

Anand Nagar, Krishnankoil - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu | info@kalasalingam.ac.in | www.kalasalingam.ac.in

SCHOOL OF BIO AND CHEMICAL ENGINEERING

DEPARTMENT OF BIOMEDICAL ENGINEERING

B.Tech.

in

BIOMEDICAL ENGINEERING



2021 REGULATION CURRICULUM



Anand Nagar, Krishnankoil - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu | info@kalasalingam.ac.in | www.kalasalingam.ac.in

SCHOOL OF BIO AND CHEMICAL ENGINEERING

DEPARTMENT OF BIOMEDICAL ENGINEERING

Institution Mission

To be a Center of Excellence of International Repute in Education and Research

Institution Vision

To Produce Technically Competent, Socially Committed Technocrats and Administrators through Quality Education and Research

Department Mission

To be a globally recognized Centre of Excellence in the field of Biomedical Engineering for the advancement of human health

Department Vision

To produce skilled Biomedical Engineers, who are technically competent and socially committed, by imparting interdisciplinary education in the field of Biomedical Engineering

Program Educational Objectives (PEOs)

- **PEO1** Graduates would have attained a basic competency in the field of Biomedical Engineering for pursuing advanced courses in Biomedical Engineering and allied fields
- **PEO2** Graduates would be successful as entrepreneurs or attain responsible positions in government, biomedical and allied industries and, research centres.
- **PEO3** Graduates would exhibit effective communication and leadership skills and contribute to the advancement of human healthcare through life-long learning.

ABET Student Outcomes (ASOs)

- **ASO1:** An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- **ASO2:** An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- ASO3: An ability to communicate effectively with a range of audiences.
- ASO4: An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- ASO5: An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- **ASO6:** An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- ASO7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Mapping of ABET Student Outcomes and PEOs

	PEO	PEO	PEO
ASUS / PEUS	1	2	3
ASO 1 - An ability to identify, formulate, and solve complex			
engineering problems by applying principles of engineering,	\checkmark		
science, and mathematics.			
ASO 2 - An ability to apply engineering design to produce			
solutions that meet specified needs with consideration of public			
health, safety, and welfare, as well as global, cultural, social,	v		
environmental, and economic factors.			
ASO 3 - An ability to communicate effectively with a range of	1		1
audiences.	·		v
ASO 4 - An ability to recognize ethical and professional			
responsibilities in engineering situations and make informed			
judgments, which must consider the impact of engineering		\checkmark	\checkmark
solutions in global, economic, environmental, and societal			
contexts.			
ASO 5 - An ability to function effectively on a team whose			
members together provide leadership, create a collaborative and			
inclusive environment, establish goals, plan tasks, and meet		v	v
objectives.			
ASO 6 - An ability to develop and conduct appropriate			
experimentation, analyze and interpret data, and use engineering		\checkmark	
judgment to draw conclusions.			
ASO 7 - An ability to acquire and apply new knowledge as needed,		1	
using appropriate learning strategies.		•	

NBA Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

PO2 – Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 – Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 – 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.

PO5 – Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 – The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 – Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

PO8 – Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 – Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

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

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

PSO1 - Utilization of Acquired knowledge: The ability of a graduate to utilize the knowledge acquired through the study of Mathematics, Basic Sciences, Biology, Environmental impact and needs, Core-engineering and, Human Anatomy and Physiology constituting the fundamentals of Biomedical Engineering.

PSO2 Recognize and Resolve Complications: The ability of a graduate to Analyze, Interpret, Model, Design, Recognize and Resolve Complications arising in the domain of Biomedical Engineering, and to satisfy the requirements of health-care industries/organizations.

PSO3 - Self-sustainability: The ability of a graduate to be self-sustainable, and to be positioned as a Leader, Administrator, Entrepreneur, or to be a supporter for a multidisciplinary team designated to meet the specified target with standards through an elitist approach.

PSO4 - Well-being of Humanity: The ability of a graduate to be committed with the context of coalescing Pedagogical, Socio-ethical and Professional practices on proceeding with the knowledge gained through Biomedical Engineering for the well-being of Humanity.

DEU/DU DEU	РО													PSO						
1 E0/1 0, 1 50	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4				
PEO1	\checkmark	\checkmark	\checkmark		\checkmark	-	-	-	-	-	-	\checkmark	\checkmark	\checkmark	-	\checkmark				
PEO2	\checkmark																			
PEO3	-	-	-	-	-	-	-	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	-	-	\checkmark	\checkmark				

POs' Consistency with Department PEOs'

2021 REGULATION CURRICULUMSTRUCTURE

Environment/Indian constitution/	44	Mathematics and sciencesEngineering ScienceCoreComputingSustainable Product DevelopmentHuman Values and CommunicationEntrepreneurship and Innovation	t on
ry skills	16	University ElectiveEngineering (outside school)Liberal arts (Or) Mathematics and Sciences	
olimenta	52	Program Core	
Comp	24	Program Elective	
ourses	16	Experiential Core Design Project Capstone	
Audit C	8	Experiential Elective CSP/Internship/UC Research /Competition	; tions

Total Credits = 160

B.Tech. Biomedical Engineering Curriculum

Foundation Core												
Sl. No.	Course Code	Course Name	L	Т	Р	X	Credits	Hours/ Week				
1	211ENG1301	English For Engineers	2	0	0	3	3	5				
2	211MEC1201	Introduction to Engineering Visualisation	0	0	2	3	2	5				
3	211MEC1401	Sustainable Design and Manufacturing	1	0	2	3	3	6				
4	211ECE1101	IoT Sensors and Devices	1	0	0	3	2	4				
5	211CSE1401	Problem Solving using Computer Programming	1	0	2	3	3	6				
6	211CSE1402	Python Programming	1	0	2	3	3	6				
7	211MBA1101	Innovation and Entrepreneurship	1	0	0	3	2	4				
8	211MAT1101	Statistics for Engineers	2	0	0	3	3	5				
9	211MAT1301	Calculus and Linear Algebra	3	2	0	0	4	5				
10	211MAT1303	Multiple Integration, Ordinarily Differential Equation, and Complex variable	3	0	2	0	4	5				
11	211PHY1301	Physics	3	0	2	0	4	5				
12	211CHY1301	Chemistry	3	0	2	0	4	5				
13	211EEE1301	Basic Electrical and Electronics Engineering	3	0	2	0	4	5				
14	211BIT1101	Biology for Engineers	3	0	0	0	3	3				
					Tot	tal	44	69				

	Program Core													
Sl. No.	Course Code	Course Name	Course Type	L	Т	Р	X	Credits	Hours/ Week	Pre-requisite				
1	212BME1304	Fundamentals in Biomedical Engineering	IC-T	2	0	2	0	3	4	-				
1	212BME1106	Medical Physics	Т	3	0	0	0	3	3	-				
2	212BME1105	Human Anatomy and Physiology	Т	3	0	0	0	3	3	-				
3	212BME1303	Electronics Devices and Circuits	IC-T	3	0	2	0	4	5	-				

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4	212BME1301	Clinical Biochemistry*	IC-T	2	0	0	3	3	5	-
5	212BME1102	Digital Logic Circuit	Т	2	0	0	0	2	2	-
6	212BME2112	Biomaterials*	Т	3	0	0	0	3	3	-
7	212BME2311	Biocontrol System*	IC-T	2	0	0	3	3	5	211MAT1303
8	215BME4215	Linear Integrated Circuits	Т	3	0	0	0	3	3	212BME1303
9	212BME2119	Pathology and Microbiology	Т	2	0	0	0	2	2	
10	212BME2320	Sensors and data acquisition*	IC-T	2	0	0	3	3	5	212BME1303
11	212BME2318	Microprocessors and Microcontrollers	IC-T	3	0	2	0	4	5	212BME1102
12	212BME2313	Biomechanics*	IC-T	2	0	0	3	3	5	212BME1105
13	212BME2117	Medical Imaging Techniques	Т	3	0	0	0	3	3	-
14	212BME2314	Diagnostic and Therapeutic Instruments I	IC-T	3	0	2	0	4	5	215BME4215
15	212BME3337	Digital Signal Processing	IC-T	2	2	2	0	4	6	211MAT1303
16	212BME3336	Digital Image Processing	IC-T	3	0	2	0	4	5	-
					T	ota	al	51	65	-

		Laboratory C	ore								
Sl. No.	Course Code	Course Name	Course Type	L	Т	P	X	Credits	Hours/ Week	Co-requisite	
1	215BME4215	Integrated Circuits Laboratory	PC	0	0	2	0	1	2	215BME4215	
	Total 1 2										

	Experiential Core													
Sl.No.	Course Code	Course Name	Course Type	L	Т	Р	X	Credits	Hours/ Week					
1	215BME4266	Design Project I	PC	0	0	9	0	3	9					

32	215BME4267	Design Project II	PC	0	0	9	0	3	9
3	215BME4265	Capstone Project	PC	0	0	30	0	10	30
						To	tal	16	48

Experiential Elective												
Sl.No.	Course Code	Course Name	Course Type	L	Т	Credits	Hours/ Week					
1	216BME4268	Community Service Project	PC	0	0	9	0	3	9			
2	216BME4271	Internship	PC	-	-	-	-	2	-			
3	216BME4269	Hospital Training	PC	-	-	-	-	1	-			
4	216BME4270	International/National Technical Competitions/Project Expo/Research Publication (Journal/ Conference/ Book chapter)	PC	_	-	_	_	2	-			
		Total 8 9										

Program Elective													
Sl. No.	Course Code	Course Name	Course Type	L	Т	Р	x	С	Pre- requisite				
1	213BME2124	Design of Medical Instruments	Т	3	0	0	0	3					
2	213BME2125	Graphical programming for Biomedical Applications	Т	3	0	0	0	3					
3	213BME1107	Patent filing	Т	3	0	0	0	3					
4	213BME3151	Introduction to Java for Biomedical Applications	Т	3	0	0	0	3					
5	213BME2131	Special Electrical Machines	Т	3	0	0	0	3	211EEE1301				
6	213BME2121	Analog and Digital Communication	Т	3	0	0	0	3	212BME1102				
7	213BME2129	Medical Optics and lasers	Т	3	0	0	0	3					
8	213BME3138	3D Printing in Medicine	Т	3	0	0	0	3					
9	213BME3154	Mobile Application Development	Т	3	0	0	0	3					
10	213BME2128	Medical Device regulatory India	Т	3	0	0	0	3					
11	213BME2126	Hospital management	Т	3	0	0	0	3					

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12	213BME2122	Clinical Engineering	Т	3	0	0	0	3	
13	213BME2127	Medical Device Marketing	Т	3	0	0	0	3	
14	213BME3148	Ergonomics	Т	3	0	0	0	3	
15	213BME3147	Embedded Systems Design*	Т	3	0	0	0	3	212BME2318
16	213BME3143	Biometric Systems	Т	3	0	0	0	3	
17	213BME3139	Advanced Microcontrollers	Т	3	0	0	0	3	212BME2318
18	213BME3153	Microcontroller based system design	Т	3	0	0	0	3	212BME2318
19	213BME3158	Robotics in Medicine	Т	3	0	0	0	3	
20	213BME2123	Computers in Medicine	Т	3	0	0	0	3	
21	213BME3159	Telehealth Technologies	Т	3	0	0	0	3	
22	213BME3141	Biomedical Informatics	Т	3	0	0	0	3	
23	213BME3146	Diagnostic and Therapeutic Instruments II	Т	3	0	0	0	3	212BME2314
24	213BME3140	Biofluids and Dynamics	Т	3	0	0	0	3	212BME2313
25	213BME3152	Mechanics of Biological systems	Т	3	0	0	0	3	212BME2312
26	213BME3149	Finite Element analysis	Т	3	0	0	0	3	
27	213BME3150	Human Assist Devices	Т	3	0	0	0	3	
28	213BME2130	Rehabilitation Engineering	Т	3	0	0	0	3	
29	213BME3155	Modeling of Physiological Systems	Т	3	0	0	0	3	212BME2311
31	213BME3157	Neural Network and Pattern Recognition*	Т	3	0	0	0	3	
32	213BME3144	Biosignal Processing	Т	3	0	0	0	3	212BME3337
33	213BME3142	BioMEMS	Т	3	0	0	0	3	
34	213BME3145	Design process in Biomaterials and artificial organs	Т	3	0	0	0	3	
35	213BME3160	Tissue Engineering	Т	3	0	0	0	3	
36	213BME3156	Biomedical Nanotechnology	Т	3	0	0	0	3	

	University Electives										
Sl. No.	Course Code	Course Name	Course Type	L	Т	Р	С				
1	214BME1109	Biomedical Instrumentation	Т	3	0	0	3				

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2	214BME2133	Medical Optics	Т	3	0	0	3
3	214BME2132	Computers in Medicine	Т	3	0	0	3
4	214BME3163	Telemedicine	Т	3	0	0	3
5	214BME1110	Biomedical Waste Management	Т	3	0	0	3
6	214BME1108	Bioethics, IPR and Standards	Т	3	0	0	3
7	214BME3161	Biometric Systems	Т	3	0	0	3
8	214BME2135	Wearable systems	Т	3	0	0	3
9	214BME2134	Rehabilitation Engineering	Т	3	0	0	3
10	214BME3164	Tissue Engineering	Т	3	0	0	3
11	214BME3162	Nanotechnology in Medicine	Т	3	0	0	3

	Honour Electives										
Sl. No.	Course Code	Course Name	Course Type	L	Т	Р	x	С			
1	216BME4173	Artificial organs	Т	3	0	0	0	3			
2	216BME4174	Biomechatronics	Т	3	0	0	0	3			
3	216BME4175	Biophotonics	Т	3	0	0	0	3			
4	216BME4172	Advanced optical imaging	Т	3	0	0	0	3			
5	216BME4180	Microfluidics	Т	3	0	0	0	3			
6	216BME4178	E-health systems	Т	3	0	0	0	3			
7	216BME4176	Brain computer interface	Т	3	0	0	0	3			
8	216BME4177	Cognitive neuroscience	Т	3	0	0	0	3			
9	216BME4179	Machine learning	Т	3	0	0	0	3			
10	216BME4182	Prosthetic science	Т	3	0	0	0	3			
11	216BME4181	Orthotic science	Т	3	0	0	0	3			

B.Tech. Biomedical Engineering Program Plan



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Summer

	Semester 5			Semester 6						
	Course Name	СН		#	Course Name	С	H			
1	Experiential E (Community Services Project/UG Research Project)	3	9	1	Design Project 2(EC)	3	9			
2	University Elective	3	3	2	University Elective	3	3			
3	BME21R***/ Sensors and Data Acquisition	3	5	3	BME21R***/ Medical Imaging Techniques	3	3			
4	BME21R***/ Microprocessor and Microcontroller	4	5	4	BME21R***/Diagnostic and Therapeutic Equipment	4	5			
5	BME21R***/ Biomechanics	3	5	5	BME21R***/Digital Signal Processing	4	6			
6	BME21R***/ Professional Elective II	3	3	6	BME21R***/Professional Elective III	3	3			
	Total	19	30		Total	20	29			

	Semester 7							
	Course Name	с	н		#	Course Name	с	H
1	**Experiential E	5			1*	Capstone	10	30
2	University Elective	3	3					
3	BME21R***/Digital Image Processing	4	5					
4	BME21R***/Professional Elective IV	3	3					
5	BME21R***/Professional Elective V	3	3					
6	BME21R***/Professional Elective VI	3	3					
7	BME21R***/Professional Elective VII	3	3					
8	BME21R***/ Professional Elective VIII	3	3			Total	10	30
	Total	27	23	1		Total	10	30

ospital Training, International/National Technical
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SYLLABUS PROGRAM CORE EARCH AI то BE EEMED UNI VERSIT Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu | info@kalasalingam.ac.in | www.kalasalingam agar, Krishnankoll **Course Code Course Name** L Т Р Х С FUNDAMENTALS OF BIOMEDICAL 212BME1304 0 2 2 0 3 **ENGINEERING** Prerequisite: Nil Syllabus revision: Nil **Course Type:** Theory with Course Category: Program core X component **Course description** This course will enable students to develop an understanding in the fundamentals of biomedical engineering with respect to Basic human anatomy. This course will also provide the practical exposure to measure and simulate physiological parameters of human body. **Course outcomes:** On successful completion of the course the students will be able to **CO1** Explain the physical characteristics, function and components of blood tissue **CO2** Elaborate the blood groups and its relevant characteristics **CO3** Describe the anatomy, functions and events of human heart **CO4** Explain the Structure, functions and anatomy of human blood vessels **CO5** Describe the basics of physiological parameters measurement in human PSO CO PO

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	М															
2		L	Н													
3				М												
4	М			L												
5	М				L											
H - High, M	I - Medi	um, 1	L – L	ow												
Unit 1	BL	OOD)								Hou	rs: 03	3			
U nit 2 Blood Group	BL sand Blo	OOD od Ty	GR(OUPS	AND Blood	BLO	OOD 7	T YPE ansfu	S sions,	Rh B	Hou	rs: 03 Group	3 9,Typ	ing a	nd C	ross
Matching Blo	oodfor Tr	ansfu	sion											C		
Unit 3	HE	CART	I								Hours: 03					
Heart- Anato Function, Fib	my, Loc rous Ske	ation, leton	, Laye of the	ers of Hear	the H t,Hear	Heart rt Val	Wall, ves an	cardi d its (ac Cl Opera	hambe ation,	ers, M Cardi	lyocar ac cyo	dial cle,	Thic	kness	s and
	Unit 4 BLOOD VESSELS										Hou	rs: 03	3			
Unit 4							A a a4		G					T 7		
Unit 4 Basic Struct Distribution,	ture of Circulati	a B onof]	lood Blood	Vess - Syst	el,Ar temic	and	Pulm	onary	es,Ca Circ	pillari ulatio	es,ve ons, C	nules Corona	and ary C	Ve Circu	ins,E latio	n.

	Total Lecture hours	45 Hours			
Text Books (F	Required Course Material)				
1	Tortora, G.J. and Derrickson, B.H., 2018. <i>Principles of</i> Wiley & Sons. (14 th Edition or latest Edition)	of anatomy and physiology. John			
Reference Bo	bks				
1	Aaronson, Philip I., Jeremy PT Ward, and Michelle system at a glance. John Wiley & Sons, 2020.	J. Connolly. The cardiovascular			
2	Martini, Frederic, Michael J. Timmons, Robert B. Ta W. Garrison, Kathleen B. Welch, and Ralph T. Hu Francisco, CA: Pearson/Benjamin Cummings, 2006.	Illitsch, William C. Ober, Claire Itchings. Human anatomy. San			
Evaluation ca	tegory				
Sl. No.	Category	Weightage (%)			
1	Sessional Examinations (I & II)	40			
2	End Semester Examination	50			
3	Assignment	10			
List of experi	nents suggested ("X" Component)				
Sl. No.	Title	Hours			
1.	Blood group identification	03			
2.	Estimation of Blood Clotting time/ Prothrombin time	03			
3.	Estimation of Bleeding time	03			
4.	Haemoglobin estimation	03			
5.	Erythrocyte Sedimentation Rate Estimation	03			

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6.	Packed cell volume	03
7.	Total count of RBCs	03
8.	MCH, MCV, MCHCestimation	03
9.	Blood Pressure Measurement	03
10.	Spo2 Measurement	03
11.	Temperature Measurement system	
12.	Heart rate Computation	03
13.	Simulation/ Generation of Electrocardiogram (ECG).	03
	Total laboratory hours	45

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Winder sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

Course Code	L	Т	Р	X	С			
212BME1106	MEDICAL PHYSICS	3	0	0	0	3		
Prerequisite: N	Syllabus revision: r.3							
Course Catego	ry: Program Core	Course Type: Theory						
Course description								
1 To understand the detection of electrical event within the body and the effect of externally applied electrical current.								

2	To explain the basic	s of radioactivity and h	now isotopes are produced.
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3	To explore the effects of radiation in matter and to understand various detectors for detecting the presence of ionizing radiation.
4	To learn the physics of light in medical imaging.

5	To understand the various effects of radiation at cellular level.

Course outcomes:

On successful completion of the course the students will be able to

C01	To understand the biological effects of low and high frequencies of electromagnetic fields and safety issues associated with the handling of electromedical equipment.									
CO2	describe the fundamentals of radioactivity and radioactive isotopes.									
CO3	To illustrates the methods of detecting and recording the is and its interaction with matter.	o illustrates the methods of detecting and recording the ionizing radiation and its interaction with matter.								
CO4	To explain the clinical applications of light in imaging tech	niques.								
CO5	To elucidate the effects of radiation on humans and va measures.	'o elucidate the effects of radiation on humans and various protection neasures.								
СО	РО	PSO								

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4		
1	Μ	Μ	Μ			Н							Н					
2	Μ	Н	Μ			Н							Μ			М		
3	М	Н	М	L		Μ							Μ			М		
4	М	М	М	L														
5	М	М	L	L		Н							M					
H–High, M–M	lediu	m, L-	-Low	,														
Unit 1	Unit 1Non-Ionizing Electromagnetic Radiation: Tissue Absorption and Safety IssuesHours: 9																	
Radiation and its types – overview, Tissue as a leaky dielectric, Effects of non-ionizing radiation – low and high frequency effects, Electromedical equipment safety standards– Physiological effects of electricity, Leakage current, Classification of equipment, Acceptance and routine testing of equipment.																		
Unit 2Principles of Radioactive NuclidesHours: 8																		
Radioactive D Isotopes – N Radioisotopes, of radionuclide	atura Isoto s in 1	ally ppe G medic	ay E Occu enera cine.	quati- urring ators,	g Ra Cycl	und F adioad otron	tait-L ctivit <u>y</u> , Rea	y, N ctor l	I rans Ieutro Produ	on F Iced I	Equil Reacti Radio	ons onucli	and des.	M App	an-Nolicat	n of Iade ions		
Unit 3	Io	nizin	g Ra	diati	on							F	Iour	s: 12	2			
Characteristics Interactions of Neutrons, Atte Permissible Le counters, Film radiation – LIN	of f Hea muati vels, dosi JAC,	intera avy (ion of meas imete Cybe	action Charg f X a surent rs, T er kni	ns, d ged I and γ nent n herm fe an	lirect Partic Radi netho olum d Ga	ly io les, i ation ds –I inesc mma	nizin Indire , Dos oniza coniza cent c knife	g rac ectly e and tion o losim	diatic Ioniz d Exj cham ietry	on – zing posur lbers, (TLI	Inte Radi e Me G-M D). A	ractio ation- asure coun pplic	ons – In omen oters, atior	of e terac it, M Scin of	electr etion Iaxir ntilla ioni	ons, s of num ation zing		
Unit 4	Ph	ysics	of L	ight	in In	nagin	g					ł	Iour	s: 5				
Infrared Photo Microwave Th basis of transil	grapl ermc lumir	hy, T ograp natior	ʻransi hy. I ı, Exp	llumi magii perim	natio ng by ental	on, In 7 Dia arrai	frare phan ngem	d ima ograp ents.	aging hy –	, Liq Clir	uid o ical	crysta Appli	1 Th catio	erm ons,	ogra Phy	phy, sical		
Unit 5Radiation BiologyHours: 11																		
Interactions at the Cell and Tissue Levels, Cell Survival Studies, Modification of Cellular Responses, Stochastic Effects of Radiation, Nonstochastic Effects of Radiation. Protection from External Sources of Radiation – Regulatory Authority for RadiationProtection, Effective Dose Limits, Safety Recommendations for Sources of X andyRadiation, Protective Barriers																		
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for Radiation Sources, Area and Personnel Monitoring. Protection from Internal Sources of Radiation – Committed Dose Equivalent, Estimating Internal Dose, Radiation Dose from Internal Radioactivity, Recommendations for Safe use of RadioactiveNuclides.

	Total Lecture hours	45
Textbooks		
1	Brown, Brian H., et al. <i>Medical physics and biomedical</i> Press, 1998.	engineering. CRC
2	Hendee, William R., and E. Russell Ritenour. <i>Medical im</i> Wiley & Sons, 2003.	aging physics. John
3	S.Webb, The Physics of Medical Imaging. Taylor & Fran	ncis Group, 1988.
Reference Bool	ζS	
1	Maqbool, Muhammad, ed. An introduction to medical 2017.	physics. Springer,
2	Dance, D. R., et al. "Diagnostic radiology physics: A har and students. Endorsed by: American Association of Phy Asia-Oceania Federation of Organizations for Medical Federation of Organisations for Medical Physics." (2014)	ndbook for teachers sicists in Medicine, Physics, European).
3	Saha, Gopal B. <i>Physics and radiobiology of nuclear</i> Science & Business Media, 2012.	medicine. Springer

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ACADEMY OF RESEARCH AND EDUCATION (DEEMED TO BE UNIVERSITY) Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

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Course Code	Course Name	L	Т	Р	X	С
212BME1105	HUMAN ANATOMY AND PHYSIOLOGY	3	0	0	0	3
Prerequisite: N	11	Syl l r.3	labu	is re	evisi	on:
Course Categor	y: Program core	Cou The	irse ory	Ty	pe:	

Course description

This course will enable students to develop an understanding of the relationships between the structures and functions of the human body. This course provides a comprehensive study of the anatomy and physiology of the human body. This course examines the biological structure of living organisms and their components, such as organs, muscles and bones.

Course outcomes:

On successful completion of the course the students will be able to

1

CO1	Ex Fu	plain nctio	the Inns	nterre	elatio	nship	s Am	ong l	Moleo	cular,	Cellu	ular, '	Tissu	ie an	d Or	gan
CO2	Ex Illı	plain ustrat	diffe e the	rent t proce	ypes ess of	and p dige	oroper stion	rties (of mu	iscula	r and	skele	etal s	yste	ms.	
CO3	De cir	escribe and categorize the organs and its functions associated with reulation of blood and perfusion.														
CO4	De	scrib	e the	passa	ige of	f neur	al sig	;nals [·]	withi	n the	huma	an bo	dy.			
CO5	De rep	escribe the basic components and functions of urinary, special sensing and productive systems.														
СО						I	20							P	SO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Н												Н			Н
2	Н	L M H H												Η		
3	Н		М										Н			Η

r			-			•	•				•				
4	Н	L										Н			Н
5	Н		L									Н			Н
H – High, M –	Mediu	т, L –	Low												
Unit 1	CEL TER	LLS, TI RMINO	SSUE LOG	S AN Y	ND B	ASIC	C ANA	ATO	MIC	AL		Но	urs:	09	
Introduction to the Human Body, Levels of Structural Organization, Basic Life Processes of the Human Body, Cell and Its Organelles, Cellular Diversity, Excitable Cells and non-Excitable Cells, Action Potential, Cell division, Cell signalling, Tissue Level of Organization, Types of Tissues. Basic Anatomical Terminology- Body Positions, Regional Names, Directional Terms, Planes and Sections, Body Cavities, Abdominopelvic Regions and Quadrants. Homeostasis															
Unit 2 MUSCULOSKELETAL SYSTEM AND DIGESTIVE SYSTEM Hours: 09															
 Muscular System: Type of muscles, properties of muscles, Functions of Muscle. Skeletal Muscle- Contraction and Relaxation of Skeletal Muscle. Skeletal System: Divisions of the Skeletal System, Types of bones, classification, Structure and composition of bone, cartilage, tendon, ligament. Joints: Classification of joints, structure and types of synovial joint, Types of Movements at Synovial Joints. Digestive System:Organs of Digestive system – Digestion and Absorption 															
Unit 3	CAF SYS	RDIOV TEM	ASCI	JLAI	R AN	D R	ESPII	RAT	ORY			Но	urs:	09	
Blood: Function and Blood Typ Heart: Anatom Cardiac Muscle Types of Blood Respiratory sy Capacities, Exc	ons and es. ny and p es, Carc l Vesse v stem: change	Propert physiolo liac Cor ls, Regu Respira and Tra	ies of ogy of nducti ilatior tory S nspor	Bloc Hear on Sy of F Syster t of C	od, Bl rt, He ystem leart 1 n An 02 and	art V , Car rate a atom d Co2	Cells alves diac c and blo y, Pul 2, Cor	– RB and (cycle, cod p mona ntrol (C, W Circu Carc ressu ry V of Re	BC, latior liac o re. entila spirat	Plate of B utput ation, tion.	lets, l lood Lun	Bloo , Pro g Vo	od G1 operti olume	oups es of e and
Unit 4	NER	RVOUS	SYS	ГЕМ								Но	urs:	09	
Organization of the Nervous System: Central and Peripheral Nervous System, Functions of the Nervous System, Structure and Types of Neurons, Synapse and Neurotransmitters, Electrical Signal in Neurons, Signal Transmission. Brain: Organization, Divisions of brain lobes and its functions, Functional Organization of the Cerebral Cortex, Cerebrospinal Fluid, Autonomic Nervous System and its function Spinal cord: Tracts of spinal cord – Reflex mechanism															
Unit 5	REN REP	NAL SY PRODU	STEN CTIV	M, SI VE SY	PECI YSTE	AL S EM	SENS	ES A	ND			Но	urs:	09	
Renal System: Anatomy and Physiology of Kidney, Nephron, Mechanism of Urine formation, Regulation of Blood pressure by Urinary System– Urinary reflex.															

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Special Senses- Reproductive S	Eye, Ear, Integumentary System system	
	Total Lecture hours	45 Hours
Textbooks		
1	Tortora, G.J. and Derrickson, B.H., 2018. <i>Principles physiology</i> . John Wiley & Sons. (14 th Edition or latest Editi	<i>of anatomy and</i> on)
Reference Book	ΧS	
1	Hall JE, Hall ME. Guyton and Hall Textbook of medical pl Elsevier Health Sciences; 2020 Jun 13.	hysiology e-Book.
2	Saladin Kenneth S., 2014. Anatomy & Physiology: The U Function. McGraw-Hill Education	Unity of Form and
3	Sembulingam, K. and Sembulingam, P., 2012. Esser physiology. JP Medical Ltd.	ntials of medical
4	Gerald Karp, Cell and Molecular Biology – Concepts and Wiley & Sons, USA, 7 th Edition, 2013.	Experiments, John
5	Gardner, E.J., Simmons, M.J. Snustad, D.P. Principles of Ge Ltd, New Delhi, 8 th Edition, 2008.	netics Wiley-India







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Course Code						Cour	se Na	me					L	T P X 0 2 0 Syllabus revisio .2 Course Type: ntegrated Cours naracteristics naracteristics aracteristics aracteristics							
212BME1303	;	E	LEC	FRO	NICS	5 DEV	VICE	CS AN	ND C	IRCU	JITS		3	0	2	0	4				
Prerequisite: <mark>h</mark> a	ave	<mark>to inc</mark>	<mark>lude</mark>	any	<mark>basic</mark>	scier	<mark>ice co</mark>	ourse				-	Syl r.2	labı	is re	visi	on:				
Course Catego	ry:	Progr	am c	ore									Co Inte	urse egrat	Ty ted C	pe: Cour	se				
Course descript	tion																				
1		To i applio	ntrod cation	luce 1	basic	e ser	nicon	ducto	or de	evices	s, th	eir c	characteristics an								
2		To ur	nderst	tand a	inalys	sis an	d des	ign o	f sim	ple tr	ansist	or cir	cuit								
3		To us	e BJ	Гasа	sma	ll sigi	nal ar	nplifi	er cir	cuit											
4		To in	introduce the negative feedback and positive feedback in transistor																		
5		To ap	ply t	he inc	culcat	ed kn	owle	dge f	or de	velop	ing si	mple	ele	ctro	nic c	ircu	its.				
Course outcom On successful c	es: comp	oletio	n of (the co	ourse	the s	stude	nts w	ill be	able	to										
CO1		Demo	onstra	ate an	unde	erstan	ding	of the	e opei	ation	of se	emico	ndu	ictor	dev:	ices					
CO2		Desig	gn an	d ana	lyse s	imple	e BJT	and	FET	circui	ts.										
CO3		Unde ampli	rstan fier c	d the	ope ts	ratio	n and	l des	ign (of va	rious	type	es c	of s	mall	sig	nal				
CO4		Discu differ	iss th ent ty	e effe ypes o	ects o of osc	f neg cillato	ative or circ	feedt uits.	back	on an	nplifi	er cir	cuit	ts an	ıd stı	ıdy	the				
CO5		Unde	rstan	d the	appli	catio	ns of	diode	es and	l trans	sistor	s									
СО							PO						PSO								
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3	L	L														
4	L	L	L	L				М					L			
5	L	L	L	М				L				М	М	L		
H – High, M –	Med	ium, .	L-L	ow		1						1	1			L]
Unit 1		INTF	ROD	UCT	ION	TOI	DIOI	DES					Hou	rs: 9)	
Review of Network and Semiconductor Basics, PN Junctions, Formation of Junction, Physical operation of diode, Contact potential and Space Charge phenomena, I – V Characteristics, Zener diode, LDR, Physical operation of special diodes (Tunnel diode, LED, OLED, Varactor diode, Schottky diode and Photo Diode). Unit 2 INTRODUCTION TO TRANSISTOR														ysical Zener liode,		
Unit 2	•	INTF	RODI	UCT	ION	TO	FRA I	NSIST	ror				Hou	rs: 9)	
Operation and Characteristics of BJT, FET, MOSFET and UJT, biasing Circuits of BJT, FET, analysis and design of CC,CE and CB configuration, Analysis and Design of CS, CD and CG, Photo transistor																
Unit 3	SMALL SIGNAL AMPLIFIERS Hours: 9															
Transistor as Amplifier, Amplifier design, Multistage amplifier: RC coupled amplifier, tuned amplifier, Thermal run away in BJT circuits																
Unit 4		FEEI	DBA	CK A	MP	LIFI	ERS	AND	OSC	CILL	ATO	R	Hou	rs: 9)	
Properties of No current series a Hartley Oscilla wave generator	egativ and c tor, (s	ve fee currer Clapp	edbac nt shu o, Cry	k, Ty int, S vstal	pes c Sinus Oscil	of fee oidal llator	dbacl Osc , non	k conf illator -sinus	igura , RC oidal	tion: Osc osci	Volta illator llator	nge sl r, Co , Sav	unt, lpit (v too	volta Osci th, T	age s llato Friar	eries, r and ıgular
Unit 5		APPI	LICA	TIO	N O	F EL	ЕСТ	RON	IC D	EVI	CES		Hou	rs: 9)	
Regulated Pow and Clamping c	er Su circui	pplie ts, M	s, De ultivi	sign brato	of Pa rs, So	ssive chmit	Filte Filte	ers, vo gger	ltage	regu	lators	s: shu	nt, se	eries	, Cli	pping
	'	Total	l Leci	ture	nour	s							45			
Textbooks																
1]	Elect	ronic	Princ	ples	s, Sev	enth	Editic	on: A	lbert	Malv	ino a	nd Da	avid	J.Ba	ites
Reference Boo	ks															
1 Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar, Microelectronic Theory and Applications, 2013, Fifth edition, Reprint, Oxford University press, New York, USA.																
2		BG.	Stree	tman	and	S.Ba	anerje	ee, So	olid S	State	Elect	tronic	Edu	icati	on,	2015,
25 KARE Department of Riemodical Engineering																

	Seventh edition, New Delhi, India
3	Jacob Millman, Christos C Halkias and SatyabrataJit, Electronic devices and circuits, 2015, Fourth edition, Tata McGraw Hill, New Delhi, India
4	Thomas L.Floyd ,Electronic Devices Electron Flow Version, Ninth Edition,Prentice Hall

Practical component

Sl. No.	Experiments	Hours
1	Study of basic tools (oscilloscope, multimeter, circuit connection, soldering)	6
2	Transistor Biasing with and without stabilization	2
3	Transistor as an Amplifier	2
4	FET characteristics and Evaluation of its parameters, MOSFET characteristics	4
5	UJT characteristics	2
6	FET biasing methods	2
7	Two stage RC coupled amplifier, Frequency response Class B Complementary symmetry power amplifier	6
8	Differential amplifier using BJT	2
9	Phase shift oscillator using BJT/FET	4
10	BJT based Multivibrators	4
	Total Lecture hours	34



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Course Code	Course Name	L	Т	Р	X	C	
212BME1301	3	0	0	0	3		
Prerequisite: Ni	1	Syllabus revision: r.3					
Course Categor	y: Program Core	Co Th	ours eory	e T <u>r</u>	ype	;	

Course description

This course deals with the chemical level of organization of living beings and offers detailed knowledge on biological macromolecules such as classification, structure and properties of carbohydrates, Lipids, Protein and Enzymes also emphasis on relation to other life sciences.

Course outcomes: On successful completion of the course the students will be able to

CO1	Desc livin	Describe the principles governing the complex interactions of chemicals in living system														
CO2	Unde mach	Understand the importance of carbohydrates and vitamins in cellular machinery														
CO3	Desc biolo	Describe the structure of proteins and elucidate the clinical significance of piological catalysts														
CO4	Unde impl	erstar icatio	nd the ons in	e strue phys	cture siolog	of va gy	rious	lipid	s and	its de	erivat	ives	with	theii	r	
CO5	Eluc	idate	the d	iffere	ent bo	onds a	and st	ructu	ral co	ompo	nents	of nı	ıclei	c aci	ds	
СО						Р	0							PS	60	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
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3	Н					М							Н			Н
4	Н					М							Н			Н

5	Н					Μ							Η			н
H – High, M	– Medi	ium, .	L-L	.ow												
Unit 1	CHI	EMIC	CAL	LEV	EL C)F O	RGA	NIZ	ATIC	DN			Ho	urs:	06	
Organization Covalent Bor Reactions- Fo Types of Cl Colloids, and Concept of pl and Its Functi	of Mat nds, H rms of hemica Suspe H, Mai onal G	ter-io ydrog Energ I Re ension intain roups	ons, m gen E gy an eactio ns, Iu iing F s.	nolect Bonds d Cho ons.In norga oH: E	ules a s, Hy emica organ nic A Buffer	and co drop al Rea nic (Acids Sys	ompo hobic actior Comp s, Bas tems,	unds. and as, En oound ses, a Orga	Cher hyd ergy s an and S nic C	nical rophi Trans d So Salts. Comp	Bond lic in sfer in olutio Acid ounds	s-Ion aterac a Che ns-W I–Bas S-Intro	tions mica ater, ater, be B oduc	onds s. Cl d Rea , So alance etion,	hemi actic lutic ce: 7 ,Cart	cal ons ons The
Unit 2	CAF	CARBOHYDRATES AND VITAMINS Hours: 06														
Classification and structure of monosaccharides, disaccharides, Polysaccharides: structural polysaccharides and storage polysaccharides. Reactions of monosaccharides.Disorders of carbohydrate metabolism. Diagnosis of diabetes mellitus. Carbohydrate chemistry in blood typing. Vitamins, Fat soluble and water-soluble vitamins; Classification, structures and physiological functions.																
	1															
Unit 3	AM	INOA	ACIE	DS, P	ROT	EIN	S AN	D EN	NZYN	AES			Ho	urs:	06	
Unit 3 Structure and – primary, see Globular and Clinical signi dehydrogenas	AMI charact condary fibrout ficance e.	INOA teristi y, ter s pro e of	ACIE ics of tiary, teins. Aspa	DS, P amin , quat . Dise artate	ROT: no acid ternar orders e ami	EIN: ds. Pe ry str s of a notra	S AN eptide uctur amino unsfer	D EN e bond e of j o acido rase,	d. Str protei 1 met Alan	MES uctur n – C aboli ine a	al org Confo sm. I umino	aniza rmati Diagn trans	Hon tion control to the structure the structure of the st	of profine of profine of profine of profine of profine of the set	06 rotein otein zyme .acta	ns is: es: te
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Unit 3 Structure and – primary, see Globular and Clinical signidehydrogenas Unit 4 Structure, an phospholipids physiological and their bioloc Unit 5	AMI charact condary fibrou ificance e. LIP d pro d, cere implic ogical f	INOA teristi y, ter s pro e of IDS A opertion ations functi	ACIE ics of tiary, teins. Aspa AND es c ides, s- Ste ions.	DS, P amin quat Disc artate HOI lassif lipo eroids	ROT: no acid ternar orders ami RMO ficatio protei s and	EIN: ds. Po ry str s of a notra NES on o ins bile a	S AN eptide ucture amino unsfer of lip and acids.	D EN e bond e of p o acido ase, bids, gang Disc	d. Str protei d met Alan fatty liosid orders	ATES uctur n – C aboli ine a ine a caci les- of li	al org Confo sm. I umino ds, t Prost pid m	aniza rmati Diagn trans: rrigly aglan tetabo	Ho ation co ion co feras Ho cerico dins olism	urs: of prof prof c enz se, L urs: les, and h. Ho urs:	06 rotein zyme Lacta 06 wax d th ormo	ns s: es: te
Unit 3 Structure and – primary, see Globular and Clinical signid dehydrogenas Unit 4 Structure, an phospholipids physiological and their biolo Unit 5 Structure of p bonds. Histon pyrimidine me	AMI charact condary fibrous fibrous ficance e. LIP d pro d, cere implic ogical f NUC urines, es – W etabolis	INOA teristi y, ter s pro e of IDS A opertion functi CLEI pyrin atson sm, d	ACIE ics of tiary, teins. Aspa AND es c ides, s- Ste ions. CAC midin n and liagno	DS , P amin , quat . Dise artate HOI lassif lipo eroids CIDS e, nu Cricl Dsis o	ROT: no acid ternar orders ami RMO ficatio proteis and cleos k mod of gene	EIN: ds. Por y str s of a notra NES on o ins bile a ides del of etic o	S AN eptide uctur amino unsfer f lip and acids.	D EN e bond e of p o acid rase, bids, gang Disc Uclec A, Ty lers	d. Str protei d met Alan fatty liosid orders otides pes o	ATES uctur n – C aboli ine a aci les- of li – pho f RN	al org Confo sm. I umino ds, t Prost pid m ospho A. Di	aniza rmati Diagn transt transt aglan tetabo	Ho ation co iostic feras Ho ceric dins olism Ho er ar ers of	urs: of pro of pro c enz se, L urs: les, and h. Ho urs: urs:	06 rotein zyme Lacta 06 wax d th ormo 06 vdrog ine a	ns s: s: te te nes gen nd
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	Freeman, 2013	
Reference B	ooks	
1	Tortora, G.J. and Derrickson, B.H., 2018. <i>Principles of anato physiology</i> . John Wiley & Sons. (14 th Edition or latest Edition	omy and on)-For unit 1
2	Murray. R.K., Granner, D.K., Mayes. P. A. and Rodwell, V.V Harpers Biochemistry, McGraw Hill, 27 th Edition, 2006.	V.,
3	Berg. J.M., Tymoczko.J.L., Stryer, L., Biochemistry, Freema 2012	an, 7 th edition,
4	Voet, D., Voet, G., Biochemistry, John Wiley and Sons, Singa 2011.	apore, 4 th Edition,
	Voet D, Voet JG., Biochemistry. 4 th edition (2011)., Willey	
List of exper	iments suggested ("X" Component)	
Sl. No.	Title	Hours
1	Visualization of macromolecule	3
2	Calculation of pH	3
3	General tests for carbohydrates	3
4	Estimation of blood glucose.	3
5	General tests for carbohydrates	3
6	Estimation of blood glucose.	3
7	Differential count of different WBCs	3
8	General tests for proteins.	3
9	Separation of amino acids by thin layer chromatography (paper chromatography)	3
10	General tests for lipids.	3
11	Estimation of cholesterol	3
12	Protein structure modelling.	3
13	Separation of DNA by agarose gel electrophoresis	3

29 | KARE

14	Estimation of creatinine and urea	3
15	DNA Modelling	3
	Total laboratory hours	45

STATING ST
Anand Nagar, Krishnankoil





- 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu | info@kalasalingam.ac.in | www.kalasalingam.ac.in

Course Code		Course NameLTPX											С			
212BME1102				DIG	ITAI	LO	GIC	CIRC	CUIT			2	0	0	0	2
Prerequisite: Electronic devices and Circuits									S N	Syllabus revision: NA						
Course Category: Program core									C T	Course Type: Theory						
Course descrip	otion															
1	Т	o rep	resen	t num	nber s	ysten	n and	diffe	rent t	ypes	of co	des				
2	Т	o rep	resen	t logi	cal fu	inctio	ons in	cano	nical	and s	tanda	rd for	ms			
3	Т	o des	ign a	nd an	alyse	the c	ombi	natio	nal lo	ogic c	ircuits	8				
4	Т	o des	ign a	nd an	alyse	the s	eque	ntial l	ogic	circui	ts					
5	Т	o imp	oleme	nt co	mbin	ationa	al and	l sequ	entia	l logi	c circi	uits us	sing	Veri	log l	HDL
Course outcom On successful o	nes: comp	pletio	n of (the co	ourse	the s	stude	nts w	rill be	able	to					
C01	A S	pply ysten	the 1	numb	per sy	ystem	and	code	es fo	r inte	erpret	ing v	vork	ingo	f Di	gital
CO2	А	pply	the B	oolea	an Ex	press	ions t	to real	lize tl	ne log	gic cir	cuits				
CO3	D	esign	a sir	nple o	comb	inatio	onal c	ircuit								
CO4	D	esign	simp	ole se	quent	tial ci	rcuits	5.								
CO5	Ir	nvesti	gatio	n of	data	conv	erters	and I	PLDs	in di	gital e	electro	onic	s sys	tems	5
СО						P	0							PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	L															
2	L	L		L									L			
3	L	М	L	L	М				М				L	L		

											•					
4	L	L	L	L	L				L				L	L		
5	L															
H – High, M – Medium, L – Low																
Unit 1	N	UME	BER	SYST	ſEM	AND	CO	DES]	Hour	s: 9		
Base or radix of number systems, Binary, Octal, Decimal and Hexadecimal number system.Binary arithmetic: Addition, Subtraction, Multiplication, Division.Subtraction using 1's complement and 2's complementCodes: BCD, Gray Code, Excess-3, ASCII codeBCD Arithmetic: BCD Addition																
Unit 2	L	OGI	C GA	ATES	AN	D LO	GIC	FAM	IILII	ES]	Hour	rs: 9		
Logic Gates: Symbol, diode/transistor switch circuit and logical expression, truth table of basic gates (AND, OR, NOT), Universal gates (NAND, NOR) and special purpose gates (Ex-OR, Ex-NOR), Tristate Logic.Laws of Boolean algebra, Duality Theorem, De-Morgan's TheoremLogic Families: Characteristics of Logic families, Comparison TTL, CMOS, Types of TTL NAND gate.											oasic , Ex- ogic AND					
Unit 3	C	COMI	BINA	TIO	NAL	LOC	GIC (CIRC	UITS	5]	Hour	rs: 9		
SOP and POS Boolean express form)Design of and Full Subt bit).Encoder/De	form ssion Arith racto ecode	is, rea : M hmeti or, Gi er,Mu	lizati inimi c circ ray t ltiple	ion us zatio cuits a co Bi exer a	sing 1 n of and co nary nd Do	NAN Bool ode co and emult	D/NC ean i onver Bi iplex	DR ga functi rter us nary er: Bu	tesK ons sing H to C uffer	-map up to K-maj Gray	redu 4 v p: Ha Code	ction ariab alf an e Co	tech les (d Ful nvert	niqu SOP ll Ad er (e for & der, up t	r the POS Half to 4
Unit 4	S	EQU	ENT	IAL	LOG	IC C	IRC	UITS]	Hour	rs: 9		
Basic Memory Flip Flops, Shi Asynchronous	Cell: ft Re Coun	RS I gister ter, S	Latch SIS ynch	- usin O, SII ronou	ig NA PO, F is Co	AND PIPO, unter	& N(PIS(DR., 7 D, 4 E	Frigge Bit U	ering nivers	Meth sal Sł	nods, nift R	SR F egist	Flip H ers (Flops Coun	s, JK ters,
Unit 5	D	АТА	CO	NVE	RTE	RS A	ND I	PLDS]	Hour	rs: 9		
DAC: Types, weighted resistor circuit and R-2RLadder circuit, DAC IC 0808 specifications, ADC: Block diagram, types and working of Dual Slope ADC, SAR ADC, ADC IC 0808/0809 specification, RAM and ROM basic building blocks, read and write operation, types of semiconductor memoriesPLD: Basic building blocks and types of PLDs, PLA, PAL, GAL.CPLD, FPGA: Basic building blocks and functionality.										ions,)809 s of PAL,						
								Tot	al Le	ectur	e hou	rs		45	5	
Textbooks		-						-				•				
1	M In In	M. Morris R. Mano and Michael D. Ciletti, Digital Design With an Introduction to the Verilog HDL, 2014, 6 th Edition, Prentice Hall of India, India.														

2	John. F. Wakerly, "Digital Design Principles and Practices", Fourth Edition, Pearson Education, 2007
Reference Books	5
1	Charles H. Roth, Jr., Fundamentals of Logic Design, 2014, 7 th Edition Reprint, Brooks/Cole, Pacific Grove, US
2	Michael D. Ciletti, Advanced Digital Design with the Verilog HDL, 2011, 2 nd Edition, Pearson Pvt. Ltd, Noida, India.
3	Stephen Brown and ZvonkoVranesic, Fundamentals of Digital Logic with Verilog Design,2013, Third Edition, McGraw-Hill Higher Education, New Delhi, India.



ALASALINGAM ADEMY OF RESEARCH AND EDUCATION DEEMED TO BE UNIVERSITY)



Moder sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

Course Code	Course Name	L	Т	Р	X	С
212BME2112	BIOMATERIALS	2	0	0	3	3
Prerequisite: N	fil	Syl rev	llab visio	ous on: 1	r.3	
Course Catego	ry: Program core	Co Th	ours eory	e T	ype	:

Course description

This course covers the principles of materials science and cell biology underlying the design of medical implants, artificial organs, and matrices for tissue engineering. Methods for biomaterials surface characterization and analysis of protein adsorption on biomaterials.

Course outcomes: On successful completion of the course the students will be able to

CO1	Expe appl	erime icatio	nt w ons	ith tl	he cl	asses	of	mater	rials	that	can	be u	sed	for 1	medi	cal
CO2	Illus and	trate the cl	the renaract	espon teriza	se of tion 1	hum hetho	an bo odolo	ody to gies f	owarc for bio	ls the omate	appl crials	icatio	on of	bior	nate	rial
CO3	Apply the Biomaterials as drug delivery systems and in ophthalmology															
CO4	To c of m	harac ateria	terize als tha	e the at cou	Bion ıld be	nateri e usec	als us l as a	sing r tissue	nicro e repl	scopy acem	and ent in	perfo nplai	orm o nt.	comł	oinat	ion
CO5	To u	nders	stand	and c	lesigi	n the	artific	cial of	rgans							
СО	PO PSO															
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Μ	L	L	L		М	М	М	М	L	L	Н	М	М	L	М
2	М	М	М	М	L	М	М	М	М	L	М	Н	М	Μ	L	М
3	Μ	М	Н	Н	Н	Н	М	М	Н	М	М	Н	Н	Η	Μ	М
4	Н	М	Н	Н	Η	Н	М	М	Η	М	М	Н	Н	Н	Η	М

5	М	М	Н	Н	Н	Н	М	М	Н	М	М	Н	М	Н	Н	Μ
H-High, M-M	edium	ı, L-I	Low									<u> </u>				
Unit 1	CLA	ASSE	S OI	F MA	TER	RIAL	S US	ED I	N MI	EDIC	CINE]	Hour	rs: 09	9	
Classification of based materials ceramics – bio PMMA bone components, S	of Bio s – cer oactiv cemer urface	omate camic e gla nt, ar e prop	rials: s – bi iss ar ticula pertie	Meta oiner nd gl ating s and	als an t cera ass c comj Bull	nd allo amics eram poner c mec	oys; s – car ics, c it – U hanic	tainle bon, a alciu JHM cal pro	ess ste alumi m ph WPE opert	eel, c na, z nosph – co ies.N	obalt ircon ate c ompo anost	base a and eram sites, tructu	d allo l titan nics – , mat ured I	oys, t ia – l - pol rix a Biom	titani bioac lyme and f nateri	ium- ctive rs – filter ials.
Unit 2	BIO	LOC	GICA	L PF	ERFO)RM	ANC	E OI	F MA	TER	IAL	S I	Hour	rs: 09	9	
Biocompatibili and wear – H hemolysis – Biocompatibili Interactions of	ty-Tis ost re appi ty tes mater	ssue (spon roach ting: rials v	Comp se – to -in vi with t	oatibi Infla thro itro a the hu	lity – mma ombo nd in ıman	mate tory presis vivo body	rial re proce tant studi 7.	espon ess – mate es of	se: – caps erial bioco	defoi ule fo devo ompa	rmati ormat elopn tibilit	on an tion - nent ty.	nd fai – coa –ca	lure - agula arcine	– fric tion ogen	ction and esis.
Unit 3	OPH DRU	HTH. UG D	ALM DELI	IOLO VER)GIC Y SY	C STE	APPI MS	LICA	TIO	NS	AN		Hour	rs: 09	9	
Materials for o Implants for C Diffusion Cont	phtha Hauco rollec	lmolo oma-I I-Wat	ogy – Impla ter pe	- cont ints f	act le or Re tion c	ens ar etinal contro	nd int Deta olled	raocu achme –Che	ilar le ent si mical	ens m urger lly Co	ateria y- dr	als – ug d lled-I	Corn elive Regul	eal I ry sy lated	mpla ysten Syst	ants- ns: - tems
Unit 4	BIO AND	MED) IMI	ICAI PLAN	L CH. TS	ARA	CTEF	RIZA'	TION	TEC	CHNI	QUE	s]	Hour	rs: 09	9	
Rheology, At Microscopy I biodegradabilit hard tissue rep	comic Fourie ty,Per lacem	For er T cutan ent I	rce] ransf leous mplai	Micro form and s nts, jo	oscop Infr skin i oint re	oy, E ared mpla eplace	Electr Spe nts, n emen	on l ctrosc naxill ts, De	Micro copy. ofaci ental	oscop Bic al au Impla	y, 7 ocom gmen ants, 1	Trans patib Itatio Panc	missi ility, n, Va reas 1	on bio scul epla	Elec Dacti ar gr ceme	etron vity, afts, ent.
Unit 5	AR	FIFI	CIAL	. OR	GAN	IS]	Hour	rs: 09	9	
Artificial bloo (oxygenator), A	d, art Artific	ificia cial K	l ski idne <u>v</u>	n, Aı y (Dia	rtifici alyze	al He r mer	eart, nbrar	Prost ne)	hetic	Carc	liac	Valve	es, A	rtifi	cial	lung
								Tot	al Le	cture	e hou	rs		4	5	
Textbooks												•				
1	Budo to M	ly D. ateria	Ratno al in N	er and Medio	d All cine"	an S.I Thire	Hoffr 1 Edit	nan E tion, 2	Bioma 2013.	ateria	ls Sc	ience	e "An	Intr	oduc	ction
2	Jona Bioc	than ompa	Blac atibili	ck, E ty, M	Biolog [arce]	gical Dek	Perf ker Ir	ormanc., 4 ^t	nce ^h edit	of n ion N	nateri New N	als, York,	Func 2005	lame 5	entals	s of
							Dei	nartı	nent	of H	liom	edic	al Ri	noin	eeri	ná

3	Joon Park, R S Lakes, Biomaterials: An Introduction, S _J Business Media, 2007	pringer science and				
4	Sujatha.VBhat, Biomaterials,II Edition Alpha Science 200)5				
Reference Boo	oks					
1	Fredrick H. Silver: Biomaterials, Medical Devices & TissueEngineering: An integrated approach. Chapman & Hall, 1994					
2	Ratner B, Hoffman A. et al. Biomaterials science: An introduction to materials in medicine, Academic Press, 2004					
3	Amit Bandhyopadhya, Susmita Bose, Characterization of Biomaterials, Newnes, 2013					
List of experi	nents suggested ("X" Component)					
Sl. No.	Title	Hours				
Sl. No. 1	TitleTeaching about the basics of Ansys software andIntroduction to the different biomaterials.	Hours 05				
Sl. No. 1 2	TitleTeaching about the basics of Ansys software and Introduction to the different biomaterials.Design and analyze of the strength for the given material and dimensions	Hours 05 05				
Sl. No. 1 2 3	TitleTeaching about the basics of Ansys software and Introduction to the different biomaterials.Design and analyze of the strength for the given material and dimensionsDesign a simple model of drug delivery system and analyze the flow of the fluid using the software.	Hours 05 05 05				
Sl. No. 1 2 3 4	TitleTeaching about the basics of Ansys software and Introduction to the different biomaterials.Design and analyze of the strength for the given material and dimensionsDesign a simple model of drug delivery system and analyze the flow of the fluid using the software.Design a simple model of dental implant by using the given material and dimensions	Hours 05 05 05 05				
Sl. No. 1 2 3 4 5	TitleTeaching about the basics of Ansys software and Introduction to the different biomaterials.Design and analyze of the strength for the given material and dimensionsDesign a simple model of drug delivery system and analyze the flow of the fluid using the software.Design a simple model of dental implant by using the given material and dimensionsModeling of an artificial organs by using the given dimensions	Hours 05 05 05 05 05 05				
	LABALING					
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56	(Q)					
-	And A					
Anand	Nagar, Krishnankoi					

ACADEMY OF RESEARCH AND EDUCATION (DEEMED TO BE UNIVERSITY)



under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

Course Code	Course Name	L	Т	Р	X	С
212BME2311	BIOCONTROL SYSTEM	2	0	0	3	3
Prerequisite: <mark>Math</mark> differential equation	course which includes z transform, n	Sylla	abus	revisi	on: r	.3
Course Category:	Program Core	Cou Theo com	rse T ory wi poner	ype: ith "X nt	<u>.</u> ,,	

Course objective

To impart profound knowledge in understanding, analyzing, and applying system concepts to physiological systems.

Course outcomes:

On successful completion of the course, the students will be able to

C01		Unc phy	lersta siolo	and a gical	and syste	apply em m	y sys lodel	stem	elen	nents	and	pro	pertie	es to	the	linear
CO2		Ana ven	alyze tilatio	stead on	ly-sta	ate ch	aract	eristi	ics of	muse	ele st	retch	refle	x, car	diac o	utput,
CO3		Ana mod	alyze del ey	the ye mo	trans ovem	ient ent c	respo ontro	onse ol, ne	of fii urom	rst & uscul	seco lar re	ond-o flex	order motic	respo n	onse a	and to
CO4		Ana	alyze	circu	ilator	y and	d ven	tilati	on m	odel	using	g sinu	isoida	ıl inpu	uts	
CO5		App ven	oly va tilatio	ariou: on	s tecł	nniqu	es to	chec	k the	stabi	ility o	of pu	pillar	y ligh	t refle	ex and
СО						Р	0							PSC	C	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Н	Н		L	Н				М				М			
2	Н	Н		L	Η				М					Н		
3	Н	Η		L	Η				Н				М	Н		
4	Η	Η		М	Η				Η					Н		

	1				<u> </u>	1	1	<u> </u>	1	1			1	1	1	
5	Η	Н		М	Н				Н					Н		
H-High, M-Me	edium	ı, L-L	Low													
Unit 1		Mod	lellir	ıg&	Syste	em r	epres	senta	tion			Но	urs:]	L: 06	, X: 0	9
Terminology a system properti systems, Laplae	nd th es, m ce tra	e bas odels nsfor	sic st s with m &	tructu n a co trans	ure o ombin sfer f	f con nation functi	ntrol n of s .on, s	syste yster tate-s	em, e n elei space	xamj ment anal	ples c s, line ysis.	of the ear m	e clos odels	sed-lo of ph	oop sy iysiol	vstem, ogical
Unit 2		Stat	ic A	nalys	sis							Но	urs:]	L: 06	, X: 0	9
Open-loop vers model, Regula analysis, regula	sus cl tion o tion o	osed of car of glu	-loop rdiac icose	os sy: outj e-inst	stem, put, o ulin, o	, Blo cardia chem	ck di ac ou ical i	agrai itput regul	m rep curv ation	orese e, ve of ve	ntatio enous entila	n of retu tion.	muso rn cu	cle str rve, o	retch closec	reflex 1-loop
Unit 3		Tim	e Do	mai	n An	alysi	S					Ho	urs:]	L: 06	, X: 0	9
The electrical a order model: in step response, a disturbances.	inalog npuls Secor	gy of e and nd-ore	lung 1 stej der d	mec pres ynar	chanio ponso nics,	cs mo e, Tr othe	odel, ansie r con	Open ent re sider	n & c spon ation	close se se : red	d-loop cond- uction	o, Tr orde n of	ansie er mo the ef	nt res del: i ffects	ponse mpuls of ex	e first- se and ternal
Unit 4		Free	quen	cy D	oma	in A	nalys	sis				Но	urs:]	L: 06	, X: 0	9
Steady-state re Nyquist plot, N	espon lichol	se to 's cha	sin art.	usoic	dal in	nputs	, Fre	equer	ncy r	respo	nse r	epres	senta	tion,	Bode	plot,
Unit 5		Stat	oility	Ana	alysis	5						Но	urs:]	L: 06	, X: 0	9
Stability & transtability criterio	nsien on, Ro	t resp elativ	onse e sta	e, Ro bility	oot lo y.	cus 1	neth	od, R	louth	-Hur	witz s	stabi	lity c	riterio	on, N	yquist
		Tota	al Le	ectur	e hou	urs						30	+ 45			
Textbooks																
1		Kho and	o, M Estir	ichae natic	el C. on. Go	K. Pł erma	nysio ny, V	logic Viley	al Co , 201	ontro] 8.	Syst	ems:	Anal	ysis,	Simul	ation,
2		Bles King	sser, gdon	Wil n, Mo	liam cGrav	B. w-Hil	A S 11, 19	Syste: 69.	ms ⊿	Appr	oach	to	Biom	edici	ne. U	Jnited
Reference Boo	oks															
1		Kuo	, B. (C. (1	995).	Aut	omat	ic co	ntrol	syste	ems. I	ndia	: Prer	tice I	Hall.	
2		Duk MA'	kipat TLA	ti, R B. Ir	. V. ndia:	(200 New	6). A Age	naly Inter	sis a natio	nd d nal.	esign	of c	contro	ol sys	stems	using
3		Bish	op, I	R. H	. (19	93).	Mod	ern c	ontro	ol sys	tems	anal	ysis a	and d	esign	using

MATLAB. United Kingdom: Addison-Wesley.

X – Component

- a) Introduction to MATLAB & SIMULINK, Implementation, and analysis of Lung mechanics model in SIMULINK
- b) Mechanical response of a cancerous tissue illustrating the lumped parameter model
- c) Conversion of muscle mechanics transfer function model into an equivalent state-space model
- d) Steady-state solution for muscle stretch reflex model with nonlinear characteristics
- e) Analyzing the steady-state characteristics regarding the cardiac output curve of a patient
- f) Steady-state values of ventilation and how the change in gas mixture affect ventilation
- g) Model of eye-movement control
- h) Simulink application of dynamics of neuromuscular reflex motion
- i) Simulink application of dynamics of glucose-insulin regulation
- j) Frequency response of ventilatory control model
- k) Frequency response of linearized lung mechanics
- 1) Frequency response model of a circulatory model
- m) Effect of how to rate sensitivity is expected to affect relative stability in the model of the ventilatory control system
- n) Stability analysis of pupillary light reflex
- o) Model of Cheyne stokes breathing

Anand Nagar, Krishnankoll	Course Cade Course Name I T D V C												
Course Code	Course Name	L	Т	Р	X	С							
215BME4215	LINEAR INTEGRATED CIRCUITS	3	0	0	0	3							
Prerequisite: Elec	tronic devices and Circuits	Syl	labu	s rev	ision	: r.2							
Course Category:	Program core	Cou The	urse cory	Тур	e:								
Course descriptio	n	-											
1	To introduce basic semiconductor devices, the application	eir c	hara	cteri	stics	and							
2	To understand analysis and design of simple OP-AM	1P ci	rcuit										
3	To use OP-AMP as a filter circuit												
4	To discuss about various analog integrated circuit												
5	To discuss about integrated circuit fabrication technology	ology	1										
Course outcomes: On successful con	: npletion of the course the students will be able to												
C01	Demonstrate an understanding of the operation of op its characteristics	oerati	onal	amp	lifier	and							
CO2	Discuss the effects of closed loop configuration and types of oscillator circuits.	study	y the	diffe	erent								
CO3	Design and analyze the performance of active filter a	and ti	imer	circu	iits								
CO4	Discuss the effects of negative feedback on amplifie different types of oscillator circuits.	r circ	cuits	and s	study	the							
CO5	Understand the various IC fabrication techniques												
СО	РО			PSC)								

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	М													М		
2	L	М	L	М									L	L		
3	L	М	L	М	М								L	L		
4	L	М	L	М								М	L	L		
5	М	L	М										L	М		
H – High, M –	Med	ium,	L-I	Low												
Unit 1		CHA OF O	RAC P-AI	TER MP	ISTI	CS A	ND A	APPL	JCA	TION	V	Hou	irs: 9)		
D.C Character bandwidth, A.C and non-invert Instrumentatior	istics C cha ting n Am	of i racte ampli plifie	deal ristic: ifiers r, Diff	op-an s – slo , Car erenti	np, pi ew ra rier ator,	in co te, fr Ampl integ	nfigu equer ifier, rator,	ration ncy c Isol log a	n of ompe ation and a	741 ensati Amj ntilog	op-ar on, A plifie amp	np, b applic r, Cl lifiers	oias, cation nopp 5.	offso ns – er A	ets, inve ampl	drift rting ifier
Unit 2		COM GEN	IPAR ERA	ATO TOR	R AN S	ND S	IGN	AL				Hou	ırs: 9)		
Comparator-reg monostable,asta bridge oscillato	gener able 1	ative nulti	cor vibra	npara tor, T	tors, riang	inpu ular v	it o wave	utput gene	cha rator,	racter R-C	ristics Phas	s, S e shi	ignal ft os	ge cillat	enera tor, V	tors- Wein
	1															
Unit 3	1	ACT	[VE]	FILT	ER A	ND '	ΓIM	ERS				Hou	ırs: 9)		
Unit 3 Filter-low pass second order f operation, Asta	, higl ilters ble C	ACT n pas , Swi	IVE I s filte itchection	FILT ers, B l capa	ER A and I acitor	ND ' Pass, filte	FIM Banc rs, 5:	E RS I Reje 55 tir	ect fi ners'	lters, func	Butte tiona	Hou erwor 1 dia	th figram) lters 1, Mo	first	and table
Unit 3 Filter-low pass second order f operation, Asta Unit 4	, higl ilters ble C	ACT n pas , Swi perat	IVE I s filte itchec ion	FILT ers, B d capa G ICS	ER A and I acitor	ND 2 Pass, filte	FIM Banc rs, 5	E RS I Reje 55 tin	ect fi ners'	lters, func	Butte	Hou erwor 1 dia Hou	th figram) lters a, Mo	first	and table
Unit 3 Filter-low pass second order f operation, Asta Unit 4 PLL-basic bloc detection, FM inverted R-2R successive appr amp regulator optocoupler IC.	, higl ilters ble C ck dia dete DAC roxim IC v	ACT n pas , Swi pperat ANA agram ection C, M nation oltag	IVE I s filto itchection LOC a, FS onoliti ADC e reg	FILT ers, B d capa G ICS eration K de thic I C, Con gulator	ER A and H acitor n, cap modu DAC, nversa r, IC	ND Pass, filte pture pture plas ion ti 723	FIMI Band rs, 5: rang n, A h AI mes o gene	E RS I Reje 55 tin e and DC DC, c of typ ral p	ect fi mers' l lock and count bical A urpos	lters, func c rang DAC er typ ADC, se reg	Butte tiona ge, sin -weig pe Al volta gulate	Hou erwor 1 dia Hou mple ghted DC, age re or, sw	th fi gram urs: 9 appl res: Dual egula vitch	lters , Mo licati istor, sloj tor – ing 1	first onos ons, R- pe A -serio regul	AM 2R& ADC, es oplator
Unit 3 Filter-low pass second order f operation, Asta Unit 4 PLL-basic bloc detection, FM inverted R-2R successive appr amp regulator optocoupler IC. Unit 5	, higl ilters ble C ck dia dete DAC roxim IC v	ACT h pas , Swi perat ANA agram ection C, M ation oltag INTE FECI	IVE I s filte itchection ILOC n, ope a, FS onoli a ADC e reg	FILT ers, B d capa G ICS eration K de thic I C, Con gulaton ATED LOG	ER A and I acitor n, cap modu DAC, nvers r, IC O CIR Y	ND Pass, filte pture alatio Flas ion ti 723	FIMI Band rs, 5: rang n, A h AI mes o gene T FA	E RS I Reje 55 tin e and DC DC, c of typ ral p	ect finners' l lock and count bical A urpos	lters, func c rang DAC er typ ADC, se reg	Butte tiona ge, sin -weig volta gulato	Hou erwor l dia, Hou mple ghted DC, age re or, sw Hou	th fi gram urs: 9 appl res: Dual egula vitch	lters , Mo licati istor, sloj tor – ing 1	first onos ons, R- pe A serio regul	AM 2R& ADC, ator
Unit 3 Filter-low pass second order f operation, Asta Unit 4 PLL-basic bloc detection, FM inverted R-2R successive appr amp regulator optocoupler IC. Unit 5 Introduction, M and Nano Tec capacitors, Inte	, higl ilters ble C ck dia dete DAC roxim IC v	ACT h pas , Swi perat ANA agram ection C, M ation oltag INTE FECI ithic ogy, d circ	IVE I s filte itchection ILOC a, FS onoli ADC e reg CGRA HNO IC Te Mon cuit p	FILT ers, B d capa d capa G ICS eration K de thic I C, Con gulaton ATED LOG echnol ackag	ER A and I acitor n, cap modu DAC, nvers r, IC OCIR Y logy-j c dic ing.	AND Pass, filte	FIMI Band rs, 5: rang n, A h AI mes o gene T FA r pro meta	ERS I Rejo 55 tin e and DC DC, c of typ ral p .BRIC cess, al ser	ect finners' l lock and count bical A urpos CAT BJT& micor	lters, func func c rang DAC er typ ADC, se reg ION	Butte tiona ge, sin -weig volta gulato	Hou erwor l dia Hou mple ghted DC, age re or, sw Hou	urs: 9 appl res: Dual egula vitch	licati istor, ing 1	first onos ons, R- pe A -serio regul	AM 2R& ADC, es op ator, EMS , IC

Text Books	
1	Op–amps and Linear Integrated Circuits, Ramakant A. Gayakward, 4 th Edition, Pearson Education
2	Linear Integrated Circuits, Roy Choudhary and D., SheilB.Jani 3 rd Edition, New Age International
Reference Books	
1	Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar, Microelectronic Theory and Applications, 2013, Fifth edition, Reprint, Oxford University press, New York, USA.
2	B G.Streetman and S.Banerjee, Solid State Electronic Education, 2015, Seventh edition, New Delhi, India
3	Robert F.Coughlin., Fredrick F.Driscoll, Op–amp and Linear Ics,6 th Edition, Pearson Education
4	Franco, Design with Operational Amplifier and Analog Integrated Circuits, 3 rd Edition, McGraw Hill Education (India) Private Limited



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Course Code	Course Name	L	Т	Р	X	С
212BME2119	PATHOLOGY AND MICROBIOLOGY	2	0	0	0	2
Prerequisite: Nil		Sy r.3	llab	us i	revis	sion:
Course Category	: Program Core	Co Th	ours eory	e Ty	ype:	

Course description

Pathology and Microbiology course offers fundamental knowledge on general pathologic mechanisms, and various pathologic conditions related to the body fluids. It also involves the study of microorganisms with particular emphasis on the biology of bacteria and viruses, and their impact on humans.

Course outcomes: On successful completion of the course the students will be able to

CO1	Illus	trate	the di	fferei	nt typ	es of	Cell	deger	nerati	on, ho	ow an	d wh	en it	gets	repa	ired.
CO2	Unde	erstar	nd dif	feren	t path	ologi	ic con	ditio	ns rel	ated t	to the	body	/ flui	ds		
CO3	Illus	trate	the st	ructu	re and	d fund	ction	of dif	feren	t type	es of 1	micro	orga	nism	ns.	
CO4	Dem them	onstr thro	ate v ugh s	ariou tainir	s cult 1g	ure to	echni	ques	for g	rowir	ıg mi	crobe	es an	d to	visu	alize
CO5	Inter syste	rpret em ai	the rond the	espon tech	ise of nique	the the test to c	huma confir	n boo m the	dy wl e pres	nen a ence	micr of mi	obe o crobe	enter e.	s the	hun	nan
СО						PC)							PS	0	
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3	Η												Н			Н
4	Η				М	Н							Н			Н

					1	1	T	1	1	1		ſ	1			
5	Н				Μ	Н							Н			Н
H – High, M -	- Medi	ium, l	L-L	<i>low</i>												
Unit 1	GEN	NERA	AL P	ATH	OLC)GY]	Hour	rs: 06	6	
Cell injury an Inflammation carcinogenesis	nd Nec and s, sprea	crosis Repa d of	, Ap air, tumo	optos Neop ors. A	sis, In plasia utops	ntrace , Cl sy and	ellula lassifi 1 biop	r accu ication osy.	umula n, B	ations enigi	s, Pat n an	holog d N	gical ⁄Ialigi	calc nant	ifica tur	ition, nors,
Unit 2	FLU	JID A	ND	HEM	10D	YNA	MIC	DER	ANG	EMI	ENTS	5]	Hour	rs: 00	5	
Edema, norma infarction, sho	al hen ck. He	nostas mato	sis, t logic	throm al dis	ibosis sorder	s, dis rs – I	semii Leuka	nated emia,	intra Lym	ivasci phon	ular o nas.	coagi	ulatio	n, e	mbo	lism,
Unit 3	STR MIC	UCT CRO(TURI DRG	E AN ANIS	D FU SMS	JNC	ΓΙΟΝ	OF]	Hour	rs: 06	5	
Structure of the	e bacte spores	erial c , Ove	cell w rviev	vall, a v of V	appen Viruse	dage es, St	s of b ructu	acteri re and	a – P 1 clas	ili an sifica	d flag tion,	gella, mult	caps tiplica	ule, s ation	slime of f	e and ungi,
Disease caused	d by vi	rus ai	nd fu	ingi												
Disease caused	MIC	rus ai C RO I	nd fu BIAI	ngi G R	OWI	ſĦ]	Hour	rs: 06	5	
Disease caused Unit 4 Growth curve techniques and techniques: Sin	of by vi MIC of b d obse mple, 0	rus an C ROH acteri rvatio Gram	nd fu BIAL a, ic on of and	Ingi GR lentif f cult AFB	OW T icatic ure. 1 stain	F H on of Princ ing.	bact bact	eria, of Lig	cultu ght ar	re m nd El	nedia ectroi	and n Mi	Hour its t crosc	ypes	5 , cu Stai	lture
Disease caused Unit 4 Growth curve techniques and techniques: Sin Unit 5	MIC of b d obse mple, 0	rus an CROH acteri rvatio Gram	nd fu BIAL a, ic on of and OPA	engi 2 GR lentif f cult AFB THO	OWI icatio ure. 1 stain	F H on of Princ ing. GY	' bact iple c	eria, of Lig	cultu ght ar	ire m nd Eli	iedia ectroi	and n Mi	Hour its t crosc Hour	rs: 00 ypes ope. rs: 00	5 , cu Stai	lture
Disease caused Unit 4 Growth curve techniques and techniques: Sin Unit 5 Natural and at inflammation, reactions, imm ELISA, monoc	MIC of b of b d obse mple, 0 IMN rtificia Immu nunolo clonal	rus an CROI acteri rvatio Gram //UN al imi une do ogical antibo	nd fu BIAL a, ic on of and OPA muni eficie tec odies	angi L GR dentif f cult AFB THO ty; Ir ency hniqu s.	OWT icatio ure. 1 stain DLOC nnate syndmes: i	TH Princ ing. GY and rome mmu	bact iple o acqui , anti ine d	eria, of Lig ired i bodie iffusi	cultu ght ar mmu s and on, i	nity, nity, nity	opso types	and n Mi nizat ; ant ctrop	Hour its t crosc Hour tion, igen ohores	rs: 00 ypes ope. rs: 00 phag and sis, 1	5 , cu Stai 5 cocyt anti RIA	llture ining cosis, body and
Disease caused Unit 4 Growth curve techniques and techniques: Sin Unit 5 Natural and a inflammation, reactions, imm ELISA, monoc	MIC MIC of b d obse mple, 0 IMN rtificia Immu nunolo clonal	rus an CROH acteri rvatio Gram /IUN antibune do ogical antibu	nd fu BIAL a, id on of and OPA muni eficie tec odies	angi a GR lentif f cult AFB THO ty; Ir ency hniqu s.	OWT icatio ure. 1 stain DLOC nnate syndmes: i	FH Princting. GY and rome mmu	bact iple c acqu , anti ine d	eria, of Lig ired i bodie iffusi Tot	cultu ght ar mmu s and on, i t al L e	nity, l its mmu	opso types noele	and n Mi nizat ; ant ctrop	Hour its t crosc Hour tion, igen ohores 30	rs: 00 ypes ope. rs: 00 phag and sis, 1	5 Stai	llture ining cosis, body and
Disease caused Unit 4 Growth curve techniques and techniques: Sin Unit 5 Natural and at inflammation, reactions, imm ELISA, monoc Text Books	 d by vi MIC of b d obse mple, 0 IMN rtificia Immu nunolo clonal 	rus an CROI acteri rvatic Gram (IUN) al imi une do ogical antibo	nd fu BIAL a, ic on of and OPA muni eficie tectodies	angi dentif f cult AFB THO ty; Ir ency hniqu s.	OWT icatio ure. I stain DLOC nnate syndmes: i	FH on of Princ ing. GY and rome mmu	bact iple c acqu , anti ine d	eria, of Lig ired i bodie iffusi Tot	cultu ght ar mmu s and on, i t al L o	nity, 1 its mmu	opso types noele e hou	and n Mi nizat ; ant ctrop	Hour its t crosc Hour tion, igen bhores 30	rs: 00 ypes ope. rs: 00 phag and sis, 1	5 , cu Stai 5 cocyt anti RIA	llture ining cosis, body and
Disease caused Unit 4 Growth curve techniques and techniques: Sin Unit 5 Natural and a inflammation, reactions, imm ELISA, monod Text Books	A by vi MIC of b d obse mple, 0 IMN rtificia Immu nunolo clonal	rus an CROI acteri rvatio Gram /IUN al imi une do ogical antibo zi S ases",	nd fu BIAL a, ic on of and OPA muni eficie tec odies	angi dentif f cult AFB THC ty; Ir ency hniqu s. an, V editio	OWT icatio ure. 1 stain DLOC nnate syndn nes: i	FH on of Princ ing. FY and rome mmu Kun B Sau	bact iple c acqu , anti ine d	eria, of Lig ired i bodie iffusi Tot z Star s Co.	cultu ght ar mmu s and on, i tal Lo nley	nity, l its mmu ectur	opso types noele e hou bbins ts I &	and n Mi nizat ; ant ctrop	Hour its t crosc Hour tion, igen ohores 30 atholo	rs: 00 ypes ope. rs: 00 phag and sis, 1	5 Stai	llture ining cosis, body and is of
Disease caused Unit 4 Growth curve techniques and techniques: Sin Unit 5 Natural and a inflammation, reactions, imm ELISA, monod Text Books 1 Reference Boo	A by vi MIC of b d obse mple, 0 IMN rtificia Immu nunolo clonal Rama Disea	rus an CROI acteri rvatio Gram AUN dl imi une do ogical antibo	nd fu BIAL a, ic on of and OPA muni eficie dies cotra , 7 th e	angi dentif f cult AFB THO ty; Ir ency hniqu s. an, V editio	OWT icatio ure. 1 stain DLOC nnate syndu ies: i	TH on of Princ ing. FY and rome mmu Kun B Sau	bact iple c acqu , anti ine d	eria, of Lig ired i bodie iffusi To t z Star s Co.	cultu ght ar mmu s and on, i tal Lo nley	nity, 1 its mmu ectur	edia ectror opso types noele e hou bbins ts I &	and n Mi nizat ; ant ctrop	Hour its t crosc Hour tion, igen bhores 30 atholo	s: 00 ypes ope. s: 00 phag and sis, 1	5 , cu Stai 5 , ocyt anti RIA Bas	llture ining tosis, body and is of
Disease caused Unit 4 Growth curve techniques and techniques: Sin Unit 5 Natural and a inflammation, reactions, imm ELISA, monod Text Books 1 Reference Boo	Image: display of the second secon	rus an CROI acteri rvatio Gram /IUN al imi une do ogical antibo zi S ases", nthan on. (U	nd fu BIAL a, ic on of and OPA muni eficie tecl odies	anan& IIII,IV	OWT icatio ure. 1 stain DLOC nnate syndn ies: i	FH on of Princ ing. GY and rome mmu Kun B Sau icker, I V).	bact iple c acqu , anti ine d nar & unders	eria, of Lig ired i bodie iffusi Tot z Star s Co.	cultu ght ar mmu s and on, i tal Lo nley	nity, l its mmu ectur L Ro (Uni	edia ectror opso types noele e hou bbins ts I &	and n Mi nizat ; ant ctrop	Hour its t crosc Hour tion, igen ohores 30 athole	s: 00 ypes ope. rs: 00 phag and sis, 1 ogic	5 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7	llture ining cosis, body and is of 10 th
Disease caused Unit 4 Growth curve techniques and techniques: Sin Unit 5 Natural and a inflammation, reactions, imr ELISA, monod Text Books 1 Reference Boo 1	A by vi MIC of b obse mple, 0 IMIN rtificia Immu nunolo clonal Rama Disea oks Anaa editi Press	rus an CROI acteri rvatio Gram (IUN) d imu ine do ogical antibo zi S ases", nthan on. (U	nd fu BIAL a, ic on of and OPA muni eficie dies odies Cotra , 7 th e araya Units Harle	anan& III,I ^V ey and	OWT icatio ure. 1 stain DLOC nate syndr ies: i Vinay n, WT &Pani V and d Kle	TH on of Princ ing. GY and rome mmu Kun B Sau icker, I V).	bact iple c acqu , anti ine d nar & inders	eria, of Lig ired i bodie iffusi Tot c Star s Co. icrob	cultu ght ar mmu s and on, i tal Lo nley 2005	nity, 1 its mmu ectur L Ro (Uni y" C	edia ectror opso types noele e hou bbins ts I &	and n Mi nizat ; ant ctrop urs (, "Pa ; II) black	Hour its t crosc Hour tion, igen bhores 30 atholo	rs: 00 ypes ope. rs: 00 phag and sis, 1 phag and sis, 1 ogic	5 5 5 7 7 7 7 7 7 7 7 7 7 7 7 7	llture ining tosis, body and is of 10 th 17

4	Atlas, RM., Principles of Microbiology. 2nd ed., 1997, McGraw-Hill
5	Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3 rd edition, 2000.

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Anand	Nanar Krishnankol	

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Course Code	Course Name	L	Т	Р	X	С
212BME2320	SENSORS AND DATA ACQUISITION	2	0	0	3	3
Prerequisite:		Syl r.3	abus	s rev	ision	:
Course Category:	Program core	Cou The com	irse ' ory v ipone	Fype vith ' ent	e: "X"	

Course description

This course educates students to about the principle of operation of different sensors and their applications in the use, selection, and design of instrumentation and data acquisition systems for agricultural, food, environmental and biological systems. Measurement of position (GPS), force, pressure, power, torque, flow, temperature and environmental sensors will be emphasized. Labs will focus on building and using measurement systems, and programming PC computers for data acquisition and analysis.

Course outcor On successful	nes: com	pletio	on of	the co	ourse	e the s	stude	ents v	vill b	e able	e to					
CO1		Unde appli	nderstand the principle of operation of different sensors and their oplications													their
CO2		Be u	e updated on the recent trends in sensor technologies.													
CO3		Desi	Design a wireless sensor network													
CO4		To le comi	earn nunic	the f	iunda syste	menta ems u	als of ised is	f sigi n meo	nal c chatro	onditi	oning syste	g, dat m dev	ta ac velop	quis men	ition t.	and
CO5		Solv	e desi	ign ar	nd mo	odelli	ng iss	sue us	sing c	ompl	ex en	ginee	ring	matl	nema	itics
СО						PO	C							PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	М	М		Μ	Μ	L		L	L	L		L	М			
2	М	М		Μ	Μ	L		L	L	L		L		М		
3	М			М	М	L		L	L	L		L			L	

4	Η	Μ										L				Μ
5	Н	Н	L	Μ	Μ	L	L					L				Н
H – High, M –	Med	lium,	L-L	.ow												
Unit 1		INT	ROD	UCT	ION							Hou	rs: 6			
Introduction to configuration s X - Componentdata acquisition	o sm uppo nt: a) n with	art se orts. Intro h usin	ensors ductions g of l	s, Pri on to DAQ	incip] MAT	les o <mark>CLAB</mark>	f op & S	eration <mark>IMUL</mark>	n, de <mark>JNK</mark>	sign <mark>and I</mark>	appr <mark>LabV</mark>	oach, <mark>IEW,</mark>	inte <mark>Impl</mark>	erface emei	e de ntatio	sign, <mark>on of</mark>
Unit 2		DAT	'A TI	RANS	SMIS	SIO	N					Hou	rs: 6			
Components of Signal Conditi Codes-Analog Analyser-Distr Concerns- X – Componer and digital I/O,	f Mea oning and ibute nt: U	asurin g F Digit d sage of ng of o	g- Inj Functi al M Auto of Inp dome	outs a ons-2 Aodu matic out an stic n	and O Analo latior on a d Our nonit	output og-to- n Tec nd tput H oring	s- Oi Digi hniq Cont Ports syste	rigin c tal Cc ues-W rol S for da em bas	of Sig ontrol Vireles byster ta Tra sed Ic	nals– -Digi ss Co ns-S(unsmi oT.	Tran ital-to omm CAD	sduce p-Ana unicat A-Arc <mark>n, Cor</mark>	er-Ser log tion-l chited ntroll	nsors Cont RF cture ing c	s-Gen rol-H Netv -Sec of An	neral Pulse work urity nalog
Unit 3		MEN	AS SI	ENS	DR							Hou	rs: 6			
MEMS sensor, in sensor desi sensor, RF Sen X – Componer	Com gn T sor, s nt: Ic	nparise Thick Sensor DT bas	on be film rs for <mark>sed do</mark>	tween and robot omest	n ME thin tics. <mark>ic mo</mark>	MS a film onitor	nd M tech ring a	lacro s nique and ale	senso Phys erting	r, Fat sical syste	oricat sens em fo	ion an ors. 1 or para	nd pa Bio s <mark>alyze</mark>	ickag enso <mark>d pat</mark>	ging i r, Sil tient.	issue licon
Unit 4		SIGN SYS	NAL FEM	CON S	DIT	IONI	NG	and D	AQ			Hou	rs: 6			
Amplification multi-channel appliances, Ma Optic Sensors Liquid Lev OpticGyroscop Instrumentation X – Componen	– Fil data anufa – Fil velM velM ne P n. nt: U	tering acquis acturir ber–O onitor olariz	– Sa sition ng, E ptic ing–(ation	ample – Da nviro Press Optic Ma	and ata lo nmer ure S alFib intair	Hold gging ital n Senso erTen ing-(nd pe	l circ g – aj nonit rs – npera Gratin	uits – pplica oring- Fiber- atureS ngsinF	Data tions Fiber -Opti ensor Fiber-	– At – At – Opt c Vo rs–Fil -Adva	juisit itomo ic Ir oltag oer–(antag	ion: S obile, ostrum e Sen OpticS ges o	Single Aero nenta sor - Stress f Fi	e cha ospac tion - Fib sSens ber	nnnel ce, H – F oer–C sorFi O	and lome iber- Dptic ber- ptics
Unit 5		APP	LICA	TIO	NS							Hou	rs: 6			
Design and 4' mathematical t Laser Trimmin Instrumentation	7imu ools g and n – T nt: N	link47 used l Melt he rol	7 issu in seu ting-S e of I netwo	ue in nsor o Smart PCA, ork ir	adv desig Instr LDA desi	anceo n. LA umer	l ser ASER hts-Ca	asing Heat alibrat	techr ing, ' ion a	ique. Weld nd St	In ing, anda	trodu Meltin rds-To	ction ng ar opics	of nd Tr in Ir	diffe rimn ntelli	erent ning- igent
						00	T	otal I	ectu	e ho	urs	30+4	5			
							1	otal L	cciul		u15	JUT4				

Text Books		
1	Kirianaki, Nikolay V., Sergey Y. Yurish, Nestor O Deynega. Data acquisition and signal processi Chichester, England: Wiley, 2002.	D. Shpak, and Vadim P. ing for smart sensors.
Reference Book	S	
1	H Rosemary Taylor, "Data Acquisition for S 1stedition, Springer Publishing, U.S	ensor systems", 2013,
2	Maurizio Di Paolo Emilio., "Data Acquis Fundamentals to Applied Design, 2013, Springer, N	ition Systems" From New York.
List of experime	ents suggested ("X" Component)	
Sl. No.	Title	Hours
1	To introduce to the LabView software.	3
2	Introduction to LabView software package and an introduction to data acquisition.	3
3	Introduce the concepts of precision, bias, calibration, linearity and other ideas best discussed when monitoring a static system.	3
4	Calibration of Sensors	3
5	Introduce to basic concepts of electrical circuits (DC and AC) and their components for data acquisition	3
6	Introduce the concepts of sensor responsiveness; zeroth, first, and second order sensors	3
7	Determine the time constant of various temperature sensors when exposed to changing conditions.	3
8	Basics of signal transmission, signal noise, and grounding for safety and signal transmission	3
9	Basics of signal conditioning including passive and active, low- and high-pass filter circuits	3
10	Transducers for measuring displacement	3
	Total Lecture hours	30

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Course Code	Course Name	L	Т	Р	X	С				
212BME2318	MICROPROCESSORS AND MICROCONTROLLERS	3	0	2	0	5				
Prerequisite: Ele	ectronic devices and Circuits	Sy r.3	llab	us r	evis	sion:				
Course Category	7: Program core	Co Int	ours egra	e Ty ated	у ре: Сог	ırse				
Course descripti	on	-								
1	To introduce basic Microprocessor and Microcontrollers	•								
2	To understand analysis the instruction sets, prog Microprocessor 8085.	ram	min	g (of	8-bit				
3	To discuss about interfacing IC for basic microprocessor	and	mic	roco	ontro	oller.				
4	To discuss about 8051 microcontroller.									
5	To apply the inculcated knowledge for developing simple	e ap	plic	atio	ns.					
Course outcome On successful co	s: mpletion of the course the students will be able to									
CO1	Describe fundamental of Microprocessor and Microcontr	olle	rs.							
CO2	Illustrate the architecture and analyze the instruction sets bit Microprocessor 8085.	, pro	ogra	mm	ing	of 8-				
CO3	Study the different peripheral devices and their interfacir	ng to	o 80	85.						
CO4	Illustrate the architecture of 8051 microcontroller.									
CO5	Study the interrupt and timers of 8051 microcontrol microcontroller based control circuit for electrical applications.	ler a	and nd	de ele	sign ectro	the onics				

						PC)							PS	0					
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4				
1	S						S					S	S							
2		L	М	М	М		L	L				М								
3			L	L	М		L					L								
4	S	S L L L									S									
5	L	L L S L S L L I										L	L							
H – High, M -	– Med	edium, L – Low																		
Unit 1	FUN MIC	FUNDAMENTALS OF MICROPROCESSORS AND Hours												s: 9						
Introduction- microprocesso input and out improvements	Impor ors, Cla put de	portance of Microprocessor and Microcontrollers, origin and evolution of Classification of Microprocessor, Microcontrollers and memories, Commo devices for computers, Bus structures used in computers and technolog																		
Unit 2	808	3085 MICROPROCESSOR Hours: 9																		
8085 architect Programming Addressing m	ure – l – Co odes	Instru unter	ction s tim	set – ie de	Addı lays	ressir – In	ig mo terrup	des- ' ots ,	Гітіі 8086	ng dia	igram hitect	– As ture	ssem -Insti	bly I ructi	Lang on s	uag et -				
-		MICROPROCESSOR INTERFACING Hours: 9																		
Unit 3	MIC TEC	CROI CHNI	QUE	S					al I/O (8251) – Parallel I/O (8255) – RS232, SPI, I2C, Introduction ar rotocols like Blue-tooth and Zigbee. Keyboard and display controller (8279)											
Unit 3 Interfacing se interfacing to ADC/DAC int	mic TEC Prial I/ protoc	CROI CHNI O (8 cols li ng.	251) ke B	– Palue-to	aralle ooth a	l I/O and Z	(82: igbee	55) – . Key	- RS2 /boar	232, d and	SPI, disp	I2C, lay c	Intro	oduc	tion (827	an(9) -				
Unit 3 Interfacing se interfacing to ADC/DAC int Unit 4	MIC TEC erial I/ protoc terfacin 8051	CROI CHNI O (8 cols li ng.	251) ke B	- Pa lue-to	aralle both a	l I/O and Z	(82: igbee	55) – . Key	- RS2 /boar	232, d and	SPI, disp	I2C, lay c	Intro ontro Hour	oduc oller s: 9	tion (827	an 9)				
Unit 3 Interfacing se interfacing to ADC/DAC int Unit 4 8051 microcon set – Address Interfacing to	MIC TEC erial I/ protoc terfacin 805 ntroller ing M extern	CROI CHNI O (8 cols li ng. I MIC r hard odes al me	QUE 251) ke B CRO ware – co mory	$\frac{-Pa}{Loc}$ $\frac{-Pa}{Loc}$ $\frac{CON}{-I/O}$ $\frac{-I/O}{and}$	TRO Pins 8 and 8255	l I/O and Z DLLF , Port	(82: igbee CR s and ers –	55) – . Key circu serial	RS2 vboar its – c l data	232, d and extern a inpu	SPI, disp al me	I2C, lay c I emory d out	Intro contro Hour y, 80: put -	oduc oller s: 9 51 In - int	tion (827 struc	an 9) ctio				
Unit 3 Interfacing se interfacing to ADC/DAC int Unit 4 8051 microcon set – Address Interfacing to Unit 5	MIC TEC erial I/ protoc terfacin 805 introller ing M extern 805	CROI CHNI O (8 cols li ng. I MI t hard odes al me	QUE 251) ke B CRO ware – co mory OGR	- I/O unter AMN	TRO Pins s and 8255.	l I/O and Z DLLE , Port time G AN	(82: igbee CR s and ers – D AF	55) – . Key circu serial	- RS2 /boar its – c l data	232, d and extern a inpu	SPI, disp al me at and	I2C, lay c Iay c I out	Intro ontro Hour y, 80: put - Hour	oduc oller s: 9 51 In - int s: 9	tion (827 struc errup	an 9) ctio				
Unit 3 Interfacing se interfacing to ADC/DAC int Unit 4 8051 microcon set – Address Interfacing to Unit 5 Assembly Lan – Serial Comm Stepper Motor debugging too	MIC TEC erial I/ protoc terfacin 805 mtrollen ing M extern 805 mguage nunica r, keyb	CROI CHNI O (8 cols li ng. I MIC r hard odes al me I PRO Prog tion - poard,	QUE 251) ke B CRO ware – co mory OGR ramn - Inte C la	– Pa lue-to CON – I/O unter and AMN ning - rrupt ngua	TRO Pins s and 8255. //INC – I/O Progu	l I/O and Z DLLF , Port time G AN Port ramm ogram	(82: igbee SR s and ers – D AF Prograing – ns. A	55) – c. Key circu serial PPLIC camm - 8051 ssemb	RS2 vboar its – e l data CAT ing – l Inte	232, d and extern a inpu IONS Time rfacir and c	SPI, disp al me at and er and s er and g wit	I2C, lay c lay c l out l out l cou th LE lers.	Intro ontro Hour y, 80: put - Hour ED, A Prog	oduc oller s: 9 51 In - int s: 9 Prog DL, rami	tion (827 struc errup ramr Sena ning	and (9) - etion ots - ning sors and				

Text Books		
1	Gaonkar, R.S., Microprocessor Architecture Programmir Wiley Eastern Ltd., New Delhi, 2005.	ng and Application,
2	M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051 Embedded Systems: Using Assembly and C",Pearson Educ	Microcontroller and cation, 2007.
Reference Boo	bks	
1	Hall, D.V., Microprocessor and Interfacing Programming McGraw Hill Publishing Company, 2 nd edition, 2012	and Hardware, Tata
2	YuCheng Liu & Glenn A Gibson, Microcomputer System 2 nd edition, Prentice Hall of India, 2005	, 8086/8088 Family,
3	Rafiquzzaman M., Microprocessor Theory and Applie Motorola, Prentice Hall of India, 2007.	cation – Intel and
4	Raj Kamal, Microcontrollers: Architecture, Programmin System Design, 5 th edition, Pearson Education India	ng, Interfacing and
5	Tze Ying Sim, Effectiveness of the Methods for Engineerin Non Homogeneous class setting, Kassel University Press.	g Courses in a Large
Practical Com	iponent	
Sl. No.	Experiments	Hours
	Introduction to Digital Trainer Kit	4
1	Simple arithmetic operations in 8085 Microprocessor	6
2	ADC and DAC interfacing using 8085 Microprocessor	6
3	Arithmetic operation with 8051 execution.	2
4	Sine wave and Square wave generation in 8051 micro controller	2
5	ADC and DAC interfacing using 8051 micro controller	2
6	Stepper motor control using 8051 micro controller	2
7	Servomotor control using 8051 micro controller	2
8	Seven segment display using 8051 micro controller	2
9	Basic programming using KEIL IDE	2
10	Traffic light control using 8051 Microcontroller	2
	Total Lecture hours	32

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A	d Nana	artes	antoi

ACADEMY OF RESEARCH AND EDUCATION (DEEMED TO BE UNIVERSITY)

Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

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Course Code	Course Name	L	Т	Р	X	С	
212BME2313	BIOMECHANICS	2	0	0	3	3	
Prerequisite: Ni	1	Syllabus revision: r.3					
Course Categor	y: Program core	Co Th	ours eory	e Ty	ype:		

Course description

To provide students with an understanding of the internal and external forces acting on the body during human movement through mechanics. To generate force and controlling movement by muscles is emphasized.

Course outcor On successful	mes: I completion of the course the students will be able to															
CO1	To d	To describe the fundamental of biomechanics														
CO2	Und artic	Understand and describe the properties of blood, bone and soft tissues like articular cartilage tendons and ligaments.											like			
CO3	Able cons and	e to titutiv their o	unde ve lav consti	erstan vs and raints	d the d bou	e un ndari	ique es ano	featu d app	ires roxin	of b natior	iolog: 1 metł	ical nods i	flow in flu	rs, e iid m	spec lecha	ially inics
CO4	Gain with body	broa hum 7.	d kno an ar	owled natom	lge al 1y to	com	he m peten	echar tly ar	nics o nalyze	of mo e gro	ving s ss mo	systei ovem	ns a ent (nd fa of th	umili e hu	arity man
CO5	Be a most and t	ble to com force	o com monl platfo	putat y use orm s	ional d me ysten	ly ana asure ns.	alyze ment	the d devic	ynam ces in	ics of the f	f hum ïeld,	ian m such	over as m	nent otio	fron n cap	n the oture
СО						PC)							PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Н	М	L	L		L	L		L			Н	Н	L	Μ	М
2	Н	L	L	М	L	Η	М	М	М	Μ	М	Η	Н	Μ	L	М
3	Н	L	М	Н	L	Н	М	М	Μ	М	М	Н	Н	Μ	L	Μ

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4	Н	Н	М	М	М	Η	М	М	М	М	М	Н	Н	Н	Μ	M
5	Н	Н	Μ	М	Μ	Н	Μ	Μ	М	М	М	Н	Н	Н	М	Μ
H-High, M-M	edium	ı, L-L	low					1		1						
Unit 1	IN	TRO	DUC	CTIO	N TO) BI(OME	СНА	NIC	5]	Hour	s: 09)	
Principles of Mechanics, Vector mechanics, Mechanics of motion – Newton's laws of motion, Kinetics, Kinematics of motion, Resultant forces of Coplaner&Noncoplaner and Concurrent & non-concurrent forces, parallel force in space, Equilibrium of coplanar forces, Work and energy, Moment of inertia.																
Unit 2	TI	SSUI	E BIO	OME	СНА	NIC	S]	Hour	s: 09)	
Hard Tissues cancellous bor healing. Soft Tissues: S Muscle; Mater Tendon, Ligan anisotropy	: Bornes, H Structuial Pro- ial Pro- iant, a	e str Electr ure ar operti and M	uctur ical j nd fui les: C Iuscle	e & prope nctior artila e.Viso	comp erties ns of s ge, T coelas	oositi of bo Soft endo stic p	on m one, t Fissue n, Lig roper	echar cype o es: Ca gamer ties, N	nical of fra urtilag nt, and Maxw	prop acture ge, Te d Mu vell &	erties es, bic endon, scle; l z Voig	of bomec omec , Lig Mod ght m	bone, chanic camer eling nodels	cor cs of nt, an : Can s –	tical frac d tilag	ane tur
Unit 3	BI	OFL	UID	MEC	CHAN	NICS]	Hour	s: 09)	
Stress, strain, e viscoelastic flu equations. Rhe Resistance aga Blood vessels.	lastic ids. E ologio inst fl Flow	ity, H Euler o cal pr ow, V propo	looke equat opert √ascu erties	s's lav ions a ies of lar tr of bl	w, vis and N f bloo ee. R lood i	cosit lavier d, lar elatic n the	y, Ne Stok ninar onship intac	wtoni e's ec flow betw t hum	an flu quatio , Velo veen o nan ca	uid, N ons, V ocity diame ardiov	Von- N Viscoe and p eters, vascul	Vewt lasti ressu mate lar sy	oniar city, ure of erial p ystem	n flui Con bloo prope	d, stitut od flo erties	ive ow, of
Unit 4	JC	DINT	S BIO	OME	СНА	NIC	S AN	D IN	IPLA	NTS]	Hour	rs: 09)	
Skeletal joints, body diagrams Design of ortho to the requirem of implants, fix	force , type opedic ient a ation	es and es of j c impl nd ch of im	l stres oint, lant, s aract nplan	sses in biom specif eristic ts.	n hun lechai ficatio cs of	nan jo nical ons fo diffe	oints, analy or a pr rent t	Analy sis of osthe ypes of	ysis c f elbo tic jo of bio	of rigi ow, sł int, b omate	d bod oulde iocom rials,	ies i er, hi npati man	n equ p, kn bility ufact	ilibr ee a , Intr uring	ium, nd ar oduc g pro	free ikle tion cess
Unit 5	M	ovem	ent B	Biom	echar	nics]	Hour	s: 09)	
				0	r mot	ion a	harac	teristi	cs ac	tions	force	es tra	insmi	tted	by jo	ints
Gait analysis, t Joints forces r Patterns: Push/ – like motions.	ody & esults Throv	& lim in th w Cor	bs: m he no ntinut	ass a ormal um B	& di	isable chani	hum e hum cs of	nan b push	ody, – like	norm e mot	al & ions, l	fast Bion	gait necha	on t inics	he le of th	rov
Gait analysis, b Joints forces r Patterns: Push/ – like motions.	oody & esults Throv	& lim in th w Cor	bs: m he no ntinut	ormal um B	& di	isable chani	e hum cs of	an b push	ody, – like al Le	norm e mot	al & ions, l e hou	fast Bion rs	gait necha	on t inics	the le of th	evel irov
Gait analysis, t Joints forces r Patterns: Push/ – like motions. Text Books	oody & esults Throv	& lim in th w Cor	bs: m he no ntinut	ormal um B	& di	isable chani	e hum cs of	nan b push	ody, – like al Le	norm e mot	ions, I	fast Bion rs	gait necha	on t inics 4	he lo of th	evel irov

1	Duane Knudson, "Fundamentals of Biomechanics", Springer Science+Business Media, 2007	Second Edition
2	Marcelo Epstein, "The Elements of Continuum Biomech 1-119-99923-2, 2012.	anics", ISBN: 978-
3	Fung, Y.C. "Biomechanics Mechanical Properties of Liv age international, ISBN: 978-81-8128-811-0, 2007	ring Tissues", New
4	Carol A. Oatis, The Mechanics and Pathomechanics of H Lippincott Williams & Wilkins, 2010	Human Movement,
Reference Boo	ks	
1	Jay D. Humphrey, Sherry De Lange, "An Introduction Solids and Fluids, Analysis and Design", Springer Media, 2004.	to Biomechanics: Science+Business
2	Shrawan Kumar, "Biomechanics in Ergonomics", Sec Press 2007.	cond Edition, CRC
3	White & Puyator, Biomechanics, Private publication UAE	, 2010
List of experim	nents suggested ("X" Component)	
Sl. No.	Title	Hours
1	Teaching about the basics of solid works software and Introduction to the mechanics of motion and forces.	05
2	Design a human femur bone by using the given dimensions	05
3	Design and modelling of blood vessels by using the given dimensions.	05
4	Design and modelling of human knee joint using the given dimensions.	05
5	Design an artificial leg by using the given dimensions.	05
	Total laboratory hours	25



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Course Code	Course Name	L	Т	Р	X	С
212BME2117	Medical Imaging Techniques	3	0	0	0	3
Prerequisite: Ni	1	Sy r.1	llab	us r	evis	sion:
Course Categor	y: Program Core	Co Th	urs eory	e Ty	ype:	

Course description:

This course aims to develop an understanding of the different modalities in Radiology and recognize the images of each modality. This also helps in understanding of the applications of physical processes to the diagnosis and treatment of disease, including an understanding of contemporary developments in professional practice.

Course outcomes: . ..

On successful	comp	ipletion of the course the students will be able														
CO1	To d	escril	be the	e wor	king j	princi	ple o	f X ra	ay ma	chine	e and	its ap	plica	ation		
CO2	To il	lustra	ate the	e prin	ciple	com	puted	tomo	ograp	hy.						
CO3	To in mag	interpret the technique used for visualizing various sections of the body using gnetic resonance imaging.														
CO4	To d	emor	istrate	e the	applio	catior	ns of 1	radio	nucli	de im	aging	3.				
CO5	To re	elate	the ut	ilizat	ion o	f ultra	asoun	d in 1	nedic	cine.						
СО						Р	0							P	so	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	М	Μ	М	М									Μ			М
2	Μ	Μ	М	М									Μ			Μ
3	Μ	М	М	М		М							Μ			М

4	М	М	М	М									М			Μ
5	М	М	М	М		М							М			М
H – High, M –	Med	ium,	L-L	.0W												
Unit 1	X-	ray I	Radio	grap	hy]	Hour	s: 12	2	
Fundamentals of X ray Tube – 7 And Tube Curr spectra and out Instrumentation Quantitative ch imaging technic	of X-1 Fube rent, tput, for aract ques.	ray pr Volta Emis Tube plan æristi	roduc age a ssion e Vac ar rac cs of	tion, nd Vo Spec uum, diogra plana	Conv oltage tra, C Env aphy ar X-	e Wa Collin velop – co ray in	nal X vefor nation e and llima mage	-Ray ms, R n and l Hou tor, a s, X-	Tube Relati Filtr Ising, Inti-se ray c	es, Er onshi ation Sp catter ontra	nergiz p bet , Fac ecial- grid st ag	ting a ween tors Purpo s, Di ents,	nd C Fila Influc ose X gital Spec	ontro ment encir K-Ra radi ializ	olling t Cun ng X y Tu ogra ed X	g the rrent ray lbes, phy, -ray
Unit 2	Co	ompu	ted T	ſomo	grap	hy]	Hour	s: 5		
Principles of CT – X ray projection, attenuation and acquisition of transmission profiles, Hounsfield units, CT Imaging System – Historical and current acquisition configurations, Gantry and table, The X ray tube and generator, Collimation and filtration, Detectors, Image reconstruction and processing – General concepts, Object space, image space and Radon space, Filtered back projection and other reconstructions, Acquisition - CT Image Quality																
Unit 3	M	agne	tic Re	esona	nce I	magi	ing]	Hour	s: 1()	
Principles of m signal, nuclear encoding, spin o scanner hardwa Diagnostic utili magnetic resona	spin spin echoe are: 1 ty an ance	r mag rela es, gra magn nd clin spect	gnetis xatio adien aet, g nical rosco	m, R ns, g t echo radier MRI, py (N	F ma radie oes, K nt co func /IRS)	gneti nt pu -spac il, R tiona , diffu	c fiel lse, a ce dat F pu l MR usion	d and slice a acqu lse tr I, ma MRI	reso selec uisiti ansm gneti , bio-	nanc tion, on an issio c res effec	e, ma phas d ima n and onand ts and	igneti se en age re d RF ce ang d safe	c res codin const sign giogra	onan g, fi truct al r aphy vels.	nce (I reque ion. I ecept (MI	MR) ency MRI tion. RA),
Unit 4	Nu	iclea	r Ima	nging]	Hour	s: 8		
Nuclear medici medicine, The camera, Single SPECT/CT, Cl (PET), Radiotra dimensional PE	ne –I distr phot inica cers T im	Radio ributi on er 1 app used aging	activi on of nissic licati for Pl g, Dat	ity an f tech on con ons c ET/C ca pro	d rad metiu mputo of SP T, Ins cessin	iotrac im-ba ed to ECT strum ng in	cer ha sed mogr and entati PET/	lf-life radiot aphy SPEC on fo CT, C	e, Pro racer (SPE CT/CT r PET Clinic	perti s wi CT), Γ, Ρο Γ/CT, cal ap	es of thin Data sitron Two plica	radio the b proc emi -dimo tions	otrace ody, cessin ssion ensio of PI	rs fo The g in ton nal a ET/C	r nuc gar SPE nogra nd th T	clear nma ECT, aphy aree-
Unit 5	Ul	traso	und	Imag	ing]	Hour	s: 1()	
Wave propagat scattering in til element ultraso characteristics	tion ssue, und t Dop	and Abs transc pler u	chara orptic lucers ultras	cteris on an s, Tra ound	tic a d tot nsdue for b	coust al att cer an lood	ic in enuat rays, flow	npeda ion c Clini meas	nce, of ult ical d surem	Wav rasou iagno ients	e ref ind, l ostic Ultr	lectio Instru scanr asour	on, re ment ling r nd co	efrac atior node ntras	tion 1 ₅ Si 2s, In 3t ago	and ngle nage ents,

Safety guidelines in ultrasound imaging, Clinical applications of ultrasound, Artifacts in ultrasound imaging.

	Total Lecture hours	45
Text Books		
1	Smith, Nadine Barrie, and Andrew Webb. Introduction to physics, engineering and clinical applications. Cambridg 2010.	o medical imaging: ge university press,
2	Hendee, William R., and E. Russell Ritenour. <i>Medical ima</i> Wiley & Sons, 2003.	aging physics. John
3	S.Webb, The Physics of Medical Imaging. Taylor & Francis	Group, 1988.
Reference Boo	oks	
1	Saha, Gopal B. <i>Physics and radiobiology of nuclear</i> Science & Business Media, 2012.	medicine. Springer
2	Dance, D. R., et al. " <i>Diagnostic radiology physics: A han and students</i> . Endorsed by: American Association of Phy Asia-Oceania Federation of Organizations for Medical Federation of Organisations for Medical Physics." (2014).	ndbook for teachers vsicists in Medicine, Physics, European

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Course Code	Course Name	L	Т	Р	X	С
212BME2314	Diagnostic & Therapeutic Instruments-I	3	0	2	0	4
Prerequisite: <mark>M</mark>	ledical Electronics, Medical Physics	Syl r.3	labu	s rev	visio	n:
Course Categor	y: Program Core	Co Inte	urse grate	Typ ed Co	e: ourse	e

Course description

To obtain thorough knowledge on the basic understanding of the diagnostic and therapeutic medical instruments.

Course outcom On successful	nes: com	pleti	on o	f the	cour	rse, t	he st	uden	its wi	ill be	able	e to					
CO1	Ur	nders	tand	and	recor	d the	elec	trica	l acti	vity o	of the	e hear	rt, mu	ıscle,	and e	eye	
CO2	Ur	nders	tand	and 1	neas	ure t	oasic	phys	iolog	ical s	signa	l me	asure	ments	3		
CO3	Ur mo	nders onito	tand ring	and instru	appl 1men	y the	e dia	gnos	tic p	roce	dures	in o	ophth	almo	logy	&feta	ıl
CO4	Ur	nders	tand	the t	herap	oeutio	c pro	cedu	res in	the	cardi	ovas	cular	syste	m		
CO5	Ur	nders	tand	the t	herap	oeutio	c pro	cedu	res in	assi	sting	vent	ilatio	n, he	aring.		
CO						Ι	20							P	SO		
						1											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	
1	Н		Η	Н									Н				
2	Н		Η	Н									Н				
3	Н			Н									Н				
4	М			Н									Н				
5	М			Η									Н]
H-High, M-	Med	lium	, <i>L</i> –	Low													-

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Unit 1		Diagnostic Instruments part 1	Hours: 09						
Monitorin measurem	ng and nent, R	recording of ECG, EEG, EMG, PCG, EOG, electro ecording system.	des for physiologica						
Unit 2		Diagnostic Instruments part 2	Hours: 09						
Heart rate flow meas	e, blood sureme	d pressure, temperature, respiration rate & cardiac outpuent.	t measurement, Blood						
Unit 3		Diagnostic Instruments part 3	Hours: 09						
Cardiac r Laryngoso	nonito cope, (r, Patient Monitoring System, Pulmonary function a Dphthalmoscope, fetal monitoring instruments, oximeters	nalyzer, Endoscopes s.						
Unit 4		Therapeutic Instruments part 1	Hours: 09						
Cardiac D administra	Defibril ation p	llators, Pacemakers, blood warmers, Heart-Lung machi umps, Haemodialysis, electro surgery machine.	ne, Intravenous blood						
Unit 5		Therapeutic Instruments part 2	Hours: 09						
Ventilator Lithotript	rs, hu ors, he	midifiers, oxygen concentrators, CPAP, BiPAP, An aring aids, audiometer.	aesthesia equipment						
		Total Lecture hours	45						
Text Boo	ks								
1		Street, L. J. (2016). Introduction to Biomedical Eng United States: CRC Press.	ineering Technology						
Reference	e Bool	XS							
1		Handbook of Biomedical Instrumentation. (2003). Education (India) Pvt Limited.	India: McGraw-Hil						
2		Pfeiffer, E. A., Weibell, F. J., Cromwell, L. Instrumentation and Measurements. United States: Prer	(2011). Biomedica ntice-Hall.						
3		Khandpur, R. S. (2020). Compendium of Biomedic Volume Set. United Kingdom: Wiley.	al Instrumentation, 3						
4		Medical Instrumentation: Application and Design. (20) Wiley.	20). United Kingdom						
Laborato	ory Co	mponents							
Sl. No.	Expe	eriments	Hours per week						
SI. No. Experiments Hours per week									

2	Design and implementation of instrumentation amplifier	02
3	Design and implementation of optical isolation amplifier	02
4	Design and implementation of the acquisition of ECG signal	02
5	Temperature & heart rate measurement	02
6	Audiometer	02
7	Surgical diathermy	02
8	Study of biotelemetry	02
9	Shortwave and ultrasonic diathermy	02
10	Electrical safety measurements	02
11	Study of ESU – cutting and coagulation modes.	02
12	Measurement of visually evoked potential	02
13	Patient Monitoring System	02
14	Doppler blood flow monitoring	02
15	Blood pressure measurement	02
	Total practical hours	30



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Course Code	Course Name	L	Т	Р	X	С
212BME3337	Digital Signal Processing	2	2	2	0	4
Prerequisite: Nil		Sy r.3	llab	us r	evis	sion:
Course Category:	Program Core	Co Int	urs egra	e Ty ited	у ре: Соі	irse

Course description: This course aims to equip students with the fundamental tools that are used to describe and analyse the various types of signals and systems along with their characteristics. This course builds a strong base for developing algorithms for signal processing systems and enables the students to understand the effects of word length in digital signal processing.

Course outcomes: On successful completion of the course the students will be able

CO1	To u	nders	stand	the b	asic t	ypes a	and p	roper	ties o	of sigr	nals a	nd sys	stem	IS.		
CO2	To a trans	analy: form	se Co and I	ontin Discr	uous ete Fe	and ourier	Disci trans	rete t sform	time	doma	uin si	gnals	by	app	lying	g Z-
CO3	To d	o design and develop algorithms for IIR filters.														
CO4	To tech	desig nique	n an s.	d de	velop	o algo	orithr	ns fo	or FI	R fil	lter o	lesign	ı us	ing	diffe	erent
CO5	To u	nders	stand	the ef	ffects	of fii	nite w	ord l	ength	ı in di	gital	Filter	s.			
СО						Р	0							P	SO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Н	H H M M H H														
2	Н	Η	Н			Η							Η	Η		

3	Η	Η	Η			Η							Н	Η		
4	Н	Н	Н			Н		М					Н	Н		
5	Н	Η	М			Н							Н	Н		
H – High, M –	Med	ium,	L-I	.0W			1									
Unit 1	Sigr	nals a	nd S	ysten	ıs								Hour	rs: 12	2	
Introduction and Classification of signals: Definition of signal and systems, communication and control systems as examples. Sampling of analog signals, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non- deterministic, energy and power. Elementary signals/Functions: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sync functions. Operations on signals: Amplitude scaling, addition, multiplication, time scaling, time shifting and time folding. Systems: Definition, Classification: linear and nonlinear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.																
Unit 2 Z Transform and Discrete Fourier Transforms Hours: 12																
Transform by F Introduction t DFT – FFT Alg – Use of FFT in	Partial o DF gorith	$\mathbf{T} - \mathbf{F}$ $\mathbf{T} - \mathbf{F}$ \mathbf{T}	- Trail ction Proper Deci ilterir	Expa ties c mationg.	of DF	T - C time	hod – Eircula Algon	- Caus ar Co rithms	z-1 sality nvolu s, Deo	and and a string of the string	Stabi – Filt ion i	lity. tering	g meth quenc	nods y Al	base gorit	d on hms
Structures of II design – Discru Bilinear transfo using frequency	R system ete tin prmat y tran	stems me II ion, 2	S: Dir R fil Appro	ect fo ter fro	orm, (om an	Casca nalog of de	ide fo filter	orm, H r – II ives -	Parall R filt – (LP	el foi er de F, H	rm st esign PF, E	ructu by In 3PF,	nres – mpuls BRF)	Ana ae In filto	log f varia er de	filter ince, esign
Unit 4	Fini	te In	npuls	e Res	pons	e Filt	ter						Hour	rs: 12	2	
Structures of FIR – Linear phase FIR filter – Fourier Series – Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques – Implementation of FIR filters by direct form realization.																
Unit 5	Fini	te W	ord l	Lengt	h Ef	fects	in Di	gital	Filte	rs			Hour	rs: 12	2	
Fixed point and rounding – qua	Fixed point and floating point number representation – ADC – quantization – truncation and rounding – quantization noise – input / output quantization – coefficient quantization error –															

product quantization error – overflow error – limit cycle oscillations due to product quantization and summation – scaling to prevent overflow.Multirate Digital Signal Processing: Decimation and Interpolation process. **Total Lecture hours** 60 Text Books John G. Proakis& Dimitris G.Manolakis, "Digital Signal Processing – Principles, 1 Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal 2 Processing", 8th Indian Reprint, Pearson, 2004. **Reference Books** Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006. 1 Sanjit K. Mitra, "Digital Signal Processing - A Computer Based Approach", 2 Tata Mc Graw Hill, 2007. Emmanuel C.Ifeachor, & Barrie.W.Jervis, "Digital Signal Processing", Second 3 Edition, Pearson Education / Prentice Hall, 2002. Laboratory Components S. No **List of Experiments** Hours Introduction to MATLAB and Basic commands 4 Representation of Continuous and Discrete time signals. 4 1 2 2 Computation of Linear and Circular Convolution. 3 2 DFT and IDFT of a Sequence. 4 2 Design of IIR Butterworth and Chebyshev filter. 5 Design of FIR filter using windowing techniques. 2 Design a Notch Filter of 50 Hz to Remove the Power Line 6 2 Interference in Acquired ECG Signal. Design a Low Pass Filter of Defined Cut-Off Frequency to Remove 7 2 the High Frequency Noises in Acquired ECG Signal. Design a High Pass Filter of Defined Cut-Off Frequency to Remove 8 2 the Low Frequency Noises in Acquired ECG Signal. Signal Averaging of ECG 2 9 10 Perform a Spectral Analysis of ECG Signal 2

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11	EMG processing using MATLAB –Rectification and Signal Averaging.	2
12	Detection of R Peak and R-R Interval from Acquired ECG Signal	2
	Total Hours	30







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Course Code					C	ourse	Nan	ne				J	L T P X C								
212BME3336				Di	gital]	Imag	e Pro	ocessi	ng			•	3 0 3 0 4								
Prerequisite: 1	Nil											8 1	Syl l ∴3	lab	us r	evis	ion:				
Course Catego	ory: I	Progr	am (Core								(I	C ot Inte	urs gra	e Ty ited	y pe: Cou	irse				
Course descrij	iption																				
To study the im To study the im To study image To study the im	age fundamentals and mathematical transforms necessary for image processin age enhancement techniques restoration procedures. age compression procedures.															sing.					
Course outcon On successful	nes: comp	les: completion of the course the students will be able to																			
CO1	Under and t	erstar the va	nd x-r arious	ay, u com	ltraso pone	und, nts of	and n imag	nagne ging s	etic re ysten	esona ns.	nce in	iterac	tio	ns	witł	n tiss	sue				
CO2	Use	funda	ament	als of	f matl	hema	tics a	nd ph	ysics	to ar	nalyze	e ima	ge	dat	a.						
CO3	Unde indu	erstar stry.	nd mo	odern	imag	ing d	evice	s and	their	appl	icatio	n in 1	neo	dici	ne a	and					
CO4	Dem stora	ionstr ige, p	ate un roces	nders sing,	tandi visua	ng of lizati	imag on, fu	e data usion,	a coll , and	ection comr	n, reso nunic	olutio ation	on,	rec	ons	truc	tion,				
CO5	Deve used	elop a in m	t com edica	peten l ima	ice in ging.	the F	Funda	ment	al ana	alytic	al and	l con	npu	tati	ona	l too	ols				
СО						PC)								PS	0					
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4			L	Μ	Н	Μ										
5	Н	L	Μ	Μ	Η	Μ							Η			
H – High, M –	Med	ium,	L-L	.ow												
Unit 1	DIG	SITA	L IM	IAGE	E FUI	NDA	MEN	TAL					Hour	rs: 9		
Elements of dig and quantization Matrix and Sin	gital i on, – gular	mage Gray Valu	e proc scal e rep	cessin e and resen	g sys Cole tatior	stems or im 1 of d	, Elei ages, iscret	nents , Som e ima	of V ne Ba ges.	isual sic r	perce elatio	eptio nshi	on, Im ps be	age s twee	samp n piz	oling xels,
Unit 2 IMAGE TRANSFORMS Hours: 9																
1D DFT, 2D D	FT, 2D DFT, Cosine, Sine Hadamard, Haar, Slant, KL transform and their properties.															
Unit 3	it 3 IMAGE ENHANCEMENT Hours: 9															
Basic gray level Transformations, Histogram – Modification and specification techniques Enhancement by point processing Image smoothening, Image sharpening, Image Segmentation generation of spatial masks from frequency domain specification, Homomorphic filtering, an color image processing.														ues, tion, and		
Unit 4IMAGE RESTORATION AND RECONSTRUCTION OF MEDICAL IMAGESHours: 9																
Noise Models, restoration, inv Radon transfor MRI Images.	, Noi erse f ms, F	se R filteri filter	educ ng, L back	tion, east 1 proje	Imag nean ection	e deg squa algo	radat re filt rithm	ion m ter, In 1, 3D	nodels nage tomo	s, Un recor grapl	const istruc iy, Fe	raine tion ourie	ed and from er reco	l Cor proje onstru	nstra ectio uctio	ined ns – n of
Unit 5	ME	DICA	AL II	MAG	E CO	OMP	RES	SION	TEC	CHN	QUI	ES	Hour	s: 9		
Run length, Hu predictive tech PET images. healthcare	ffmar nique Case	n codi es, Ap studi	ing, a oplica ies –	rithm ation Medi	etic c of im cal i	oding age j mage	g, Pix proce ana	el coc ssing lysis	ling, tech App	transt nique licatio	form s in on of	codin therr f Im	ng, JP nogra age J	EG S phy, proce	Stand SPE essing	lard, ECT, g in
								Tot	al Le	ectur	e hou	irs	45 + 3	30		
Text Books																
1	Rafa Educ	el C., cation	, Gon 1 Asia	zalez a, 200	and 1	Richa	rd E.	Woo	ds, D	igita	l Ima	ge Pi	rocess	sing,	Pear	son
2 Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 1997.												dia,				
Reference Boo	oks															
1	Will	liam l	K. Pr	att, D	igital	Imag	ge Pro	ocessi	ng, J	ohn V	Viley	, NJ,	1987	•		
2	Albe	ert M	acous	ski, M	Iedica	al Im	aging	syste	ems, I	Prenti	ce H	all, N	Jew J	ersey	v.198	3.
_	2 Albert Macouski, Medical Imaging systems, Prentice Hall, New Jersey.1983.															

3	Sid Ahmed M.A., Image Processing Theory, Algorithm and McGraw Hill, 1995.	l Architectures,
List of experi	ments	
Sl. No.	Title	Hours
1	Digital image Fundamentals – Sampling and quantization.	3
2	Image Enhancement – Spatial filtering, Filtering in frequency domain	3
3	Removal of noise in medical images.	3
4	Image Transformation in spatial domain and frequency domain.	3
5	Edge detection and boundary tracing techniques.	3
6	Region based processing	3
7	Color image processing	3
8	Basic Morphological operations.	3
9	Image compressions.	3
10	Image segmentation by Thresholding	3
	Total laboratory hours	30

PROGRAM ELECTIVES



Course Code	Course Name	L	Т	Р	X	С
213BME2124	Design of Medical Instruments	3	0	0	0	3
Prerequisite: BN	ME21R251, BME21R404	Sy r.3	llab	us r	evis	sion:
Course Categor	y: Program Elective	Co Th	ours	e Ty	ype:	

Course description

To understand and analyze the design procedures in medical instruments from idea to product realization

Course outcomes: On successful completion of the course, the students will be able to

CO1	To ins	o unde strum	erstan ents	d the	med	ical d	evice	class	ificat	ion a	nd de	sign o	crite	ria in	mec	lical
CO2	To me	o unde edical	erstan l instr	d the umer	feasi nts.	bility	, relia	ability	y and	huma	an fac	tors i	n de	sign	of	
CO3	To	anal	analyze the risk and safety analysis in the design of medical instruments													
CO4	To	o anal	analyze the validation and verification in medical instruments design													
CO5	To	understand the manufacturing of medical devices														
СО						I	?0							P	SO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1			Н								Н	Н		Н		
2			Н		Н						Н	Н		Н		
3			Н		Н						Н	Н		Н		
4			Н		Н						Н	Н		Н		

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5		Н								Н	Н		Н		
H - High, M - N	Iedium, I	L-L	ow												
Unit 1	Introdu	iction	1]	Hour	's: 09)	
General Medica Operation modes Compensation te	l Instrur s, Classif chniques	nenta icatio , Desi	tion on of ign C	Syst Bion riteri	em, nedica a.	Medi al Ins	cal N trume	Measu ents,	ireme Interf	ent C ering	Const and	raints Mod	, Al ifyin	ltern g in	ative puts,
Unit 2	Feasibi	lity]	Hour	's: 09)	
Reliability, failu requirements eng	re concej gineering,	pt, de liabi	esign lity, l	& de IP, pr	eveloj oject	omen team	t proo , relia	cess, bility	desig goal	n dei & pl	finitio an.	on, h	umai	n fac	ctors,
Unit 3	Design]	Hour	rs: 09)	
Safety & risk m design & risk and	anageme alysis, so	nt, H ftware	ardw e cod	are d ing.	esign	& ri	isk ar	nalysi	s, de	sign	for s	ix sig	gma,	soft	ware
Unit 4	Verifica	Verification & Validation Hours: 09													
Types of testing standards, hardw	g, Medica are & sof	al dev ftware	vice e veri	direc ficati	tive - on &	– FD valic	A, C lation	E, IE , harc	EC 60 Iware)601, & sc	ISO oftwa) 13485 and other are data analysis.			
Unit 5	Design	Tran	sfer	& M	anufa	actur	ing]	Hour	's: 09)	
Transfer to manu data analysis	facturing	, hard	lware	& so	ftwar	e mai	nufac	turing	g, con	figura	ation	mana	agem	ient,	field
							Tot	tal Lo	ectur	e hou	irs 4	45			
Text Books															
1	Fries, R Press.	C. (2016). Re	liable	e Desi	ign of	Med	lical I	Devic	es. U	Jnited	l Sta	tes:	CRC
2	King, P and Sys	. H., F tems,	Fries, Thir	R. C d Edi	., Joh ition.	nson, Unite	A. T ed Kii	. (201 ngdoi	4). D n: Ta	esign ylor d	of B & Fra	iome ancis.	dica	l De	vices
3	Perez, Elsevier	R. (2 r Scie	2002) ence.	. De	sign	of M	ledica	al Ele	ectror	nic D)evic	es. U	Unite	d St	ates:
Reference Book	S														
1	Prutchi, Instrum of Medi	D., N entati cal D	Norris ion: A Device	s, M. A Prae es. Ge	(2005 ctical ermar	5). De Persj ny: W	sign a pectiv iley.	and D e of t	evelo he De	opmei esign	nt of , Cor	Medi Istruc	cal E tion,	election and	ronic Test
2	Ogrodn Market.	ik, P. Neth	J. (2 Ierlan	2012) ds: E	. Mec	lical l er Sci	Devic ence.	e De	sign:	Inno	vatio	n fro	m Co	once	pt to

3	Becchetti, C., Neri, A. (2013). Medical Instrument Design and Development: From Requirements to Market Placements. Germany: Wiley.
4	Webster, J. G. (1997). Design of Pulse Oximeters. United Kingdom: CRC Press.

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Course Cod	le				С	ourse	e Nan	ne				L	Т	Р	X	C	
213BME212	25		GRA BI	PHI OMI	CAL EDIC	PRO CAL A	GRA APPI	MM JCA	ING TIOI	FOR NS	2	3	0	0		3	
Prerequisite: 1	Nil	•	Syllabus revision:														
Course Catego	ory: F	Progra	rogram Elective Course Type: Theory														
Course descrij	otion																
1		To i	To introduce virtual instrumentation concepts														
2		Тос	Γo design VI using LabVIEW														
3		То и	Fo use data acquisition and control in VI														
4		To I	To Interface various communication protocol in LabVIEW														
5		To a med	apply ical a	the pplic	incul ation	cated s	knov	wledg	ge in	Lab	VIEW	/ fo	r dev	velop	ing s	simple	
Course outcon On successful	nes: comp	oletio	n of t	he co	ourse	the s	tude	nts w	ill be	able	e to						
CO1		To c the j	compr preser	ehen nt cor	d and ntemp	l appr oorary	eciate wor	e the : ld	signif	ficano	ce and	d rol	e of t	this c	cours	e in	
CO2		Iden	tify s	alien	t trait	s of a	virtu	al ins	strum	ent.							
CO3		Und	erstar	nd the	e use	of VI	for c	lata a	cquis	ition.							
CO4		Exp	erime	nt, ai	nalyz	e and	docu	ment	diffe	rent (ypes	of iı	nterfa	aces			
CO5		App	ly the	e virtı	ual in	strum	entat	ion te	echno	logie	s for	med	ical a	appli	catio	ns	
CO						Ι	20							PS	0		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	
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2		М	M M M M														

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										•						
3		S	Μ										М	М		
4		S	S			Μ		М					М	М		
5		S	Μ			S		S					М	М		
H-High, M-	Med	ium,	L-L	ow												
Unit 1		Intr	oduc	tion								Ho	urs: 9			
History of Virt instrument, Pro basics – LabVI	ual In gram EW e	nstrur ming enviro	nenta parac onmer	tion(ligm 1t.	VI), a s – Vi	advan rtual	tages Instr	s, bloo umen	ck dia tatior	agran 1 – La	n and abVIE	arch EW so	itectu oftwai	re of œ−L	a vi abV	rtual IEW
Unit 2	nit 2 VI Using LabVIEW Hours: 9															
Creating, Editir and sequence st	iting and debugging a VI in LabVIEW – Creating a sub VI – Loops and charts – Case structures – File I/O – VI customization.															Case
Unit 3	Init 3Data Acquisition And Control In VIHours: 9															
Plug-in DAQ boards – Organization of the DAQ VI System – Performing analog input and analog output – Scanning multiple analog channels – Driving the digital I/Os – Buffered data acquisition – Simple problems															alog ition	
Unit 4	Unit 4 Instrument Interfaces Hours: 9															
Current loop, F PCMCIA, netw & processing, N	RS 23 /orkii Motic	32C/R ng ba on Co	S 48 sics fentrol.	5, Aı or of ADC	duino fice & C, DA	b Boa k indu C, D	rds, 1stria IO, E	GPIB il app DMM,	, Sys licati wav	tem on V eforn	basics ISA a n gen	s, Int & IV erato	erface I, ima r	basi ge ac	cs: U quis	JSB, ition
Unit 5		Арр	olicati	ion o	f VI]	In Bi	omed	lical	Engiı	neeri	ng	Ho	urs: 9			
Design of virtu Flow and Lu: Measurement, I	ial aj ng V Biofe	oplica Volun edbao	tions ne, F ck, Vi	for leart rtual	Electi Rate Real	rocarc e vai ity &	liogr iabil 3D g	aphy ity a graphi	(ECC nalys cal 7	G), E is, 1 2imu	lectro Nonin link7	omyo vasiv 2, Vi	graphy ve Bl rtual I	y (EN ood Proto	MG) Pres typir	, Air ssure 1g.
							Τ	otal]	Lectu	ıre h	ours	45				
Text Books												•				
1		Gar Edit	y Joh ion,1	nson 997	"LA	BVII	EW C	Graph	ical I	Progr	ammi	ng",	McG	raw H	Hill,	2 nd
2		Sanj Tata 2003	iay G Mc (5.	upta Graw	and Jo – Hi	oseph ll Put	Johr olishi	n, " V ng Co	irtual ompa	Instr ny Li	umer imitec	itatio I, Ne	n usin w Del	g Lal hi, 1 ^s	oVIE ^t Edi	EW", tion,
Reference Boo	ks															
1	1 Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2000.													for		
2	S. Gupta, J.P. Gupta," PC Interfacing for Data Acquisition and Process Control", ISA, 2 nd Edition, 1994.															
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3	Technical Manuals for DAS Modules of Advantech and National Instruments.															
4	Jon B. Olansen, Eric Rosow, "Virtual Bio-Instrumentation: Biomedical, Clinical, and Healthcare Applications in LabVIEW" Pearson Education, 2001.															

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Course Code					Co	ourse	Nam	e				I	,	Г	Р	X	С
213BME1107					PAT	ENT	FILI	NG				3	3	0	0	0	3
Prerequisite: N	: Nil												ylla JA	ıbu	s re	visi	on:
Course Category: Program Elective													C ou Theo	rse ory	Туј	pe:	
Course descrip	otion																
To understand a get granted	and ii	mpler	nent	the pi	roced	ures a	and st	eps ii	nvolv	ed in	pater	nting	proc	cedu	ıres	and	l to
Course outcom On successful o	ies: comp	oletio	n of 1	the co	ourse	, the	stude	ents v	vill b	e able	e to						
C01	To pate	under ented	rstand	d the	basic	pater	nting	systei	n and	d the	subje	ct cor	ntent	ts tł	nat c	can	be
CO2	То	under	rstand	the	paten	ting a	ability	v towa	ards a	ı subj	ect m	atter					
CO3	То	know	the j	paten	ting a	pplic	ation	proce	edure								
CO4	То	under	rstand	d and	knov	v the	proce	dures	in pa	atenti	ng reg	gistra	tion				
CO5	То	under	rstanc	the	licen	cing a	and co	omme	rciali	sing	proce	dures	5				
СО						P	0								PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	2	3	4
1						Н			Н		Н]	H	Н
2						Н			Η		Н]	H	Н
3						Н			Η		Н]	H	Н
4						Н			Η		Н]	H	Н
5						Н			Η		Н]	H	Н
H-High, M-	Med	ium,	L-L	.0W													
Unit 1	Int	rodu	ction									I	Iou	rs:	09		

Patent system, i subject matter	nvention, grant of patent, discovery vs invention, patent ac	t in India patentable									
Unit 2	Patent ability	Hours: 09									
Utility, novelty, publication, non-obvious and obvious, tests of hindsight, combination patents, foreign patents, claims											
Unit 3	Patent application Hours: 09										
Specification, pi to specification	itch, marrow, claims to be supported for description, construc	tion and amendment									
Unit 4	Patent registration	Hours: 09									
Controller of pa and revocation of	atents, examination, register of patents, opposition to grant of patents	of patents, surrender									
Unit 5	Patent rights	Hours: 09									
Patent rights and	d infringement, licencing of patents, patent rights and marke	eting rights									
	Total Lecture hours	45									
Text Books											
1	Guru, M., Rao, M. B., Rao, M. B. (2010). Patent Law in In Kluwer Law International.	idia. Netherlands:									
2	Rao, M. B., Guru, M. (2010). Patent Law in India. Netherl Kluwer.	ands: Wolters									
Reference Bool	ks										
1	PATENTING IN INDIA. (n.d.). (n.p.): Lulu.com.										
2	Kankanala, K., Radhakrishnan, V., Narasani, A. (2012). In and Practice. India: OUP India.	dian Patent Law									
3	Karhad, P. (2018). How to Patent an Idea in India: From Id Patent in Quickest Time, Saving Costs and Making Money Patented Invention; a Step by Step Guideline on Intellectua (n.p.): Independently Published.	lea to Granted with Your al Property Rights.									

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Anand	Nanar Krishnankol

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Course Code	Course Name	L	Т	Р	X	С	
213BME3151	Introduction to Java for Biomedical Applications	3	0	0		3	
Prerequisite: Ni	Syllabus revision: NA						
Course Categor	Course Type: Theory						

Course description

1	To comprehend the Fundamentals of OOP and Java Language Constructs
2	To familiarize the student with Object Oriented Programming in Java.
3	To solve problems using the OOP language constructs
4	To familiarize the functions and protocols of each layer of TCP/IP protocol suite.
5	To Develop Web applications with Java.

Course outcomes:

CO1	De	sign	probl	em so	olutio	ons us	ing C	bject	Orie	nted '	Techr	nique	s.			
CO2	Ap pro	Apply the concepts of polymorphism, overloading, and inheritance for problem solutions.														
CO3	Us	Use the concepts of Java for problem solving														
CO4	Ex to	Examine important technologies that are being used today by web developers to build a wide variety of web applications.														
CO5	То	desig	gn we	eb apj	plicat	ions	ısing	Java,	Serv	lets, I	XML	•				
СО						P	0							PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	L												М	М		
2		М	М										М	М		

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3	5	S N	1									М	N	1	
4	1	s s	1		Μ		М					М	N	1	
5		S N	1		S		S					М	N	1	
H – High, M –	- Mediun	n, L –	Low	<u> </u>	A							L			
Unit 1	Fundamentals Of Object Oriented Programming And Hours: 9 Java														
Introduction to Variables, Ope and Objects, S Packages.	o OOP. rators, E trings, C	Introc xpress onstru	luction sions, S actors	to J Statem and D	ava – ients, l estruc	- Java Block ctors,	a Spec s, Con Type (cifica ntrol Cast	atior flov ting,	ns, Ja v Sta Pacl	ava teme kage	Langu ents, A Acce	iage rray ss –	bas s, Cl Java	ics - asses AP
Unit 2	Inhei In Ja	Inheritance, Polymorphism And Exception Handling Hours: 9 In Java													
Inheritance – S – User Define	Sub Class ed Excep – Abstra	ses an otion '	d Subo Гуреs	class T – As	Types, sertio	, Exce ns –	eption Garba	Han ge (dlin Colle	g- Ja ectio	iva E n an	Except d Me	ion thoc	Hiera I fina	archy alize
of and Down C Multithreading	Casting –	ict Cla final	isses a Metho	nd Me ods and	thods d Clas	- Ove sses –	erloadi Clone	ng a clas	and C ss -1	Overr Inter	iding face	g, Ope – Imp	erato lem	entat	tance ion -
of and Down C Multithreading	Casting –	And S	usses a Metho Strean	nd Me ods and ns In J	ethods d Clas Java	- Ove sses –	erloadin Clone	ng a clas	and C ss – 1	Overr Inter	iding face	g, Ope – Imp Hou i	erato lem	or instended	tance ion –
of and Down C Multithreading Unit 3 Files and Streat – Generic Clas	Files Files ms – For ses and N	And S mattee	Strean d Outp ds – Ja	nd Me ods and ns In J ut – O tva uti	ethods d Clas Java bject lity Pa	- Ove sses – Concu	crloadin Clone urrency es and	ng a clas y- Se Bit	nd C ss –] erial Mar	Overr Inter izationipula	iding face	g, Ope – Imp Hou Gener	erato lem rs: 9 ic C a Co	or instended	tance ion – tions
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of and Down C Multithreading Unit 3 Files and Streat – Generic Clas Unit 4 Review of Net and Domain N Mail, Telnet, F URN, URL, M Unit 5	Files Files ms – For ses and M Intro work tec Vames, H FTP, NFS IME Ty Java	And S mattee Methoo duction hnolo Higher S.WW pe. Progr	Asses a Metho Strean d Outp ds – Ja on To gies, Ii -level W- V	nd Me ods and ns In 3 ut – O tva uti The I Proto ersion	Iava bject blity Pa ntern t addr cols, s – H	- Ove sses – Concu ackage et ressing Addro TTP –	g, Inte ess res – Requ	ng a clas y- So Bit ernet solu uest	nd C ss –] erial Mar : Pro tion and	izatio izatio ipula tocol prot Res	iding face	g, Ope – Imp Houn Gener – Jav Houn FCP/I s (AR se Mes Houn	rato lem rs: 9 ic C a C rs: 9 P, U P/R ssag	or instended	tance ion - etions tions DNS DNS DNS
 of and Down C Multithreading Unit 3 Files and Streat – Generic Clas Unit 4 Review of Net and Domain N Mail, Telnet, F URN, URL, M Unit 5 Web Clients: - Java Script, PH Invocation – Ja Java servlets applications, De 	Files The set of the	And S mattee Methoo ductio hnolo Higher S.WW pe. Progr ction hectin base C hitectu II base	Asses a Metho Strean d Outp ds – Ja on To gies, Ii -level W- V w- V connec re- J ed bior	nd Me ods and ns In . ut – O iva uti: The I The I Proto ersion ing In ML- C reb- In tivity ISP medica	Java bject 0 lity Pa ntern t addr cols, s – H The CSS, 2 ntrodu – con Techr al app	- Ove sses – Concu ackage et ressing Addro TTP Intern KHTN ction nectivn nology	rloadin Clone urrency es and g, Inte ess res – Requ net ML, XI to Jaw vity – Q y Int ons	ng a class class y- Se Bit ernet solu uest ML 7a A Quer trodu	erial Mar Pro tion and Pars pple rying uctio	izationipula izationipula tocol prot Res ser – ets- s g stat	iding face	g, Ope – Imp Houn Gener – Jav Houn FCP/I s (AR se Mes Houn ent Sid gs- Re nts – J nning	rato lem rs: 9 ic C a Ca rs: 9 P, U P/R ssag rs: 9 Crs: 9	or instended	tance ion - tion: tions DNS DNS DNS DNS DNS DNS DNS DNS DNS DNS
of and Down C Multithreading Unit 3 Files and Streat – Generic Clas Unit 4 Review of Net and Domain N Mail, Telnet, F URN, URL, M Unit 5 Web Clients: - Java Script, PH Invocation – Ja Java servlets applications, De	Files Tosh Files ms – For ses and N Intro work tec James, H TP, NF IME Tyj Java Introdu- HP. Com- ava Datal - Arch esign GU	And S mattee Metho ductio hnolo Higher S.WW pe. Progr ction hectin base C itectu II base	Asses a Metho Strean d Outp ds – Ja on To gies, If -level W- V w- V cammi to HTl g to w Connec re- J ed bior	nd Me ods and ns In . ut – O tva util The I Proto ersion ing In ML- C reb- In tivity ISP medica	t addr bject (lity Pa ntern t addr cols, s – H The CSS, 2 ntrodu – con Techr al app	- Ove sses – Concu ackag et ressing Addre TTP Intern XHTN ction nectiv nology licatic	rloadin Clone urrenc <u>es</u> es and g, Inte ess res – Requ net ML, XI to Jav Vity – C y Into ons Total	ng a class class y- So Bit ernet solu uest ML va A Quen trodu	erial Mar Pro tion and Pars pple rying uctic	izatio izatio iipula tocol prot Res ser – ets- s g stat	iding face	g, Ope – Imp Houn Genera – Jav Houn FCP/I s (AR se Mes Houn ent Sid gs- Re nts – J nning 45	rato lem rs: 9 ic C a C rs: 9 P, U P/R ssag rs: 9 de S mot Resu ba	or instended	tance ion - tions ions DNS). E URI URI JSP JSI
<pre>orymorphism of and Down C Multithreading Unit 3 Files and Streat – Generic Clas Unit 4 Review of Net and Domain N Mail, Telnet, F URN, URL, M Unit 5 Web Clients: - Java Script, PH Invocation – Ja Java servlets applications,De Text Books</pre>	Files Total and No. Casting – Files ms – For ses and N Intro work tec Vames, H TP, NF IME Ty Java Introdu HP. Com- and Arche esign GU	And S mattee Metho duction hnolo ligher S.WW pe. Progr ction base C itectu JI base	Asses a Metho Strean d Outp ds – Ja on To gies, Ii -level W- V connec re- J ed bior	nd Me ods and ns In . ut – O wa uti The I nterne Proto ersion ing In ML- C reb- In tivity ISP nedica	ethods d Class d Class bject 0 lity Pa ntern t addr cols, s – H The CSS, 2 ntrodu – con Techn al app	- Ove sses – Concu ackage et ressing Addre TTP Intern XHTN ction nectivn nology licatio	rloadin Clone urrency es and g, Inte ess res – Requ net ML, XI to Jaw vity – C y Into Das Total	ng a class y- Se Bit ernet solu uest ML /a A Quen trodu	erial Mar Pro tion and Pars pple rying uctio	izatio izatio iipuli tocol prot Res ser – ets- s g stat on- e hou	iding face	g, Ope – Imp Houn Genera – Jav Houn TCP/I s (AR se Mes to A se Mes	rato lem rs: 9 ic C a Co rs: 9 P, U P/R ssag rs: 9 de S mot Resu ba	or instended	tance ion - tion tions DNS DNS DNS DNS DNS DNS DNS DNS DNS DNS

2	Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann Publishers Inc., 5 th Edition, 2011									
Reference Books										
1	Y. Daniel Liang, "Introduction to Java Programming Comprehensive Version", Pearson Education, 10 th Edition, 2014.									
2	Sachin Malhotra, Sourabh Choudhary, "Programming in Java", Oxford University Press, 2 nd Edition, 2018.									
3	William Stallings, "Data and Computer Communications", Pearson Education, 10 th Edition, 2013.									
4	Deitel and Deitel, "Internet and World Wide Web: How to Program", Pearson Education, 5 th Edition, 2012.									

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Anand Nagar, Krishnankoil

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Course Code					С	ours	e Nar	ne				Ι	1	Г	Р	X	С	
213BME2131			SPE	CIAL	ELI	ECTI	RICA	LM	ACH	INES	5	3	3 ()	0		3	
Prerequisite: Knowledge in DC Machines and Transformers and AC machines.													Syllabus revision: NA					
Course Category: Program Elective													Course Type: Theory					
Course description																		
The main objective of the course is to understand various SRM, PMBLDC and PMSM construction, operating principles and control techniques of special electrical machines.														1SM				
Course outcon On successful	nes: comj	pletio	n of 1	the co	ourse	the s	stude	ents w	vill bo	e able	e to							
CO1	A	Analyze the performance of synchronous reluctance motor & vernier motor.																
CO2	A p	.pply ractic	the l al apj	know plicat	ledge ions a	of r and a	nodes nalyz	s of o e its l	opera inear	tion (& no	of va on-lin	rious ear p	stej erfo	pp rm	er 1 Iano	noto ce.	or in	
CO3	D d	escril	be the nt op	e perf eratin	forma Ig mo	nce c des o	of pov of swi	ver se tched	emico reluc	onduc etance	tor sv e mot	vitchi or.	ng c	ciro	cuit	ts fo	r the	
CO4	D it	etern s chai	nine t racter	he El istics	MF a & dr	nd to iver o	rque circui	produ ts.	iction	s of	a PM	BLD	C m	not	or l	oase	d on	
CO5	A o	.nalyz n its c	the the constr	perf ructio	orma nal fe	nce o eature	of a p es & c	ermai open a	nent 1 and cl	nagn losed	et syı loop	nchro contr	nou ol o	s r of i	not t.	or b	ased	
СО]	PO								PS	50		
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1	L	М		L	L	L		L	L	L		L	Μ					
2	L	М		L	L	L		L	L	L		L		I	М			
3	L			L	L	L		L	L	L		L				L		
4	L	М										L					М	
5	L	Н	L	Μ	Μ	L	L					L					Н	

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H-High, M-M	Iedium, L – Low	
Unit 1	SYNCHRONOUS RELUCTANCE MOTORS	Hours: 9
Constructional for Variable Relucta characteristics –	eatures – Types – Axial and Radial flux motors – Opence Motors – Voltage and Torque Equations – Phasor diage Applications.	erating principles – gram – performance
Unit 2	STEPPER MOTORS	Hours: 9
Constructional fe Single and mu Characteristics – control-Concept	atures – Principle of operation – Variable reluctance moto ti-stack configurations – Torque equations – Mode Drive circuits – Microprocessor control of stepper mo of lead angle– Applications.	or – Hybrid motor – es of excitation – otors – Closed loop
Unit 3	SWITCHED RELUCTANCE MOTORS	Hours: 9
Constructional fe performance pre Sensor less opera	eatures -Principle of operation- Torque prediction-Charact diction – Analytical Method – Power controllers – Con tion of SRM -Applications.	eristics Steady state trol of SRM drive-
Unit 4	PERMANENT MAGNET BRUSHLESS DC MOTORS AND INDUCTION MACHINES	Hours: 9
Constructional fe and torque equati Induction motor Tutorial-4.	eatures – Principle of operation – Types and magnetic circ ons – Power driving circuits – Motor characteristics and co – Induction voltage regulator – Rotor position sensors	cuit analysis – EMF ntrol – Synchronous – Linear motors –
Unit 5	PERMANENT MAGNET SYNCHRONOUS MOTORS	Hours: 9
Constructional fe – Power controll Microprocessor b	atures – Principle of operation – EMF and torque equationers – Converter – volt–ampere requirements – Torque spectage control – Tutorial-5.	ns – Phasor diagram eed characteristics –
	Total Lecture hours	45
Text Books		
1	K.Venkataratnam, 'Special Electrical Machines', Univer Private Limited, 2008.	sities Press (India)
1	K.Venkataratnam, 'Special Electrical Machines', Univer Private Limited, 2008.T.J.E. Miller, 'Brushless Permanent Magnet and Relucta Clarendon Press, Oxford, 1989.	sities Press (India)
1 2 Reference Books	 K.Venkataratnam, 'Special Electrical Machines', Univer Private Limited, 2008. T.J.E. Miller, 'Brushless Permanent Magnet and Relucta Clarendon Press, Oxford, 1989. 	sities Press (India) ance Motor Drives',

2	P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus London, 1982.
3	T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.

Course Code			Srivillip	uttur (V	C Act ia), Viru	1956. dhunaga	Accre	dited I amil Nac	ND I IVE by NA/	EDU ERS C with @kalas	CATI IT h "A" G alingam.	irade	www.ka	lasalin	gam.a	c.in
					С	ourse	e Nan	ne				Ι	T	P	X	C
213BME2121		ANA	LOG	5 ANI	D DI	GITA	AL C	OMN	IUNI	[CAT	ION		3 0	0	0	3
'rerequisite: Nil											S r	Sylla evisi	bus ion:r	÷.2		
Course Category: Program Elective									(]	C our Theor	rse T	ype:				
Course descrij	ption															
To understand user radio com	analo munio	og and catior	d dig 1.	ital co	omm	unica	tion t	echni	ques	and t	o gai	n kno	owle	dge (on m	nulti
Course outcon On successful	nes: comj	pletio	n of 1	the co	ourse	the s	stude	nts w	rill be	able	to					
CO1	De	escrib	e typ	es of	the A	nalog	g mod	lulati	on teo	chniq	ues					
CO2	De	escrib	e typ	es of	the P	ulse 1	nodu	lation	tech	nique	S					
CO3	Ar	nalyse	e the	types	of D	igital	modu	ulatio	n and	trans	missi	ion te	chni	ques		
CO4	De	escrib	e the	infor	matic	on the	eory a	nd co	ding							
CO5	Sp	oread	Spect	trum a	and ty	ypes o	of Mu	ıltiple	Acc	ess						
СО						I	20							P	SO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	М	Μ	Н					L	L	L		L	Μ			
2	Н	М	М					L	L	L		L		Μ		
3	М	М	М					L	L	L		L			L	
4	М	М	М									L				M
5	M	Н	M	M	М	L	L					L				Η
11 – High, M – Unit 1	Med	ium, NAL	L - L		[]][. \ '	TIO	N					T	Hour	s: 0		

Introduction to Communication Systems – Modulation – Types – Need for Modulation. Theory of Amplitude Modulation-Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Superheterodyne receivers.

Unit 2	PULSE MODULATION	Hours: 9

Low pass sampling theorem – Quantisation – PAM – Line coding – PCM, DPCM, DM, ADPCM and ADM, Channel Vocoder – Time Division Multiplexing, Frequency Division Multiplexing 57- Data Communication Circuits – Data Communication Codes – Data communication Hardware – serial and parallel interfaces.

Unit 3	DIGITAL MODULATION AND TRANSMISSION	Hours: 9
	TECHNIQUES	

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-arysignaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers.

Unit 4	INFORMATION THEORY AND CODING	Hours: 9
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Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon"s limit – Error control codes – Cyclic codes, Syndrome calculation – Convolutional Coding, Sequential and Viterbi decoding.

Unit 5	SPREAD SPEC	TRUM AND MUL	ΓIPL	LE ACC	ESS	ł	Hours:	9
		5 6 6 6	1		<u> </u>	Ŧ		-

PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – Global System for Mobile Communications (GSM) – FDMA, TDMA, CDMA,

Total Lecture hours 45

Text Books

1	H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007.
2	S. Haykin "Digital Communications" John Wiley 2005.

Reference Books

1	1. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3/e, Oxford University Press, 2007
2	H P Hsu, Schaum Outline Series – "Analog and Digital Communications" TMH 2006
3	B.Sklar, Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007.

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Course Code	Course Name	L	Т	Р	X	С
213BME2129	Medical Optics & Lasers	3	0	0	0	3
Prerequisite: <mark>h</mark> a	ave to include any basic science course	Sy r.2	llab	us r	evis	sion:
Course Categor	y: Program Elective	Co Th	ours eory	e Ty ⁄	ype:	
Course descript	tion					
1	To understand the basics of tissue optics					
2	To analyze the principles of photonic detection methods					
3	To understand the biomedical diagnostic applications					
4	To analyze the optical biopsy techniques					
5	To apply and evaluate the intervention and diagnostic tech	nniq	ues			
Course outcome On successful co	es: ompletion of the course the students will be able to					
C01	Demonstrate an understanding of the tissue optical instrumentation	pro	pert	ties	anc	l its
CO2	Enlighten the principles of photonic detection techniques same in biomedical imaging	and	the	usa	ge o	f the
CO3	Understand the various biomedical diagnostic applicati biomedical engineering	ons	in	the	fiel	d of
CO4	Analyze the concepts involved in various fluoroscopy diagnostics	/ ba	used	bio	ome	dical
CO5	Evaluate and expound the diagnostic methodologies foll	owe	ed ir	ı bio	ome	dical

photonics

СО						P	0						PSO				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	
1		Н		Н									Н	Н			
2		Н		Н									Н	Н			
3		Н		Н	Н								Н	Н			
4		Н		Н	Н								Н	Н			
5		Н		Н	Н								Н	Н			
H – High, M –	Med	ium,	L-L	.ow													
Unit 1	Ti	ssue	Optic	es &]	Photo	onic I	Devic	es					Hour	rs: 9			
Optical propert in Medicine, Ba	ies of asic I	f tissu nstrui	e, lig menta	ht-tis ation	sue ii in Ph	nterac otoni	tions cs	, Opti	ical E	Diffus	ion T	omo	ograph	ıy, L	aser	ligh	
Unit 2	Ph	otoni	ic De	tectio	on an	d Im	aging	g Tec	hniq	ues			Hour	:s: 9			
Lifetime based Coherence Tor imaging for bio	imag nogra ologic	ging, a aphy al and	near- imag d meo	field ing, 1 dical	imag Laser diagn	ing in dopp ostic	n biol pler p s	ogica perfus	l and ion 1	l bion nonit	nedic oring	al aj ; anc	oplica 1 ima	tions ging	s, Op , the	otica rma	
Unit 3	Bi	omed	lical]	Diag	nostic	es							Hours: 9				
Glucose diagn applications, fu	ostics	s, In nal in	vitro nagin	o clin g wit	nical h difi	diag fusing	nostic g ligh	: inst t	rume	entatio	on, b	oiose	nsors	for	me	dica	
Unit 4	Ol	ptical	Biop	osy									Hours: 9				
Optoacoustic characterization biomedical diag	Tom 1 of b gnost	iograj piolog ics	ohy, fical t	Ultı tissue	rason usin	ically g opt	mo ical s	odula pectro	ted oscor	optic oy, Fl	cal uores	imaş cenc	ging, ce spe	qu ectros	antit scop	ativ y fo	
Unit 5	In	terve	ntion	and	Diag	nosti	c Teo	chniq	ues				Hour	:s: 9			
Principles of I ophthalmology	PDT :	and i er trea	ts cli atmer	nical nt for	appl breas	icationst turn	ons, 1 ors, i	aser mage	tissue guid	e wel led su	ding, rgery	las	er in	dern	natol	logy	
								Tot	al Le	ectur	e hou	rs	45				
Text Books																	
1	Bi Fra	omed ancis.	ical F	Photo	nics I	Handl	book.	(200	3). U	nited	King	dom	ı: Tay	lor &	Ż		
Reference Boo	ks																

1	Biomedical Photonics Handbook, Second Edition: Fundamentals, Devices, and Techniques. (2014). United States: Taylor & Francis.
2	Biomedical Photonics Handbook, Second Edition: Biomedical Diagnostics. (2014). United States: Taylor & Francis.
3	Biomedical Photonics Handbook, Second Edition: Therapeutics and Advanced Biophotonics. (2014). United Kingdom: Taylor & Francis.
4	Biomedical Photonics Handbook, 3 Volume Set. (2014). United States: CRC Press.

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Course Code	L	Т	Р	X	С	
213BME3138	3	0	0	0	3	
Prerequisite: Ni	Syllabus revision r.1					
Course Categor	Co Th	ours eory	e Ty ′	ype:		
Course descript						

This course deals with the basics of additive manufacturing and 3D printing technologies and its application in medicine.

Course outco On successful	nes: comp	oletio	n of t	the co	ourse	the s	stude	nts w	rill be	e able	to								
CO1	Unc	Understand the basics of additive manufacturing in product development.																	
CO2	Iden	dentify the 3D printing technology for specific application.																	
CO3	Proc	Process the radiological images using tools.																	
CO4	Desc	bescribe the various applications of 3D printing in medicine.																	
CO5	Iden mod	Identify the technical considerations and regulatory bodies for making 3D models using 3D printing technologies.														3D			
СО						Р	0							Р	PSO				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	1		
1	М	М											М						
2		М	М										М						
3		М	М		Н								М						
4	L	L											L						
5								М								Т	I		

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H – High, M -	- Medium, L – Low	
Unit 1	Introduction to Additive Manufacturing and Basic Principles	Hours:
Systematics of Structure of A Product Deve Generation of Generating the Evaluation of t	f Manufacturing Technologies, Systematics of Layer Techr dditive Manufacturing Processes, Integration of Additive M lopment Process, Basic Principles of the Additive Man Layer Information, Physical Principles for Layer Genera Physical Layer, Classification of Additive Manufacturing I the Theoretical Potentials of Rapid Prototyping Processes.	hology, Hierarchical Ianufacturing in the ufacturing Process, ation, Elements for Processes, Summary
Unit 2	3D Printing Technologies	Hours:
Communicatin Printing Tech Extrusion, Pov Reproducibilit	g with a 3D Printer: The Standard Tessellation File Form nologies – Vat Photopolymerization, Material Jetting, Bind wder Bed Fusion, Other Technologies. 3D Printer Resolut y, 3D Printing Materials.	at and Beyond, 3D ler Jetting, Material ion, Accuracy, and
Unit 3	Post-processing of DICOM Images	Hours:
Image Segmer and CAD Des Special Applic Lab.	ntation, STL Generation, Computer-Aided Design Software, ign, Virtual Procedural Planning, Model Quality, Preparati cations. Beginning and Developing a Radiology-Based In-H	Model Refinement on for 3D Printing, Iospital 3D Printing
Unit 4	Application of 3D Printing in Medicine	Hours:
3D Printing i Craniofacial A	n Neurosurgery, Cardiovascular 3D Printing, Musculosk pplications, Medical Imaging and Digital Design of Patient-Ma	eletal 3D Printing, atched Implants
Unit 5	FDA Regulatory and Technical Considerations	Hours:
The FDA's Ro Classification, Design Process Safety of 3D-F	le, Brief Overview of FDA Regulatory Pathways for Medical Regulatory Landscape for 3D-Printed Medical Devices, Prin s, The Manufacturing Process, Verification and Process Vali Printed Medical Models	Devices – Resources, nting Materials, The dation. Quality and
	Total Lecture hours	
Text Books		
1	Rybicki, Frank J., and Gerald T. Grant. "3D printing in Springer International Publishing (2017).	m medicine." <i>Cham:</i>
Reference Bo	bks	
1	Gebhardt, Andreas, and Jan-Steffen Hötter. "Additive printing for prototyping and manufacturing". Carl Hanse	<i>manufacturing: 3D</i> r Verlag GmbH Co
RIKARE	Department of Riomedia	al Engineering

	KG, 2016.
2	Kalaskar, Deepak M., ed. "3D printing in medicine". Woodhead Publishing, 2017.
3	Ian Gibson, Ian Gibson. "Additive manufacturing technologies 3D printing, rapid prototyping, and direct digital manufacturing." (2015).

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Course Code					C	Course Name L T P X																
213BME3154		MO	BIL	E AP	PLIC	CATI	ION I	DEVI	ELO	PME	NT	3	3 0 0 3									
Prerequisite: Nil													Syllabus revision: NA									
Course Category: Program Elective												C T	Course Type: Theory									
Course description																						
1	То	Γο Understand system requirements for mobile applications																				
2	То	o Generate suitable design using specific mobile development frameworks												rks								
3	То	o Generate mobile application design																				
4	То	o Implement the design using specific mobile development frameworks																				
5	То	To Deploy the mobile applications in marketplace for distribution																				
Course outcome On successful c	es: omp	oletio	n of t	he co	ourse	the s	stude	nts w	vill be	able	to											
CO1	De	escrit	be the	requ	ireme	ents f	or mo	bile a	applio	cation	IS											
CO2	Di	scuss	the c	challe	enges	in m	obile	appli	catio	1 desi	gn an	d dev	elop	me	nt							
CO3	De	velop	o desi	gn fo	r mol	bile a	pplica	ations	s for s	specif	ic req	uiren	nent	3								
CO4	Im	plem	ent th	e des	sign u	sing	Andro	oid S	DK													
CO5	Im	plem	ent th	e des	sign u	sing	Objec	ctive	C and	l iOS												
СО						I	20							P	SO							
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1	L												Μ	Μ								
2		М	М										Μ	Μ								
3		S	М										Μ	М								

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4		S	S			Μ		Μ					Ν	I N	1		
5		S	Μ			S		S					Ν	[]]	1		
H-High, M-	Med	ium,	L-I	Low									T				
Unit 1	Int	trodu	ictio	n									Но	irs:	9		
Introduction to mobile applications – Embedded systems – Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications																	
Unit 2	2 Basic Design Hours: 9																
Introduction – Basics of embedded systems design – Embedded OS – Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – user interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.																	
Unit 3	Ad	lvano	ced D	esign	1								Но	irs:	9		
Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications, Swift Programming																	
Unit 4	Μ	[obile	e OS	Tech	nolog	gy I –	And	roid					Но	irs:	9		
Introduction – and views – In Interaction with social media ap	Estab teract n serv oplicat	olishin ing w er sid tions	ng th vith U le app	e dev JI – F plicati	velopr Persis ions –	nent ting c - Usir	envir lata u Ig Go	onme sing (ogle l	ent – SQLi Maps	Andı te – , GP	roid Pack S and	arch tagir d Wi	nitectu ng and iFi – I	ıre – l dej nteg	- A plo trat	ctiv yme ion	vities ent – with
Unit 5	M	obile	OS 7	Гесhı	nolog	y II –	- IOS	5					Но	irs:	9		
Introduction to persistence usin Map Kit – Inte iPhone marketp	Obje ng Co gratin place.	ective ore Dang cal	e C – ata an lenda	iOS Id SQ r and	featu Lite - addr	res – - Loc ess b	UI in ation ook y	mplen awar with s	nenta e app ocial	tion licat med	– To ions ia ap	ouch usin oplic	fram g Cor ation	iewo re Lo – U	orks oca Isin	s – 1 tion 1g W	Data and Vifi–
	То	tal L	ectu	re ho	urs								45				
Text Books																	
1	Jef De	ff M velop	cWh omen	erter t", W	and rox, 2	Sco 2012	tt G	owell	, "P	rofes	sion	al	Mobi	le A	App	olica	ation
2	Ch Dr	arlie eamT	Colli Tech,	ins, N 2012	lichae	2 Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech, 2012											ice",
3	3 David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", Apress, 2013.																

Reference Book	ΩS
1	Matthew R Mageeon" Swift Programming ",The Big Nerd Ranch Guide, 2 nd Edition,2017
2	Matthew Mehrtenson , "iOS Programming", The Big Nerd Ranch Guide, 6 th Edition, 2017.
3	Bill Phillips, ChrisStewart, and 92 imulinMarsictano "Android Programming", The Big Nerd Ranch Guide, 3 rd Edition 2017.
4	James Dovey and Ash Furrow, "Beginning Objective C", Apress, 2012



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Course Code	L	Т	Р	X	С		
213BME2128	3 0 0 0						
Prerequisite: Ni	Syllabus revision: NA						
Course Categor	Co Th	ours eory	e Ty	ype:			

Course description

This course is designed to impart the fundamental knowledge on the medical devices and in vitro diagnostics, basis of classification and product life cycle of medical devices, regulatory requirements for approval of medical devices in regulation in India along with WHO regulations. It prepares the students to learn in detail on the harmonization initiatives, quality and ethical considerations, regulatory and documentation requirements for marketing medical devices and IVDs in regulated countries.

Course outcor On successful	nes: comp	oletio	n of 1	the co	ourse	the s	stude	nts w	rill be	able	to					
CO1	Have	Have basic knowledge about the medical devices.														
CO2	Desc	Describe the medical devices divisions in India.														
CO3	Und	Understand the ethics and standards of medical devices.														
CO4	Disc	Discuss the laws and regulations of medical devices in India.														
CO5	Und	Understand the rules framed for medical devices by FDA and WHO.														
СО						Р	0							Р	SO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	L	М	Η	М	М	Η	М	М	М	М	М	Η	L	М	Н	М
2	L	М	Н	М	L	Н	L	L			М	Н	L	L	Н	М
3	L M H M L H L L H M H L L M M													М		
4	L	Μ	Н	Μ	L	Н	L	L	Н		М	Η	Μ	Μ	Η	Μ

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													1	I		
5	L	Μ	Η	Μ	L	Η	L	L	Η		Μ	Н	Μ	Μ	Н	Μ
H-High, M-M	edium _.	, <i>L-L</i>	ow													
Unit 1	INT	ROD	UCI	TION	TO	MED	ICAI	L DE	VIC	ES			Hour	rs: 09)	
Introduction, I Devices and IV that of pharmac Devices and C	Definit VDs. ceutica lassific	tion, Diffe als. H catior	Risk erentia istory 1 of N	base base ating y of N Aedic	ed cl medi Iedic al De	assifi cal d al De evices	evice evice vice I i IMD	n and s IVI Regul RF/C	d Est Os an lation GHTF	sentia d Co - Pro 7.	d Pri mbin duct l	ncip atior Lifec	les c n Pro cycle	of M ducts of M	edic from edic	al m al
Unit 2	MEI	DICA	L D	EVIC	CE D	IVIS	ION	IN IN	NDIA				Hour	s: 09)	
Functions of m of new medica Concerns in cli	edical l devic inical t	devi ces- C trials.	ce di Const Dive	visio itutio ersity	n- Re n of 1 of m	gistra nedic edica	ation a cal adv l devi	and L visor ces.	licens y con	sing- nmitt	Impo ees. C	rt Pr Clinio	ocedu cal tri	ure- A al re	Appr gula	oval tion-
Unit 3	ETH INV	IICS ESTI	A] IGA]	ND FION	STA OF	AND. MEI	ARDS DICA	5 I L DE	N EVIC	CLII ES	NICA		Hour	rs: 09)	
Clinical Invest Good Clinical Quality System Medical Devic Reporting of M	igation Practic n Reg es: IS ledical	n of ce for ulatic O 14 devi	Medi Clin ons o 971, ce. C	cal I ical I f Me Valio urren	Devic nvest dical dation t tren	es- C igatic Dev n and ds in	Clinication of r ices: Veri the us	l Inv nedio ISO ficati e of s	vestig cal de 1348 on of standa	ation vices 5, Q f Meo ards in	Plan (ISC uality dical n mec	for 141 Ris devi lical	Med 55:20 sk Ma ce. A devic	ical 011). anag dver ce reg	Devi Qua emer se E gulati	ices- lity: nt of vent ions.
Unit 4	LAV MEI	VS DICA	AND	GI EVIC	UIDE CES A	ELIN AND	ES DRU	FOR GS I	HA N IN	AND DIA	LING	;	Hour	rs: 09)	
Objectives of I state licensing	Drugs author	& Co rities,	osmet Drug	tic Ao g Tes	ct 194 ting I	40 & Labor	Rules atorie	s 194 s, Di	5, Fu fferei	nctio nces ł	ns of betwe	CDS en d	SCO, rugs :	Fun and c	ction levic	is of
Unit 5	REG DEV	GULA VICE	ATIO S IN	NS A		GUII	DELI	NES	OF N	MED	ICAI					es.
					0 11	ID FI	DA		011		-		Hour	s: 09)	
Introduction, Working Gro Nomenclature Devices.	Organi oups, (GME	izatio Sum DN).	onal s mary WHC	Struc Te) reg	ture, chnic ulatic	Purp al I ons of	DA oose a Docum f Med	and 1 nent lical	Funct (ST Devi	ions ED), ces, I	of F Glo FDA	legu bal regu	Hour latory Mec latior	s: 09 Gu dical	ideli De Meo	ines- vice dical
Introduction, Working Gro Nomenclature Devices.	Organi oups, (GME	izatio Sum DN).	onal s mary WHC	Struc Te) reg	ture, chnic ulatic	Purp al I ons of	DA oose a Docun f Med	and linent lical	Funct (ST Device al Le	ions ED), ces, I	of F Glo FDA	Regu bal regu	Hour latory Mec latior 45	s: 09 Gu dical ns of	iideli De Meo	ines- vice dical
Introduction, Working Gro Nomenclature Devices. Text Books	Drgani ups, (GME	izatio Sum DN).	mal S mary WHC	Struc Te) reg	ture, chnic ulatic	Purp al I ons of	DA pose a Docum f Med	and 1 nent lical Tot	Funct (ST Devia	ions ED), ces, I	of F Glo FDA e hou	Regu bal regu	Hour latory Mec latior 45	rs: 09 7 Gu dical ns of	iideli De Meo	ines- ovice dical
Introduction, Working Gro Nomenclature Devices. Text Books	Organi ups, (GME FDA biolo	izatio Sum DN). regu gics t	onal s mary WHC	Struc Te) reg y affa	ture, chnic ulatic	Purp al I ons of a gui isano	DA pose a Docum f Med de foa	and linent lical Tot r pre id Ma	Funct (ST Device al Le scrip	ions ED), ces, I ecture tion o	of F Glo FDA e hou	Regu bal regu rs	Hour latory Mec latior 45	rs: 09 7 Gu dical ns of	ideli De Med	and

3	Medical Product Regulatory Affairs: Pharmaceuticals, Diagnostics, Medical Devices by John J. Tobin and Gary Walsh.
4	Regulatory Affairs for Biomaterials and Medical Devices, Edited by: S. Amato and B. Ezzell, Woodhead Publishing.



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Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

Course Code	Course Name	L	Т	Р	X	С
213BME2126	HOSPITAL MANAGEMENT	3	0	0	0	3
Prerequisite: Ni	1	Sy r.3	llab	us r	revis	sion:
Course Categor	y: Program Elective	Co Th	ours eory	e Ty	pe:	

Course description

This course equips the students with managerial skills like planning, organizing and decision making in healthcare industry and also helps in understanding the functional and structural organization of various departments in hospitals.

Course outco On successful	mes: comp	oletio	n of (the co	ourse	e the s	stude	nts w	vill be	e able	e to					
CO1	Kno	w ho	w to p	olan f	or bu	ilding	g a ne	w ho	spital	•						
CO2	Und	erstar	nd the	e orga	nizat	ional	struc	ture a	ind pi	rocess	s invo	olved	in re	cruit	men	t.
CO3	Plan	and	desig	n mec	lical	and a	ncilla	ry sei	rvices	S						
CO4	Plan	and	desig	n vari	ious s	suppo	rt ser	vice c	lepar	tment	S					
CO5	Und	erstar	nd the	e sign	ificar	nce of	engi	neerii	ng de	partn	nents	in ho	spita	1.		
СО						Р	0							Р	SO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	L	L				Μ	М	М	М	Μ	М				М	L
2										М	М				М	L
3	L	L	L				М	М			М				М	L
4	L	L	L				М	М			М				М	L
5							L	L			L				L	L
H-High, M-	- Med	ium,	L-L	.ow	-	-	-	-	-	-	-	-		-	-	

Unit 1	Hospital Facility Planning	Hours: 9
Planning for a Preliminary su Operational an Building contr capital equipm	new hospital, Guiding principles in planning hospital fac rvey, Financial planning, Equipment planning, Permanent H d Functional plan, Facility master plan, Design team and act and contract documents, Furnishing and Equipping the h ent.	ilities and services, lealth Organization, development stage, ospital, Purchase of
Unit 2	Hospital Organization and Management	Hours: 9
Organization s the hospital, P Training and D	tructure, Management structure, organizational chart, Two least of the hospital, Recruitment and Selevelopment.	ines of authority in lection, Orientation,
Unit 3	Planning and Designing Medical and Ancillary Services	Hours: 9
Outpatient ser Surgical depa Recreational th	vices, Emergency services, Clinical Laboratories, Radio tment, Labor and Delivery suite, Physical therapy, oc- erapy, Speech and hearing therapy, Pulmonary medicine, CA	logical department, cupational therapy, ATH lab.
Unit 4	Planning and Designing Support Services	Hours: 9
Admitting dep Dietary service Designing of P	artment, Medical Record department, CSSD, Pharmacy, Ma , Laundry and linen service, Housekeeping, Volunteer depar- ublic area and Staff facilities.	tterial management, tment. Planning and
Unit 5	Hospital Engineering	Hours: 9
Engineering D systems, Con	epartments – Air conditioning, Medical Gas supply systems, I munication systems, Transportation, Solid waste mar	Plumbing, Electrical
Engineering de	partment. Safety and Security in hospitals.	ingement, emileur
Engineering de	partment. Safety and Security in hospitals. Total Lecture hours	45
Engineering de Text Books	partment. Safety and Security in hospitals. Total Lecture hours	45
Engineering de Text Books	partment. Safety and Security in hospitals. Total Lecture hours Kunders, G. D. <i>Hospitals: facilities planning and managen</i> Hill Education, 2004.	45 ment. Tata McGraw-
Engineering de Text Books 1 Reference Boo	partment. Safety and Security in hospitals. Total Lecture hours Kunders, G. D. <i>Hospitals: facilities planning and managen</i> Hill Education, 2004. ks	45 ment. Tata McGraw-



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Course Code	Course Name	L	Т	Р	X	С
213BME2122	CLINICAL ENGINEERING	3	0	0	0	3
Prerequisite: Ni	11	Sy r.3	llab	us r	evis	sion:
Course Categor	y: Program Elective	Co Th	ours eory	e Ty	ype:	

Course description

This course gives an introduction to the role of clinical engineer in various departments in hospital specifically in device designing, equipment planning and maintenance, quality control and evaluation.

Course outcomes: On successful completion of the course the students will be able to

C01	Unde	erstan	nd the	daily	y acti	vities	of cl	inical	engi	neer i	n hos	spital.	1			
CO2	Iden deple	tify oyme	the	techn medi	ology cal te	y ma chnol	inage logy.	ment	pra	ctices	for	the	ass	essm	ient	and
CO3	Unde quali	erstan ity pa	nd the	e nuts care.	s and	bolts	s to ł	ouild	an ei	nviror	nmen	t whi	ch si	uppo	orts h	igh-
CO4	Unde man	erstan ufactı	nd the uring,	e spe and	cific contr	issue ol.	es to	be c	consid	dered	in n	nedic	al de	evice	e des	sign,
CO5	Unde invo	erstan lveme	nd the	e im ith m	pact edica	and l devi	impo ices.	ortanc	e of	the	vario	ous re	egula	atory	boo	dies'
СО						Р	0							Р	SO	
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1						М					L				L	
2							М	М			М				М	Μ
3							М	М			М				М	М

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4							М	М			М				М	М
5							М	М	М		М				М	М
H – High, M -	- Med	ium,	L-L	.ow				1	1							
Unit 1	Intr	oduc	tion	to Cli	inica	l Eng	ineer	ing]	Hour	:s: 9		
Clinical Engin Functions of a Clinical Engir Services and C Bedside.	eering a Clin heering looper	g, The ical E g in a rative	e Role Engine an Ac s, Nat	of C eering aden ionw	linica g Dej nic M ide C	ll Eng partm Iedica	ineer ent, 1 al Cei al Eng	ing V A Mo nter, gineer	Vithir odel (Regio ring S	the I Clinic onal yster	Hospi cal Er Clinic n, Cli	tal O ngine cal E nical	rgani ering ngine Engi	zatic Der eerin	on, M partm g Sh ing a	lajor ient, ared it the
Unit 2	Hea	lth T	'echn	ology	v Ma i	nagei	nent]	Hour	:s: 9		
Introduction to Medical Equi Technology E Computerized A Strategy to Directions in A Management,	o Mec opmen valuat Maint Maint Acquir Nation	lical t, He ion, T tenan tain E ring a nal He	Techn Fechn ce Ma Essent nd Ou ealth	nolog Care ology anage ial M utsou Tech	y Ma Str y Pro ment ledica rcing nolog	anage ategic curen Syste al Equ High gy Po	ement Planent, ems, l uipmo I-Tecl licy.	Prac nning Equij Maint ent in h Ser	tices g Ut omen tenan Dev vices	, Goo ilizin; t Con ce an elopi by H	od Ma g Teo trol a d Rep ng Co ospita	anage chno nd A air o ountr als, V	emen logy Asset f Meo ies, N Vendo	t Pra Ass Man dical dical New or and	ictice sessm agem Devi Strat d Ser	for nent, nent, ices, tegic rvice
Unit 3	Eng	gineer	ring t	he C	linica	al En	viron	ment	t]	Hour	:s: 9		
Physical Plan Systems, Supp Systems in He	t, Hea oort So alth C	ting, ervice are F	Vent es, Co aciliti	tilatic onstru ies, D	on, an action Disast	nd Ai and er Pla	r Co Renc nning	nditio ovatic g	oning on, Ra	, Ele adiati	ctrica on Sa	l Po fety,	wer, Sani	Med itatio	lical on, W	Gas /ater
Unit 4	Mec and	lical Con	Devio trol	ces: I	Desig	n, Ma	anufa	ctur	ing, I	Evalu	ation	,]	Hour	:s: 9		
Medical Devie Human Facto Medical Devi Evaluating In Devices: Utiliz	ce De rs: Er ice S vestig zation	sign iviror oftwa ationa and S	and C nment are D al De Servic	Contro t, Me Develo evices ce.	ol in edical opme s for	the l Dev nt, C Insti	Hospi vices: Comp tutior	tal, M Fail arativ nal R	Medic ure M ve Ev eviev	cal D Aode: valua v Bo	evice s, Ac tions ards.	Rescident	earch nts, a Medi rviev	and and ical v of	l Des Liabi Devi Mec	sign, ility, ices, dical
Unit 5	Mee	lical	Devio	ce Sta	anda	rds, I	Regul	ation	ıs, an	d the	e Law	,]	Hour	:s: 9		
Primer on Star Agencies, Hea Engineering S Medical Devic Fort Liability	ndards lth Ca Standa ce Dir for Cl	and re Qu rds o ective inical	Regu iality of Pra es anc Engi	latior and I actice l Vig neers	ns, M SO 9 for ilance and	edica 001:2 Cana e Sys Devie	l Dev 000, 1 da, R tem, 1 ce Ma	ice R Hosp Legula Unite anufa	egula ital F ations d Sta cture	atory aciliti s and tes F	and T ies Sa the ood &	fety fety Law 2 Dru	nolog Stanc , Eur ug Ac	y As lards copea dmin	sessr , Clir in U istrat	nent nical nion tion,
								Tot	tal Lo	ectur	e hou	rs 4	45			
9 KARE							Dep	artn	nent	of B	iome	dica	l En	gine	erin	ıg

Text Books	
1	Dyro, Joseph, ed. Clinical engineering handbook. Elsevier, 2004.
Reference Boo	oks
1	Taktak, Azzam, et al., eds. <i>Clinical engineering: a handbook for clinical and biomedical engineers</i> . Academic Press, 2019.



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Course Code	Course Name	L	Т	Р	X	С
213BME2127	Medical Device Marketing	3	0	0	0	3
Prerequisite: Nil		Syl NA	llab A	us r	evis	sion:
Course Category	: Program Elective	Co Th	ours eory	e Ty	ype:	
Course description	DN					
This course focus Successful Produc	ses on Medical Device Marketing Strategies, Game-plar et Management.	ns 8	z Ro	esou	irces	s for
Course outcomes On successful con	: mpletion of the course the students will be able to					

CO1	Und	erstar	nd the	fund	lamer	ntals o	of cus	tome	rs and	d buy	ers cl	naract	terist	ics		
CO2	Perc	eive t	he ste	eps ai	nd pro	ocedu	res fo	or pro	oduct	devel	opme	ent an	ıd laı	ınch		
CO3	Anal mana	lyze t ager.	he pro	oduct	phas	e-out	proc	ess ai	nd als	so unc	lersta	nd th	e rol	es of	è proo	luct
CO4	Anal	lyze a	and co	ompai	re the	strat	egies	of m	arket	ing						
CO5	Strat	egize	the p	olanni	ing fo	or rela	itions	hip n	narke	ting p	orogra	ım				
СО	РО													PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1						М	Μ								М	
2						Μ	М								М	
3						Μ	Μ								М	

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4						М	М								М	
5						М	Μ								Μ	
H–High, M–M	lediun	n, L -	-Lov	V												
Unit 1					In	trodu	uctio	1					Hour	rs: 09	9	
Introduction, reimbursement Business plan- gate process	custo and h – Mar	mers iealth ket ro	, Dencare eseare	ecisio econo ch, ac	n m omics cessi	aking , the ng op	g, B letter oportu	uyer of la inity,	and w, et fina	Fo hics a ncial	llow- and re analy	up, espon sis, p	Func Isibili projec	lame ties. t sco	ntals	stag
Unit 2			Pro	oduct	Dev	elopı	nent	and]	aunc	h			Hour	s: 09	9	
Project definit managing issue Product launch line.	tion, es, me 1 – Foi	finan eting recas	cial deac ting,	targe llines Pricir	ts, pl ng, Pr	hysic oduc	ian i t and	nput, sales	FD.	A ap ort. N	oprova Manag	al ar	nd re an ex	imbu isting	irsen g pro	nen odu
Unit 3		Pro	duct	Phase	e out	and	prod	uct n	nana	ger r	ole		Hour	rs: 09	9	
Phase-out che analysis, distril Product manag	cklist bution ger role	, As: 1 deci e – sa	sessin sions ales a	ng lif and t and ma	fecycl timing arketi	le, c gs, pi ng, c	uston romot critica	ners ion p l skil	and ossib l sets	comj ilitie	petitic s, Ext	on, I ernal	Finan l com	cials mun	, pri icatio	cir on.
Unit 4			S	trate	gy an	ıd m	arket	plan	ning				Hour	:s: 09	9	
Strategic Plann Alliances, Mar Process: The F	iing, N keting ive-St	Aarke g Plar tage I	eting nning Mode	Strate : Buy el, Org	egies, ers K ganiza	Reas ey Pa ation	ssessi sychc al Bu	nent logic ying a	of Mi al Pro and E	issior ocess Decisi	n State es, Th on M	emen ne Bu aking	nt, Stra uying g	ategi Dec	c ision	l
Unit 5			Re	latio	nship	mar	·ketir	ıg pro	ograi	n			Hour	:s: 09	9	
Business and b professional se marketing cam	rand o gmen paign	objec tatior s, me	tives, n for i dia p	, spec relatio	ial co onshij ng an	nside p mai d sele	eratio rketir ectior	n, seg g, pe 1.	gment rsona	tatior s and	n strate l expe	egy o eriend	develo ces by	opme y seg	ent, men	t,
								To	tal L	ectur	e hou	irs	45			
Text Books												1				
1	Terri Succ 9781	Wel essfu 4327	ls, M 1 Pr 75072	edica oduct 25, 14	l Dev Ma 32750	ice N nage 0720.	Aarke ment . (Uni	ting: Ou t I, II	Strate tskirt , III)	egies s Pr	, Gam ess,	epla 2010	ns & 1), 1 st	Resc Ed	ource	s f Bl
Reference Boo	oks															_
A9 KADF							n		nord	of P		dice		dina		
							DC	CUN UN			101110	.urca		Sme	-C1-11	S

1	Kotler, Philip, Joel I. Shalowitz, and Robert J. Stevens. Strategic marketing for health care organizations: building a customer-driven health system. John Wiley & Sons, 2008. (Unit IV)
2	Haimowitz, Ira J. Healthcare relationship marketing: strategy, design and measurement. CRC Press, 2016. (Unit V)



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Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

Course Code	Course Name	L	Т	Р	X	С
213BME3148	ERGONOMICS	3	0	0	0	3
Prerequisite: Nil		Sylla NA	abu	s re	visi	on:
Course Category	: Program Elective	Cou The	i rse ory	Тур	be:	

Course description

This course describes the concept of ergonomics design in equipment and the performance of work space design considering physical space and inters personal space.

Course outcor On successful	Course outcomes: On successful completion of the course the students will be able to																
CO1	То р	To provide basic introduction about the ergonomics															
CO2	To u	To understand the workspace design process of various workers.															
CO3	To u	To understand the factors to be considered for designing the product.															
CO4	To u	To understand the medical issues caused by the ergonomics.															
CO5	To d	esign	the v	vheel	chair	and	its pe	rforn	nance	by aj	pplyi	ng the	e tecl	nniqu	ies.		
СО						Р	0							PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	
1	L	L	М	М		М	L	М	L	L	М	Н	М	М	L	М	
2	Μ	Н	Н	Н	М	Н	L	М	М	М	М	Н	М	Η	Н	М	
3	Μ	Н	Н	Н	М	Н	L	М	М	М	М	Н	Н	Н	Н	М	
4	L	М	М	М	L	Н	М	М	М	L	М	Н	L	Μ	Μ	L	

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														1		1		
5	M	Н	Η	Н	М	Η	L	М	М	М	Μ	Η	Η	Η	Η	М		
H-High, M-Me	dium	n, L-L	.0W															
Unit 1	INT	ROD	UCI	TION									Hour	s: 09				
Introduction to motions. Muscu planes and mov	Ergo ulosk emer	onomi eletal nts	ics ar , care	nd its diova	app] scula	lication r and	on; M l nerv	Ian-N yous s	Iachii systei	ne-Er n. Aı	nviron natom	ime lica	nt Sys l posit	stem tion,	and refei	joint ence		
Unit 2	wo	WORK SPACE DESIGN Hours: 09																
Anthropometry – workspace design for standing and seated workers – Arrangements o components within a physical space – Interpersonal aspect of workplace design.												ts of						
Unit 3	DES	DESIGN OF EQUIPMENT Hours: 09																
Programme factors to be considered, design of displays and controls – design for maintainability – heat stresses – manual lifting													bility					
Unit 4	FAC ISSU	FACTORS CAUSING ERGONOMICS RELATED ISSUES											Hours: 09					
Work Posture, Environmental factors and human performance; Designing of Controls and Displays, Control panel Organization; Principals of product design; Problem solving; Seminar on ergonomics related issues in Medicine . Ergonomics- Gait analysis, Design of work station, Sports biomechanics, Injury mechanics.											and nar ion,							
Unit 5	DES PER	SIGN RFOF	OF RMA	WHE NCE	EELC	CHAI	RAN	ND I'	ſS				Hour	s: 09)			
Wheel chairs: Ergonomics of Transportation Wheelchair rest	Cate f Wh for traint	gorie leelch the Mecl	s of nair 1 Hand nanis	Whe Propu icap: ms.	eelcha Ilsion Veł	airs, 1, Po 1icle	Whee wer Selee	elchai Whee ction,	ir str elchai Lift	uctur ir El : Me	e and ectric chani	d C al sms	Compo Syster s, Ha	nent ns. nd (des Perso Contr	ign, onal ols,		
								Tot	al Le	cture	e hou	rs		4	5			
Text Books												8						
1	Mart	in He	elande	er, A	Guid	e to E	Ergon	omic	s of N	Ianuf	actur	ing,	, TMH	[, 199	96.			
Reference Boo	ks																	
1	E.J. 1976	E.J. McCormick: <i>Human Factors in Engineering and Design</i> , Tata Mcgraw-Hill, 1976.																
05 KARE							Den	artn	ient	of B	iome	dic	al En	gine	erin	Ø		

2	O.P. Astrand& R. Kaare: Textbook of Work Physiology, McGraw Hill, 1970.
3	W.T. Singleton: <i>The Body at Work: Biological Ergonomics</i> , Cambridge University Press, 1982.
4	E.R. Tichauer: The Biomechanical Basis of Ergonomics, Wiley, 1978.
5	R.D. Huchingson: New Horizons for Human Factor Design, McGraw-Hill, 1981.

Anand Nagar, Krishnanko	oil - I	ACA (D Under 626126.	DEN BEC. 3 Srivillip	MY C of UG	DFR DT	SA ESE 10 1956. udhunag	ARC ACCTR ar (D1),	H A UN adited	ND by NA	EDU ER AC wi	A CAT SIT th "A" salingar	rion Y) Grade n.ac.in		vw.ka	lasali	ngam.	ac.in		
Course Code					(Cours	e Nai	me]	L	Т	Р	X	С		
213BME3147			E	MBE	DD	ED SY	YSTI	EM D	ESI	GN			3	0	0		3		
Prerequisite: Nil	1											Syllabus revision: r.3							
Course Category: Program Electives Course Theory										e T	ype:								
Course description																			
1	Г е	Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.														l the ns.			
2	Г	lo acc	uire	know	ledg	e in v	ariou	s proc	cesso	rs em	ploye	ed in o	em	bed	ded	syst	tems		
3	I	mplei	menta	ation	of co	oncurr	ent p	roces	s and	l data	flow	mod	lels						
4	Γ	Desigi	n real	time	emb	eddeo	d syst	ems	using	the c	conce	pts o	f R	ТО	S				
5	A	Apply	the c	conce	pt of	embe	edded	syste	em in	vario	ous m	edic	al a	ıppl	licat	tions	5.		
Course outcome On successful co	es: omp	pletio	n of	the c	ours	e the	stude	ents v	vill b	e abl	e to								
C01	Г е	Descri mbed	be th	ne dif syster	ffere n, al	nces 1 so rec	oetwe ogniz	en th ze the	ne ge clas	neral sifica	com tion c	putir of em	ng : ibeo	syst dde	tem d sy	and sten	l the ns.		
CO2	Г	lo acc	uire	know	ledg	e in v	ariou	s proc	cesso	rs em	ploye	ed in (em	bed	ded	syst	tems		
CO3	I	mplei	menta	ation	of co	oncurr	ent p	roces	s and	l data	flow	mod	lels						
CO4	Γ	Design	n real	time	emb	eddeo	d syst	ems	using	the c	conce	pts o	f R	ТО	S				
CO5	A	Apply	the c	conce	pt of	embe	edded	syste	em in	vario	ous m	edic	al a	ıppl	licat	tions	5.		
СО						I	0								PS	0			
	1	2	3	4	5	6	7	8	9	10	11	12	1		2	3	4		
1	S	S]	Μ					

2	S				S		S	S	S	S				S	S	S		
3	S	S	L	L	Μ		М	М	М	М			М	L				
4	S	S	S	S	М		L	М	М	М			S	S				
5			S	L	М		L	М	М	М								
H-High, M-Me	ediun	n, L-l	Low															
Unit 1	Ι	Introduction To Embedded System Hours: 9											rs: 9					
Introduction, design challenge, processor technology, IC technology, Design technology, Trade-offs, Single purpose processors, RT-level combinational logic, sequential logic (RT-level), custom single purpose processor design (RT-level) and optimization techniques.																		
Unit 2	(General Purpose Processors, State Machine Hou												s: 9				
Basic architecture, operation, Pipelining, Programmer"s view, development environment, Application Specific Instruction-Set Processors (ASIPs) – Micro Controllers and Digital Signal Processors, models Vs. languages, finite state machines with data path model (FSMD), using state machines, program state machine model (PSM),																		
Unit 3	(Conci	ırren	t Pro	ocess	Mod	els					J	Hours: 9					
Concurrent process model, concurrent processes, communication among processes, synchronization among processes, implementation, data flow model, real-time systems.																		
Unit 4		Com	muni	catio	n In	terfac	es]	Hours: 9					
Need for com RS485, USB, I	muni nfrar	cation ed, IE	n inte EEE 1	erface 394]	s, IS Firm	SO/OS wire, 1	SI lay Ether	ver ai met, I	rchite EEE	cture 802.1	RS2	232 / lue to	UA ooth.	RT,	RS4	22 /		
Unit 5	A	Appli	catio	ns]	Hour	s: 9				
Embedded We applications: O Interface, Drug	b Se phtha deliv	rver a almol very s	applic ogy – syster	catior - Glau ns, Pa	ns, E ncom atien	mbed a scre t mon	ded I ening itorin	Datab g dev: ng Sys	ase A ice, N stems	Appli /Iedic s.	cation al Im	ns, E aging	mbeo g Acc	dded Juisit	meo tion	lical User		
	J	Fotal	Lect	ure h	ours	5						2	15					
Text Books	1																	
1	F F	Frank Hardw	Vahi vare/S	d, To Softw	ony] are I	D. Giv ntrodu	vargis	s, "E1 1", Jo	mbed hn W	ded S Viley,	Syster 2002	m De	esign	– A	Un	ified		
2	k 2	K.V.K 2005.	.K. 1	Prasa	d, "]	Embeo	lded	/ Re	al Ti	me S	syster	ns",	Drea	mtec	ch P	ress,		
Reference Boo	oks																	
1	Sri Ram V Iyer– Pankaj Gupta, "Embedded Real Time Systems Programming", Tata McGraw Hill, 2005.																	
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2	Steve Heath, "Embedded System Design", Elsevier, Second Ed., 2004.																	



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Course Cod	ode Course Name L T P X												
213BME314	43	BIOMETRIC SYSTEMS	3	0	0	0	3						
Prerequisite:	Nil		Sy r.3	llab	us i	revision:							
Course Categ	Co Th	ours eory	e Ty	ype:									
Course descri	<u> </u>												
1	Τοι	understand the technologies of fingerprint, iris, face.	face.										
2	To understand the general principles of design of biometric systems and underlying trade-offs.												
3	To : iden	recognize personal privacy and security implications tification technology.	of b	iom	etri	cs b	ased						
4	To i	dentify issues in the realistic evaluation of biometrics b	ased	sys	tem	.s.							
5	Τοι	understand the technologies of speech recognition.											
Course outco On successful	mes: com	pletion of the course the students will be able to											
CO1	Understand the concept of Biometrics and its applications												
CO2	Illus	strate the various methodologies involved in fingerprint	tech	nolo	ogy								
CO3	Dev	elop techniques for face recognition and hand geometry	' bio	met	rics								
CO4	CO4 Demonstrate the multimodal biometrics and the methods for evaluating the performance												

СО						PC)						PSO				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	
1	L	L			L								Н				
2	М												Н				
3		Н															
4		M L M															
5														М			
H – High, M –	Medi	ium, I	L-L	.ow	I												
Unit 1	INT	ROD	DUCI	ΓΙΟΝ	TO	BIO	мет	RICS	5				Hou	rs: 9			
Enrollment – characteristics- and biometrics	temp Auth and p	lates entica olicy	– a ation -Bion	lgorit techr metrio	hm iologi c syst	– vei ies –N æms.	rifica Jeed 1	tion for str	– Bi ong a	omet uther	ric a nticati	pplic on –	cation - Prote	ıs –l ectin	biom g pri	etrie vac <u>y</u>	
Unit 2	FIN	GER	PRI		ECH		.0G	Y · ,					Hou	rs: 9			
Unit 2 Finger print fea fingerprint qua images – finger matching.	FIN ature j ality a rprint	GER proce assess enha	Sing ssing smen ncem	NT T techi t – c nent –	ECH nique compt - Feat	INOL es – fi uter e ture e	nger nger enhan xtrac	Y print s iceme tion –	senso ent aı - fing	rs usi nd 11 erprii	ng Rl 1imu nt clas	F im Ilink ssific	Hour aging 111 cation	rs: 9 g tech of fi n – fi	nniqu nger nger	ies - prin prin	
Unit 2 Finger print fea fingerprint qua images – finger matching. Unit 3	FIN ature p ality a rprint FAC	GER proce assess enha	eprin ssing smen ncem ECO	NT T techi t – c nent – GNI	ECH nique compt - Feat FIO	NOL es – fi uter e cure e	D HA	y print s iceme tion –	senso ent an fing GEO	rs usi nd 11 erprin	ng Rl 1imu nt clas	F im Ilink ssifie	Houn aging 111 cation Houn	rs: 9 g tech of fi n – fi rs: 9	nniqu nger nger	ies - prin prin	
Unit 2 Finger print fea fingerprint qua images – finger matching. Unit 3 Face recognition – Adaptive Cla extraction – typ	FIN ature p ality a rprint FAC on fro assifie	GER proce assess enha CE R m con ers -V	PRII ssing smen ncerr ECO rrespo /isual rithm	NT T t tech: t - c ent - GNI onder - Bas	ECH nique compu- Feat FION nce m sed F	NOL es – fi uter e cure e N AN haps – deature	DGY ngerp enhan xtrac DHA - Han e Ext	Y print s aceme tion – AND d geo tractic	senso ont an offing GEO ometron an	rs usi nd 11 erprin DME T y – so d Pat	ng Rl 1imu nt clas FRY cannin tern (F im Ilink ssific	Hour aging 111 c catior Hour Featu sifica	rs: 9 g tech of fi n – fi rs: 9 ure E tion	nniqu nger nger Cxtrao – fea	es – prin prin	
Unit 2 Finger print fea fingerprint qua images – finger matching. Unit 3 Face recognition – Adaptive Cla extraction – typ Unit 4	FIN ature p ality a rprint FAC on fro assifie bes of MU PEF	GER proce assess enha CE R m con ers -V algon LTIM	PRII ssing smen ncem ECO rrespo risual rithm (IOD RMA	NT T techi t - c nent - GNI' onder - Bas - AL F NCE	ECH nique compu- Feat FION nce m sed F BION EVA	INOL es – fi uter e uter e NAN aps – featur IETF	DHA A Han E Ext	Y print s iceme tion – AND d geo ractic AND	senso ent an - fing GEO ometron an	rs usi nd 11 erprin 9 ME 7 y – so d Pat	ng Rl 1imu nt clas F RY cannin tern (F im Ilink Ssifio Ig – Class	Houn aging 111 c cation Houn Featu sifica Houn	rs: 9 g tech of fin - fin rs: 9 ure E tion rs: 9	nniqu nger nger	prin prin ctior	
Unit 2 Finger print fea fingerprint qua images – finger matching. Unit 3 Face recognitio – Adaptive Cla extraction – typ Unit 4 Behavioral Bio Architecture – multimodal bio	FIN ature p ality a rprint FAC on fro assifie bes of MU PEF ometri level ometri	GER proce assess enha CE R m con ers -V algon LTIN RFOF cs – I of fu c syst	PRII ssing smen ncer ECO rrespo risual rithm ADD RMA	NT T tech: t - c nent - GNI' onder - Bas AL F NCE luctic - cor - Per	ECH nique compu- Feat FION nce m sed F BION EVA on to p nbina form	INOL es – fi uter e uter e N AN eatur featur fETF	DHA Han E Ext Construction Cons	Y print s iceme tion – AND d geo ractic AND N l bior gy –t ation	senso ent ai - fing GEO ometro on an - stat	rs usi nd 11 erprin DMET y – so d Pat c syst ng and istica	ng Rl 1imu nt clas F RY cannin tern (em – d ada 1 Mea	F im llink ssifio ng – Class Inte	Houn aging 111 c catior Houn Featu sifica Houn gratic ility - es of l	rs: 9 g tech of fin - fi rs: 9 ure E tion rs: 9 on stu - exa Biom	aniqu nger nger 2xtrao – fea - fea - fea - ateg ampli	ies - prin prin ctior ature ies - ies of ss.	
Unit 2 Finger print fea fingerprint qua images – finger matching. Unit 3 Face recognition – Adaptive Cla extraction – typ Unit 4 Behavioral Bio Architecture – multimodal bio Unit 5	FIN ature p ality a rprint FAC on fro assifie bes of MU PEF ometri level ometri level bmetri	GER proce assess enha CE R m con ers -V algon LTIN RFOF cs – I of fu c syst	PRII ssing smen ncer ECO rrespo /isual rithm /IOD RMA introc sion tems	NT T tech: t - c nent - GNI' onder - Bas - AL E NCE luctic - cor - Per CAU'	ECH nique compu- Feat FION nce m sed F BION EVA on to m nbina form	INOL es – fi uter e nure e NAN eatur featur IETE ALUA multipance ance	DHA Han E Ext CATIO	Y print s aceme tion – AND d geo ractic AND N l bior gy –t ation ON	senso ent an - fing GEO ometr on an - netric rainin - Stat	rs usi nd 11 erprin ME y – so d Pat c syst ng and istica	ng Rl 1 imu nt clas T RY cannin tern (em – d ada 1 Mea	F im llink ssific ng – Class Inte ptab	Hour aging 111 c catior Hour Featu sifica Hour gratic ility - es of 1 Hour	rs: 9 g tech of fin n - fin rs: 9 ure E tion rs: 9 on stur - exa Biom rs: 9	aniqu nger nger Cxtrac – fea rateg ample netric	ies - ctior ature ies - es o: s.	
Unit 2 Finger print fea fingerprint qua images – finger matching. Unit 3 Face recognitio – Adaptive Cla extraction – typ Unit 4 Behavioral Bio Architecture – multimodal bio Unit 5 Biometric Aut Authentication Machines. Bior Securing and tr	FIN ature p ality a rprint FAC on fro assifie bes of MU PEF ometri level ometri level ometri by F metric usting	GER proce assess enha CE R m con ers -V algon LTIN CS – I of fu c syst MET cation face I c auth g a bi	PRII ssing smen ncerr ECO rrespo visual rithm MOD RMA Introc sion tems FRIC n Sy Recog entic omet	NT T techi t – c nent – GNI Onder - Bas - AL F NCE luctic - cor - Per Stems gnitio ation ric tra	ECH nique compu- Feat TION nce m sed F BION EVA on to r nbina form FHEI s - n by finansac	INOL as – fi uter c ture e NAN aps – reature feature IETF LUA multing ance of NTIC Biom Expendence	DHA ngerpenham xtract DHA Han e Ext RICS TIO moda strate evalu CATI etric ctatio rint - mate	Y print s iceme tion – AND d geo ractic AND I bior gy –t ation ON auth on- M -biom ching	senso ent an - fing GEO ometron an - metric rainin - Stat eentic faxin locat	rs usi nd 11 erprin DME y – so d Pat c syst ng and istica ation nizatio authe tion.	ng Rl 1imu nt clas T RY cannin tern (d ada 1 Mea by on the entica	F im llink ssifid ng – Class Class Inte ptab ssure fing eory tion	Houn aging 111 c catior Houn Featu sifica Houn gratic ility - es of 1 Houn erprin - Su by ha	$\frac{\mathbf{rs: 9}}{\mathbf{rs: 9}}$	aniqu nger nger 2xtrao – fea amplo aetric Biom rt Vo geom	ies - prin prin ctior ature ies - es o: s. etric etry	

Text Books	
1	James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation", Springer, 2005
2	S.Y. Kung, S.H. Lin, M.W.Mak, "Biometric Authentication: A Machine Learning Approach"Prentice Hall, 2005
Reference Boo	oks
1	Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.
2	Nalini K Ratha, Ruud Bolle, "Automatic fingerprint Recognition System", Springer, 2003
3	L C Jain, I Hayashi, S B Lee, U Halici, "Intelligent Biometric Techniques in Fingerprint and Face Recognition" CRC Press, 1999.

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Course Code	Course Name	L	Т	Р	X	С				
213BME3139	ADVANCED MICROCONTROLLERS	3 0 0								
Prerequisite: Mi	isite: Microprocessor and Microcontroller Syll NA									
Course Category	Program Elective	Co Th	ours eory	e Ty	ype:					

Course description

This subject focuses on the study of advanced microcontroller along with the use of microcontroller. It also briefs the students about interfacing of memory and various I/O devices like A to D converter, D to A converter to advanced microcontrollers. The students learn the Programming language (Embedded C) used for microcontrollers. They will be able to use the advanced fast microcontroller in electrical engineering related fields like Power system protection, instrumentation, power electronics.

Course outcomes: On successful completion of the course the students will be able to

CO1	L n	escril	be wo	orking	g of P	IC 18	F Mi	croco	ntrol	ler Ar	chite	cture	and	Prog	ramr	ning
CO2	Ľ	Design interfacing circuits for PIC 18F Microcontroller.														
CO3	R	Review of the advanced features in 8051 Microcontroller.														
CO4	Γ	Design of basic circuits for ARM microcontroller.														
CO5	I	Implement assembly and c-program of ARM microcontrollers														
СО]	PO							P	SO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	М	М		Μ	L	L		L	L	L		L	М			
2	М	Μ		М	L	L		L	L	L		L		Μ		
3	М			М	L	L		L	L	L		L			L	

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4	L	М										L				Μ
5	L	Н	L	М	Μ	L	L					L				Н
H-High, M-	Med	ium,	L-L	.0W												
Unit 1	Р	IC M	licroo	contr	oller							•	Hour	rs: 9		
PIC 18F Software PIC18F addressing modes, Instruction set, Instruction format, Integrated Development Environment (IDE), Assembling, Debugging, and Executing a program using MPLAB IDE in assembly and embedded C. Data copy operation, Arithmetic operation, Branch and Skip operation, Logic operations, bit Operation, Stack and Subroutine, Code conversion programs and Software Design.														rated using anch rsion		
Unit 2	Iı	ntegra	egrated peripherals of PIC Microcontroller Hours: 9													
Integrated peripherals of PIC 18F Microcontroller I/O ports, Timer, capture/compare/PWM (CCP) module, ECCP module. Master Synchronous Serial Port (MSSP) Module, Enhanced Universal Synchronous, Asynchronous Receiver Transmitter (EUSART), Analog-To-Digital Converter (A/D) Module, Comparator module.												WM nced gital				
Unit 3	A	dvan	ced o	conce	pts i	n 805	1 arc	hitec	ture				Hour	rs: 9		
communication MCP3304 / MC study of PCA t output toggle m	Review of 8051 architecture, concept of synchronous serial communication, SPI and I2C communication protocols, study of SPI port on 89LP 51RD2, study of SAR ADC/DAC MCP3304 / MCP 33, interfacing concepts for SPI based ADC/DAC, study of watchdog timer, study of PCA timer in different modes like capture mode, PWM generation mode, High speed output toggle mode Embedded 'C' programming for the above peripherals.												DAC mer, peed			
Unit 4	Iı	ntrod	uctio	on to .	ARN	I CO	RTE	XM	profi	le		•	Hour	rs: 9		
CORTEX M0 Operating Mod handling ,NVIC	and I es, T C (Ne	M4 co humb ested V	ores, -2 In Vecto	Harva struct ored In	ard a ion S nterru	nd V let, M upt C	on N lemoi ontro	euma ry Ma ller), s	nn ar p, Bu systei	chite Is Inte m ticl	ctures erface < time	s, CF e, bit er, D	PU Re bend ebug	egist ing , syste	ers, (inter em	CPU rrupt
Unit 5	A	dvan	ced o	conce	pts i	n Em	bedd	ed 'C	C' pro	ogran	nmin	g	Hour	:s: 9		
Pointers, structu for memory ma Round robin are interrupt archite	ures, pped chited ecture	unior regis cture, e	is, po ters, Roui	ointers enum nd rol	s to s erato oin w	tructu ors, In vith	ires, j terru	pointe pt Ha	ers to ndler	funct sEmb	tions, bedde	addı d sof	ressin tware	ig me e arcl	echai hitec	nism ture:
	Т	'otal l	Lectu	ire ho	ours								45			
Text Books												•				
1	Jo	ohn .E	3.Pea	tman,	"De	sign v	with 1	PIC M	licro	contro	oller"	, Pre	ntice	Hall	, 199	97.
2	A D eo	ndrev Develo dition	v N. oper"s , Moi	.Sloss s Gui rgan l	s, Do de : Kaufi	omini Desig nann	ic Sy gning Publ	mes and shers	and Opti , 200	Chr mizin 4.	is W 1g Sy	/righ stem	t "A Soft	RM	Syster",	stem First

Reference Bo	oks
1	Steve Furber, "ARM System –On –Chip architecture", Addision Wesley, 2000.
2	Valvano, "Embedded Microcomputer Systems", Thomson Asia PVT LTD first reprint 2001. Readings: Web links www.ocw.nit.edu <u>www.arm.com</u>
3	Mazidi M.A., PIC 18F Microcontroller & Embedded systems, Pearson Education Second edition.
4	Ramesh Gaonkar, Fundamentals of Microcontrollers and application in Embedded system (With PIC 18 Microcontroller family) Penram International Publishing.







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Course Code	Course Name	L	Т	Р	X	С
213BME3153	MICROCONTROLLER BASED SYSTEM DESIGN	3	0	0	0	3
Prerequisite: M	icroprocessor and Microcontroller	Syl NA	llab	us r	revis	sion:
Course Categor	y: Program Elective	Co Th	urs eory	e Ty	ype:	

Course description

This subject focuses on the study of

- To introduce the architecture of PIC microcontroller •
- To educate on use of interrupts and timers •
- To educate on the peripheral devices for data communication and transfer •
- To introduce the functional blocks of ARM processor .
- To educate on the basics of Embedded system •

Course outcomes:

On successful completion of the course the students will be able to

CO1	Ur	nderst	and c	once	pts of	F PIC	contr	oller	and H	Progra	ammi	ng th	em.			
CO2	Ur apj	Understand concepts of Interrupt handling and timer circuits in PIC controller applications.														
CO3	Ar ap	Analyse and implement various interfacing circuits necessary for various applications														
CO4	Ur	Understand concepts of ARM Processor.														
CO5	Ur	Understand the basics of embedded system														
CO						F	0							P	SO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	L	М		L	L	L		L	L	L		L	М			
2	L	М		L	L	L		L	L	L		L		М		
3	L			L	L	L		L	L	L		L			L	

				-				-	-		-	-				
4	L	М										L				М
5	L	Н	L	Μ	Μ	L	L					L				Н
H-High, M-	Med	ium,	L – I	Low												
Unit 1	IN	TRC	DU	CTIO	N T() PIC	CMI	CRO	CON	TRO	OLLF		Hour	rs: 09)	
Introduction to Pipelining – P Addressing mo) PIC rogra des –	C Mi m M Simp	icroc lemoi ple O	ontrol ry com perati	ller–F nside ions.	PIC ratio	16C6 1s –	x and Regis	d PI ster F	C16C File S	7x A	Archit ure –	tectur Inst	re–P] ructi	IC16 on S	exx-
Unit 2	IN	TER	RUF	PTS A	ND '	TIM	ER]	Hour	rs: 09)	
PIC micro co subroutine – Ti switches– Disp	ontrol mers lay o	ller -Tim f Con	Interr er Pro Istant	rupts- ogran and V	Ext nming Varia	ernal g– Fr ble st	Inte ont p trings	errupt anel I	s-Inte /O-So	errupt oft K	eys–	ogram State	nming mac	g–Lo hines	op and	time key
Unit 3	PF	ERIP	HER	ALS	ANI) INI	reri	FACE	NG]	Hour	rs: 09)	
I2C Bus for P Analog to Digi LCD and keybo	eriph tal C oard I	erals onver Interf	Chij rter–V acing	p Acc UAR g -AD	cess– Γ-Baι C, D	Bus ad rat AC, a	open te sel- and S	ration ectior ensor	-Bus 1–Dat Inter	subro a har facing	outin Idling g.	es– S g circ	erial uit–I	EEI nitial	PRO izati	M— on –
Unit 4	IN	TRC	DU	CTIO	N T() AR	AM P	ROC	ESSO	OR]	Hour	rs: 09)	
ARM Architect –ARM Assem Operating syste	ure – bly ms.	-ARN Lang	1 pro guage	gramı Pro	mer's ogram	s mod Iming	lel –A g–Sin	ARM I	Deve Exan	lopme nples-	ent to -Arcl	ols- N hitect	Mem ural	ory H Sup	liera port	rchy for
Unit 5	EN	MBE	DDE	D SY	STE	MS]	Hour	rs: 09)	
Introduction to characteristics - system design p	emt -syst	bedde em or ss.	ed sy n chij	stems p-cha	– h lleng	ardw es in	are a embe	nd so edded	oftwar comj	re co puting	mpoi g sys	nents tem d	–typ lesigi	es- (n — e	exam mbeo	nples dded
								Tot	tal Le	ectur	e hou	irs 4	45			
Text Books																
1	Pe Co	atma ontrol	n,J.B lers"	., Pearse	onEd	"De ucati	sign on,3 ^{rc}	¹ Editi	w on, 20	vith 004.		Pl	[C		M	licro
2	Fu Co	rber, mpu	S., " ter Pu	ARM ublica	Systion,	stem 2000	on (Chip	Arch	itectu	re"	Addis	son '	Wesl	ey t	rade
Reference Boo	ks															

Department of Biomedical Engineering

2	Elahi, A., Arjeski, T., ARM Assembly Language with Hardware Experiments, Springer, (2014)
3	Hintenaus P, Engineering Embedded Systems, Springer, (2015)

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Course Code	•	Course Name L T P X													С		
213BME3158	3			ROE	BOTI	CS I	N MI	EDIC	INE			3	8 0	0)	0	3
Prerequisite:	Nil	il Syllab NA												bus	5 r(evis	ion:
Course Categ	ory:	ry: Program Elective Course Type: Theory															
Course descri	ption																
This course pr mathematics to	rovide o desc	vides an introduction to the field of robotics, fundamentals ideas and basic escribe the position and orientations in space.															
Course outco On successful	nes: comp	es: completion of the course the students will be able to															
C01	Und	erstar	nd the	basio	cs of	robot	ic sys	stems									
CO2	Desi	gn ba	sic R	oboti	cs sy	stem	and f	ormu	late F	Kinem	natics						
CO3	Und	erstar	nd and	l able	e to de	esign	a flex	kible	robot	s to p	erfor	m a sj	peci	fic t	as	k.	
CO4	Cons conf	struct igura	Inve tions.	erse H	Kinen	natic	moti	on pl	annii	ng so	lutior	ns for	va	riou	IS	Rot	otic
CO5	Desi	gn Ro	obotic	e syst	ems f	for M	edica	l app	licati	on.							
СО						Р	0]	PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		3	4
1	Н	Н											Н	H			
2	Н	Н	Н										Н	Η			
3	Н	Н											Н	Н			
4	Н	Н	Н										Н	H			
5	Н	Н	Н										Η	H			

H – High, M –	Medium, L – Low	
Unit 1	Introduction to Robotics and Automation	Hours: 9
Introduction A Direct Kinema coordinates Lin	Automation and Robots, Classification, Application, Speci atics Dot and cross products, Coordinate frames, Rotati the coordination arm equation – Five-axis robot, Four-axis rob	fication, Notations ons, Homogeneous bot, Six-axis robot
Unit 2	Kinematics	Hours: 9
Inverse Kinem Four axis, Six examples, wor motion, Straigh	atics – General properties of solutions tool configuration, Fiv axis Robot, Workspace analysis and trajectory planning kspace fixtures, Pick and place operations, Continuous path n nt-line motion.	ve axis robots, Three work envelope and motion, Interpolated
Unit 3	Robot Vision	Hours: 9
Robot Vision Segmentation - numbers, Persp	Image representation, Template matching, Polyhedral object – Thresholding, region 120imulink120, Shrink operators, Sw pective transformation, Structured illumination, Camera calib	cts, Shane analysis vell operators, Euler pration.
Unit 4	Planning	Hours: 9
Task Planning Planning, Gras scenes, Task P	Task level programming, Uncertainty, Configuration, Sp p Planning, Fine-motion planning, Simulation of planar moti- lanner simulation.	pace, Gross motion on, Source and Goa
Unit 5	Robotic Applications in Medicine	Hours: 9
Applications in Engineering, A Surgical – Gyn	Biomedical Engineering – Bio Engineering Biologically Insp Application in Rehabilitation – Interactive Therapy, Bionic aecology, Orthopaedics, Neurosurgery	pired Robots, Neura Arm, Clinical and
	Total Lecture hours	45
Text Books		
1	Schilling, Robert J. Fundamentals of robotics: analysis and Schuster Trade, 1996.	control. Simon &
2	Craig, John J. Introduction to robotics: mechanics and contact Education India, 2009.	rol, 3/E. Pearson
Reference Boo	bks	
1	Groover, Mikell P., Mitchel Weiss, Roger N. Nagel, Nich Ashish Dutta. Industrial robotics: technology, programmin	nolas G. Odrey, and g, and applications
90 KADE	Department of Diamedic	

	McGraw-Hill, 2012.
2	Stadler, Wolfram. Analytical robotics and mechatronics. McGraw-Hill, Inc., 1995.
3	Niku, Saeed B. <i>Introduction to robotics: analysis, systems, applications</i> . Vol. 7. New Jersey: Prentice hall, 2001.
4	Staugaard Jr, Andrew C. <i>Robotics and AI: an introduction to applied machine intelligence</i> . Prentice-Hall, Inc., 1987.



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Course Code	Course Name	L	Т	Р	X	С						
213BME2123	COMPUTERS IN MEDICINE	3	0	0	0	3						
Prerequisite: 1	erequisite: Nil											
Course Catego	gory: Program Elective Course Typ Theory											
Course descri	ption											
1	Describe general functions, purposes and benefits of health	info	rmat	ion	syst	ems.						
2	Describe the evolution and adoption of health information s	syste	ems									
3	Compare health information systems in terms of their a requirements of a health care enterprise.	bility	y to	sup	opor	t the						
4	Propose the hardware, software, operating system and netwo necessary for effective data storage and use in health care of	orkin rgan	ig co izat	onsio ions	dera	tions						
5	Utilize the tools and techniques for collecting, storing, second reporting health care data.	ıring	g, re	triev	ving,	, and						
Course outcor On successful	nes: completion of the course the students will be able to											
CO1	To understand the system of information managed in the ho	ospit	al.									
CO2	To demonstrate the application of software employed in me management.	dica	ıl da	ta								
CO3	To examine medical imaging data with an assist of computers.											
CO4	To understand the concept of maintaining digital patient red	cords	s.									
CO5	To acquire knowledge in delivering instructions in medicin	e usi	ing o	com	pute	ers.						
СО	РО			PS	0							

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Μ				Μ								L			
2	L				Μ								L			
3	L	L			Μ	L	L						L			
4	Μ	L			Μ	Μ						L	L			
5	L	М			М	Μ							L			
H – High, M –	Med	ium,	L-L	ow												
Unit 1	HO	SPIT	AL I	NFO	RMA	TIO	N SY	STE	Μ			ŀ	Hour	s: 9		
Introduction – Information Infra	Introduction –Foundations of Health-care Informatics- Ethics- Electronic Health Records											ords-				
Unit 2	COMPUTERISED PATIENT DATABASE MANAGEMENT Hours: 9															
Data base approach –EHR Functionality including Online Use of an EHRGovernment EHR Certification – Technical Infrastructure -Security - Interoperability & Health Information Exchanges - EHR Deployment & Project Management –Patient Centered EHR										EHR						
Unit 3	CO DE	MPU CISI(TER DN M	ASS IAKI	ISTE NG	CD M	EDIO	CAL	IMA	GIN	G AN	D	Hour	s: 9		
Computer Assi Systems Algor Networks – De	sted ithms cisior	Medi 5 –Ar 1 Ana	cal E nalysi llysis	Decisi s –C in Cl	on M BR-P inical	laking roduo Med	g-Mo ction licine	del o Rule –Clii	f CM Syst nical	ID-Aj tems- Decis	pproa Cogn sion S	ches- itive Suppo	Dec Moc ort.	ision lels-	Sur Sema	port antic
Unit 4	CO	MPU	TER	ISEI	PAT	ΓIEN	T RI	ECOI	RD			ł	Hour	rs: 9		
Computerised I Computer – C Computer Assi Online –Electro	Patier ompu isted onic C	nt Re iterise Patie Comn	cord ed Pr ent E nunic	–Intro escrij ducat ation	oduct otions ion A With	ion-H s For And 1 Patie	listor Patie Healt ents-I	y Tak ents-I h Ca mpor	ting I Introd re In tance	By Co luctio forma Of B	ompu n-Ad ation sehav	ter-D verse –Intr iour N	ialog Dru oduc Modi	gue V Ig R ction ficat	With eacti —He ion.	The ons- ealth
Unit 5	CO ME	MPU DICI	TER NE	ASS	ISTE	D IN	ISTR	UCT	ION	IN		I	Iour	rs: 9		
Computer Assis Computational For Cancer-0 fr	sted I Repr com C	Drug resent Gene 7	Disco ation To Sc	Overy Of N Preen.	And Aolec	Deve cules-	lopm Mode	ent, N elling	Molec GPC	ular I CRS-I	Mode Pharm	lling nacop	By C hore	Comj s-Ne	outer w D	- rugs
								Tot	al Le	ectur	e hou	rs 4	5			
												1				

Text Books	
1	R. D. Lee, Computers in Medicine, Tata McGraw Hill Publishing Company Limited, New Delhi, 1993.
Reference Boo	oks
1	Harold Sackamn, Biomedical Information Technology, Academic Press, New York.
2	S.K.Chachan, PC Organisation, S.K. Kataria and Sons, Delhi 2000.



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Course Code	Course Name	L	Т	Р	X	С			
213BME3159	TELEHEALTH TECHNOLOGIES	3	0	0	0	3			
Prerequisite: Ni	11	Syllabus revision: r.3							
Course Categor	y: Program Elective	Course Type: Theory							

Course description

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This course covers the role of information and communications technologies in enabling remote patient care, health professional collaboration at a distance, and in supporting patient-self management. Also enables the students to evaluate business and technology infrastructure models required for supporting telehealth services.

On successful	mes: comp	oletio	n of 1	the co	ourse	e the	stude	ents v	vill b	e able	e to							
CO1	Kno	Know the essential parameters, scope, benefits and limits of telemedicine.																
CO2	Expl telen	Explain the application of multimedia and needs of communication networks in elemedicine.																
CO3	Desc	cribe	the ne	eds o	of acq	uisiti	on de	vices	in tel	eheal	th mo	onito	ring a	and d	iagn	osis.		
CO4	Und mod	Understand the use and necessity of various security and standards in telehealth modules.																
CO5	App	ly tel	eheal	th in I	healtl	hcare												
СО						PC)							PS	0			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4		
1			М										L					
2	L	L	М										L L					
3	L	L	М										L	L				

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4			М			М										М
5	L	L	Μ										L	L		
H – High, M –	Med	ium,	L-I	Low												
Unit 1	1 Introduction to Telemedicine Hours: 9															
History and Evolution of telemedicine, Functional diagram of telemedicine system, Essentia Parameters for Telemedicine, Delivery Modes in Telemedicine, Benefits and Limitations of Telemedicine.												ential ns of				
Unit 2	Unit 2Multimedia and Communication NetworksHours: 9															
Principles of Multimedia – Text, Audio, Video, data. Types of Communication and networkir – PSTN, POTS, ANT, ISDN, Internet, Wireless Communications Basics, Types of Wirele Networks, Wireless Communication – GSM satellite, and Micro wave, Satellite communicatio Cellular Digital Packet Data (CDPD).											rking eless ttion,					
Unit 3	Data	a Aco	quisi	tion A	And §	Stora	ge Sy	ystem	l				Hou	s: 9		
Acquisition Sy Displays, Holo System, Optica	vstem ograpi d Sys	– Ca nic R tem,	amera Repres Solid	a, Sca sentat State	inners ion, e Disl	s, Dis Virtu ĸ.	play al S	Syst creen	ems - devi	– An ces,	alogı Stora	ie De ige S	evices ysten	, LC 1 –]	D, I Mag	Laser netic
Unit 4	Data	a Sec	urity	and	Stan	dard	S						Hou	rs: 9		
Security in Te Digital certific DICOM, HL7, PSTN). Ethica safety and regu	elemed ate, I H. 3 1 and 1 and	dicino Digita 20 se lega y issu	e sys al Ti eries l asp ies.	tems mesta (Vide ects	– Ao ump. eo ph of tel	ccess Proto one b emed	con cols based licine	trol, 1 : TCI ISB1 e – C	Fire P/IP, N) T. onfid	wall, ISO- 120 entia	Enc: OSI, , H.3 llity,	ryptic Star 24 (V socia	on, A ndards Video Il and	uther to pho lega	ntica follo ne b al is	tion, owed based sues,
Unit 5	Арр	olicat	ions										Hou	rs: 9		
Teleradiology, Health and Cyl	Telep per M	oatho edici	logy, ne.	Tele	cardi	ology	, Tel	eonco	ology	, Tel	ederr	natol	ogy, [Feles	urge	ery, e
								To	tal L	ectur	e ho	urs	45			
Text Books												•				
1	Olga	Ferre	er Roc	a, M.	Sosal	udicis	ssa, "	Hand	book	of Te	leme	dicine	e", IOS	5 pres	ss, 20	002.

3	Norris A C, "Essentials of Telemedicine and Telecare", John Wiley, New York, 2002.
Reference Bo	oks
1	Khandpur R S, "TELEMEDICINE – Technology and Applications", PHI Learning Pvt Ltd., New Delhi, 2017.



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Course Code	Course Name	L	Т	Р	X	С		
213BME3141	BIOMEDICAL INFORMATICS	3	0	0	0	3		
Prerequisite: Ni	1	Syllabus revis						
Course Categor	Course Type: Theory							

Course description

This course will enable you to: Become familiar with the basic definitions, key concepts, terminology, and historical context of Health Informatics Understand fundamental characteristics of data, information, and knowledge in the Health Informatics domain Become familiar with common algorithms for health applications and IT components in representative clinical processes. Develop understanding of population health and precision medicine Understand basic principles of knowledge management systems in biomedicine. Develop understanding of various aspects of Health Information Technology Standards. Become familiar with IT aspects of clinical process 128imulink128 and health information systems

Course outcor On successful	Course outcomes: On successful completion of the course the students will be able to															
CO1	Able	Able to understand the fundamentals of health informatics														
CO2	Able syste	Able to understand the history and national landscape of health information system.														
CO3	Το ι mak	inder ing ir	stand 1 med	the i ical.	medio	cal al	goritl	nms f	for di	fferei	nt apj	plicat	ions	and	deci	sion
CO4	To u	nders	stand	the ap	pplica	tions	of 12	8imu	ılink1	28 an	ıd sim	ulatio	on in	bior	nedi	cine
CO5	To c	learly	und	erstar	nd the	stan	dards	in he	alth i	nforn	natics	•				
СО						P	0							Р	SO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	L			М		М	L			L	М	Η	Μ	L	L	L
2	L	L	М	М		М	L			L	М	Н	L	L	М	L

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3	М	М	М	М	L	М	L		М	М	М	Н	М	Η	М	Μ
4	Н	Н	Η	Η	М	Н	L	L	Μ	М	М	Н	М	Η	Η	М
5	М	М	L	Μ		М	L	L	Μ	М	Μ	Н	М	Μ	М	М
H-High, M-Me	ediun	ı, L-l	Low													
Unit 1 Introduction to Health Informatics & Data, Information, and Knowledge Hours: 09)				
Introduction to health informatics and its significance Definitions and key concepts in health informatics Background disciplines, historical overview, and future challenges. Introduction to knowledge hierarchy: Data, information, and knowledge. The definitions of healthcare data and information Types of healthcare information.																
Unit 2	The Hea	Nati	ional are Ir	Lano form	lscap natio	oe of 1 n Sys	Heal tem	thcar	e IT d	& His	story	of	H	Iour	s: 09)
Ine major influences snaping the health II landscape in the US- The roles played by the major government initiatives and private sectors in advancing health IT in the US- The major events that have influences the adoption of health IT and systems. History and evolution of healthcare information systems (HCIS)- The major advances in information technology and significant federal initiatives that influenced the adoption of healthcare information systems- The major types of administrative and clinical information systems used in healthcare Current issues pertaining to the use HCIS.																
Unit 3	Mee	dical	Algo	rithn	15 &	Med	ical l	Decisi	on M	akin	g		H	Iour	s: 09)
Various ways Introduction to regression Ca specificity. Medical decisio clinical decisio	to de med lculat on-m	scrib ical a tion aking king	e alg Ilgori of r g proc Introe	orithr thms- neasu cess (ductio	ns, s Alg reme diagr on to	uch a orithi ents nosis, evide	ns flo ns in of c treat	wcha comp lassif ment, based	rt, pso outer icatio mon medi	eudoo scien n pe itorin cine.	code, ce, su erforn ng, pr	and ich as nance ogno	conc s dec e—se sis) I	eptu ision nsiti nfor	al gr tree vity matio	aph- and and cs in
Unit 4	Moo Pree	delin	g an n Me	d Sin dicin	nulat e	tions	& P	opula	ation	Hea	lth a	nd	H	Iour	s: 09)
Develop under 129imulink129 Data and infor and strategies f	stand and natio	ing o simu n nee pulat	f 129 lation d of l ion h	imuli in bi health ealth	nk12 omeo syst mana	9 and licine ems i agem	l sim e. n ma ent C	ulatio nagin	n Bec g pop ots of	come oulation preci	famil on he sion i	liar w alth H medio	vith a Key h cine.	pplic ealth	cation n IT 1	ns of cools
Unit 5			Sta	ndar	ds ir	n Hea	lth I	nforn	natics	5			H	Iour	s: 09)
Introduction to standards-The Need for Health Informatics Standards-The role of federal initiative and legislation that have significant impact on the adoption of healthcare information standards in the United States- Major types of healthcare information standards and the																

organization that develop or approve them- the importance of healthcare IT standards to the future of the US health care delivery system.

	Total Lecture hours 45									
Reference Books										
1	Wager, K. A., Lee, F. W., & Glaser, J. P. (2017). Health care information systems: A practical approach for health care management -4 th Edition. Jossey-Bass.									
2	Trotter, F. and Uhlman, D. (2011). Hacking healthcare: A guide to standards, workflows, and meaningful use.									
3	Braunstein, M. L. (2014). Contemporary Health Informatics. American Health Information Management Association									



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Course Code	Course Name	L	Т	Р	X	С
213BME3146	Diagnostic & Therapeutic Instruments-II	2	0	0	0	2
Prerequisite: <mark>Me</mark>	dical Electronics, Medical Physics	Sy NA	llab A	us r	evis	sion:
Course Category	: Program Elective	Co Th	ours eory	e Ty	ype:	

Course description

The course provides a basic knowledge and understanding on the instruments used in dental and eye applications in surgery and diagnosis

Course outcomes: On successful completion of the course the students will be able to

	CO1	T st	To understand the principle, working, usage and applications of ophthalmic urgical instruments														
	CO2	T ii	`o un 1strun	dersta nents	and t	he p	rincip	ole, v	vorki	ng, u	sage	and	appli	icatio	ons o	of d	ental
	СО]	PO							P	50	
ſ		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
	1		Н											Н			
	2		Н											Н			

H-High, M-Medium, L-Low

Unit 1	Ophthalmic surgical instruments Part -1	Hours: 09
Instruments for ca	ataract surgery, refractive surgery, strabismus surgery	

Unit 2Ophthalmic surgical instruments Part - 2Hours: 09

Instruments for corneal surgeries and eye banking, oculoplastic surgeries, glaucoma surgeries, sterilization of surgical instruments

	Ι	
Unit 3	Dental Instruments part 1	Hours: 09
Exam and basic h instruments, resto	and instruments, diagnostic and treatment planning instrumentive instruments	ments, hand cutting
Unit 4	Dental Instruments part 2	Hours: 09
Dental handpiece instruments	s, dental burs and rotatory instruments, impression and lab	ooratory-based
Unit 5	Dental Instruments part 3	Hours: 09
Oral and maxillof radiological instru	facial surgery instruments, orthodontic and endodontic instruments and infection control	truments,
	Total Lecture hours	45
Textbooks		
1	Titiyal, J. S., Sinha, R., Sharma, V. K. (2017). Ophthalm Instruments. India: Jaypee Brothers, Medical Publishers	ic Surgical Pvt. Limited.
2	Boyd, L. B. (2020). Dental Instruments – E-Book: A Po States: Elsevier Health Sciences.	ocket Guide. United
Reference Books	3	
1	Scheller– Sheridan, C. (2013). Basic Guide to Dental Ins Wiley.	truments. Germany:
2	Boyd, L. B. (2020). Dental Instruments: A Pocket Gu Elsevier – Health Sciences Division.	uide. United States:
3	Ophthalmic Instruments and Surgical Tools. (2019). Singapore.	. Germany: Springer







nd Nagar, Krishnankoll - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu | info@kalasalingam.ac.in | www.kalasalingam.ac.in

Course Code	Course Name	L	Т	Р	X	С	
213BME3140	BIOFLUIDS AND DYNAMICS	3	0	0	0	3	
Prerequisite: <mark>B</mark>	ME18R351-Biomechanics	Syllabus revision r.2					
Course Categor	y: Program Elective	Co Th	ours eory	e Ty	ype:		

Course description

This course elaborates on the application of fluid mechanics principles to major human organ systems. The course is an introduction to physiologically relevant fluid flow phenomena, underlying physical mechanisms from an engineering perspective and integration of various fluid mechanics concepts to address relevant problems of the human body's systems.

Course outcor On successful	Course outcomes: On successful completion of the course the students will be able to															
CO1	To understand the basic fluid mechanisms, models and testing methods															
CO2	To understand fluid flow and the properties of blood and vessel walls.															
CO3	То с	To classify the fluids according to its characteristics.														
CO4	To s	To study the biofluid dynamic concepts and its models														
CO5	To u flow	se thi prop	s kno erties	wledg	ge in	study	ing th	e bio	fluid	mech	anics	ofor	gan s	syste	m's	fluid
СО						PC)							PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	М	М	М	М		М	L				L	Н	Μ	L	L	Μ
2	Н	М	Η	М	L	Η	L	М	L	М	L	Η	Η	М	М	М

3	Μ	Μ	Μ	Μ		Η	L				L	Н	M	Μ	Μ	Μ
4	Н	Μ	Н	Μ	Μ	Η	L	Μ	L	Μ	L	Н	Н	М	М	Μ
5	М	Μ	Н	Μ	Μ	Н	L	М	L	Μ	L	Н	Μ	М	М	Μ
H-High, M-M	edium	n, L-L	low													
Unit 1	INT	ROE	DUCI	TION	[]	Hour	's: 09)	
Stress, strain, Viscoelasticity Harmonic Exc rheometer, A i in vitro	Strain / – m itatior noncor	rate, axwe n, Me ntact i	Nonvell, V thods metho	visco oigt of te od for	us Flu and esting three	uid, N kelvi - Ost e-dim	lewton mo twald ensio	onian odel, visco onal a	Visco Resp omete nalys	ous F onse er, Co is of v	luid, of a ouette vascu	Hool Vise visc lar el	kean coela omet astic	Elas stic er, co ityin	tic S Bod one-j vivc	olic y t plat an
Unit 2	PRO)PEF	RTIE	S OF	BLO	OOD	AND) VES	SSEL	WA	LL]	Hour	s: 09)	
on Viscometr Viscosity and Red Cells in T on Cell Stress	ic Dat Relati ightly	a an ve V Fittir	dCass iscos ng Tu	son's ity, F bes, I	Equa Fahrae Hema	ation, eus-L tocrit	Lan indqy in V	ninar vist E ery N	Flow ffect arrov	of 1 and i v Tub	Blood Its in Ses, E	l in verse ffect	a Tu effe of Tu	be, ct, N urbul	Appa Iotic lent I	arer on c Flov
Unit 3 Fluids - Pro	BIO	VIS n. N	C OE I	LSTI	C FI	LUID	S AN	D SC)LID Traci	S t. Sa	liva] Cer	Hour vical	rs: 09 Mu		an
Unit 3 Fluids - Pro Semen,Synovi Solids –Collag Uniaxial Load Elasticity, Bia	BIO toplass al flui gen, T ling, xial Lo	n, M ds herm Quasi padin	C OE Iucus odyna i-Line g Exp	LSTI from amics ear V perim	The function of the formation of the for	LUID e Re Elastic elastic on So	S AN espira c Def city (ft Tis	tory formation f	DLID Trac tion, ft Ti Strai	S t, Sa Beha ssues n-En	liva, viour , Th ergy	Cer of S e Co Func	Hour vical oft T oncep tion	r s: 0 9 Mu Tissu t of) Icus es U Pse	an Inde udo
Unit 3 Fluids - Pro Semen,Synovi Solids –Collag Uniaxial Load Elasticity, Bia Unit 4	BIO toplasi al flui gen, T ding, xial Lo BIO	n, M ds herm Quasi Dadin	COE Iucus odyna i-Lind g Exp	LSTI from amics ear V perim	C FI m th s of E discose ents of MIC	LUID e Re Elastic elastic on So C CO	S AN espira c Def city o ft Tis NCE	tory formation f	DLID Trac tion, oft Ti Strai	S t, Sa Beha ssues n-En	liva, viour , Th ergy	Cer of S e Co Func	Hour vical oft T oncep tion Hour	Tissu Tissu t of) Icus es U Pse	ane Inde udo
Unit 3 Fluids - Pro Semen,Synovi Solids –Collag Uniaxial Load Elasticity, Bia Unit 4 Biofluid-comp and Microvaso	BIO toplast al flui gen, T ding, xial Lo BIO partme cular E	Market Ma	COE Iucus odyna i-Line g Exp ID D odels, Cardi	LSTI from amics ear V perim VNA Tissu	C FI n th s of E viscos ents o MIC ue He cular	LUID e Re Elastic con So CO eat and syste	S AN espira c Def city (ft Tis NCE d Mas m	tory formatof So ssues, PTS ss Tra	DLID Trac tion, oft Ti Strai	S t, Sa Beha ssues n-Ent	liva, viour , Th ergy t Lub	Cer f of S e Co Func l pricat	Hour vical Soft T oncep tion Hour	rs: 09 Mu Tissu t of rs: 09) es U Pse) Frans	an Inde udo
Unit 3 Fluids - Pro Semen,Synovi Solids –Collag Uniaxial Load Elasticity, Bia Unit 4 Biofluid-comp and Microvaso Unit 5	BIO toplasi al flui gen, T ding, xial Lo BIO partme cular E BIO	oVIS m, M ds herm Quasi Dadin OFLU ant Mo Beds, O FLU	COE fucus odyna i-Lina g Exp f ID D odels, Cardi	LSTI from amics ear V perim YNA Tissu tovase IECH	C FI n th s of E discose ents of MIC ue He cular HAN	LUID e Re Elastic con So C CO cat and syste	S AN espira c Def city o ft Tis NCE d Mas m DF O	tory formatof So ssues, PTS ss Tra RGA	DLID Trac tion, oft Ti Strai	S t, Sa Beha ssues n-En , Join	liva, viour , Th ergy t Lub MS	Cer of S e Co Funct 1 pricati	Hour vical oft T oncep tion Hour ion, C	s: 09 Mu Tissu t of s: 09 Cell 7 s: 09) es U Pse) Frans	an Inde udo
Unit 3 Fluids - Pro Semen,Synovi Solids –Collag Uniaxial Load Elasticity, Bia Unit 4 Biofluid-comp and Microvaso Unit 5 THE LUNGS in an Artificia	BIO toplasi al flui gen, T ding, xial Lo bartme cular E BIO - Resp Kidne	vIS m, M ds herm Quasi badin FLU ort Mo Seds, FLU pirato	COE fucus odyna i-Lind g Exp (ID D odels, Cardi (ID N odels, '	LSTI from amics ear V perim YNA Tissu ovase iecr iecr fract C THE	C FI n th s of E discose ents of MIC ue He cular HAN Beomo	LUID e Re Elastic con So C CO eat and syste ICS C etry. ' ER - F	S AN espira c Def city o ft Tis NCE d Mas m DF O THE Fluid	tory formation formation formation formation sources formation for	DLID Trac tion, oft Ti Strai	sues n-En Join STE S - Fl Mass	liva, viour , Th ergy t Lub t Lub MS uid F Trans	Cer f of S e Co Funct 1 oricati 1 low a sfer in	Hour vical oft T oncep tion Hour ion, C Hour and N n a L	rs: 09 Mu Tissu t of rs: 09 Cell 7 rs: 09 Mass iver) Icus es U Pse) Frans) Tran Mod	an inde udo spor
Unit 3 Fluids - Pro Semen,Synovi Solids –Collag Uniaxial Load Elasticity, Bia Unit 4 Biofluid-comp and Microvaso Unit 5 THE LUNGS in an Artificia	BIO toplasi al flui gen, T ding, xial Lo BIO partme cular E BIO - Resp Kidne	n, M ds herm Quasi Dadin FLU nt Mo Beds, D FLU Dirato	COE fucus odyna i-Line g Exp (ID D odels, Cardi odels, ry Tr odel.	LSTI from amics ear V perim YNA Tissu ovase IECH ract C THE	C FI n th s of E /iscore ents o MIC ue He cular HANI Geomo	LUID e Re Elastic con So C CO eat and syste ICS C etry. ' ER - F	S AN espira c Def city o ft Tis NCE d Mas m DF O THE Fluid	tory formation f	DLID Trac tion, oft Ti Strai strai nsfer NSY and N SY	S t, Sa Beha ssues n-En , Join 7 STE S - Fl Mass ecture	liva, viour , Th ergy t Lub MS uid F Trans	Cer of S e Co Funct pricat	Hour vical oncep tion Hour ion, (Hour and M n a L	rs: 09 Mu Tissu t of rs: 09 Cell 7 S: 09 Mass iver 4) es U Pse) Trans) Trans Mod	an Inde udc spor
Unit 3 Fluids - Pro Semen,Synovi Solids –Collag Uniaxial Load Elasticity, Bia Unit 4 Biofluid-comp and Microvasc Unit 5 THE LUNGS in an Artificia Text Books	BIO toplasi al flui gen, T ding, xial Lo BIO bartme cular E BIO - Resp Kidne	n, M ds herm Quasi Dadin FLU nt Mo Beds, FLU pirato by Mo	COE fucus odyna i-Lind g Exp (ID D odels, Cardi odels, TID N odel.	LSTI amics ear V perim YNA Tissu iovase IECH ract C THE	C FI n th s of E /iscose ents o .MIC ue He cular HANI Geomo	LUID e Re Elastic con So C CO eat and syste ICS (etry. ' ER - F	S AN espira 2 Def 2 Def	tory formation f	DLID Trac tion, oft Ti Strai	sues n-En , Join S - Fl Mass	liva, viour , Th ergy t Lub MS uid F Trans e hou	I Cer of S e Co Funct I orication I Iow a sfer in Irs	Hour vical oncep tion Hour ion, (Hour and N n a L	rs: 09 Mu Tissu t of rs: 09 Cell 7 Vass iver 4) es U Pse) Trans) Trans Mod	an Inde udc spor
Unit 3 Fluids - Pro Semen,Synovi Solids –Collag Uniaxial Load Elasticity, Bia Unit 4 Biofluid-comp and Microvasc Unit 5 THE LUNGS in an Artificia Text Books	BIO toplasm al flui gen, T ding, xial Lo BIO bartme cular E BIO - Resp Kidne	NISO n, M ds herm Quasi- padin FLU or FLU pirato pru pirato y Mo	COE fucus odyna i-Lina g Exp (ID D odels, Cardi odels, Cardi odels, Cardi odels, Cardi odels, Cardi	LSTI amics ear V perim YNA Tissu ovase iovase iovase iecr THE	C FI n th s of E l'iscoe ents o MIC ue He cular HANI Geome LIVE	LUID e Re Elastic con So C CO eat and syste ICS (etry. ' ER - F	S AN espira c Def city o ft Tis NCE d Mas m DF O THE Fluid Mech 3 (Un	tory formation f	DLID Trac tion, oft Ti Strai strai nsfer NEYS and N SY and N SY and N SY and N	s t, Sa Beha ssues n-En , Join S - Fl Mass cture	liva, viour , Th ergy t Lub MS uid F Trans e hou es o	I Cer of S e Co Funct I oricatt I	Hour vical oncep tion Hour ion, (Hour and M n a L	rs: 09 Mu Tissu t of rs: 09 Cell 7 S: 09 Mass iver 4 tissu) es U Pse) Frans) Tran Mod 5	an inde udc spo spo nsfe lel
Unit 3 Fluids - Pro Semen,Synovi Solids –Collag Uniaxial Load Elasticity, Bia Unit 4 Biofluid-comp and Microvasc Unit 5 THE LUNGS in an Artificia Text Books 1 Reference Bo	BIO toplasi al flui gen, T ding, T xial Lo bartme cular E BIO - Resp Kidne	vVISO n, M ds herm Quasi Dadin FLU or Mo FLU pirato by Mo	COE fucus odyna i-Lind g Exp (ID D odels, Cardi odels, Cardi odels, Cardi odels, Cardi odels, Cardi	LSTI amics ear V perim VNA Tissu ovase ievase ievase ract C THE	C FI n th s of E l'iscoe ents o MIC ue He cular HAN Geomo LIVE	LUID e Re Elastic con So CO eat and syste ICS (etry. ' ER - F	S AN espira c Def city o ft Tis NCE d Mas m DF O THE Fluid Mech 3 (Un	tory formatof So ssues, PTS ss Tra RGA KIDN Flow Tot	DLID Trac tion, oft Ti Strai strai nsfer NEYS and N cal Le	sues n-En , Join S - Fl Vass ecture	liva, viour , Th ergy t Lub MS uid F Trans e hou es o	I Cer of S e Co Function I orication I orication I Iow assertion Iow assertion	Hour vical oncep tion Hour ion, (Hour and N n a L	rs: 09 Mu Tissu t of rs: 09 Cell 7 rs: 09 Mass iver 49 tissu) Icus es U Pse) Trans) Trans Mod 5	an inde udc spor

Department of Biomedical Engineering

1	Clement Kleinstreuer–"Biofluid DynamicsPrinciples and Selected Applications" (2006, CRC Press) (unit 4 and 5)
2	K.L.Kumar, "Engineering fluid mechanics", Eurasia Publishing House (P) Ltd., New Delhi, 1998.
3	D.H.Bergel, "Cardiovascular fluid dynamics"- Vol. I, Academic press, London & New York, 1972.
4	David A. Rubenstein, Weiyin, Mary D. Frame, "Biofluid Mechanics- An Introduction to fluid
5	Mechanics, Macrocirculation and Microcirculation", Springer, 2013.



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Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

Course Code	Course Name	L	Т	Р	X	С	
213BME3140	MECHANICS OF BIOLOGICAL SYSTEMS	3	0	0	0	3	
Prerequisite: Ni	1	Syllabus revisi r.3					
Course Categor	y: Program Elective	Co Th	ours eory	e Ty	ype:		

Course description

This course describes the basic concepts of human skeletal muscle mechanics. It also helps to examine the mechanics behind human motion and performance, including projectile motion, in sport and exercise.

Course outcor On successful	ourse outcomes: n successful completion of the course the students will be able to															
CO1	Illus	llustrate the basics of soft tissue mechanics														
CO2	Ana	Analyze the mechanics of head and neck after having an injury														
CO3	Dist	istinguish the mechanics of different joints of the body														
CO4	Inter	pret t	he ga	it ana	alysis											
CO5	Disc	uss tł	ne fur	oction	s of c	organ	s duri	ng sp	orts a	and ex	xercis	se				
СО						PC								PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Μ	L				М	L	L			М	Н	М	М	L	М
2	Μ	Н	М	М	М	Н	L	L	М	М	L	Н	М	М	L	М
3	М	М	L	L		Н			L		L	Н	М	М	L	М

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	1			1	1	1	1			1	1	1	1	1	T	—
4	Н	Н	Н	Η	Н	Н	L	L	М	М	М	Н	Н	Н	М	Μ
5	Н	Н	Н	Н	Η	Н	L	L	Μ	М	М	Н	Н	Η	М	N
H-High, M-M	edium	ı, L-L	low													
Unit 1	MO TIS	DEL SUE	LINO BIO	G BIO MEC	OLO CHAN	GIAI NICS	L SYS	STEN	Л & S	SOFI			Hour	rs: 09	9	
Introductions Fundamentals Contraction Ve Tendon Biome	to M of Sof elocity chani	olecu It Tiss 7, Mu cs.	lar E sue M scle l	Dynar Iecha Force	nics, nics: -Len	Mor Muso gth R	te C cle Ai elatio	arlo chite nship	and cture o, Mu	Lang , Max scle]	evin Mus Force	dyna cle S -Vel	amics Stress ocity	sin , Ma Rela	nulati x Mu ations	ion isc] shij
Unit 2	ME	СНА	NIC	S OF	HEA	AD A	ND N	ECF	K				Hour	rs: 09	9	
Injury Mechan Abdominal Im Case studies or	isms, pact, []] n the i	Mecl Biom njury	hanic echar mecl	al Re nical i hanis	spon: Respo m of	se, Re onses chest	egion Duri and a	al To ng In abdor	leran pact, ninal	ce, B Inju impa	iomeo ry Ris act.	chani sk As	ics of ssessr	[°] Che nent	est ar	ıd
Unit 3	BIOMECHANICS OF DIFFERENT JOINTS OF HUMAN BODY Hours: 09															
Geometry of A Shoulder, Elb Hydrodynamic	Articu oow, : Lubr	lating Wris icatic	g Surf t, Ha on The	faces, and), eorie:	Join Tril s, Bo	t Cor oolog undar	ntact, y (F y Lul	Axes rictio pricat	of F n, V ion, S	Rotati Vear Synov	on of and vial Jo	(An Sur Dints.	kle, 1 face	Knee Dar	e, Hij mage	р, ;),
Unit 4	GA	IT Al	NAL	YSIS									Hour	rs: 09	9	
Clinical Gait A Systems (Stri Measurement, Information.	de an Dyn	is Inf nd T amic	forma fempo Eleo	tion, oral ctrom	Data Paran iyogr	Colleneters aphy)	ection s, M Cas	Prototion	ocol, Me udies	Mea asure on	suren ment Clin	nent , , Gr	Appro ound Gait	Dach Re Ar	es ar eactic nalys	ıd on is
Unit 5	PHY	YSIO	LOG	GY IN	I SPO	ORTS	S AN	D EX	ERC	CISE			Hour	rs: 09	9	
Muscle Energ Responses, Op physiological 1	etic, (timiza respon	Cardi ation use of	ovaso Tech the s	cular nique ports	Adju es, Tł perso	istme nerma on	nts,] ll Res	Maxii ponse	mum e, Ap	Oxy plica	gen tions.	Upta Cas	ke, F e stud	Respi dies	iraton on th	y ie
								Tot	al Le	ectur	e hou	irs		4	5	
Text Books																
1	J. D.	Bron	zino,	"Bio	medi	cal E	ngine	ering	Hano	lbook	s", 3 rd	ed,C	RC P	ress,	, 200	6.
97 KADF							Der	ont	10	of D	ioma	dies				

2	Nordine-Frankel, "Basic Biomechanics of the Musculoskeletal System", Lea &Febiger, 2012.
3	Arthur T. Johnson, "Biomechanics and Exercise Physiology", 2 nd edition, John Wiley and Sons, 2007.
Reference Boo	oks
1	Duane Knudson, "Fundamentals of Biomechanics", Springer, 2 nd Edition, 2007.
2	Donald R.Peterson, Joseph D.Brozino, "Biomechanics –Principles and Applications", 2 nd Edition, CRC press, 2007.
3	Ross Ethier, Craig A.Simmons, "Introductory Biomechanics-from cells to organisms", 1 st edition, Cambridge University Press, 2007.
4	Cees Oomens, Marcel Brekelmens, Frank Baaijens, "Biomechanics: Concepts and Computation", 1 st edition, Cambridge University Press, 2010







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Course Code	Course Name	L	Т	Р	X	С		
213BME3149	FINITE ELEMENT ANALYSIS	3	0	0	0	3		
Prerequisite: <mark>M</mark>	athematics, Engineering Mechanics	Syllabus revision NA						
Course Categor	Co Th	ours eory	e Ty	ype:				

Course description

This course focuses on the fundamentals concepts and formulation of the finite element methods for solving differential equations arising in solid and fluid mechanics.

Course outcomes: On successful completion of the course the students will be able to

CO1	Perc (FEA	Perceive and implement various steps involved in the Finite element Analysis FEA)														
CO2	Anal plan	nalyze 1D, 2D and 3D members using corresponding Finite elements (bar, ane and brick).														
CO3	Appl appli	ly FI icatio	EM t ns	ools	to th	ne ar	eas c	of str	uctur	al, th	erma	l and	d flu	id d	lynai	mics
CO4	Anal	lyze S	Struct	ural c	lynan	nics a	nd co	orresp	ondi	ng ma	them	atical	fun	ction	S	
CO5	Scru	tinize	the I	Finite	elem	ient a	nalys	is for	• bion	nedica	ıl eng	ineer	ing a	appli	catio	ns
CO						P	0							P	<mark>SO</mark>	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Н	Н											Н			
2	Н	Н											Н			
3	Н	Н			М								Н			

_																											
4	Н	Н											Н														
5			Μ		М									М													
H – High, M –	Med	ium,	L-L	ow																							
Unit 1		Basi	ic Co	ncept	ts of	the F	inite	Elem	ent I	Meth	od]	Hour	s: 07	7												
Introduction, F Relations, Spr Potential energ Galerkin's met	Introduction, FEM Working, General Procedure, Strain – Displacement Relations, Stress – strain Relations, Spring, Bar and truss as FE, Strain energy, 140imulink140140o's First theorem, Potential energy and equilibrium; the 140imulink-ritz method. Method of weighted residuals – Galerkin's method.																										
Unit 2				One]	Dime	ensio	nal P	roble	ms]	Hour	rs: 1()												
Finite Element Modelling, One dimensional Elements, Triangular elements, Rectangular Elements, Coordinates and shape function, The Potential energy approach, Treatment of boundary conditions, Quadratic shape Function, Gaussian Quadrature, Problems.																											
Unit 3		Applications in Heat Transfer, Fluid and solid MechanicsHours: 10																									
Steady State H Governing eq Incompressible plane quadrila problems.	leat T uation visco teral	Fransf ns fo ous fl elem	fer (1) r inc ow, I ent,	D and compr Plane Axisy	d 2D ressib stres ymme	Hea le f s and etric	t Con low, l strait stress	ducti Velo n ana ana	on, 1 city lysis lysis,	D ar poter Isop Stro	nd 2D ntial param ess an	heat funct etric nd st	t tran ion form rain	isfer in 2 ulati com	in F D f on o puta	Steady State Heat Transfer (1D and 2D Heat Conduction, 1D and 2D heat transfer in Fins), Governing equations for incompressible flow, Velocity potential function in 2D flow, Incompressible viscous flow, Plane stress and strain analysis, Isoparametric formulation of the plane quadrilateral element, Axisymmetric stress analysis, Stress and strain computation, problems											
Unit 4	nit 4 Structural Dynamics and Dynamic Considerations Hours: 10																										
The simple harmonic oscillator, Multiple degree of freedom system, Bar and beam elements. Mass matrix for a general element, Evaluation of Eigenvalues and Eigenvectors, Interfacing with											tions	;]]	Hour	rs: 1()												
The simple ha Mass matrix fo previous finite	rmoni r a gen eleme	tructo c osc neral ent pr	ural l villato elemo ograr	Dyna r, Mu ent, E ns and	mics ultiple valua d a p	and e deg ation rogra	Dyna gree o of Eig um for	mic (f free genva	C ons edom lues rmini	syste and E ng ci	em, E Eigenv	ar ar vector speed	Hour nd be rs, In ds of	es: 10 am e terfa shaf) elem cing ts.	ents, with											
The simple hat Mass matrix fo previous finite Unit 5	rmoni r a ger eleme	tructo c osc neral ent pr	illato eleme ograr Bion	Dyna r, Mu ent, E ns an nedic	mics ultiple valua d a p al Er	and e deg ation rogra	Dyna gree o of Eig um for eering	mic (f free genva deter App	Cons edom lues rmini licat	syste and E ng cr	em, E Eigenv itical	ar ar ar ar ar ar speed	Hour nd be rs, Int ds of Hour	rs: 10 am e terfa shaf rs: 08) elem cing ts.	ents, with											
The simple ha Mass matrix fo previous finite Unit 5 Building Bone of the abdomin	rmoni r a ger elema mode al aor	tructo le osc neral ent pr el fror rtic ar	illato eleme ograr Bion n CT neury:	Dynai r, Mu ent, E ns and nedic: Data, sm wa	mics ultiple valua d a pr al Er , FEN all.	and e deg ation rogra ngine	Dyna gree o of Eig im for eering	mic (f free genva deter App Fem	Cons edom lues rmini licat	systand E ng cr ion th an	em, E Eigenv itical	ar ar vector speed	Hour nd be rs, In ds of Hour Aater	s: 10 am e terfae shaf shaf	elements.	ents, with FEA											
The simple ha Mass matrix fo previous finite Unit 5 Building Bone of the abdomin	rmoni r a ger eleme mode al aor	c osc neral ent pr el fror rtic ar	illato elemo ograr Bion n CT neury:	Dynai r, Mu ent, E ns and nedica Data, sm wa	mics ultiple valua d a pr al Er al Er al En	and e deg ation rogra ngine	Dyna gree o of Eig um for eering del of	mic (f free genva deter App Fem	Cons edom lues rmini licat ur wi	syste and E ng cr ion th an	em, B Eigenv itical isotro e hou	ar ar vector speed 1 opic N	Hour ad be rs, Int ds of Hour Aater 45	s: 10 am o terfao shaf	elements.	ents, with FEA											
The simple ha Mass matrix fo previous finite Unit 5 Building Bone of the abdomin	rmoni r a ger elema mode al aor	el fror	illato elemo ograr Bion n CT neury	Dynai r, Mu ent, E ns and nedic: Data, sm wa	mics altiple valua d a pr al Er al Er all.	and e deg ation rogra ngine	Dyna gree o of Eig im for eering del of	mic (f free genva deter App Fem Tot	Cons edom lues rmini licat ur wi	syste and E ng cr ion th an	em, E ligenv itical isotro e hou	ar ar vector speed	Hour nd be rs, Int ds of Hour Aater 45	am e terfa shaf	elements.	ents, with											
The simple ha Mass matrix fo previous finite Unit 5 Building Bone of the abdomin Text Books	rmoni r a ger elema mode al aor	c osc neral ent pr el fror rtic ar	illato elemo ograr Bion n CT neury:	Dynai r, Mu ent, E ns and nedica Data, sm wa	ndan	and e deg ation rogra ngine I Mo	Dyna gree o of Eig im for eering del of	mic (f free genva deter App Fem Tot	Cons edom lues rmini licat ur wi	syste and E ng cr ion th an ectur	em, B Eigenv itical isotro e hou	ar ar vector speed ppic N urs 4	Hour ad be rs, Int ds of Hour Aater 45	s: 10 am o terfao shaf s: 08 ials, w-hi	elements.	ents, with FEA											

Reference Books										
1	Yang, Z. C. Finite element analysis for biomedical engineering applications. CRC Press, 2019.									
2	Cook, Robert D. Concepts and applications of finite element analysis. John wiley& sons, 2007.									
3	Liu, Gui-Rong, and Siu Sin Quek. The finite element method: a practical course. Butterworth-Heinemann, 2013.									
4	Rao, Singiresu S. The finite element method in engineering. Butterworth- heinemann, 2017.									



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Course Code	Course Name	L	Т	Р	X	С		
213BME3150	HUMAN ASSIST DEVICES	3	0	0	0	3		
Prerequisite: Ni	1	Syllabus revision: r.3						
Course Categor	y: Program Elective	Co Th	ours eory	e Ty	ype:			

Course description

This course offers basic understanding on principle, design and application of various human assist devices which include extracorporeal devices, cardiac assist devices, respiratory devices and hearing aids. This course also comprises the design aspects of prosthetic and orthotic devices for the disability.

Course outcomes: On successful completion of the course the students will be able to																
CO1	Illus its w	ustrate the various building blocks of Heart lung Machine, artificial heart and working principle.														
CO2	Unde devie	nderstand and describe the principle and working of various cardiac assist evices.														
CO3	Und	erstar	nd the	e role	and v	vorki	ng of	artifi	cial k	kidney	y and	visua	ıl auş	gmer	ntatio	on
CO4	Abil	ity to	spec	ify th	e typ	e of a	ssisti	ve de	vices	for r	ehabi	litatio	on.			
CO5	Cate	goriz	e the	diffe	rent t	ypes	of res	pirato	ory as	ssist d	levice	es and	l hea	ring	aids.	
СО						PC)							PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Μ														М	
2	Μ			М											М	

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3	М			L											Μ	
4	М			Η											Μ	
5	М			Η											Μ	
H – High, M –	Medi	ium, I	L-La)W												
Unit 1	HEA HEA	ART ART	LUN	G M.	ACH	INE	ANI) AR'	FIFI	CIAI	L]	Hour	rs: 09)	
Condition to be and Continuous Driving Mecha Mock test setup	e satis s Type nism, p for a	fied b es, M Bloo assess	by the lonitor od Han sing its	H/L ing l dling s Fur	Syst Proce g Sys nction	em. I ess, S tem, []] ns	Differ hunti Funct	ent ty ng, T ionin	pes c he In g and	of Ox dicati l diffe	ygena ion fo erent t	itors, r Car ypes	Pum diac ' of Ar	ps, P Trans rtifici	ulsa splai al H	tile nt, ear
Unit 2	CAI	RDIA	AC AS	SIS	ГDE	EVIC	ES]	Hour	s: 09)	
Synchronous Counter pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, Intra-Aortic Balloon Pumping, Veno Arterial Pumping, Prosthetic Cardio Valves, Principle and problem, Biomaterials for implantable purposes, its characteristics and testing.Case study.																
Unit 3ARTIFICIAL KIDNEY, SENSORY AUGMENTATION AND ITS SUBSTITUTIONSHours: 09																
Indication and heamodialysers and analysis. C	d Prin s, Mor ase st	nciple nitori udy	e of ing Sy	Hae stem	emod 1s, W	ialysi 'earał	s, N ole A	Iemb rtifici	rane, al Ki	Dia dney	lysate , Imp	e, D lantii	iffere ng Ty	ent t pe-N	ypes ⁄Iode	s c elin
Classification Augmentation, auditory substit	of Vi Tact tution	isual tile v , Ass	Impai vision istive	irme subs devi	nts, stituti ces fo	Preve ion, or the	entior audit visu	n and ory s al imp	curo ubsti paireo	e of tution 1	visua n and	l im aug	pairn gment	nents tation	, Vi n, ta	isua ctil
Unit 4	PRO)STH	IETIO	CAN	ND O	RTH	ΙΟΤΙ	C DE	EVIC	ES]	Hour	s: 09)	
Hand and Arm Lower Limb ar Devices, Mater	Repland Up	acem per li or Pro	ent – I mb or ostheti	Diffe thoti c and	rent ' c dev d orth	Type vices, notic	s of N Func devic	Iodel tiona es, H	s Ext l Elec aptic	ernal ctrica Devi	ly Pov l Stim ices	were	d Lin on, S	nb Pre ensor	osth ry A	esi: ssi:
Unit 5	RES	SPIR	АТОБ	RY A	ND	HEA	RIN	G AI	DS]	Hour	rs:09		
Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, Construction and Functional Characteristics																
								Tot	tal Lo	ectur	e hou	rs 4	48 Ho	ours		
Text Books												I				
							D -			.e P	1		1 1			
							nel			VI II	Tome	ALLUCC		5		5

1	Kolff W.J, "Artificial Organs", John Wiley and Sons, New York, 1979.										
Reference Boo	Reference Books										
1	Andreas.F.Vonracum, "Hand book of biomaterial evalution", Mc-Millan Publishers, 1980.										
2	Albert M.Cook, Webster J.G., "Therapeutic Medical Devices", Prentice Hall Inc., New Jersey, 1982.										
3	John. G. Webster – Bioinstrumentation – John Wiley & Sons (Asia) Pvt Ltd, 2004.										
4	Muzumdar A., "Powered Upper Limb Prostheses: Control, Implementation and Clinical Application, "Springer, 2004.										
5	Rory A Cooper, "An Introduction to Rehabilitation Engineering, Taylor & Francis, CRC Press, UK. 2006.										


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Course Code	Course Name	L	Т	Р	X	С	
213BME2130	REHABILITATION ENGINEERING	2	0	0	3	3	
Prerequisite: Ni	1	Syllabus revision: r.2					
Course Categor	Course Type: Theory						

Course description

This course discuss the broad area of rehabilitation engineering solutions and their limitations for persons who suffer from physical or sensory impairments and its application to assist people with impairments in sensing, communication, seating, manipulation, and mobility.

Course outcor On successful	nes: comp	oletio	n of t	the co	ourse	the s	tude	nts w	ill be	able	to					
CO1	Have	Have basic knowledge about the principles of rehabilitation.														
CO2	Desc the a	Describe the features of human movement in health and disability and discuss he application of these properties in rehabilitation engineering design.														
CO3	Lear	earn therapeutic Exercise Techniques.														
CO4	Disc	Discuss the various rehabilitation communication techniques.														
CO5	Und	Understand orthopedic prosthetics and orthotics in rehabilitation														
СО						PC)							PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Μ	L	L	L		М						Н	М	М	Η	Μ
2	Μ	М	М	М	L	Н	L	М	М	L		Н	Μ	М	Н	Μ
3	Μ	Н	Н	М	М	Н	L	М	М	Μ		Н	М	Н	Н	Μ
4	М	Н	Н	М	Μ	Н	L	Μ	Μ	Н		Н	М	Н	Н	Μ

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5	M I	H	Η	Μ	Μ	Н	L	Μ	Η	Μ		H	Μ	Н	Н	Μ				
H-Hign, M-Ma	INT REF	, <i>L-L</i> ROD IABI	ow DUCI	TION ATIC	TO DN T	REH EAM	ABI	LITA	TIO	N &			Hour	rs: 09	•					
What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Psychiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Rehabilitation team-Classification of members. HAAT – Human Activity Assistive Technology.																				
Unit 2	PRI TEC	INCIPLES OF REHABILITATION AND ITS CHNOLOGY Hours: 09																		
Introduction, The Human Component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles – Practice of Rehabilitation and Assistive Technology. Wheel chairs: Categories of Wheelchairs, Wheelchair structure and Component design, Ergonomics of Wheelchair Propulsion, Power Wheelchair Electrical Systems																				
Unit 3	THE	IERAPEUTIC EXERCISE TECHNIQUE Hours: 09																		
Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction, Mobilization exercises, Endurance exercises.																				
Unit 4	Sens	ory I	Rehat	oilitat	tion S	ysten	ns						Hour	rs: 09)					
Engineering co System- types o Writing aids.	oncepts of visu	s in 1al ai	senso ds Aı	ry re aditor	habil y sys	itation tem-	n, Se Heari	nsory ng ai	Aug ds, T	ment ypes	ation of co	& sonver	substi ntiona	tution I hea	n: Vi aring	isual aid,				
Unit 5	ORT	ГНО	TIC	& PF	ROST	нет	TIC E	EVI	CES				Hour	rs: 09)					
General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO. Application of motor control principles to rehabilitation engineering; emphasis on iterative interdisciplinary collaborations. Prosthetic devices: Hand and arm replacement, Body powered prosthetics, Myoelectric controlled prosthetics and Externally powered limb prosthetics.																				
								Tot	al Le	ectur	e hou	rs		4	5					
Text Books																				
1	Dr. S. Sunder, Rehabilitation Medicine-, 3 rd Edition, Jaypee Medical Publications, New Delhi. 2010 (Units I, III, IV & V)																			

2	Joseph D.Bronzino, The Biomedical Engineering Handberger Three Volume Set, CRC Press, 2006 (Units II & V).	ook, Third Edition:							
Reference Books									
1 Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francis, CRC press, 2006.									
2	2 Susan B O'Sullivan, Thomas J Schmitz, Physical Rehabilitation. 5 th Edition, Davis publications, 2007.								
List of experi	nents suggested ("X" Component)								
Sl. No.	Title	Hours							
1	Design of wheel chair for the patients	10							
2	Design of the prosthetic hand	10							
	Total laboratory hours	20							

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	d Names Velaburation





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Course Code					Co	ourse	Nam	le				I	L T P X							
213BME3155		MOI	DELI	NG (OF P	HYS	OLC	OGIC	CAL S	SYST	EM	2	2 () (0	3	3			
Prerequisite: <mark>H</mark>	BME ²	21R2	<mark>51</mark>									S r	Syllabus revision: r.3							
Course Catego	gory: Program Elective											(] c	Course Type: Theory with "X" component							
Course descrip	otion																			
To understand tapplication	the pl	nysio	logica	al sys	tem 1	148im	nulink	:148 o	conce	pts ai	nd its	SIM	ULI	NK	-					
Course outcon On successful	nes: comp	s: mpletion of the course the students will be able to																		
C01	То	To understand the system elements and properties																		
CO2	То	under	stanc	the s	systei	n ana	lysis	with	comb	oined	prope	erties								
CO3	To and	unde perio	rstanc odical	l the l sign	impe als	dance	e cono	cept i	n phy	vsiolo	gical	syste	m 1	48i	im	ulinl	x148			
CO4	То	under	stanc	the t	transi	ent re	espon	se												
CO5	То	under	stanc	l the j	physi	ologi	cal sy	stem	mod	els an	d sin	nulati	on							
СО						Р	0								PS	50				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	2	3	4			
1	Н	Н			Н								Η	I	I					
2	Н	Н Н Н									Η	I	I							
3	Н	Н			Н								Η	ŀ	I					
4	Н	H H H										Η	I	I						
5	Н	Н			Н								Η	I	I					

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H-High, M-Medium, L-Low Unit 1 **System Concept & Properties** Hours: 15 Characterization of physiological system, models and analogs, resistive system property, static and dynamic resistance, distributed and lumped systems, Thermal resistance in human systems, System with volume storage capacity and its electrical analog, combined hollow elastic and cylindrical elements, storage in thermal and mechanical systems, non-energized muscle tissue, dual representation of storage property. Unit 2 System analysis with combined properties & Transfer Hours: 12 Function Step response of resistant-compliant systems, step-function, step-response data, Dye dilution study, pulse response of first order system, System as operator, first order operator, use of Transfer function, Block diagrams of coupled systems, Examples using transformed signals. Hours: 12 Unit 3 The Impedance Concept & Periodic Signals circuits into transfer function with impedance concept, transfer function from impedance, impedance from transfer function, higher-order systems, Sinusoidal Functions, Analysis of an Instrument system, transfer function and sinusoidal response, sinusoidal analysis of second-order system, sinusoidal impedance, gain and phase plots as a function of frequency, transfer function from frequency-response, Relationship between Phase lag and Time Delay, fourier expansion. Unit 4 Hours: 12 **Transient response & Feedback** Transient Response of an Underdamped Second order system, General Description of Natural Frequency Damping, Physical Significance of underdamped responses, underdamped response of a physiological system, constants, resonance, Characterization of Physiological Feedback systems, linearization and analysis of a simple system, stability considerations and system stability. **Model & Simulation** Hours: 15 Unit 5 Model of neuronal dynamics, nonlinear model of baroreflex and respiratory modulated heart rate, model of cardiovascular variability, model of circadian rhythms, 149imulink: dynamics of neuromuscular reflex motion, dynamics of glucose-insulin regulation **Total Lecture hours** 66 **Text Books** 1 Blesser, W. B. (1969). A Systems Approach to Biomedicine. United Kingdom: McGraw-Hill.

2	Khoo, M. C. K. (2018). Physiological Control Systems: A and Estimation. United Kingdom: Wiley.	nalysis, Simulation,						
3	Ottesen, J. T., Larsen, J. K., Olufsen, M. S. (2004). Ap Models in Human Physiology. Switzerland: Society for Ind Mathematics.	plied Mathematical dustrial and Applied						
Reference Boo	ks							
1 Riggs, D. S. (1976). Control Theory and Physiological Feedback Mechanisms. United States: R. E. Krieger Publishing Company.								
2	Dukkipati, R. V. (2006). Analysis and design of control systems using MATLAB. India: New Age International.							
3	Bishop, R. H. (1993). Modern control systems analysis and design using MATLAB. United Kingdom: Addison-Wesley.							
4	Gopal, M. (2002). Control Systems: Principles and Design. Education (India) Pvt Limited.	India: McGraw-Hill						
5	Handbook of Bioengineering. (1987). United Kingdom: M	cGraw-Hill.						
List of experin	nents suggested ("X" Component)							
Sl. No.	Title	Hours						
1	Simulink implementation of any physiological model that is not discussed in the course lecture	4						
2	Prototype or working model	4						
	Total laboratory hours	08						

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Course Code	Course Name	L	С								
213BME3157	NEURAL NETWORK AND PATTERN RECOGNITION	3	0	0	0	3					
Prerequisite: Nil		Syllabus revision: r.2									
Course Category	Program Electives	Co Th	ours eory	e Ty	ype:						
Course description	on and a second s										
1	To Understand the concept of ANN										
2	To study about various ANN models										
3	To Obtain knowledge about the self-organizing maps and competitive networks										
4	To Design and apply different types of pattern classifica	tion	tec	hnic	ques						
5	To Analyze about the application of AI in medical field extraction based on clustering.	and	use	fea	ture						
Course outcomes On successful con	: npletion of the course the students will be able to										
CO1	Understand the basic concepts of artificial neural networ	rks ((AN	N)							
CO2	Familiarize about various ANN models										
CO3	Obtain knowledge about the self-organizing maps and content of networks	omp	oetit	ive							
CO4	Design and apply different types of pattern classification	n tec	chnie	ques	5						
CO5	Analyze about the application of AI in medical field and use feature extraction based on clustering.										
СО	PO PSO										

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4		
1	S	S											М					
2	S				S		S	S	S	S				S	S	S		
3	S	S	L	L	М		М	М	М	М			M L					
4	S	S	S	S	М		L	М	М	М			S	S				
5			S L M L M M M															
H-High, M-Medium, L-Low																		
Unit 1]	Intro	ntroduction And Simple Neural Net Hours: 9															
Elementary neu Architecture, b	iroph iases	ysiol and t	ogy a hresh	nd bio olds,	ologia Hebb	cal ne	eural 1 Perce	netwo ptron	ork- A , Ada	Artific aline	ial ne and N	eural /Iadal	netw line.	ork-				
Unit 2]	Back	Prop	agati	on ai	nd As	ssocia	tive]	Mem	ory		I	Hour	s: 9				
Back propagation network, generalized delta rule, Bidirectional Associative memory Hopfield Network																		
Unit 3	I	Neural Networks Based On Competition Hours: 9																
Kohonen Self organizing map, Learning Vector Quantisation, Counter Propagation network.																		
Unit 4		Intro	ducti	ion a	nd Su	iperv	vised	Lear	ning			I	Hour	s: 9				
Overview of Pa approach, Bay histograms, ker	attern vesian mels,	reco clas wind	gnitio sifier ow es	on, Ty , Dis stimat	ypes o scrim tors, l	of Pa inant <- nea	ttern func arest 1	recog tion, neigh	nitio non bor c	n, Pa para lassif	ramet ametr ier, es	tric a ic do stima	nd N ensity tion (onpa y es of er	tima tima	etric tion, ates		
Unit 5	l	Unsuj	pervi	sed L	<i>l</i> earn	ing A	And C	Cluste	ering	Anal	ysis	I	Hour	s: 9				
Unsupervised l Algorithm, Av Algorithm, k-m	learni erage neans	ing- H e-link algor	Hierar age a rithm	chial Igori and I	clust thm a sodat	tering and ` a Alg	g- Sin Ward [®] gorith	gle-li `s me m	inkag ethod	e Alg . Par	gorith tition	ım, C al cl	Comp uster	lete ing-	–linl For	kage gy‴s		
								Tot	al Le	ecture	e hou	rs 4	15					
Text Books												I						
1]	Dudal Editio	R.O,H n 200	Iart P)0	.G, "]	Patte	rn Cla	ussific	cation	and	scene	e anal	ysis"	, Wi	ley			
2]	Earl C Image	arl Gose, Richard Johnsonbaugh Steve Jost, "Pattern Recognition and mage Analysis", Prentice Hall of India Pvt Ltd., New Delhi, 1999															

3	Hagan, Demuth and Beale, "Neural network design", Vikas Publishing House Pvt Ltd., New Delhi, 2002
4	Freeman J.A., and Skapura B.M, "Neural networks, algorithms, applications and programming techniques", Addison- Wesley, 2003.
Reference Books	
1	Robert Schalkoff, "Pattern recognition, Statistical, Structural and neural approaches" John Wiley and Sons(Asia) Pvt Ltd., Singapore, 2005.
2	LaureneFausett, "Fundamentals of neural networks- Architectures, algorithms and applications", Prentice Hall, 1994.



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Course Code	Course Name	L	Т	Р	X	С		
213BME3144	BIOSIGNAL PROCESSING	3	0	0	0	3		
Prerequisite: Ni	1	Syllabus revision: NA						
Course Categor	Course Type: Theory							

Course description

This course provides variety of mathematical formula and algorithms to process and analysis physiological signals to extract vital information like heart rate, respiration rate, brain activity, muscle functioning etc.,

Course outcor On successful	nes: comp	oletio	n of t	the co	ourse	the s	stude	nts w	vill be	e able	to					
CO1	Und	erstar	nd and	d desi	gn fi	lters t	o ren	nove	artefa	icts in	phys	siolog	gical	signa	als.	
CO2	Extr	act in	forma	ation	from	the p	rovid	ed bi	osign	al.						
CO3	Proc algor	ess a rithm	and a	analy	ze va	arious	s bio	signa	ıls u	sing	math	emat	ical	form	nula	and
CO4	Anal	ysis l	biosig	gnals	in fre	quen	cy do	main								
CO5	Mod	odel various biological systems using variety of algorithms.														
СО		PO PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Н	Н	М		М								Н	Н		
2	H H M M												Н	Н		
3	Н	Н			М								Н	Η		
4	ц	ц			м								н	н		

5H $H - High, M - M$ Unit 1FiBiomedical signa (Synchronized Av Integration, Deriv Filtering: The WeithUnit 2EDerivative based A Dicrotic Notch DerivUnit 3W	H H edium, A iltering al origi eraging ative-ba iner Filt vent De Approace	L for H n & g, Morased of ter, A etection ches f	dyn dyn ving A opera daptiv	M val o amic Avera tor), ve Fi	of Ar s. S age), Freq lterin	tefact tatisti Time uency	ts cal F e dom y Dor	Prelim ain fi	ninari	es, Ti	H ime	H Hour	H s: 12	2	
H - High, M - MaUnit 1FiBiomedical signal (Synchronized Av Integration, Deriv Filtering: The WeithUnit 2EDerivative based A Dicrotic Notch Deriv Unit 3	edium, A iltering al origi reraging rative-ba iner Filt vent De Approace etection,	L - L for H n & g, Mov ased of ter, A etection ches f	ow Remo dyn ving opera daptiv on	val o amic Avera tor), ve Fi	of Ar s. S age), Freq lterin	tefact tatisti Time uency	ts cal F e dom y Dor	Prelim ain fi	ninari	es, Ti	H	Hour	s: 12	2	
Unit 1FiBiomedical signal (Synchronized Av Integration, Deriv Filtering: The WeilUnit 2EDerivative based A Dicrotic Notch DerivUnit 3W	iltering al origi eraging ative-ba iner Filt vent De Approace etection,	for H n & g, Mov ased o ter, A etection ches f	dyn dyn ving 2 opera daptiv on	val o amic Avera tor), ve Fi	of Ar s. S age), Freq lterin	tefact tatisti Time Juency ng Sel	ts cal F e dom y Dor	Prelin ain fi	ninari	es, Ti	H ime	Hour	rs: 12	2	
Biomedical signa (Synchronized Av Integration, Deriv Filtering: The Wei Unit 2 E Derivative based A Dicrotic Notch Der Unit 3 W	al origi eraging ative-ba iner Filt vent De Approace	n & s, Mo ased o ter, A etection ches f	dyn ving A opera daptiv on	amic Avera tor), ve Fi	s. S age), Freq lterir	tatisti Time Juency ng Sel	cal F dom y Dor	relin ain fi	inari	es, T	ime	dam			
Unit 2EDerivative based ADicrotic Notch Derivative based AUnit 3	vent De Approace etection,	ches f	on				ecting	nain g App	Iterin Filter propri	g (Mo ing (N ate Fil	ving Notcl lter.	don Ave h Fil	iain rage ter),	filt Filt Op	ering ter to timal
Derivative based A Dicrotic Notch De Unit 3 W	Approace tection,	ches f									I	Hour	's: 12	2	
Unit 3 W		, COII	for QI relation	RS, E on Ar	Detect nalys	tion F is of I	an To EEG S	ompk Signa	ins A l, Hoi	lgorith nomo	ım fo rphio	or QI c Filt	RS D	etec g.	ction,
	avefor	m Ar	nalysi	S							I	Iour	's: 12	2	
Illustrations of p coefficient, The M demodulation, The rate, Turns Count,	roblem Iinimur e Envel Form f	with n pha ogran actor	i case ase co n, An	e stu orresp alysi	dies, oonde s of	Mor ent.Si activi	rpholo gnal l ty– R	ogical engtł oot N	Ana n, Env ⁄Iean	ılysis velop Squar	of I Extra e val	ECG actio lue, Z	, Co n, A Zero	orrel mpl -cro	ation itude ssing
Unit 4 F	requen	cy-do	omain	Cha	aract	eriza	tion				H	Hour	's: 12	2	
Periodogram, Ave Estimator, Measur	eraged H es deriv	Perioc ved fr	lograi om P	m, B SD.	lackr	nan-T	Tukey	Spec	etral H	Estima	tor,	Dani	ell's	Spe	ectral
Unit 5 M	lodellin	g of]	Biom	edica	al Sy	stems	5				H	Iour	s: 12	2	
Motor unit firing Parametric system random signals, C gain factor, Covar Relation between and zeros.	pattern n model omputatiance m AR and	n, Ca lling, tion o ethoc 1 Cep	ardiac Auto of moo l, Spe ostral	rhy regre del pa ctral coeff	thm, essive arame matc ficien	Form e mod eters, ching its, A	nants lel, A Levir and pa RMA	and utoco ison-] arame mod	pitch orrela Durbi eteriz el, Se	of s tion m n algo ation, equent	peec nethcorithr Mod ial es	h, P od, A n, Co lel or stima	oint appli ompu oder s ation	pro catio itati selec	cess, on to on of ction, poles
							Tot	al Le	ecture	e hour	:s 6	50			
Text Books															
1 Ra	angayya	in, Ra	ingara	ijM.	Bion	nedico	al sigr	ıal ar	nalysi	s. Joh	n Wi	iley &	& So	ns, 2	2015.
Reference Books															
1 W	villis J. 7	Tomp	okins.	Biom	nedico	al Dig	gital S	ignal	Proc	essing	3. EE	EE, P	HI, 2	2004	ŀ
2 D M	C Red lcGraw-	dy. <i>B</i> -Hill l	<i>liome</i> Publis	<i>dical</i> shing	l Sign ; Co.	nal P Ltd, 2	rocess 2005	sing:	Prino	ciples	and	Tecl	hniqi	ues.	Tata



ALASALINGAM DEMY OF RESEARCH AND EDUCATION EEMED TO BE UNIVERSITY



Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

Course Code	Course Name	L	Т	Р	X	С
213BME3142	BioMEMS	3	0	0	0	3
Prerequisite: <mark>M</mark>	icrosystems, Microfabrication and Microfluidics	Sy r.1	llab	us r	evis	ion:
Course Categor	y: Program Elective	Co Th	urs eory	e Ty	pe:	

Course description

This course focuses on the various fabrication techniques, principles and application of Microelectromechanical systems (MEMS).

Course outcomes:
On successful completion of the course the students will be able to

CO1	Perc	eive a	and in	nplen	nent	variou	is stej	ps inv	volve	d in N	/IEM	S and	mic	rosy	stem	
CO2	Unde varie	erstar ous ty	nd and pes o	d ana f sens	lyze sors a	the p and ac	rincip ctuato	oles c ors.	of mio	crosy	stem	and a	ılso t	to di	sting	guish
CO3	Desi as pe	gn ar er the	nd mie requi	crofa ireme	bricat nt	te the	mate	erial	basec	l on v	variou	is me	thod	s and	d pro	ocess
CO4	Anal total	Analyze, compare, and appreciate the performance and merit of different Micro total analysis system.														
CO5	Apply MEMS in different field of Biology and Medicine															
СО						Р	0							Р	SO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	L												L			
2	L					Μ	Μ						L			
3	L	L	Н										L			

4	Μ	М	Н													
													Μ			
5	L	L	Μ										L			
H-High, M-H	Medi	um,	L-L	.ow								-			•	•
Unit 1					In	trodu	ictior	1]	Hour	s: 09	•	
MEMS and M Microfabrication Miniaturization Application – Telecommunica	Aicro n, N and Au ations	syste /licro scali tomo	ems, syste ng – otive	Typi m a Geor Indu	cal nd metri ustry,	MEM Micro cal so He	IS an pelect caling calthc	nd M ronic g, scal are	ficros s, D ling o Indus	syster esigr of for stry,	m Pr n, M rces, s Aero	oduc anuf scalin ospac	cts, I acturing of ce In	Evol ing f phe ndus	utior proc enom stry	n of cess, nena. and
Unit 2	Pri	incip	les of	f Mic	rosys	stem	and I	BioM	EMS	Mat	erials	s 1	Hour	s: 09)	
Microsensors, Microfluidics. C Compounds, Pc Application	Mic Classi olyme	eroac ificat eric N	tuatio ion o Aater	on, f elec ials f	MEN etroni for M	MS ic Ma EMS	with aterial , Ma	M S, Sil terial	icroa icon, Seleo	ctuat Prop ction	ors, perties for N	Mio s of t Aedio	croac hin F cal ar	celer Films nd B	rome s, Sil iolog	eters, icon gical
Unit 3		N	Aicro	fabri	icatio	on M	ethod	ls and	l Pro	cess		1	Hour	s: 09)	
Microlithograph resolution, photo and surface M Assembly and P	y – Photolithography Process, Photoresists, Photolithography Tools and comasks. Doping, Micromachining- Subtractive process, Additive Process, Bulk Aicromachining, LIGA, Microstereolithography. Water bonding Methods, Packaging, Surface treatments.															
Unit 4		Mic	roflu	idics	and]	Micr	o tota	ıl ana	lysis	syste	em]	Hour	s: 09)	
Fluid flow, Coud Inductance, Flui microchannel, ` introduction, Se	ette fl idic C Valvi parat	low, Circui ing, ion.	Poise it theo Pumj	uille ory, S oing,	flow, tokes Mix	Hydi s Draş ing.	raulic g, Flu Lab-c	Resis id – T on-a-c	stance Transj hip	e, Hy port F – Sa	drody Phenor mple	rnami mena pret	ic Caj a, Lar treatn	pacit nina nent,	tance r Flo Sai	e and w in mple
Unit 5			Biol	ogica	ıl and	l Me	dical	Appl	icatio	on		1	Hour	s: 09	•	
Applications to Cells – Cell culture reactor and adhesion, Retention. Application to Nucleic Acids and Proteins. Clinical Monitoring – Flow cytometry, Mircodialysis, Catheter-Based Sensor, Endoscopy. Implantable MEMS and sensors, Microelectrodes and neural probes, Drug Delivery.																
								Tot	al Le	ectur	e hou	rs 2	45			
Text Books												•				
	E. M	eng,	Bion	nedic	al Mi	icrosy	stem	s, CR	C Pr	ess, 2	2010,	1 st E	Ed. IS	SBN-	-13:	978-

Department of Biomedical Engineering

2	Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002. (Unit I, II).
Reference Boo	oks
1	P. Tabeling, S .Chen, Introduction to microfluidics, Oxford University Press, 2010, 1 st Ed. ISBN-13: 978-0199588169
2	Rai-Choudhury, Prosenjit; Mems and Moems Technology and Applications SPIE 2000
3	Wanjun Wang, Stephen A.Soper, "BioMEMS: Technologies and Applications", CRC Press, New York, 2007.







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Course Code					C	ourse	e Nan	ne				Ι	, 1	Г	Р	X	С
213BME3145		DES	IGN	PRO AF	CES RTIF	S IN ICIA	BIOI L OI	MAT RGAI	ERIA NS	ALS A	AND	3	6 ()	0	0	3
Prerequisite: 1	Mate	rial D	Desigi	n, Ma	nufa	icturi	ng					S r	ylla 3	ıbı	us 1	revis	ion:
Course Catego	ory: 1	Progr	am E	lectiv	/e							(1	Cou Theo	rse ory	e Ty	ype:	
Course descri	ption																
This course fo Biomaterials ba	cuses ased a	on t artific	he pi ial or	rocess gans.	s of a	desig	ning,	man	ufactı	uring,	testi	ng ar	nd s	tei	riliz	zatio	n of
Course outcom On successful	nes: completion of the course the students will be able to																
CO1	Understand the basics of Design process in Artificial organs																
CO2	Analyze and compare various Artificial organs available in the market																
CO3	Com	prehe	end th	ne selo	ectio	n crite	eria a	nd pr	ocess	of de	ental i	mpla	nts	de	sigı	1.	
CO4	Perc	eive t	he Et	hical	issue	es inv	olved	l in in	nplan	t desi	gn.						
CO5	Desi	gn th	e Art	ificial	l orga	ıns ba	ised c	on the	stand	dard p	orotoc	col.					
СО						Р	0								P	SO	
	1 2 3 4 5 6 7 8 9 10 11												1		2	3	4
1	L M L												L				
2	L	L				М	L						L				
3	L	L				М							L				
4	L	L				Μ		L					L				

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5	L						L						L			
H-High, M-	Med	ium,	L-I	Low												
Unit 1				Bas	sics o	f Des	ign P	roces	S S]	Hour	rs: 08	3	
Introduction, A Materials, Lo Customization.	Adopt bad,	ive an Proc	nd A ess.	daptiv Safe	ve De ety	esign, of	, Intro produ	oducti icts,	ion to Mar	o Ma nufac	chine turab	Des ility,	ign, 1 Sta	Mech Indar	nanis diza	m – tion,
Unit 2			Ar	tificia	al Par	ncrea	s des	ign p	roces	S S]	Hour	rs: 1()	
Pancreas – Ar approach, Gen Amylin Combi Control, Gluca	tificia e the nation gon C	al Pai rapy n, Fee Combi	ncrea appro edbac	s, Int oach, k of F	tensiv Med Real-'	ve ins ical I Time	sulin Equip Bloo	theraj ment d Glu	py ar appr cose	nd in oach, Data	sulin , Clir to an	pum ical Insul	ip. B Tests lin Pu	ioeng , Ins Imp f	ginee sulin for B	ring and olus
Unit 3		De	ental	Imp	lants	Desi	gn an	d ma	nufa	cture)]	Hour	s: 1()	
Dental Implar characteristics, Placement of in	nts – Bone nplan	Cor facto its, Cl	npon ors, L linica	ients, loadin il and	type 1g Co bion	es in nditic necha	use ons, N nical	. Bit lumbe consi	ing er, Di derat	force stribu ion.	, Im ition,	plant Orie	s sh ntatic	ape, on an	Sur d des	face sign,
Unit 4	Art	tificia	l Rej	place	ment Imp	s of I lants	Liver Desi	and] gn	Ethic	al Is	sues i	in J	Hour	rs: 09)	
Liver – Lobes, system, Compa Ethical Issues Clinical Trials,	, Syn arison of In Ethic	thesis to liv plant cal Iss	, Bre ver di s – 1 sues (eakdo alysis Freatr of De	wn. s. Pro nent ntal I	Bio-a gress Moda mplai	rtifici towa ality, nts.	ial Li ird an Trans	ver I Artif splan	Devic ficial ts and	e – I liver d Imj	Funct Tran plants	ion, splan s, Im	Hollo t. plant	ow F Fai	[∓] iber lure,
Unit 5	Ma	nufa	cturi	ng, T	estin	g, an	d Ste	riliza	tion	of In	ıplan	ts]	Hour	s: 09)	
Casting, Forgin Rapid Prototy Physical Agent	ng, N ping,	letal- Nor	Shap Iconv	oing N ventio	Aachi nal	ine T Mach	ools, ining	Man , No	ufact ndest	uring ructi	Imp ve T	lants estin	at a g, Si	Hig terili	h Sp zatio	veed, on —
								Tot	al Le	ectur	e hou	rs 4	45			
Text Books																
1	Pal, Sprin	Subra nger I	uta. E US, 2	Design 2014.	n of a	artific	ial hı	ıman	joint	s & (organ	s. Vo	ol. 1.	Bost	on, I	MA:
Reference Boo	oks															
1	Hench, L., and J. Jones, eds. Biomaterials, artificial organs and tissue engineering. Elsevier, 2005.															

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Course Code	Course Name	L	Т	Р	X	С
213BME3160	TISSUE ENGINEERING	3	0	0	0	3
Prerequisite: N	lil	Sy r.1	llab	us r	evis	sion:
Biosignal Course Catego	ry: Program Elective	Co Th	ours eory	e Ty	ype:	
Course Objecti	ve					

To impart knowledge on the concepts of Tissue engineering, new tissue generation and organ transplantation.

Course outcomes: On successful completion of the course the students will be able to

CO1	Desc engin	ribe neerii	and ng a t	undei issue	rstanc in vit	the tro an	basio d its	cs of testin	tissu g	ie en	ginee	ring	and	prin	ciple	s of
CO2	Und	erstar	d the	aspe	cts of	f cell	cultu	re and	l bioı	eacto	or					
CO3	Und	erstar	d the	desi	gn, fa	lbrica	tion o	of sca	ffold	and c	ell-bi	iomat	terial	inte	racti	on.
CO4	Describe the biomaterials for tissue engineering and various tissue transplants.															
CO5	Understand the ethical and regulatory issues and case studies on various transplantation.															
СО	PO PSO															
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	М	L	L	М		М	L		L	L			Н	Н	Н	Н
2	Μ	L	L	М		М	L		L	L			М	М	Μ	Н
3	Μ				Н			Μ								Н

		-					•								
4	М			Н	М									Н	Н
5	Μ				М										Н
H - High, M -	Medium,	L-L	ow												
Unit 1	INTRO	DUC	ΓΙΟΝ]	Hour	:s: 9		
Introduction to vascularity and tissue in vitro,	o tissue e l angioge current so	enginee nesis, cope of	ering, basic f deve	Strue wour lopm	ctural nd he ient a	orga aling nd us	anizat , cell e in ti	ion o migr herap	of tiss ation eutic	sues: , Prii and	Epit nciple in-vit	helia s of tro te	l, co engii sting	nnec neeri	tive; ng a
Unit 2	CELL	CULT	URE]	Hour	rs: 09)	
Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Tissue microenvironment and bioreactor Cell signaling molecules, Receptor-ligand binding kinetics, Cell surface markers.														-cell cell ptor-	
Unit 3	SCAFF INTER	OLD ACTI	& CE ON	LL-]	BION	/IAT	ERIA	L]	Hour	rs: 09)	
Scaffold:Design, fabrication, properties and characterization, cells and in vitro culture of cells, cell seeding cell-biomaterial interaction: cell adhesion, migration, aggregation, Cell proliferation and differentiation, cell–scaffold construct & its characterization,													ells, and		
Unit 4	SCAFF	OLD	AND	TRA	NSP	LAN	Т]	Hour	rs: 09)	
Engineering b polylactic acid Engineering tis transplant imm	iomateria l), poros ssues for unology	ls for ity, m replac stems o	tissu nechar cing t cells:	e en nical pone, intro	ginee strer cart ductio	ring, igth, ilage, on, he	Deg 3-D tend epatop	radab arch ons, ooiesi	le m itectu ligan s	ateri are a nents	als (o and o , skin	collag cell i n and	gen, incor 1 live	silk pora er. E	and tion. Basic
Unit 5	CASES	STUD	Y AN	D RI	EGUI	LAT	ORY	ISSU	JES]	Hour	rs: 09)	
Case study cardiovascular, engineering.	of multi neural, v	ple a viscera	pproa l tissu	ches: e eng	cel ginee	l tra ring.	anspla Ethica	intati al, FI	on f DA ai	for nd re	liver, gulato	mu ory is	sculo	oskel of ti	etal, ssue
							Tot	al Le	ectur	e hou	irs 4	45			
Text Books											•				
1	B. Palss	on, S.	Bhatia	ı, Tis	sue E	Ingin	eering	g, Pea	rson	Pren	tice I	Hall, 2	2003		
Reference Boo	oks														
1	G. Vunj WIS, 20	ak-No)06	vakov	vic, R	. Ian I	Fresh	ney, (Cultu	reof	Cells	for T	issue	e Eng	ginee	ring,

2	B. Palsson, J.A. Hubbell, R. Plonseyand J.D. Bronzino, Tissue Engineering, CRC- Taylor&Francis
3	R. P. Lanza, R. Langerand W. L. Chick, Principles of tissue engineering, Academic press, 1997
4	Clemens van Blitterswijk, Tissue Engineering", Academic Press, 2008
5	Bernhard O.Palsson, "Tissue Engineering", Pearson Education, 1st Edition, 2016
6	John P.Fisher, antoniosG.Mikos, Joseph D.Bronzino, "Tissue Engineering", CRC Press, 2007
7	Robert Lanza, Robert Langer, Joseph P.vacanti, "Principles of Tissue Engineering", Academic Press, 2011.



DEMY OF RESEARCH AND EDUCATION DEEMED TO BE UNIVERSIT Y)



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Course Code	Course Name	L	Т	Р	X	С
213BME3156	BIOMEDICAL NANOTECHNOLOGY	3	0	0	0	3
Prerequisite: Nil		Sy r.3	llab	us r	evis	sion:
Course Category	: Program Elective	Co Th	ours eory	e Ty	ype:	

Course description

This course provides an overview of nanotechnology, fabrication, characterization and functions of nanoscale structures, and serves as an introduction to major areas in biomedical sectors influenced by developments in nanotechnology.

Course outcon	nes:
On successful	completion of the course the students will be able to

CO1	Desc nano	ribe parti	and cles.	unde	erstan	d the	e syn	thesis	s, ch	aracte	erizati	ion,	and	prop	ertie	s of	
CO2	Unde study	erstar y anti	nd abo bacte	out th rial a	e pro nd an	otein a ntican	ind D cer p	NA n roper	anote ties o	echno f nan	ology omate	and i erials	n vit	ro m	etho	ds to	
CO3	Desc toxic	cribe colog	the y.	nano	partic	cles	used	to d	liagno	osis	and	its e	thica	l iss	sues	and	
CO4	Desc	ribe	the na	anopa	rticle	es use	d in t	herap	eutic	s.							
CO5	Unde	erstar	nd the	e appl	icatio	ons of	nanc	otechr	nolog	y in r	nedic	al fie	ld.				
СО						PC)							PS	PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	
1	М	L	L	М	Н	М	L		L	L			Н	Н	Н	Н	
2	М	L	L	М	Н	М	L		L	L			М	Μ	Μ	М	
3	м							м									

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4	М					М										Н
5	М					Μ										Н
H - High, M -	Medi	ium, I	L – Le	ow												
Unit 1	F	FUND	AMI	ENTA	ALS (OF N	ANO	PAR	FICL	ES]	Hour	rs: 9		
Overview of na Synthesis of na biological meth	anote anom nods,	echnol nateria , Chara	ogy f ls by acteri	rom r phys zatio	nedic sical a n of n	al pe and c anon	rcept hemi nateri	ive, Iı cal m als.	ntrod ethoo	uction ls, Sy	n to n /nthe	iano, sis of	Nanc f nan	o-bio omat	mim erial	icry, s by
Unit 2	E	BIOFU	UNC'	TION	JALI	ZAT	ION]	Hour	's: 09)	
DNA nanotechnology, Protein &glyco nanotechnology, Lipid nanotechnology, Bio- nanomachines, Carbon nanotube and its bio-applications. Cellular uptake mechanisms of nanomaterials, Nanopharmacology& drug targeting, In vitro methods to study antibacterial and anticancer properties of nanomaterials														Bio- s of and		
Unit 3 NANOPARTICLES IN DIAGNOSIS Hours: 09																
Introduction to nanoparticles in diagnostics nuclear imaging, optical imaging, PET, Micro PET, cardio vascular disease studies, imaging and therapy of thrombosis, emerging Ethical issues and toxicology of nanomaterials.													PET, and			
Unit 4	N	NANO	THE	ERAF	PEUT	TICS]	Hour	s: 09)	
Nanoparticles a transport acros bone treatment	as ca s bio , nan	rriers logica lo part	in dr 1 bar icles	ug de riers, for oi	livery nano al va	- des techn ccina	sign, olog tion a	manu y in C and sl	factu lance kin di	re and r ther sease	d phy apy,	/siocł lung	nemic infec	cal pr tious	ropei s dise	rties, ease,
Unit 5	F N	POTE NANC	NTLA DTEC	AL A CHN(PPLI)LO(ICAT GY I	TION N MI	S OF EDIC	INE]	Hour	rs: 09)	
Nanotubes, nar Introduction to systems (NEM in organ printir	nowin mol s). N ng	res, an lecular Janote	d nar elec chnol	nodev tronic logy i	ices-i cs - F n tiss	introc ield (sue er	luctio emiss ngine	on - F tion a ering,	unction nd Sl Nan	onal l nieldi o arti	Nano ng - ficia	struct Nanc l cells	tures belect s, Na	– rome notee	echai chno	nical logy
								Tot	al Le	ectur	e hou	irs	45			
Text Books				-				-								
1	Mal	lsch, N	J.H.,	"Bior	nedic	al Na	note	chnol	ogy",	CRC	C Pres	ss. (2	005).			
Reference Boo	oks															
1 Kumar, C. S. S. R., Hormes, J. and Leuschner C., "Nanofabrication Towards Biomedical Applications: Techniques, Tools, Applications, and Impact",																

	WILEY -VCH Verlag GmbH & Co. (2005).
2	Mirkin, C.A. and Niemeyer, C.M., "Nanobiotechnology II: More Concepts and Applications", Wiley-VCH. (2007).
3	Lamprecht, A., "Nanotherapeutics: Drug Delivery Concepts in Nanoscience", Pan Stanford Publishing Pte. Ltd. (2009).
4	Jain, K.K., "The Handbook of Nanomedicine", Humana press. (2008).
5	CM, Niemeyer, C.A. Mirkin, "Nano biotechnology Concepts, Applications and Perspectives", Wiley, 2004.
6	Challa, S.S.R. Kumar, Josef Hormes, Carola Leuschaer., "Nanofabrication towards Biomedical Applications, Techniques, Tools, Applications and Impact" Wiley, 2005.
7	Harry F. Tibbals, Medical Nanotechnology and Nanomedicine, CRC Press, 2010
8	Vinod Labhasetwar, Diandra L. Leslie-Pelecky, "Biomedical Applications of Nanotechnology", John Wiley & Sons, 2007.

UNIVERSITY ELECTIVE COURSES

Anand Nagar, Krishnankoil -	KALASALINGAN ACADEMY OF RESEARCH AND EDUCATION (DEEMED TO BE UNIVERSITY) Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grad 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu info@kalasalingam.ac.ir		w.kali	asalin	J am.ar	c.in								
Course Code	Course Name	L	Т	Р	X	С								
214BME2133	Medical Optics & Lasers	3	0	0	0	3								
Prerequisite: <mark>have</mark>	e to include any basic science course r.3													
Course Category:	University Elective	Co Th	ours eory	e T	ype:									
Course description	1													
1	To understand the basics of tissue optics													
2	To analyze the principles of photonic detection method	ls												
3	To understand the biomedical diagnostic applications													
4	To analyze the optical biopsy techniques													
5	To apply and evaluate the intervention and diagnostic t	ech	niqu	les										
Course outcomes: On successful com	pletion of the course the students will be able to													
C01	Demonstrate an understanding of the tissue optical propinstrumentation	pert	ies a	und i	its									
CO2	Enlighten the principles of photonic detection techniqu the same in biomedical imaging	es a	nd t	he u	isage	e of								
C03	Understand the various biomedical diagnostic applicati biomedical engineering	ons	in t	he f	ield	of								
CO4	Analyze the concepts involved in various fluoroscop diagnostics	y b	ased	l bio	ome	dical								

CO5		Evalu photo	uate a	ind ex	poun	d the	diagr	nostic	meth	nodol	ogies	follo	wed	in bi	ome	dical				
СО							PO							Р	SO					
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4				
1	Η				Н								Н							
2	Η				Н							Н								
3	Η		Н																	
4	Η				Н								Н							
5	Η				Н								Н							
H - High, M - I	Medi	um, I	n, L - Low																	
Unit 1		Tissu	ie Op	otics	& Ph	otoni	c De	vices				I	Iour	s: 9						
Optical properties of tissue, light-tissue interactions, Optical Diffusion Tomography, Laser light in Medicine, Basic Instrumentation in Photonics																				
Unit 2		Phot	onic	Dete	ction	and	[mag	ing T	echn	ique	5	I	Iour	rs: 9						
Lifetime based Coherence Ton imaging for bio	imag nogra ologic	ging, r iphy i cal and	near-f magin d meo	ïeld i ng, La lical o	magi aser c diagn	ng in lopple ostics	biolo er per	gical fusio	and n mo	biomo nitori	edical	l appl nd ima	icatio aging	ons, g, the	Optio erma	cal I				
Unit 3		Bion	nedic	al Di	agnos	stics						ł	Iour	rs: 9						
Glucose diagno applications, fu	ostics	, In vi onal in	tro cl nagin	linica g wit	l diag h diff	gnosti fusing	c inst g ligh	rume t	ntatio	on, bi	osens	sors fo	or me	edica	1					
Unit 4		Opti	cal B	iopsy	7							ł	Iour	rs: 9						
Optoacoustic T characterization biomedical diag	omog n of t gnost	graphy piolog ics	y, Ult ical t	trasor issue	nically using	y moo g optie	lulate cal sp	ed opt ectro	tical i scop	magi y, Flu	ng, q oresc	uantit ence	ative spec	e trosc	opy	for				
Unit 5		Inter	vent	ion a	nd D	iagno	ostic [Гесhı	nique	es		H	Iour	s: 9						
Principles of Pl ophthalmology	DT ai , Las	nd its er trea	clinio atmer	cal ap nt for	plica breas	tions, st tum	laser ors, i	• tissu mage	e we guid	lding led su	, lase rgery	r in de	erma	tolog	gy,					
		Tota	l Lec	ture	hour	s						4	5							

Text Books	
1	Biomedical Photonics Handbook. (2003). United Kingdom: Taylor & Francis.
Reference Books	
1	Biomedical Photonics Handbook, Second Edition: Fundamentals, Devices, and Techniques. (2014). United States: Taylor & Francis.
2	Biomedical Photonics Handbook, Second Edition: Biomedical Diagnostics. (2014). United States: Taylor & Francis.
3	Biomedical Photonics Handbook, Second Edition: Therapeutics and Advanced Biophotonics. (2014). United Kingdom: Taylor & Francis.
4	Biomedical Photonics Handbook, 3 Volume Set. (2014). United States: CRC Press.



ACADEMY OF RESEARCH AND EDUCATION (DEEMED TO BE UNIVERSITY)



Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

Course Code	e	Course Name	L	Т	Р	X	С							
214BME213	2	COMPUTERS IN MEDICINE	3	0	0	0	3							
Prerequisite:	Nil		Sy r.3	llab	us r	evis	vision:							
Course Categ	Course Category: University Elective													
Course descri	ptio	on												
1	Describe general functions, purposes and benefits of health information syste													
2	De	Describe the evolution and adoption of health information systems												
3	Co reo	ompare health information systems in terms of their ab quirements of a healthcare enterprise.	oility	v to	sup	por	t the							
4	Pr ne	opose the hardware, software, operating system and netwo cessary for effective data storage and use in healthcare or	rkin gani	g co zati	nsic ons	lera	tions							
5	Ut rej	tilize the tools and techniques for collecting, storing, secuporting healthcare data.	iring	, ret	riev	ving,	, and							
Course outcor On successful	nes cor	: npletion of the course the students will be able to												
C01	To	o understand the system of information managed in the ho	spit	al.										
CO2	To ma	o demonstrate the application of software employed anagement.	d ir	n m	iedio	cal	data							
CO3	To	examine medical imaging data with an assist of compute	ers.											
CO4	Тс	o understand the concept of maintaining digital patient rec	ords	5.										
CO5	To acquire knowledge in delivering instructions in medicine using computer													

СО						PC)							PS	0				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4			
1	М				М								L						
2	L				М								L						
3	L	L			М	L	L						L						
4	Μ	L			М	Μ						L	L						
5	L M M M L																		
H - High, M - Medium, L – Low																			
Unit 1	HO	HOSPITAL INFORMATION SYSTEMHours: 9																	
Introduction –Foundations of Health-care Informatics- Ethics- Electronic Health Records- Information Infrastructure- computer based medical information retrieval.																			
Unit 2	CO MA	COMPUTERISED PATIENT DATABASE MANAGEMENT Hours: 9																	
Data base appr Certification - Exchanges - El	roach Tecł HR D	-EH nnical eploy	R Fu Infr ment	nctio astru & Pi	nality cture roject	/ incl -Se Man	uding curity agem	g Onl y - I ent -I	ine U ntero Patier	Jse of perab nt Cei	f an ility nterec	EHR & F 1 EH	Gove Iealth R	ernm Inf	ent l orma	EHR ation			
Unit 3	CO AN	MPU D DE	TER CISI	ASS ON I	ISTH MAK	ED M ING	EDI	CAL	IMA	GIN	G		Hour	rs: 9					
Computer Assi Systems Algor Networks – De	isted rithms cision	Medi s –Ar n Ana	cal E nalysi Ilysis	Decisi s –C in Cl	on M BR-F inica	Iaking Produc I Mec	g-Mo ction licine	del o Rule –Cli	f CN Syst nical	ID-A tems- Decis	pproa Cogn sion S	aches nitive Supp	-Dec Moc ort.	ision lels-	Sur Sema	oport antic			
Unit 4	CO	MPU	TER	ISEI) PA'	ΓIEN	T RI	ECO	RD				Hour	rs: 9					
Computerised Computer - Computer Ass Online –Electro	Patier ompu isted onic (nt Re iterise Patie Comn	cord ed Pre ent E nunic	–Intro escrip ducat ation	oduct otions ion A With	ion-H For And Patie	listor Patie Healt ents-I	y Tak ents-I h Ca mpor	ting l ntrod re In tance	By Co luctio forma Of E	ompu n-Ad ation Sehav	iter-E verse –Int iour	Dialog e Dru roduc Modi	gue V Ig R ction ficat	With eacti —He tion.	The ons- ealth			
Unit 5	CO ME	MPU DICI	TER NE	ASS	ISTE	ED IN	ISTR	UCT	ION	IN			Hour	rs: 9					
Computer Assisted Drug Discovery And Development, Molecular Modelling By Computer- Computational Representation Of Molecules-Modelling GPCRS-Pharmacophores-New Drugs For Cancer-0 from Gene To Screen.												rugs							

		r
	Total Lecture hours	45
Text Books		
1	R. D. Lee, Computers in Medicine, Tata McGraw Hill P Limited, New Delhi, 1993.	ublishing Company
Reference Bo	oks	
1	Harold Sackamn, Biomedical Information Technology, Ac York.	cademic Press, New
2	S.K.Chachan, PC Organisation, S.K. Kataria and Sons, Del	hi 2000.



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ALASALINGAM



Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

Course Code	Course Name	L	Т	Р	X	С		
214BME1109	BIOMEDICAL INSTRUMENTATION	3	0	0	0	3		
Prerequisite: Ni	1	Syllabus revision: r.1						
Course Categor	y: University Elective	Co Th	ours eory	e Ty	ype:			

Course description

The course offers basic concepts and understanding of Instrumentation involved in medical field and human physiology. Biomedical Instrumentation is application of technology for medical field. During the course, students will explore Electro- physiological measurements, basic medical equipment etc.

Course outcor On successful	nes: comp	es: completion of the course the students will be able to														
CO1	Desc elect	Describe and understand the origin of biopotentials and different types of electrodes used in bio-potential recording.														
CO2	Unde amp	Understand and design the basic bioelectric signal recording systems and bio amplifiers.														bio
CO3	Illus para	lustrate and design the medical instrument used to measure non electrical arameters.														
CO4	Unde instr	Understand and illustrate the working principle of basic life supporting instruments.														rting
CO5	Desc and s	ribe safety	the w	orkin andlii	ng and ng me	d usag dical	ge of equi	analy pmen	/tical t.	equij	omen	t and	elec	trica	l haz	ards
СО						PC)							PS	0	
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1	Η												Н			

													-			r	
2		L												L			
3			Н			Н									Н	Η	
4							L						Н			Н	
5			М			Н		Н				Н	H H I				
H - High, M -	Mediı	um, I	L – La)W							1						
Unit 1BIOPOTENTIAL AND ELECTRODESHours: 09																	
Components of Medical Instrumentation System- Origin of Biopotentials, Electrical Activity of Cells, Electrode Skin interface, Electrode-Electrolyte interface, motion artifact, half-cell potentialPolarization effects of electrode – Nonpolarizable electrodes. Types of electrodes - Surface; needle and micro electrodes – ECG – EMG - EEG Electrodes.																	
Unit 2	nit 2 BIOELECTRIC SIGNALS RECORDING AND Hours: 09																
Recording of ECG, EEG and EMG - Einthoven triangle, Standard 12-lead configurations - ECG Machine - EMG machine – 10-20 electrodes placement system for EEG - EEG machine. Bioamplifiers- Carrier Amplifier, - Isolation Amplifier - Differential amplifier - Chopper Amplifier - Instrumentation Amplifier																	
Unit 3MEASUREMENT OF NON-ELECTRICAL PARAMETERSHours: 09																	
Human body T Measurement o Pulmonary fun ESR, GSR mea	Cempe of Hea action	eratur art rat meas nents	e, Me e, Me suren	easure easure nents	ement ement – spi	t of b t of H irome	lood eart s eter, 1	press sound Blood	sure – I I Gas	- Mea anal	asurei ysers	nen : fin	t of C 1ger-ti	ardia p ox	ac ou yme	itput ter -	
Unit 4	LIF	E SU	PPO	RT I	NSTI	RUM	ENT	S					Hour	s: 09)		
Pacemaker-Types of Pacemakers, mode of pacing and its application, Defibrillator-AC and DC Defibrillators and their application, Heart Lung machine and its application during surgery, Hemodialysis system and the precautions to be taken during dialysis.																	
Hemodialysis s	system	n and	the p	recau	itions	to be	e take	n dur	ing d	ialysi	S.		on du		surg	gery,	
Unit 5	ANA ELE	and ALY CTH	the p	L IN	itions	to be UME Y	take	n dur	ing d	ialysi	S.		Hour	s: 09	surg	gery,	
Unit 5 Principle of Spectrofluoron Physiological e of accident pre	ANA ELE colo neter; effects ventio	and ALY CCTE orime pH of el	the p FICA RICA try, meter ectric	L IN L SA pho Blo al cu	tions STR FET tomet bod C rrent,	to be UMF Y ry Cell c Shoc	and and k Ha	n dur AION pH er; Bi zards	ing d ANI me ioche from	asure mical elect	ement anal rical o	. S lyze equi	Hour Spectr rs; Na pment	s: 09 opho a-K t and	surg otom analy met	eter; yzer,	

Text Books									
1	Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2014								
Reference Books									
1	Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007								
2	John G. Webster, "Medical Instrumentation Application and Design", John Willey and Sons, 2009.								
3	Carr, J.J. and Brown, J.M., Introduction to Biomedical Equipment Technology, Prentice Hall (2000) 4th edition or current.								
4	Geddes, L.A., and Baker, L.E., Principles of Applied Biomedical Instrumentation, Wiley InterScience (1989) 3 rd or current Edition.								







And Nagar, Krishnankoil - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu | info@kalasalingam.ac.in | www.kalasalingam.ac.in

Course Code	Course Name	L	Т	Р	X	С					
214BME2134	3ME2134 REHABILITATION ENGINEERING										
Prerequisite: N	Til	Syllabus revision: r.1									
Course Catego	Course Type: Theory										

Course description

This course discuss the broad area of rehabilitation engineering solutions and their limitations for persons who suffer from physical or sensory impairments and its application to assist people with impairments in sensing, communication, seating, manipulation, and mobility.

Course outcor	nes:
On successful	completion of the course the students will be able to
CO1	Have basic knowledge about the principles of rehabilitation.

CO2	Describe the features of human movement in health and disability and discuss
002	the application of these properties in rehabilitation engineering design.

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CO4 Discuss the various rehabilitation communication techniques.

CO4	Disc	uss u	ie vai	Tous	renau	miau		JIIIII	imcai		echini	ques.	, 						
CO5	Und	Understand orthopedic prosthetics and orthotics in rehabilita																	
СО		РО													PSO				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4			
1	М	L	L	L		М						Η	М	М	Н	М			
2	М	М	М	М	L	Н	L	М	М	L		Н	М	М	Н	Μ			

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		-		-		-				-						
4	М	Н	Н	М	М	Н	L	М	М	Н		Н	М	Н	Н	М
5	М	Н	Н	М	М	Н	L	М	Н	М		Н	М	Н	Н	М
H-High, M-M	edium	ı, L-I	Low													
Unit 1	INT REI	'ROI HAB]	DUCT	FION ATIC	TO DN T	REH EAM	ABI	LITA	TIO	N &		I	Hour	rs: 09)	
What is Reha Preventive Re Psychiatry in Disabilities, Re Assistive Techr	What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Psychiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Rehabilitation team-Classification of members. HAAT – Human Activity Assistive Technology.															
Unit 2PRINCIPLES OF REHABILITATIONHours: 09																
Introduction, The Human Component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles - Practice of Rehabilitation and Assistive Technology.																
Unit 3 THERAPEUTIC EXERCISE TECHNIQUE Hours: 09																
Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction, Mobilization exercises, Endurance exercises.																
Unit 4	SEN	ISOR	Y RI	EHAF	BILIT	CATI	ON S	YSTI	EMS			I	Hour	rs: 09)	
Engineering co System- types o Writing aids.	oncept of vis	s in ual ai	senso ids A	ory re uditoi	ehabil Ty sys	itation tem-	n, Se Heari	nsory ing ai	Aug ds, T	gment ypes	ation of co	& si nven	ubstit tiona	tution l hea	n: V aring	isua aid
Unit 5	OR	гно	TIC	& PF	ROST	HET	TIC E	DEVI	CES			I	Hour	rs: 09)	
General ortho Orthosis. Calip Myoelectric co	tics, (bers. I	Class Prostl ed pr	ificat netic osthe	ion c devic tics a	of ort es: H nd Ex	hotic and a xterna	s-fun and a ally p	ctiona rm re owere	al & place ed lin	regie ment nb pro	onal, , Bod osthet	Gen ly po ics.	eral were	prin d pr	ciple osthe	es o
								Tot	al Le	ecture	e hou	rs 4	15			
Text Books												1				
1	Dr. Publ	S. S.	Sunde ons, N	er, R Iew D	ehab Delhi.	ilitati 2010	on N (Uni	Лedic ts I, I	ine-, II, IV	3rd 7 & V	Edit ()	tion,	Jay	pee	Me	dica
77 KARE							Dep	artn	ient	of Bi	iome	dica	l Em	gine	erin	ıg

2	Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006 (Units II & V).
Reference Boo	oks
1	Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francis, CRC press, 2006.
2	Susan B O'Sullivan, Thomas J Schmitz, Physical Rehabilitation. 5th Edition, Davis publications, 2007.



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Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

Course Code	Course Code Course Name									
214BME3163	TELEMEDICINE	3	0	0	0	3				
Prerequisite: Nil					Syllabus revision: r.3					
Course Categor	y: University Elective	Course Type: Theory								

Course description

This course covers the role of information and communications technologies in enabling remote patient care, health professional collaboration at a distance, and in supporting patient-self management. Also enables the students to evaluate business and technology infrastructure models required for supporting telehealth services.

Course outco On successful	mes: comp	oletio	n of t	the co	ourse	the s	stude	nts w	vill be	e able	to					
CO1	Kno	w the	essei	ntial j	paran	neters	, scoj	pe, be	nefit	s and	limit	s of te	elem	edici	ne.	
CO2	Expl telen	ain th nedic	ne app ine.	olicat	ion o	f mul	timed	lia an	d nee	ds of	com	nunic	catio	n net	worl	ks in
CO3	Und mod	erstar ules.	nd the	use	and n	ecess	ity of	e vario	ous se	ecurit	y and	stanc	lards	s in te	elehe	alth
CO4	Desc diag	cribe 1 nosis.	the ne	eeds o	of acc	luisiti	on de	evices	s in te	lehea	lth m	onito	ring	and		
CO5	App	ly tele	ehealt	th in l	healtl	ncare.										
СО						Р	0							Р	SO	
	1 2 3 4 5 6 7 8 9 10 11 12 1 2									3	4					
1			М											L		
2	L	L	М										L	L		

				-				-		-	-	-		-		1
3			М			М										Ν
4	L	L	М										L	L		
5	L	L	М										L	L		
H - High, M -	Medi	um, l	L - La	w												
Unit 1	Fun	dam	ental	s of 🛛	ſelem	nedici	ine						Hour	s: 9		
History of tele Systems, bene	emedic fits &	cine, limit	defin ation	ition s of t	of tel eleme	lemec	licine e.	e, tele	e-heal	th, te	le-cai	re, sc	cope,	Tele	med	icir
Unit 2	Tec	hnolo	ogy o	f Tel	emed	icine	Syst	ems					Hour	rs: 9		
Audio, video, s ANT, ISDN, i and ubiquitous	still in nterne healt	ages t, air/ hcare	, text / wire 2.	and c	lata, fa comn	ax-ty nunic	pe of ation	com s, GS	munic SM sa	ation tellite	s and e, mic	netw ro w	vork:] vave,]	PSTI Mobi	N, P(ile h	OT: eal
Unit 3	Ethi	ical a	nd L	egal	Aspe	cts of	f Tel	emed	licine				Hour	s: 9		
Confidentiality relationship, a	, pati	ient 1	rights	and	cons	sent:	conf	ïdent	iality	and	the	law,	the j	patie	nt-de	oct
jurisdictional i	ssues,	to intel	medio lectu	cal r al pro	ecord operty	s, co right	onsen ts.	t tre	atmen	t - (data	prote	ection	&	seci	ırit
jurisdictional i Unit 4	ssues,	to intel ure A	medio lectua Archi	cal r al pro ving	ecord operty and	s, cc right Com	onsen ts. muni	t tre	atmen	t - o	data	prote	ection Hour	& 's: 9	secu	ırit
jurisdictional i Unit 4 Introduction to assessment, tee	Pict Pict radio	to intel ure A logy l Issu	media lectua Archi infor ues, P	cal r al pro ving matic	ecord operty and on sys archi	s, co right Com tem a tectu	muni muni and A re.	t tre	atmen on Sys	t - (stem M, P.	data	strate	Hour egic p	s: 9	secu	
jurisdictional i Unit 4 Introduction to assessment, teo Unit 5	Pict Pict radio chnica	to intel ure A logy l Issu	media lectua Archi infor ues, P ions	cal r al pro ving matic ACS of Te	ecord operty and on sys archi	s, co right Com tem a tectu dicin	onsen ts. muni und A re. e	t tre	atmen on Sys DICO	t - (stem M, P.	data	strate	Hour Hour Hour	s: 9 lan a	secu	eec
jurisdictional i Unit 4 Introduction to assessment, teo Unit 5 Teleradiology, Health and Cy	Pict Pict radio chnica App Telep ber M	to intel intel ure A logy ll Issu blicat patho edici	media lectua Archi infor ues, P ions logy, ne.	cal r al pro ving matic ACS of Te Tele	and (on sys archi eleme cardio	s, co right Com tem a tectu dicin	muni muni and A re. e	t tre	on Sys	t - (stem M, P,	data ACS :		Hour egic p Hour	\$ s: 9 lan a s: 9 Feles	urge	ırit eec
jurisdictional i Unit 4 Introduction to assessment, teo Unit 5 Teleradiology, Health and Cy	Pict Pict radio chnica App Telep ber M	to intel intel ure A logy ll Issu Dicat patho edici	Archi infor ies, P ions logy, ne.	cal r al pro ving matic ACS of Tele	ecord operty and on sys archi eleme cardio	s, co right Com tem a tectu dicin	muni muni and A re. e	t tre	on Sys DICO ology,	t - d stem M, P. , Tele ectur	data ACS a ederm e hou		Hour egic p Hour ogy, 7 45	a & rs: 9 lan a rs: 9 Feles	urge	ry,
jurisdictional i Unit 4 Introduction to assessment, teo Unit 5 Teleradiology, Health and Cy Text Books	Pict Pict radio chnica App Telep ber M	to intel intel ure A logy l Issu blicat	Archi infor ies, P ions logy, ne.	cal r al pro ving matic ACS of Te Tele	ecord operty and (on sys archi eleme cardio	s, co right Com tem a tectu dicin	muni muni and A re. e	t tre	ology,	t - d stem M, P.	data ACS : ederm e hou		Hour egic p Hour ogy, 7 45	s: 9 lan a s: 9	secu and n urge	ry,
jurisdictional i Unit 4 Introduction to assessment, teo Unit 5 Teleradiology, Health and Cy Text Books	Pict Pict Pict Pict App Telep ber M	to intel intel ure A logy l Issu blicat batho edicit	Archi infor ies, P ions logy, ne.	cal r al pro ving matic ACS of Te Tele	ecord operty and (on sys archi elemed cardio	s, co right Com tem a tectu dicin ology	emed	t tre	atmen	t - d stem M, P. , Tele ectur	ACS are", .	strate atolo	Hour egic p Hour ogy, 7 45 Wile	x rs: 9 lan a rs: 9 Feles	secu and n urge ew Y	ry,
jurisdictional i Unit 4 Introduction to assessment, teo Unit 5 Teleradiology, Health and Cy Text Books 1 2	Pict Pict Pict Pict App Telep ber M	to intel intel ure A logy il Issu olicat oatho edicii	Archi infor ies, P ions logy, ne. C, "E uang, ons"	cal r al pro ving matic ACS of Tele Sssent	ecord operty and on sys archi eleme cardio ials o ACS y, Nev	s, co right Com tem a tectu dicin ology f Telo and w Jer	emed	t tre icatio CS, 1 eonce To licine	atmen on Sys DICO ology, otal Lo and T	t - d stem M, P. , Tele ectur	ACS ederm e hou are", .	strate aatolo John Basi	Hour egic p Hour ogy, 7 45 Wile	s: 9 lan a rs: 9 Teles y, No	secu and n urge ew Y bles	rit
jurisdictional i Unit 4 Introduction to assessment, teo Unit 5 Teleradiology, Health and Cy Text Books 1 2 Reference Boo	Pict Pict Pict Pict App Telep ber M	to intel intel ure A logy il Issu olicat oatho edicit	media lectua Archi infor ies, P ions logy, ne. C, "E uang, ons"	cal r al pro ving matic ACS of Te Tele	ecord operty and (on sys archi elemed cardio ials o ACS y, Nev	s, co right Com tem a tectu dicin ology f Tel and w Jer	emed	t tre	atmen on Sys DICO ology, otal Lo ; Info	t - d stem M, P. , Tele ectur	data ACS adderm ederm are", . ics:	strate atolo John Basi	Hour egic p Hour ogy, 7 45 Wile	x s: 9 lan a rs: 9 Feles y, No	ew Y	ry,
1	Olga Ferrer Roca, Marcelo Sosa Iudicissa, "Handbook of Telemedicine", IOS Press, Netherland, 2002.															
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2	Khandpur R S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.															
3	Khandpur R S, "TELEMEDICINE – Technology and Applications", PHI Learning Pvt Ltd., New Delhi, 2017.															



ALASALINGAM ADEMY OF RESEARCH AND EDUCATION DEEMED TO BE UNIVERSITY)



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Course Code	Course Name	L	Т	Р	X	С
214BME3163	TISSUE ENGINEERING	3	0	0	0	3
Prerequisite: Nil		Sy r.1	llab	us r	evis	sion:
Course Category	: University Elective	Co Th	ours eory	e Ty	ype:	

Course Objective

To impart knowledge on the concepts of Tissue engineering, new tissue generation and organ transplantation.

Course outcomes: On successful completion of the course the students will be able to

CO1	Desc engi	ribe neerii	and ng a t	undei issue	rstand in vit	1 the tro an	basio d its	cs of testin	tissu g	ie en	ginee	ring	and	prin	ciple	s of
CO2	Unde	Understand the aspects of cell culture and bioreactor														
CO3	Unde	Understand the design, fabrication of scaffold and cell-biomaterial interaction.														
CO4	Desc	ribe	the bi	omat	erials	for t	issue	engir	neerir	ng and	l vari	ous ti	ssue	tran	splar	nts.
CO5	Unde trans	erstar plant	nd the ation	e eth	ical	and	regul	atory	issu	es ar	nd ca	se st	udie	s on	var	rious
СО						PC)							PS	0	
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3	М				Н			Μ								Н

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4	М				Н	Μ										Н	Н
5	М					Μ											Н
H - High, M -	Mediu	ım, L	L - L c)W													
Unit 1	INT	ROD	OUCI	ΓΙΟΝ									H	Iour	rs: 9		
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Unit 2	CEL	LC	ULT	URE									H	Iour	rs: 09)	
Different cell interaction. A characterizatio ligand binding	types, spect on, Tiss kineti	proge of c sue n cs, C	enitor cell nicro ell su	r cells cultur enviro ırface	and e: co onme marl	cell c ell e nt an cers.	liffer xpans d bio	entiat sion, reacto	ions, cell or Ce	diffe tran ll sig	erent sfer, gnali	kin ce ng n	d o ll nol	of ma stora lecul	atrix age es, I	, cell and Rece _l	-ce ce ptoi
Unit 3	SCA	FFO															
	INT	ERA	CTI	& CE ON	LL-]	BION	/IAT	ERIA	L				H	Iour	rs: 0)	
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Scaffold:Desig cell seeding cell-biomateria differentiation Unit 4	INT gn, fab al inte , cell–s SCA	ricati oractionscaffe	on, p on: c old co	& CE ON proper cell a onstru AND	ties and hes a ct & TRA	BION and cl ion, its ch	AAT narac migra naract LAN	ERIA teriza ation, erizat	L tion, agg ion,	cells regat	and ion,	in v Ce	/itr 11	Iour o cu prol: Iour	s: 09 lture ifera	of c tion	cells an
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Scaffold:Desig cell seeding cell-biomateria differentiation Unit 4 Engineering b polylactic acid Engineering ti introduction, h Unit 5 Case study cardiovascular engineering. Text Books 1	INT: gn, fab: al inte , cell–s iomate d), po ssues epatop CAS of m , neura	ricati scaffe sc	on, p on, p on: c old co oLD a for y, m replac is FUDY	& CE ON proper cell a onstru AND tissu echar cing s Y AN pproa l tissu Bhatia	TRA e en nical skin s D RI ches: e ens	BION and cl ion, its ch NSP ginee strer and 1 EGUI cel gineer	AAT narac migra aract LAN ring, ngth, iver. LAT 1 tra ring.	ERIA teriza ation, erizat T Degu 3-D Basic DRY unspla Ethica Tot	L tion, agg ion, radab arch c tran ISSU attati al, FI al Le	cells regat le m itectu spla JES on t DA at ectur	and ion, nater ure nt in for nd ro e ho Prer	in v Ce ials and nmu live egula urs	H vitr ll H (cc cc uno H aton H 4	Iour o cu prol: Iour ollag ell i logy Iour mu ry is 5	s: 09 Iture	of c tion silk pora ms c oskel of ti	an an tion cell leta
Scaffold:Desig cell seeding cell-biomateria differentiation. Unit 4 Engineering b polylactic aci Engineering ti introduction, h Unit 5 Case study cardiovascular engineering. Text Books 1 Reference Boo	INT: gn, fab: al inte , cell–s SCA siomate d), po ssues epatop CAS of m , neura	ricati ractions scaffor FFO erials for r poiesi SE ST ultipl al, vis	on, p on, p on: c old co old c	& CE ON proper cell a onstru AND tissu iechar cing s Y AN pproa l tissu Bhatia	TRA e en nical skin s D RI ches: e eng	BION and cl ion, its ch NSP ginee stren and 1 EGUI cel gineer sue E	AAT narac migra aract LAN ring, ngth, iver. LAT l tra ing.	ERIA teriza ation, erizat T Degr 3-D Basic ORY unspla Ethica Tot	L tion, agg ion, radab arch c tran ISSU alta al Le	cells regat le m itectu spla JES on t DA at ectur	and ion, nater ure nt in for nd ro e ho	in v Ce ials and nmu live egula urs	H Vitr II (cc cc uno H aton H aton H	Hour o cu prol: Hour ollag ell i logy Hour mu ry is 5 all, 2	rs: 09 lture ifera gen, ncor ste: scul sues	of c tion silk pora ms c oskel of ti	cell an an tion cell leta

2	B. Palsson, J.A. Hubbell, R. Plonseyand J.D. Bronzino, Tissue Engineering, CRC- Taylor&Francis
3	R. P. Lanza, R. Langerand W. L. Chick, Principles of tissue engineering, Academic press, 1997
4	Clemens van Blitterswijk, Tissue Engineering", Academic Press, 2008
5	Bernhard O.Palsson, "Tissue Engineering", Pearson Education, 1st Edition, 2016
6	John P.Fisher, antoniosG.Mikos, Joseph D.Bronzino, "Tissue Engineering", CRC Press, 2007
7	Robert Lanza, Robert Langer, Joseph P.vacanti, "Principles of Tissue Engineering", Academic Press, 2011.

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Course Code	Course Name	L	Т	Р	X	С					
214BME2135	WEARABLE SYSTEMS	3	0	0		3					
Prerequisite: Nil		Syllabus revision r.3									
Course Category:	: University Elective	Co Th	ours eory	e Ty	ype:						
Course description	n										
1	To introduce basic sensors for wearable systems										
2	To analysis signals acquired by wearable sensors										
3	To use different sources of energy for wearable system										
4	To analyze the technical aspects of wireless health syste	ems									
5	To apply the inculcated knowledge in wearable sensors simple medical applications	for	deve	elop	ing						
Course outcomes On successful con	: npletion of the course the students will be able to										
C01	Differentiate the sensors that can be used for wearable s	yste	ms								
CO2	Process the signals picked by the wearable sensors										
C03	Utilize different sources of energy to be used for wearab	ole s	yste	ems							
CO4	Analyze the technical aspects of wireless health systems	8									
CO5	Apply the wearable sensors into novel medical application	ons									

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CO							PO							P	SO				
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4		S	S			М		М					Μ	М					
5		S	М			S		S					Μ	Μ					
H - High, M -	Medi	um, I	L - Lo	W															
Unit 1	5	Senso	rs]	Hour	's: 9					
CMOS – Base Unit 2 Wearability iss design, signal	d Bios	Signa Signa	rs, E- l pro cal sh , Con	Texti cessi ape a strair	ng ng nd pl nt on s	Bio co lacem sampl	ent o	f sens	y. sor, T ncy f	Sechnic For reconstruction	ical ci luced	halle	Hour enges rgy co	- ser	nsor mpti	on,			
Unit 3		Energ	sing, gy ha	rvest	ing f	or we	eleva earab	le de	vices	ition,	Data		ing. Hour	rs: 9					
Solar cell, Vib Hybrid thermo	ration electr	base ic pho	d, Th otovo	erma ltaic	l base energ	ed hur gy har	nan b vests	ody a , The	as a h rmop	eat so viles.	ource	for p	power	r gen	erati	on,			
Unit 4		Wire	less l	nealtl	h syst	tems]	Hour	rs: 9					
Need for wirel BAN and Heal – Introduction,	ess m thcare Wire	onito e, Tec less c	ring, hnica	ISO/0 al Cha iunica	OSI la alleng ation	ayer a ges- S techn	rchite ysten iques	ecture n secu	e, De urity	finitio and re	on of eliabi	Body lity,	y area BAN	netv Arc	work hitec	, cture			
Unit 5	I	Appli	catio	ns of	wea	rable	syste	ems]	Hour	rs: 9					
Onit 5		tics, Medical Monitoring-Patients with chronic disease, Hospital patients, Multi parameter monitoring, Neural recording, Gait analysis, Sports																	
Medical Diagn Elderly patient Medicine, Sma	ostics s, Mu art Fal	s, Meo lti pa orics.	dical rame	Moni ter m	torin; onito	g-Pati ring, 1	ients Neura	with o al reco	chron ordin	nic dis g, Ga	sease, it ana	Hos Ilysis	spital s, Spc	patie orts	ents,				

Text Books	
1	Annalisa Bonfiglio,Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.
2	Sandeep K.S. Gupta, TridibMukherjee, Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013.
Reference Books	
1	Hang, Yuan-Ting, "wearable medical sensors and systems", Springer-2013
2	Mehmet R. Yuce, JamilY.Khan, "Wireless Body Area Networks Technology, Implementation and Applications", Pan Stanford Publishing Pvt.Ltd, Singapore, 2012.
3	Guang-Zhong Yang(Ed.), "Body Sensor Networks, "Springer, 2006
4	Andreas Lymberis, Danilo de Rossi ,'Wearable eHealth systems for Personalised Health Management - State of the art and future challenges ' IOS press, The Netherlands, 2004.



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Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

Course Code	Course Name	L	Т	Р	X	С		
214BME3162	NANOTECHNOLOGY IN MEDICINE	3	0	0	0	3		
Prerequisite: Nil		Sy r.1	llab	us r	evis	sion:		
Course Category	: University Elective	Course Type: Theory						

Course description

This course provides an overview of nanotechnology, fabrication, characterization and functions of nanoscale structures, and serves as an introduction to major areas in medical sectors influenced by developments in nanotechnology

Course outcomes:	
On successful completion of the course the students will be able to	

CO1	Desc nanc	Describe and understand the synthesis, characterization, and properties of nanoparticles and identify different types of nano biomaterials.														
CO2	Und	Understand about the protein and DNA based nanostructures														
CO3	Desc toxic	Describe the nanoparticles used to diagnosis and its ethical issues and coxicology.														
CO4	Desc	ribe	the na	anopa	rticle	es use	d in t	herap	eutic	s.						
CO5	Und	erstar	nd the	appl	icatio	ons of	nanc	otechr	nolog	y in n	nedic	al fie	ld.			
СО						PC)							PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	М	L	L	М	Н	М	L		L	L			Н	Н	Н	Н
2	М	L	L	М	Н	М	L		L	L			М	М	М	Μ
3	Μ							М								

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4	М					М										Н
5	М					М										Н
H - High, M -	Medi	um, I	L - L d)W												
Unit 1	FUN NAN	NDAN NOPA	MEN' RTIC	TAL CLES	S OF	NAN	NOS	CIEN	CE A	AND		I	Hour	rs: 9		
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Unit 2	BIO NAI	FUN NOM	CTI ATE	ONA RIA	LIZA LS	TIO	N O	F				ł	Hour	rs: 09	9	
Nanocarriers, nanostructures	lipos ; DNA	somes A base	s, p ed nai	olym nostru	er ca acture	apsu s.	les,	poly	mer	nan	opart	icles.	Pr	oteiı	ı b	ased
Unit 3	NAI	NANOPARTICLES IN DIAGNOSIS												rs: 09	•	
Introduction to cardio vascula toxicology of 1	nano r disea nanom	partic se stu ateria	eles in udies, als.	n diag imag	nostic ging a	es nu nd th	clear erapy	imag y of tł	ing, o roml	optica oosis,	l ima eme	iging, rging	PET Ethi	r, Mi cal is	icro I ssues	PET, s and
Unit 4	NAI	TON	HER	APE	UTIC	S						I	Hour	s: 09	9	
Unit 4 Nanoparticles transport acros bone treatment	NAN as car ss biol t, nanc	NOT riers ogica part	HER in dru 1 barr icles 1	APE 1g del 1ers, for or	UTIC livery nanote al vac	S - des echn ccina	ign, 1 ology tion 2	manu 7 in C and sk	factu lance	re and r ther sease	d phy apy,	I vsioch lung i	Hour emic infec	s: 09 cal pr tious	9 rope: s disc	rties, ease,
Unit 4 Nanoparticles transport acros bone treatment Unit 5	NAN as car s biol t, nanc POT NAN	NOT riers ogica part FENT	HER. in dru l barr icles f FIAL ECH	APE ag del iers, for or APP NOL	UTIC livery- nanote al vac PLICA OGY	S - des echn ccina ATIC IN I	ign, 1 ology tion a DNS (MED	manu 7 in C and sk OF ICIN	factu cance cin di	re and r ther sease	d phy apy,	I I I I I I I I I I I I I I I I I I I	Hour emic infec Hour	rs: 09 cal pr tious) rope: s disc	rties, ease,
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Unit 4 Nanoparticles transport across bone treatment Unit 5 Nanotubes, na to molecular el - Nanotechnolo	NAN as car s biol t, nanc POT NAN nowire ectror ogy in	NOT riers ogica part part TEN NOT es, an nics - tissu	HER in dru l barr icles f FIAL ECH d nar Field e eng	APE ig del iers, for or APP NOL nodev emissineer	UTIC livery- nanote al vac PLICA OGY vices-i sion at ing, N	S echn ccina ATIC IN I ntroo nd sh Jano	ign, 1 ology tion a DNS MED duction artifi	manu y in C and sk OF ICIN on - F ng, N cial c Tot	factu: cance cin di IE Functi anoel ells, I al Le	re and r ther sease ional lectro Nano	d phy apy, Nanc mech techn	Figure 1 and a structure of the structur	Hour infec Hour tures il sys in o	eal pr tious s-Intri tems organ	rope: s dise s dise s (NE s (NE	rties, ease, ction EMs) nting
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Unit 4 Nanoparticles transport acros bone treatment Unit 5 Nanotubes, na to molecular el - Nanotechnolo Text Books	NAN as car ss biol t, nanc POT NAN nowire ectror ogy in	NOT riers ogica part TEN NOT NOT tissu	HER in dru l barr icles f FIAL ECHI id nat Field e eng	APE ig del iers, for or APP NOL nodev emiss ineer	UTIC livery- nanoto al vac PLICA OGY vices-i sion at ing, N	S echn ccina ATIC IN I ntroc nd sh Jano	ign, 1 ology tion a DNS MED duction ieldi artifi	manur y in C and sk OF ICIN on - F ng, N cial c Tot	factu: cance cin di IE Functi anoel ells, I al Le echno	re and r ther sease ional lectro Nanot ecture	l phy apy, Nanc mech techn e hou	Image: Provide structure Image: Provide	Hour infec Hour tures il sys in c I5	eal pr tious s-Intri tems organ	rope: s dise s dise codue s (NE a prir	rties, ease, ction EMs) nting and
Unit 4 Nanoparticles transport across bone treatment Unit 5 Nanotubes, na to molecular el - Nanotechnolo Text Books 1 Reference Boo	NAN as car is biol t, nanc NAN nowire ectror ogy in CM, Persj oks	NOT riers ogica part TENT NOT es, an tics - tissu	HER in dru l barr icles f FIAL ECHI ad nar Field e eng	APE ig del iers, for or APP NOL nodev emiss ineer	UTIC livery- nanote al vac PLICA OGY vices-i sion at ing, N	S - des echn ccina ATIC IN I ntroo nd sh Jano	ign, 1 ology tion a DNS (MED ductionieldi artifi	manu in C and sk OF ICIN on - F ng, N cial c Tot	factu: cance cin di IE Functi anoel ells, l al Le echno	re and r ther sease ional lectro Nanot	d phy apy, Nanc mech techn e hou	I H Presioch lung i H ostruc nanica ology urs 4 cepts,	Hour infec Hour tures d sys in c IS	s: 09 cal pritious rs: 09 c-Intritems organ	p ropers disc s disc p coduces s (NE s (NE s prin	rties, ease, ction EMs) nting and
Unit 4 Nanoparticles transport acros bone treatment Unit 5 Nanotubes, na to molecular el - Nanotechnole Text Books 1 Reference Boo	NAN as car is biol t, nanc NAN nowire ectror ogy in CM, Persj oks Chai towa Wile	NOT riers ogica part part TEN NOT es, an ics - tissu Nien pectiv	HER in dru l barr icles f FIAL ECH d nat Field e eng heyer, zes", v S.S.R. Biome 005.	APE ig del iers, for or APP NOL nodev emissive ineer , C.A Wiley Kur edical	UTIC livery- nanoto al vac PLICA OGY /ices-i sion at ing, N . Mirk /, 200-	S - des echn ccina ATIC IN I ntroo nd sh Jano cin, " 4.	ign, 1 ology tion a DNS duction ieldi artifi Nance	manur in C and sk OF ICIN on - F ng, N cial c Tot o bioto	factu: cance cin di IE Functi anoel ells, l al Le echno Carc iques	re and r ther sease ional ectro Nanot ecture blogy	d phy apy, 1 Nanc mech techn e hou Conc eusch	I H Presioch lung i F Sostruc nanica ology urs 4 cepts, naer., pplica	Hour emic infec Hour tures d sys in o IS App "Na ation	s: 09 cal pr tious s-Intr tems organ	rope: s dise s dise codue s (NE prir codue s (NE prir	rties, ease, ction EMs) nting and ation

3	Nicholas A. Kotov, "Nanoparticles Assemblies and Superstructures", CRC, 2006
4	T. Pradeep, "Nano: The Essentials", McGraw Hill education 2007.
5	Vinod Labhasetwar, Diandra L. Leslie-Pelecky, "Biomedical Applications of Nanotechnology", John Wiley & Sons, 2007.



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ALASALINGAM



Moder sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

Course Code	Course Name	L	Т	Р	X	С								
214BME316	BIOMETRIC SYSTEMS	3	0	0	0	3								
Prerequisite:	Nil	Sy r.3	llab	us i	revis	sion:								
Course Catego	ory: University Elective	Co Tł	ours neory	e T	ype:									
Course descri	ption													
1	Γο understand the technologies of fingerprint, iris, face.													
2	o understand the general principles of design of biometric systems and t nderlying trade-offs.													
3	To recognize personal privacy and security implication identification technology.	ns of t	oiom	etri	cs b	ased								
4	To identify issues in the realistic evaluation of biometric	sbased	l sys	tem	s.									
5	To understand the technologies of speech recognition.													
Course outcor On successful	nes: completion of the course the students will be able to													
CO1	Understand the concept of Biometrics and its application	S												
CO2	Illustrate the various methodologies involved in fingerpr	nt tecl	nnol	ogy										
CO3	Develop techniques for face recognition and hand geometry	try bic	omet	rics										
CO4	Demonstrate the multimodal biometrics and the meth	ods fo	r ev	alua	ating	; the								

CO5 Distinguish the authentication mechanism of the biometric systems

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performance

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1	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
T	L	L			L								Н			
2	М												Н			
3		Н														
4				L		М										
5					L								Η	Μ		
H - High, M - M																
Unit 1	INT	ROD	OUCI	TION	ТО	BIO	MET	RICS	5]	Hour	s: 9		
Enrollment – t characteristics- A and biometrics a	temp Auth and p	lates entication	– pa – a ation -Bion	lgorit techn netrio	hm lologi c syst	inetrio – ver ies – N zems.	rifica leed f	tion for str	– Bi	omet	ric a	pplic	ation Prote	s –ł	piom g pri	etric vacy
Unit 2	FIN	GER	PRI	NT T	ECH	INOL	.0GY	Y]	Hour	s: 9		
Finger print feat fingerprint quali fingerprint enha	ture j ity as ncen	proce ssessi nent -	essing ment - Feat	tech – con ture e	nique mpute xtrac	es - fi er enl tion -	ngerp nance - fing	orint s ment erprir	enso and nt cla	rs usi mode ssifica	ng Ri ling ation	F ima of fir – fin	aging 1gerp gerpi	tech rint i rint n	iniqu imag natcl	ies – ges – ning.
Unit 3	FAC	CE R	ECO	GNI	ΓΙΟΙ	N AN	D HA	ND	GEO	MET	RY]	Hour	s: 9		
Face recognition - Adaptive Clas extraction – type	n from ssifie es of	m con rs -V algon	rrespo 'isual rithm	onder - Bas	nce m sed F	aps – eature	- Han e Ext	d geo ractic	ometr <u>i</u> on an	y – sc d Pat	annin tern	ng – Class	Featu sifica	re E tion	xtrao - fea	ction ature
Unit 4	MU PER	LTIN RFOF	AOD RMA	AL E NCE	BION EVA	IETR ALUA	RICS ATIO	AND N)]	Hour	rs: 9		
Behavioral Bion Architecture – le multimodal bior	netri evel netri	cs - I of fu c sys	ntrod sion tems	uctio – cor – Per	n to 1 nbina form	multin tion s ance (noda strate evalu	l bion gy —ti ation-	netric rainir - Stat	systen systen stica	em – d ada l Mea	Integ ptabi asure	gratio lity – s of E	n str - exa 3iom	ateg mple etric	ies – es of :s.
Unit 5	BIO	MEI	FRIC	AU.	FHE	NTIC	CATI	ON					Hour	s: 9		
Biometric Auth Authentication I Machines. Biom Securing and tru	nentio by F netric 1sting	cation face 1 acth g a bi	n Sy Recog entic omet	stems gnitio ation ric tra	s – on by fi ansac	Biom Expe ngerp tion –	etric ectatio rint – - mate	auth on- N biom ching	entic Iaxin etric locat	ation nizatio authe ion.	by on th entica	finge eory tion	erprin - Su by ha	it -E ippoi nd g	Biom t Ve eom	etric ector etry-

	Total Lecture hours 45
Text Books	
1	James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation", Springer, 2005
2	S.Y. Kung, S.H. Lin, M.W.Mak, "Biometric Authentication: A Machine Learning Approach"Prentice Hall, 2005
Reference Bo	oks
1	Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.
2	Nalini K Ratha, Ruud Bolle, "Automatic fingerprint Recognition System", Springer, 2003



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Course Code	Course Name	L	Т	Р	X	С
214BME1110	BIOMEDICAL WASTE MANAGEMENT	3	0	0	0	3
Prerequisite: Ni	1	Syll r.3	abu	s re	visi	on:
Course Categor	y: University Elective	Cou The	i rse ory	Туј	pe:	
Course Categor	y: University Elective	r.3 Cou The	i rse ory	Туј	pe:	

Course description

This course deals with the general and hazardous health care waste: Infectious waste, geno-toxic waste, Sharps, categorization and composition of biomedical waste, major and minor sources of biomedical waste, Segregation of waste, Color coding, waste handling and disposal, Hazard of Biomedical Waste, Treatment Technologies for Wastes, Laws OF Biomedical Waste Handling, Guidelines.

Course outcomes: On successful completion of the course the students will be able to

CO1	Disti disp	inguis osal r	sh the netho	e diffe dolog	erent gies	types	of h	azard	ous t	oiome	dical	wast	e, its	s han	dlin	g and
CO2	Enur	nerat	e the	hazar	ds ca	used	by no	on dis	posal	l of m	edica	ıl was	ste			
CO3	Anal	analyze the various treatment techniques of processing biomedical waste														
CO4	Illus	trate	the la	ws fo	r han	dling	the b	oiome	dical	wast	e					
CO5	Dem	onstr	ate th	e gui	delin	es pro	ovideo	d by V	WНО	for n	nanag	gemer	nt of	hosp	ital v	waste
CO						Р	0							Р	SO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	М	L	L	L		Н	Н	L	М	L	L	М	L	L	Н	М
2	Μ	L	L	L	L	Н	Н	L	М	L	L	М	L	М	Н	Н
3	Μ	М	М	Н	М	Н	Н	М	Н	М	Н	М	М	М	Н	М

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4	Μ	Μ	L	М	L	Н	Н	М	Н	М	Н	Μ	Μ	L	Н	Μ
5	М	Μ	L	М	L	Η	Η	Μ	Η	Μ	Н	Μ	Μ	L	Η	Μ
H-High, M-M	edium	, L-L	.0W									Ĩ				
Unit 1	INT	ROE	DUCI	ΓΙΟΝ								I	Hour	s: 09)	
Definition of g sharps, catego biomedical was	eneral rizatio ste, Se	and on ar	hazan nd co ation	rdous ompos of wa	healt sition aste, (h car of I Color	e was Biome codi	te, In edical ng, w	fectio l was aste l	ous w ste, n handl	aste, najor ing ar	geno and nd di	-toxi min sposa	cwa ors d	ste, v ource	waste es of
Unit 2	HAZ	ZAR	D OF	F BIO	MEI	DICA	LW	AST	E			I	Hour	s: 09)	
Need for disposal of biomedical waste, Specifically Communicable diseases, Diseases epidemiology and mode of transmission of disease, Environmental pollution by biomedical waste - causes, consequences, mitigation and remedies.																
Unit 3	TRE	EATN	MEN	т те	CHN	IOL	OGIE	S FC	OR W	AST	ES	I	Hour	s: 09)	
Mechanical Treatment & Chemical Disinfections, Conventional Treatment Technologies: Wet thermal technology, Incineration, Microwave Technology, Autoclave system, Hydro clave system, Electro Thermal Reactivation (ETP), Treatment Process Electron beam Technology, Plasma Pyrolysis/ Gasificaton systems																
Unit 4	LAV	WS C	F BI	[OM]	EDIC	CAL V	WAS'	ГЕ Н	IANE	DLIN	G	I	Hour	s: 09)	
Legislation, po Biomedical wa	olicies ste ma	s and anage	l law	v reg t and	ardin hand	g en ling r	viron ules 1	ment 998	on and it	Healt s amo	h car endm	re w ent.	/aste	mai	nagei	nent,
Unit 5	GUI	DEL	INE	S								I	Hour	s: 09)	
CPCB guidelin Hospital waster	nes. V S	World	d He	alth	Orgai	nizati	on g	uideli	ines	on M	lanag	eme	nt of	wa	stes	from
								Tot	al Le	cture	hou	rs 4	15			
Reference Boo	oks															
1	Ana Publ	ntpre isher	et Sin s (P)	ngh, S Ltd, I	Sukhj India,	it Ka , 2012	ur, "I 2.	Biom	edical	l Was	ste Di	spos	al", 1	st e	d., Ja	урее
I Publishers (P) Ltd, India, 2012. 2 Sushma Sahai, "Bio-Medical Waste Management", APH Publishing 2 Comparation India 2000																
2	Sushma Sahai, "Bio-Medical Waste Management", APH Publishin Corporation, India, 2009. Sanskriti Sharma, "Hospital Waste Management and Its Monitoring", Jaype														shing	

Anand Nagar, Krishn	Anad Nagar, Krishnankoll - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu info@kalasalingam.ac.in www.kalasalingam.ac.in www.kalasalingam.ac.in																
Course Code	•				C	ourse	Nan	ne]	L]	r I		X	С
214BME1108	3				3 () ()	0	3								
Prerequisite:	Nil	il													s re	evis	ion:
Course Categ	ory:	Unive	ersity	Elec	tive								C ou Theo	rse ' ory	Гуј	pe:	
Course descri	ption																
1	То	discus	ss ab	out v	variou	ıs asp	oects	of b	iosaf	ety re	egulat	tions					
2	То	discus	ss ab	out v	variou	is asp	oects	of II	PR								
3	То	discus	ss ab	out v	variou	ıs asp	oects	of b	ioeth	ic							
4	Risk	Asse	ssme	nt an	d Ma	nager	nent										
5	IPR	rights	5														
Course outcor On successful	mes: comj	pletio	n of t	he co	ourse	the s	tude	nts w	ill be	able	to						
CO1	Und	erstar	nd the	bion	nedic	al eth	ics										
CO2	Ana	lyze t	he iss	ues a	rise i	n bio	nedio	cal de	vices								
CO3	Kno	w abo	out th	e basi	ic pri	nciple	es of I	IPR la	aw								
CO4	Desc	cribe a	about	the s	afety	meas	sures	in orc	ler to	use a	a bior	nedic	al d	evic	e		
CO5	Und	erstar	nd the	bion	nedica	al sta	ndard	s.									
СО						PO)							Р	SO)	
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H - High, M -	Medi	um, I	L - Le)w												
Unit 1	BIO	MEI	DICA	AL EI	THIC	CS]	Hour	rs: 9		
Biosafety and and law, The related to bio	risk Cart osafet	asse agena y	ssme a pr	ent is: otocol	sues; on	Reg bios	ulator afety,	ry fra WT	amew O ai	vork; nd otl	Nati ner in	ional iterna	bios tiona	afety l ag	y pol: reem	icies ients
Unit 2	ETH MA	HICA NUF	L IS ACT	SSUE: TURE	S IN OF	DESI MED	IGN . DICA	AND L DE	VIC	ES]	Hour	rs: 9		
General principallergenicity, artificial ecolog	ples fo antibi gies; .	or the otic	e labo resis	orator tance,	y and etc	l envi ; Imj	ronm pact	ental on e	bios nviro	afety nmer	; Hea nt: g	alth as ene f	spects low i	s; to: n na	xicol tural	ogy, and
Unit 3	BAS	BASIC PRINCIPLES OF IPR LAWS												rs: 9		
History of IPR-GATT,WTO,WIPO & TRIPs, Role of IPR in Research & Development, Concept of property, Different forms of IPR, Layout designs of Integrated circuits, Patents, Geographical Indications, Plant varieties, Trade secrets.																
Unit 4	SAF	ТЕТҮ	7]	Hour	rs: 9		
Ecological aspedetecting transgenics to l	ects of 1sgeni humar	f GM ics; n heal	Os a Rad lth	nd im iation	pact o saf	on bic ety	diven and	sity; noni	Moni radio	torin iso	g stra topic	ategie proc	s and edure	met e; Be	hods enefi	for ts of
Unit 5	STA	NDA	ARD	S]	Hour	rs: 9		
Safety and star filing; Convent commercializa	ndardi tion o tion o	zatio n bio f biot	n for logic cechn	risk 1 cal div ology	nana versit proc	geme y; In lucts.	nt, Iı ıplica	ndian tions	pate of i	nt aont	ct ar	id an proj	nendr perty	nent righ	s, pa ts oi	atent n the
								Tot	al Le	ectur	e hou	irs 4	45			
Text Books																
1	Dani York	el A [*] , 200	Valle)7.	ero, "I	Biom	edica	l ethi	cs for	Engi	neers	s", A	cader	nic P	ress,	New	J
Reference Boo	oks															
1	Prab 2001	ouddg 1.	haG	anguli	, "In	tellec	tual P	roper	ty Ri	ghts'	', TM	IH Pu	ıblish	ing (Co. L	.td.,
2	Pate	nts b	y N.I	R. Sut	bara	m Ph	arma	Bool	c Svn	dicat	о Us	doral	had I	ndia	200)6.

HONOR ELECTIVE COURSES

Anand Nagar, Krishna	KALASALINGAN ACADEMY OF RESEARCH AND EDUCATION DECEMED TO BE UNIVERSITY Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade Anand Nagar, Krishnankoll - 626126. Srivilliputtur (Via), Virudhunagar (Bt), Tamil Nadu Info@kalasalingam.ac.in www.kalasalingam.ac.in															
Course Code					Co	ourse	Nan	ıe]	L I	P	X	C
214BME1108		BIOMECHATRONICS												0	0	3
Prerequisite:	Nil	Vil													NA	
Course Catego	ourse Category: Honor Elective														Суре	:
Course descri	ptior	1														
i his course air biomechanical ar will cover state-o devices, rehabilita Course outcor On successful	ns to nd neu f-the ation r nes: com	build ro-sc -art i obots	i pros ientif n the , and e	sthesi fic pr field exoske	is arn incip of B eletons	ns and les u io me s. se the	a legs nderl echat	s. Thi ying ronic	s cour huma s inclus	se airr in mo uding be a l	is to p verner assisti	nt. Ad	e an u ditior hnole	nders nally, ogies,	stands the c	ing of ourse thetic
C01	То	unde	rstan	d the	basi	cs of	bio n	necha	anics							
CO2	То	have	adec	luate	knov	vledg	e on	senso	ors an	nd act	uator	•				
CO3	То	study	y abo	ut the	e meo	lical	instru	ımen	ts							
CO4	То	learn	abo	ut the	e sens	ory a	issist	devi	ces ar	nd we	earab	le me	chat	roni	cs.	
CO5	То	knov	v the	conc	epts	of act	tive a	nd pa	assive	e pros	stheti	c lim	bs			
СО						P	0							PS	0	
	1 2 3 4 5 6 7 8 9 10 11											12	1	2	3	4
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3	Η	Н	Н	М	Н	М	L	М	М	М		Н	Μ	Н	Н	М

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H-High, M-M	ediun	n, L-	Low													
Unit 1	BI	O M	ECH	ANI	CS A	ND S	SIGN	JAL]	PRO	CES	SING	;]	Hou	rs: 0	9	
Cardiovascular ergonomic, Re Isolation barrie	bic habil rs, B	omec litatio io-in	hanic on. B nage	es, N io-m proce	Iuscu edica essing	ıloske Il sig g.	eletal nals,	and Sign	l ort al ac	hope quisi	dic t tion a	oiom and s	echa signa	nics, 1 pro	hu ocess	man sing-
Unit 2	BIG	O SE	NSO	ORS A	AND	ACT	CUA'	FOR	5]	Hou	rs: 0	9	
Introduction to Bio mechatronics, Electrodes - Types, - Measurement of blood pressure - Blood Gas analyzers: pH of blood, Smart actuators for biological applications															ure -	
Unit 3	Mł	MEDICAL MEASUREMENTS Hours: 09														
Unit 3 MEDICAL MEASUREMENTS Hours: 09 Heart rate - Heart Sound - Pulmonary Function Measurements – Spirometer-Fingertip oximeter - ESR, GSR Measurements Spirometer-Fingertip															ertip	
Oximeter - ESR, GSR MeasurementsUnit 4SENSORY ASSIST DEVICES & WEARABLE MECHATRONICSHours: 09																
Hearing aids- i Respiratory aid Wearable Art rehabilitation s	mpla ls, T tificia yster	nts- actile al k n, W	Optic e dev Cidne earab	cal Pr vices ey, V ole ha	osthe for v Wirel nd re	etics, risual ess ehabil	Visu ly ch caps itatio	al Ne allen ule on.	europ ged. endo	rosth Wea scop	esis - rable e, V	Son mec Veara	ar ba chatro able	sed onics Ex	Syst dev oske	ems, vices letal
Unit 5	AC	TIV	E AN	ND P	ASS	IVE]	PRO	STH	ETIC	C LII	MBS]	Hou	rs: 0	9	
Introduction to Active Prosthe Mechanisms, P	pros esis-C Prostł	thetic Contr nesis	cs, Pa ol of Susp	ssive f Pro ensio	Pros sthet	thetic ic ar	cs-W ms a	alkin nd h	g Dy ands,	namio Leg	cs, Kr g Meo	nee a chan	nd Fo	oot F , An	roth kle-	esis, Foot
								Tot	al Le	cture	e hou	rs		4	5	
Text Books																
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Reference boo	k															
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2	Ray Par	ymor 1 Stai	nd To nford	ong K Publ	Kaiyu lishir	. — Ig, Cl	Bio-1 RC P	necha ress, 1	atron 2011	ics ir	Med	licin	e and	l He	altho	care∥

Anand Nagar, Krishnan	KALASALINGAN ACADEMY OF RESEARCH AND EDUCATION DEEMED TO BE UNIVERSITY) Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade kell - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu Info@kalasalingam.ac.in		kalas	alinga	Im.ac.						
Course Code	Course Name	L	Т	Р	X	С					
216BME4177	COGNITIVE NEUROSCIENCE	3	0	0	0	3					
Prerequisite: Ni	1	Sy NA	llab \	us i	revis	sion:					
Course Category: Honor Elective Course Type: Theory											
Course description											

This course explores the cognitive and neural processes that support sound, speech, music, attention, sleep, and consciousness. It introduces basic neuroanatomy and behavioral measures of cognition, and discusses methods by which inferences about the brain bases of cognition are made.

Course outcomes:
On successful completion of the course the students will be able toCO1Describe the functional neuroanatomy, pathways and its connectivity.CO2Explain the mechanism of learning, control and loss of memory.CO3Illustrate the process of sound, speech and music perception.

CO4 Describe sleep, levels of consciousness and sleeping disorders

CO5 Illustrate exceptional states of mind and purposeful thoughts and actions.

СО						PC)						PSO				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	
1	Н		М										Н			Н	
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3	Н												Н			Н	
4	Н												Н			Н	
5	Н												Н			Н	

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H - High, M	Medium, L – Low								
Unit 1	A FRAMEWORK FOR MIND AND BRAIN	Hours: 09							
Consciousness, Neuroanatomy Oscillations	Cortical Core, Connectivity, and Consistency. Brain Brain Pathways-Neuro connectivity, Brain Dynamics-E	Function-Functional Brain Rhythms and							
Unit 2	LEARNING AND REMEMBERING	Hours: 09							
Episodic Learn and Models, Co	ing and Memory, Memory Trace Formation and Consolidation transmission of Memory, Loss of memory	on, Memory Traces							
Unit 3	SOUND, SPEECH, AND MUSIC PERCEPTION	Hours: 09							
Introduction, A Cortex, Cortica	Model for Sound Processing, Sound and Hearing Basics, Pa I Auditory Functions and Pathways, Speech and Music Perce	thways to Auditory eption							
Unit 4	SLEEP AND LEVELS OF CONSCIOUSNESS	Hours: 09							
Introduction, D Sleep Disorder	Daily Rhythms for Sleep, Architecture of Sleep, Memory ans.	d Sleep, Dreaming,							
Unit 5	ATTENTION, CONSCIOUSNESS AND BRAIN DISORDERS	Hours: 09							
Waking: Purpo Mind. Brain Disord Sclerosis,Ataxi	oseful Thoughts and Actions, Consciousness, Attention, Exers:Acute spinal cord injury, Alzheimer's Disease, Ar a, Bell's Palsy, Brain Tumors, Cerebral Aneurysm, Epilepsy	xceptional States of myotrophic Lateral and Seizures.							
	Total Lecture hours	45							
Text Books									
1 Baars B, Gage NM. Fundamentals of cognitive neuroscience: a beginner's guide. Academic Press; 2018.									
Reference Boo	ks								
1	Eagleman D, Downar J. Brain and behavior: a cogn perspective. New York: Oxford University Press; 2016.	nitive neuroscience							
2	Baars B, Gage NM. Fundamentals of cognitive neuroscience Academic Press; 2013.	e: a beginner's guide.							
3 Passingham R. Cognitive neuroscience: a very short introduction. Oxford University Press; 2016 Sep 15.									

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Course Code					С	ourse	e Nan	ne				I	<u> </u>	C P	X	С
216BME4175					BIO	РНО	TON	ICS				2	2 1	0	0	3
Prerequisite: <mark>E</mark>	BME2	<mark>21</mark>]	<mark>Medi</mark>	<mark>cal o</mark> j	ptics	and la	asers					S N	Syll a NA	bus	revi	sion:
Course Catego	Course Type: Theory															
Course descrip	tion															
To understand the techniques and applications of photonics in the field of Biology and medicine																
Course outcon On successful	nes: completion of the course the students will be able to															
CO1	То	unde	erstan	d the	basio	cs of	light	intera	ction	tech	nique	s and	its j	prop	erties	5
CO2	То	unde	erstan	d the	instr	umer	itatio	n in th	ne op	tical s	sourc	es and	d fib	ers		
CO3	То	unde	erstan	d the	instr	umer	itatio	n in tł	ne op	tical o	detect	ors				
CO4	То	unde	erstan	d and	l anal	lyze t	he mi	crosc	opic	and s	pectr	oscop	oic to	echn	iques	5
CO5	То	anal	yze tł	ne ma	ijor re	ecent	appli	catio	ns of	photo	onics	in bio	olog	y		
СО	PO PSO															
	1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4															
1	Η	H H H H H H														
2	Η	Н		Н									Η	Μ		

3	Η	Н		Н									Н	М		
4	Η	Н		Н									Η	М		
5	Н	Н		Н									Н	Н		
H-High, M-Me	dium	i, L-I	Low													
Unit 1	In	trodı	uctior	n and	con	cepts							Hour	s: 12	2	
Biophotonics, s lightwave char interference, op	pectr acteri tical	al win istics, coher	ndow , pola rence,	s, lig rizati , ligh	ht abs ion, j t-way	sorpti photo ve mo	on, si on en olecul	ignal a ergy a ar dip	attenu and r oole in	nation nome nterac	n, biol entum etion	ogic , ref	al cel lectio	ls ano n, re	d tiss efrac	sues, tion,
Unit 2	Ol	ptical	l fibe	rs an	d sou	irces							Hour	s: 12	2	
Light-guiding p solid-core fiber LED's, laser die	orinci rs, cr odes,	ples, ystal supe	grade fiber rlumi	ed-in s, sil nesce	dex o ica f ent di	optica ibers, odes	ıl fibe , plas	ers, cl tic, g	harac lowir	teristi ng fit	ics of pers, :	gen radio	eral o ometr	optica y, ar	al fil c lai	bers, mps,
Unit 3	De	etecto	ors &	prot	oes								Hour	rs: 12	2	
Pin photodetect fiber probe con biosensors, fibe	or, av figura erbrag	valand ation gg gra	che pl and ti ating s	notod p geo senso	iode, ometr r, fib	mult y, op er na	itude tical nopro	detec senso obes	tors, rs, int	PMT terfer	, filtei ometi	rs, co ric se	oupler ensors	rs, cir s, cry	cula stal :	tors, fiber
Unit 4	M	icros	copic	& sj	pectr	oscoj	pic te	chniq	lues				Hour	s: 12	2	
Concepts and p multiphoton, R spectroscopy	orinci	iples n mic	of m crosco	icros opy,	copy FTIR	, reso , ph	olutio oton	n, dif corre	fracti lation	on li , ela	mit, (stic a	confo	ocal, diffus	fluor e co	resce	ence, ation
Unit 5	Ap	oplica	ation										Hour	rs: 12	2	
Nano biophoto nanoparticle de	nics, tectic	opti on	cal n	nanip	ulatio	on, n	nicros	scope	in a	n nee	dle,	neur	ophot	onic	s, si	ngle
	Το	otal L	.ectu	re ho	urs								60			
Text Books																
1	Ke Sp	eiser, oringe	G. er Sing	(2016 gapor	б). В re.	lioph	otoni	cs: C	Conce	pts t	o Ap	oplic	ations	s. Si	ngap	oore:

Reference Boo	ks
1	Handbook of Biophotonics. (2011). Germany: Wiley-VCH.
2	Nano Biophotonics: Science and Technology. (2007). Netherlands: Elsevier Science.
3	Shoham, S. (2020). Handbook of Neurophotonics. United States: CRC Press.

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Course Code					C	ourse	e Nan	ne				I	r 1	P	X	С
216BME4176	IE4176 BRAIN-COMPUTER INTERFACE 2 1												0	0	3	
Prerequisite: <mark>N</mark>	Medical electronics, signal processing r.1												sion:			
Course Catego	tegory: Honor Elective Course Type: Theory															
Course descrip	iption															
To understand, apply and analyze the Brain-Computer interface and its associated techniques in the effective usage of humans																
Course outcom On successful o	nes: comp	oletio	n of (the co	ourse	thes	stude	nts w	ill be	e able	e to					
CO1	To	unde	erstar	d the	braiı	n sigr	als a	nd its	attrit	outes						
CO2	To tra	o desi Inslati	gn ar ion	nd im	plem	ent b	rain s	signal	acqı	isitic	on via	feat	ure e	extra	ction	and
CO3	To	anal	yze tl	ne ins	trum	entati	on in	BCIs	8							
CO4	Тс	unde	erstar	id and	l anal	lyze t	he ap	plicat	ion o	of BC	Is in 1	notoi	con	trol		
CO5	To understand and analyze the application of BCIs in gadget control using LABVIEW environment															
СО	PO PSO															
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Η	Н											Н	Н		

2	Н	Н											Н	Н		
3	Н	Н	Н	Н									Н	Н		
4	Н	Н											Н	Н		
5	Н	Н			Н								Н	Н		
H-High, M-Me	edium	ı, L-1	LOW			-	-	-			-	-				
Unit 1	In	trodu	ictio	n]	Hour	s: 12	2	
Brain signals an noninvasive an	nd fea d elec	atures etrom	, reco agne	ording tic me	g EEC ethod	G, sigi s	nal pr	ocess	sing, l	BCI t	ypes,	comj	poner	nts of	finte	erest,
Unit 2	De	esign	& In	nplen	nenta	ntion]	Hour	s: 12	2	
Acquiring brain	n sign	als fi	om v	vithin	and	outsid	de the	brai	n, fea	ture e	extrac	tion,	featu	re tra	ansla	ation
Unit 3	BC	CIs]	Hour	s: 12	2	
BCIs that use F	2300 e	event	-relat	ed po	tentia	al, ser	nsorir	notor	[.] rhytł	nms, 1	brain	meta	bolic	sign	als	
Unit 4	A	oplic	ation	S]	Hour	s: 12	2	
A two-dimensivisuomotor tas	ional ks in fter b	brain a bra rain c	n-com ain-co lama	nputer ompu ge	r inte ter in	erface	asso asso	ociate alysis	d wit s, BC	th hu I to i	man mpro	natur ve co	ral m omm	iotor unica	cor ation	trol, and
Unit 5	Applications Hours: 12															
BCI to control a in state and chr	a mob onic s	oile ve strok	ehicle e, BC	and u I for	using patie	LabV nts w:	/IEW ith di	′ envi sorde	ronm ers of	ent, E conse	BCI in ciousr	the cness	comp	letely	y loc	ked-
	To	otal I	.ectu	re ho	urs							•	60			
Textbooks												I				
1	Az Ag	zar, oplica	A. T tions	. (2 . Ger	014). many	Bra : Spr	in-Co	ompu Inter	iter l	nterf	aces: ublish	Cur ing.	rrent	Tre	nds	and

2	Schalk, G., Mellinger, J. (2010). A Practical Guide to Brain–Computer Interfacing with BCI2000: General-Purpose Software for Brain-Computer Interface Research, Data Acquisition, Stimulus Presentation, and Brain Monitoring. United Kingdom: Springer London.
3	Wolpaw, E. W. (2012). Brain-Computer Interfaces: Principles and Practice. United Kingdom: Oxford University Press.
Reference Book	s
1	Recent Advances in Brain-Computer Interface Systems. (2011). Croatia: InTech.
2	Brain-Computer Interfaces: Lab Experiments to Real-World Applications. (2016). Netherlands: Elsevier Science.
3	Paszkiel, S. (2019). Analysis and Classification of EEG Signals for Brain- Computer Interfaces. Germany: Springer International Publishing.

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Course Code	•				C	ours	e Nai	ne				Ι	ני	P	X	С
216BME4176	5			A	RTIF	ICIA	L 0	RGA	NS			3	3 (0	0	3
Prerequisite: 1	Nil											S N	S yll a NA	bus	revi	sion:
Course Catego	ory: I	y: Honors Elective Course Type Theory												ype		
Course descrij	ption															
growing shorta will play a larg recovery or tran Course outcon On successful	ge of ger ro nsplar nes: comp	dono ole in ntatio	n of 1	ans, 1 aging	nakes g pati	s it cl ents	e gen ear th with	nat org end-s	gan a tage	ssista disea	nce a se by	and su	ıbsti /idir	tutiong a	n de ^v bridg	vices ge to
CO1	To u	nders	tand	the b	asic i	ntrod	uctio	n abo	ut the	artif	icial	organ	s.			
CO2	To a devid	pply ces	the e	engine	eering	g des	ign ii	n the	artifi	cial l	neart	and o	circu	ilato	ry as	sist
CO3	To u	nders	tand	and d	lesigr	the a	artific	ial ki	dney	and b	olood	•				
CO4	To design and develop the artificial lungs and pancreas.															
CO5	To a	pply	the er	ngine	ering	desig	n in t	the ca	rdiac	valv	e pro	sthesi	s.			
CO						Р	0							P	SO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	М		М		L	М			М	М		Н	Μ	Н	L	L

2	М		Н	Н	Н	Н	М	М	М	М		Η	М	Н	М	М
3	М		Н	Н	Н	Н	М	М	М	М		Η	М	Н	М	М
4	М		Н	Н	Н	Н	М	М	М	М		Η	М	Н	М	М
5	М		Н	Н	Н	Н	М	М	М	М		Η	М	Н	М	М
H-High, M-M	edium	ı, L-L	.ow													
Unit 1	INT	ROE	DUCI	TION	ТО	ART	IFIC	IAL	ORG	ANS		I	Iour	s: 09)	
Introduction to inflammation, Substitutive me	o art rejec edicin	ificial tion, ie, ou	l org corr tlook	ans: ection for o	Bior n. pr rgan	nateri oblen replae	als uns as	used ssocia nt, de	in a ited sign o	rtifici with consi	al org extrac deratio	gans orpo n, e	anc oreal valua	l pr blc ation	osthe ood proo	eses, low: cess.
Unit 2	AR' ASS	FIFI(SIST 1	CIAL DEV	, H ICES	IEAF S	RT	ANI) (CIRC	ULA	TORY	ľ	Hour	s: 09	•	
Engineering de introduction, to interfacing imp skin implants,	sign o otal ar olants maxil	of arti rtifici for so lofaci	ificial al hea oft tis ial im	hear arts & sues- plant	t and z ven sutu s, eye	circu tricul res ar e and	latory ar as nd all ear in	y assis sist d ied au nplar	st dev evice 1gme 1ts	vices, s, vas ntatic	blood scular j on devi	inte pros ces,	rfaci sthese perc	ng ir es, n sutan	npla on-b eous	nts – lood and
Unit 3	AR	FIFI	CIAL	, KIĽ	DNEY	AN	D AR	RTIFI	[CIA]	L BL	OOD	I	Hour	s: 09)	
ARTIFICIAL KIDNEY: Functions of the kidneys, kidney disease, renal failure, rena transplantation, artificial kidney, dialyzers, membranes for haemodialysis, haemodialysi machine, peritoneal dialysis equipment-therapy format, fluid and solute removal. ARTIFICIAL BLOOD: Artificial oxygen carriers, fluorocarbons, hemoglobin for oxygen carrying plasm expanders, hemoglobin based artificial blood.								renal lysis ZIAL asma								
Unit 4	AR' PAN	FIFI(NCRI	CIAL EAS	LUI	NGS	AND	AR	TIFIC	CIAL			ł	Hour	s: 09)	
ARTIFICIAL machine)-princ functions, hepa PANCREAS: diabetes, insuli	LUN tiple, tic fai Struct n, ins	GS: blocl ilure, ture a ulin t	liver k dia liver and fu herap	Gas gram suppo inctic by, ins	exch and ort sy ons of sulin	ange worl stems f pan admin	syst king, s, gen creas nistra	ems, artif eral r , end tion s	Card icial eplac ocrine syster	liopul lung emen e pan ns. Tr	monar versus t of fur creas cacheal	y b s na nctio and rep	ypas atural ons. 1 insu olaced	s (h l lun ART lin s ment	eart- ng. I IFIC secre	lung Liver LIAL tion, ices,

laryngeal replacement devices, Artificial esophagus Artificial Skin: Vital functions of skin, current treatment of massive skin loss, design principles for permanent skin replacement.										
Unit 5	CARDIAC VALVE PROSTHESES	Hours: 09								
CARDIAC V prostheses, tiss prosthetic hear design, vascul hyperplasia, gr	ALVE PROSTHESES: Mechanical valves, tissue valves sue versus mechanical, engineering concerns and hemodyn t valves, implications for thrombus deposition, durability, cu ar grafts-history, synthetic grafts, regional patency, thro aft infections	s, current types of amic assessment of rrent trends in valve ombosis, neointimal								
Total Lecture hours 45										
Text Books										
1	Biomedical Engineering Handbook-Volume 1, 2nd Edition CRC.	1 - by J.D.Bronzino,								
2	Biomedical Engineering Handbook-Volume 2 (2nd Edition CRC) - by J.D.Bronzino,								
3 Handbook of Biomedical Engineering. Bronzino. Joseph										
4 Handbook of Biomedical Instrumentation. R.S.Khandpur										
5 Artificial Organs. Erie.D.Blom, Howard.B.Rotham. Biomedical Engineering 5 Principles (Volume – II). David O. Cooney., Marcel Dekker Inc										

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Course Code	Course Name	L	Т	Р	X	С			
216BME4178	E-HEALTH SYSTEMS	3 0 0 3							
Prerequisite: Nil		Sy	llab	us r	evis	ion:			
Course Category	: Honor Elective	Co Th	ours eory	e Ty	ype:				
Course description	on	•							
1	1 Understand the basic concepts in Biomedical Informatics								
2	Apply the various aspects of health informatics and medical standards.								
3	Develop clinical decision support systems.								
4	Comprehend the basics of bioinformatics and the resource	ces i	n th	e fie	eld				
5	Design and implement the construction standards in a ho	spit	al.						
Course outcomes On successful co	s: mpletion of the course the students will be able to								
C01	CO1 To gain knowledge in various aspects of health informatics and medical standards.								
CO2	To apply these techniques in proper health care delivery								
CO3	Analyze various bioinformatics tools and explore the dat	abas	ses.						
CO4	Implementation of Standard in hospital.								

CO5	A	Apply the standards in proper health care delivery														
СО		PO PSO														
	1	2 3 4 5 6 7 8 9 10 11 12										12	1	2	3	4
1	М	М		М	М	L		L	L	L		L	Μ			
2	М	М		М	М	L		L	L	L		L		Μ		
3	М			М	М	L		L	L	L		L			L	
4	Н	Μ										L				Μ
5	Η	Η	L	М	М	L	L					L				Η
H-High, M-Me	ediun	n, L-L	low													
Unit 1	B	Biome	dical	Info	rmat	ics]	Hour	's: 9		
Historical high functional onli Informatics, Nu	nlight ine a arsing	s and ind o g Info	d Ev ffline rmati	olutio mod cs, Pi	on, H dules, ublic	lospit Hea Healt	al In ulth I h Inf	forma nform ormat	ation natics tics, I	Syst s, Me magi	em, edical ng in	its c Info forma	harao orma atics.	cteris tics,	stics Cli	and nical
Unit 2	E	lectr	onic	Patie	nt Re	ecord	and	Stan	dard	S]	Hour	s: 9		
Electronic Pati PACS, Medica Standards -JCA	ent R l Stan AHO,	Record Idards HIPA	l, Me s for V AA	edical Vocat	data oulary	form , ICE	ats, 1 9 10, 1	Medic DRG,	cal St MeS	anda H, U	rds, H MLS,	IL7, SNC	DIC)ME	OM, D. H	LO ealth	INC, ncare
Unit 3	E	lectr	onic	Decis	ion S	Suppo	ort Sy	ystem	S]	Hour	rs: 9		
Biomedical de Decision Supp Strategies for	cision ort, medi	n mal Meth cal ki	king. 10ds 10wle	Pro for edge a	babil deci cquis	istic sion sition	clinic supj , Prec	cal re port, lictive	asoni Clin e tool	ng. iical ls for	Med deci clinic	ical sion- al de	Kno supp ecisio	owleo ort on su	lge syst ppor	and ems, t
Unit 4	B	Bioinf	orma	tics [Fools]	Hour	s: 9		
NCBI, Human CLUSTALW,	Genc Phylo	ome P ogene	rojec tic an	t, Gei alyse	nBan s.	k, Sec	luenc	e alig	gnmei	nt, BI	LAST	, FA	STA,	,		
Unit 5	5 Norms for Hospitals Hours: 9															
Design and con- general guideli hospitals.	Design and construction standards for the hospitals, BIS –India, JCIA, AIA and NHS, general guidelines and standard for out-patient area, in-patient area and diagnostic area in the hospitals.															
								Tot	al Le	ectur	e hou	rs 4	15			

Text Books	
1	Edward H. Shortliffe, James J. Cimino, "Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Health Informatics)", 2014, 4th edition, Springer, New York.
Reference Books	
1	Kenneth R. Ong, "Medical Informatics: An Executive primer", 2015, 1stedition, HIMSS Publishing, Chicago
2	Lazakidou, Athina A., "Web-Based Applications in Healthcare and Biomedicine, Annals of Information Systems", 2010, 7thedition, Springer, New York.

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Course Code	Course Name												L	Т	Р	X	С
216BME4180	•				MIC	ROF	LUI	DICS					3	0	0	0	3
Prerequisite:	isite: Nil Syllabus revision: NA											sion:					
Course Catego	ory: H	Ionor	Elec	ctive									Co Th	ours eory	e T	ype:	
Course descri	ption																
This course a microfluidic sy	addres /stems	sses and	the jits ap	ohysio oplica	cal f tions	ounda in he	ations althc	s, too are.	ols, r	nethc	ods a	ind	dev	vice	s to	o de	esign
Course outcor On successful	nes: comp	oletio	n of 1	the co	ourse	the s	stude	nts w	rill be	e able	to						
CO1	Und	erstar	id the	e basi	c con	cepts	of pł	nysics	in m	icrof	luidic	cs.					
CO2	Iden micr	tify th ofluic	ne ma lic de	aterial evices	s and	l fabr	icatio	on tecl	hniqu	es fo	r prot	otyp	oing	g an	d pr	oduo	cing
CO3	Eval	uate t	he sy	vstem	using	g nun	nerica	ıl sim	ulatio	ons.							
CO4	Und	erstar	id an	d desi	gn di	igital	micro	ofluid	ic sys	stems	•						
CO5	Understand the fundamentals of computational microfluidics with applications in pulmonary and arterial drug delivery.																
СО						PC)								PS	0	
	1 2 3 4 5 6 7 8 9 10 11 12									1	2	3	4				
1	Н	Н]	H			

2	L		М								L	
3	Н	Н		L	М				L	Н	Н	
4			М								L	
5	Н	Н		L	М				L	Н	Н	

H - High, M - Medium, L - Low

Unit 1	Fundamental Concepts and Physics in Microfluidics	Hours: 9
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Basic Concepts of Liquids and Gases, Mass and Heat Transfer Principles for Fluid, Surfaces and Interfaces in Microfluidics, Development of Driving Forces for microfluidic Processes, Construction Materials Considerations.

Unit 2	Microfluidics Devices: Fabrication and Surface Modification	Hours: 9
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Microfluidics Device Fabrication – Silicon and Glass Fabrication Process, Polymer Fabrication Process, Fabrication for Emerging Microfluidics Devices.

Surface Modification in Microfluidics Fabrication - Plasma Treatment, Surface Modification Using Surfactant, Surface Modification with Grafting Polymers, Nanomaterials for Bulk Modification of Polymers.

Unit 3	Numerical Simulation in Microfluidics	Hours: 9
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Numerical Simulation Models in Microfluidics - Molecular Dynamics (MD), The Direct Simulation Monte Carlo (DSMC) Method, The Dissipative Particle Dynamics (DPD), Continuum Method (CM), The Lattice Boltzmann Method (LBM), Computational Fluid Dynamics (CFD).

Numerical Simulation Software in Microfluidics - CFX Software:Microfluidics Applications, FLOW-3D Software: Microfluidics Applications, Other Software: Microfluidics Applications.

Unit 4	Digital Microfluidic Systems	Hours: 9
Comparison be	tween the processes using traditional automation methods	versus microfluidi

ics systems, Types of Digital Microfluidic Systems, DMF Chip Fabrication Techniques, Different Electrode Configurations in DMF Systems, Digital Microfluidic Working Principle, Electrical Signals Used and Their Effect on the DMF Operations, Droplet Metering and Dispensing Techniques in DMF Systems, The Effect of the Gap Height between the Top Plate and the Bottom Plate in DMF Systems, Modeling and Controlling Droplet Operations in DMF Systems, **Examples for Chemical and Biological Applications**

Performed on the DMF Platform

Т

Unit 5	Computational Microfluidics Applied to Drug Delivery in Pulmonary and Arterial SystemsHours: 9											
Modeling Methods – Governing equations, model closure, Fluid–Particle Dynamics Modeling Ferrofluid Dynamics, Nonspherical Particle Dynamics, Flow through Porous Media, Pulmonary Drug Delivery, Intravascular Drug Delivery.												
	Total Lecture hours	45										
Text Books												
1	Song, Yujun, Daojian Cheng, and Liang Zhao, Fundamentals, Devices, and Applications. John Wiley & So	eds. <i>Microfluidics:</i> ons, 2018.										
Reference Books												
1	1 Tabeling, Patrick. <i>Introduction to microfluidics</i> . OUP Oxford, 2005.											
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Course Code	Course Name	L	Т	Р	X	С						
216BME4179	MACHINE LEARNING	3	0	0		3						
Prerequisite: N	Prerequisite: Nil Syllabus revision: NA											
Course Catego	ry: Honor Elective	Co Th	ours eory	e Ty	ype:							
Course descrip	tion											
1	1 To introduce students to the basic concepts and techniques of Machine Learning											
2	To have a thorough understanding of the Supervised and U learning techniques	Jnsu	perv	vise	d							
3	To study the various probability based learning techniques											
4	To understand graphical models of machine learning algor	ithn	ıs									
5	To apply the knowledge for developing Probabilistic Learn	ning	•									
Course outcom On successful o	es: completion of the course the students will be able to											
CO1	Distinguish between, supervised, unsupervised and semi-se	uper	vise	ed le	arni	ng						
CO2 Apply the appropriate machine learning strategy for any given problem												
C03	Suggest supervised, unsupervised or semi-supervised le for any given problem	earni	ng	algo	orith	ms						
CO4	Design systems that uses the appropriate graph models of	mac	hine	lea	rnin	g						

C05	Mo effi	Modify existing machine learning algorithms to improve classification efficiency														
СО						PO)							PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
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2	М	М		М	М	L		L	L	L		L		М		
3	М			Μ	М	L		L	L	L		L			L	
4	Н	М										L				М
5	Н	H H L M M L L I										L				Н
H-High, M-Me	H-High, M-Medium, L-Low															
Unit 1	Int	Introduction Hours: 9														
Design a Lea Learning Task Version Spaces Perceptron –Lin	ng – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – n a Learning System – Perspectives and Issues in Machine Learning – Concept ng Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – on Spaces and the Candidate Elimination Algorithm – Linear Discriminants – otron – Linear Separability – Linear Regression.													ncept sis – nts –		
Unit 2	LI	NEAI	R MO	ODEI	LS]	Hour	rs: 9		
Multi-layer Pe Multi-layer Per Propagation –R Dimensionality	ercept cepti adial –Inte	ron - on ir l Ba erpola	-Goir n Pra sis I ations	ng Fo ctice Funct s and	orwai –Exa ions Basis	rds –(mples and Func	Going s of u Splin ctions	g Ba ising nes – –Suj	ckwa the l Conc pport	rds: MLP epts Vect	Back –Ove –RBI or Ma	Trviev rviev F Ne achin	opaga v –De etwor es-De	tion erivin k – eep I	Err ng B Curse Learr	ror – ack- e of ning.
Unit 3	TR	EE A	ND	PRO	BAB	ILIS	ΓΙΟ	MOD	ELS]	Hour	's: 9		
Learning with Trees –Decision Trees –Constructing Decision Trees –Classification and Regression Trees –Ensemble Learning –Boosting –Bagging –Different ways to Combine Classifiers –Probability and Learning –Data into Probabilities –Basic Statistics –Gaussian Mixture Models –Nearest Neighbor Methods –Unsupervised Learning –K means Algorithms –Vector Quantization.																
Unit 4	DIMENSIONALITY REDUCTION AND Hours: 9 EVOLUTIONARY MODELS															
Dimensionality Reduction –Linear Discriminant Analysis –Principal Component Analysis – Factor Analysis –Independent Component Analysis –Locally Linear Embedding –Isomap – Self Organizing Feature Map -Least Squares Optimization –Evolutionary Learning –Genetic																

algorithms –Genetic Offspring: -Genetic Operators –Using Genetic Algorithms – Reinforcement Learning –Overview –Getting Lost Example –Markov Decision Process											
Unit 5	PROBABILISTIC LEARNING	Hours: 9									
Bayesian Learning, Bayes Optimal Classifier, Naïve Bayes Classifier, Bayesian Belier Networks, Mining Frequent Patterns											
	Total Lecture hours 45										
Text Books											
1	EthemAlpaydin, —Introduction to Machine Learnin Computation and Machine Learning Series)I, Third Edition	ng 3e (Adaptive on, MIT Press, 2014									
Reference Bool	ks										
1	Jason Bell, —Machine learning –Hands on for Develo ProfessionalsI, First Edition, Wiley, 2014	pers and Technical									
2	Peter Flach, —Machine Learning: The Art and Science Make Sense of Datal, First Edition, Cambridge University	of Algorithms that Press, 2012									
3 Stephen Marsland, —Machine Learning –An Algorithmic Perspectivel, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014											
4 Tom M Mitchell, —Machine Learning ^{II} , First Edition, McGraw Hill Education, 2013											

Anand Nagar, Krishmankoil - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu info@kalasalingam.ac.in www.kalasalingam.ac.in www.kalasalingam.ac.in www.kalasalingam.ac.in www.kalasalingam.ac.in www.kalasalingam.ac.in																	
Course Code	e				(Cour	se Na	me				Ι	. , 	Г	P	X	С
216BME417	2		Al	DVA	NCE	D OF	TIC	AL II	MAG	ING		3	3	0	0	0	3
Prerequisite: Medical Optics & Lasers Syllabus revision: NA NA																	
Course Category: Honor Elective Course Type: Theory																	
Course descrip	Course description																
To understand the advanced optical imaging techniques in the domain of biology and medicine																	
Course outcomes: On successful completion of the course the students will be able to																	
CO1 To understand and analyze the diffuse optical imaging techniques																	
CO2		To u	nders	tand	the o	ptics	invol	ved ir	n end	oscop	y tec	hniqu	ies				
CO3		To u	nders	tand	the ad	lvanc	emer	nt of p	olari	zatio	n-base	ed im	agi	ng			
CO4		To u	nders	tand	the te	chnic	ques i	n con	focal	imag	ging						
CO5		To u	nders	tand	the te	chnic	ques i	n opti	ical c	ohere	nce t	omog	grap	hy			
СО							PO								PS	0	
	1	2	3	4	5	6	7	8	9	10	11	12	1		2	3	4
1	Η	Н											Н]	H		
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3	Н	Η	н Н Н Н Н Н														
4	Н	Η											Н]	H		
5	Η	Н											Н]	H		
H - High, M - 1	H - High, M - Medium, L - Low																

Unit 1	DOI Hours: 12										
Tissue optics, instru	mentation, DOT, DOI combined with other imaging mo	odalities									
Unit 2	Endoscope Optics	Hours: 12									
Basic optics, ray ler	nses, objective lenses, illumination systems, wireless end	loscopes									
Unit 3	Polarization Imaging	Hours: 12									
Polarized light-tissu effects in optical sys	e interaction with tissues, imaging systems, polarizers, re stem	tarders, polarization									
Unit 4	Confocal Imaging	Hours: 12									
Components and re system	quirements, scanning systems, optical design, fiber-opt	ic confocal imaging									
Unit 5	ОСТ	Hours: 12									
Introduction and comeasuring light economic generation, OCT is ophthalmology	omparison with other imaging modalities, imaging uses hoes using interferometry, image resolution, detection system, OCT and optical biopsy, application in car	light versus sound, 1 sensitivity, image ncer diagnosis and									
	Total Lecture hours	60									
Text Books											
1	Liang, R. (2010). Optical Design for Biomedical Ima Society of Photo Optical.	ging. United States:									
2 Liang, R. (2013). Biomedical Optical Imaging Technologies: Design and Applications. Germany: Springer Berlin Heidelberg.											
Reference Books											
1	Fujimoto, J. G., Farkas, D. (2009). Biomedical Optic Kingdom: Oxford University Press, USA.	cal Imaging. United									

KALASALINGAN ACADEMY OF RESEARCH AND EDUCATION DEEMED TO BE UNIVERSITY Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade Anand Nagar, Krishnankoll - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu info@kalasalingam.ac.in www.kalasalingam.ac.in																	
Course Code					(Cours	se Na	me					I	Т	Р	x	С
216BME4182	;			PF	ROST	THE	FIC S	SCIE	NCE				3	0	0	0	3
Prerequisite:	isite: Nil														bus ion	5 : NA	Ą
Course Categ	ourse Category: HonorElective Course Type: Theory																
Course descri	ourse description																
This course introduces the technologically advanced solution to improve the mobility of lower limb amputees.																	
Course outcomes: On successful completion of the course the students will be able to																	
CO1	Unde	erstar	nd the	e gene	eral is	sues	with	moto	r cont	rol aı	nd co	ordin	ateo	d m	ove	men	ts.
CO2	Desi	gn an	nd dev	velop	hydra	aulic	powe	er and	cont	rol sy	rstem						
CO3	Mod	lel an	d sim	ulate	biolo	gical	ly ins	pired	syste	ems.							
CO4	Desi	gn an	nd dev	velop	the b	elow	- and	abov	e-kne	e pro	sthes	es.					
CO5	Cond	duct e	experi	iment	s to e	evalua	ate the	e pros	sthetio	c leg.							
СО						Р	0								PS	0	
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3	Η	Н	М		L								Н	Н		
4	Н	Н	М			L							Н	Н		
5	Н	Н			L									Н		
H - High, M - Medium, L – Low																
Unit 1	Hur	nan 1	noto	r syste	em								Ho	ours:	9	
Human motor system, Motor Human moven prosthetic devi	contr mem nent t ce, Si	ol, M ory a transi mula	lotor nd le tion f	redund arning from s of clim	danc g, Po sittin lbing	y and stural g to y varie	l opti l con climt ous ty	miza trol, I oing, /pes c	tion, Biomo Kine of stai	Adap echar matic rs.	otabili nical a anal	ity of analys ysis o	the sis of of th	hum f mo e ab	an m vem ove-	iotoi ent - knee
Unit 2	Hyd	lraul	ic po	wer ai	nd co	ontro	l sys	tem					Ho	ours:	9	
Parameter defi knee prosthesi actuators, Pow active robotic p	nition s, cor er sup prosth	and astructopply structops and the second structors and the second stru	desig tive (select	n of th concep ion fo	ne hy ot of r hy	drau a lir drauli	lic lir near a ic po	iear a actuat wer u	ctuato cor, g nit, H	orfor lobal Iydra	mech hydr ulic o	naniza raulic contro	tion syst ol of	of th em f an ii	ne ab for li ntelli	ove- near gent
Unit 3Prosthetic modelling and simulationHours: 9																
General proceed of the above-ket of the DC engineer passivity prince	lure f nee pr ine, R iple, S	or sin rosthe loboti Simul	nulat esis, l c ma ation	ions, N Model nipula result	Mode of h tor c s of	elling ydrau contro the dy	biol bilic a bl tecl ynam	ogica ctuato hniqu ic mo	lly in or for es, R odel a	spire knee obust nd co	d sys and t cont ontrol	tems, ankle trol th ler.	Ana join eory	lytic ts, N base	al m Iode ed oi	odel lling 1 the
Unit 4	Pro	sthet	ic des	sign a	nd p	rotot	yped	evelo	pme	nt			Ho	ours:	9	
SmartLeg over kinematics of pressure resear	view, the a ch, D	Artif above ynam	ficial -knee iics-b	foot, H eprosth ased a	Proto nesis loction	otype , Mo 1 reco	deve tion ogniti	lopme analy onfor	ent, E vsis a moto	xperind nd fi	iment nite entior	al inv eleme n pred	estig ent a lictio	gation naly on.	n inte sis,	o the Foot
Unit 5	Exp	erim	ental	valid	atio	n of t	hepr	osthe	tic le	g			Ho	ours:	9	
Adaptive changes in motor patterns, Testing of the hydraulic actuator, Measurements on subjects with and without amputation, Testing the first prototype with actuated knee and ankle joints, Prototype with actuated knee and ankle joints.																
]	Fotal	Lect	ure h	ours	45			
Text Books																
223 KARE							Der	artn	nent	of B	iome	dica	En	gine	erin	12

1	Jelacic, Zlata, RemzoDedic, and HarisDindo. <i>Active Above-Knee Prosthesis: A Guide to a Smart Prosthetic Leg.</i> Academic Press, 2020.									
Reference Boo	oks									
1 Taktak, Azzam, et al., eds. <i>Clinical engineering: a handbook for clinical and biomedical engineers</i> . Academic Press, 2019.										

KALASALINGAN CADEMY OF RESEARCH AND EDUCATION DEEMED TO BE UNIVERSITY) Inder sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade																	
Course Code					C	ourse	e Nan	ne				1	Ľ	Т	Р	X	С
216BME4181				0	RTH	ΟΤΙΟ	C SCI	IENC	CE				3	0	0	0	3
Prerequisite: Nil Syllabus revision: NA																	
Course Catego	Course Category: Honor Elective Course Type: Theory																
Course descri	ption																
This course aims at designing of various mobility aids for patient with disabilities and gait analysis.																	
Course outcom On successful	Course outcomes: On successful completion of the course the students will be able to																
CO1	Under and 1	erstar Identi	nd the fy th	Anat e tool	omic s, tec	and B hniqu	iomeo ues ar	chanic nd pro	al Pri	nciple es in c	es Rel desig	ated to n of c	o O orth	rtho otio	otic l cs.	Prov	ision
CO2	Iden uppe	tify th r extr	ne cor remit	mpon y.	ents a	and fa	abrica	tion j	proce	ss foi	r prot	otypi	ng	the	har	nd ar	nd
CO3	Unde	erstar	nd the	desi	gn pr	incip	les of	foot	ortho	ses.							
CO4	Iden	tify tl	ne co	mpon	ents	requi	red fo	or the	desig	n of l	lower	limb	or	tho	ses.		
CO5	Disc	uss tł	ne coi	npon	ents 1	requir	red to	build	l spec	ial pu	urpos	e ortł	1056	es.			
СО						Р	0								PS	50	
	1	1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4															
1	М	1 M M															

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2	Μ	Μ											М			
3	Μ	Μ											Μ			
4	Μ	М											М			
5	Μ	Μ											М			
H - High, M - Medium, L - Low																
Unit 1	ait 1 Foundations of Orthotics Hours: 12															
Foundations of Occupation - B Orthotic Proces Orthotic Provis Reasoning for (Ortho ased sses, ' sion, Ortho	otics Orth Tools Clini tic Fa	- Def otic I s and cal E abrica	initio nterv Tech xami ation.	n of S entio nique natio	Splint n, Ma es, Ar n and	and (ateria natom I Imp	Drtho als an nic an licati	sis, C nd Te nd Bic ons fe	harac chno omecl or Or	terist logy nanica thotic	ics of for (al Pri c Inte	f an Io Ortho incipl erven	deal (otic S es R tion,	Orth Scier elate Clii	osis, nce - ed to nical
Unit 2	Ort	hoses	s in tl	ne Ma	anag	emen	t of I	Iand	Dysf	uncti	on]	Hour	s: 9		
Immobilization Orthoses, Bion Tips for Dyna Precautions for Orthoses.	, Ort necha mic a M	hotic nical Ortho	Prin otic l zatio	the ciple Provis	Fing s, Co sion, mam	ers. I ommo Mate ic) Or	Mobil n Fea erials rthosi	lization atures and s, Cl	on Or s of M Equi inical	rthose Mobil pmer Con	es - ' lization at for sidera	Fype on O a I ation	es of Orthose Dynan as for	Moł es, T nic (Moł	oiliza Techi Orth	ation nical osis, ation
Unit 3	Foo	t Ort	hose	8]	Hour	s: 9		
History of the F Gait, Biomech Weight-Bearing Intervention, M Deformity, Or Orthoses and L	History of the Functional Foot Orthosis, Triplanar Structure of the Foot, Function of the Foot in Gait, Biomechanical Examination, Non–Weight-Bearing Open Chain Examination, Static Weight-Bearing Closed Kinetic Chain Examination, Functional Foot Orthoses, Goals of Orthotic Intervention, Measurement and Fabrication, Managing Rearfoot Deformity, Managing Forefoot Deformity, Orthotic Checkout and Troubleshooting, Controversy With Root's Paradigm, Orthoses and Lower Extremity Function.										ot in tatic notic efoot igm,					
Unit 4	Low	ver E	xtrer	nity (Orth	oses]	Hour	s: 12	2	
Biomechanics modifications, orthoses, Hip or	of th Ankler rthose	ne hi e–foo es, H	ip, k ot ort ip–kr	nee, hoses iee–ai	and , Kn nkle-	ankle ee–ar foot o	e, Bio 1kle–1 1000 orthos	omec foot (ses, C	hanic orthos Compo	s of es - ound	the cont ortho	foot, rollii ses.	, Sho ng the	es a e kno	ind ee, H	shoe Knee
Unit 5	Special Purpose OrthosesHours: 12															

Orthoses for Spinal Dysfunction - Anatomy and Biomechanics, The Three-Column Concept, Scoliosis - Types of braces. Orthoses for the Pediatric Population. Lower limb orthoses for persons who have had a stroke.Knee orthoses for sports-related disorders.

	Total Lecture hours	45
Text Books		
1	Chui, Kevin C., et al. Orthotics and Prosthetics in Reh Elsevier Health Sciences, 2019.	abilitation E-Book.
2	Coppard, Brenda M., and Helene Lohman. Introduction to Clinical Reasoning and Problem-Solving Approach. Elsevi 2019.	Orthotics E-Book: A ier Health Sciences,
3	Hsu, John D., John Michael, and John Fisk. AAOS Atlas of or devices e-book. Elsevier Health Sciences, 2008.	rthoses and assistive
Reference Boo	oks	
1	Werd, Matthew B., E. Leslie Knight, and Paul R. Langer, ed and orthoses in sports medicine. New York: Springer, 2010	ls. Athletic footwear).