UNIT III CORROSION AND ITS CONTROL 6

Types – Chemical corrosion – Electrochemical corrosion (galvanic and differential aeration) – Factors influencing corrosion – Corrosion control methods – Sacrificial anode and impressed current method – Protective coating – Electroplating – Ni plating

UNIT IV PHASE RULE AND ALLOYS 6

Phase rule – Explanation of terms – Advantages and limitations of phase rule – Application of phase rule to one component system (water) – Reduced phase rule – Two component system (simple eutectic system, lead, silver system) – Alloys – Definition – Purpose of making alloys –Ferrous (stainless steel) – Heat treatment – Nonferrous alloys (brass, dutch metal, german silver) – Composition – Properties and uses

UNIT V NANOCHEMISTRY AND ITS APPLICATIONS 6

Types – Properties of nanomaterials – Size dependent properties – General methods of synthesis – Top down (laser ablation and CVD) – Bottom up (solvothermal and precipitation) – Application of nanotechnology (medicine, electronics, defence and agriculture)

LIST OF EXPERIMENTS

1. Determination of total, permanent and temporary hardness of a given sample water by EDTA method
2. Determination of chloride content in the water sample
3. Estimation of ferrous ion by potentiometric titration
4. Determination of strength of HCl by pH metric method
5. Determination of corrosion rate by weight loss method
6. Electroplating of Cu and electroless plating of Cu
7. Estimation of copper in brass by EDTA method
8. Determination of phase and degrees of freedom in $CuSO_4 5H_2O$ / KI and water / $FeCl_3 12H_2O$ / phenol-water
9. Preparation of nano ruby (Al_2O_3-Cr) by combustion method
10. Preparation of nano ZnO by co-precipitation method

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Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Total: 60 Periods

TEXT BOOKS:

1. Jain P.C and Monika Jain, "Engineering Chemistry", 16th edition, Dhanpat Rai Publishing Company, Pvt Ltd, New Delhi, 2015
2. Vairam S, Kalyani P and Suba Ramesh, "Engineering Chemistry", 2nd edition, Wiley India Pvt Ltd, New Delhi, 2013

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", 2nd edition, Scientific International Pvt Ltd, New Delhi, 2014
2. Prasanta Rath, "Engineering Chemistry", 1st edition, Cengage Learning India, Pvt Ltd, Delhi, 2015
3. Shikha Agarwal, "Engineering Chemistry, Fundamentals and Applications", 1st edition, Cambridge University Press, 2015

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply the principles of water technology in treatment of industrial and domestic water and estimate the various constituents of industrial water	Apply
CO2	Describe the utilization of electrochemical principles for chemical cellsand determine experimentally the EMF of the cells	Understand
CO3	Outline the corrosion process and prevention methods that is adopted in industries	Understand
CO4	Examine the number of phases, components and variants in different heterogeneous systems, construct the phase diagrams and ferrous alloys, composition and applications and relate the change in properties due to heat treatment	Understand
CO5	Classify the different nanomaterials, recall their properties and relate them to applications	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	1	-	1	1	-	1	-	-
CO2	3	1	-	-	-	-	1	-	1	1	-	1	-	-
CO3	3	1	-	-	-	-	1	-	1	1	-	1	-	-
CO4	3	1	-	-	-	-	1	-	1	1	-	1	-	-
CO5	3	1	-	-	-	-	1	-	1	1	-	1	-	-
CO	3	1	-	-	-	-	1	-	1	1	-	1	-	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)					3: Substantial (High)				

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SEMESTER I

U19CSG01	PROBLEM SOLVING USING PYTHON PROGRAMMING	Category: ES			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To learn basics of computers and problem solving techniques
- To understand syntax and semantics of python programming
- To develop simple python programs

UNIT I COMPUTER BASICS AND PROBLEM SOLVING STRATEGIES 6

Introduction to computers – Characteristics – Classification – Applications – Components – Hardware and software – Algorithms – Algorithmic building blocks – Notations – Pseudo code – Flowchart – Programming language – Programming paradigms – Computational thinking

UNIT II LANGUAGE BASICS 6

Python interpreter and interactive mode – Tokens – Data types – Numbers and math functions – Input and output operations – Comments – Reserved words – Indentation – Operators and expressions – Precedence and associativity – Type conversion – Debugging – Common errors in python – Classes and objects

UNIT III CONTROL STATEMENTS, FUNCTIONS AND MODULES 6

Selection/conditional branching statements – if – if-else – Nested-if – elif statements – Iterative statements – While – For loop – Break – Continue and pass statements – Functions – Function definition and function call – Variable scope and lifetime – Return statement – Lambda functions or anonymous functions – Recursion – Modules and packages

UNIT IV PYTHON DATA STRUCTURE 6

Strings – Slicing – Immutability – Built-in string methods and functions – Concatenating – Appending and multiplying strings – String modules – Regular expressions – List – Creation – Accessing values – Slicing – List methods – In-built functions for lists – Tuples – Creation – Operations on tuples – Traversing – Indexing and slicing – Tuple assignment – In-built functions for tuples – Sets – Creation – Operations – Dictionaries – Operations and methods

UNIT V EXCEPTION AND FILE HANDLING 6

Exceptions – Errors and exceptions – Handling exception – Built-in and user-defined exceptions – Files – Types – Operations – Open – Read – Write – Close

LIST OF EXPERIMENTS

1. Algorithms, flowchart and pseudo code
2. Language basics
3. Input and output statements
4. Looping and decision-making statements
5. String operations
6. Recursive functions
7. Python data structures
8. Searching and sorting
9. Generating histogram
10. File and exception handling

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Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Total: 60 Periods

TEXT BOOKS:

1. Reema Thareja, "Python Programming: Using problem solving approach", Oxford Press, 2017
2. Roland Backhouse, "Algorithmic Problem Solving", 1st edition, John Wiley & Sons, 2011

REFERENCES:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Ashok Namdev Kamthane and Amit Ashok Kamthane, "Programming and Problem Solving with Python", McGrawHill Education, 2018
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach". Pearson India Education Services Pvt. Ltd., 2016
4. Roland Backhouse, "Algorithmic Problem Solving", John Wiley & Sons, 2011

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Interpret computer basics and algorithmic solutions for a given problem	Understand
CO2	Demonstrate the usage of data types, operators and expressions in python programming	Apply
CO3	Design python programs using functions, modules and packages	Apply
CO4	Develop programs using python data structures	Apply
CO5	Demonstrate the usage of exceptions and file handling	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	2	2	2	-	2	-	-
CO2	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO3	3	3	3	-	-	-	-	2	2	2	-	2	-	-
CO4	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO5	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO	3	2.8	2	-	-	-	-	2	2	2	-	2	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER I

U19MEG01	ENGINEERING GRAPHICS	Category: ES			
		L	T	P	C
		1	0	4	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To expose to the standards and conventions followed in preparation of engineering drawings
- To comprehend the concepts of orthographic and isometric projections using CAD software
- To develop the ability of producing engineering drawings and conveying the information through drawings using CAD software

BASICS OF ENGINEERING DRAWING AND CAD (Not for examination) 3

Introduction – Drawing instruments and its uses – Sheet layout – BIS conventions – Lines – Lettering and dimensioning practices lines – Coordinate points – Axes – Poly lines – Square – Rectangle – Polygons – Splines – Circles – Ellipse – Text – Move – Copy – off-set – mirror – rotate – Trim – Extend – Break – Chamfer – Fillet – Curves – Constraints viz tangency – Parallelism – Inclination and perpendicularity

UNIT I CONICS, SPECIAL CURVES AND PROJECTION OF POINTS 3+12

Construction of parabola – Ellipse and hyperbola using eccentricity method – Construction of involutes for squares and circles – Construction of tangent and normal to the above curves – Introduction – Method of projection – Planes of projection – Reference line and notations – Orthographic Projection of points – Points in all the four quadrants

UNIT II PROJECTION OF STRAIGHT LINE AND SURFACES 3+12

Projection of straight lines – Lines inclined to HP/VP plane – Inclined to both HP and VP planes (straight lines are assumed to be in first quadrant only) – Projection of planes – Projection of squar0065 – Rectangle – Pentagon – Hexagon and circular plane – Inclined to both the plane by change of position method

UNIT III PROJECTION OF SOLIDS 3+12

Introduction – Projection of solids – Prisms – Pyramids – Cylinders and cones with axis inclined to both the planes (Solids resting on HP only)

UNIT IV DEVELOPMENT OF LATERAL SURFACES OF SOLIDS 3+12

Introduction – Cutting plane – Sectional views of right regular solids resting with base on HP: Prisms – Pyramids – Cylinder and cone and true shapes of the sections – Development of lateral surfaces of right regular prisms – Pyramids – Cylinders – Cones resting with base on HP only – Development of their frustums and truncations

UNIT V ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS 3+12

Orthographic projections – Simple machine components using free hand sketching – Isometric projection – Simple solid exercises and combination of solids

Contact Periods:

Lecture: 15 Periods Tutorial: – Periods Practical: 60 Periods Total: 75 Periods

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TEXT BOOKS:

1. Bhat N.D and Panchal V.M, "Engineering Drawing", 51st edition, Charotar Publishing House, Gujarat, 2013
2. Venugopal K, Prabhu Raja V, "Engineering Graphics", New Age International (P) Limited, 2010

REFERENCES:

1. Natrajan K.V, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2017
2. Sam Tickoo, "AutoCAD 2013 for Engineers and Designers", Dreamtech Press, 2013
3. Annaiah M.H and Rajashekar Patil, "Computer Aided Engineering Drawing", 4th Edition, New Age International Publishers, 2012
4. Basant Aggarwal, "Engineering Drawing", 1st Edition, Tata McGraw Hill Education Private Limited, 2010
5. Kulkarni D.M, Rastogi A.P and Sarkar A.K, "Engineering Graphics with Auto CAD", Revised Edition, PHI Learning Private Limited, New Delhi, 2010

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Sketch curves, orthographic projections of points as per BIS conventions	Apply
CO2	Illustrate the orthographic projections of straight lines and plane surfaces	Apply
CO3	Depict the orthographic projections of solids, lateral surfaces of frustums, truncated solids and its development	Apply
CO4	Translate pictorial and isometric views of simple objects to orthographic views	Apply
CO5	Convert the orthographic views into isometric projections	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	1	-	1	-	-
CO2	3	2	-	-	1	-	-	-	-	1	-	1	-	-
CO3	3	2	-	-	1	-	-	-	-	1	-	1	-	-
CO4	3	2	-	-	1	-	-	-	-	1	-	1	-	-
CO5	3	2	-	-	1	-	-	-	-	1	-	1	-	-
CO	3	2	-	-	1	-	-	-	-	1	-	1	-	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER I

U19BM101	WORKSHOP (BME)	Category: ES			
		L	T	P	C
		0	0	4	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire knowledge about electrical, electronic components and equipment
- To learn the various types of wiring systems, wiring tools, soldering, lightning and wiring accessories
- To develop practical knowledge about household electrical appliances

LIST OF EXPERIMENTS

ELECTRONICS

1. Study of electronic components and equipment
   a. Resistor colour coding using digital multimeter
   b. Assembling electronic components on breadboard
2. Measurement of AC signals parameters using cathode ray oscilloscope and function generator
3. Soldering of components on the dot board
4. Verification of logic gates (OR, AND, NOR, NOT, NAND, EX-OR)

ELECTRICAL

1. Study of electrical symbols and power components (Eg: learning about the cables and sockets for different applications)
2. Residential house wiring using fuse, switch, indicator, lamp and energy meter
3. Staircase wiring
4. Measurement of electrical quantities – voltage, current, power and power factor in RLC circuit
5. Measurement of energy using single phase energy meter
6. Measurement of resistance to earth of electrical equipment

MECHANICAL

1. Study of welding - Metal arc welding tools and equipment, exercises by arc welding and TIG welding Processes
2. Plumbing - Tools, operations
3. Carpentry – T-Joint and L- Joint, types of joints

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Total: 60 Periods

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand about electronic components and equipment	Understand
CO2	Learn the soldering method for electronic components	Understand
CO3	Interpret basic electrical engineering knowledge for house wiring practice	Understand
CO4	Measure the electrical quantities	Apply
CO5	Demonstrate on welding and plumbing works	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	2	-	1	1	1	-	1	-	-
CO2	3	-	-	-	-	2	-	1	1	1	-	1	-	-
CO3	3	-	-	-	-	2	-	1	1	1	-	1	-	-
CO4	3	-	-	-	-	2	-	1	1	1	-	1	-	-
CO5	3	-	-	-	-	2	-	1	1	1	-	1	-	-
CO	3	-	-	-	-	2	-	1	1	1	-	1	-	-
Correlation levels:	1: Slight (Low)					2: Moderate (Medium)						3: Substantial (High)		

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SEMESTER II

U19LE201	ADVANCED COMMUNICATIVE ENGLISH	Category: HSM			
		L	T	P	C
		1	0	2	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- Foster their ability to develop communicative strategies and skills
- Strengthen the learners to evocate their listening skills and enhance writing ability
- Exhibit proactive reading strategies and speaking techniques

UNIT I LANGUAGE ADEPTNESS 9

Cloze test – Sentence completion – Relative clause – Transformation of sentences – Common errors – Discourse markers – Formal and Informal expressions – Framing questions – Figures of speech

UNIT II LISTENING 9

Listening to announcements – Interviews – Group discussions– Dialogues – News items – Documentaries – IELTS – GRE – TOEFL based listening

UNIT III SPEAKING 9

Real life situations through role play – Language use – Pronunciation, Stress and Intonation – Narrating events – Presentation – Group discussion

UNIT IV READING 9

Reading strategies – Reading comprehension – Reading short stories – Journal articles – Inferring editorial column – Cloze reading

UNIT V WRITING 9

Book review – Guided writing – Writing gadget review – Free writing – Rephrasing – Interpreting text – Email writing – Process description

LIST OF EXPERIMENTS

1. Listening for announcements
2. Listening to dialogues
3. Listening to documentaries
4. Listening to interviews
5. IELTS based listening
6. Role play
7. Product description
8. Group discussion
9. Book review
10. General presentation

Contact Periods:

Lecture: 15 Periods Tutorial: – Periods Practical: 30 Periods Total: 45 Periods

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TEXT BOOKS:

1. K N Shoba, Lourdes Joavani Rayen, "Communicative English", Cambridge University Press, 2017
2. Sudharshana N P and Savitha C, "English for Technical Communication", 1st edition, Cambridge University Press, 2016

REFERENCES:

1. Murphy, Raymond, "Intermediate English Grammar", 3rd edition, Cambridge University Press, 2009
2. Means, Thomas L, "English and Communication for Colleges", 4th edition, Cengage 2017
3. "Using English: A Coursebook for Undergraduate Engineers and Technologists", 1st edition Orient BlackSwan, 2006

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Inculcate effective reading strategy	Understand
CO2	Express opinions in real life situations	Understand
CO3	Construct academic and professional writing	Apply
CO4	Impart the listening ability in self learning	Apply
CO5	Adept to the needs of the second language learner in a grammatical context	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	2	-	2	-	3	-	1	-	-
CO3	-	-	-	-	-	2	-	-	2	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	1	-	-
CO5	-	-	-	-	-	-	2	2	-	3	-	1	-	-
CO	-	-	-	-	-	2	2	2	2	3	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER II

U19MA202	COMPLEX VARIABLES AND PARTIAL DIFFERENTIAL EQUATIONS	Category: BS			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To make the students knowledgeable in evaluating multiple integrals and also in the areas of vector calculus
- To make the students build their knowledge in the areas of Laplace transform
- To develop an understanding of the essentials of complex variables and its applications

UNIT I MULTIPLE INTEGRALS 9+3

Double integrals – Change of order of integration –Triple integrals – Applications to areas and volumes

UNIT II VECTOR CALCULUS 9+3

Gradient – divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem – Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds

UNIT III PARTIAL DIFFERENTIAL 9+3

Formation through elimination of constants and functions – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Solution methods for second and higher order homogeneous equations with constant coefficients

UNIT IV COMPLEX DIFFERENTIATION 9+3

Functions of a complex variable – Analytic functions: Cauchy–Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Bilinear transformations

UNIT V COMPLEX INTEGRATION 9+3

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Cauchy's residue theorem – Applications – Contour Integration using circular and semicircular Contours

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Total: 60 Periods

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Pvt. Ltd, New Delhi, 2015
2. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017

REFERENCES:

1. N.P.Bali and Manish Goyel, A textbook of Engineering Mathematics, 25th edition, Laxmi Publications; 2016
2. G.B.Thomas and R.L Finney, Calculus and Analytic Geometry, 9th edition, Pearson Education India; 2010
3. Maurice D. Weir, Joel Hass, Christopher Heil, "Thomas Calculus", 14th edition, Pearson Education,Uttar Pradesh, 2018
4. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi, 2015
5. https://pvpsitrealm.blogspot.com/2016/09/higher–engineering–mathematics–by–bs.html

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K–Level
CO1	Extend the integral techniques for determining the area enclosed by plane curves and volume of solids	Understand
CO2	Apply basic concepts of vector calculus to evaluate line, surface and volume Integrals	Apply
CO3	Form and solve partial differential equations through standard procedures and techniques	Apply
CO4	Construct analytic functions and bilinear transformations	Apply
CO5	Evaluate contour integrals using Cauchy's integral theorem and residue theorem	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	1	-	-	1	-	-
CO2	3	2	-	-	-	-	-	-	1	-	-	1	-	-
CO3	3	2	-	-	-	-	-	-	1	-	-	1	-	-
CO4	3	2	-	-	-	-	-	-	1	-	-	1	-	-
CO5	3	2	-	-	-	-	-	-	1	-	-	1	-	-
CO	3	2	-	-	-	-	-	-	1	-	-	1	-	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)					3: Substantial (High)				

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SEMESTER II

U19PH201	MEDICAL PHYSICS	Category: BS			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire the basics of atomic physics and non–ionizing radiation
- To inculcate the principles behind senses and radioactive nuclides
- To gain the knowledge of interaction of radiation and its effects in human body

UNIT I ATOMIC PHYSICS AND NON IONIZING RADIATION 9

Atomic Physics: Absorption and emission of light – Spin – Orbit coupling – Zeeman effect – Quantum mechanical explanation of Zeeman effect – Anomalous Zeeman effect – Stark effect, Non-ionizing Radiation: Non–ionizing Electromagnetic Radiation: Non–ionizing radiation effects: Low frequency effects and high frequency effects

UNIT II PHYSICS OF THE SENSES 9

Introduction and objectives – Cutaneous sensation – The chemical senses – Audition – Doppler effect – Vision – Psychophysics (Introduction)

UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES 9

Radioactive decay – Spontaneous emission – Isomeric transition – Gamma ray emission, alpha, beta, Positron decay, Sources of radioisotopes: Natural and artificial radioactivity - Radionuclide – Cyclotron and reactor produced radionuclide – Radionuclide used in medicine

UNIT IV INTERACTION OF RADIATION WITH MATTER 9

Interaction of charged particles with matter — Specific ionization — Linear energy transfer range, bremsstrahlung, annihilation, interaction of X-ray and gamma radiation with matter – Attenuation of Gamma radiation, Interaction of neutron with matter and their clinical significance (Radiation Dosimetry)

UNIT V RADIATION QUANTITIES AND RADIATION EFFECTS 9

Radiation quantities: Inverse square law – KERMA and absorbed dose – Stopping power – relationship between the dosimetric quantities – Bragg's curve – Concept of LD 50 – Radiation effects and prevention measures: Stochastic and non–stochastic effects – Principles of radiation Protection indiagnostic medical exposure – Individual prevention measures

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Brown B. H. Smallwood R. H. Barber D. C.Lawford P. V. and Hose D. R.– Medical Physics and Biomedical Engineering, 2nd Edition, IOP Publishers, 2001
2. Gopal B. Saha, Physics and Radiobiology of Nuclear Medicine, 4th Edition, Springer, 2013

REFERENCES:

1. Meredith W. J. and Massey J. B. – Fundamental Physics of Radiology, 5th edition, Varghese Publishing house, 1992
2. Webb S. – The Physics of Medical Imaging, 1st edition, Taylor and Francis, 1988
3. Woodcock J. P, Ultrasonics Medical Physics Handbook – 1, 4th Edition, Adam Hilger Ltd, Bristol, 2002
4. John R. Cameran, James Skotfronick G, Medical Physics, 1st edition, John–Wiley & Sons, 1978

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K–Level
CO1	Illustrate the basics of atomic physics and non – ionizing radiation	Understand
CO2	Analyze about the types of senses, vision and audition	Understand
CO3	Relate the basic concept of radioactivity and radionuclides to use in various medical applications	Understand
CO4	Explain the interaction of radiation with matter and its clinical significance	Understand
CO5	Outline the concepts of radiation exposure, dosage effects and prevention measures	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	1	1	-	-	-	-	-	1	1	-
CO2	3	1	-	-	1	1	-	-	-	-	-	1	1	-
CO3	3	1	-	-	1	1	-	-	-	-	-	1	1	-
CO4	3	1	-	-	1	1	-	-	-	-	-	1	1	-
CO5	3	1	-	-	1	1	-	-	-	-	-	1	1	-
CO	3	1	-	-	1	1	-	-	-	-	-	1	1	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER II

U19CY201	FUNDAMENTALS OF BIOCHEMISTRY	Category: BS			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire knowledge on structural and functional properties of carbohydrates, proteins, lipids and nucleic acids
- To emphasize the role of biomolecules in metabolic processes in living systems
- To gain knowledge about drugs and their mode of action

UNIT I CARBOHYDRATES 6

Classification of carbohydrates, chemical properties, structure – Monosaccharides – Glucose, disaccharides – Sucrose and Polysaccharides – Starch, isomerism, racemisation and mutarotation. Digestion and absorption of carbohydrates, metabolic pathways – Glycolysis, glycogenesis, glycogenolysis – TCA cycle

UNIT II LIPIDS 6

Classification of lipids – Simple, compound and derived lipid – Nomenclature of fatty acid, physical and chemical properties of fat – (Hydrogenation, Acid, Iodine and saponification values, Reichert – Meissl value), Metabolic pathways – Synthesis and degradation of fatty acid (beta oxidation), ketogenesis, disorders of lipid metabolism

UNIT III NUCLEIC ACID 6

Structure of purines and pyrimidines – Nucleoside – Nucleotide, DNA act as a genetic material, Chargoffs rule – Watson and crick model of DNA – Structure of RNA and its type – Disorder of purines and pyrimidines nucleotide

UNIT IV AMINO ACIDS AND PROTEINS 6

Amino acids – Classification – Physical properties – Chemical properties of glycine – Proteins– classification – Structural organization – Properties and testing

UNIT V MEDICINAL CHEMISTRY 6

Synthetic drugs – Requirement of drug, Classification based on chemical structure and therapeutic action, Definition – structure and properties – Antibacterial (sulfonamides, Ciprofloxacin), Anti–inflammatory (Salicylic acid, indomethacin) – Ant malarial (Chloroquinine) – analgesics (aspirin, acetaminophen) – Cardiovascular drugs (barbiturates, Lidocaine) – Anesthetics (Benzocaine, Promethazine)

LIST OF EXPERIMENTS

1. Spectroscopy: Determination of absorption maxima (λ max) of a drug (Paracetamol / Ciprofloxacin)
2. Estimation of Haemoglobin
3. Estimation of blood glucose
4. Preparation of serum and plasma from blood
5. Estimation of creatinine
6. Estimation of urea
7. Estimation of uric acid

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8. Estimation of cholesterol
9. Separation of amino acids by TLC
10. Determination of absorption maxima (λmax) of a drug (Paracetamol / Ciprofloxacin)
11. Identification of blood collection tubes and Phlebotomy equipment (Demo)
12. ELISA test (Demo)

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Total: 60 Periods

TEXT BOOKS:

1. Rafi M.D., "Text book of biochemistry for Medical Student", 2nd, University Press, 2014
2. David L Nelson and Michael M, Lehninger, "Principles of Biochemistry", 7th Edition, W.H. Freeman & Co. Ltd, 2017

REFERENCES:

1. Keith Wilson & John Walker, "Practical Biochemistry – Principles & Techniques", 2nd edition, Oxford University Press, 2009
2. Pamela.C. Champe & Richard.A. Harvey, "Lippincott Biochemistry Lippincott's Illustrated Reviews", 2nd edition, Raven publishers, 1994
3. Ashutoskar, "Medicinal Chemistry", 4th edition, New age international, 2010

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K–Level
CO1	Apply the knowledge of carbohydrates, their reactions and metabolic pathways	Apply
CO2	Illustrate the nomenclature, metabolic pathways degradation and disorders of lipid metabolism in living beings	Understand
CO3	Elucidate the structure of nucleic acids, its types DNA and RNA	Remember
CO4	Outline the classification, structure and properties of proteins and amino acids	Remember
CO5	Summarize the concepts in medicinal chemistry, synthetic drugs and its classification	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	1	-	-	-	-	1	-	-
CO2	3	1	-	-	-	-	1	-	-	-	-	1	-	-
CO3	3	1	-	-	-	-	1	-	-	-	-	1	-	-
CO4	3	1	-	-	-	-	1	-	-	-	-	1	-	-
CO5	3	1	-	-	-	-	1	-	-	-	-	1	-	-
CO	3	1	-	-	-	-	1	-	-	-	-	1	-	-
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

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KPRIET

SEMESTER II

U19CSG02	COMPUTATIONAL THINKING	Category: ES			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- U19CSG01 – Problem Solving Using Python Programming

COURSE OBJECTIVES:

- To formulate problems in a way that enables the use of a computer to solve them
- To logically organize and analyze data
- To identify, analyze and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources

UNIT I PRINCIPLES OF COMPUTATIONAL THINKING 6

Programming – Algorithmic thinking – Bitwise and boolean algebra – Compiler vs interpreter – Pseudo coding – Problem definition – Data collection – Problem decomposition – Abstraction – Flowcharting – Name binding – Selection – Repetition – Modularization – Sample exercise problems and deriving solutions

UNIT II DATA ORGANIZATION & PROCESSING USING PYTHON 6

Operators, variables and data types – Loops and conditions – Nested loop – Strings – Euclid's algorithm – Arrays – Functions – Recursion

UNIT III REVERSE ENGINEERING & SOLUTIONS 6

Algorithm Tracing technique (simulating execution) – Best practices – Keeping it simple – documentation – Style – Idioms – DRY code – Naming conventions and comments – Debugging – Anticipating output from pseudo code

UNIT IV APPLIED COMPUTATIONAL THINKING 6

Operating systems basics – Networking basics – Database Management System (DBMS) – SQL – No SQL – JSON – API – XML

UNIT V EFFICIENCY ANALYSIS AND BENCHMARKING 6

Algorithm efficiency – Time complexity in programs – Mathematical preliminaries – Asymptotic analysis – Recurrence relations – Algorithm design paradigms – Divide and conquer algorithms – Dynamic programming and greedy algorithms

LIST OF EXPERIMENTS

1. Print the difference of indices of largest and smallest number in an array
2. Length of the longest substring without repeating characters
3. Prime factors of a given number
4. Product of the sum of diagonals of an array
5. The greatest common divisor (GCD) of two numbers – with & without Euclid's algorithm
6. Finding output of sequencing and looping puzzles
7. Finding output of pattern matching puzzles
8. Using only indexing technique– storing and retrieving Array elements (without library functions)
9. Add, subtract, multiply, and check for equality in the two given matrices (without library functions)
10. Utilize the Pythagorean Theorem to calculate a third side of a right triangle, given the other two sides

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11. Time complexity analysis –Tower of Hanoi (using Recursion) – 3 rods and n disks
12. Time complexity analysis – Tower of Hanoi (using Recursion) – 4 rods and n disks

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Total: 60 Periods

TEXT BOOKS:

1. David Riley and Kenny Hunt, "Computational thinking for modern solver", Kindle Edition, Chapman & Hall/CRC, 2014
2. Karl Beecher, "Computational Thinking: A beginner's guide to problem solving and programming", Kindle Edition, BCS, The Chartered Institute for IT, 2017

REFERENCES:

1. Paul Curzon and Peter William Mcowan, "Power of Computational Thinking, The: Games, Magic And Puzzles To Help You Become A Computational Thinker", Kindle Edition, World Scientific Publishing Europe Ltd, 2017
2. FabrizioLuccio, Paolo Ferragina, "Computational Thinking: First Algorithms, Then Code", Kindle Edition, Springer, 2018
3. Jane Krauss, Kiki Prottsman, "Computational Thinking and Coding for Every Student: The Teacher's Getting-Started Guide" Kindle Edition, SAGE Publications,2016
4. GUVI Technical Learning Platform, Certifications, Assessments and FDP/FEM for KPRIET

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K–Level
CO1	Illustrate the basic principles of Computational thinking	Understand
CO2	Examine the data organization and processing using Python	Apply
CO3	Outline the basic algorithm tracing techniques	Understand
CO4	Explore the basics of operating system, networking, database management system, API and XML	Analyze
CO5	Determine efficiency of algorithms	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	2	-	-	-	-	-	-	1	-	1
CO2	3	2	1	-	2	-	-	-	-	-	-	1	-	1
CO3	3	1	-	-	2	-	-	-	-	-	-	1	-	1
CO4	3	2	2	-	2	-	-	-	-	-	-	1	-	1
CO5	3	2	1	-	2	-	-	-	-	-	-	1	-	1
CO	3	1.6	1.3	-	2	-	-	-	-	-	-	1	-	1
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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KPRIET

SEMESTER II

U19BM201	ELECTRONIC DEVICES AND CIRCUITS	Category: ES			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamentals of diodes and its characteristics
- To learn the operation and applications of unipolar and Bipolar transistor
- To learn the characteristics of the amplifier and its feedback systems

UNIT I PN JUNCTION DEVICES 6

PN junction diode – Structure, operation and V–I characteristics – Rectifiers – Half wave and full wave rectifier – Bridge rectifier – Inductor and capacitor – L and π – Section filter– Filter peak inverse voltage and surge Current – Zener diode characteristics – Zener reverse characteristics – Zener as regulator

UNIT II TRANSISTORS 6

BJT – Structure, operation, load line characteristics and biasing – Configuration of CE, CB, CC amplifiers – Gain and frequency response JFET – Depletion mode, Enhancement mode analysis of CS and Source follower – Gain and frequency response

UNIT III MULTISTAGE AMPLIFIERS AND POWER 6

Cascade amplifier – Single tuned amplifier – Double tuned amplifier– Stagger tuned amplifier – Gain and frequency response – Power amplifiers – Types – Class A Operation, Class B operation, Class C operation

UNIT IV FEEDBACK AMPLIFIERS 6

Basic concepts of feedback – Effect of negative feedback – Types of negative feedback connections – Advantages of negative feedback – Voltage / Current – Series – Shunt feedback

UNIT V OSCILLATORS 6

Positive feedback – Condition for oscillations – Frequency of oscillation RC phase shift – Wien Bridge – Hartley – Colpitt and crystal oscillators

LIST OF EXPERIMENTS

1. Rectifiers – HWR and FWR (with & without capacitor filter) using PN Junction Diode
2. Zener diode as regulator
3. Design of CE, CB and CC Configuration of a transistor
4. Design of Field Effect Transistor
5. Design of Voltage series feedback amplifier
6. Design of Class A and Class B amplifier
7. Design of RC phase shift oscillator
8. Design of Hartley Oscillator

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Total: 60 Periods

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TEXT BOOKS:

1. Boylestad & Nashelsky, "Electronic Devices & Circuit Theory", 11th edition, Prentice Hall of India (P) Ltd., 2012
2. Jacob. Millman, Christos C. Halkias, "Electronic Devices and Circuits", 3rd edition, Tata McGraw Hill Publishing Limited, New Delhi, 2014

REFERENCES:

1. David A.Bell, "Electronic Devices and Circuits", Prentice Hall of India Private Limited, 5th edition New Delhi, 2008
2. Malvino, "Electronic Principles", 7th edition, Tata McGraw Hill, 2000

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K–Level
CO1	Illustrate the structure and working operation of basic electronic devices	Understand
CO2	Outline the characteristics of different electronic devices such as diodes and transistor	Understand
CO3	Infer the required components to construct an amplifier circuit	Understand
CO4	Demonstrate the working of multistage amplifiers	Understand
CO5	Demonstrate the working of oscillators	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	2	-	-	-	-	-	-	1	1	-
CO2	3	1	-	-	2	-	-	-	-	-	-	1	1	-
CO3	3	1	-	-	2	-	-	-	-	-	-	1	1	-
CO4	3	1	-	-	2	-	-	-	-	-	-	1	1	-
CO5	3	1	-	-	2	-	-	-	-	-	-	1	1	-
CO	3	1	-	-	2	-	-	-	-	-	-	1	1	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER II

U19BM202	CIRCUIT THEORY	Category: ES			
		L	T	P	C
		2	1	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To verify an electric circuit using network theorems
- To compute the transient response of an electric circuit
- To design a resonance circuit and sketch its frequency response

UNIT I CIRCUIT ANALYSIS AND NETWORK TOPOLOGY 6+3

DC & AC circuits – Ohm's law – Resistors in series and parallel – Kirchoff's law – Branch – Node – Mesh – Mesh current and node voltage method – Concept of tree branch – Tree link – Junctions – Incident matrix – Tie – Set matrix – Cut set matrix – Determination of loop current and node voltages

UNIT II NETWORK THEOREMS FOR AC AND DC CIRCUITS AND TWO PORT NETWORKS 6+3

Superposition theorem – Thevenin's theorem – Norton's theorem – Maximum power transfer theorem – Reciprocity theorem – Two port Network – Admittance parameter – Impedance parameters

UNIT III MAGNETIC CIRCUITS 6+3

Magnetic Circuits – Faraday's laws of electromagnetic induction – Concept of self and mutual inductance – Dot convention – Coefficient of coupling – Composite magnetic circuit – Analysis of series and parallel magnetic circuits

UNIT IV RESONANCE 6+3

Introduction – Series resonance – Parallel resonance – Definition – Q Factor – Frequency response – Half power frequency – Resonant frequency – Bandwidth

UNIT V TRANSIENT CIRCUITS 6+3

Basics of RL – RC – RLC transient circuits – Source free and forced response – Sinusoidal excitation – Laplace transform – Time constant and natural frequency of oscillation

Contact Periods:

Lecture: 30 Periods Tutorial: 15 Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis" McGraw Hill Science Engineering, Eighth Edition, 11th Reprint 2016
2. Joseph Edminister and Mahmood Nahvi, "Electric Circuits", Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, 5th Edition Reprint 2016

REFERENCES:

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis)", 7th edition, Dhanpath Rai & Sons, New Delhi, 2018
2. Jegatheesan, R., "Analysis of Electric Circuits," 2nd edition, McGraw Hill, 2015
3. Mahadevan, K., Chitra, C., "Electric Circuits Analysis," 3rd edition, Prentice–Hall of India Pvt Ltd., New Delhi, 2015

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K–Level
CO1	Relate and evaluate the AC and DC circuits and network topology	Understand
CO2	Learn the electrical circuit theorems in real time	Understand
CO3	Demonstrate the fundamentals of magnetic circuits	Understand
CO4	Outline the basics of resonance circuits	Understand
CO5	Identify the response of the various circuits of sinusoidal excitation	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	2	-	-	-	-		-	1	1	-
CO2	3	2	1	-	2	-	-	-	-	-	-	1	1	-
CO3	3	2	-	-	2	-	-	-	-	-	-	1	1	-
CO4	3	2	-	-	2	-	-	-	-	-	-	1	1	-
CO5	3	3	1	-	2	-	-	-	-	-	-	1	1	-
CO	3	2.2	1	-	2	-	-	-	-	-	-	1	1	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER III

U19MA301	TRANSFORMS AND ITS APPLICATIONS	Category: BS			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand Fourier analysis for periodic and aperiodic signals
- To apply and summarize the mathematical aspects that contribute to the solution of one-dimensional wave and heat equations
- To apply Laplace Transforms to find solutions of initial value problems for linear ordinary differential equations

UNIT I FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic analysis

UNIT II ONE DIMENSIONAL BOUNDARY VALUE PROBLEMS 9+3

Fourier series solution – Vibration of strings – One dimensional wave equation – One dimensional heat flow equation (unsteady state)

UNIT III TWO DIMENSIONAL BOUNDARY VALUE PROBLEMS 9+3

Fourier series solution –Two dimensional (steady state) heat flow equations (Cartesian form only) Separation of variables

UNIT IV FOURIER TRANSFORM 9+3

Fourier transform pair –Fourier sine and cosine transforms – Properties (Without proof) – Transforms of simple functions – Convolution theorem – Parseval's identity

UNIT V LAPLACE TRANSFORM 9+3

Transform of standard functions –Transform of unit step function and unit impulse function – Transforms of derivatives and integrals –Transform of periodic functions – Inverse Laplace transform – Convolution theorem – Ordinary differential equations with constant coefficients

Contact Periods:

Lecture: 45 Periods Tutorial: –15 Periods Practical: – Periods Total: 60 Periods

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, John Wiley & Sons, New Delhi, 2018
2. Wylie C. R. and Barrett L. C., "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2016
3. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2017

REFERENCES:

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 2016
2. Bali. N.P and Dr.Manish Goyal, "A Textbook of Engineering Mathematics", Laxmi Publications Pvt. Ltd, 9th Edition, 2014
3. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2016
4. James, G., "Advanced Modern Engineering Mathematics", Pearson Education,3rd Edition, 2013

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Identify the periodicity of a function and formulate the same as a combination of sine and cosine	Apply
CO2	Analyze and solve one dimensional wave equation and heat equation	Analyze
CO3	Analyze and solve two-dimensional heat equation	Analyze
CO4	Apply the spectral characteristics of continuous-time a periodic signal using Fourier Transform	Apply
CO5	Apply the Laplace transform for analyze of continuous-time signals and systems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO	2.8	2	-	-	-	-	-	-	-	-	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER III

U19BM301	BIOMEDICAL SENSORS AND MEASUREMENTS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Engineering Physics

COURSE OBJECTIVES:

- To explore the purpose of measurement, the methods of measurements and errors associated with measurements
- To analyze the classifications and the characteristics of different transducers
- To compare the different display and recording devices

UNIT I MEASUREMENT SYSTEM 9

Generalized measurement system – Sensor classification – Static characteristics – Dynamic characteristics

UNIT II DISPLACEMENT, PRESSURE AND TEMPERATURE MEASUREMENT 9

Potentiometers – Strain gauges – Bridge circuits – Variable inductance and LVDT – Capacitive type - Types of diaphragms – Bellows – Bourdon tubes – Thermistors – Thermocouple – Resistive temperature detector – Radiation thermometry – Fiber optic temperature sensor

UNIT III PHOTOELECTRIC AND PIEZOELECTRIC TRANSDUCERS 9

Phototube – Scintillation counter – Photo Multiplier Tube (PMT) – Photovoltaic – Photoconductive cells – Photodiodes – Phototransistor – Comparison of photoelectric transducers – Optical displacement sensors and optical encoders – Piezoelectric transducer – Equivalent circuit and its characteristics

UNIT IV RECORDERS AND DISPLAYS 9

Reading/Recording devices – Graphic recorders – Magnetic and optical recorders – Data acquisition systems – Human factors in displays – Cathode Ray Tube (CRT) – Liquid Crystal Displays (LCD) – Plasma-driven flat panel displays – Light Emitting Diode Displays (LED)

UNIT V CHEMICAL BIOSENSORS 9

Blood gas and acid-base physiology – Electrochemical sensors – Reference electrode pH, pO2, pCO2 electrodes – Ion-Selective Field Effect Transistor (ISFET) – Noninvasive blood – Gas monitoring – Blood glucose sensors –Transcutaneous arterial oxygen tension and carbon dioxide tension monitoring enzyme electrode

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. John G. Webster, "Medical Instrumentation Application and Design",4th edition, Wiley India Pvt Ltd, New Delhi, 2015
2. A.K. Sawhney, "Electrical & Electronics Measurement and Instrumentation", 19th edition, Dhanpat Rai & Co, New Delhi, Reprint 2014

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REFERENCES:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd edition, Tata McGraw-Hill, New Delhi, 2014
2. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice hall ofIndia, New Delhi, 2015

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply the characteristics of transducers in the measurement system	Apply
CO2	Compare the working of displacement, pressure and temperature sensors in a system	Analyze
CO3	Identify the significance of photoelectric and piezoelectric transducers	Apply
CO4	Summarize the operation of recording and display devices of a system	Understand
CO5	Illustrate the working principle of chemical biosensors	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	1	-	-	-	-	-	1	2	-
CO2	3	3	2	-	1	-	-	-	-	-	-	1	2	-
CO3	3	2	2	-	1	-	-	-	-	-	-	1	2	-
CO4	3	1	-	-	1	-	-	-	-	-	-	1	2	-
CO5	3	1	-	-	-	-	-	-	-	-	-	1	3	-
CO	3	1.8	2	-	1	1	-	-	-	-	-	1	2.2	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

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SEMESTER III

U19BM302	HUMAN ANATOMY AND PHYSIOLOGY	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To identify all the organelles of an animal cell and their function
- To comprehend the structure and functions of the various types of human body systems
- To explore the importance of anatomical features and physiology of human systems

UNIT I THE CELL AND GENERAL PHYSIOLOGY 9

Structure of the cell – Function of each components of the cell – Genetic control of protein synthesis – Cell reproduction – Membrane potential – Action potential – Generation and conduction – Electrical simulation – Blood cells – Immunity – Blood clotting – Blood groups – Estimation of RBC – WBC – Platelet

UNIT II CARDIAC AND NERVOUS SYSTEM 9

Blood pressure – Feedback control of blood pressure – Nervous control of heart – Coronary and peripheral reflex action – Velocity of conduction of nerve impulses – Autonomic nervous system

UNIT III SKELETAL AND RESPIRATORY SYSTEM 9

Skeletal – Types of bone and function – Physiology of bone formation – Division of skeleton –Types of joints and function – Types of cartilage and function – Respiratory – Pulmonary ventilation and Physical principles of gas exchanges –Transport – Oxygen and carbon dioxide in the blood and body fluids – Regulations of respiration

UNIT IV DIGESTIVE AND EXCRETORY SYSTEMS 9

General principles of gastrointestinal function – Secretory functions of the alimentary tract digestion and absorption in the gastrointestinal tract – Structure of nephron – Mechanism of urine formation – Skin and sweat gland

UNIT V SPECIAL SENSES 9

Optics of vision – Receptor and neural function of the retina – Photochemistry of vision – Central neurophysiology of vision – Physiology of hearing mechanism – Hearing loss – Taste and smell sensors

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Jain A K, "Textbook of Physiology", Avichal Publishing Company,1st edition, 2009
2. Arthur C Guyton, John E Hall, "Textbook of Medical Physiology", Saunders Elsevier, 1st edition, 2006

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REFERENCES:

1. Anil Baran Singha Mahapatra, "Essential of Medical Physiology", Current Book International, Kolkata, 2007
2. Ranganathan T S, "A Textbook of Human Anatomy", S.Chand & Co. Ltd., New Delhi, 2012
3. Sujit K Chaudhuri, "Concise Medical Physiology", New Central Book Agency Pvt.Ltd, Kolkata, 2011
4. Sarada Subramanyam, K Madhavan Kutty, Singh H D, "Textbook of Human Physiology", S. Chand and Company Ltd, New Delhi, 2012

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Outline basic structure, functions and physiology of human cell organelles and blood cell	Understand
CO2	Illustrate the structure and working of cardiovascular and nervous system	Understand
CO3	Infer the skeletal and respiration system mechanism	Understand
CO4	Summarize the working of digestive and the excretory system	Understand
CO5	Identify the structure and physiology special senses	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	1	-	-	-	-	-	1	1	-
CO2	3	1	-	-	-	1	-	-	-	-	-	1	1	-
CO3	3	1	-	-	-	1	-	-	-	-	-	1	1	-
CO4	3	1	-	-	-	1	-	-	-	-	-	1	1	-
CO5	3	1	-	-	-	1	-	-	-	-	-	1	1	-
CO	3	1	-	-	-	1	-	-	-	-	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER III

U19BM303	SIGNALS AND SYSTEMS	Category: PC			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To comprehend the basic properties of signal and systems
- To know the methods of characterization of LTI systems in time domain
- To analyze discrete time signals and system in the Laplace and Z transform domain

UNIT I INTRODUCTION 6 + 3

Representation and classification of continuous time (CT) and discrete time (DT) signals – Basic CT and DT signals – Basic operations on CT and DT signals

UNIT II CONTINUOUS TIME, DISCRETE TIME SIGNALS AND SYSTEMS 6 + 3

Continuous time signals and systems: Linear Time Invariant (LTI) systems– Convolution integral – Causality and stability – CT system representation by differential equations – Discrete time signals and systems – Linear Shift Invariant (LSI) systems – Convolution sum – Causality and stability – DT system representation by difference equations

UNIT III FOURIER ANALYSIS OF SIGNALS 6 + 3

Introduction to transformation – Fourier series representation of periodic signals – Convergence of Fourier series and Gibb's phenomenon – Fourier transform and its properties – Fourier transform as system – Fourier transform of aperiodic signals and some basic properties – Convolution theorem – Periodic convolution and autocorrelation

UNIT IV SAMPLING AND RECONSTRUCTION 6 + 3

Sampling and reconstruction of band limited signals – Aliasing – Ideal low pass filter – Discrete time Fourier transform and its properties – Inverse DTFT

UNIT V LAPLACE AND Z-TRANSFORM 6 + 3

Laplace transform – Transform and region of convergence – Properties of Laplace and z-transform – Inverse Laplace and z-transform – Rational system functions – Inverse Laplace and z-transform of rational functions – Analysis of LTI system with rational system functions

LIST OF EXPERIMENTS

1. Study of Scientific and Simulation Packages
2. Generation of Basic Signals
3. Basic operation on signals
4. Computation of Step Response of the system
5. Computation of Impulse response of the system
6. Verification of Linearity property
7. Verification of Time Variant property
8. Solving difference Equations

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9. Computation of Linear Convolution
10. Computation of Circular Convolution.
11. Computation of DTFT of a sequence.
12. Sampling and Aliasing

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: 15 Periods Total: 60 Periods

TEXT BOOKS:

1. Oppenheim A V, Wilsky A Sand Hamid Nawab S, "Signals and Systems", Prentice Hall of India, New Delhi, 2011
2. A. Nagoor Kani, "Signals and Systems: Simplified", Tata McGraw Hill, New Delhi, 2018

REFERENCES:

1. Roberts M J,"Signals, Systems - Analysis using Transform Methods and MATLAB", Tata McGraw Hill, New Delhi, 2004
2. Samir S Soliman, Srinath M D, "Continuous and Discrete Signals and Systems", Prentice Hall International, New Delhi, 2003
3. Lathi B P, "Linear Systems and Signals", Oxford University Press Inc, 2nd Edition, 2009

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

Cos	Statements	K-Level
CO1	Inspect on classification and representation of continuous and discrete signals	Apply
CO2	Determine causality and stability of systems in continuous and discrete signals	Apply
CO3	Demonstrate signals with Fourier series and Fourier transform	Apply
CO4	Examine basic filtering, model sampling and reconstruction techniques for signals	Analyze
CO5	Analyze Laplace and Fourier transform for signals and system	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	2	-	-	1	1	1	-	1	-	3
CO2	3	2	1	-	2	-	-	1	1	1	-	1	-	3
CO3	3	2	1	-	2	-	-	1	1	1	-	1	-	2
CO4	3	3	1	1	2	-	-	1	1	1	-	1	-	3
CO5	3	3	1	1	2	-	-	1	1	1	-	1	-	2
CO	3	2.4	1	1	2	-	-	1	1	1	-	1	-	2.6

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER III

U19BM304	LINEAR INTEGRATED CIRCUITS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce the basic fabrication technique of integrated circuits
- To explore the linear and non-linear applications of operational amplifiers
- To examine the types of A-D and D-A converters

UNIT I FABRICATION OF INTEGRATED CIRCUIT 9

Classification of IC's – Fundamentals of IC technology – Basic processes in fabrication of IC – Silicon wafer preparation – Epitaxial growth – Etching – Masking – Doping – Atomic Diffusion – Ion implantation – Metallization – Assembly and packing

UNIT II OPERATIONAL AMPLIFIERS AND ITS CHARACTERISTICS 9

Characteristics of an Ideal Operational Amplifier – Schematic and characteristics of IC741 – Open loop gain – CMRR – Slew rate and transfer characteristics – Input bias and output offset voltages – Offset compensation techniques – Frequency response characteristics – Frequency compensation

UNIT III APPLICATIONS OF OPERATIONAL AMPLIFIER 9

Inverting and Non-inverting amplifiers – Voltage follower – Summing – Differential and Instrumentation amplifiers – Integrator and Differentiator – Voltage to current converter – Phase changers – Sinusoidal oscillators – Active filters – Low pass – High pass – Band pass and band stop Butterworth filters – Comparator – Zero crossing detector – Sample and hold circuit – Precision diode – Rectifiers – Clipper and Clamper

UNIT IV 555 FAMILY ICs AND PHASE LOCKED LOOP 9

555 Timer Functional block diagram and description – Mono-stable and Astable operation – Applications – Derivations of expressions for Lock and Capture ranges – Applications– Frequency Synthesis – Frequency Translation

UNIT V A-D AND D-A CONVERTERS 9

Analog to digital converters – Continuous – Counter ramp– successive approximation – Single and dual slope and parallel types – Digital to Analog converters – Binary weighed and R-2R Ladder types – DAC/ADC performance characteristics and comparison

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Ramakant A.Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th edition, Pearson education, 2009
2. Roy Choudhury and Shail Jain, "Linear Integrated Circuits", 4th edition, Wiley Eastern, New Delhi, 2012

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REFERENCES:

1. Coughlin & Driscoll, "Operational-Amplifiers and Linear Integrated Circuits", Pearson education, 1st edition, 2001
2. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", TataMcGraw Hill, 2nd edition, 2002

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

Cos	Statements	K-Level
CO1	Outline the processes in the fabrication of integrated circuits	Understand
CO2	Summarize the characteristics of operational amplifier	Understand
CO3	Examine the linear and non-linear applications of operational amplifier	Analyze
CO4	Discuss the working and applications of 555 ICs	Apply
CO5	Compare the working and performance of A-D and D-A converters	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	1	-	-	-	-	-	-	1	3	-
CO3	3	2	2	-	1	-	-	-	-	-	-	1	3	-
CO4	3	2	1	-	1	-	-	-	-	-	-	1	3	-
CO5	3	2	2	-	1	-	-	-	-	-	-	1	3	-
CO	3	1.6	1.67	-	1	-	-	-	-	-	-	1	3	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

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SEMESTER III

U19EC305	DATA STRUCTURES	Category: ES			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Basic C programming

COURSE OBJECTIVES:

- To study the fundamentals of C programming
- To learn and explore the applications of linear and non–linear data structures
- To understand basic sorting and searching algorithms

UNIT I BASICS OF C PROGRAMMING 7

Structure of C program –Pre–processor directives – Compilation and Linking processes – Data Types –Storage classes – Constants – Variables – Operators – Expressions – Input / Output statements – Assignment statements – Decision making statements – Switch statement – Looping statements – Arrays–: declaration, initialization, one–dimensional and two–dimensional arrays –Strings: declaration, initialization and operations on strings

UNIT II FUNCTIONS, POINTERS, STRUCTURES AND UNIONS 6

Functions: Pass by value, Pass by reference and Recursion – Pointers – definition, initialization, Pointers arithmetic – Structures and Unions– definition, structure within a structure, Programs using structures and unions

UNIT III LINEAR DATA STRCUTURES 7

Stacks and Queues – Array–based implementation– Linked lists – Linked list–based implementation of Stacks and Queues – Evaluation of Expressions – Linked list based polynomial addition

UNIT IV NON–LINEAR DATA STRCUTURES 5

Trees – Binary Trees – Binary tree representation and traversals – Binary Search Trees – Applications of trees, set representations – Union – Find operations. Graph and its representations–Graph Traversals.

UNIT V SEARCHING AND SORING ALGORITHMS 5

Linear Search – Binary Search – Bubble Sort – Insertion sort – Merge sort – Quick sort – Hash tables – Overflow handling

Contact Periods:

Lecture: 30 Periods Tutorial – Periods Practical: 30 Periods Total: 60 Periods

LIST OF EXPERIMENTS

1. Josephus Problem, Subset Sum Problem, Kadane's Algorithm
2. Shuffling Algorithms, Sliding Window, Prefix Sum Technique
3. Memorization, Tabulation
4. LCS, Coin Change, Knapsack
5. Subset Sum, Palindrome Partitioning
6. Rabin Karp Algorithm and KMP Algorithm
7. Rotations Check of two Strings and Anagram
8. Multidimensional Array Search, Transpose and Rotate
9. Egg drop puzzle
10. Backtracking
11. Stack: array–based and linked–list based implementation

12. Queue: array–based and linked–list based implementation
13. Shortest path problem
14. Searching –Two pointer approach
15. Sorting
    a. Union and Intersection of sorted arrays
    b. Inversions count
    c. Tail call elimination quick sort
    d. Cycle Sort
    e. Merge

TEXT BOOKS:

1. Reema Thareja, "Programming in C", 1st edition, Oxford University Press, 2018
2. ReemaThareja, "Datastructures using C", Oxford University Press, 2014

REFERENCES:

1. Pradip Dey, Manas Gosh, "Programming in C", 1st edition, Oxford University Press, 2018
2. Herbert Schildt, "C: The Complete Reference", 2nd edition, McGraw Hill Education, 2017
3. R. Venkatesan, S. Lovelyn Rose, "Data Structures", 2nd edition, Wiley, 2019
4. Seymour Lipschutz, "Data structures with C", 4th edition, McGraw Hill Education, 2017

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K–Level
CO1	Apply the concepts of C programs to solve basic problems	Apply
CO2	Make use of functions, pointers, structures and unions to write simple programs	Apply
CO3	Construct Stack and Queue using arrays and linked–list	Apply
CO4	Utilize non–linear data structure to minimize computational complexity	Apply
CO5	Analyze the performance of different searching and sorting techniques	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	2	-	-	1	1	1	-	-	-	-
CO2	3	2	1	-	2	-	-	1	1	1	-	-	-	-
CO3	3	2	1	-	2	-	-	1	1	1	-	-	-	-
CO4	3	2	1	-	2	-	-	1	1	1	-	-	-	-
CO5	3	3	1	-	2	-	-	1	1	1	-	-	-	-
CO	3	2.2	1	-	2	-	-	1	1	1	-	-	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER III

U19BM305	HUMAN ANATOMY AND PHYSIOLOGY LABORATORY	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To analyze and quantify blood cells
- To learn different methods for identification of blood groups
- To estimate haematological parameters

LIST OF EXPERIMENTS

1. Experimental verification of Microscope with Neubauer chamber
2. Estimation of RBC
3. Estimation of WBC count
4. Estimation of eosinophil count
5. Estimation of platelet count
6. Estimation of differential count
7. Hemoglobin estimation
8. Packed cell volume / ESR
9. Blood grouping / osmotic fragility
10. Bleeding time / clotting time
11. Hearing test (Tuning fork)
12. Visual Activity (Snellen's Chart)
13. Study of Bones (Anatomy)
14. Study various organs and systems (Anatomy)

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Categorize the blood cells based upon their morphological features	Analyze
CO2	Examine the blood group of an individual	Analyze
CO3	Experiment with haematological parameters to identify the diseases	Apply
CO4	Interpret the sensory organs of human body using anatomical models	Apply
CO5	Demonstrate the structure and function of various organs and bones using anatomical models	Understand

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	1	1	1	1	1	-	1	1	-
CO2	3	2	1	-	-	1	1	1	1	1	-	1	1	-
CO3	3	1	1	-	-	1	1	1	1	1	-	1	1	-
CO4	3	1	1	-	-	1	1	1	1	1	-	1	1	-
CO5	3	-	-	-	-	1	1	1	1	1	-	1	1	-
CO	3	1.5	1	-	-	1	1	1	1	1	-	1	1	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

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SEMESTER III

U19BM306	SENSORS AND TRANSDUCERS LABORATORY	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To impart knowledge about various sensors and transducers and their functioning
- To design transducer-based circuits
- To simulate circuits using sensors and transducers

LIST OF EXPERIMENTS

1. Design a circuit to measure displacement using strain gauge
2. Design a circuit to study the characteristics of LVDT
3. Design a circuit to study the characteristics of a load cell
4. Design a circuit to study the variation of resistance in a photo-resistor
5. Design a circuit to study the characteristics of photodiode
6. Design a circuit to study the characteristics of phototransistor
7. Design a circuit to study the characteristics of thermistor
8. Measurement of heart rate using IR based sensor
9. Measurement of temperature using thermocouple
10. Level measurement using proximity sensors
11. Measure oxygen saturation of the blood using photoelectric transducer
12. Study of DSO
13. Simulate the working of photo transducers in Tinkercad

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Categorize various types of sensors and transducer	Analyze
CO2	Examine circuits using photo transducers	Analyze
CO3	Develop circuits based on Thermal transducers	Apply
CO4	Analyze physiological parameters using sensors	Analyze
CO5	Examine the working of sensors using open source software	Analyze

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COURSE ARTICULATION MATRIX:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	1	1	1	1	1	3	-
CO2	3	2	1	1	1	-	-	1	1	1	1	1	3	-
CO3	3	2	1	-	1	-	-	1	1	1	1	1	3	-
CO4	3	2	2	1	1	-	-	1	1	1	1	1	3	-
CO5	3	2	1	1	3	-	-	1	1	1	1	1	1	2
CO	3	2	1.2	1	1.5	-	-	1	1	1	1	1	2.6	2
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

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SEMESTER III

U19BM307	LINEAR INTEGRATED CIRCUITS LABORATORY	Category: PC			
		L	T	P	C
		0	0	4	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To design and test the linear integrated circuits using available ICs
- To explore the circuits designed using 555 timer
- To investigate and simulate the applications of op-amp

LIST OF EXPERIMENTS

1. Design and testing of inverting and non-inverting amplifier
2. Design and testing of summing, averaging amplifier and subtractor
3. Design and testing of differentiator and integrator
4. Design and testing of instrumentation amplifier
5. Design and testing of active filters (LPF, HPF and BPF)
6. Design and testing of Schmitt trigger
7. Design and testing of astable and monostable multivibrator using op-amp
8. Design and testing of astable and monostable multivibrator using IC 555
9. Design of RC phase shift and Wien bridge oscillators using op-amp
10. Design and simulate analog to digital converter
11. Design and simulate digital to analog converter
12. Design and simulate peak detector

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Experiment with the applications of operational amplifiers	Apply
CO2	Inspect filters using op-amp and perform experiment on frequency response	Analyze
CO3	Examine the working of astable and monostable multivibrator using 555 timer and op-amp	Analyze
CO4	Develop and test the applications of oscillators	Apply
CO5	Make use of simulation software to design op-amp based circuits	Apply

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	1	1	1	-	1	3	-
CO2	3	3	1	-	1	-	-	1	1	1	-	1	3	-
CO3	3	3	1	-	1	-	-	1	1	1	-	1	3	-
CO4	3	2	1	-	1	-	-	1	1	1	-	1	3	-
CO5	3	2	1	-	3	-	-	1	1	1	-	1	1	2
CO	3	2.4	1	-	1.4	-	-	1	1	1	-	1	2.6	2
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

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SEMESTER IV

U19MA401	PROBABILITY AND STATISTICS	Category: BS			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the basic concepts of probability, one- and two-dimensional random variables and some standard distributions applicable to engineering
- To apply the concepts of testing of hypothesis for small and large samples in the field of Biomedical engineering
- To apply the design of experiments in the field of biocontrol systems

UNIT I PROBABILITY AND RANDOM VARIABLES 9

Probability – Axioms of Probability – Conditional probability – Discrete and Continuous random variables – Moments – Moment generating functions – Distributions – Poisson and Normal

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 9

Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and linear regression

UNIT III TESTING OF HYPOTHESIS 9

Large sample test for single mean and difference of means – Small sample test: t, Chi-square and F distributions

UNIT IV DESIGN OF EXPERIMENTS 9

One way and two way classifications – Completely Randomized Design – Randomized Block Design – Latin Square Design

UNIT V BIOSTATISTICAL QUALITY CONTROL 9

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits – Acceptance sampling

Contact Periods:
Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Johnson, R. A., Miller I and Freund J., Miller and Freund's, "Probability and Statistics for Engineers", 8th edition, Pearson Education, Asia, 2015
2. Veerarajan T, "Probability Statistics and Random Process", 3rd edition, Tata McGraw Hill, publishing company Ltd, 2009

REFERENCES:

1. Devore J.L., "Probability and Statistics for Engineering and the Sciences", 8th Edition Cengage Learning, New Delhi, 2014
2. Papoulis A and Unnikrishna Pillai S., "Probability, Random Variables and Stochastic Processes", 4th edition, McGraw Hill Education India, New Delhi, 2010
3. Ross S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd edition, Elsevier, 2010

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4. Walpole R.E., Myers. R.H.,Myers. S.L.and Ye. K., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2014

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply the probability theory and random variable as a need for the analysis of random experiment	Apply
CO2	Utilize discrete and continuous probability distributions including requirements, mean and variance for making decisions	Apply
CO3	Distinguish correlation and linear regression in two dimensional random variables	Apply
CO4	Analyze the hypothesis test of small and large samples	Analyze
CO5	Design and conduct experiments and analyze the results	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO5	3	2	2	1	-	-	-	-	-	-	-	1	-	-
CO	3	2	1.2	1	-	-	-	-	-	-	-	1	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER IV

U19BM401	DIGITAL LOGIC DESIGN	Category: PC			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To implement digital circuits using simplified boolean functions
- To classify and design combinational circuits
- To illustrate the design of synchronous and asynchronous sequential circuits

UNIT I BOOLEAN ALGEBRA AND LOGIC GATES 6

Number Systems – Arithmetic operations – Binary codes – Boolean algebra and logic gates – Theorems and properties of Boolean algebra – Boolean functions – Canonical and standard forms – Simplification of Boolean functions using Karnaugh map – Logic gates – NAND – AND – NOR implementations

UNIT II COMBINATIONAL LOGIC CIRCUITS 6

Combinational Circuits – Analysis and design procedures – Binary adder-subtractor – Decimal adder – Binary multiplier – Magnitude comparator – Decoders – Encoders – Multiplexers – Introduction to HDL – HDL models of combinational circuits

UNIT III SYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS 6

Sequential Circuits – Storage elements – Latches – Flip-flops – Analysis of clocked sequential circuits – State reduction and assignment – Design procedure – Registers and Counters – HDL models of sequential circuits

UNIT IV ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS 6

Analysis and design of asynchronous sequential circuits – Reduction of state and flow tables – Race – Free state assignment – Hazards

UNIT V MEMORY AND PROGRAMMABLE LOGIC CIRCUITS 6

Basics of semiconductor memory – RAM – SRAM and DRAM – ROM – Programmable logic devices – Programmable logic array – Programmable array logic – Implementation of Boolean functions with PLA and PAL – Introduction to Field Programmable Gate Array (FPGA)

LIST OF EXPERIMENTS

1. Study of logic gates
2. Study of simulation packages
3. Design and implementation of adder and subtractor
4. Design and implementation of code converters for BCD to gray conversion and BCD to seven segment code conversion
5. Design and implementation of multiplexers and demultiplexers
6. Study of flip-flops
7. Design and testing of shift registers
8. Design and implementation of ring counter and Johnson counter
9. Design and implementation of synchronous UP/DOWN counters
10. Design of sequence detector circuit using JK flip-flop
11. Store and retrieve data using Static RAM

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Contact Periods:

Lecture: 30 Periods Tutorial: -- Periods Practical: 30 Periods Total: 60 Periods

TEXT BOOKS:

1. Morris Mano M, Michael D Ciletti and John F Wakerly, "Digital Design", 5th edition, Pearson Education, 2012
2. Thomas L. Floyd, "Digital Fundamentals", 11th edition, Pearson Education, 2015

REFERENCES:

1. Roger L Tokheim, "Digital Electronics - Principles and Applications", 6th edition, Tata McGraw Hill, New Delhi, 2012
2. Donald D. Givone, "Digital Principles and Design", Tata McGraw Hill, 2012
3. Anil K. Maini, "Digital Electronics: Principles and Integrated Circuits", Wiley India Pvt Ltd, 2010

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Outline the fundamental concepts and techniques used in digital circuits	Understand
CO2	Analyze the design procedures of the combinational circuits	Analyze
CO3	Construct synchronous sequential circuits using latches and flip-flops	Apply
CO4	Explain the concept of asynchronous sequential circuits	Understand
CO5	Experiment with the basics of memory and programmable logic devices	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	2	-	-	1	-	1	1	1	-	-	1	-
CO3	3	2	1	-	-	1	-	1	1	1	-	-	1	-
CO4	3	2	-	-	-	1	-	-	-	-	-	-	1	-
CO5	3	2	1	-	-	1	-	1	1	1	-	-	1	-
CO	3	2	1.33	-	-	1	-	1	1	1	-	-	1	-
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

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KPRIET

SEMESTER IV

U19BM402	MICROBIOLOGY AND PATHOLOGY	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To familiarize the basics of culture, staining and smearing
- To identify the morphology of microorganisms
- To compare the different diseases and disorders

UNIT I INTRODUCTION TO MICROBIOLOGY 9

Microscopy – Light microscope – Phase contrast and Electron microscopes – Sterilization techniques – Culture methods – Pure culture – Isolation and maintenance – Culture media – Selective and enrichment media – Staining and smearing – Simple staining – Negative staining and Gram's staining – Acid-fast staining and spore staining – Growth curve and generation time

UNIT II MORPHOLOGICAL STUDIES 9

Morphology and structure – Bacteria – Algae – Fungi and virus – Reproductive structures and importance of fungi – Cultivation of viruses – Plaque assay – T4 Phages and lambda stages – lifecycle – Synthesis and assembly of protein switch between lysogeny and lytic cycle

UNIT III DISEASES 9

Normal human micro flora – Host - Parasitic interaction – Epidemics – Exo and Endotoxins – Aetiology – Symptoms and prevention of air borne diseases – Tuberculosis – Diphtheria – Polio – Myelitis – Influenza – Waterborne diseases – Typhoid – Cholera and Bacillary dysentery – Direct contact disease – Rabies

UNIT IV DISORDERS OF KIDNEY, LIVER, PLASMA PROTEINS AND ENZYMES 9

Acute and chronic renal failure – Proteinuria and nephritic syndrome – Acute and chronic liver failure – Hepatitis – Cirrhosis – Gilbert's – Crigler – Jaundice and Diabetes in pregnancy – Hypoalbuminaemia – Hypogammaglobulinaemia – Hypergammaglobulinaemia – Types of hyperlipidaemias – Lipoprotein deficiency – Abetalipoproteinemia

UNIT V DISORDERS OF HORMONES AND METABOLIC ASPECTS OF CANCER 9

Acromegaly and Gigantism – Cushing's disease – Conn's syndrome – Congenital adrenal hyperplasia – Hyperthyroidism – Hypothyroidism – Goiter and Thyroid cancer – Metabolic aspects of cancer – Metabolic complications of prostate and lung cancer – Tumour markers – α-Fetoprotein (AFP) – Carcinoembryonic antigen (CEA) – Para proteins – Enzymes as tumour markers and Carbohydrate antigen (CA) markers

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Anantha Narayanan R, C .K Jayaram Panicker, "Text Book of Microbiology", 4th edition, Orient Longman Publication, 1992
2. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", 7th edition, WB Saunders Co, 2005

REFERENCES:

1. Underwood, "JCE: General and Systematic Pathology", Churchill Livingstone, 3rd edition, 2000

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2. Prescott, Harley and Klein, "Microbiology", 10th edition, McGraw Hill, 2017

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Organize the staining procedure and identify the growth of microorganism in a given culture.	Apply
CO2	Outline the structure and morphology of microorganisms	Understand
CO3	Explain the cause and pathogenesis of disease	Understand
CO4	Illustrate the pathophysiology of disorders and compare the relation among disorders.	Understand
CO5	Outline the hormonal disease and explain the metabolic effect of cancer	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	1	-	-	-	-	-	1	1	-
CO2	3	1	-	-	-	2	-	-	-	-	-	1	1	-
CO3	3	1	-	-	-	2	-	-	-	-	-	1	1	-
CO4	3	1	-	-	-	2	-	-	-	-	-	1	1	-
CO5	3	1	-	-	-	2	-	-	-	-	-	1	1	-
CO	3	1.2	-	-	-	1.8	-	-	-	-	-	1	1	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)		

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SEMESTER IV

U19BM403	BIOMEDICAL INSTRUMENTATION	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To illustrate the origin of bio potentials and its propagations
- To design bio amplifier for various physiological recordings
- To learn the different measurement techniques for non-physiological parameters

UNIT I BIOPOTENTIAL ELECTRODES 9

Origin of biopotential and its propagation – Electrode-Electrolyte interface – Electrode-Skin interface – Half-Cell potential – Contact impedance – Polarization effects of electrode – Non polarizable electrodes –Types of electrodes – Surface Electrode – Needle and Micro electrodes and their equivalent circuits recording problems – Motion artifacts

UNIT II BIOMEDICAL VARIABLES MEASUREMENT AND PATIENT MONITORING 9

Blood pressure measurement – Heart sound measurement – Blood flow measurement – Ventilation measurement – Blood chemistry measurement – Patient monitoring system and its components – Organization and equipment used in ICCU and ITU – Computer assisted patient monitoring system

UNIT III BIOPOTENTIAL AMPLIFIERS 9

Bio amplifier – Operational amplifiers – ECG Amplifiers – Electric interference – Transient protection – Driven Right leg system – EMG amplifier – EEG amplifiers – Preamplifier– Cardio tachometers – EMG integrators – Evoked potentials and signal averages

UNIT IV PATIENT SAFETY 9

Physiological effects of electrical currents – Macro shock – Micro shock – Preventive measures to reduce shock hazards – Leakage current – Isolation of patient circuits – Safety of electrically susceptible patients – Radiation hazards and safety – Shielding – Open ground problem and earthing methods

UNIT V INSTRUMENT DESIGN 9

Designing an electronic hearing aid – Designing glucometer virtual instrumentation – Historical Perspectives – Advantages – Block diagram and architecture of a virtual instrument – Data-flow techniques – Graphical programming in data flow and comparison with conventional programming

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Webster, "The Measurement, Instrumentation and Sensors Handbook", 2nd edition, CRC press, 2014
2. John G. Webster, "Medical Instrumentation: Application and Design, 3rd edition, Tata McGraw Hill Pvt. Ltd., 2011

REFERENCES:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd edition, Tata McGraw-Hill, New Delhi, 2014
2. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice Hall of India, New Delhi, 2015

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Illustrate the various types of electrodes for measuring the biopotentials	Understand
CO2	Summarize the electrical and non-electrical measurement parameters of the body	Understand
CO3	Apply the knowledge of amplifiers designs in the application of biopotential signals	Apply
CO4	Interpret the electrical safety features designed in medical equipment	Understand
CO5	Analyze the various design of medical instruments using virtual instrumentation	Analyze

COURSE ARTICULATION MATRIX:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	1	3	-
CO2	3	1	-	-	-	-	-	-	-	-	-	1	3	-
CO3	3	2	1	-	1	-	-	-	-	-	-	1	3	-
CO4	3	1	-	-	-	1	-	-	-	-	-	1	3	-
CO5	3	2	2	1	2	-	-	1	-	-	-	1	1	2
CO	3	1.4	1.5	1	1.5	1	-	1	-	-	-	1	2.6	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER IV

U19EC405	OBJECT ORIENTED PROGRAMMING AND ADVANCED DATA STRUCTURES	Category: ES			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Data Structures in C

COURSE OBJECTIVES:

- To learn basics of Object Oriented Programming concepts and characteristics of Java
- To understand the Exceptions and use I/O streams
- To learn the usage of hierarchical data structures, graphs and its applications

UNIT I OOP AND JAVA FUNDAMENTALS 6

Object Oriented Programming – Abstraction – Objects and classes – Encapsulation – Inheritance – Polymorphism – OOP in Java – Characteristics of Java – The Java Environment – Java Source File – Structure – Compilation – Fundamental Programming Structures in Java – Defining classes in Java – Constructors – Methods – Access specifiers – Static members – Comments – Data Types – Variables – Operators – Control Flow – Arrays – Packages – JavaDoc comments

UNIT II INHERITANCE AND INTERFACES 6

Inheritance – Super classes – Sub classes – Protected members – Constructors in sub classes – The Object class – Abstract classes and methods – Final methods and classes – Interfaces – Defining an interface – Implementing interface – Differences between classes and interfaces and extending interfaces – Object cloning – Inner classes – Array Lists – Strings

UNIT III EXCEPTION HANDLING AND I/O 6

Exceptions – Exception hierarchy – Throwing and catching exceptions – Built in exceptions – Creating own exception – Stack Trace Elements – Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files

UNIT IV HIERARCHICAL DATA STRUCTURES 6

AVL Trees – AVL Tree Rotation – BTree – B+ Tree – Heap – Applications of heap

UNIT V GRAPHS 6

Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs

LIST OF EXPERIMENTS

1. Program to implement Operators, Flow controls concepts
2. Program to implement Classes, Constructors, Overloading and Access control
3. Program using Nested & Inner Classes, Static and Final
4. Program using File Streams and I/O Streams
5. Program to implement Strings, String Buffer Concept
6. Program using Interfaces, Abstract Classes
7. Develop a Java application to generate telephone bill
8. Develop a java application to implement currency converter, distance converter, time converter using packages
9. Develop a java application for an employee payroll system
10. Program to implement AVL-Tree
11. Program to implement B-Tre

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12. Program to implement Topological sort
13. Shortest path algorithm using Dijkstra

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Total: 60 Periods

TEXT BOOKS:

1. Herbert Schildt, "Java The complete reference", 11th Edition, McGraw Hill Education, 2018
2. Mark allen Weiss, "Data Structures and Algorithm Analysis in JAVA", 3rd Edition, Pearson Publication, 2012

REFERENCES:

1. Cay S. Horstmann, Gary cornell, "Core Java Volume – I Fundamentals", 9th Edition, Prentice Hall, 2013
2. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006
4. S.Sridhar, "Design and Analysis of Algorithms", 1st Edition, Oxford University Press. 2014

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Develop Java programs using OOP principles	Apply
CO2	Apply the concepts inheritance and interfaces to develop a Java programs	Apply
CO3	Build Java applications using exceptions and I/O streams	Apply
CO4	Understand the various algorithms using tree to solve computing problems	Understand
CO5	Construct algorithms using graph structure to solve real-life problems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	1	1	1	-	-	-	-
CO2	3	3	2	1	-	-	-	1	1	1	-	-	-	-
CO3	3	3	2	1	-	-	-	1	1	1	-	-	-	-
CO4	3	1	-	-	-	-	-	1	1	1	-	-	-	-
CO5	3	3	2	1	-	-	-	1	1	1	-	-	-	-
CO	3	2.6	2	1	-	-	-	1	1	1	-	-	-	-
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)					3: Substantial (High)						

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SEMESTER IV

		Category: EEC			
UI9CA001	NUMERICAL APTITUDE AND VERBAL ABILITY - I	L	T	P	C
		1	0	0	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of coding, decoding, interpreting and applying
- To comprehend the basics concepts of logical reasoning and verbal reasoning

UNIT I CODING AND DECODING 3

Clocks & calendars – Alpha numeric series – Coding & decoding – Blood relations – Odd man out – Direction

UNIT II DATA INTERPRETATION 3

Syllogism – Order and ranking – Puzzles – Cubes and dices – Statements – Assumptions and conclusions – Seating arrangements – Data sufficiency – Data interpretation

UNIT III GRAMMAR 3

Parts of speech (Nouns – Pronouns – Verbs – Adjectives – Adverbs – Prepositions – Conjunctions – Interjections) – Gerunds – Phrases and clauses

UNIT IV WRITING 3

Tenses – Active and passive voice (Tense usage) – Reported speech – Verbal ability (Vocabulary and Reasoning)

UNIT V READING 3

Cloze test – Sentence formation – Para jumbles – Passage formation – Spotting errors – Verbal analogies

Contact Periods:

Lecture: 15 Periods Tutorial: – Periods Practical: – Periods Total: 15 Periods

TEXT BOOKS:

1. R S Aggarwal, "Quantitative Aptitude for Competitive Examinations", 17th Edition S Chand Publishing, New Delhi, 2017
2. R S Aggarwal, "Objective General English", S Chand Publishing, New Delhi, 2017

REFERENCES:

1. Abhijit Guha – Quantitative Aptitude for Competitive Examination, McGraw Hill Education (India) Private Limited, 5th Edition, 2015
2. R S Aggarwal - A Modern Approach to Verbal & Non-Verbal Reasoning, S Chand Publishing, New Delhi, 2017

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply the concept of coding and decoding for numerical reasoning and data interpretation through Graphs and Charts	Apply
CO2	Choose appropriate words/phrases for the sentences and present comprehensively	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	1	-	-	-	-
CO	3	1	-	-	-	-	-	-	-	1	-	-	-	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER IV

U19BM404	MICROBIOLOGY AND PATHOLOGY LABORATORY	Category: PC			
		L	T	P	C
		0	0	4	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To comprehend the factors that affect/effect growth of microorganism
- To use the instruments used for analyzing microorganisms
- To apply the fundamentals of laboratory precautions and preparations and the techniques of culturing bacteria

LIST OF EXPERIMENTS

1. Effect of temperature on the growth of micro-organism
2. Effect of salt concentration on the growth of microorganisms
3. Study of parts of compound microscope
4. Pure culture techniques (Pour plate method, Spread plate method, Streak plate)
5. Culture media preparation
6. Simple staining of bacteria
7. Gram staining of bacteria
8. Capsule (Positive and Negative) staining
9. Spore staining
10. Bacteria motility test
11. Acid fast staining
12. Anaerobic cultivation
13. Quality analysis of phytochemical components in herbal extracts
14. Antimicrobial activity of medical plants

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Analyze the factors influencing the growth of microorganisms	Analyze
CO2	Develop the media for culturing bacteria	Apply
CO3	Identify the different types of bacteria using staining techniques	Apply
CO4	Inspect the oxygen content of culture media and bacterial mobility	Analyze
CO5	Examine the phytochemical components and microbial activities of herbal extracts	Analyze

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Learn Beyond

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	1	-	1	1	1	-	1	1	-
CO2	3	2	1	-	-	1	-	1	1	1	-	1	1	-
CO3	3	2	1	-	-	1	-	1	1	1	-	1	1	-
CO4	3	2	2	-	-	1	-	1	1	1	-	1	1	-
CO5	3	2	2	-	-	1	-	1	1	1	-	1	1	-
CO	3	2	1.6	-	-	1	-	1	1	1	-	1	1	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)		

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SEMESTER IV

U19BM405	BIOMEDICAL INSTRUMENTATION LABORATORY	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To study the instrumentation of various biomedical devices
- To explore the fundamentals of bio signal acquisition and analysis
- To investigate the applications of various biomedical devices

LIST OF EXPERIMENTS

1. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts
2. Design of EMG amplifier
3. Design of ECG amplifier to detect QRS complex and measure heart rate
4. Design of EOG amplifier to detect eye blink
5. Design a right leg driven ECG amplifier
6. Design and study the characteristics of optical Isolation amplifier
7. Design a multiplexer and de multiplexer for any two bio signals
8. Measurement of pulse-rate using photo transducer
9. Measurement of pH and conductivity
10. Measurement of blood pressure using sphygmomanometer
11. Measurement and recording of peripheral blood flow
12. Design a PCB layout for any bio amplifier using suitable software tool

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Construct amplifiers to acquire bio signals	Apply
CO2	Build a circuit to detect QRS complex	Apply
CO3	Identify the physiological parameters	Apply
CO4	Analyze the recording of peripheral blood flow	Analyze
CO5	Construct PCB layout design for bio-amplifiers	Analyze

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	1	1	1	1	1	3	-
CO2	3	2	1	-	1	-	-	1	1	1	1	1	3	-
CO3	3	2	1	-	1	-	-	1	1	1	1	1	3	-
CO4	3	3	2	1	1	-	-	1	1	1	1	1	3	-
CO5	3	3	2	1	1	-	-	1	1	1	1	1	3	-
CO	3	2.4	1.4	1	1	-	-	1	1	1	1	1	3	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER V

U19BM501	BIOCONTROL SYSTEMS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Transforms and its applications

COURSE OBJECTIVES:

- To introduce the types of control systems with mathematical representation
- To examine the performance of a control system
- To apply the knowledge of control system engineering in modeling physiological system

UNIT I INTRODUCTION TO CONTROL SYSTEMS 9

Control system – Open loop and closed loop systems – Mechanical and electrical modeling of physical systems – Transfer function – Block diagram representation – Signal flow graphs – State variable representation – Feedback principles and characteristics of control system

UNIT II ANALYSIS OF CONTROL SYSTEMS 9

Time domain and frequency domain specifications – Type 0 – Type 1 – Type 2 systems – Error coefficients and constants – Routh Hurwitz criteria – Nyquist criterion – Bode plot – Root locus method – Relative stability analysis – Compensation of feedback control systems – Concept of state and state model

UNIT III PHYSIOLOGICAL CONTROL SYSTEMS 9

Introduction to physiological control systems – Art of modeling physiological systems – Linear models of physiological systems – Parametric and non-parametric fitting – Eye movement system and its mathematical model – Oculomotor muscle model

UNIT IV ANALYSIS OF PHYSIOLOGICAL CONTROL SYSTEMS 9

Steady state analysis of muscle stretches reflex action – Transient response analysis of neuromuscular reflex model – Frequency domain analysis – Linearized model of lungs mechanics – Stability analysis of pupillary light reflex – Static analysis – Regulation of heart – Regulation of ventilation

UNIT V APPLICATIONS OF CONTROL SYSTEMS 9

Significance of control systems – Adaptive and constrained control theories – Ventilator control action – Glucose insulin regulation model – Biological performance criteria and adaptive control systems

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Nagarath I J, Gopal M, "Control Systems Engineering", 6th edition, New Age International Pvt. Ltd., New Delhi, 2018
2. Khoo Michael C K, "Physiological Control Systems: Analysis, Simulation and Estimation", 2nd edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2018

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REFERENCES:

1. Olansen Jon B, Eric Rosow, "Virtual Bioinstrumentation Biomedical, Clinical and Healthcare applications in LabVIEW", 1st edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2001
2. Vadrevu Sree Hari Rao, Ponnada Raja Sekhara Rao, "Dynamic Models and Control of Biological Systems", 1st edition, Springer-Verlag, 2009
3. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt. Ltd., New Delhi, 2015

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Outline the need for mathematical modeling of various systems, representation of system in block diagrams and signal flow graphs	Understand
CO2	Examine the time response, frequency response, stability of various systems and state model	Analyze
CO3	Infer the fundamentals for modeling basic physiological systems	Understand
CO4	Identify the aspects of time and frequency responses in physiological control systems	Apply
CO5	Utilize the concepts of adaptive and constrained theories for physiological control system	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	1	-	-	-	-	-	-	-	2	1
CO2	3	2	2	1	1	-	-	-	-	-	-	-	2	1
CO3	3	1	-	-	-	-	-	-	-	-	-	-	2	1
CO4	3	2	1	1	1	-	-	-	-	-	-	-	2	1
CO5	3	2	1	1	1	-	-	-	-	-	-	-	2	1
CO	3	1.6	1.3	1	1	-	-	-	-	-	-	-	2	1
Correlation levels:		1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)						

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SEMESTER V

U19BM502	MICROPROCESSOR AND RISC ARCHITECTURE	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Digital Logic Design

COURSE OBJECTIVES:

- To introduce system design concepts with 8086 microprocessor and its interfacing devices like 8255, 8253, 8259 and 8251
- To explain the design aspects of microcontrollers with foundational concepts of microcontroller architecture and programming
- To represent the concepts of ARM architecture with LPC2148

UNIT I 8086 MICROPROCESSOR 9

Architecture of 8086 Microprocessor – Addressing modes of 8086 – Instruction set of 8086 – Assembly language programs – Pin diagram of 8086 – Minimum mode and maximum mode of operation – Timing diagram – Memory interfacing to 8086

UNIT II INTERFACING 8086 9

8255 programmable peripheral interface – 8253 programmable interval timer – 8259 programmable interrupt controller – Direct Memory Access (DMA) and 8257 DMA controller – 8279 programmable keyboard display interface – Serial I/O and data communication – 8251 USART – Interfacing data converters ADC and DAC

UNIT III MICROCONTROLLER 8051 9

Intel MCS51 Architecture – Special Function Registers (SFR) – I/O pins – Ports and circuits – Instruction set – Addressing modes – Assembly language programming – Timer and counter programming – Serial communication – Interrupts programming – External memory interfacing

UNIT IV PROGRAMMING A MICROCONTROLLER 9

Design of Simple I/O systems using switches – LEDs – Buzzers – Interfacing character and graphical LCD Displays – RTC interfacing – Interfacing external ADC and DAC – DC motor speed control system – Stepper motor interfacing – Relays – Keypads – Interfacing SD cards and touch screens – Signal processing applications

UNIT V RISC ARCHITECTURE 9

ARM 7 Architecture – LPC2148 – Microcontroller introduction – Internal memory map – Peripheral details – Implementation of GPIO – Timer/counter – UART – Interrupt architecture – ADC and DAC – SPI – I2C and USB features of LPC2148 – Firmware development using embedded C – Introduction to data types – Conditional statements – Loops – Simple programs using embedded C

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Ray A K, Burchandi K.M, "Advanced Microprocessor and Peripherals", 3rd Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2012
2. Mohammed Ali Mazidi and Janice Gillispie Mazidi, "The 8051 Microcontroller and Embedded System", 2nd Edition, Pearson Education Asia, New Delhi, 2006

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REFERENCES:

1. Trevor Martin, "The Insider's Guide to the Philips ARM7- Based Microcontrollers",1st edition, Hitex Publications, UK, 2005
2. Yu-Cheng Liu, Glenn A. Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", 2nd edition, Prentice Hall of India, New Delhi, 2007
3. Janice Gillispie Mazidi, Mohammed Ali Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller: A Systems Approach", 2nd edition, Pearson Education Pvt. Ltd., New Delhi, 2012
4. Jonathan W Valvano, "Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers", 5th edition, Createspace Independent Publishing Platform, UK, 2018

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Illustrate the system design concepts of 8086 microprocessors	Understand
CO2	Explain the design aspects of interfacing devices like 8255, 8253, 8259 and 8251 in system design	Understand
CO3	Outline the design concepts of microcontrollers including the foundational concepts of microcontroller architecture and programming	Understand
CO4	Develop programs using microcontroller 8051 in assembly and embedded C	Apply
CO5	Interpret ARM 7 architecture and its features	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	1	2	1
CO2	3	2	-	-	1	-	-	-	-	-	-	1	2	1
CO3	3	2	-	-	1	-	-	-	-	-	-	1	2	1
CO4	3	2	1	1	1	-	-	-	-	-	-	1	1	2
CO5	3	2	-	-	1	-	-	-	-	-	-	1	3	-
CO	3	2	1	1	1	-	-	-	-	-	-	1	2	1.25
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER V

U19BM503	BIOMATERIALS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To identify the properties and classification of biomaterials
- To explore the types of biomaterials such as metallic, polymeric and tissue-based replacements
- To illustrate the concept of biocompatibility and the methods for biomaterials testing

UNIT I INTRODUCTION TO BIOMATERIALS 9

Definition and classification of biomaterials – Mechanical properties – Viscoelasticity – Biomaterial performance – Body response to implants – Wound healing – Blood compatibility – Nanoscale phenomena

UNIT II METALLIC AND CERAMIC BIOMATERIALS 9

Metallic implants – Stainless steels – Co-based alloys – Ti-based alloys – Shape memory alloy – Nanostructured metallic implants – Degradation and corrosion – Ceramic implant – Bio inert – Biodegradable or bioresorbable – Bioactive ceramics – Nanostructured bio ceramics

UNIT III POLYMERIC IMPLANT MATERIALS 9

Polymerization – Factors influencing the properties of polymers – Polymers as biomaterials – Biodegradable polymers – Bio polymers – Collagen – Elastin and chitin – Natural Polymers – Wool – Silk – Cellulose – Medical textiles – Materials for ophthalmology – Contact lens – Intraocular lens – Membranes for plasma separation and blood oxygenation – Electro spinning a new approach

UNIT IV TISSUE REPLACEMENT IMPLANTS 9

Small intestinal submucosa and other decellularized matrix biomaterials for tissue repair – Extra cellular matrix – Soft tissue replacements – Sutures – Surgical tapes – Adhesive – Percutaneous and skin implants – Maxillofacial augmentation – Vascular grafts – Hard tissue replacement implants – Joint replacements – Tissue scaffolding and engineering using nano biomaterials

UNIT V ASSESSMENT OF BIOMATERIALS 9

Biocompatibility – Blood compatibility and tissue compatibility tests – Toxicity tests – Sensitization – Carcinogenicity – Mutagenicity and special tests – In-vitro and in-vivo testing – Sterilization of implants and devices – Gamma radiation – Autoclaving – Dry Heating – Open Flame Sterilization

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Sujata V. Bhat, "Biomaterials", 2nd Edition, Narosa Publishing House, New Delhi, 2012
2. Seeram Ramakrishna, Murugan Ramalingam, Sampath Kumar. T. S, Winston O. Soboyejo, "Biomaterials a nano approach", 1st edition, CRC press, United States, 2016

REFERENCES:

1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", 1st edition, McGraw Hill Education, 2009

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2. John Enderle, Joseph D. Bronzino, Susan M. Blanchard, "Introduction to Biomedical Engineering", 3rd edition, Elsevier Science, United States, 2012
3. Buddy D Ratner, Allan S Hoffman, Fredrick J Schoen, "Biomaterials science: An introduction to materials in medicine" 3rd edition, Academic Press, Canada 2012
4. Lanza. R, Langer. R, Vacanti. J, "Principles of tissue engineering", 4th edition, Academic Press, Canada, 2007

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the properties of biomaterials and its tissue interaction	Understand
CO2	Identify metals and ceramic implants used for medical applications	Understand
CO3	Compare different polymeric materials and its drug delivery functions in biomedical field	Understand
CO4	Outline the concept behind the different tissue replacements	Understand
CO5	Demonstrate various assessment and evaluation techniques as per biomaterials standards.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	1	3	-
CO2	3	1	-	-	-	-	-	-	-	-	-	1	3	-
CO3	3	1	-	-	-	1	1	-	-	-	-	1	3	-
CO4	3	1	-	-	-	-	-	-	-	-	-	1	3	-
CO5	3	2	1	-	-	-	-	1	-	-	-	1	3	-
CO	3	1.2	1	-	-	1	1	1	-	-	-	1	3	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER V

U19BM504	BIOSIGNAL PROCESSING	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Signals and Systems

COURSE OBJECTIVES:

- To interpret the design aspects of FIR and IIR filter
- To summarize different bio signals and its associated artifacts
- To explore the power estimation and shape analysis of signals for classification

UNIT I INTRODUCTION TO DIGITAL SIGNAL PROCESSING 9

Review of sampling and reconstruction – Discrete-time signals & systems – Correlation of discrete time signals DFT and its properties – FFT algorithm and its application to convolution – Overlap-add methods – Overlap-save methods – Introduction to random process – Methods of description – Stationarity – Time averaging and ergodicity

UNIT II FILTER DESIGN 9

Analog Filter design – Analog Butterworth – Chebyshev LPF design – Transformations – Analog frequency Transformation – Digital Filter Structures – IIR realizations – All Pass Realizations – IIR filter design – IIR design by bilinear transformation – Digital to Digital frequency Transformation – FIR Design – FIR Design by windowing and frequency sampling

UNIT III BIOMEDICAL SIGNALS AND ARTIFACT REMOVAL 9

Nature of Biomedical signals – Characteristics of various bio-signals – Interference associated with each bio-signal – Computer aided diagnosis – Time domain filtering – Synchronous averaging – Moving average filters – Derivative based frequency domain filtering – Optimal filtering – Adaptive filtering using LMS algorithm

UNIT IV POWER SPECTRUM ESTIMATION AND EVENT DETECTION 9

Introduction – Non parametric methods – The Periodogram – Modified Periodogram – Bartlett – Welch 7 Blackman – Turkey methods – Performance comparison – Event detection – ECG – Correlation analysis of EEG channels – Homographic filtering

UNIT V ANALYSIS ON WAVESHAPE SIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition – Statistical signal classification – Linear discriminant function – Back propagation neural network-based classification – Analysis of EEG using Empirical mode decomposition (EMD)

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. John G Proakis and Dimitris G Manolakis, "Digital signal Processing: Principles, Algorithms and Applications", 4th Edition, Prentice Hall of India, New Delhi, 2007
2. Rangaraj M Rangayyan, "Biomedical Signal Analysis: A Case-Study Approach", 2nd edition, Wiley India, New Delhi, 2015
3. Willis J Tompkins, "Biomedical Digital Signal Processing", 1st edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008

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REFERENCES:

1. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", 4th edition, Tata Mc GrawHill Pvt. Ltd., 2011
2. Eugene N Bruce, "Biomedical Signal Processing and Signal Modelling", 1st edition, Wiley India, New Delhi, 2007

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Summarize the basics of discrete time signals and systems	Understand
CO2	Construct the IIR and FIR filters based on the given specifications	Apply
CO3	Identify the biosignals and methods for artifact removal	Apply
CO4	Outline the power spectrum estimation and event detection	Understand
CO5	Interpret the analysis and classification of events in biosignals	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	1	-	3
CO2	3	2	1	-	2	-	-	-	-	-	-	1	-	3
CO3	3	2	1	-	2	1	-	-	-	-	-	1	-	3
CO4	3	2	-	-	2	1	-	-	-	-	-	1	-	3
CO5	3	2	2	-	2	1	-	-	-	-	-	1	-	3
CO	3	2	1.33	-	2	1	-	-	-	-	-	1	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

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SEMESTER V

U19CA002	NUMERICAL APTITUDE AND VERBAL ABILITY II	Category: EEC			
		L	T	P	C
		1	0	0	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of number system, profit and loss and infer time, speed and distance
- To write sentences with appropriate grammatical structure in a professional context

UNIT I NUMBER SYSTEMS 3

Divisibility tests (Divisibility factor – Prime factor – Divisibility rules – Finding unit digit) – LCM & HCF (Listing multiples, Prime Factorization, Division method, etc.) – Number System (Numbers, Prime, Composite, Co-prime, numbers) – Percentage (Percentage – Fractions of percentages – Expenditure – Price – Consumption – Population – Depreciation)

UNIT II PROFIT AND LOSS 3

Profit, Loss & Discounts – (CP, SP, MP, Profit, Loss, Discount) – Ratio & Proportion (Compounded Ratio – Mean – Proportional – Componendo.– Dividendo – Directly proportional – Inversely proportional), Age problems (Various techniques to solve age problems)

UNIT III AVERAGES AND ALLIGATIONS 3

Averages (Simple average, weighted average) – Mixture and Alligations (Various techniques to solve mixtures and alligations) – Boats and streams (Downstream, upstream, average speed)

UNIT IV PERMUTATION AND COMBINATION 3

Time & work (Problems on time, work and effectively) – Permutations & combinations (Arrangements & selections, together and not together problems) – Probability (Coins, card, dice) Logarithms (Log function, common log, natural log, binary log, laws of logarithms) – Areas and volumes

UNIT V WRITING 3

Reading comprehension – Letter writing – Email writing – Creative writing – Resume building

Contact Periods:

Lecture: 15 Periods Tutorial: – Periods Practical: – Periods Total: 15 Periods

TEXT BOOKS:

1. R S Aggarwal, "Quantitative Aptitude for Competitive Examinations", 17th Edition, S Chand Publishing, New Delhi, 2017
2. R S Aggarwal, "Objective General English", S Chand Publishing, New Delhi, 2017

REFERENCES:

1. R S Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", S Chand Publishing, New Delhi, 2017
2. Abhijit Guha, "Quantitative Aptitude for Competitive Examination", 5th edition, McGraw Hill Education India) Private Limited, 2015
3. Arun Sharma, "How to prepare for Quantitative Aptitude for CAT", 8th edition, McGraw Hill Education, Chennai, 2018

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Use basics of counting through permutation and combination for arrangement of tasks	Apply
CO2	Draft letters, emails and make notes with appropriate use of words	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	1	-	-	-	-
CO	3	1	-	-	-	-	-	-	-	-	-	-	-	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)					3: Substantial (High)				

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SEMESTER V

U19BM505	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	Category: PC			
		L	T	P	C
		0	0	4	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To program 8086 microprocessor
- To perform ALP for arithmetic and logical operations in 8086 and 8051
- To interface different I/O's with Microprocessors

LIST OF EXPERIMENTS

1. Basic arithmetic and logical operations using 8086
2. Move a data block without overlap using 8086
3. Code conversion, decimal arithmetic and matrix operations using 8086
4. Floating point operations, string manipulations, sorting and searching using 8086
5. Traffic light controller using 8086
6. Stepper motor controller using 8086
7. Digital clock using 8086
8. A/D and D/A interface and waveform generation using 8086
9. Basic arithmetic and logical operations using 8051
10. Square and cube program, find 2's complement of a number using 8051
11. Unpacked BCD to ASCII using 8051
12. Motor control using 8051
13. LED using 8051
14. Seven segment display using 8051

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply algorithm and program 8086 for basic arithmetic operations	Apply
CO2	Contrast the core and peripherals and its interfaces	Analyze
CO3	Organize the interfacing of peripherals with 8086	Apply
CO4	Develop software programs using microcontroller 8051	Apply
CO5	Experiment with interfacing peripherals with 8051	Apply

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Learn Beyond

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	2	-	-	1	1	1	-	1	2	1
CO2	3	2	1	-	2	-	-	1	1	1	-	1	2	1
CO3	3	2	2	1	2	-	-	1	1	1	-	1	2	1
CO4	3	2	1	-	2	-	-	1	1	1	-	1	2	1
CO5	3	2	1	-	2	-	-	1	1	1	-	1	2	1
CO	3	2	1.2	1	2	-	-	1	1	1	-	1	2	1
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)		

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SEMESTER V

U19BM506	BIOSIGNAL PROCESSING LABORATORY	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Signals and Systems

COURSE OBJECTIVES:

- To design IIR and FIR filters for biomedical signal processing using DSP processor
- To apply the methods of time domain filtering in biomedical signal
- To develop analysis systems for biomedical signal - based applications

LIST OF EXPERIMENTS

1. DSP Processor - Linear and Circular convolutions
2. DSP Processor - Auto correlation and Cross correlation
3. DSP Processor - Frequency analysis of a signal using DFT
4. DSP Processor Design of FIR filters LPF/HPF/BPF/BSF)
5. DSP Processor Design of Butterworth filter and Chebyshev IIR
6. Power Spectrum Estimation
7. Temporal and Synchronous Averaging
8. Adaptive filtering using LMS algorithm
9. Detection of QRS complex in ECG
10. Analysis of EMG
11. Analysis of heart rate variability
12. Spectral analysis of EEG signals

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply the mathematical foundation of convolution, correlation and frequency analysis to a biosignal.	Apply
CO2	Build the IIR and FIR filter for the biosignals	Apply
CO3	Identify the steps to compute power spectrum and filtering techniques	Apply
CO4	Interpret and measure the parameters in ECG	Analyze
CO5	Analyze and interpret the spectral content in EMG and EEG	Analyze

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	3	-	-	1	1	1	-	1	-	3
CO2	3	2	1	-	3	-	-	1	1	1	-	1	-	3
CO3	3	2	1	-	3	-	-	1	1	1	-	1	-	3
CO4	3	2	2	1	3	-	-	1	1	1	-	1	-	3
CO5	3	2	2	1	3	-	-	1	1	1	-	1	-	3
CO	3	2	1.4	1	3	-	-	1	1	1	-	1	-	3
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)		

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SEMESTER V

U19BM507	TECHNICAL SEMINAR	Category: EEC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To identify a topic or problem related to the curriculum
- To represent the collected detail in the form of charts, tables, block diagrams etc.
- To demonstrate the analysis with better professionalism, communication and technical skills utilizing different tools in the presentation and report

There is no specific content in this course; however, teachers/students are supposed to follow the following guidelines

1. Students will select topics on their own. The topics may be on any aspect of science and technology related to healthcare
2. Student would organize preliminary presentations before faculty and other students, in which he/she would explain the topic
3. It is mandatory that each student should present at least 2 topics before the final presentation
4. During the final seminar, each student has to present for duration not less than 30 minutes
5. A technical report with a title page, introduction, body chapters and a conclusion with references, running to not less than 15 pages will be submitted by each student and will be evaluated by the faculty coordinator/guide

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Plan to tackle any problem during group discussion in the interviews	Apply
CO2	Analyze the problem statement given and present them	Analyze
CO3	Develop skills for presenting topics in seminars and conferences	Apply
CO4	Make use of new tools and techniques that projects the professionalism	Apply
CO5	Summarize the technical report	Understand

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Learn Beyond

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	1	1	-	1	-	-
CO2	3	2	2	1	-	1	-	1	1	1	-	1	-	-
CO3	3	2	1	-	-	1	-	1	1	1	-	1	-	-
CO4	3	2	1	-	-	1	-	1	1	1	-	1	-	-
CO5	3	1	-	-	-	1	-	1	1	1	-	1	-	-
CO	3	1.8	1.3	1	-	1	-	1	1	1	-	1	-	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER VI

U19BM601	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To infer the working of devices for diagnosis and treatment of cardiac and neuro emergency
- To explain the techniques used for the analysis and support of respiratory action and waste removal
- To interpret the various sensory measurements and imaging techniques that hold clinical importance

UNIT I CARDIAC AND NEUROLOGICAL EQUIPMENT 9

Heart rate monitor – Holter monitor – Pacemaker – Defibrillator – Evoked Potential – Visual auditory and somatosensory – MEG (Magneto Encephalogram) – Brain stimulation treatment – Biotelemetry

UNIT II MUSCULAR AND BIOMECHANICAL EQUIPMENT 9

Recording and analysis of EMG waveforms – Fatigue characteristics – Muscle stimulators – Nerve stimulators – Nerve conduction velocity measurement – EMG bio feedback instrumentation- Diathermy – Electrosurgical equipment – Cryotherapy – Static measurement – Load Cell – Pedobarograph – Dynamic measurement – Velocity – Acceleration – Gait

UNIT III RESPIRATORY AND UROLOGY EQUIPMENT 9

Spirometer – Pneumotachometer – Whole body Plethysmograph – Intra alveolar and thoracic pressure measurements – Apnoea Monitor – Ventilator modes and working – Heart lung machine – working – Haemodialysis – Peritoneal dialysis – Principle and equipment

UNIT IV SENSORY EQUIPMENT 9

Psychophysiological Measurements – Polygraph – Basal skin resistance (BSR) – Galvanic skin resistance (GSR) – Sensory responses – Audiometer – Pure tone – Speech – Eye Tonometer – Applanation Tonometer – Hearing aids

UNIT V ULTRASONIC AND THERMOGRAPHY TECHNIQUE 9

Tissue Reaction – Application of ultrasound as diagnostic tool – Cardiology – Obstetrics and Gynecology – Ophthalmology – Thermography – Recording and clinical application

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. John G Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt ltd, 2015
2. Joseph J Carr and John M Brown, "Introduction to Biomedical Equipment Technology", 2nd edition, Pearson education, 2012

REFERENCES:

1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", 2nd edition, McGraw Hill, 2003 d
2. Khandpur R S, "Handbook of Biomedical Instrumentation", 3rd edition, Tata McGraw-Hill, 2014
3. Geddes LA and Baker LE, "Principles of Applied Biomedical Instrumentation", 3rd edition, Tata McGraw Hill, 2008

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4. Leslie Cromwell, Fred J Weibell, Erich A Pfeiffer, "Biomedical Instrumentation and Measurement", 2nd edition, Prentice Hall of India, 2015

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Interpret the working of equipment used for cardio and neuro care	Apply
CO2	Identify equipment used for analysis and support of muscular and neurology	Apply
CO3	Explain about parameters related to cure respiratory and urinary system failure	Understand
CO4	Categorize the measurement techniques of sensory responses	Analyze
CO5	Apply the principle of ultrasonic and thermography in medicine	Apply

COURSE ARTICULATION MATRIX:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	1	-	-	-	-	-	1	3	-
CO2	3	2	1	-	1	1	-	-	-	-	-	1	3	-
CO3	3	1	-	-	1	1	-	-	-	-	-	1	3	-
CO4	3	2	2	-	1	1	-	-	-	-	-	1	3	-
CO5	3	2	1	-	1	1	-	-	-	-	-	1	3	-
CO	3	1.8	1.25	-	1	1	-	-	-	-	-	1	3	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER VI

U19BM602	BIOMECHANICS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To summarize the fundamental concepts of biomechanics
- To explore the structure and properties of solid, fluid, hard and soft tissues
- To illustrate the concept of joint mechanics and sport mechanics

UNIT I INTRODUCTION TO BIOMECHANICS 9

Definition and perspective of biomechanics – Kinematics concept for analyzing human motion – kinetic concepts for analyzing human motion – Linear kinetics of human movement – Free body diagram and equilibrium – Angular kinetics of linear movement

UNIT II MECHANIICS OF BIOSOLIDS AND BIOFLUIDS 9

Constitutive equation – Stress – Strain – Viscoelasticity – Flow properties of blood – Rheology of blood in micro vessels – Bio viscoelastic solids

UNIT III MECHANICS OF HARD AND SOFT TISSUES 9

Bones – Structure – Composition – Mechanical properties – Anisotropy – Fracture mechanisms – Pseudo elasticity – Structure – Function – Mechanical properties of Skin – Ligaments – Skeletal muscles and tendons – viscoelastic property

UNIT IV MECHANICS OF JOINTS 9

Skeletal joints – Force and stresses in human joints – Mechanics of the elbow – Mechanics of shoulder – Mechanics of spinal column – Mechanics of hip – Mechanics of knee – Mechanics of ankle

UNIT V SPORTS BIOMECHANICS 9

Gait analysis – Qualitative biomechanical analysis to improve technique – Understand injury development – Motion analysis using video – Force and pressure measurement – Introduction to accelerometer

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Susan J Hall, "Basic Biomechanics", 7th edition, McGraw Hill, 2015
2. Peter M McGinnis, "Mechanics of sports and exercise", 1st edition, Human kinetics, 2013
3. Fung Y C, "Biomechanics: mechanical properties of living tissues", 2nd edition, Springer, 2013

REFERENCES:

1. Michael W Whittle, "Gait analysis: An Introduction", Butterworth Heinemann, 3rd edition, Elsevier, 2007
2. Arthur T Johnson, "Biomechanics & Exercise Physiology", 2nd edition, CRC Press, 2007
3. Carl J Payton and Adrian Burden, "Biomechanical Evaluation of Movement in Sport and Exercise", 2nd edition, Routledge, 2017

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply the basic concepts of biomechanics	Apply
CO2	Illustrate significant mechanical properties of biosolids and biofluids	Understand
CO3	Classify the significant mechanical properties of hard and soft tissues	Understand
CO4	Utilize the function of mechanics of joints	Apply
CO5	Examine the applications of biomechanical studies in sports	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	3	-
CO2	3	1	-	-	-	-	-	-	-	-	-	1	3	-
CO3	3	1	-	-	-	-	-	-	-	-	-	1	3	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	3	-
CO5	3	2	2	-	1	-	-	-	-	-	-	1	2	1
CO	3	1.6	1.33	-	1	-	-	-	-	-	-	1	2.8	1

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER VI

U19BM603	HEALTHCARE MANAGEMENT	Category: HSM			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To gain the knowledge on the basics of healthcare management
- To introduce the human resource management and marketing for hospitals
- To examine the quality and safety aspects in healthcare management

UNIT I INTRODUCTION TO HEALTHCARE ADMINISTRATION 9

Distinction between hospital and industry – Challenges in healthcare administration – Hospital planning – Equipment planning – Functional planning – Current issues in healthcare management – Telemedicine – Bio-medical waste management

UNIT II HUMAN RESOURCE MANAGEMENT AND MARKETING 9

Principles of HRM – Functions of HRM – Profile of HRD manager – Tools of HRD – Human resource inventory – Manpower planning – Different departments of hospital – Recruitment – Selection – Training guidelines – Methods of training – Evaluation of training – Leadership grooming – Promotion and transfer – Quality improvements – Managing healthcare professionals

UNIT III QUANTITATIVE METHODS IN HEALTHCARE MANAGEMENT 9

Introduction to quantitative decision-making methods in healthcare management – Forecasting – Decision making in healthcare facilities – Facility location – Facility layout – Reengineering – Staffing – Scheduling – Productivity – Resource allocation – Supply chain and inventory management – Quality control – Project management – Queuing models and capacity planning

UNIT IV HOSPITAL INFORMATION SYSTEMS AND SUPPORTIVE SERVICES 9

Management decisions and related information requirement – Clinical information systems – Administrative information systems – Support service technical information systems – Medical transcription – medical records department – Central Sterilization and supply Department (CSSD) – Pharmacy – Food services – Laundry services

UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL MANAGEMENT 9

Quality system – Elements – Implementation of quality system – Documentation – Quality auditing – International Standards ISO 9000 – 9004 – Features of ISO 9001 – Environment Management systems – Security – Prevention – Fire safety – Alarm system – Safety rules – Health insurance and managing healthcare – Types of Biomedical waste – Segregation of medical waste – Autoclaving

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Goyal R. C "Hospital Administration and Human Resource Management", 4th edition, PHI, 2006
2. Kunders G D, "Hospitals – Facilities Planning and Management", 5th edition, Tata McGraw Hill, 2007

REFERENCES:

1. Sharon B. Buchbinder and Nancy H. Shanks, "Introduction to Healthcare Management", 1st edition Jones and Bartlett Learning, 2017
2. Cesar A. Caceres and Albert Zara, "The Practice of Clinical Engineering", 1st edition, Academic Press,1977

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3. Norman Metzger, "Handbook of healthcare Human Resources Management", 2nd edition, Aspen Publication Inc. Rockville, Maryland, 1990
4. Arnold D. Kalcizony and Stephen M. Shortell, "Healthcare Management", 6th edition, Cengage Learning, 2011

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Summarize the challenges and advancements in healthcare administration	Understand
CO2	Explain the human resource management and marketing for hospitals	Understand
CO3	Apply various quantitative management methods in healthcare	Apply
CO4	Outline the hospital information system and various supportive services	Understand
CO5	Summarize about quality and safety aspects in hospital management	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	1	1	1	-	-	-	-	-	-
CO2	3	1	-	-	-	1	1	1	-	-	-	-	-	-
CO3	3	2	1	-	-	1	1	1	-	-	-	-	-	-
CO4	3	1	-	-	-	1	1	1	-	-	-	-	-	-
CO5	3	1	-	-	-	1	1	1	-	-	-	-	1	-
CO	3	1.2	1	-	-	1	1	1	-	-	-	-	1	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

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SEMESTER VI

U19BM604	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY	Category: PC			
		L	T	P	C
		0	0	4	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To demonstrate the recording and analysis of different bio potentials
- To examine different therapeutic modalities
- To have knowledge on the working principle of critical care equipment

LIST OF EXPERIMENTS

1. Measure the electrical signal recorded over the occipital cortex in response to light stimulus
2. Study of Pacemaker and Defibrillator as a lifesaving unit
3. Telemetry of vital signals
4. Study of electrical safety of equipment
5. Analyze the working of electro surgical unit in cutting and coagulation
6. Observe the use of high frequency electromagnetic current for the physical therapy and surgery (ultrasound and shortwave)
7. Record the ventilation capacity of lungs
8. Analyze the method and instrument used to produce mechanical ventilation
9. Spot the cleaning of blood using artificial kidney in case of renal failure
10. Spot the working of heart lung machine
11. Record the level of sweat gland activity in response to a situation
12. Measure the hearing ability of an individual using an audiogram
13. Explore the working transducers and image formation in ultrasound scanners for any 2 applications
14. Study of Transcutaneous electrical nerve stimulation using medical simulator

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Total: 60 Periods

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Examine different bioelectric and non-bioelectric signals using various methods	Analyze
CO2	Experiment with the concept of image formation using ultrasound scanners	Apply
CO3	Experiment with the working of various therapeutic equipment	Apply
CO4	Identify the working of life saving equipment	Apply
CO5	Identify the need of electrical safety of biomedical equipment	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	-	1	1	1	1	-	-	3	-
CO2	3	2	1	-	-	-	1	1	1	1	-	-	3	-
CO3	3	2	1	-	-	-	1	1	1	1	-	-	3	-
CO4	3	2	1	-	-	-	1	1	1	1	-	-	3	-
CO5	3	2	1	-	-	-	1	1	1	1	-	-	3	-
CO	3	2.2	1.2	-	-	-	1	1	1	1	-	-	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER VI

U19BM605	MINI PROJECT	Category: EEC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To teach and develop skills to formulate a technical project and to use new tools algorithms and techniques required to carry out the projects
- To estimate the ability of the student in transforming the theoretical knowledge studied so far into aworking model of a biomedical system
- To provide guidelines to prepare technical report of the project

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Analyze a real world problem and requirement and develop the design solutions	Analyze
CO2	Plan the technical ideas, strategies and methodologies	Apply
CO3	Develop the solutions through new tools, algorithms and techniques	Create
CO4	Evaluate through conformance of the developed prototype and analysis the cost effectiveness	Evaluate
CO5	Organize a technical report and present the demonstrations	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	1	1	1	1	1	1	3	3
CO2	3	3	3	3	3	3	1	1	1	1	1	1	3	3
CO3	3	3	3	3	3	3	1	1	1	1	1	1	3	3
CO4	3	3	3	3	3	3	1	1	1	1	1	1	3	3
CO5	3	3	3	3	3	3	1	1	1	1	1	1	3	3
CO	3	3	3	3	3	3	1	1	1	1	1	1	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

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SEMESTER VII

U19BM701	RADIOLOGICAL EQUIPMENT	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To gain knowledge about imaging methodology using X- ray source.
- To educate the working of MRI imaging system and radio diagnostic equipment.
- To discuss the radiation therapy techniques and radiation safety.

UNIT I MEDICAL X-RAY EQUIPMENT 9

Nature of X-rays – X-ray Absorption, tissue contrast, X-ray equipment block diagram – X-ray tube, collimator, bucky grid, power supply – Digital radiography – Discrete digital detectors, image intensifier tubes, digital fluoroscopy, angiography, digital subtraction angiography, mammography

UNIT II COMPUTER TOMOGRAPHY 9

Principles of tomography – Attenuation, CT number, generation of CT scanners, image reconstruction technique, spiral CT scanning, advances of CT with conventional X-ray imaging – collimation, CT detectors, viewing system

UNIT III MRI 9

Interaction of nuclei with static magnetic field and radio frequency wave, rotation and precession, induction of a magnetic resonance signal, bulk magnetization and relaxation processes T1 and T2 – System magnet, generation of gradient magnetic fields, radio frequency coils, shim coils

UNIT IV NUCLEAR MEDICINE SYSTEMS 9

Radio isotopes – Radio pharmaceuticals, Radiotracers – Radiation detectors – Gas filled ionization chambers, proportional counter, GM counter, scintillation detectors – Gamma Camera – Principle of operation, collimator, photo multiplier tube, X-Y positioning circuit, pulse height analyser – Principle and applications of SPECT and PET imaging

UNIT V ULTRASOUND 9

Fundamentals of acoustic propagation, acoustic impedance, reflection, refraction, attenuation, scattering, absorption of ultrasonic energy, velocity of propagation and doppler effect – Ultrasound image capture and display principles of A-Mode – Echo ophthalmoscopes, echoencephalography and echocardiography

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Steve webb, "Physics of Medical Imaging", Taylor and Francis, 2nd edition, 2008
2. Hendee.R, Russell Ritenour, "Medical Imaging Physics", William Wiley, 4th Edition, 2002

REFERENCE BOOKS:

1. Gopal B.Saha, "Physics and Radiobiology of Nuclear Medicine", Springer, 3rd Edition, 2006
2. Myer Kutz, "Standard handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2nd edition, 2009
3. K Kirk Shung, Michael B smith and Benjamim M W Tsui, "Principles of Medical Imaging", Academicpress, 1st edition, 2012

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Interpret the working of X-ray imaging	Apply
CO2	Explain the functional mechanism of computed tomography	Understand
CO3	Make use of the principle of magnetic resonance imaging and interpret the T1 and T2 MRI images	Apply
CO4	Outline the working of nuclear imaging systems	Understand
CO5	Identify the various modes in ultrasound imaging technique and examine the sonograms taken for different diseases	Apply

COURSE ARTICULATION MATRIX

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	1	2	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO4	3	-	1	-	-	-	-	-	-	-	-	1	2	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO	3	2	1	-	-	-	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER VII

U19BM702	MEDICAL IMAGE PROCESSING	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To interpret the fundamentals of image formation and operations.
- To apply the image enhancement and segmentation techniques in medical images.
- To use the techniques of image descriptors in recognition.

UNIT I FUNDAMENTALS OF DIGITAL IMAGES AND TRANSFORMS 9

Digital image processing – Origin, fundamentals, representation – Elements of visual perception – Image sampling – Optimal quantizer – Uniform quantizer – Neighbourhood pixel relationships – Basic image operations – Image transform – 2D DFT, discrete cosine, Haar and Hadamard transforms

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Basic gray level transformation – Histogram equalization and histogram matching – Spatial domain filtering – Smoothening and sharpening – Frequency domain filtering – Color models – Image degradation models – Restoration – Mean filter – Order statistics filter – Adaptive filters

UNIT III IMAGE SEGMENTATION 9

Detection of discontinuities – Detection of points, line and edges – Gradient operators – Laplacian edge linking and boundary detection – Thresholding – Region-based segmentation – Morphological operations – Erosion and dilation – Opening and closing – Hit or miss transformations

UNIT IV IMAGE COMPRESSION AND RECONSTRUCTION 9

Fundamentals – Compression standards – Image compression models – Error free compression – Run length coding – Loss less predictive coding – Lossy predictive coding – Radon transforms – Inverse Radon transform – Filter back projection algorithm – Fourier reconstruction of MRI images

UNIT V IMAGE DESCRIPTION AND RECOGNITION 9

Representation – Boundary descriptors – Regional descriptors – Principal Component Analysis – Recognition based on decision theory and structural methods

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Period

TEXT BOOKS:

1. Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 3rd edition, 2015
2. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education Asia, 4th edition, 2017

REFERENCES:

1. William K. Pratt, "Digital Image Processing", John Wiley and Sons, 4th edition, 2007
2. Suetens P, "Fundamentals of image processing", Cambridge University Press, 1st edition, 2002

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3. Albert Macouski, "Medical Imaging Systems", Prentice Hall Pvt. Ltd., 2nd edition, 1997

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Interpret the image formation, basic operations and transforms deployed on digital images	Analyze
CO2	Analyze different techniques employed for enhancement of images	Analyze
CO3	Apply segmentation methods and morphological operations on images	Apply
CO4	Examine the image compression and reconstruction techniques	Analyze
CO5	Identify image descriptors and recognition methods in medical images	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	1	-	-	-	1	-	3
CO2	3	2	2	-	1	-	-	1	-	-	-	1	-	3
CO3	3	2	1	-	1	-	-	1	-	-	-	1	-	3
CO4	3	2	2	-	1	-	-	1	-	-	-	1	-	3
CO5	3	2	1	1	1	-	-	1	-	-	-	1	-	3
CO	3	2	1.6	1	1	-	-	1	-	-	-	1	-	3

Correlation levels:	1: Slight (Low)	2: Moderate(Medium)	3: Substantial (High)

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SEMESTER VII

U19BM703	PROJECT MANAGEMENT AND ENTREPRENEURSHIP	Category: HSM			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To Understand the Project, Project Life Cycle, Roles, Challenges and Importance of Project Management
- To Interpret the key aspects of managing risks in project proposals
- To Impart the entrepreneurial competencies efficiently and effectively

UNIT I INTRODUCTION TO PROJECT MANAGEMENT 9

Project Management – Definition –Goal – Lifecycles - Project Environment. Project Manager – Roles-Responsibilities and Selection

UNIT II PLANNING, BUDGETING AND RISK MANAGEMENT 9

The Planning Process – Work Break down Structure. Cost Estimating and Budgeting - Process, Summaries, schedules and forecasts. Managing risks - concepts, identification, assessment and response planning

UNIT III PROJECT EVALUATION 9

PERT & CPM Networks - Project durations and floats - Crashing – Capital Budgeting: Discounted and Non-Discounted Cash flow Techniques

UNIT IV ENTREPRENEURAL COMPETENCE AND BUSINESS 9

Entrepreneurship concept – Entrepreneurship as a Career – Personality, characteristics, Knowledge and Skills of a successful Entrepreneur. Sources of Product for Business – Prefeasibility Study – Criteria for Selection of Product Project Profile Preparation

UNIT V BUSINESS PLAN AND LAUNCHING OF SMALL BUSINESS 9

Matching Entrepreneur with the Project – Feasibility Report Preparation and Evaluation Criteria – Finance and Human Resource Mobilization - Operations Planning - Market and Channel Selection – Growth Strategies - Product Launching – Incubation, Venture capital, Start-ups

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Panneerselvam. R, Senthilkumar. P, Project Management, PHI Learning, 2009
2. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2016

REFERENCES:

1. John M. Nicholas, Project Management for Business and Technology - Principles and Practice, Second Edition, Pearson Education, 2006
2. Dr. Vasant Desai, "Small Scale Industries and Entrepreneurship", HPH, 2006
3. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 8 th edition, 2017

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K–Level
CO1	Explain the project life cycle, challenges and importance of project management	Understand
CO2	Illustrate the tools and techniques for successful project management	Understand
CO3	Summarize the risk management and mobilizing the project resources	Understand
CO4	Utilize the entrepreneurial skills in business	Apply
CO5	Develop the competencies for effective business management	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	-	1	1	1	1	-	1	1	-	-
CO2	1	1	-	-	-	1	1	1	1	-	1	1	-	-
CO3	1	1	-	-	-	1	1	1	1	-	1	1	-	-
CO4	1	1	1	-	-	1	1	1	1	-	1	1	-	-
CO5	1	1	1	-	-	1	1	1	1	-	1	1	-	-
CO	1	1	1	-	-	1	1	1	1	-	1	1	-	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER VII

U19BM704	MEDICAL IMAGE PROCESSING LABORATORY	Category: PC			
		L	T	P	C
		0	0	4	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To apply the image enhancement and segmentation techniques in medical images.
- To use the image descriptors and representation in medical images.
- To utilize the image compression models and reconstruction techniques.

LIST OF EXPERIMENTS

1. Basic operations on images
2. Sampling and quantization
3. Gray level transformation on images
4. Histogram equalization
5. Image enhancement using spatial filtering
6. Image enhancement using frequency domain filtering
7. Image segmentation
8. Color image processing
9. Morphological operations on images
10. Image representation using descriptors
11. Lossless and lossy compression on images
12. Texture and morphological analysis of medical images
13. Image reconstruction using Radon transform
14. Mini project

Contact Periods:

Lecture: 0 Periods Tutorial: -- Periods Practical: 30 Periods Total: 30 Periods

REFERENCES:

1. Gonzalez R. C, Woods R. E, Eddins S. L, "Digital Image Processing Using MATLAB", Prentice Hall India Pvt. Ltd., 1st edition, 2004.
2. MATLAB Image Processing Toolbox, https://www.mathworks.com/products/image.html
3. Python Scikit-Image, https://scikit-image.org/

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COURSE OUTCOMES:

Upon completion of the course, the students will be able to

COs	Statements	K-Level
CO1	Identify the basic operations that can be deployed on images	Apply
CO2	Make use of image enhancement and segmentation techniques in the processing of medical images	Apply
CO3	Compare lossless and lossy image compression techniques	Analyze
CO4	Inspect the features of an image using various image descriptors and morphological operations	Analyze
CO5	Apply radon and inverse radon transform to reconstruct an image	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	3	-	-	1	1	1	-	1	-	3
CO2	3	2	1	1	3	-	-	1	1	1	-	1	-	3
CO3	3	3	2	1	3	-	-	1	1	1	-	1	-	3
CO4	3	3	2	1	3	-	-	1	1	1	-	1	-	3
CO5	3	2	1	1	3	-	-	1	1	1	-	1	-	3
CO	3	2.4	1.4	1	3	-	-	1	1	1	-	1	-	3
Correlation levels:				1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)		

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SEMESTER VIII

U19BM801	PROJECT WORK	Category: EEC			
		L	T	P	C
		0	0	20	10

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop the ability to identify and solve a specific problem in the field of Biomedical Engineering
- To develop the ability to identify and solve a specific problem in the field of Biomedical Engineering
- To train the students in preparing project reports and to face reviews and viva voce examination

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Identify and define complex problems related to biomedical engineering	Apply
CO2	Analyze the technical aspects of the chosen project with comprehensive surveys and systematic approach	Analyze
CO3	Design and implement appropriate methodologies to address identified problems and experimental procedures of developed technical project in a team	Create
CO4	Examine the project data with appropriate statistical and qualitative analysis techniques in biomedical engineering	Evaluate
CO5	Conclude and report the solution for the problem identified in Biomedical Engineering	Evaluate

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	1	1	1	1	1	1	3	3
CO2	3	3	3	3	3	3	1	1	1	1	1	1	3	3
CO3	3	3	3	3	3	3	1	1	1	1	1	1	3	3
CO4	3	3	3	3	3	3	1	1	1	1	1	1	3	3
CO5	3	3	3	3	3	3	1	1	1	1	1	1	3	3
CO	3	3	3	3	3	3	1	1	1	1	1	1	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19BMP01	AI AND MACHINE LEARNING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To utilize the fundamentals of probability distribution for machine learning
- To formulate the mathematical foundation behind supervised and unsupervised learning
- To apply the supervised and unsupervised methods to develop decision systems

UNIT I INTRODUCTION TO AI 9

Artificial Intelligence (AI) – Foundation – History – State of the art – Problem solving by searching – Problem solving agents – Problem formulation – Search types – Breadth-first – Uniform-cost – Depth -first – Depth-limited – Iterative depth – First search

UNIT II LEARNING TYPES AND METHODS 9

Components of learning – Simple learning model – Types of learning – Supervised – Reinforcement – Unsupervised – Other views of learning – Error and noise – Error measures – Noisy targets

UNIT III REGRESSION 9

Supervised learning – Linear regression – Algorithm – Univariate – Bivariate – Generalization issues – Bias – Variance – Learning curve – Overfitting – Regularization – Case study – Breast Cancer Wisconsin (Prognostic) – Parkinsons Telemonitoring Data Set

UNIT IV CLASSIFICATION 9

Linear classification – Non separable data – Logistic regression – Gradient descent – Artificial Neural Network (ANN) – Single-layer feed forward – Multi-layer feed forward – Back propagation – Support Vector Machines (SVM) – Case study – Mammographic mass detection

UNIT V UNSUPERVISED CLUSTERING 9

General problem – K-means clustering – Choosing the k Mixture models – EM algorithm – Gaussian mixture model – Bayesian network

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", 3rd edition, Prentice Hall Series, 2016
2. Abu-Mostafa Y.S, Magdon-Ismali M, Lin H.T, "Learning from Data", 1st edition, AML Book Publishers, 2012

REFERENCES:

1. Simon Rogers, Mark Girolami, "A first Course in Machine Learning", 1st edition, CRC Press, 2011
2. Alpaydin Ethem, "Introduction to Machine Learning", 2nd edition, MIT Press, 2014
3. UCI Machine learning repository, https://archive.ics.uci.edu/

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Summarize the fundamentals and problem solving techniques in AI	Understand
CO2	Infer the types of learning methods	Understand
CO3	Apply linear regression methods on any given dataset	Apply
CO4	Identify data using neural networks and support vector machine	Apply
CO5	Make use of appropriate unsupervised clustering technique on any given data	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	1	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	1	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	1	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	1	-	-	-	-	-	-	-	-	-
CO	3	1.6	1	-	1	-	-	-	-	-	-	-	-	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19BMP17	BIOSENSORS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To illustrate the basic principle of operation of biosensors
- To explore the basics of biosensor fabrication using different techniques
- To interpret the medical applications of various types of biosensors

UNIT I INTRODUCTION 9

Biosensors – Advantages and limitations – Various components of biosensors – Biocatalysis-based biosensors – Bio affinity-based biosensors and microorganisms-based biosensors – Biologically active material and analyte – Types of membranes used in biosensor constructions

UNIT II TRANSDUCERS IN BIOSENSORS 9

Various types of transducers – Principles and applications – Calorimetric – Optical – Potentiometric / Amperometric – Conductometric – Piezoelectric – Semiconductor – Impedimetric – Chemiluminescence based biosensors

UNIT III BIORECEPTORS AND BIOSENSOR SYSTEMS 9

Enzyme – Nucleic acid – Cell based systems – Biomimetic receptors – Immobilization of biomolecules – Biosensors for various applications – Medical diagnosis – Food analysis – Drug development – Environmental monitoring

UNIT IV CHEMICAL BIOSENSORS 9

Blood gas and pH sensors – Bio-analytical sensor – Enzymatic biosensors – Optical biosensors – pO2 and pCO2 sensor – Manufacturing techniques of biosensors

UNIT V APPLICATION AND USES OF BIOSENSORS 9

Biosensors in clinical chemistry – Medicine and health care – Biosensors for environmental monitoring – Application of enzymes in analysis – Design of enzyme electrodes and their application as biosensors in industry – Healthcare – Food and environment

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Brian R Eggins, "Biosensors an Introduction", 1st edition, John Wiley & Sons Publishers, 1996
2. Sing-Tze Bow, "Pattern Recognition and Image Processing", 2nd edition, Marcel Dekker Inc, 2002
3. Donald G. Buerk, "Biosensors Theory and Applications", 1st edition, Technomic Publishing, 1993

REFERENCES:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd edition, Tata McGraw – Hill, 2014
2. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt. Ltd, 2015
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurement", 2nd edition, Prentice Hall of India, 2015
4. Harry. N. Norton, "Biomedical Sensors - Fundamentals and applications", 1st edition, Noyes Publication, 1982

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the basic principles and working of biosensors	Understand
CO2	Classify the various types of transducers and their corresponding applications	Analyze
CO3	Illustrate the types of bio-molecules for immobilization	Understand
CO4	Interpret the working principles of several of types of chemical biosensors	Understand
CO5	Identify the applications of biosensors with respect to its types	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	1	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	1	3	-
CO3	3	1	-	-	-	-	-	-	-	-	-	1	3	-
CO4	3	1	-	-	-	-	-	-	-	-	-	1	3	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	3	-
CO	3	1.4	1.5	-	-	-	-	-	-	-	-	1	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19BMP24	BIOMEMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To explore the fundamentals micro fabrication technology
- To infer the engineering mechanics concepts relevant to micro systems
- To analyze the concepts of micro sensors and micro actuators in biomedical applications

UNIT I FABRICATION TECHNOLOGIES 9

MEMS and microsystems – Silicon and its compounds – Photolithography – Ion implantation – Diffusion – Oxidation – CVD – PVD – Etching – Surface micromachining – Bulk micromachining – LIGA

UNIT II ENGINEERING MECHANICS FOR MICROSYSTEMS DESIGN 9

Mechanics for MEMS design – Static bending of thin plates – Mechanical vibration analysis – Thermo mechanical analysis – Fractures mechanics analysis – Thin film mechanics – Overview of finite element analysis

UNIT III MICRO SENSORS AND MICRO ACTUATORS 9

Biosensors – Chemical sensors – Optical sensors – Thermal sensors – Micro actuators – Thermal forces – Shape memory alloys – Electrostatic forces – Piezoelectric actuation – Micro Accelerometer

UNIT IV MICROFLUIDIC DEVICES AND COMPONENTS FOR BIO-MEMS 9

Microfluidics – Continuity equation – Momentum equation – Laminar flow in circular conduits – Micropump – Microvalves – Micromotors – Micromixers – Applications in Bio-MEMS

UNIT V SENSING TECHNOLOGIES FOR BIO-MEMS APPLICATIONS 9

Capillary electrophoresis – MEMS based drug delivery – Microneedle – Micro reservoir – Micro dispensing – Microchip capillary electrophoresis systems for DNA analysis – BioMEMS devices for proteomics – Pharmaceutical analysis using Bio-MEMS

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", 2nd edition, Tata McGraw Hill Publishers, 2002
2. Wanjun Wang, Stephen A. Soper, "BioMEMS: Technologies and Applications", 1st edition, CRC Press, 2007

REFERENCES:

1. Marc J. Madou, "Fundamentals of Micro-fabrication: The Science of Miniaturization", 1st edition, CRC Press, 2002
2. Chang Liu, "Foundations of MEMS", 1st edition, Pearson Education International, 2006
3. Nitaigour, Premchand Mahalik, "Micro Electro Mechanical Systems (MEMS)", 1st edition, Tata McGraw Hill Publishers, 2007

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Illustrate the micro fabrication technologies	Understand
CO2	Infer the engineering mechanics concepts involved in different structures	Understand
CO3	Analyze the suitable biosensors and micro actuators for BioMEMS applications	Analyze
CO4	Illustrate the fluid dynamics concepts for micro actuations	Understand
CO5	Apply the knowledge in specific biological applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	1	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO	3	1.5	1.5	-	-	-	-	-	-	-	-	-	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

		Category: PE			
U19BMP15	COMPREHENSION I	L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Calculus and Differential Equations, Complex Variables and Complex Differential Equations, Electronic Devices and Circuits, Signals and Systems, Linear Integrated Circuits, Probability and Statistics and Digital Logic Design

COURSE OBJECTIVES:

- To utilize the fundamentals of probability distribution for machine learning
- To formulate the mathematical foundation behind supervised and unsupervised learning
- To apply the supervised and unsupervised methods to develop decision systems

UNIT I ENGINEERING MATHEMATICS I 9

Linear Algebra: Matrix algebra – Systems of linear equations – Eigenvalues and Eigenvectors
Calculus: Mean value theorems – Theorems of integral calculus – Partial derivatives – Maxima and Minima – Multiple integrals – Fourier series – Vector identities – Line – Surface and Volume integrals – Stokes – Gauss and Green's theorems

Differential equations: First order linear and nonlinear differential equations – Higher order linear differential equations with constant coefficients – Method of separation of variables – Cauchy's and Euler's equations – Initial and boundary value problems – Solution of partial differential equations

UNIT II ENGINEERING MATHEMATICS II 9

Analysis of complex variables: Analytic functions – Cauchy's integral theorem and integral formula – Taylor's and Laurent's series – Residue theorem

Probability and Statistics: Sampling theorems – Conditional probability – Mean – Median – Mode and standard deviation – Random variables – Discrete and continuous distributions – Normal – Poisson and binomial distributions – Tests of Significance – Statistical power analysis – Sample size estimation – Linear Regression and correlation analysis

Numerical Methods: Matrix inversion – Numerical solutions of nonlinear algebraic equations – Iterative methods for solving differential equations – Numerical integration

UNIT III ELECTRICAL CIRCUITS 9

Voltage and current sources – Independent – Dependent – Ideal and practical – V-I relationships of resistor – Inductor and Capacitor – Transient analysis of RLC circuits with de excitation – Kirchhoff's laws – Superposition – Thevenin – Norton – Maximum power transfer and reciprocity theorems – Peak – Average and rms values of ac quantities – Apparent – Active and reactive powers – Phasor analysis – Impedance and admittance – Series and parallel resonance – Realization of basic filters with R – L and C elements – Bode plot

UNIT IV SIGNALS AND SYSTEMS 9

Continuous and Discrete Signal and Systems – Periodic – Aperiodic and impulse signals – Sampling theorem – Laplace and Fourier transforms – Impulse response of systems – Transfer function – Frequency response of first and second order linear time invariant systems – Convolution – correlation – Discrete time systems – Impulse response – Frequency response – DFT – Z – transform – Basics of IIR and FIR filters

UNIT V ANALOG AND DIGITAL ELECTRONICS 9

Basic characteristics and applications of diode – BJT and MOSFET Characteristics and applications of operational amplifiers – Difference amplifier – Adder – Subtractor – Integrator – Differentiator – Instrumentation amplifier – Buffer – Filters and Waveform generators

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Number systems – Boolean algebra – Combinational logic circuits – Arithmetic circuits – Comparators – Schmitt trigger – Encoder/decoder – MUX/DEMUX – Multi-vibrators – Sequential circuits – Latches and flip flops – State diagrams – Shift registers and counters – Principles of ADC and DAC – Microprocessor – Architecture – Interfacing memory and input – Output devices

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

1. Anil K. Maini, Varsha Agrawal, Nakul Maini, "Wiley Acing the Gate: Engineering Mathematics, (Kindle Edition), 1st edition, Wiley India Pvt Limited, 2016
2. Jacob Millman, Christos C. Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems", 1st edition, McGraw-Hill, 2007
3. Ronald J. Toccii , "Digital Electronic Principles and applications", Pearson Publications
4. BP Lathi, "Modern digital and analog Communications system", 4th edition, Indian Edition
5. Alan V. Oppenheim, "Signals & Systems", 2nd edition, Eastern Economy Edition, 1997

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Identify eigenvalues and eigenvectors and apply Laplace transform technique to solve the given ordinary differential equation	Apply
CO2	Solve Partial Differential Equations, linear, nonlinear, homogeneous and non–homogeneous, by various methods	Apply
CO3	Analyze the applications and characteristics of electronic circuits	Analyze
CO4	Apply the fundamentals of signals and systems	Apply
CO5	Analyze the fundamentals of modern digital and analog communication systems	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO5	3	2	2	1	-	-	-	-	-	-	-	-	1	-
CO	3	2	1.4	1	-	-	-	-	-	-	-	-	1	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

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PROFESSIONAL ELECTIVE

U19BMP02	DATA MINING AND PATTERN RECOGNITION	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To interpret the knowledge representation in data mining
- To apply the techniques of data mining and clustering in data
- To deploy the pattern recognition methods in healthcare applications

UNIT I CONCEPT OF DATA MINING 9

Data Mining – Exploratory data analysis – Pattern mining – Clustering and classification – Numerical attributes – Univariate – Bivariate and Multivariate analysis – Categorical attributes – Univariate – Bivariate and Multivariate analysis

UNIT II TECHNIQUES OF DATA MINING 9

Graph models – Kernel methods – Kernel matrix and vector kernels – Basic kernel operations – Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Itemset mining – Algorithms – Sequence mining

UNIT III CLUSTERING 9

Representative based clustering – K-Means – Expectation maximization – Hierarchical clustering – Density based clustering – DBSCAN – Kernel density estimation

UNIT IV PATTERN RECOGNITION 9

Patterns and pattern recognition – Significance and potential function of pattern recognition system – Configuration – Representation of patterns – Approaches to their machine recognition – Paradigm applications

UNIT V PICTORIAL PATTERN RECOGNITION 9

Image edge sharpening – Morphological operation – Boundary detection and contour tracing – Image analysis via medial axis transformation – Shape descriptors – Exemplary applications – Computer aided diagnosis system for medical images – Document image analysis

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Mohammed J. Zaki, Wagner Meira Jr, "Data Mining and Analysis: Fundamental Concepts and Algorithms", 1st edition, Cambridge University Press, 2014
2. Sing-Tze Bow, "Pattern Recognition and Image Processing", 2nd edition, Marcel Dekker Inc., 2002

REFERENCES:

1. Hastie Tibshirani and Friedman, "The Elements of Statistical Learning", 2nd edition, Springer Series in Statistics, 2013
2. Jain Pei, Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", 3rd edition, Elsevier, 2011
3. Richard O Duda, Peter E Hart and David G Stork, "Pattern Classification", 2nd edition, John Wiley and sons, 2010
4. Earl Gose, Richard Johnsonbaugh and Steve Jost, "Pattern Recognition and Image Analysis", 1st edition, Prentice Hall, New Delhi, 2009

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Demonstrate the concept of data analysis and processing	Understand
CO2	Illustrate the techniques pertaining to data mining	Understand
CO3	Apply various clustering techniques for pattern recognition	Apply
CO4	Inspect the mathematical foundations in supervised learning methods	Analyze
CO5	Analyze pictorial pattern recognition in healthcare data	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	1	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	1	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	1	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	1	-	-	-	-	-	-	-	-	1
CO	3	1.6	1.67	-	1	-	-	-	-	-	-	-	-	1
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19BMP09	INTERNET OF MEDICAL THINGS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To describe what IoT is and how it works today
- To recognize the factors that contributed to the emergence of IoT
- To design and program IoT devices

UNIT I INTERNET OF THINGS 9

Defining internet of things – Internet of Medical Things IoMT – A web 3.0 views – a panoramic view of IOT applications – Important vertical IOT applications – Telematics and intelligent transport systems – Smart grid and electric vehicles – Smarter planet and smart buildings – Four pillars of IOT

UNIT II MIDDLEWARE FOR IOT 9

An overview of middleware– Communication middleware for IoT– MTC/M2M middleware – SCADA middleware – RFID middleware – WSN middleware – LBS and surveillance middleware

UNIT III PROTOCOL STANDARDIZATION FOR IOT 9

IoT protocol standardization – M2M and WSN protocols – SCADA and RFID protocols – Issues with IoT standardization – Unified data standards – Challenging task – Platform middleware for WoT – Unified multitier WoT architecture

UNIT IV CLOUD OF THINGS 9

Introduction to cloud storage models – Grid – SOA – Cloud computing – Cloud middleware – Mobile cloud – Could of things architecture

UNIT V TRENDS IN THE INTERNET OF MEDICAL THINGS 9

Wearable in the workplace – Personal healthcare devices – Data-driven health – Solutions from unexpected sources – Remote health monitoring – Diagnostic IoT – Personalized healthcare with Watson

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Honbo Zhou, "The Internet of Things in the Cloud A Middleware Perspective", 1st edition, CRC Press, 2013
2. Adrain Mc Ewen, Hakim Cassimally, "Designing the Internet of Things", 1st edition Wiley, 2014
3. Ken Briodagh, "IoT Time: Evolving Trends in the Internet of Things", 1st edition, IoT Evolution, TMCnet & Crossfire Media, 2017

REFERENCES:

1. Marco Schwartz, "Internet of Things with the Arduino Yun", 1st edition, Packt Publishing, 2014
2. Arshdeep Bahga, Vijay K. Madisetti, "Internet of Things A Hands-on Approach", 1st edition, VPT, 2014
3. Rolf H. Weber, Romana Weber, "Internet of Things Legal Perspectives", 1st edition, Springer, 2010

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Outline the basic concepts in IoMT	Understand
CO2	Summarize the different middleware involved in the IoT	Understand
CO3	Utilize prescribed standards for IoT protocols	Apply
CO4	Explain the cloud of things	Understand
CO5	Apply the internet of things in healthcare	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1		-	1	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	1	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	1	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	1	-	-	-	-	-	-	-	-	-
CO	3	1.4	1.56	-	1	-	-	-	-	-	-	-	-	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)		

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PROFESSIONAL ELECTIVE

U19BMP13	BIOPHOTONICS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To interpret the different optical signatures found in biological systems
- To evaluate modern biophotonic instrumentation
- To analyze the applications in the field of biophotonics

UNIT I OVERVIEW OF BIOPHOTONICS 9

Nature of light – Biophotonics spectral windows – Light absorption – Signal attenuation – Macromolecules – Biological cells – Biological tissues and organs – Diverse applications

UNIT II PROPERTIES OF LIGHT AND BIOPHOTONICS LASER 9

Light wave characteristics – Polarization – Quantized photon energy and momentum – Reflection and refraction – Snell's law – Fresnel equations – Diffuse reflection – Biophotonics laser – Laser action – Laser diode – Solid state laser – Gas laser – Optical fiber laser

UNIT III PHOTOBIOLOGY 9

Photo processes in biopolymers – Human eye and vision – Photosynthesis – In vivo photo excitation and spectroscopy – Optical biopsy – Single molecule detection

UNIT IV LIGHT ACTIVATED THERAPY 9

Photodynamic therapy (PDT) – Basic principles – Photo sensitizers for PDT – Mechanism of photodynamic action – Light irradiation of PDT – Two-photon PDT – Applications

UNIT V BIOSENSORS AND TECHNOLOGY APPLICATIONS OF BIOPHOTONICS 9

Optical Sensor – ELISA – Optical fiber movements – Microbending fiber sensor – Interferometric sensor – Mach Zehnder – Michelson – Sagnac interferometers – Optical manipulation – Miniaturized analyses tools – Microscope in a needle – Single nanoparticle detection – Neurophotonics

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Paras N. Prasad, "Introduction to Biophotonics", 1st edition, A John Willey & Sons Publications, 2003
2. Gerd Keiser," Biophotonics - concepts to applications", 2nd edition, Springer Publication, 2016

REFERENCES:

1. Vasa.P, Mathur.D, "Ultrafast Biophotonics", 1st edition, Springer International Publishing, 2016
2. Tuan Vo-Dinh, "Biomedical Photonics – Handbook", 1st edition, CRC Press, 2014
3. Markolf H. Niemz, "Laser-Tissue Interaction Fundamentals and Applications", 1st edition, Springer, 2007
4. David Baxter.G, "Therapeutic Lasers – Theory and Practice", 1st edition, Churchill Livingstone Publications, 2001

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Illustrate the light interaction process on tissues and organs	Understand
CO2	Apply the properties of light and biophotonics laser	Apply
CO3	Explain the non-ionizing radiations in living organisms	Understand
CO4	Categorize the detectors for ionizing radiations	Analyze
CO5	Identify the development and applications of biophotonics	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO3	3	1	-	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO	3	1.6	1	-	-	-	-	-	-	-	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19BMP18	BIOTECHNOLOGY FOR BIOMEDICAL ENGINEERS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To illustrate the basics of protein engineering and monoclonal antibodies
- To interpret the principles behind antisense technology, genome analysis and gene therapy
- To cognize the basics of vaccine production, cell engineering and metabolic engineering

UNIT I CONCEPTS OF BIOTECHNOLOGY 9

Introduction to cell biology – Macromolecules – Molecular biology – Genetic engineering – Culturing of cells: plants & animals – Bioinformatics

UNIT II PROTEINS, STRUCTURE & PROTEOMICS 9

Protein structures: Primary, Secondary, tertiary and quaternary – Alpha helix, beta sheets and loop structures – Substrate binding sites – Structure and function relations – Components of proteomics – Protein arrays – Cross linking methods

UNIT III ANTIBODIES 9

Introduction to antibodies – Immunoglobulins: monoclonal, polyclonal, structure and function – Antibody engineering – Expression vector and host system – Cell culture optimization – Downstream processing – Stability – Composition – Toxicology – applications

UNIT IV GENOME ANALYSIS, GENE EXPRESSIONS AND GENE THERAPY 9

General principles – Enabling technologies – Tools for genome analysis – Recombinant retroviruses and adenoviruses – Adeno associated viruses – Direct injection of naked DNA – Particle-mediated gene transfer – Liposome-mediated gene delivery – Other gene transfer methods, mRNA mediated targets

UNIT V CELL ENGINEERING AND METABOLIC ENGINEERING 9

Cell engineering – Basic principles – Cell proliferation – Cell adhesion – Cell migration – Metabolic engineering – Basic principles – Problem definition – Analysis of metabolic networks – Implementing changes – Analysis of changes

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Martin L. Yarmush, Mehmet Toner, Robert Plonsey, Joseph D.Bronzino, "Biotechnology for Biomedical Engineers", 1st edition, CRC Press, 2005
2. Ghasem Najafpour, "Biochemical Engineering and Biotechnology", 2nd edition, Elseiver Science, 2015

REFERENCES:

1. Mauro giacca, "Gene Therapy", 1st edition, Springer Verlag Italia, 2010
2. Conrad Lichtenstein, Wolfgang nellen, "Antisense Technology: A Practical Approach", 1st edition, Oirl Press, 1997

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply the basic concepts of biotechnology	Apply
CO2	Interpret the structure and functions of proteins	Understand
CO3	Identify the types of antibodies and their processing	Apply
CO4	Utilize the interaction of gene therapy in biology	Apply
CO5	Explain the concepts of cell engineering and metabolic engineering	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO	3	1.6	-	-	-	-	-	-	-	-	-	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19BMP03	HEALTHCARE DATA ANALYTICS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To compare the existing systems of healthcare data
- To interpret the data acquired using various sensors
- To explore the applications of natural language processing in healthcare industry

UNIT I INTRODUCTION 9

Healthcare data sources and basic analytics – Applications and practical systems for healthcare

UNIT II HEALTHCARE DATA SOURCES AND BASIC ANALYTICS 9

Electronic Health Records (EHR) – Components – Benefits– Challenges – Biomedical image analysis – Biomedical imaging modalities – Object detection – Image segmentation – Feature extraction

UNIT III MINING OF SENSOR DATA AND GENOMICS 9

Taxonomy of sensors – Sensor data mining applications – Biomedical signal analysis – Types – Signal analysis – Algorithms for time series analysis – Genome data analysis – Genomic data generation – Methods for data analysis

UNIT IV NATURAL LANGUAGE PROCESSING FOR CLINICALTEXT 9

Report analyzer – Core NLP components – Mining information from clinical text – Information Extraction – Current methodologies – Evaluation metrics

UNIT V APPLICATIONS / CASE STUDIES 9

Data analytics for pervasive health – Data analytics for pharmaceutical discoveries – Clinical decision support systems knowledge based CDSS – Non-knowledge based CDSS – Diagnostic decision support – Medical imaging case studies CT – MRI disease detection

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: –Periods Total: 45 Periods

TEXT BOOKS:

1. Chandan K. Reddy and Charu C. Aggarwal, "Healthcare Data Analytics", 5th edition, Chapman and Hall/ CRC Press, 2015
2. Hui Yang and Eva K. Lee, "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement", 1st edition, John Wiley & Sons, 2016

REFERENCES:

1. Trevor L. Strome, "Healthcare Analytics for Quality and Performance", 1st edition, 2013
2. Jain Pei, Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques",3rd edition, Elsevier, 2011
3. Richard O Duda, Peter E Hart and David G Stork, "Pattern Classification", 2nd edition, Wiley India Private limited, 2010

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

Cos	Statements	K-Level
CO1	Interpret the concept of healthcare data sources	Apply
CO2	Analyze the methods for biomedical data analysis	Analyze
CO3	Identify the methods to analyze the sensor and genomic data	Apply
CO4	Select the methods of analysis in natural language processing	Apply
CO5	Apply the data analysis methods in clinical decision support systems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	1	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	1	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	1	-	-	-	-	-	-	-	-	-
CO	3	2	1.2	-	1	-	-	-	-	-	-	-	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19BMP05	VIRTUAL REALITY	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To explore the technology through demonstrations, case studies and applications
- To analyze the concepts of virtual reality to build a biomedical real time application
- To apply the augmented reality concepts to build a biomedical engineering application

UNIT I INTRODUCTION 9

The three 1's of virtual reality – Commercial VR technology and the five classic components of a VR system – Input devices – Trackers– Navigation and gesture interfaces – Three dimensional position trackers – Navigation and manipulation Interfaces – Gesture interfaces - Output devices – Graphics displays – Sound displays and haptic feedback

UNIT II DEVELOPMENT PROCESS 9

Geometric modeling – Kinematics modeling – Physical modeling – Behavior modeling – Model Management – Advantages and disadvantages

UNIT III HEALTH AND SAFETY CONSIDERATIONS 9

Methodology and terminology – User performance studies – VR health and safety issues – Usability of virtual reality system – Cyber sickness – Side effects of exposures to virtual reality environment

UNIT IV WEB AND MOBILE 9

JS – Pros and cons – Building blocks – WebVR – WebGL – Three.js – Device orientation events – Frameworks – A frame – React VR – Google VR for android – Scripts – Mobile device configuration – Building to android – Cameras and interaction – Teleporting – Spatial audio – Assessing human parameters – Device development and drivers – Design Haptics

UNIT V APPLICATIONS 9

Medical applications – Military applications – Robotics applications – Advanced real-time tracking – Other applications – Games – Movies and simulations

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Burdea and Philippe Coiffet C, "Virtual Reality Technology", 2nd edition, John Wiley and Sons, 2008
2. Jason Jerald, "The VR Book: Human-centered design for virtual reality", 1st edition, Association for Computing Machinery and Morgan and Claypool, 2015

REFERENCES:

1. Dieter Schmaltz stag and Tobias Hollered, "Augmented Reality: Principles and Practice (Usability)", 2nd edition, Pearson Education (US), 2016
2. Steve Aukstakal Nix, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)", 1st edition, Addison-Wesley Professional, 2016
3. Robert Scoble and Shel Israel, "The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything", 1st edition, Patrick Brewster Press, 2016
4. Tony Parisi, "Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages", 1st edition, O'Reilly Media, 2014

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the components of input and output devices in VR	Understand
CO2	Identify problem statements and function as a member of an engineering design team.	Analyze
CO3	Describe the health and safety considerations of VR environment	Understand
CO4	Explore the ways of applying VR technologies for assistive devices and consider design applications	Apply
CO5	Apply the Virtual Reality techniques and models in different fields	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	1	-	-	-	1	-	-	-	-	-	-	-	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-	1	1
CO5	3	2	-	-	1	-	-	-	-	-	-	-	-	-
CO	3	1.6	1	-	1	1	-	-	-	-	-	-	1	1
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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PROFESSIONAL ELECTIVE

		Category: PE			
U19BMP11	EMBEDDED SYSTEMS FOR BIOMEDICAL ENGINEERS	L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce the basic principles of embedded systems
- To impart knowledge on the design of embedded systems, memory requirements and interfacing
- To render knowledge on real time operating systems and software development tools

UNIT I INTRODUCTION TO EMBEDDED SYSTEM 9

Introduction – Design challenge – Processor technology – IC technology – Design technology – Tradeoffs – Single purpose processors – RT level combinational logic – Sequential logic – RT level – Custom single purpose processor design – RT level and optimization techniques

UNIT II GENERAL PURPOSE PROCESSORS AND STATE MACHINE 9

Basic architecture – Operation – Pipelining – Programmer's view – Development environment – Application Specific Instruction set Processors (ASIPs) – Micro controllers and digital signal processors – Comparison of models and languages – Finite State Machines with Data path model (FSMD) using state machines – Program State Machine model (PSM)

UNIT III COMMUNICATION INTERFACES 9

Need for communication interfaces – RS232 / UART– RS422 / RS485 – USB – Infrared – IEEE 1394 Firmware – Ethernet – IEEE 802.11 – Bluetooth

UNIT IV BASIC CONCEPTS OF REAL TIME OPERATING SYSTEM 9

Architecture of the kernel tasks and task scheduler – Interrupt service routines – Semaphores – mailboxes – Message queues – Event registers – Pipes – Signals – Timers – Memory management – Priority inversion problem – Embedded operating systems – Embedded Linux – Real time operating systems

UNIT V CASE STUDY 9

Ophthalmology – Glaucoma screening device– Medical imaging acquisition user interface – Drug delivery systems – Patient monitoring systems

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Frank Vahid and Tony D. Givargis, "Embedded System Design A Unified Hardware/Software Introduction", 1st edition, John Wiley, 2006
2. Prasad K.V.K.K, "Embedded / Real Time Systems", 1st edition, Dreamtech Press, 2005

REFERENCES:

1. Steve Heath, "Embedded Systems Design", 2nd edition, Newness, 2005
2. David E. Simon, "An Embedded Software Prime", 1st edition, Pearson Education Asia, 2000
3. Raj Kamal, "Embedded Systems Architecture, Programming and Design", 3rd edition, Tata McGraw Hill, New Delhi, 2009
4. Steve Heath, "Embedded System Design",2nd edition, 2004

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the fundamentals of an embedded system	Understand
CO2	Identify the general-purpose processors and state machines	Apply
CO3	Analyze the communication interfaces	Analyze
CO4	Interpret the concepts of the real time operating systems	Understand
CO5	Utilize the embedded system design in healthcare	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO	3	1.6	1.33	-	-	-	-	-	-	-	-	-	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19BMP21	ADVANCED BIOMATERIALS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To illustrate the basics of biomaterials and biocompatibility
- To interpret the applications of biomaterials in cardiovascular system, orthopedics and ophthalmology
- To impart knowledge about the basics of tissue engineering and artificial organs

UNIT I INTRODUCTION TO BIOMATERIALS AND BIO COMPATIBILITY 9

Definition – Biomaterial applications and tissue engineering for artificial organs – Types of biomaterials and their applications for the human body – Issues of biocompatibility and its evaluation – Surface characterization of biomaterials – Biomaterials– Blood bio fluid interface – Surface modification for improved compatibility

UNIT II BIOMATERIALS FOR CARDIOVASCULAR SYSTEM 9

Collagen – Hyaluronic acid and other biopolymer applications – Cardiovascular implant biomaterial – Artificial heart valves – Mechanicals and bio prosthetic valves – Materials used – Criteria required for fulfillment of physiological functions – Vessel grafts – Endothelial cell seeding as a surface modification of biomaterials

UNIT III BIOMATERIALS FOR ORTHOPEDICS 9

Orthopedic implant materials – Temporary external fixators – Materials for reconstruction of cartilage – Ligaments and tendons – Bone replacement and bone cement – Artificial joint replacement

UNIT IV BIOMATERIALS FOR OPHTHALMOLOGY 9

Artificial cornea – Contact lenses – Intraocular lenses – Artificial aqueous and artificial vitreous humor – Artificial tears – Artificial tympanic membrane

UNIT V TISSUE ENGINEERING AND ARTIFICIAL ORGANS 9

Properties of skin – Wound dressings – Artificial skin – Facial implants – Dental restorative materials – Implanted dental interfaced – Denture resins and cements – Artificial red blood cells – Artificial lung surfactants – Artificial saliva – Artificial synovial fluid – Dialysis membranes – Artificial liver – Artificial pancreas – Biodegradable block copolymers and their applications for drug delivery materials used for neuronal reconstruction and regeneration

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Frederick H. Silver, "Biomaterials, Medical Devices and Tissue Engineering: An integrated approach", 1st edition, Chapman and Hall, 1994
2. Larry L. Hench and Julian R. Jones, "Biomaterials, artificial organs and tissue engineering", 1st edition, Woodhead Publishing Limited, 2005

REFERENCES:

1. Joseph D. Brozino, "Tissue Engineering and Artificial Organs", 1st edition, CRC Press, 2006
2. Fredrick H. Silver and David L. Christiansen, "Biomaterials Science and Biocompatibility",1st edition Springer, 1999
3. Donald L.Wise,Debra J. Trantolo, David E. Altobelli, Michael J. Yaszemski, Joseph D. Gresser and Edith R. Schwartz, "Encyclopedic Handbook of Biomaterials and Bioengineering", 1st edition, Marcel Dekker, 1995

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the basic concepts of biomaterials and biocompatibility	Understand
CO2	Illustrate the different biomaterials used for cardiovascular systems	Understand
CO3	Outline the biomaterials functions in the field of orthopedics	Understand
CO4	Interpret the biomaterials concept in ophthalmology applications.	Understand
CO5	Apply tissue engineering and artificial organs in biomedical applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	1	-	-	-	-	-	-	2	-
CO2	3	1	-	-	-	1	-	-	-	-	-	-	2	-
CO3	3	1	-	-	-	1	-	-	-	-	-	-	2	-
CO4	3	1	-	-	-	1	-	-	-	-	-	-	2	-
CO5	3	2	1	-	-	1	-	-	-	-	-	-	2	-
CO	3	1.2	1	-	-	1	-	-	-	-	-	-	2	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)			

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PROFESSIONAL ELECTIVE

U19BMP04	BIG DATA IN HEALTHCARE	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To interpret the different characteristics and requirement of big data frameworks
- To apply concepts of distributed file system and MapReduce programming
- To utilize the big data techniques in healthcare case studies

UNIT I INTRODUCTION 9

Big data overview – Characteristics of big data – Business intelligence and data analytics – Data analytics life cycle – Data analytics in industries – Exploring big data challenges in handling big data

UNIT II BIG DATA TOOLS 9

Need of big data tools – Understanding distributed systems – Overview of Hadoop – Comparing SQL databases and Hadoop – Hadoop ecosystem – Distributed file system – HDFS – Design of HDFS writing files to HDFS – Reading files from HDFS

UNIT III HADOOP ARCHITECTURE 9

Hadoop daemons – Hadoop cluster architecture – YARN – Advantages of YARN – Developing MapReduce program – Anatomy of MapReduce Code – Simple MapReduce program – Counting things – Map phase shuffle and sort

UNIT IV INTRODUCTION TO DEEP NEURAL NETWORKS 9

Neural networks feed forward – Network training using back propagation – Activation function linear – Sigmoid – Tanh – SoftMax – Rectified Linear Unit (RLU) – Hyper parameters learning rate – Regularization – Momentum – Basics of deep learning

UNIT V DEEP NETWORKS 9

Deep learning definition – Building blocks of deep networks – Restricted Boltzmann machines (RBMs) – Auto encoders – Network architecture – CNN – RNN – LSTM – Applications – CNN in medical images – LSTM for time series data – Google net – Alex net

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Tom White, "Hadoop The Definitive Guide", 4th edition, O'Reilly Media, Inc, 2015
2. Josh Patterson and Adam Gibson, "Deep Learning: A practitioner's approach", 1st edition, O'Reilly Media Inc, 2017

REFERENCES:

1. Peter Langkafel, "Big Data in Medical Science and Healthcare Management, 1st edition, De Gruyter, 2016
2. Chuck Lam, "Hadoop in Action", 1st edition, Wiley India Pvt. Ltd, 2011
3. Jimmy Lin and Chris Dyer, "Data-IntensiveTextProcessingwithMapReduce",1st edition Morgan and Claypool, 2010
4. Cloudera, "Intro to Hadoop and Map Reduce", Udacity Online Course, https://www.udacity.com/course/intro-to-hadoop-and-mapreduce--ud617

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Interpret the characteristics of big data and explain the data science life cycle	Understand
CO2	Identify the use of the Hadoop eco-system	Apply
CO3	Compare the scalable frameworks of large data	Analyze
CO4	Explain the deep neural networks	Understand
CO5	Summarize the network architecture and applications	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	1	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	1	-	-	-	-	-	-	-	-	1
CO3	3	2	1	-	1	-	-	-	-	-	-	-	-	1
CO4	3	1	-	-	1	-	-	-	-	-	-	-	-	1
CO5	3	1	-	-	1	-	-	-	-	-	-	-	-	1
CO	3	1.4	1	-	1	-	-	-	-	-	-	-	-	1

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19BMP20	REHABILITATION ENGINEERING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To identify the engineering concepts that can be applied in rehabilitation medicine and the role of engineers in various rehabilitation disciplines
- To illustrate the different types of therapeutic exercise technique
- To interpret the various orthotic devices and prosthetic devices to overcome orthopedic problems

UNIT I PRINCIPLE OF REHABILITATION ENGINEERING 9

Introduction to 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 and secondary disabilities – Clinical practice of rehabilitation engineering – Universal design – Design based on human ability – Standards for assistive technology

UNIT II THERAPEUTIC EXERCISE TECHNIQUE 9

Co-ordination exercises – Frenkels exercises – Gait analysis – Pathological gaits – Gait training – Relaxation exercises – Methods for training relaxation – Strengthening exercises – Strength training – Types of contraction – Mobilization exercises – Endurance exercises

UNIT III MANAGEMENT OF COMMUNICATION 9

Impairment – Introduction to communication – Aphasia – Types of aphasia – Treatment of aphasic patient – Augmentative communication – General form of communication – Types of visual aids – Hearing aids

UNIT IV ORTHOTIC PROSTHETIC DEVICES AND RESTORATIONTECHNIQUES 9

General orthotics – Classification of orthotics – Functional and 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)

UNIT V CASE STUDY 9

Geriatric Rehabilitation – Visual and auditory challenges faced by geriatrics and methods to overcome those challenges– Pediatric rehabilitation – Visual and auditory challenges faced by cerebral palsy – Muscular dystrophy and autism children – Methods to overcome those challenges – Glaucoma screening device – Medical imaging acquisition user interface – Drug delivery systems – Patient monitoring systems

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. S Sunder, "Textbook of Rehabilitation", Jaypee Brothers Medical Publishers private limited, New Delhi, 4th edition, 2019
2. Joseph D. Bronzino, "The Biomedical Engineering Handbook", 3rd edition, Taylor and Francis, 3 volume set, 2006

REFERENCES:

1. Rory A. Cooper, Hisaichi Ohnabe and Douglas A.Hodson, "An Introduction to Rehabilitation Engineering" , 1st edition, CRC Press, 2014

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2. Marion A. Hersh and Michael A. Johnson, "Assistive Technology for Visually impaired and blind people", 1st edition, Springer Verlag, 2014
3. Warren E. Finn and Peter G. Lo Presti, "Handbook of Neuroprosthetic Methods", 1st edition, CRC Press, 2002

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the principles of rehabilitation system	Understand
CO2	Apply exercise procedures involved in rehabilitation process	Apply
CO3	Analyze rehabilitation management in communication	Analyze
CO4	Identify restoration techniques in rehabilitation	Apply
CO5	Contrast the effectiveness of rehabilitation	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	1	-
CO	3	1.8	1.5	-	-	-	-	-	-	-	-	-	1	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)			

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PROFESSIONAL ELECTIVE

		Category: PE			
U19BMP23	MEDICAL TEXTILES	L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To illustrate the basics of biomaterials and biocompatibility
- To interpret the applications of biomaterials in cardiovascular system, orthopedics and ophthalmology
- To impart knowledge about the basics of tissue engineering and artificial organs

UNIT I INTRODUCTION TO MEDICAL TEXTILES 9

The role of textile structures and biomaterials in healthcare – Types of textiles and biomaterials for medical applications – Properties of medical textile products – Reusable medical textiles – Advantages and types of reusable medical textiles used for medical applications – Processing Procedures

UNIT II TEXTILES FOR WOUND THERAPIES AND IMPLANTS 9

Wounds – Wound dressings – Venous leg ulcers and their treatment – Wound dressing structures textiles as implants – Textiles for regenerative medicine – Testing of implants and materials for regenerative medicine – Drug releasing textiles – Classification – Fabrication and characterization – Applications

UNIT III TEXTILES AND THE SKIN 9

Skin contact sensations – Textile properties influencing skin contact sensations – Mechanical skin irritations due to textiles: human skin – Skin irritation – Skin responses to mechanical forces – Measurement of irritating mechanical factors – Factors causing a textile to be mechanically irritating – Allergies caused by textiles – Main types of allergies caused by textiles – Ways to minimize or avoid allergies caused by textiles

UNIT IV INFECTION PREVENTION AND CONTROL 9

Infection prevention and control and the role of medical textiles – Principles and practice of infection prevention and control in hospitals – The role of textiles in infection prevention and control – Hospital laundries and their role in medical textiles – Issues of hospital laundries – Impact of hospital laundries on the hygiene of medical textiles – Testing and quality control of hygienic properties in hospital laundries

UNIT V MEDICAL TEXTILE CASE STUDIES AND APPLICATIONS 9

Key issues and the role of medical bandages and stockings – Improving patient acceptance of medical bandages and stockings – Methods of obtaining superabsorbent polymers and their chemicalstructure – Development stages of superabsorbent materials according to appropriate patents – Applications of superabsorbent in medicine – Nanofibrous textiles – Applications of nanofibers in the medical field

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: –Periods Total: 45 Periods

TEXT BOOKS:

1. Bartels. V. T, "Handbook of medical textiles", 1st edition, Wood head Publishing Limited, 2011.
2. Rajendran S. Miraftab M, Subhash C. Anand and John F. Kennedy, "Medical Textiles and Biomaterials for Healthcare", 1st edition, Wood head Publishing Limited, 2005

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REFERENCES:

1. Lieva Van Langenhove, "Smart Textiles for Medicine and Healthcare: Materials, Systems and Applications", 1st edition, Wood head Publishing Limited, 2007
2. Brian J. McCarthy, "Textiles for Hygiene and Infection Control", 1st edition, Wood head Publishing Limited, 2011

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the basic knowledge on medical textiles	Understand
CO2	Interpret the concept of textiles for wound therapies and implants	Understand
CO3	Identify different textile fabrics for the skin	Apply
CO4	Illustrate the functions of textiles for prevention and control.	Understand
CO5	Analyze the case studies of medical textiles in healthcare application	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	1	-	-	-	-	-	-	1	-
CO2	3	-	-	-	-	1	-	-	-	-	-	-	1	-
CO3	3	-	-	-	-	1	-	-	-	-	-	-	1	-
CO4	3	1	-	-	-	1	-	-	-	-	-	-	1	-
CO5	3	2	1	-	-	1	-	-	-	-	-	-	1	-
CO	3	1.5	1	-	-	1	-	-	-	-	-	-	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19BMP16	COMPREHENSION II	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce the basics of control system
- To identify the sensors and its application to human system
- To introduce the concept of biomechanics and biomaterials

UNIT I MEASUREMENTS AND CONTROL SYSTEMS 9

SI units – Systematic and random errors in measurement – Expression of uncertainty – Accuracy and precision index – Propagation of errors – PMMC – MI and dynamometer type instruments – De potentiometer – Bridges for measurement of R, L and C – Q-meter – Basics of control system – Transfer function

UNIT II SENSORS AND BIOINSTRUMENTATION 9

Sensors – Resistive – Capacitive – Inductive – Piezoelectric – Hall effect – Electro chemical – Optical – Sensor signal conditioning circuits – Application of LASER in sensing and therapy – Origin of bio- potentials and their measurement techniques – ECG, EEG, EMG, ERG, EOG, GSR, PCG, Principles of measuring blood pressure – Body temperature – Volume and flow in arteries– Veins and tissues – Respiratory measurements and cardiac output measurement

Operating principle of medical equipment – Sphygmomanometer – Ventilator– Cardiac pacemaker – Defibrillator – Pulse oximeter – Hemodialyzer – Electrical isolation (optical and electrical) and Safety ofbiomedical instruments

UNIT III HUMAN ANATOMY PHYSIOLOGYMEDICAL IMAGING SYSTEMS 9

Basics of cell types of tissues and organ systems – Homeostasis – Basics of organ systems – Musculoskeletal – Respiratory – Circulatory, Excretory, Endocrine, Nervous, Gastro-intestinal and Reproductive systems – Medical Imaging – Basic physics – Instrumentation and image formation techniques in medical imaging modalities such as X-Ray, Computed Tomography (CT), Single Photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET), Magnetic Resonance Imaging (MRI) and Ultrasound

UNIT IV BIOMECHANICS 9

Kinematics of muscles and joints – Free body diagrams and equilibrium – Forces and stresses injoints – Biomechanical analysis of joints – Gait analysis – Hard tissues – Definition of stress and strain – Deformation mechanics – Structure and mechanical properties of bone – Cortical and cancellous bones – Soft tissues – Structure – Functions – Material properties – Viscoelastic properties – Maxwell and voight models – Biofluid mechanics – Flow properties of blood in the intact human cardiovascular system

UNIT V BIOMATERIALS 9

Basic properties of biomaterials – Metallic – Ceramic – Polymeric and composite – Fundamental characteristics of implants – Biocompatibility – Bioactivity – Biodegradability – Basics of drug delivery – Basics of tissue engineering – Biomaterial characterization techniques – Rheology – Atomic force microscopy – Electron microscopy – Transmission Electron Microscopy (TEM), Fourier Transform Infrared Spectroscopy (FRIS)

Contact Periods:

Lecture: 45 Periods Tutorial: Periods Practical: – Periods Total: 45 Periods

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REFERENCES:

1. A. K. Sawhney," Electrical and Electronics Measurement and Instrumentation", 10th edition, Dhanpat Rai and Co, New Delhi, 19th edition 2011, Reprint 2014
2. I.J Nagarath and M.Gopal, "Control System Engineering", 5th edition, Anshan Publishers, 2008
3. Prabhjot Kaur, "Text Book of Anatomy and Physiology", 1st edition, Lotus Publishers, 2014
4. Y.C.Fung, "Bio Mechanics – Mechanical properties of tissues", Springer_ Verlag, 1998
5. Sujatha V.Batt, "Biomaterials", 2nd edition, Naraso Publishing House,2005

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Identify the parameters with an RLC network and apply it for control systems	Apply
CO2	Select various sensor circuits for human electrical signals and understand basic instruments	Apply
CO3	Explain the human anatomy and various medical imaging techniques to examine	Understand
CO4	Interpret various mechanisms associated with joints and materials used to design implants	Understand
CO5	Outline the basics of biomaterials, tissue engineering and the instruments associated with biomaterials	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO5	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO	3	1.4	1	-	-	-	-	-	-	-	-	-	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19BMP07	MEDICAL INFORMATICS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce medical standards and health informatics
- To comprehend practices adopted in hospital information systems with reference to medical standards
- To interpret the medical data formats and recent trends in hospital information systems

UNIT I OVERVIEW OF MEDICAL INFORMATICS 9

Introduction – Medical informatics – Bioinformatics – Health informatics – Structure of medical informatics – Hospital information system – Characteristics – Functional online and offline modules

UNIT II MEDICAL STANDARDS 9

Evolution of medical standards – HL7 – DICOM – PACS – Electronic patient records – Healthcare standard organizations – JCAHO – JCIA – Steganography – Virtual hospital

UNIT III MEDICAL DATA STORAGE AND AUTOMATION 9

Medical data formats – Signal – Image and video formats – Representation of data – Data modeling techniques – Relational hierarchical and network approach – Normalization techniques for data handling – Plug-in data acquisition and control boards

UNIT IV HEALTH INFORMATICS 9

Bioinformatics databases – Bio information technologies – Semantic web and bioinformatics – Genome project – Clinical informatics – Nursing informatics – Public health informatics – Education and training

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9

Medical expert systems – Virtual reality applications in medicine – Virtual environment – Surgical simulation – Radiation therapy and planning – Telemedicine – Virtual hospitals – Smart medical Homes – Personalized e-health services – Biometrics – GRID and cloud computing in medicine

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Mohan Bansal, "Medical informatics", 1st edition, Tata McGraw Hill Publishing Ltd, 2003
2. Lele. R. D, "Computers in medicine progress in medical informatics", 1st edition, Tata McGraw Hill Publishing Ltd, 2005

REFERENCES:

1. Yi Ping Phoebe Chen, "Bioinformatics Technologies", 1st edition, Springer, 2014
2. Godbole.A.S, Kahate.A, "Web Technologies TCP/IP to Internet Application Architectures", 1st edition, TMH Publication, 2007
3. Orpita Bosu, Simminder Kaur Thukral, "Bioinformatics Databases, Tools and Algorithms",1st edition, Oxford University press, 2007
4. Charles P. Friedman, Jeremy C. (EDT) Wyatt, "Evaluation Methods in Medical Informatics", 1st edition, Springer Verlag, 1997

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Analyze the structure of health informatics	Analyze
CO2	Infer knowledge about the medical standards	Understand
CO3	Interpret the hierarchical and network approach and medical data formats	Understand
CO4	Examine health informatics of public and hospital employees	Analyze
CO5	Identify the recent trends in medical informatics	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	1	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	1	-	-	-	-	-	-	-	-
CO3	3	1	-	-	-	1	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	1	-	1	-	-	-	-	-	-
CO5	3	2	-	-	-	1	-	-	-	-	-	-	-	-
CO	3	1.8	1	-	-	1	-	1	-	-	-	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19BMP10	ROBOTICS IN MEDICINE	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To gain knowledge about robotics
- To explore kinematic motion planning for various robotic configurations
- To explore various applications of robots in medicine

UNIT I INTRODUCTION 9

Automation and Robots – Classification – Specification – Notations – Direct kinematics – Dot and cross products – Coordinate frames – Rotations – Homogeneous coordinates – Link coordinates – Arm equation – Four-axis robot

UNIT II KINEMATICS 9

Inverse Kinematics – General properties of solutions tool configuration – Four axis – Workspace analysis – Trajectory planning work envelope – Examples – Workspace fixtures – Pick and place operations – Continuous path motion – Interpolated motion and straight-line motion

UNIT III ROBOTS IN SURGERY 9

Minimally invasive surgery and robotic integration – Surgical robotic sub systems – Synergistic control – Control modes – Orthopaedic surgery – Cardiac surgery – Neurosurgery

UNIT IV IMAGE GUIDED INTERVENTIONS 9

Robot compatibility with medical imagers – Image segmentation and modelling – Tracking devices – Frames and Transformations – Surgical navigation

UNIT V ROBOTS IN PATIENT CARE 9

Rehabilitation for Limbs – Assistive robots – Types of assistive robots – Biologically inspired robots – Application in Rehabilitation – Interactive therapy – Bionic Arm

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Robert Schilling, "Fundamentals of Robotics - Analysis and Control", 1st edition, Prentice Hall, 2003
2. J.J.Craig, "Introduction to Robotics", 3rd edition, Pearson Education, 2005

REFERENCES:

1. Paula Gomes, "Medical robotics minimally invasive surgery", 1st edition, Woodhead, 2012
2. Jocelyne Troccaz, "Medical Robotics", 1st edition, Wiley-ISTE, 2012
3. Matthew, Mauro M.D, "Image-Guided Interventions", 2nd edition, Saunders, 2013
4. Fu K.S, Gonzales R, Lee C.S.G, "Robotics", 1st edition, McGraw Hill, 2008

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Infer with the basics of robotic systems	Understand
CO2	Explain the basic design and kinematics of robotic systems	Understand
CO3	Outline the role of robots in surgery	Understand
CO4	Analyze the technical aspects of robotic technology in image guided interventions	Apply
CO5	Illustrate the various roles that robotics can play in healthcare	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	1	-
CO5	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO	3	1.4	-	-	-	-	-	-	-	-	-	-	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19BMP12	WEARABLE TECHNOLOGY	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To gain knowledge about sensors and its application in wearable systems
- To explore the energy harvesting for wearable devices
- To illustrate the applications of wearable systems

UNIT I SENSORS FOR WEARABLE SYSTEMS 9

Need for wearable systems – Sensors for wearable systems – Inertia movement sensors – Respiration activity sensor – Inductive plethysmography – Impedance plethysmography – Pneumography – Wearable ground reaction force sensor – GSR – Radiant thermal sensor – Wearable motion sensors – CMOS based biosensors – E - textiles

UNIT II SIGNAL PROCESSING FOR WEARABLE SYSTEMS 9

Wearability issues – Physical shape and placement of sensor – Technical challenges – Sensor design – Signal acquisition – Constraint on sampling frequency for reduced energy consumption – Lightweight signal processing – Rejection of irrelevant information – Data mining

UNIT III ENERGY HARVESTING FOR WEARABLE DEVICES 9

Solar cell – Energy Harvesting – Vibration based – Thermal based – Human body as a heat source for power generation – Hybrid thermoelectric photovoltaic energy harvests – Thermopiles

UNIT IV WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring – Definition of Body Area Network – BAN and healthcare – Technical challenges – System security and reliability – BAN architecture – Introduction – Wireless communication techniques

UNIT V APPLICATION OF WEARABLE SYSTEMS 9

Medical diagnostics – Medical monitoring – Patients with chronic disease – Hospital patients – Elderly patients – Multi parameter monitoring – Neural recording – Gait analysis – Sports medicine – Smart fabrics – Case study on Wearable technology as a tool to motivate health behavior

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", 3rd edition, Springer, 2014
2. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar, Venkata subramanian, "Body Area Networks Safety, Security, and Sustainability", 2nd edition, Cambridge University Press, 2013

REFERENCES:

1. Hang, Yuan-Ting, "Wearable medical sensors and systems", 1st edition, Springer, 2013
2. Andreas Lymberis, Danilo de Rossi, "Wearable Health systems for Personalised Health Management - State of the art and future challenges", 1st edition, IOS press, 2004
3. Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation and Applications", 1st edition, Pan Stanford Publishing Pvt. Ltd, 2012

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Infer the fundamentals of sensors for wearable systems	Understand
CO2	Apply the concept of signal processing for wearable systems	Apply
CO3	Explain the different techniques used as energy harvester for wearable devices	Understand
CO4	Interpret the functions of wireless health care system	Understand
CO5	Examine the concepts of design and working of wearable systems for healthcare applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	1	-
CO	3	2	-	-	-	-	-	-	-	-	-	-	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19BMP19	ERGONOMICS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To illustrate the principles of ergonomics
- To comprehend the mechanics of muscle physiology
- To discover design aspects of biomedical devices

UNIT I VISUAL AND AUDITORY ERGONOMICS 9

Process of seeing – Visual capabilities – Factors affecting visual acuity and contrast sensitivity – Human factor aspects of hard copy text and computer screen text – Factors in selecting graphic representations symbols – Qualitative visual display – Process of hearing – Principles of auditory display

UNIT II MUSCLE PHYSIOLOGY 9

Muscle physiology – Muscle metabolism – Respiratory response – Joint motion study – Measure of physiological in-efficiency and energy consumption – Work rest cycles – Aspects of manual and posture study – Material handling (MMH) bio-mechanical recommended limits of MMH

UNIT III CONTROLS AND DISPLAYS 9

Spatial compatibility physical arrangement of displays and controls – Movement capability – Rotary controls and rotar displays movement of displays orientation of the operator and movement relationships control orders and control responses – Human limitations in tracking task

UNIT IV ANTHROPOMETRY 9

Anthropometry – Anthropometric design principles – Work space envelope – Factors in design of work space surfaces – Principles of seat design – Principles of control panel – Organization classification of human errors theories of accident causation – Reducing accidents by altering behaviour

UNIT V APPLICATIONS OF ERGONOMICS 9

Case Study 1 – Computer design – Control panel design of an electronic instrument – Computer key board – Hand drill – Case Study 2 – Biomedical application – Design optimization of medical equipment

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Pascale Carayon, "Handbook of Human Factors and Engineering", 2nd edition, CRC Press, 2011
2. Martin Helander, "Guide to Human Factors and Engineering", 2nd edition, CRC Press, 2005

REFERENCES:

1. Stephen Pheasant, Christine M. Haslegrave, "Bodyspace: Anthropometry, Ergonomics and the Design of Work", 3rd edition, CRC Press, 2016
2. Robert. N. Bailey, "Human Performance Engineering", 3rd edition, Prentice Hall, 1996
3. Shrawan Kumar, "Biomechanics in Ergonomics", 2nd edition, CRC Press, 2007

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Outline the process of visual and auditory ergonomics	Understand
CO2	Interpret the concept of muscle physiology	Understand
CO3	Illustrate the techniques of controls and displays based on ergonomics	Understand
CO4	Relate the functions of anthropometry	Apply
CO5	Classify the concepts of ergonomics in various fields	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO5	3	3	2	1	-	-	-	-	-	-	-	-	1	-
CO	3	1.6	1.5	1	-	-	-	-	-	-	-	-	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19BMP06	BIOINFORMATICS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To adapt basic knowledge on the biological information and databases
- To analyze the sequence data in different databases
- To discover the practical use of tools for specific bioinformatics areas

UNIT I BIOLOGICAL INFORMATION 9

Definition and goals of bioinformatics – Structure of DNA – RNA – Protein – Peptide bond – Prediction of Physicochemical properties – Secondary structure prediction – Prediction of domains and motifs

UNIT II GENOMIC DATA AND DATABASES 9

Genomic data – Sequence data formats – Classification of databases – Primary databases – Secondary databases – Specialized databases – Sequence submission – Data search – Data Retrieval

UNIT III SEQUENCE ALIGNMENT AND SIMILARITY SEARCH 9

Sequence alignment – Sequence identity – Sequence similarity – Sequence homology – Global Alignment – Local Alignment – Pairwise Alignment – Multiple Alignment – Scoring matrix

UNIT IV DYNAMIC PROGRAMMING 9

Dynamic Programming – Needleman – Wunsch Algorithm – Smith – Waterman Algorithm – BLAST – PSI BLAST – FASTA

UNIT V GENOME ANNOTATION AND PHYLOGENETIC ANALYSIS 9

Genome sequence – Sequence Assembly – Genome annotation – Gene prediction – ORF – Phylogenetic analysis – Phylogenetic tree – Construction – Monophyly – Polyphyly – Paraphyly

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Supratim Choudhuri, "Bioinformatics of Beginners", 1st edition, Academic Press, 2014
2. David W. Mount, David Mount, "Bioinformatics: Sequence and Genome Analysis", 2nd edition, CSHL Press, 2004

REFERENCES:

1. Hooman H. Rashidi, Lukas K. Buehler, "Bioinformatics Basics: Applications in Biological Science and Medicine", 2nd edition, CRC Press, 2005
2. Per Jambeck, Cynthia Gibas, "Developing Bioinformatics Computer Skills", 1st edition, O'REILLY, 2001
3. Stephen Misener, Stephen A Krawetz, "Bioinformatics Methods and Protocols", 1st edition, Humana Press, 2010

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Learn Beyond

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Interpret the basics of bioinformatics and biological data	Understand
CO2	Explain the databases, tools, repositories and be able to use each one to extract specific information	Understand
CO3	Outline the scoring matrices	Understand
CO4	Build the sequences using dynamic programming method	Apply
CO5	Examine the concept of genome annotation and phylogenetic analysis	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	1
CO2	3	1	-	-	-	-	-	-	-	-	-	-	-	1
CO3	3	1	-	-	2	-	-	-	-	-	-	-	-	1
CO4	3	2	-	-	2	-	-	-	-	-	-	-	-	1
CO5	3	3	2	-	2	-	-	-	-	-	-	-	-	1
CO	3	1.6	2	-	2	-	-	-	-	-	-	-	-	1
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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PROFESSIONAL ELECTIVE

U19BMP08	HEALTH TELEMATICS AND TELEMEDICINE	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To define the key principles for telemedicine and health
- To explain the protocols behind encryption techniques for transmission of data
- To apply the multimedia technologies in telemedicine

UNIT I INTRODUCTION TO TELEMEDICINE 9

Introduction – Telemedicine – Telecare – Telehealth – Origin and development of telemedicine – Drivers of telemedicine and telecare – Technological – Non-technological – Types of telemedicine – Telemedicine – Patient and career perception – Global and Indian scenario – Benefits and limitations of telemedicine – Barriers to progress in telemedicine

UNIT II TELEMEDICAL TECHNOLOGY 9

Types of telemedicine information – Compression – Frame rate and bandwidth – Telecommunication standards – Components of telecommunication system – Telecommunication options – Public Switched Telephone Network (PSTN) – Satellite – Wireless technology – Store and forward operation – Real time telemedicine

UNIT III ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE 9

Confidentiality – Patient rights and consent – Data protection and security – Ethical and legal aspects of internet – Guidelines for patient information – Telemedicine malpractice – Jurisdictional issues – Intellectual property right

UNIT IV MOBILE TELEMEDICINE 9

Tele radiology – Tele pathology – Multimedia databases – Compression methods – Interactive control of color – Medical information storage and management for telemedicine – Hospital information system – Pharmaceutical information system

UNIT V TELEMEDICAL APPLICATIONS 9

Telemedicine access to health care services – Introduction to robotics surgery – Telesurgery – Telecardiology – Telemedicine in neurosciences – Electronic documentation – E-health services security and interoperability – Business aspects – Project planning – Usage of telemedicine

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Norris. A.C, "Essentials of Telemedicine and Telecare", 2nd edition, Wiley, 2006
2. O'Carroll, P W, Yasnoff W.A., Ward E.Ripp, L.H., Martin, E.L., "Public Health Informatics and Information Systems", 1st edition, Springer, 2003
3. Ferrer - Roca, O., Sosa-Iudicissa, M, "Handbook of Telemedicine", 3rd edition, IOS Press, 2002

REFERENCES:

1. Simpson. W, "Video over IP- A practical guide to technology and applications", 2nd edition, Focal Press (Elsevier), 2006
2. Wootton R. Craig, J., Patterson V, "Introduction to Telemedicine", 2nd edition, Royal Society of Medicine Press Ltd, 2006

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the concept of telemedicine and its scope	Understand
CO2	Classify the different communication modes of telemedicine	Understand
CO3	Outline the ethical and legal issues of telemedicine	Understand
CO4	Illustrate the flexibility of mobile telemedicine	Understand
CO5	Develop simple telemetry system to transfer a vital parameter	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	-	-	-	-	2	-	1	-	-	-	-	1	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO5	3	2	1	-	2	-	-	1	-	-	-	-	1	-
CO	3	2	1	-	2	2	-	1	-	-	-	-	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19BMP14	ELECTRICAL SAFETY AND QUALITY ASSURANCE	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To identify engineering concepts that can be applied in electrical hazards
- To illustrate the different types of standards and regulatory requirements in health care
- To interpret the standardization of quality of medical care in hospitals

UNIT I ELECTRICAL HAZARDS 9

Review of electrical concept – Electrostatic – Electro magnetism – Electrical hazards – Energy leakage – Clearance and insulation – Current surges – Electrical causes of fire and explosion – Human interface with electricity – Human resistance to electricity

UNIT II STANDARDS AND REQUIREMENTS 9

National electrical safety code – Standards and statutory requirements – Indian electricity acts and rules – Statutory requirements from electrical inspectorate – Hazardous area classification and classification of electrical equipment for hazardous areas (IS – NFPA – API and OSHA standards)

UNIT III ELECTRICAL PROTECTION AND MAINTENANCE 9

Selection of environment – Protection and interlock – Discharge rods and earthing device – Safety in the use of portable tools – Preventive maintenance – First aid – Cardio pulmonary resuscitation (CPR)

UNIT IV STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS 9

Define quality – Need for standardization and quality management – QM in health care organization – Quality assurance methods – QA in diagnostic services – Classification of equipment – CE and FDA regulations – Accreditation for hospitals – JCI – NABH and NABL – Other regulatory codes

UNIT V RADIATION THERAPY AND RADIATION SAFETY 9

Radiation therapy – LINAC – Cyclotron – Betatron – SRT and SRS techniques – 3DCRT – IMRT – cyber knife – Radiation protection in medicine – ALARA principle – Radiation measuring instruments – Film badges – Thermo luminescent dosimeters – Electronic dosimeter – ICRP regulation – Practical reduction of dose to staff and visitors – Laser safety

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Sakharkar.B. M, "Principles of Hospital administration and Planning", 2nd edition, Jaypee Brothers, Medical Publishers Pvt. Ltd, 2009
2. Cesar A. Caceres and Albert Zana, "The Practice of Clinical Engineering", 2nd edition, Academic press, 1977

REFERENCES:

1. Webster J.G and Albert M. Cook, "Clinical Engineering, Principles and Practices", 1st edition, Prentice Hall Inc., 1979
2. Karen Parsley, Philomena Corrigan, "Quality improvement in Healthcare", 2nd edition, Nelson Thrones Publication, 2002
3. Joseph F Dyro, "Clinical Engineering Handbook", 1st edition, Elsevier Publishers, 2004

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the electrical hazards in a healthcare environment	Understand
CO2	Outline the standards and requirements of electrical safety	Understand
CO3	Interview the safety aspects in handling an equipment in a healthcare environment	Apply
CO4	Summarize the standards of quality care in hospitals	Understand
CO5	Outline the radiation safety in a healthcare environment	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	1	1	-	-	-	-	-	1	-
CO2	3	2	1	-	-	1	1	-	-	-	-	-	1	-
CO3	3	1	-	-	-	1	1	-	-	-	-	-	1	-
CO4	3	1	-	-	-	1	1	-	-	-	-	-	1	-
CO5	3	1	-	-	-	1	1	-	-	-	-	-	1	-
CO	3	1.2	1	-	-	1	1	-	-	-	-	-	1	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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PROFESSIONAL ELECTIVE

U19BMP22	CLINICAL RESEARCH	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To gain knowledge about bio-ethics and regulations in clinical research
- To describe the essential of medical writing
- To collect information regarding the importance of patient selection in research

UNIT I BIOETHICS IN CLINICAL RESEARCH 9

Research involving human subjects – Ethics of research involving vulnerable subjects – Ethics in Key areas of research and practice – Ethical challenges in India and other developing countries – National Bioethics Organizations

UNIT II MEDICAL DEVICES-REGULATIONS AND RESEARCH 9

Phases in the lifespan of medical device – Conducting clinical trials on medical devices – Medical device regulations across the world medical device safety

UNIT III PRINCIPLES OF PATIENT RECRUITMENT 9

The Patient – Our partner in the clinical research process – Strategies for successful recruitment – general recruitment planning and site-based strategies – Feasibility analysis – Case study – Medical community outreach – General public and patient facing strategies – Community outreach and health associations – Emerging strategies for recruitment – General instructions for effective recruitment

UNIT IV ESSENTIALS OF MEDICAL WRITING 9

Fundamentals of good medical writing – Types of medical writing – Types of research publications – Requirements for writing research articles – Career opportunities – Qualifications and skills needed – Initiating the writing carrier – Tools – Software needed – Professional gains – Organizations for medical and science writers

UNIT V SAFETY AND MEDICAL MONITORING IN CLINICAL TRIALS 9

Monitoring in clinical trials – Role and Responsibilities of a medical monitor in clinical trials – Good and safety and medical monitoring practices – Future trends

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Gupta S.K, "Drug discovery and clinical research", 1st edition, JP Medical Ltd., 2011
2. Friedman, Lawrence M, Curt D. Furberg, David L. DeMets, David M. Reboussin, Christopher B. Granger, "Fundamentals of clinical trials", 5th edition, Springer, 2015

REFERENCES:

1. Ed. Stephen P., Glasser, "Essentials of clinical research", 1st edition, Springer, 2008
2. Hulley S.B, "Designing clinical research", 1st edition, Lippincott Williams & Wilkins, 2007
3. Goodman N.W., Edwards M.B., Langdon-Neuner.E., "Medical writing", 1st edition, Cambridge University Press, 2014

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Illustrate the features of bioethics in clinical research	Understand
CO2	Identify the regulations and research of medical devices	Apply
CO3	Outline the awareness of clinical trial opportunities and to encourage enrollment	Understand
CO4	Infer the purpose and publication writing for medical education	Understand
CO5	Summarize the safety aspects and medical monitoring techniques in clinical trials.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	1	1	1	-	-	-	-	1	-
CO2	3	1	-	-	-	1	1	1	-	-	-	-	1	-
CO3	3	-	-	-	-	1	1	1	-	-	-	-	1	-
CO4	3	-	-	-	-	1	1	1	-	1	-	-	1	-
CO5	3	-	-	-	-	1	1	1	-	-	-	-	1	-
CO	3	1	-	-	-	1	1	1	-	1	-	-	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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