



**KPR Institute of  
Engineering and  
Technology**

Learn Beyond (Autonomous, NAAC "A")

Avinashi Road, Arasur, Coimbatore.

**Great  
Place  
To  
Work®**

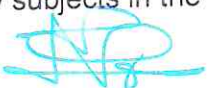
**Certified**

MAR 2022 - MAR 2023

INDIA™

# **B.E. Biomedical Engineering Curriculum and Syllabi Regulations – 2021(Revised)**

**Curriculum and Syllabi Comparison – Regulations 2021 (Revised)**

Curriculum and Syllabi Comparison																																																																																			
Curriculum / syllabi	Semester	Existing controlled copy of syllabus book (Prepared during Nov / Dec 2023)	Revised controlled copy of syllabus book (Prepared during June / July 2024)																																																																																
Curriculum / Syllabi	-	Existing controlled copy has five verticals.	<p>Included new vertical VI – Medical Systems</p> <p><b>U21BMP41 – Ophthalmology Systems</b></p> <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr></table> <p><b>U21BMP42 – Pulmonology Systems</b></p> <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr></table> <p><b>U21BMP43 – Gynecology and Obstetric Systems</b></p> <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr></table> <p><b>U21BMP44 – Neurology Systems</b></p> <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr></table> <p><b>U21BMP45 – Orthopedic Systems</b></p> <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr></table> <p><b>U21BMP46 – Urologic and Nephralgic Systems</b></p> <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr></table> <p><b>U21BMP47 – Chemotherapy Techniques</b></p> <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr></table> <p><b>U21BMP48 – Pediatric Systems</b></p> <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr></table>	L	T	P	J	C	3	0	0	0	3	L	T	P	J	C	3	0	0	0	3	L	T	P	J	C	3	0	0	0	3	L	T	P	J	C	3	0	0	0	3	L	T	P	J	C	3	0	0	0	3	L	T	P	J	C	3	0	0	0	3	L	T	P	J	C	3	0	0	0	3	L	T	P	J	C	3	0	0	0	3
L	T	P	J	C																																																																															
3	0	0	0	3																																																																															
L	T	P	J	C																																																																															
3	0	0	0	3																																																																															
L	T	P	J	C																																																																															
3	0	0	0	3																																																																															
L	T	P	J	C																																																																															
3	0	0	0	3																																																																															
L	T	P	J	C																																																																															
3	0	0	0	3																																																																															
L	T	P	J	C																																																																															
3	0	0	0	3																																																																															
L	T	P	J	C																																																																															
3	0	0	0	3																																																																															
L	T	P	J	C																																																																															
3	0	0	0	3																																																																															
Curriculum / Syllabi	-	Removed subjects from verticals IV	Included new subjects in the verticals IV 																																																																																



		U21BMP32 – Bioinformatics	U21BMP49 – AI and ML for Medical Diagnostics
		U21BMP28 – Data Mining and Pattern Recognition	U21BMP50 – Medical Data Visualization
		U21BMP26 – AI for Medical Diagnostics	U21BMP51 – Cybersecurity for Medical Data



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
SRASUR COIMBATORE-641 407

**Curriculum and Syllabi Comparison – Regulations 2021 (Revised)**

Curriculum / syllabi	Semester	Existing controlled copy of syllabus book (Prepared during Nov / Dec 2023)	Revised controlled copy of syllabus book (Prepared during June / July 2024)
Curriculum / Syllabi	VII	Project Phase I – U21BM706  Evaluation pattern changed	Project Phase I – U21BM706  <b>Internal Assessment (60 Marks)</b> Review I – 10 marks Review II – 20 marks Review III – 30 marks  <b>End semester Examinations (40 Marks)</b> <b>Project Report</b> Supervisor – 10 marks External – 10 marks <b>Viva-Voce</b> Internal – 10 marks External – 10 marks
Curriculum / Syllabi	VIII	Project Phase II – U21BM802  Evaluation pattern changed	Project Phase II – U21BM802  <b>Internal Assessment (60 Marks)</b> Review I – 10 marks Review II – 20 marks Review III – 30 marks  <b>End semester Examinations (40 Marks)</b> <b>Project Report</b> Supervisor – 10 marks External – 10 marks <b>Viva-Voce</b> Internal – 10 marks External – 10 marks







Curriculum and Syllabi Comparison – Regulations 2021(Revised)

Curriculum / Syllabi	Semester	Existing controlled copy of syllabus book (Prepared during June / July 2023)	Revised Controlled copy of syllabus book (Prepared during Nov / Dec 2023)																				
Curriculum & Syllabi	VI	U21BM605 Biomechanics <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>2</td><td>0</td><td>0</td><td>2</td><td>3</td></tr></table>	L	T	P	J	C	2	0	0	2	3	U21BM603 Biomechanics <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>2</td><td>0</td><td>2</td><td>0</td><td>3</td></tr></table>	L	T	P	J	C	2	0	2	0	3
L	T	P	J	C																			
2	0	0	2	3																			
L	T	P	J	C																			
2	0	2	0	3																			
Curriculum	VI	U21BM606 Proto Studio II	U21BM605 Proto Studio II (Course code change)																				
Curriculum & Syllabi	VII	U21BM703 Rehabilitation Engineering <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>3</td><td>0</td><td>0</td><td>2</td><td>4</td></tr></table>	L	T	P	J	C	3	0	0	2	4	U21BM707 Rehabilitation Engineering <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr></table>	L	T	P	J	C	3	0	2	0	4
L	T	P	J	C																			
3	0	0	2	4																			
L	T	P	J	C																			
3	0	2	0	4																			
Curriculum & Syllabi	VII	U21BM706 Medical Image Processing Laboratory <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>0</td><td>0</td><td>4</td><td>0</td><td>2</td></tr></table>	L	T	P	J	C	0	0	4	0	2	U21BM708 Medical Image Processing Laboratory <table><tr><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr><tr><td>0</td><td>0</td><td>2</td><td>0</td><td>1</td></tr></table>	L	T	P	J	C	0	0	2	0	1
L	T	P	J	C																			
0	0	4	0	2																			
L	T	P	J	C																			
0	0	2	0	1																			
Curriculum	VII	U21BM705 Project Phase I	U21BM706 Project Phase I (Course code change)																				

HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407



B.E. - BM - R2021 - CBCS

#### **I. Vision and Mission of the Institute**

##### **Vision**

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

##### **Mission**

- Commitment to offer value-based education and enhancement of practical skills.
- Continuous assessment of teaching and learning processes through scholarly activities.
- Enriching research and innovation activities in collaboration with industry and institutes of repute.
- Ensuring the academic processes to uphold culture, ethics and social responsibilities.

#### **II. Vision and Mission of the Department**

##### **Vision**

To be a centre of excellence for dissemination of knowledge, research and development in biomedical engineering to serve the society with moral values.

##### **Mission**

The Mission of the Department is to

- Impart value-based education in biomedical engineering using modern equipment and tools
- Build an integrated team of biomedical engineers to foster technologies through research, development and innovation
- Provide healthcare industries with solutions imbibed through lifelong learning with ethics and moral values.

#### **III. Program Educational Objectives (PEOs)**

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

**PEO1:** Apply the knowledge gained from biomedical engineering to help solve the technological problems in industries.

**PEO2:** Design and develop healthcare products and processes through continuous skill upgradation and research.

**PEO3:** Demonstrate professional and ethical standards of behavior and commit to lifelong learning to meet the needs of society.

#### **IV. Program Outcomes (POs)**

Graduates of Biomedical Engineering will be able to

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

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

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



**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 modeling to complex Biomedical engineering activities with an understanding of the limitations.

**PO6 The engineer and society:** Apply reasoning informed by the contextual knowledge to access societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

**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.

#### **V. Program Specific Outcomes (PSOs)**

Graduates of Biomedical Engineering will be able to

**PSO1:** Design and evaluate medical solutions using biosensors, biomaterials, biomechanics, and diagnostic and therapeutic equipment for the healthcare industries.

**PSO2:** Identify, analyze, solve and develop algorithms for addressing healthcare problems using the software skills acquired through bio-signal and image processing advancements.





# B.E. - BM - R2021 - CBCS

## VI. Mapping of Course Outcomes with Program Outcomes

SEM	Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
SEM I	Heritage of Tamils	-	-	-	-	-	-	✓	✓	-	✓	-	✓	-	-
	Calculus and Differential Equations	✓	✓	-	-	-	-	-	-	-	-	-	✓	✓	-
	Basics of Electrical and Electronics Engineering	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓	-
	English for Technologists	-	-	-	-	-	-	-	✓	✓	✓	-	✓	-	-
	Engineering Physics	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
	Engineering Chemistry	✓	✓	-	-	-	-	✓	-	✓	-	-	✓	✓	-
	Problem Solving and C Programming	✓	✓	✓	✓	-	✓	-	✓	✓	✓	-	✓	-	✓
	Engineering Graphics	✓	✓	✓	-	✓	-	-	✓	-	✓	-	✓	-	✓
	Tamils and Technology	-	-	-	-	-	-	✓	✓	-	✓	-	✓	-	-
	Transforms and its Applications	✓	✓	-	-	-	-	-	-	-	-	-	-	-	✓
SEM II	Medical Physics	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓	-
	Devices and Integrated Circuits	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	✓
	Personality Enhancement	-	-	-	-	-	-	-	✓	✓	✓	-	✓	-	-
	Python Programming	✓	✓	✓	✓	✓	-	-	✓	✓	✓	-	✓	-	✓
	Fundamentals of Biochemistry	✓	✓	✓	-	-	-	✓	✓	✓	✓	-	✓	✓	-
	Devices and Integrated Circuits Laboratory	✓	✓	✓	✓	✓	-	-	✓	✓	✓	-	✓	✓	-
	Engineering Studio	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓	✓	-

[illegible]



SEM VI		SEM VII		SEM VIII		VERTICAL I	
Microcontroller Laboratory	✓	✓	✓	✓	✓	✓	✓
Proto Studio I	✓	✓	✓	✓	✓	✓	✓
Diagnostic and Therapeutic Equipment	✓	✓	✓	✓	✓	✓	✓
Hospital Management	✓	✓	✓	✓	✓	✓	✓
Biomechanics	✓	✓	✓	✓	✓	✓	✓
Soft Skills - III	-	-	-	-	-	-	-
Diagnostic and Therapeutic Equipment Laboratory	✓	✓	✓	✓	✓	✓	✓
Proto Studio II	✓	✓	✓	✓	✓	✓	✓
Radiological Equipment	✓	✓	✓	✓	✓	✓	✓
Medical Image Processing	✓	✓	✓	✓	✓	✓	✓
Rehabilitation Engineering	✓	✓	✓	✓	✓	✓	✓
Medical Image Processing Laboratory	✓	✓	✓	✓	✓	✓	✓
Project work Phase - I	✓	✓	✓	✓	✓	✓	✓
Project work Phase - II	✓	✓	✓	✓	✓	✓	✓
Industrial training/Internship	✓	✓	✓	✓	✓	✓	✓
Nanotechnology in Medicine	✓	✓	✓	✓	✓	✓	✓
Advances in Drug Delivery	✓	✓	✓	✓	✓	✓	✓
Immunoengineering	✓	✓	✓	✓	✓	✓	✓
Biosensors	✓	✓	✓	✓	✓	✓	✓
Tissue Engineering	✓	✓	✓	✓	✓	✓	✓
Bioprinting	✓	✓	✓	✓	✓	✓	✓

[illegible]

[illegible]





**B.E. BIOMEDICAL ENGINEERING  
REGULATIONS – 2021 (Revised)  
For the students admitted 2022 onwards  
CHOICE BASED CREDIT SYSTEM  
CURRICULUM FOR I - VIII SEMESTERS  
SEMESTER I**

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21GEG01	Heritage of Tamils	HSMC	1	0	0	0	1
2	U21MA101	Calculus and Differential Equations	BSC	3	1	0	0	4
3	U21EEG01	Basics of Electrical and Electronics Engineering	ESC	3	0	0	0	3
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>								
4	U21EN101	English for Technologists	HSMC	1	0	2	0	2
5	U21PH101	Engineering Physics	BSC	2	0	2	0	3
6	U21CY101	Engineering Chemistry	BSC	2	0	2	0	3
7	U21CSG01	Problem Solving and C Programming	ESC	2	0	2	0	3
<b>LABORATORY COURSES</b>								
8	U21MEG01	Engineering Graphics	ESC	0	0	4	0	2
<b>MANDATORY NON CREDIT COURSES</b>								
9	U21MYC01	Induction program	MNC	Three Weeks				
<b>TOTAL</b>				<b>14</b>	<b>1</b>	<b>12</b>	<b>0</b>	<b>21</b>

**SEMESTER II**

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21GEG02	Tamils and Technology	HSMC	1	0	0	0	1
2	U21MA202	Transforms and its Applications	BSC	3	0	0	0	3
3	U21PH202	Medical Physics	BSC	3	0	0	0	3
4	U21BM203	Devices and Integrated Circuits	ESC	3	0	0	0	3
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>								
5	U21EN201	Personality Enhancement	HSMC	1	0	2	0	2
6	U21CSG02	Python Programming	ESC	2	0	2	0	3
7	U21CY201	Fundamentals of Biochemistry	BSC	2	0	2	0	3
<b>LABORATORY COURSES</b>								
8	U21BM204	Devices and Integrated Circuits Laboratory	ESC	0	0	4	0	2
9	U21ECG03	Engineering Studio	ESC	0	0	4	0	2
<b>MANDATORY NON CREDIT COURSES</b>								
10	U21MYC02	Environmental Sciences	MNC	1	0	0	0	0
<b>TOTAL</b>				<b>16</b>	<b>0</b>	<b>14</b>	<b>0</b>	<b>22</b>



## SEMESTER III

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21MA302	Linear Algebra and Complex Analysis	BSC	3	1	0	0	4
2	U21BM301	Human Anatomy and Physiology	PCC	3	0	0	0	3
3	U21BM303	Biomaterials and Artificial Organs	PCC	3	0	0	0	3
4	U21BM306	Biomedical Sensors and Instrumentation	PCC	3	0	0	0	3
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>								
5	U21ECG01	Digital Electronics	ESC	2	0	2	0	3
6	U21CSG03	Data Structures	ESC	2	0	2	0	3
<b>LABORATORY COURSES</b>								
7	U21BM304	Biomedical Sensors and Instrumentation Laboratory	PCC	0	0	4	0	2
8	U21BM305	Human Anatomy and Physiology Laboratory	PCC	0	0	4	0	2
9	U21BM307	Design Studio I	EEC	0	0	0	2	1
<b>MANDATORY NON CREDIT COURSES</b>								
10	U21MYC03	Essence of Indian Traditional Knowledge	MNC	1	0	0	0	0
<b>TOTAL</b>				<b>17</b>	<b>1</b>	<b>12</b>	<b>2</b>	<b>24</b>

## SEMESTER IV

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21MA406	Probability and Stochastic Processes	BSC	3	0	0	0	3
2	U21BM401	Microbiology and Pathology	PCC	3	0	0	0	3
3	U21AMG04	Artificial Intelligence and Machine Learning	ESC	3	0	0	0	3
4		Open Elective - I	OEC	3	0	0	0	3
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>								
5	U21CSG04	Java Programming	ESC	2	0	2	0	3
6	U21BM402	Biophysical Signals and Systems	PCC	2	0	2	0	3
<b>LABORATORY COURSES</b>								
7	U21BM403	Microbiology and Pathology Laboratory	PCC	0	0	4	0	2
8	U21SSG01	Soft Skills – I	HSMC	0	0	2	0	1
9	U21BM404	Design Studio II	EEC	0	0	0	2	1
<b>MANDATORY NON CREDIT COURSES</b>								
10	U21MYC04	Indian Constitution	MNC	1	0	0	0	0
<b>TOTAL</b>				<b>17</b>	<b>0</b>	<b>10</b>	<b>2</b>	<b>22</b>





## SEMESTER V

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21BM501	Microcontroller and its Applications	PCC	3	0	0	0	3
2		Professional Elective - I	PEC	3	0	0	0	3
3		Professional Elective - II	PEC	3	0	0	0	3
4		Open Elective - II	OEC	3	0	0	0	3
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>								
5	U21BM502	Biosignal Processing	PCC	2	0	2	0	3
<b>THEORY COURSE WITH PROJECT COMPONENT</b>								
6	U21BM505	Biocontrol Systems	PCC	2	0	0	2	3
<b>LABORATORY COURSES</b>								
7	U21SSG02	Soft Skills - II	HSMC	0	0	2	0	1
8	U21BM504	Microcontroller Laboratory	PCC	0	0	4	0	2
9	U21BM506	Proto Studio I	EEC	0	0	0	2	1
<b>MANDATORY NON CREDIT COURSES</b>								
10	U21MYC05	Cyber Security Essentials	MNC	1	0	0	0	0
<b>TOTAL</b>				<b>17</b>	<b>0</b>	<b>8</b>	<b>4</b>	<b>22</b>

## SEMESTER VI

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21BM601	Diagnostic and Therapeutic Equipment	PCC	3	0	0	0	3
2	U21BM602	Hospital Management	HSMC	3	0	0	0	3
3		Professional Elective - III	PEC	3	0	0	0	3
4		Professional Elective - IV	PEC	3	0	0	0	3
5		Open Elective - III	OEC	3	0	0	0	3
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>								
6	U21BM603	Biomechanics	PCC	2	0	2	0	3
<b>LABORATORY COURSES</b>								
7	U21SSG03	Soft Skills - III	HSMC	0	0	2	0	1
8	U21BM604	Diagnostic and Therapeutic Equipment Laboratory	PCC	0	0	4	0	2
9	U21BM605	Proto Studio II	EEC	0	0	0	2	1
<b>MANDATORY NON CREDIT COURSE</b>								
9	U21MYC06	Introduction to UN SDGs: An Integrative Approach	MNC	1	0	0	0	0
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>8</b>	<b>2</b>	<b>22</b>

## SEMESTER VII



SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
<b>THEORY COURSES</b>								
1	U21BM701	Radiological Equipment	PCC	3	0	0	0	3
2	U21BM702	Medical Image Processing	PCC	3	0	0	0	3
6		Professional Elective - V	PEC	3	0	0	0	3
4		Professional Elective - VI	PEC	3	0	0	0	3
5		Open Elective - IV	OEC	3	0	0	0	3
<b>THEORY COURSE WITH LABORATORY COMPONENT</b>								
6	U21BM707	Rehabilitation Engineering	PCC	3	0	2	0	4
<b>LABORATORY COURSES</b>								
7	U21BM708	Medical Image Processing Laboratory	PCC	0	0	2	0	1
8	U21BM706	Project work Phase - I	EEC	0	0	0	4	2
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>4</b>	<b>4</b>	<b>22</b>

## SEMESTER VIII

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21BM802	Project work Phase - II	EEC	0	0	0	16	8
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>0</b>	<b>16</b>	<b>8</b>

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21BMI01	Industrial Training / Internship*	EEC	0	0	0	0	2
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>

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

HoD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407





## NCC CREDIT COURSES:

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21NCC01	National Cadet Corps I	-	1	0	2	0	2
2	U21NCC02	National Cadet Corps II	-	1	0	2	0	2
3	U21NCC03	National Cadet Corps III	-	1	0	2	0	2
4	U21NCC04	National Cadet Corps IV	-	2	0	2	0	3
5	U21NCC05	National Cadet Corps V	-	1	0	2	0	2
6	U21NCC06	National Cadet Corps VI	-	2	0	2	0	3
<b>TOTAL</b>				<b>8</b>	<b>-</b>	<b>12</b>	<b>-</b>	<b>14</b>

NCC Credit Course (Level 1 – Level 6) are offered for NCC students only. The grades earned by the students will be recorded in the mark sheet, however the same shall not be considered for the computation of CGPA.

**TOTAL CREDITS: 165**

HoD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

Vertical I Bio Engineering	Vertical II Medical Device Development and Management	Vertical III Mechanics	Vertical IV Intelligent Systems for Medicine	Vertical V Advanced Healthcare Systems	Vertical VI Medical Systems
Nanotechnology in Medicine	Foundation Skills in Integrated Product Development	Sports Biomechanics	Internet of Medical Things	BioMEMS	Ophthalmology systems
Advances in Drug Delivery	Medical Device Design	Biofluids	AI and ML for Medical Diagnostics	Critical Care Equipment	Pulmonology systems
Immunoeengineering	Quality management and Accreditations in Healthcare	Physiological modelling	Virtual reality and Augmented Reality in Healthcare	Human Assist Devices	Gynecology and Obstetric systems
Biosensors	Patient safety, Standards and Ethics	Assistive Technology	Medical Data Visualization	Communication Network Systems	Neurology systems
Tissue Engineering	Medical Device Regulations	Ergonomics	Brain Computer Interface and Applications	Robotics in Medicine	Orthopedic systems
Bioprinting	Healthcare Data Analytics	Haptics	Wearable devices	Nuclear Medicine	Urologic and Nephralgic systems
Biophotonics	Medical Waste Management	Implant Selection and Development	Virtual Instrumentation and DAQ Systems	Embedded Systems for Biomedical Engineers	Chemotherapy techniques
Ethical Issues and Intellectual Property Rights	Testing and Calibration	Bone Remodeling	Cybersecurity for Medical Data	VLSI for Medical Devices	Pediatric systems

**Professional Elective Courses from Verticals:**

Professional Elective Courses will be registered in Semesters V and VII. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VII.

**PROFESSIONAL ELECTIVE COURSES: VERTICALS****VERTICAL I: BIO ENGINEERING**

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21BMP01	Nanotechnology in Medicine	PEC	3	0	0	0	3
2	U21BMP02	Advances in Drug Delivery	PEC	3	0	0	0	3
3	U21BMP03	Immunoengineering	PEC	3	0	0	0	3
4	U21BMP04	Biosensors	PEC	3	0	0	0	3
5	U21BMP05	Tissue Engineering	PEC	3	0	0	0	3
6	U21BMP06	Bioprinting	PEC	3	0	0	0	3
7	U21BMP07	Biophotonics	PEC	3	0	0	0	3
8	U21BMP08	Ethical Issues and Intellectual Property Rights	PEC	3	0	0	0	3

**VERTICAL II: MEDICAL DEVICE DEVELOPMENT AND MANAGEMENT**

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21BMP09	Foundation Skills in Integrated Product Development	PEC	3	0	0	0	3
2	U21BMP10	Medical Device Design	PEC	3	0	0	0	3
3	U21BMP11	Quality management and Accreditations in Healthcare	PEC	3	0	0	0	3
4	U21BMP12	Patient safety, Standards and Ethics	PEC	3	0	0	0	3
5	U21BMP13	Medical Device Regulations	PEC	3	0	0	0	3
6	U21BMP14	Healthcare Data Analytics	PEC	3	0	0	0	3
7	U21BMP15	Medical Waste Management	PEC	3	0	0	0	3
8	U21BMP16	Testing and Calibration	PEC	3	0	0	0	3





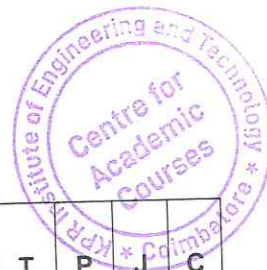
## VERTICAL III: MECHANICS

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21BMP17	Sports Biomechanics	PEC	3	0	0	0	3
2	U21BMP18	Biofluids	PEC	3	0	0	0	3
3	U21BMP19	Physiological modelling	PEC	3	0	0	0	3
4	U21BMP20	Assistive Technology	PEC	3	0	0	0	3
5	U21BMP21	Ergonomics	PEC	3	0	0	0	3
6	U21BMP22	Haptics	PEC	3	0	0	0	3
7	U21BMP23	Implant Selection and Development	PEC	3	0	0	0	3
8	U21BMP24	Bone Remodeling	PEC	3	0	0	0	3

## VERTICAL IV: INTELLIGENT SYSTEMS FOR MEDICINE

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21BMP25	Internet of Medical Things	PEC	3	0	0	0	3
2	U21BMP49	AI and ML for Medical Diagnostics	PEC	3	0	0	0	3
3	U21BMP27	Virtual reality in Healthcare	PEC	3	0	0	0	3
4	U21BMP50	Medical Data Visualization	PEC	3	0	0	0	3
5	U21BMP29	Brain Computer Interface and Applications	PEC	3	0	0	0	3
6	U21BMP30	Wearable devices	PEC	3	0	0	0	3
7	U21BMP31	Virtual Instrumentation and DAQ Systems	PEC	3	0	0	0	3
8	U21BMP51	Cybersecurity for Medical Data	PEC	3	0	0	0	3



**VERTICAL V: ADVANCED HEALTHCARE SYSTEMS**

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21BMP33	BioMEMs	PEC	3	0	0	0	3
2	U21BMP34	Critical Care Equipment	PEC	3	0	0	0	3
3	U21BMP35	Human Assist Devices	PEC	3	0	0	0	3
4	U21BMP36	Communication Network Systems	PEC	3	0	0	0	3
5	U21BMP37	Robotics in Medicine	PEC	3	0	0	0	3
6	U21BMP38	Nuclear Medicine	PEC	3	0	0	0	3
7	U21BMP39	Embedded Systems for Biomedical Applications	PEC	3	0	0	0	3
8	U21BMP40	VLSI for Medical Devices	PEC	3	0	0	0	3

**VERTICAL VI: MEDICAL SYSTEMS**

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21BMP41	Ophthalmology systems	PEC	3	0	0	0	3
2	U21BMP42	Pulmonology systems	PEC	3	0	0	0	3
3	U21BMP43	Gynecology and Obstetric systems	PEC	3	0	0	0	3
4	U21BMP44	Neurology systems	PEC	3	0	0	0	3
5	U21BMP45	Orthopedic systems	PEC	3	0	0	0	3
6	U21BMP46	Urologic and Nephralgic systems	PEC	3	0	0	0	3
7	U21BMP47	Chemotherapy techniques	PEC	3	0	0	0	3
8	U21BMP48	Pediatric systems	PEC	3	0	0	0	3

MOO - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 007

OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

OPEN ELECTIVES – I (SEMESTER: IV)

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21BMX01	Virtual Instrumentation	OEC	3	0	0	0	3
2	U21BMX02	Biometric Systems	OEC	3	0	0	0	3

OPEN ELECTIVES – II (SEMESTER: V)

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21BMX03	Biomedical Visualization	OEC	3	0	0	0	3
2	U21BMX04	Food as Medicine	OEC	3	0	0	0	3

OPEN ELECTIVES – III (SEMESTER: VI)

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21BMX05	Medical informatics	OEC	3	0	0	0	3
2	U21BMX06	Telemedicine	OEC	3	0	0	0	3

OPEN ELECTIVES – IV (SEMESTER: VII)

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21BMX07	Biomedical Instrumentation	OEC	3	0	0	0	3
2	U21BMX08	First aid and Safety for Human	OEC	3	0	0	0	3



## Scheme of Credit distribution – Summary

S.No	Stream	Credits/Semester								Credits
		I	II	III	IV	V	VI	VII	VIII	
1.	Humanities and Social Sciences including Management (HSMC)	3	3	-	1	1	4	-		12
2.	Basic Science Courses (BSC)	10	9	4	3	-	-	-		26
3.	Engineering Science Courses (ESC)	8	10	6	6	-	-	-		30
4.	Professional Core Courses (PCC)	-	-	13	8	11	8	11		51
5.	Professional Elective Courses (PEC)	-	-	-	-	6	6	6		18
6.	Open Elective Courses (OEC)	-	-	-	3	3	3	3		12
7.	Employability Enhancement Courses (EEC)	-	-	1	1	1	1	2	8	14
8.	Industrial Training/ Internship	-	-	-	-	-	-	-	2	2
9.	Mandatory Non-Credit Course (MNC)	-	-	-	-	-	-	-	-	0
Total		21	22	24	22	22	22	22	8+2	165

Head

Centre for Academic Courses  
KPR Institute of Engineering and Technology  
Coimbatore - 641 407

MOO - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407



## SEMESTER I

U21GEG01	HERITAGE OF TAMILS (Common to all programs)	Category: HSMC				
		L	T	P	J	C
		1	0	0	0	1

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

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

- To learn the extensive literature of classical tamil
- To review the fine arts heritage of tamil culture
- To realize the contribution of tamils in Indian freedom struggle

## COURSE OUTCOMES:

CO1: Understand the extensive literature of Tamil and its classical nature (Understand)

CO2: Understand the heritage of sculpture, painting and musical instruments of ancient people (Understand)

CO3: Review on folk and martial arts of tamil people (Understand)

CO4: Realization of thina concepts, trade and victory of Chozha dynasty (Understand)

CO5: Understand the contribution of tamils in Indian freedom struggle, Self-esteem movement and siddha medicine (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I LANGUAGE AND LITERATURE

3

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature – Management Principles in Thirukural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry – Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidhasan





**UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3**

Hero stone to modern sculpture - Bronze icons – Tribes and their handicrafts – Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments – Mridhangam, Parai, Veenai, Yazh and Nadhaswaram – Role of Temples in Social and Economic Life of Tamils

**UNIT III FOLK AND MARTIAL ARTS 3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils

**UNIT IV THINAI CONCEPT OF TAMILS 3**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – Education and Literacy during Sangam Age – Ancient Cities and Ports of Sangam Age – Export and Import during Sangam Age – Overseas Conquest of Cholas

**UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3**

Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books

**Contact Periods:**

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

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies)
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

**EVALUATION PATTERN:**

Continuous Internal Assessment	Total
	100

## SEMESTER I



U21GEG01	தமிழர் மரபு (அனைத்து துறைகளுக்கும் பொதுவனது)	Category: HSMC				
		L	T	P	J	C
		1	0	0	0	1

முன்கூட்டிய துறைசார் அறிவு: தேவையில்லை

பாடத்தின் நோக்கங்கள்:

- தமிழ் மொழியின் இலக்கியச் செறிவைக் கற்றுணர்தல்
- தமிழர் பண்பாட்டின் நுண்கலைகள் பற்றிய ஒரு மீள்பார்வை
- இந்திய தேசிய இயக்கத்தில் தமிழர்களின் பங்கினை அறிதல்

பாடம் கற்றதின் விளைவுகள்:

- CO1: தமிழ் மொழியின் செந்தன்மை மற்றும் இலக்கியங்கள் குறித்த தெரிதல் (புரிதல்)
- CO2: தமிழர்களின் சிற்பக்கலை, ஓவியக்கலை மற்றும் இசைக்கருவிகள் குறித்த தெளிவு (புரிதல்)
- CO3: தமிழர்களின் நாட்டுப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகள் குறித்த அறிமுகம் (புரிதல்)
- CO4: தமிழர்களின் திணைக் கோட்பாடுகள், சங்ககால வணிகம் மற்றும் சோழர்களின் வெற்றிகள் குறித்த தகவல்கள் (புரிதல்)
- CO5: இந்திய தேசிய இயக்கம், சுயமரியாதை இயக்கம் மற்றும் சித்த மருத்துவம் பற்றிய புரிதல் (புரிதல்)

## CO-PO MAPPING:

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

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

பாடத்திட்டங்கள்:

அலகு I மொழி மற்றும் இலக்கியம்

3

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



**அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - 3**  
**சிற்பக்கலை**

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப்பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரி முனையில் திருவள்ளுவர் சிலை - இசைக்கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக, பொருளாதார வாழ்வில் கோவில்களின் பங்கு

**அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3**

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

**அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள் 3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்க காலத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும், துறைமுகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி

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

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிற பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிக்க - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு

**Contact Periods:**

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

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல. சுந்தரம் (விகடன் பிரசுரம்)
3. சீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies)
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)



B.E. - BM - R2021 - CBCS

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

மதிப்பீட்டு முறை:

தொடர்ச்சியான உள் மதிப்பீடு	மொத்தம்
	100

HOI - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407



## SEMESTER I



U21MA101	CALCULUS AND DIFFERENTIAL EQUATIONS (Common to AD, BM, CE, CH, CS, CS(AIML), EC, IT, ME, MI)	Category: BSC				
		L	T	P	J	C
		3	1	0	0	4

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

- CO1:** Apply the knowledge of matrices with the concepts of eigenvalues to study their problems in core areas (Apply)
- CO2:** Apply the basic techniques and theorems of functions of several variables in other areas of mathematics (Apply)
- CO3:** Analyze the triple integrals techniques over a region in two dimensional and three dimensional geometry (Apply)
- CO4:** Apply basic concepts of integration to evaluate line, surface and volume integrals (Apply)
- CO5:** Solve basic application problems described by second and higher order linear differential equations with constant coefficients (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I MATRICES

9 + 3

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

## UNIT II FUNCTIONS OF SEVERAL VARIABLES

9 + 3

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

**UNIT III MULTIPLE INTEGRALS**

9 + 3

Double integrals – Change of order of integration – Triple integrals – Applications in area and volume

**UNIT IV LINE AND SURFACE INTEGRALS**

9 + 3

Line integrals – Surface integrals – Green's theorem in a plane – Gauss divergence theorem – Stokes' theorem (excluding proofs)

**UNIT V ORDINARY DIFFERENTIAL EQUATIONS**

9 + 3

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

**Contact Periods:**

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

**TEXT BOOKS:**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10<sup>th</sup> Edition, Wiley India Pvt Ltd, New Delhi, 2018
2. Grewal B S, "Higher Engineering Mathematics", 44<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2017

**REFERENCES:**

1. Bali N P and Dr Manish Goyal, "A text book of Engineering Mathematics", 12<sup>th</sup> Edition, Laxmi Publications, 2016
2. Thomas G B and Finney R L, "Calculus and Analytic Geometry", 14<sup>th</sup> Edition, Pearson Education India, 2018
3. Maurice D Weir, Joel Hass and Christopher Heil, "Thomas Calculus", 14<sup>th</sup> Edition, Pearson Education, India, 2018
4. James Stewart, "Calculus: Early Transcendental", 7<sup>th</sup> Edition, Cengage Learning, New Delhi, 2015

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations	
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments		
*Individual Assignment / Seminar / MCQ	Written Test	*Individual Assignment / Seminar / MCQ	Written Test			
40	60	40	60			
Total					200	100
					40	60
					100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

## SEMESTER I



U21EEG01	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING (Common to AD, AM, BM, CB, CS and IT)	Category: ESC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To solve an electric network by applying basic laws
- To acquire the knowledge of operating principle, characteristics, starting, methods of DC and AC Machines
- To acquire the knowledge of construction, operating principle, characteristics of semiconductor devices and its applications

## COURSE OUTCOMES:

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

**CO1:** Solve an electric network by applying basic laws (Apply)

**CO2:** Acquire the knowledge of operating principles, characteristics, starting, and speed control methods of DC motors (Understand)

**CO3:** Explain the operating principles of AC motor and characteristics, starting methods of induction motor (Understand)

**CO4:** Summarize the construction, principle and characteristics of semiconductor devices (Understand)

**CO5:** Interpret the applications of semiconductor devices (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I BASIC CONCEPTS OF ELECTRIC CIRCUITS

9

Active elements – Passive elements – Sources – Elements in series and parallel connections – Star and delta conversion – Ohm's law and Kirchhoff's laws – Mesh and Nodal analysis in DC Networks

## UNIT II DC MOTOR

9

DC motor – Construction, principle of operation, types, torque equation, characteristics and applications – Starters for DC motor: Two point – Three point – Speed control – Armature and field control (Qualitative Analysis only)



**UNIT III TRANSFORMER AND AC MOTOR**

9

Single phase transformer – Three phase induction motor – Construction, principle of operation, characteristics and applications – Starters – DOL, Star-delta. (Qualitative Analysis only).

**UNIT IV SEMICONDUCTOR DEVICES**

9

Construction, operation and characteristics: PN Junction, Zener Diode – BJT – FET

**UNIT V APPLICATIONS OF SEMICONDUCTOR DEVICES**

9

Rectifier– Half wave, Full wave – Filters – Voltage regulator – Series and shunt – CE, CB and CC Configuration

**Contact Periods:**

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

**TEXT BOOKS:**

1. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", McGraw-Hill Education, New Delhi, 5<sup>th</sup> Edition, Jul 2017
2. R.K.Rajput, "Electrical Machines", Laxmi Publications, 6<sup>th</sup> Edition, Jan 2016
3. V.K Metha and Rohit Metha, "Principles of Electronics", S.Chand Publications, 12<sup>th</sup> Edition, 2020

**REFERENCES:**

1. J William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw-Hill Education, New Delhi, 8<sup>th</sup> Edition, Aug 2013.
2. S.K. Bhattacharya, "Electrical Machines", McGraw-Hill Education, New Delhi, 4<sup>th</sup> Edition, July 2017
3. R.S.Sedha, "A text book of Applied Electronics", S.Chand Publications, Revised Edition, Jul 2017

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					200
					40
					60
					100

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

## SEMESTER I



U21EN101	ENGLISH FOR TECHNOLOGISTS (Common to AD, BM, CH, CE, CS, CS(AIML), EE, EC, ME, MI, IT)	Category: HSMC				
		L	T	P	J	C
		1	0	2	0	2

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To infer and interpret the meaning of Technical, Business, Social and Academic contexts
- To enhance the listening skills and facilitate effective pronunciation
- To make effective presentation and conversation in technical and professional environment

## COURSE OUTCOMES:

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

- CO1:** Comprehend language and learn strategies for error-free communication (Understand)
- CO2:** Improve speaking skills in academic and social contexts (Apply)
- CO3:** Enhance both reading and writing skills to excel in professional career (Analyse)
- CO4:** Evaluate different perspectives on a topic (Analyse)
- CO5:** Develop listening skills to understand complex business communication in a variety of global English accents through Personality Development (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I SUBJECTIVE INTROSPECTION

9

## Module:1 Vocabulary Building

Activity: Word Puzzles, Snappy words, Word Sleuthing

## Module:2 Introducing and Sharing Information

Activity: Get to know oneself, Introducing Peer Members

## Module:3 Opinion Paragraph

Activity: Note making, analyzing and writing a review

## UNIT II CAREER ENHANCEMENT

9

## Module:4 Reading Comprehension

Activity: Reading Newspaper articles/Blogs, Sentence completion

B.E. - BM - R2021 - CBCS

**Module:5 E-mail Communication**

Activity: Drafting personal and professional emails

**Module:6 Career Profiling**

Activity: Resume Writing & Digital Profiling

**UNIT III LANGUAGE ADEPTNESS**

**Module:7 Rewriting passages**

9

Activity: Conversion of voices & Rephrasing Articles

**Module:8 Enhancing Pronunciation skills**

Activity: Listening to short technical Reels and reproducing it

**Module:9 Making Conversations**

Activity: Role play & Narrating Incidents

**UNIT IV TECHNICAL WRITING**

**Module:10 Spotting Errors**

9

Activity: Proof reading, Rewriting sentences

**Module:11 Data interpretation**

Activity: Interpretation of Graphics/Charts/Graphs

**Module:12 Expository Writing**

Activity: Picture inference, Captions for Posters & Products

**UNIT V LANGUAGE UPSKILLING**

**Module:13 Listening for Specific Information**

9

Activity: TED talks/Announcement/Documentaries

**Module:14 Presentation**

Activity: Extempore & Persuasive Speech

**Module:15 Team Communication**

Activity: Team building activities, Group Discussion

**LIST OF EXERCISES**

1. Introducing oneself
2. Role play
3. Listening to short technical Reels
4. Listening to TED Talks/ Announcements/ Documentaries
5. Presentation
6. Group Discussion

**Contact Periods:**

Lecture: 15 Periods	Tutorial: 0 Periods	Practical: 30 Periods	Project: – Periods
			Total: 45 Periods

**TEXT BOOKS:**

1. Ashraf Rizvi, "Effective Technical Communication", 2<sup>nd</sup> Edition, Mc Graw – Hill. India 2017
2. Rod Ellis, "English for Engineers & Technologists", Vol. II: (English for Engineers and Technologists: A Skills Approach). 2<sup>nd</sup> Edition, Orient Black Swan, 1990

**REFERENCES:**

1. Raymond Murphy, "Intermediate English Grammar", 2<sup>nd</sup> Edition, Cambridge University Press, 2009
2. Thomas L Means, "English and Communication for Colleges", 4<sup>th</sup> Edition, Cengage 2017




3. Using English: "A Coursebook for Undergraduate Engineers and Technologists", 1<sup>st</sup> Edition, Orient Black Swan, 2017

**EVALUATION PATTERN:**

EVALUATION PATTERN:				End Semester Examinations
Continuous Internal Assessments				Practical Examinations (Examinations will be conducted for 100 Marks)
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		
Individual Assignment / Seminar / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	
40	60	75	25	
25		25		
50				50
Total: 100				

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

  
 HOd - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 WASUR COIMBATORE 641 407

## SEMESTER I

U21PH101	ENGINEERING PHYSICS (Common to all branches)	Category: BSC				
		L	T	P	J	C
		2	0	2	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To understand the fundamental principles of laser and fibre optics with their applications
- To acquire the knowledge of ultrasonic waves, thermal conductivity and properties of liquids
- To understand the concepts of crystals

## COURSE OUTCOMES:

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

CO1: Demonstrate the types of laser for various industrial and medical applications (Understand)

CO2: Apply the concepts of fibre optics in engineering (Understand)

CO3: Understand the production methods of ultrasonic waves and uses in engineering and medicine (Understand)

CO4: Apply the concepts of thermal conductivity in hybrid vehicles and viscosity of liquids in engineering applications (Understand)

CO5: Explain the basic concepts of crystals and its growth techniques (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I LASER

6

Laser characteristics – Spontaneous and stimulated emission – Pumping methods – CO<sub>2</sub> laser – Semiconductor laser – Material Processing – Selective laser Sintering – Hologram – Medical applications (Ophthalmology)

## UNIT II FIBER OPTICS

6

Total internal reflection – Numerical aperture and acceptance angle – Classification of optical fibers (Materials, modes and refractive index profile) – Fiber optical communication system – Displacement and temperature sensor – Medical Endoscopy

**UNIT III ULTRASONICS**

6

Properties of ultrasonic waves – Piezoelectric generator – Acoustic grating – Applications of ultrasonics in industry – SONAR – NDT – Ultrasonic scanning methods – Fetal heart movement

**UNIT IV THERMAL PHYSICS AND PROPERTIES OF FLUIDS**

6

Modes of heat transfer – Thermal conductivity – Lee's disc method – Solar thermal power generation – Hybrid vehicles – Microwave oven – Surface tension and coefficient of viscosity – Poiseuille's flow experiment

**UNIT V CRYSTAL PHYSICS**

6

Unit cell – Bravais lattices – SC, BCC, FCC structures – Miller indices – d spacing in cubic lattice – Crystal growth from melt: Bridgman Technique – Silicon ingots from Czochralski method – Silicon wafers from ingots and its applications.

**LIST OF EXPERIMENTS**

1. Determination of the wavelength of a given laser source
2. Determination of acceptance angle and numerical aperture of an optical fibre
3. Determination of velocity of sound and compressibility of a liquid using Ultrasonic interferometer
4. Determination of thermal conductivity of a bad conductor using Lee's disc method
5. Determination of viscosity of the given liquid using Poiseuille's flow method

**Contact Periods:**

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

**TEXT BOOKS:**

1. Bhattacharya D K and Poonam Tandon, "Engineering Physics", 2<sup>nd</sup> Edition, Oxford University Press, Chennai, 2017
2. Marikani A, "Engineering Physics", 3<sup>rd</sup> Edition, PHI publishers, Chennai, 2021

**REFERENCES:**


1. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", 2<sup>nd</sup> Edition, Pearson India Education Services Private Limited, Chennai, 2018
2. Avadhanulu M N, Kshirsagar P G and Arun Murthy TVS, "A Text book of Engineering Physics", 2<sup>nd</sup> Edition, S Chand Publishing, New delhi, 2018
3. Thyagaran K, Ajoy Ghatak, "Lasers – Fundamentals and Applications", 2<sup>nd</sup> Edition, Laxmi Publications Pvt Limited, New delhi, 2019
4. <https://nptel.ac.in/downloads/104104085/>
5. <https://nptel.ac.in/courses/122107035/8/>



**EVALUATION PATTERN:**

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

  
 HOD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 PONDICHERRY

## SEMESTER I

U21CY101	ENGINEERING CHEMISTRY (Common to all BE./B.Tech. courses)	Category: BSC				
		L	T	P	J	C
		2	0	2	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To inculcate the fundamentals of water technology and electrochemistry
- To gain basic knowledge of corrosion of metals and alloys
- To acquire knowledge about the properties of fuels and applications of polymers

## COURSE OUTCOMES:

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

- CO1:** Apply the principles of water technology in treatment of industrial and domestic water and estimate the various constituents of industrial water (Apply)
- CO2:** Describe the principles and applications of electrochemical cells, fuel cells and solar cells (Understand)
- CO3:** Outline the different types of corrosion processes and preventive methods adopted in industries (Understand)
- CO4:** Explain the analysis and calorific value of different types of fuels (Understand)
- CO5:** Classify the polymers and their engineering applications (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I CHARACTERISTICS OF WATER AND ITS TREATMENT

6

Characteristics of water – Hardness – Types, Dissolved oxygen, Total dissolved solids, Disadvantages due to hard water in industries – (Scale, Sludge, Priming, Foaming and Caustic embrittlement), Water softening methods – Lime-soda, Zeolite, Ion exchange processes and reverse Osmosis and their applications, Specifications of domestic water (ICMR and WHO) – Water treatment for municipal supply – Sedimentation with coagulant – Sand Filtration – Chlorination, Disinfection methods – UV treatment, Ozonolysis, Electro dialysis

## UNIT II ELECTROCHEMISTRY AND ENERGY STORAGE SYSTEMS

6

Introduction, Electrodes – (Calomel electrode), Electrochemical series and its applications, Brief introduction to conventional primary and secondary batteries – (Pb acid, Lithium) – Fuel cells – Polymer

membrane fuel cells, Solid-oxide fuel cells – Working principles, advantages, applications. Solar cells – Dye sensitized solar cells – Working principles, characteristics and applications

### UNIT III CORROSION AND ITS CONTROL

6

Types – Dry – Chemical corrosion and Wet – Galvanic and differential aeration (Pitting, Crevice, pipeline) – Factors influencing rate of corrosion – Corrosion control methods – Sacrificial anode and impressed current method – Protective coating – Electroplating – Ni plating.

Alloys – Ferrous (stainless steel), Heat treatment – Non-ferrous alloys (Brass -Dutch metal, German Silver) – Composition, properties and uses

### UNIT IV FUELS AND COMBUSTION

6

Fuels- Solid fuel: Coal - Analysis of coal (Proximate analysis only) – Liquid fuel – Manufacture of synthetic petrol (Bergius process) – Octane number, cetane number, Knocking in engines- Anti-knocking agents, Gasoline additives, Gaseous fuel: Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Composition only.

Calorific value – Higher and lower calorific values – Flue gas analysis (ORSAT method). Measurement of calorific value using bomb calorimeter, Three-way catalytic converter – Selective catalytic reduction of NO<sub>x</sub>

### UNIT V POLYMERS

6

Introduction – Monomer, dimers, functionality, degree of polymerisation, transition glass temperature Classification of polymers, Difference between thermoplastics and thermosetting plastics, Engineering application of plastics - ABS, PVC, PTFE and Bakelite.

Types of compounding of plastics – Moulding, Injection moulding, Extrusion moulding, Compression moulding Conducting polymers – Polypyrrole, Polyacetylene, Polyaniline – Structure and applications, Composites – FRP – Properties and applications

#### LIST OF EXPERIMENTS

1. Determination of total, permanent and temporary hardness of a given sample water by EDTA method
2. Estimation of ferrous ion by potentiometric titration
3. Estimation of Copper in Brass by EDTA method
4. Determination of percentage of moisture, volatile, ash and carbon content in a given sample of coal.
5. Determination of molecular weight and degree of polymerization of an oil sample by viscosity measurement (Ostwald's viscometer).
6. Determination of chloride content in the water sample
7. Determination of strength of HCl by pH metric method

#### Contact Periods:

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

#### TEXT BOOKS:

1. Jain P C and Monika Jain, "Engineering Chemistry", 16<sup>th</sup> Edition, Dhanpat Rai Publishing Company, Pvt. Ltd., New Delhi, 2015
2. Vairam S, Kalyani P and Suba Ramesh, "Engineering Chemistry", 2<sup>nd</sup> Edition, Wiley India Pvt. Ltd, New Delhi, 2014

#### REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", 2<sup>nd</sup> Edition, Scientific International Pvt. Ltd, New Delhi, 2014
2. Prasanta Rath, "Engineering Chemistry", 1<sup>st</sup> Edition, Cengage Learning India, Pvt. Ltd, Delhi, 2015
3. Shikha Agarwal, "Engineering Chemistry, Fundamentals and Applications", 1<sup>st</sup> Edition, Cambridge University Press, 2015
4. <https://nptel.ac.in/courses/113/104/113104008/>



## EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations  (Examinations will be conducted for 100 Marks)	Practical Examinations  (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HO - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER I



U21CSG01	PROBLEM SOLVING AND C PROGRAMMING (Common to All Branches)	Category: ESC				
		L	T	P	J	C
		2	0	2	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To provide exposure to problem-solving through programming
- To develop computational thinking perspective of one's own discipline
- To write, compile and debug programs using C language

## COURSE OUTCOMES:

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

- CO1: Formulate the algorithmic solutions for a given computational problem (Understand)  
 CO2: Describe modularization, structures and pointers in C language (Understand)  
 CO3: Design and implement algorithms for a given problem using C control structures (Apply)  
 CO4: Apply the C programming constructs for searching and sorting techniques (Apply)  
 CO5: Solve real time problems using suitable non-primitive data structures in C (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I COMPUTATIONAL THINKING

6

Computational Thinking – Modern Computer – Information based Problem solving – Real world information and Computable Data – Data types and data encoding – Number Systems – Introduction to programming languages – Basics of C programming – variables– Data types – keywords – C program structure – Simple programs in C

## UNIT II ALGORITHMIC APPROACH

6

Logic – Boolean Logic – Applications of Propositional logic – Problem Definition – Logical Reasoning and Algorithmic thinking – Pseudo code and Flow chart – Constituents of algorithms – Sequence, Selection and Repetition – Problem understanding and analysis – Control structures in C – Algorithm design and implementation using control structures

**UNIT III     SEARCHING, SORTING, AND MODULARIZATION**

6

Data Organization – Arrays – Introduction to Searching and Sorting – Linear Search, Binary Search – Basic sorting techniques – Two-dimensional arrays – Matrix manipulation – Modularization – Functions – Function prototype – Function definition – Function call – Built-in functions (string functions and math functions) – Recursion

**UNIT IV     STRUCTURES AND POINTERS**

6

Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Example Program – Sorting of names – Parameter passing – Pass by value – Pass by reference – Structure – Nested structures – Pointer and Structures – Array of structures – Example Program using structures and pointers – Unions

**UNIT V     FILES**

6

Files – Types of file processing – Sequential access – Random access – Sequential access file – Example Program – Finding average of numbers stored in sequential access file – Random access file – Example Program – Transaction processing using random access files – Command line arguments

**LIST OF EXPERIMENTS**

**A. Lab Programs**

1. Using IO Statements, get higher secondary marks of a student. Calculate and display the medical and engineering cut-off marks. [ Assume the calculation formula ]
2. Develop a C program to emulate the operations of an ATM using control structures. Authentication, Deposit, Withdrawal, and Balance check and pin change operations are to be supported.
3. Develop a calculator to perform the operations including addition, subtraction, multiplication, division and square of a number.
4. Given different prices of a vegetable which is varying through the day (from morning to evening), find out the best buy price and sell price for the maximum profit. Eg. For the prices [33, 35, 28, 36, 39, 25, 22, 31], best buy is at 28 and best sell is at 39.
5. Collect height and weight of 4 of your friends and calculate their body mass index. Use 2 dimensional array to store the values.
6. Weights of 10 students of your class who are standing in a line is given in a random order. Find out if there is a heavy person whose weight is the sum of previous two persons.
7. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
8. From a given paragraph perform the following using built-in functions:
  - a) Find the total number of words.
  - b) Capitalize the first word of each sentence.
9. Solve Towers of Hanoi using recursion.
10. Develop an expense manager which reads date, product, price and product category. The program should display the total expense amount based on product category or date as per user's selection. Use structures.
11. Develop a banking application to store details of accounts in a file. Count the number of account holders based on a search condition such as - whose balance is less than the minimum balance.





## B.E. - BM - R2021 - CBCS

### B. Mini Project (SAMPLE)

Create a Railway Reservation system with the following modules of Booking,

- Availability checking
- Cancellation
- Prepare chart

#### Contact Periods:

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

#### TEXT BOOKS:

1. David D. Railey and Kenny A.Hunt , "Computational Thinking for Modern problem Solver", 1<sup>st</sup> Edition, CRC Press, 2014
2. Brian W. Kernighan and Dennis Ritchie, " The C Programming Language", 2<sup>nd</sup> Edition, Pearson, 2015

#### REFERENCES:

1. Paolo Ferragina and Fabrizio Luccio, "Computational Thinking First Algorithms", Then Code", 1<sup>st</sup> Edition, Springer International Publishing, 2018
2. Reema Thareja, "Programming in C", 2<sup>nd</sup> Edition, Oxford University Press, 2016
3. Paul Deitel and Harvey Deitel, "C How to Program", 7<sup>th</sup> Edition, Pearson Publication
4. Juneja, B. L and Anita Seth, "Programming in C", 1<sup>st</sup> Edition, Cengage Learning India Pvt. Ltd., 2011
5. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", 1<sup>st</sup> Edition, Oxford University Press, 2009

#### EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25			
50				50	
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



U21MEG01	ENGINEERING GRAPHICS	Category: ESC				
		L	T	P	J	C
		0	0	4	0	2

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To expose the standards and conventions followed in preparation of engineering drawings
- To develop graphic skills for communication of concepts, ideas and engineering drawings
- To expose on 2D & 3D drawings and its projections

**COURSE OUTCOME:**

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

**CO1:** Sketch the curves and orthographic projections of points as per BIS conventions (Apply)

**CO2:** Illustrate the orthographic projections of straight lines and plane surfaces (Apply)

**CO3:** Sketch the orthographic projections of solids, lateral surfaces of frustums, truncated solids and its development (Apply)

**CO4:** Develop the lateral surfaces of simple solids (Apply)

**CO5:** Interpret the orthographic and isometric views of simple components (Apply)

**CO PO Mapping:**

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

**SYLLABUS:****BASICS OF ENGINEERING DRAWING AND CAD (Not for examination)**

Introduction – Drawing instruments and its uses – Sheet layout – BIS conventions – Lines – Lettering and dimensioning practices – Lines – Co – Ordinate points – Axes – Poly lines – Square – Rectangle – Polygons – Splines – Circles – Ellipse – Text – Move – Copy – Off – Set – Mirror – Rotate – Trim – Extend – Break – Chamfer – Fillet – Curves – Constraints viz. agency – Parallelism – Inclination and perpendicularity

**UNIT I CONICS, SPECIAL CURVES AND PROJECTION OF POINTS**

12

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

**UNIT II PROJECTION OF STRAIGHT LINES AND SURFACES**

12

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

**UNIT III PROJECTION OF SOLIDS**

12

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

**UNIT IV DEVELOPMENT OF LATERAL SURFACES OF SOLIDS**

12

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

**UNIT V ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS**

12

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

**Contact Periods:**

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

**TEXT BOOKS:**

1. ND Bhat & VM Panchal, "Engineering Drawing", Charotar Publishing House, Gujarat, 51<sup>st</sup> Edition, 2013
2. Venugopal K. and Prabhu Raja V, "Engineering Graphics", New Age International (P) Limited, 6<sup>th</sup> Edition, 2019

**REFERENCE BOOKS:**

1. Natrajan K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 21<sup>st</sup> Edition, 2017
2. Sam Tickoo, AutoCAD 2013 for Engineers and Designers, Dream tech Press, 1<sup>st</sup> Edition, 2013
3. M.H.Annaiah & Rajashekar Patil, Computer Aided Engineering Drawing, New Age International Publishers, 4<sup>th</sup> Edition, 2012
4. Basant Aggarwal, Engineering Drawing, Tata Mc Graw Hill Education Private Limited, 1<sup>st</sup> Edition, 2010
5. D.M.Kulkarni, A.P.Rastogi, A.K.Sarkar, "Engineering Graphics with AutoCAD", PHI Learning Private Limited, New Delhi, Revised Edition., 2010

**EVALUATION PATTERN:**

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	
75	25	
100		100
60		40
100		



## SEMESTER II



U21GEG02	TAMILS AND TECHNOLOGY (Common to all programs)	Category: HSMC				
		L	T	P	J	C
		1	0	0	0	1

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To learn weaving, ceramic and construction technology of Tamils
- To understand the agriculture, irrigation and manufacturing technology of Tamils
- To realize the development of scientific tamil and tamil computing

## COURSE OUTCOMES:

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

- CO1:** Understand the weaving and ceramic technology of ancient tamil people nature (Understand)  
**CO2:** Understand the construction technology, building materials in sangam period and case studies (Understand)  
**CO3:** Infer the metal process, coin and beads manufacturing with relevant archeological evidence (Understand)  
**CO4:** Realize the agriculture methods, irrigation technology and pearl diving (Understand)  
**CO5:** Apply the knowledge of scientific tamil and tamil computing (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

**UNIT I WEAVING AND CERAMIC TECHNOLOGY 3**

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries

**UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3**

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period

**UNIT III MANUFACTURING TECHNOLOGY****3**

Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold – Coins as source of history – Minting of Coins – Beads making – Industries Stone beads – Glass beads – Terracotta beads – Shell beads/ bone beads – Archeological evidences – Gem stone types described in Silappathikaram

**UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY****3**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society

**UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING****3**

Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project

**Contact Periods:**

Lecture: 15 Periods      Tutorial: - Periods      Practical: - Periods      Project - Periods  
Total 15 Periods

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருதை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies)
7. Historical Heritage of the Tamils (Dr.S.V.Subalamanan, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

**EVALUATION PATTERN:**

Continuous Internal Assessment	Total
	100



## SEMESTER II

U21GEG02	தமிழரும் தொழில்நுட்பமும் (அனைத்து துறைகளுக்கும் பொதுவனது)	Category: HSMC				
		L	T	P	J	C
		1	0	0	0	1

முன்கூட்டிய துறைசார் அறிவு: தேவையில்லை

பாடத்தின் நோக்கங்கள்:

- தமிழர்களின் சங்ககால நெசவு, பாணை வனைதல் மற்றும் கட்டட தொழில்நுட்பம் குறித்து அறிதல்
- தமிழர்களின் சங்ககால வேளாண்மை, நீர்ப்பாசனம் மற்றும் உற்பத்தி முறைகள் குறித்த கற்றல்
- நவீன அறிவியல் தமிழ் மற்றும் கணித்தமிழ் குறித்த புரிதல்

பாடம் கற்றதின் விளைவுகள்:

- CO1: சங்ககாலத் தமிழர்களின் நெசவு மற்றும் பாணை வனைதல் தொழில்நுட்பம் குறித்த கற்றுணர்ந்தல் (புரிதல்)
- CO2: சங்ககாலத் தமிழர்களின் கட்டட தொழில்நுட்பம், கட்டுமானப் பொருட்கள் மற்றும் அவற்றை விளக்கும் தளங்கள் குறித்த அறிவு (புரிதல்)
- CO3: சங்ககாலத் தமிழர்களின் உலோகத்தொழில், நாணயங்கள் மற்றும் மணிகள் சார்ந்த தொல்லியல் சான்றுகள் பற்றிய அறிவு (புரிதல்)
- CO4: சங்ககாலத் தமிழர்களின் வேளாண்மை, நீர்ப்பாசன முறைகள் மற்றும் முத்து குளித்தல் குறித்த தெளிவு (புரிதல்)
- CO5: நவீன அறிவியல் தமிழ் மற்றும் கணித்தமிழ் குறித்த புரிந்துகொள்ளலும் மற்றும் பயன்படுத்துதலும் (கற்றலை பயன்படுத்துதல்)

CO-PO MAPPING:

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

பாடத்திட்டங்கள்:

அலகு I நெசவு மற்றும் பாணைத் தொழில்நுட்பம்

3

சங்க காலத்தில் நெசவுத் தொழில் – பாணைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்





**அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்**

3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் மற்றும் சங்க காலத்தில் வீட்டுப் பொருட்களின் வடிவமைப்பு - சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும் கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல் - மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாடு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை

**அலகு III உற்பத்தித் தொழில்நுட்பம்**

3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருகுதல், எக்கு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள் - கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்

**அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்**

3

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்

**அலகு V அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்**

3

அறிவியல் தமிழின் வளர்ச்சி - கணினித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக் கழகம் - தமிழ் மின்நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்

**Contact Periods:**

Lecture: 15 Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods  
Total: 15 Periods


**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies)
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

B.E. - BM - R2021 - CBCS

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
  11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
  12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book
- மதிப்பீட்டு முறை:

தொடர்ச்சியான உள் மதிப்பீடு	மொத்தம்
	100

  
HoD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407



## SEMESTER II

U21MA202	TRANSFORMS AND ITS APPLICATIONS (For BM)	Category: BSC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To understand Fourier analysis for periodic and aperiodic signals
- To understand the concepts of Laplace Transforms to find solutions of initial value problems for linear ordinary differential equations
- To understand the concept of Z-transform techniques in the field of engineering

## COURSE OUTCOMES:

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

- CO1: Use the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series (Understand)
- CO2: Analyze the spectral characteristics of signals using Fourier transforms (Apply)
- CO3: Apply the concepts of Laplace transform with their properties in circuit theory and control systems (Apply)
- CO4: Apply the concepts of Inverse Laplace transform with their properties in core engineering applications (Apply)
- CO5: Analyze the signal discretized in time and check for their stability, frequency response (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I FOURIER SERIES

9

Dirichlet's conditions – general Fourier series – odd and even functions – half range sine series – Half range cosine series – Parseval's identity – harmonic analysis

## UNIT II FOURIER TRANSFORM

9

Fourier transform pair – Fourier sine and cosine transforms – properties (without proof) – transforms of simple functions – convolution theorem – Parseval's identity



**UNIT III LAPLACE TRANSFORM**

9

Transform of standard functions – transform of unit step function and unit impulse function – transforms of derivatives and integrals – transform of periodic functions

**UNIT IV INVERSE LAPLACE TRANSFORM**

9

Inverse Laplace transform – convolution theorem – ordinary differential equations with constant coefficients

**UNIT V Z – TRANSFORM**

9

Z-transforms – elementary properties – inverse Z-transform – initial and final value theorems (statement only) – convolution theorem – formation of difference equations – difference equations using Z – transform

**Contact Periods:**

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

**TEXT BOOKS:**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10<sup>th</sup> Edition, Wiley India Pvt Ltd, New Delhi, 2018
2. Wylie C. R. and Barrett L. C., "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2016
3. Grewal B S, "Higher Engineering Mathematics", 44<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2017

**REFERENCES:**

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers", 1<sup>st</sup> Edition, SPIE Press, 2016
2. Bali N P and Dr Manish Goyal, "A text book of Engineering Mathematics", 12<sup>th</sup> Edition, Laxmi Publications, 2016
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 1<sup>st</sup> Edition, Cengage, New Delhi, 2016
4. James, G., "Advanced Modern Engineering Mathematics", Pearson Education, 3<sup>rd</sup> Edition, 2013

**EVALUATION PATTERN:**

EVALUATION PATTERN:					
Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Seminar / MCQ	Written Test	*Individual Assignment / Seminar / MCQ	Written Test		
40	60	40	60	200	
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

U21PH202	MEDICAL PHYSICS (For BM only)	Category: BSC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

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

**COURSE OUTCOMES:**

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

CO1: Interpret the basics of atomic physics and non – ionizing radiation (Understand)

CO2: Classify the types of senses, vision and audition (Understand)

CO3: Utilize the basic concepts of radioactivity and radionuclides in various medical applications (Understand)

CO4: Examine the interaction of radiation with matter and its clinical significance (Understand)

CO5: Identify the radiation exposure, dosage effects and prevention measures (Understand)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I ATOMIC PHYSICS AND NON-IONIZING RADIATION**

9

Atomic Physics: Absorption and Emission of light – Spin-orbit coupling – Zeeman effect – Quantum mechanical explanation of Zeeman effect – Anomalous Zeeman effect – Stark effect – Non – ionizing radiation: Non – ionizing electromagnetic radiation: Non – ionizing radiation effects: Low frequency effects and High frequency effects

**UNIT II PHYSICS OF THE SENSES**

9

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

**UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES**

9

Radioactive Decay – Spontaneous Emission – Isomeric Transition – Gamma ray emission, alpha, beta, Positron decay – Sources of Radioisotopes: Natural and artificial radioactivity – Radionuclide – Cyclotron and reactor produced Radionuclide – Radionuclide used in Medicine



**UNIT IV INTERACTION OF RADIATION WITH MATTER****9**

Interaction of charged particles with matter – Specific ionization – Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X – ray and gamma radiation with matter – Attenuation of gamma radiation, Interaction of neutron with matter and their clinical significance (Radiation Dosimetry)

**UNIT V RADIATION QUANTITIES AND RADIATION EFFECTS****9**

Radiation Quantities: Inverse square law – KERMA and absorbed dose – Stopping power – Relationship between the dosimetric quantities – Bragg 's curve – Concept of LD 50 – Radiation Effects and Prevention Measures: Stochastic and Non – Stochastic effects – Principles of radiation protection in diagnostic medical exposure – Individual prevention measures

**Contact Periods:**

Lecture: 45 Periods

Tutorial: – Periods

Practical: – Periods

Project: – Periods

Total: 45 Periods

**TEXT BOOKS:**

1. Brown B. H., Smallwood R. H., Barber D., Lawford P. V and Hose D. R., "Medical Physics and Biomedical Engineering", 1<sup>st</sup> edition, CRC Press, 2017
2. Gopal B. Saha., "Physics and Radiobiology of Nuclear Medicine", 4<sup>th</sup> edition, Springer, 2013

**REFERENCES:**

1. Meredith W. J. and Massey J. B., "Fundamental Physics of Radiology", 1<sup>st</sup> Edition, Varghese Publishing house, 1992
2. Muhammad Maqbool– "An Introduction to Medical Physics", Reprinted 1<sup>st</sup> edition, Springer, 2018
3. Woodcock J. P., "Ultrasonics Medical Physics Handbook – 1", 1<sup>st</sup> Edition, Adam Hilger Ltd, Bristol, 2002
4. Attix F H, "Introduction to Radiological Physics and Radiation dosimetry", 1<sup>st</sup> Edition, Wiley – VCH, Verlag, 2004
5. <https://nptel.ac.in/courses/115103101>

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.







## SEMESTER II

U21BM203	DEVICES AND INTEGRATED CIRCUITS	Category: ESC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- U21EEG01 - Basics of Electrical and Electronics Engineering

## COURSE OBJECTIVES:

- To introduce the basic characteristics of operational amplifiers
- To learn the linear and non – linear applications of operational amplifiers
- To learn the types of A - D and D - A Converters

## COURSE OUTCOMES:

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

CO1: List the characteristics of MOSFET (Understand)

CO2: Illustrate the linear applications of operational amplifier (Apply)

CO3: Explain the nonlinear applications of operational amplifier (Analyze)

CO4: Outline timer and PLL operation (Understand)

CO5: Compare and contrast the converters (Analyze)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I MOSFET

9

MOSFET – Depletion type – Construction, operation and characteristics – Enhancement type – Construction, operation and characteristics – CMOS – Fabrication of MOSFET IC

## UNIT II LINEAR APPLICATIONS OF OP-AMP

9

Ideal Characteristics: Open loop gain – CMRR – Slew rate and transfer characteristics – Inverting and non-inverting amplifier – Voltage follower – Summing amplifier – Differential amplifier – Instrumentation amplifiers – Integrator – Differentiator

## UNIT III NON - LINEAR APPLICATIONS OF OP - AMP

9

Comparator – Zero crossing detector – Sample and hold circuit – Precision diode – Rectifiers – Clipper and Clamper – Sinusoidal oscillators – Active filters – Low pass – High pass – Bandpass and bandstop Butterworth filters

**UNIT IV 555 FAMILY IC'S AND PHASE LOCKED LOOP**

9

IC 555 Timer – Functional block diagram – Mono-stable operation – Astable operation – Applications – IC 556 Voltage Controlled Oscillator – Functional Block Diagram – Principle of operation – Building block of PLL – Characteristics and mathematical expressions for Lock and Capture ranges – Applications

**UNIT V D - A AND A - D CONVERTERS**

9

Digital to Analog converters – Weighed Resistor – R - 2R Ladder – Inverted R - 2R Ladder – Analog to digital converters – Flash ADC – Counter ADC – Successive approximation – Dual slope – DAC/ADC specifications – Performance comparison

**Contact Periods:**

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

**TEXT BOOKS:**

1. Boylestad RL, Nashelsky L, "Electronic devices and circuit theory" Prentice Hall, 9<sup>th</sup> edition, 2013
2. Roy Choudhury and Shail Jain, "Linear Integrated Circuits", 4<sup>th</sup> edition, Wiley Eastern, New Delhi, 2012

**REFERENCES:**

1. Coughlin & Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Pearson education, 1<sup>st</sup> edition, 2001
2. Sergio Franco, "Design with operational amplifier and analog integrated circuits", Tata McGraw Hill, 2<sup>nd</sup> edition, 2002

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

## SEMESTER II



U21EN201	PERSONALITY ENHANCEMENT (Common to AD, BM, CH, CE, CS, CS(AIML), EE, EC, ME, MI and IT)	Category: HSMC				
		L	T	P	J	C
		1	0	2	0	2

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To develop of personality traits that contributes in the professional environment
- To create a basic awareness about the significance of soft skills in professional and interpersonal communications
- To enhance the level of self-confidence that helps to excel in the leadership skills

## COURSE OUTCOMES:

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

CO1: Nurture a deep understanding of personality development and interpersonal relationship for overall self-development (Understand)

CO2: Communicate proficiently in high-end interviews and in all social situations (Understand)

CO3: Synthesize complex concepts and present them in speech and writing (Analyze)

CO4: Negotiate and lead teams towards success (Understand)

CO5: Present ideas in an effective manner using web tools (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I LEXICAL REASONING

9

## Module:1 Establishing Associations

Activity: Verbal Analogy, Logical Reasoning

## Module:2 Lateral Thinking

Activity: Reasoning and Assertions

## Module:3 Sentence Completion

Activity: Cloze Test, Single Word Substitutes



**UNIT II SOCIAL CORRESPONDENCE**

9

**Module:4 Etiquettes**

Activity: Brain storming & performing in actions

**Module:5 Introspection**

Activity: SWOT Analysis, Goal Setting

**Module:6 Co-verbal Gesture**

Activity: Body Language, Non verbal cues

**UNIT III ART OF NETWORKING**

9

**Module:7 Addressing a Multitude**

Activity: Welcome address, Vote of Thanks, Public Speaking

**Module:8 Persuasive Communication**

Activity: Making Technical Presentation

**Module:9 Career Oriented Communication**

Activity: Face to face Conversation, Mock Interview

**UNIT IV CRITICAL THINKING**

9

**Module:10 Organizing ideas**

Activity: Mind Mapping

**Module:11 Problem Solving Skills**

Activity: Conflict management, Case Study

**Module:12 Critical Review**

Activity: Book/ Movie Review, Comparative Analysis

**UNIT V CONTENT WRITING**

9

**Module:13 Reports**

Activity: Writing Event Report, Project Report

**Module:14 Writing for Digital platform**

Activity: Writing Posts, Blogs

**Module:15 Developing Content**

Activity: Product Description, Writing Proposals

**LIST OF EXERCISES**

1. Listening to Inspirational Speech
2. Listening to Product Description
3. Book/Movie Review
4. Presentation
5. Mock Interview
6. Public Speaking

**Contact Periods:**

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

**TEXT BOOKS:**

1. Meenakshi Raman & Sangeetha Sharma. "Professional English: for AKTU", 1st Edition, Oxford University Press, 2018
2. Barun. K.Mitra. "Personality Development and Soft Skills", OUP India. 2nd Edition, 2016

**REFERENCES:**

1. Mathew Allen. "Smart Thinking: Skills for Critical Understanding and Writing", 2<sup>nd</sup> Edition, OUP India, 2016
2. Means, Thomas L, "English and Communication for Colleges", 4<sup>th</sup> Edition, Cengage 2017
3. Using English: "A Coursebook for Undergraduate Engineers and Technologists", 1<sup>st</sup> Edition, Orient Black Swan, 2017

**EVALUATION PATTERN:**

Continuous Internal Assessments				End Semester Examinations
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Seminar / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	
40	60	75	25	
25		25		
50				50
Total: 100				

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HO - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER II

U21CSG02	PYTHON PROGRAMMING (Common to All Branches)	Category: ESC				
		L	T	P	J	C
		2	0	2	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To understand syntax and semantics of python programming
- To implement programs using python data structures
- To gain expertise in using python libraries for solving real time problems

## COURSE OUTCOMES:

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

CO1: Describe the basic operations of tokens in python (Understand)

CO2: Demonstrate the programs using control statements (Apply)

CO3: Develop programs using python data structures (Apply)

CO4: Implement the exceptions in file-handling concepts (Apply)

CO5: Apply the python libraries in real-world problems (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I LANGUAGE BASICS

6

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

## UNIT II CONTROL STATEMENTS, FUNCTIONS, AND MODULES

6

Selection – Conditional branching statements – if – if-else – Nested-if – if-elif-else statements – Iterative statements – while – for loop – break – continue and pass statements – Functions – Function Definition and Function call – Variable scope and Lifetime – Return statement – Lambda functions or Anonymous functions – Recursion – Modules and Packages



### UNIT III PYTHON DATA STRUCTURES

6

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

### UNIT IV EXCEPTION AND FILE HANDLING

6

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

### UNIT V NUMPY and PANDAS

6

Numpy – Introduction – Computations using NumPy functions – Computation on Arrays – Aggregation – Indexing and Sorting – Pandas – Introduction and Basic Pandas Concepts – Data frames – Data Handling

### LIST OF EXPERIMENTS

1. Programs on selection and Iteration operations
2. Get an integer input from a user. If the number is odd, then find the factorial of a number and find the number of digits in the factorial of the number. If the number is even, then check the given number is palindrome or not
3. Strings and its operations
4. Given two strings, PRINT (YES or NO) whether the second string can be obtained from the first by deletion of none, one or more characters
5. List and its operations
6. Programs for positive and negative indexing
7. Program to check if the given list is in Ascending order or Not
8. Tuples and its operations
9. Python program to convert a tuple to a string
10. Python program to reverse a tuple
11. Sets and its operations
12. Python program to check if a set is a subset of another set
13. Dictionaries and its operations
14. Python program to iterate over dictionaries using for loops
15. Computations using NumPy functions
16. NumPy program to convert a list of numeric value into a one-dimensional NumPy array
17. NumPy program to convert a list and tuple into arrays
18. Data manipulations using Pandas
19. Program to convert a NumPy array and series to data frames
20. Program to add, subtract, multiple and divide two Pandas Series
21. Program to retrieve and manipulate data using dataframes

#### Contact Periods:

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

#### TEXT BOOKS:

1. Reema Thareja, "Python programming: Using problem solving approach", 1<sup>st</sup> Edition, Oxford Press, 2017
2. William McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2<sup>nd</sup> Edition, Shroff/O'Reilly Publication, 2017

**REFERENCES:**

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2<sup>nd</sup> Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
2. Ashok Namdev Kamthane and Amit Ashok Kamthane, "Programming and Problem Solving with Python", 2<sup>nd</sup> Edition, McGrawHill Education, 2018
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", 1<sup>st</sup> Edition, Pearson India Education Services Pvt. Ltd., 2016
4. <https://python-iitk.vlabs.ac.in/List%20of%20experiments.html>
5. <http://greenteapress.com/wp/think-python/>

**EVALUATION PATTERN:**

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOd - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER II

U21CY201	FUNDAMENTALS OF BIOCHEMISTRY	Category: BSC				
		L	T	P	J	C
		2	0	2	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

CO1: Apply the knowledge of carbohydrates, its reactions and metabolic pathways (Apply)

CO2: Describe the nomenclature, metabolic pathways, degradation and disorders of lipid metabolism in living beings (Understand)

CO3: Elucidate the structure of nucleic acids, its types, DNA and RNA (Understand)

CO4: Outline the classification, structure and properties of amino acids and proteins (Understand)

CO5: Apply the concept of synthesis, mode of action of various drugs in human being (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I CARBOHYDRATES

6

Classification of carbohydrates, chemical properties, structure – Monosaccharides – Glucose, disaccharides – Sucrose and polysaccharides – Starch, Digestion and absorption of carbohydrates, metabolic pathways – Glycolysis, glycogenesis, glycogenolysis - TCA cycle

## UNIT II LIPIDS

6

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



**UNIT III NUCLEIC ACIDS**

6

Structure of purines and pyrimidines, nucleoside, nucleotide, DNA act as a genetic material, Chargoff's rule, Watson and Crick model of DNA – Structure of RNA and its type, Disorder of purines and pyrimidines nucleotide.

**UNIT IV AMINO ACIDS & PROTEINS**

6

Amino acids – Classification – Physical properties, chemical properties of glycine – Proteins- classification, structural organization – Properties and testing.

**UNIT V MEDICINAL CHEMISTRY**

6

Synthetic drugs – Requirement of drug, classification based on chemical structure and therapeutic action. Definition, structure, mode of action and properties – Antibacterial (Sulfonamides, Ciprofloxacin), Anti-inflammatory (Salicylic acid, Indomethacin), Antimalarial (Chloroquine), Analgesics (Aspirin, acetaminophen), Cardiovascular drugs (Barbiturates, Lidocaine), Anesthetics (Benzocaine, Promethazine)

**LIST OF EXPERIMENTS**

1. Qualitative tests for carbohydrates – Glucose, Fructose, Starch
2. Qualitative tests for proteins
3. Qualitative tests for lipids
4. Estimation of blood glucose
5. Estimation of uric acid
6. Estimation of cholesterol
7. Separation of amino acids by TLC

**Contact Periods:**

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

**TEXT BOOKS:**

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

**REFERENCES:**

1. Keith Wilson and John Walker, "Principles and techniques of practical biochemistry", 5<sup>th</sup> edition, Oxford University Press, 2009
2. Pamela C. Champe and Richard. A. Harvey, "Lippincott Biochemistry - Lippincott's Illustrated Reviews", 2<sup>nd</sup> edition, Raven publishers, 1994
3. Ashutoskar, "Medicinal Chemistry", 4<sup>th</sup> edition, New age international, 2010
4. <https://nptel.ac.in/courses/102/106/102106087/>

## EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER II

U21BM204	DEVICES AND INTEGRATED CIRCUITS LABORATORY	Category: ESC				
		L	T	P	J	C
		0	0	4	0	2

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To design and test the linear integrated circuits using available ICs
- To analyze the circuits designed using 555 timers
- To analyze and simulate the applications of op-amp

## COURSE OUTCOMES:

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

- CO1:** Demonstrate the V-I characteristic study of MOSFET (Apply)  
**CO2:** Produce circuits to realize linear characteristics of operational amplifiers (Apply)  
**CO3:** Experiment the nonlinear characteristics of operational amplifiers (Apply)  
**CO4:** Create waveforms using operational amplifiers (Apply)  
**CO5:** Construct and stimulate converters (Analyze)

## CO-PO MAPPING:

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

## LIST OF EXPERIMENTS

1. Record the current-vs-voltage (I-V) operating curves of the MOSFET
2. Design and testing of inverting and non-inverting amplifier
3. Design and testing of differential amplifier
4. Design and testing of differentiator and integrator
5. Design and testing of instrumentation amplifier
6. Design and testing of low pass and high pass active filters
7. Design and testing of band pass active filters
8. Design and testing of a clipper circuit
9. Design and testing of Schmitt trigger using IC 555



## B.E. - BM - R2021 - CBCS

10. Design and testing of monostable multivibrator using IC 555

11. Design and testing of astable multivibrator using IC 555

12. Design and simulate ADC and DAC converters

### Contact Periods:

Lecture: – Periods

Tutorial: – Periods

Practical: 60 Periods

Project: – Periods

Total: 60 Periods

### REFERENCES:

1. Shrikrishna Yawale, Sangita Yawale, "Operational Amplifier Theory and Experiments", 1<sup>st</sup> edition, Singapore: Springer Nature Singapore, 2021.
2. Harold Weinstock, Richard W. Ralston, "The New Superconducting electronics" 1<sup>st</sup> edition Netherlands: Kluwer Academic Publishers, 1993.

### EVALUATION PATTERN:

Continuous Internal Assessments			End Semester Examinations
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Innovative project / Application oriented project	Model Semester Lab Examination	
40	35	25	
100			100
60			40
Total			100



HO D - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
PILASUR COIMBATORE-641 407

## SEMESTER II

U21ECG03	ENGINEERING STUDIO (Common to all Programmes)	Category: ESC				
		L	T	P	J	C
		0	0	4	0	2

## PRE-REQUISITES:

- NIL

## COURSE OBJECTIVES:

- To enable the students understand the functioning of simple to complex devices and systems
- To help the students design and build simple applications on their own
- To create an immersive environment in the engineering lab

## COURSE OUTCOMES:

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

CO1: Understand basics of electronics (Understand)

CO2: Use basic electronic components and Arduino for prototyping (Apply)

CO3: Create simple real time use cases (Create)

## CO-PO MAPPING:

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

## LIST OF EXPERIMENTS

## Basics of Electronics

- Breadboard Basics – LED glowing, Ohm's Law  
Series and Parallel Circuits
- Controlling the circuit response using Potentiometer  
Capacitor Charging and Discharging
- Water level Indicator using transistor  
Touch sensor using transistor
- Automatic night light- (LDR –transistor) circuit  
Fire alarm Circuit
- IR Sensor-Obstacle detecting circuit  
Doorbell using 555 Timer circuit
- LED Chaser circuit using Counter IC  
Shadow detector using IC741
- Regulated output using Regulator IC  
Logic gate Realization

**B.E. - BM - R2021 - CBCS**

**Basics of IoT (With Arduino)**


1. Basics of ARDUINO and IoT  
Working with LEDs
2. Working with digital switch  
Adjusting voltage using potentiometer
3. Measuring the presence / absence of light using LDR  
Finding the distance of an object using ultrasonic sensor
4. Finding the Temperature and Humidity in the surroundings  
Detecting the motion of human using PIR
5. Working with Servo motor  
Establish communication using Bluetooth

**Contact Periods:**

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

**EVALUATION PATTERN:**

Continuous Internal Assessments
Evaluation of course workbook, Tasks (Rubrics based)
100

  
HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
RASUR COIMBATORE-641 407



## SEMESTER III

U21MA302	LINEAR ALGEBRA AND COMPLEX ANALYSIS (For BM)	Category: BSC				
		L	T	P	J	C
		3	1	0	0	4

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To understand the concepts of vector space for solving time domain control theory
- To use the concepts of complex analysis in electrostatics
- To understand the concepts of singularities in the various domains of engineering fields

## COURSE OUTCOMES:

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

**CO1:** Apply the concepts of linear systems to solve the real-life problems (Apply)

**CO2:** Analyze the concepts of basis and dimensions of vector spaces and express vector spaces in different dimensions (Understand)

**CO3:** Attribute the various properties of analytic functions and construct the analytic functions using various methods (Understand)

**CO4:** Evaluate complex contour integrals directly by applying the Cauchy integral theorem in various forms (Understand)

**CO5:** Evaluate complex integrals using the residue theorem and represent functions as Taylor, power and Laurent series (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I LINEAR SYSTEMS

9 + 3

Geometric interpretation of linear system in 2 and 3 unknowns – Row reduction and echelon forms – vector equation – Matrix equation  $Ax=b$ -LU decomposition – Applications of linear systems

## UNIT II VECTOR SPACES

9 + 3

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions - General linear transformations – Kernel and range – Matrices of general linear transformation – Change of basis

**UNIT III COMPLEX DIFFERENTIATION****9 + 3**

Functions of a complex variable – Analytic functions: Cauchy-Riemann equations (Cartesian form) and sufficient conditions (excluding proof) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Bilinear transformation

**UNIT IV COMPLEX INTEGRATION****9 + 3**

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula

**UNIT V SINGULARITIES AND RESIDUES****9 + 3**

Taylor's and Laurent's series expansions – Singular points – Classification of singularities – Residues – Cauchy's residue theorem – Applications to real integral

**Contact Periods:**

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

**TEXT BOOKS:**

1. Grewal B.S, "Higher Engineering Mathematics", 44<sup>th</sup> Edition, Khanna Publishers, 2017
2. Howard Anton and Chris Rorres, "Elementary Linear Algebra", 11<sup>th</sup> Edition, John Wiley & Sons, 2011

**REFERENCES:**

1. Bali N.P and Manish Goyal, "A text book of Engineering Mathematics", 12<sup>th</sup> Edition, Laxmi Publications, 2016
2. Thomas G.B and R.L Finney, "Calculus and Analytic Geometry", 14<sup>th</sup> Edition, Pearson Education India, 2010
3. Gilbert Strang, "Linear Algebra and its Applications", 4<sup>th</sup> Edition, Cengage India Pvt. Ltd., 2005
4. Steven J. Leon, "Linear Algebra with Applications", 9<sup>th</sup> Edition, Pearson College Division, 20014

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations	
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments		
Individual Assignment / Seminar / MCQ	Written Test	Individual Assignment / Seminar / MCQ	Written Test			
40	60	40	60			
Total					200	100
					40	60
					100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER III



U21BM301	HUMAN ANATOMY AND PHYSIOLOGY	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To identify all the organelles of a human cell and their function
- To comprehend the structure of various organs in human body systems
- To explore the functions and importance of anatomical features in human body systems

## COURSE OUTCOMES:

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

- CO1:** Outline basic structure, functions and physiology of human cell organelles and blood cell (Understand)
- CO2:** Illustrate the structure and working of cardiovascular and nervous system (Understand)
- CO3:** Infer the skeletal and respiration system mechanism (Understand)
- CO4:** Summarize the working of digestive and the excretory system (Understand)
- CO5:** Identify the structure and physiology of endocrine system and different senses (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I THE CELL AND GENERAL PHYSIOLOGY

9

Structure and functions of human cell organelles – Cell reproduction – Genetic control of protein synthesis – Membrane potential – Action potential – Resting potential – Generation and conduction – Blood cells structure and function – Immunity – Blood groups – Blood clotting

## UNIT II CARDIAC AND NERVOUS SYSTEM

9

Structure of heart and heart valves – Cardiac cycle – ECG wave pattern – Heart sounds – Blood pressure classification – Nerve tissues – Physiology of nervous system – Nervous control of heart – Feedbacks in human body – Feedback control of blood pressure



**UNIT III SKELETAL AND RESPIRATORY SYSTEM**

9

Structure and types of bone – Function – Physiology of bone formation – Joints and Cartilage – Organs of respiration – Pulmonary ventilation – Principles of gas exchange – Regulations of respiration

**UNIT IV DIGESTIVE AND EXCRETORY SYSTEM**

9

Organs of alimentary tract – Propulsion and mixing of food – Secretory functions – Digestion and absorption in the gastrointestinal tract – Structure of kidney and nephron – Urine formation

**UNIT V ENDOCRINE SYSTEM AND SPECIAL SENSES**

9

Anatomical loci of Endocrine glands – Hormones and their functions – Structure of eye – Optics of vision – Structure of ear – Physiology of hearing – Taste and smell sensors – Structure of skin

**Contact Periods:**

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

**TEXT BOOKS:**

1. Arthur C Guyton, John E Hall, "Textbook of Medical Physiology", 2<sup>nd</sup> Edition, Saunders Elsevier, 2019
2. Jain A K, "Textbook of Physiology", 9<sup>th</sup> Edition, Avichal Publishing Company, 2019

**REFERENCES:**

1. Anil Baran Singha Mahapatra, "Essential of Medical Physiology", 2<sup>nd</sup> Edition, Current Book International, Kolkata, 2007
2. Ranganathan T S, "A Textbook of Human Anatomy", 2<sup>nd</sup> Edition, S.Chand & Co. Ltd., New Delhi, 2012
3. Sujit K Chaudhuri, "Concise Medical Physiology", 2<sup>nd</sup> Edition, New Central Book Agency Pvt.Ltd, Kolkata, 2011
4. Sarada Subramanyam, K Madhavan Kutty, Singh H D, "Textbook of Human Physiology", 5<sup>th</sup> Edition, S. Chand and Company Ltd, New Delhi, 2014

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations	
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments		
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test			
40	60	40	60			
Total					200	100
					40	60
					100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



## SEMESTER III

U21BM303	BIOMATERIALS AND ARTIFICIAL ORGANS	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To interpret the classification and characteristics of biomaterials
- To understand the different biocompatible metals, ceramics and polymers
- To infer the importance of artificial organs and tissue replacements

## COURSE OUTCOMES:

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

CO1: Explain the different types of biomaterials and its properties (Understand)

CO2: Identify the different metals and ceramics used as biomaterials (Apply)

CO3: Describe the importance of polymeric biomaterials (Understand)

CO4: Examine the significance of various artificial organs (Analyze)

CO5: Analyze the various types of tissue replacements (Analyze)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I INTRODUCTION TO BIOMATERIALS

9

Definition and classification of biomaterials – Biocompatibility – Nature – Mechanical properties – Viscoelasticity – Biomaterial performance – Nano-scale phenomena

## UNIT II METALLIC AND CERAMIC MATERIALS

9

Metallic implants – Stainless steels – Co-based alloys – Ti-based alloys – Shape memory alloy – Nanostructured metallic implants – Degradation and corrosion – Ceramic implant – Bioinert – Bioresorbable – Bioactive ceramics – Nanostructured bioceramics

## UNIT III POLYMERIC BIOMATERIALS

9

Polymerization – Biopolymers – Collagen – Elastin – Cellulose – Chitin – Synthetic polymers – Polyolefins – Polyamides – Acrylic polymers – Hydrogels – Silicone rubber

**UNIT IV INTRODUCTION TO ARTIFICIAL ORGANS**

9

Artificial heart – Prosthetic cardiac valves – Artificial Pancreas – Artificial liver – Artificial muscle – Artificial skin – Artificial blood

**UNIT V TISSUE REPLACEMENT AND IMPLANTS**

9

Soft tissue replacements – Sutures, surgical tapes, adhesives – Percutaneous and skin implants – Maxillofacial augmentation – Hard tissue replacement implants – Internal fracture fixation devices – Joint replacements – Dental implants – Body response to implants

**Contact Periods:**

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

**TEXT BOOKS:**

1. Sujata V. Bhatt, "Biomaterials", 3<sup>rd</sup> Edition, Alpha Science International Ltd, 2017
2. Kopff W.J, "Artificial Organs", 1<sup>st</sup> Edition, John Wiley and sons, New York, 1976


**REFERENCES:**

1. B. D. Ratner, F. J. Schoen, A. S. Hoffman, J. E. Lemons, "Biomaterials Science: An Introduction to Materials in Medicine", 3<sup>rd</sup> Edition, Academic Press, 2012
2. Andrew F. Von Racum, "Handbook of Biomaterials Evaluation: Scientific, Technical and Clinical Testing of Implant Materials", 2<sup>nd</sup> Edition, CRC Press, 1998
3. Gray E. Wnek and Gray L. Browlin, "Encyclopedia of Biomaterials and Biomedical Engineering", Marcel Dekker Inc., New York, 2004
4. Park J.B., "Biomaterials Science and Engineering", Plenum Press, 1984
5. Joseph D. Bronzino, "Tissue Engineering and Artificial Organs", 3<sup>rd</sup> Edition, CRC press, 2006

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations	
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments		
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test			
40	60	40	60			
Total					200	100
					40	60
					100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

  
 HoD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407





## SEMESTER III

U21BM306	BIOMEDICAL SENSORS AND INSTRUMENTATION	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- U21EEG01 - Basics of Electrical and Electronics Engineering

## COURSE OBJECTIVES:

- To acquaint with measurement, methods and associated errors
- To explore the various biopotential electrodes and biomedical sensors
- To get familiarized with different displays and patient safety

## COURSE OUTCOMES:

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

**CO1:** Understand the concept of measurement, methods and errors (Understand)

**CO2:** Select the suitable biosensor for designing the biomedical instrument (Understand)

**CO3:** Identify the biopotential electrode and interface circuit (Apply)

**CO4:** Measure blood flow, ECG, EEG, EMG and explain the patient monitoring system (Apply)

**CO5:** Illustrate different display systems and safety aspects of a biomedical circuit (Analyze)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I MEASUREMENT SYSTEM

9

Generalized measurement system – Units and standards – Sensor classification – Static and dynamic characteristics – Errors in measurement

## UNIT II SENSORS FOR BIOMEDICAL APPLICATIONS

9

Thermistor – Thermocouple – Resistance temperature detector – Strain gauge – Diaphragms – Bourdon tube – LVDT – Photodiode, phototransistor, photomultiplier tube – Piezoelectric transducers

## UNIT III BIOPOTENTIAL ELECTRODES AND INTERFACES

9

Biopotential – Contact impedance – Electrode electrolyte interface – Electrode skin interface – Motion artifacts – Types of electrodes – Surface, needle and micro electrodes – pH, pO<sub>2</sub>, pCO<sub>2</sub> – ISFET – Blood glucose measurement

#### UNIT IV BIOMEDICAL PARAMETERS MEASUREMENT

9

Blood flow measurement – ECG, EEG, EMG measurement – Evoked potential – Signal averaging – Computer assisted patient monitoring and ICU

#### UNIT V DISPLAYS AND PATIENT SAFETY

9

Cathode ray oscilloscope – Digital storage oscilloscope – LED display – LCD – Graphic recorders – Physiological effects of electric current – Micro shock – Macro shock – Leakage current – Isolation circuits – Electromagnetic interference – Radiation hazards and safety – Shielding

#### Contact Periods:

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

#### TEXT BOOKS:

1. Khandpur R S, "Handbook of Biomedical Instrumentation", 3<sup>rd</sup> Edition, Tata McGraw Hill, New Delhi, 2014
2. Shawney A. K, "Electrical, Electronic Measurement and Instrumentation" 19<sup>th</sup> Edition, Dhanpat Rai & Co, New Delhi, 2014

#### REFERENCES:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", 2<sup>nd</sup> Edition, Prentice Hall of India, New Delhi, 2015
2. John G. Webster, "Medical Instrumentation: Application and Design", 3<sup>rd</sup> Edition, Tata McGraw Hill Pvt. Ltd, 2011
3. Joseph J Carr and John M Brown, "Introduction to Biomedical Equipment Technology" 4<sup>th</sup> Edition, Pearson Edition, 2002
4. Ernest O. Doebelin, "Measurement System, Application and Design", 6<sup>th</sup> Edition, McGraw Hill, 2006

#### EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations	
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments		
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test			
40	60	40	60			
Total					200	100
					40	60
					100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

## SEMESTER III

U21ECG01	<b>DIGITAL ELECTRONICS</b> (Common to EC, BM, CS, CSBS, AI & ML, IT and AD: For CS, CSBS, AI & ML, IT and AD, It is offered during II Semester and For EC and BM, It is offered during III Semester)	Category: ESC				
		L	T	P	J	C
		2	0	2	0	3

## PRE-REQUISITES:

- NIL

## COURSE OBJECTIVES:

- To understand the fundamentals of digital logic circuits
- To design the combinational logic circuits.
- To design the synchronous and asynchronous sequential circuits

## COURSE OUTCOMES:

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

CO1: Apply various reduction methods to simplify logic expressions (Apply)

CO2: Implement the combinational logic circuits using gates (Apply)

CO3: Examine the performances of latches and flip-flops (Analyze)

CO4: Construct sequential logic circuits using flip-flops (Apply)

CO5: Design hazard free circuit for asynchronous sequential circuit (Analyze)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I BOOLEAN THEOREMS AND LOGIC REDUCTION

6

Number system – Complements – Boolean theorems – Codes – Logic gates – NAND and NOR gates – Representation of boolean expression – SOP, POS, canonical form – Simplification of logic functions using K-map, Quine McCluskey method

## UNIT II COMBINATIONAL LOGIC DESIGN

6

Adder-1 Bit adder/subtractor, parallel adder, 2's complement adder/subtractor – Implementation of combinational circuits – Multiplexers, decoders, encoders, demultiplexers – Code converters – Error detection and correction codes – Parity generator and checker

## UNIT III LATCHES AND FLIPFLOPS

6

Latches – NOR, NAND – Digital pulses – Clocked flip-flops – Master/Slave flip-flop – Asynchronous inputs – Flip-flop timing considerations – Conversion of flip-flop



**UNIT IV SEQUENTIAL CIRCUITS**

6

General model of sequential circuits – Mealy/Moore models, excitation table, state table, state diagram  
 – Design of synchronous sequential circuits – Synchronous up/down counters, modulus counters –  
 Asynchronous counter – Sequence detector

**UNIT V REGISTERS AND HAZARDS**

6

Shift registers – Ring counter, Johnson counter – Hazards and Essential Hazards in logic circuits –  
 Design of Hazard free circuits

**LIST OF EXPERIMENTS (INDICATIVE)**

1. Characteristics of digital IC's
2. Implementation of combinational logic design using MUX IC's
3. Design and implementation of various data path elements (Adder/Subtractor)
4. Characteristics of flip-flop
5. Design and implementation of synchronous sequential circuit (Counters/ Shift registers)
6. Design and implementation of asynchronous mod counters

**Contact Periods:**

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

**TEXT BOOKS:**

1. M.Morris Mano, Michael D Ciletti, "Digital Design", 6<sup>th</sup> Edition, Pearson, 2018
2. Charles H. Roth, Jr, Larry L. Kinney, "Fundamentals of logic design", 7<sup>th</sup> Edition, Kluwer Academic Publishers, 2014

**REFERENCES:**

1. Thomas L.Floyd, "Digital Fundamentals", 11<sup>th</sup> Edition, Prentice Hall, 2015
2. A.Anand Kumar, "Fundamentals of Digital Circuits", 2<sup>nd</sup> Edition, PHI Learning, 2013
3. Ronald J Tocci, Neal S Widmer, Gregory L Moss, "Digital Systems Principles and Applications", 10<sup>th</sup> Edition, Pearson, 2009
4. D. Donald Givone, "Digital Principles and Design", 4<sup>th</sup> Edition, Tata McGraw Hill, 2008

**EVALUATION PATTERN:**

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25			
50				50	
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

## SEMESTER III

U21CSG03	DATA STRUCTURES (Common to AM, BM, CB, EC, EE, IT)	Category: ESC				
		L	T	P	J	C
		2	0	2	0	3

## PRE-REQUISITE:

- U21CSG01 – Problem Solving and C Programming

## COURSE OBJECTIVES:

- To understand the concepts of ADT and list operations
- To learn linear data structures – stacks and queues
- To apply Tree and Graph structures

## COURSE OUTCOMES:

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

CO1: Explain the concept of linear and non-linear data structures (Understand)

CO2: Demonstrate stack and queue with suitable applications (Apply)

CO3: Implement various searching, sorting, and hashing techniques (Apply)

CO4: Analyze non-linear data structures – trees (Apply)

CO5: Implement various problems in graph data structures (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I LINEAR DATA STRUCTURES – LIST

6

Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list-based implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of linked list

## UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES

6

Stack ADT – Operations – Applications – Evaluating arithmetic expressions – Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – DeQueue – Applications of queues

**UNIT III      SEARCHING, SORTING, AND HASHING TECHNIQUES**

6

Introduction to Searching – Types of search – Linear Search – Binary Search – Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing

**UNIT IV      NON-LINEAR DATA STRUCTURES – TREES**

6

Tree ADT – Tree traversals – Binary Tree ADT – Expression trees – Implementation of expression tree – Applications of trees – Binary search tree ADT – Operations in binary search tree – Introduction to Heap – Properties

**UNIT V      NON-LINEAR DATA STRUCTURES – GRAPHS**

6

Introduction to Graph – Types of graph – Graph traversal – Breadth-first traversal – Depth-first traversal – Topological Sort – Minimum spanning tree algorithms – Shortest path algorithm – Dijkstra's algorithm

**LIST OF EXPERIMENTS (INDICATIVE)**

1. Write a function program to perform the following operations on a singly linked list
  - i. Create a list cube
  - ii. Insert an element to the list
  - iii. Delete the maximum element from the list
  - iv. Arrange the list in a sorted order
  - v. Display the elements of the list
2. Write a main method to demonstrate the above functionalities
3. Creation of Array and linked list implementation of Stack and Queue ADTs
4. Implementation of quick, heap, and shell sort
5. Program to sort the elements in ascending order using selection sort and bubble sort
6. Implementation of hashing technique
7. Develop a program to perform a linear and binary search
8. Program to construct an expression tree for a given expression and perform various tree traversal methods.
9. Implement Prim's algorithm with the following functionalities
  - i. Read a set of vertices minimum of six from the keyboard
  - ii. Get the number of edges and form the graph
  - iii. Find the value of each edge by using the distance formula for two points.
  - iv. Develop a Minimum Spanning Tree for the graph
  - v. Find the total length of all edges. Write a main method to execute the above functionalities
10. Choose an appropriate data structure and create a token system for banking service (withdrawal, deposit, and money transfer)
11. Create a food delivering system that allocates the path for the delivery of food using appropriate data structures
12. Create a book rack allocation system in a library, which allocates appropriate space for the books based on category using appropriate data structures

**Contact Periods:**

Lecture: 30 Periods

Tutorial: – Periods

Practical: 30 Periods

Project: – Periods

Total 60 Periods

Page 77 of 237



**TEXT BOOKS:**

1. Reema Thareja, "Data structures using C", 1<sup>st</sup> Edition, Oxford University Press, 2018
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2<sup>nd</sup> Edition, University Press, 2017

**REFERENCES:**

1. R. Venkatesan, S. Lovelyn Rose, "Data Structures", 1<sup>st</sup> Edition, Wiley, 2019.
2. Seymour Lipschutz, "Data structures with C", 4<sup>th</sup> Edition, McGraw Hill Education, 2017

**EVALUATION PATTERN:**

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25			
50				50	
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOE - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER III

U21BM304	BIOMEDICAL SENSORS AND INSTRUMENTATION LABORATORY	Category: PCC				
		L	T	P	J	C
		0	0	4	0	2

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To study the functioning of sensors in various biomedical applications
- To explore the application of amplifiers in biosignal acquisition and analysis
- To identify the apt measurement setup for various parameters

## COURSE OUTCOMES:

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

CO1: Identify the best transducers to measure displacement (Apply)

CO2: Demonstrate the measurement of bio-signals (Understand)

CO3: Experiment with the various parameters of ECG signals (Apply)

CO4: Analyze the data from pulse rate and blood pressure measurement (Analyze)

CO5: Outline the simulation of amplifiers for biomedical applications (Understand)

## CO-PO MAPPING:

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

## LIST OF EXPERIMENTS

- Study of Digital Storage Oscilloscope
- Strain gauge measurement
- Measurement of displacement using LVDT
- Measurement of temperature using a thermocouple
- Real time monitoring of EMG
- ECG wave analysis using simulator
- Detection of QRS component from ECG signals using analog circuits
- Measurement of ECG using a right leg driven ECG amplifier
- Measurement of pulse-rate using photo transducer

**B.E. - BM - R2021 - CBCS**

10. Measurement of pH and conductivity
11. Measurement of blood pressure using sphygmomanometer
12. Design a PCB layout for any bio amplifier using suitable software tool

**Contact Periods:**

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

**REFERENCES:**

1. Webster, "The Measurement, Instrumentation and Sensors Handbook", 2<sup>nd</sup> Edition, CRC press, 2014
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", 3<sup>rd</sup> Edition, Tata McGraw-Hill, New Delhi, 2014
3. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2<sup>nd</sup> Edition, Prentice Hall of India, New Delhi, 2015

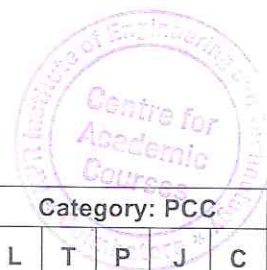
**EVALUATION PATTERN:**

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	
75	25	
100		100
60		40
100		



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407





U21BM305	HUMAN ANATOMY AND PHYSIOLOGY LABORATORY	Category: PCC				
		L	T	P	J	C
		0	0	4	0	2

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To estimate type of blood cells
- To understand the essential parameters of haematology
- To get familiarized with essential first aid technique

**COURSE OUTCOMES:**

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

CO1: Identify the type of blood cells (Understand)

CO2: Enumerate the haematological parameters (Understand)

CO3: Analyze the special sensory organs (Apply)

CO4: Identify the structure and function of different bones (Understand)

CO5: Practice essential first aid technique (Understand)

**CO-PO MAPPING:**

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

**LIST OF EXPERIMENTS**

1. Separation of blood cells, blood plasma and study of Neubauer chamber
2. Estimation of RBC count
3. Estimation of WBC count
4. Estimation of eosinophil count
5. Estimation of platelet count
6. Estimation of differential count
7. Estimation of haemoglobin
8. Identification of blood group
9. Determination of bleeding time and clotting time

**B.E. - BM - R2021 - CBCS**

10. Testing of Visual Activity (Snellen's Chart) and Hearing Ability (Tuning fork)
11. Study of bones
12. Essential first aids – Wound Dressing and CPR Techniques

**Contact Periods:**

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

**REFERENCES:**

1. Arthur C Guyton, John E Hall, "Textbook of Medical Physiology", 2<sup>nd</sup> Edition, Saunders Elsevier, 2019
2. Jain A K, "Textbook of Physiology", 9<sup>th</sup> Edition, Avichal Publishing Company, 2019

**EVALUATION PATTERN:**

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	
75	25	
100		100
60		40
100		



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER III

U21BM307	DESIGN STUDIO I	Category: EEC				
		L	T	P	J	C
		0	0	0	2	1

**PRE-REQUISITES:**

- U21ECG03 - Engineering Studio

**COURSE OBJECTIVES:**

- To inculcate the problem-solving & Innovation mindset
- To provide a platform for self-learning, experimenting, solving the real-world problems and to develop a product.
- To enable hands-on experience for active learning.

**COURSE OUTCOMES:**

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

**CO1:** Understand Design thinking, system thinking, mapping the problem statements to UNSDG.

**CO2:** Apply the design thinking steps "Empathize, Define, ideate and prototype".

**CO3:** Create Experimental proof of concept (TRL 3)

**CO4:** Demonstrate teamwork, project management, technical report writing and presentation skills

**CO-PO MAPPING:**

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

**Course conduction:**

- The students will be divided into batches (maximum 4 students / batch). They will be provided the space, time, resources, and a mentor.
- With the guidance of assigned mentor, the students will find & validate a problem statement, map to UNSDG, identify the skills required for the project and self-learn.
- Applying the design thinking concept, the students will provide a solution and produce the version 1 of prototype.
- The student will learn teamwork, project management, technical report writing and presentation skills through this course.

**Contact Periods:**

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



**EVALUATION PATTERN:**

<b>Review 0</b> (Within 10 days of commencement of semester)	<b>Review 1</b> (Between 35 <sup>th</sup> to 40 <sup>th</sup> working day)	<b>Review 2</b> (Between 80 <sup>th</sup> to 90 <sup>th</sup> working day)	<b>Total</b>
<b>0</b>	<b>40</b>	<b>60</b>	<b>100</b>



HoD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER IV

U21MA406	PROBABILITY AND STOCHASTIC PROCESSES (For BM)	Category: BSC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To understand the concepts of probability, random variable and distributions that are applicable in the field of engineering
- To understand the concepts of stochastic processes with real life examples
- To understand the concepts of testing of hypothesis for small and large samples which plays an important role in testing of fertilizers and chemical products

## COURSE OUTCOMES:

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

CO1: Apply probability axioms and the moments of discrete and continuous random variables to core engineering problems (Apply)

CO2: Use discrete probability distributions including requirements, mean and variance for making decisions (Understand)

CO3: Compare correlation and linear regression with respect to two dimensional random variables (Understand)

CO4: Analyze the simple classes of discrete random processes to model random arrivals (Apply)

CO5: Analyze large and small sample tests and perform small sample tests based on Chi-square t and F distributions (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I PROBABILITY

9

Probability – Axioms of probability – Conditional probability – Baye's theorem – Discrete and continuous random variables – Moments – Moment generating functions

## UNIT II DISTRIBUTION FUNCTIONS

9

Binomial distribution – Poisson distribution – Geometric distribution – Uniform distribution – Exponential distribution – Normal distribution

**UNIT III TWO DIMENSIONAL RANDOM VARIABLES 9**

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

**UNIT IV STOCHASTIC PROCESSES 9**

Classification – Stationary process – Markov chain – Bernoulli and Poisson process

**UNIT V TESTING OF HYPOTHESIS 9**

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

**Contact Periods:**

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

**TEXT BOOKS:**

1. Milton J S and Arnold J C, "Introduction to Probability and Statistics", 4<sup>th</sup> edition, Tata McGraw Hill, 2008
2. Oliver C.Ibe, "Fundamentals of Applied Probability and Random Processes", Elsevier Academic Press, 2<sup>nd</sup> edition, 2014

**REFERENCES:**

1. Johnson R A, "Miller and Freund's Probability and Statistics for Engineers", 8<sup>th</sup> edition, Pearson Education, Asia, 2015
2. Devore J L, "Probability and Statistics for Engineering and the Sciences", 8<sup>th</sup> edition, Cengage Learning, New Delhi, 2014
3. Ross S M, "Introduction to Probability and Statistics for Engineers and Scientists", 3<sup>rd</sup> edition, Elsevier, 2010
4. Stark H., and Woods J.W., "Probability and Random Processes with Applications to Signal Processing", 3<sup>rd</sup> edition, Pearson Education, Asia, 2002

**EVALUATION PATTERN:**

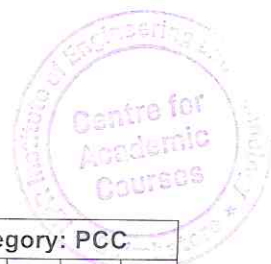
Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Seminar / MCQ	Written Test	*Individual Assignment / Seminar / MCQ	Written Test		
40	60	40	60	200	
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HoD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407





## SEMESTER IV

U21BM401	MICROBIOLOGY AND PATHOLOGY	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- U21BM301 - Human Anatomy and Physiology

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

- CO1: Perform staining procedure and identify the growth of microorganism in a given culture (Understand)
- CO2: Outline the structure and morphology of microorganisms (Apply)
- CO3: Explain the cause and pathogenesis of disease (Understand)
- CO4: Outline the pathophysiology of disorders and compare the relation among disorders (Understand)
- CO5: Characterize the hormonal disease and explain the metabolic effect of cancer (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I INTRODUCTION TO MICROBIOLOGY

9

Microscopy – Light microscope – Phase contrast and Electron microscopes – Sterilization techniques – Culture methods – Isolation and maintenance – Culture media – Selective and enrichment media – Staining techniques – Acid-fast staining – Growth curve and generation time

## UNIT II MORPHOLOGICAL STUDIES

9

Fr Morphology, structure and classification: bacteria and virus – Pathogenesis and pathology of viral infections – Routes of infection and spread – Endogenous and exogenous infections – Plaque assay – T4 Phages and lambda stages

**UNIT III IMMUNOPATHOLOGY**

9

Normal human microflora – Host – Parasitic interaction – Exo and Endotoxins – Natural and artificial immunity – Auto-immune disorders – Antigen and antibody reactions – Immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, Monoclonal antibodies

**UNIT IV DISORDERS OF KIDNEY AND PLASMA PROTEINS**

9

Acute and chronic renal failure – Proteinuria and nephritic syndrome – Acute and chronic liver failure  
Hypoalbuminaemia – Hypogammaglobulinaemia – Hypergammaglobulinaemia

**UNIT V DISORDERS OF HORMONES AND METABOLIC ASPECTS OF CANCER**

9

Congenital adrenal hyperplasia – Hyperthyroidism – Hypothyroidism – Pathogenesis of cancer – Tumour markers –  $\alpha$ -Fetoprotein (AFP) – Carcinoembryonic antigen (CEA) – Para proteins – Enzymes as tumour markers and Carbohydrate antigen (CA) markers

**Contact Periods:**

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

**TEXT BOOKS:**

1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", 7<sup>th</sup> Edition, WB, Saunders Co. 2015
2. Ananthanarayanan and Panicker, "Textbook of Microbiology", 10<sup>th</sup> Edition, Orient blackswan, 2017

**REFERENCES:**

1. Prescott, Harley and Klein, "Microbiology", 10<sup>th</sup> Edition, McGraw Hill, 2017

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60		
Total					
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HoD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407



## SEMESTER IV

U21AMG04	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (For BM)	Category: ESC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

CO1: Summarize the history and state of the art of AI (Understand)

CO2: Formulate the framework of machine learning models (Apply)

CO3: Deploy the linear regression methods on any dataset (Apply)

CO4: Apply the architecture of neural networks and SVM (Apply)

CO5: Choose the appropriate unsupervised techniques for any given data (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I INTRODUCTION TO AI

9

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

## UNIT II LEARNING TYPES AND METHODS

9

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

## UNIT III REGRESSION

9

Introduction to Supervised learning – Linear regression – Algorithm – Univariate – Bivariate – Generalization issues – Bias – Variance – Learning curve – Overfitting – Regularization – Case study



**UNIT IV CLASSIFICATION**

9

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

**UNIT V CLUSTERING**

9

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

**Contact Periods:**

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

**TEXT BOOKS:**

1. Stuart Jonathan Russell, Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", 4<sup>th</sup> Edition, Pearson, 2020
2. Abu-Mostafa Y.S, Magdon-Ismali M, Lin H.T, "Learning from Data", 1<sup>st</sup> Edition, AML Book Publishers, 2012

**REFERENCES:**

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

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60		
Total					
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HO.D - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER IV

U21CSG04	JAVA PROGRAMMING (Common to AM, BM, CB, CS, EC, EE, IT)	Category: ESC				
		L	T	P	J	C
		2	0	2	0	3

**PRE-REQUISITE:**

U21CSG01 - Problem Solving and C Programming

**COURSE OBJECTIVES:**

- To describe object-oriented programming paradigm and its principles
- To implement programs with Core Java features and API
- To develop applications with Java Collections

**COURSE OUTCOMES:**

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

CO1: Describe the object-oriented programming concepts to develop simple java programs  
(Understand)

CO2: Develop Java programs using Inheritance principle (Apply)

CO3: Apply exception handling techniques in Java programs (Apply)

CO4: Develop Java programs with Input Output classes and multithreading (Apply)

CO5: Implement Java programs with Collections (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I OBJECT ORIENTED DEVELOPMENT AND JAVA BASICS**

6

Object Oriented Programming – Concepts – Abstraction – Encapsulation – Comparison with function oriented programming – Characteristics of Java – Java Environment – JVM and JDK – Classes – Constructors – Methods – Static members – Comments – Data Types – Variables – Operators – Control Flow

**UNIT II PACKAGES AND INHERITANCE**

6

Defining a Package – Importing Packages – Inheritance – Creating super classes and sub classes – Access modifiers – Constructors in sub classes – Polymorphism – Method overloading – Method overriding – Abstract classes and abstract methods – Interfaces – Defining an interface – Implementing interface – Extending interfaces – Object class

**UNIT III EXCEPTION HANDLING**

6

Exceptions – Throwing and catching exceptions – Checked and unchecked exceptions – Exception hierarchy – Built in exceptions – Creating own exception – Chained exceptions – Stack Trace Elements

**UNIT IV I/O STREAMS AND MULTITHREADING**

6

Input / Output Basics – Scanner class – Streams – Byte streams and Character streams comparison – Reading from and Writing to Console and Files – Multithreaded Programming – The Java Thread Model – Creating multiple threads – Thread class – Runnable Interface

**UNIT V COLLECTIONS**

6

Collections Framework Overview – Basics of List – Set – Queue – Programs using Array list – HashMap and HashSet – Hashcode and equals methods

**LIST OF EXPERIMENTS**

1. Write a Java program to create a class Student with private data members and public methods to implement encapsulation and abstraction.
2. Develop a Java program to implement constructor overloading and method overloading.
3. Develop a Java program to implement run-time polymorphism with inheritance.
4. Develop a Java program to implement inheritance using Interfaces and Abstract classes. Use packages.
5. Develop a Java program to demonstrate exception handling
6. Develop a multithreaded java program using a Thread class and Runnable interface
7. Develop a Java program to implement basic console IO and File IO.
8. Develop a Java program to store multiple objects in an Array List and to implement search and sort operations.

**Contact Periods:**

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

**TEXT BOOKS:**

1. Herbert Schildt, "Java: The Complete Reference", 11<sup>th</sup> Edition, McGraw Hill Education, 2018
2. Cay.S.Horsmann and Gary Cornell, "Core Java 2, Vol 1, Fundamentals", 11<sup>th</sup> Edition, Pearson Education, 2020

**REFERENCES:**

1. J.Nino and F.A. Hosch, "An Introduction to Programming and OO Design using Java", 1<sup>st</sup> Edition, John Wiley & Sons, 2018
2. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3<sup>rd</sup> Edition, Pearson, 2015
3. E Balagurusamy, "Programming with Java", 6<sup>th</sup> Edition, McGraw Hill Education, 2019



## EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25			
50				50	
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER IV

U21BM402	BIOPHYSICAL SIGNAL AND SYSTEMS	Category: PCC				
		L	T	P	J	C
		2	0	2	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To understand the basic properties of signals and systems
- To analyze discrete time signals and systems in the Laplace and Z transform domain
- To understand analysis of physiological signals

## COURSE OUTCOMES:

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

CO1: Identify the continuous and discrete time signals (Understand)

CO2: Enumerate the equations governing the continuous and discrete time systems (Apply)

CO3: Formulate the sampling and reconstruction techniques with Fourier transform (Apply)

CO4: Utilize the representation of systems using Laplace and Z transform (Analyze)

CO5: Integrate Physiological systems and analysis (Analyze)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I INTRODUCTION

9

Introduction to Signals and systems – Mathematical operations on Continuous time signals – Introduction to Discrete time signals - Representation of DT signals - Mathematical operations on Discrete time signals – Classification of continuous signals – Problems

## UNIT II CONTINUOUS TIME, DISCRETE TIME SIGNALS

9

Continuous time signals : Block diagram representation of CT systems in time domain – Convolution integral – Convolution Integral by graphical method – Discrete time signals – Convolution sum – Linear convolution by graphical, tabulation and matrix method – Problems

## UNIT III SAMPLING AND ANALYSIS OF DISCRETE TIME SIGNALS

9

Sampling and aliasing – Fourier transform of DT signals – Properties of DT Fourier transform – Frequency spectrum and Aliasing due to sampling – Signal reconstruction – Problems on Fourier transform

**UNIT IV ANALYSIS OF SIGNALS WITH TRANSFORMS**

9

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

**UNIT V PHYSIOLOGICAL SIGNALS**

9

Analysis of wave shape and waveform complexity – Case study 1 – Real Time ECG QRS Detection with Simulink – Block diagram - ECG signal pre-processing and filtering – Case study 2 – Analysis of respiration - Extraction of a respiratory signal as time series and estimation of Respiration rate from the respiratory signal

**LIST OF EXPERIMENTS**

1. Study of Scientific and Simulation Packages.
2. Generation of Basic Signals.
3. Basic operation on signals.
4. Computation of Step Response of the system.
5. Computation of Impulse response of the system.
6. Verification of Linearity property.
7. Verification of Time Variant property.
8. Solving difference Equations.
9. Computation of Linear Convolution.
10. Computation of Circular Convolution.
11. Signal visualization and measurement
12. Plotting respiratory rate

**Contact Periods:**

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

**TEXT BOOKS:**

1. Oppenheim A V, Wilsky A and Hamid Nawab S, "Signals and Systems", Prentice Hall of India, New Delhi, 2011
2. A. Nagoor Kani, "Signals and Systems: Simplified", Tata McGraw Hill, New Delhi, 2018
3. M. Rangaraj Rangayyan, "Biomedical Signal Analysis", Wiley Publishers, New Delhi, 2016

**REFERENCES:**


1. Roberts M J, "Signals, Systems - Analysis using Transform Methods and MATLAB", Tata McGraw Hill, New Delhi, 2004
2. Samir S Soliman, Srinath M D, "Continuous and Discrete Signals and Systems", Prentice Hall International, New Delhi, 2003
3. <https://in.mathworks.com/help/dsp/ug/real-time-ecg-qrs-detection.html>
4. Charlton P H, Villarroel M, Salguero F, "Waveform Analysis to Estimate Respiratory Rate" 2016
5. <https://www.ncbi.nlm.nih.gov/books/NBK543644/> doi: 10.1007/978-3-319-43742-2\_26
6. <https://in.mathworks.com/help/dsp/ug/signal-visualization-and-measurements-in-matlab.html>
7. <https://in.mathworks.com/matlabcentral/answers/427625-matlab-plotting-and-breathing-rate>



**EVALUATION PATTERN:**

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER IV

U21BM403	MICROBIOLOGY AND PATHOLOGY LABORATORY	Category: PCC				
		L	T	P	J	C
		0	0	4	0	2

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

CO1: Analyze the factors influencing the growth of microorganism (Understand)

CO2: Develop the media for culturing bacteria (Apply)

CO3: Identify the different types of bacteria using staining techniques (Apply)

CO4: Inspect the oxygen content of culture media and bacterial mobility (Apply)

CO5: Identify the activity of microbes in a culture media (Analyze)

## CO-PO MAPPING:

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

## LIST OF EXPERIMENTS

1. Study of parts of compound microscope
2. Culture media preparation and Pure culture techniques (Pour plate method, Spread plate method, Streak plate)
3. Effect of temperature on the growth of micro-organism
4. Effect of salt concentration on the growth of microorganisms
5. Simple staining of bacteria
6. Gram staining of bacteria
7. Capsule (Positive and Negative) staining



**B.E. - BM - R2021 - CBCS**

8. Spore staining
9. Bacteria motility test
10. Quality analysis of phytochemical components in herbal extracts
11. Antibacterial susceptibility of a bacterial isolate
12. Cryoprocessing of tissue and cryosectioning (Study)

**Contact Periods:**

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

**REFERENCES:**

1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, —Pathologic Basis of Diseases, 7<sup>th</sup> edition, WB, Saunders Co. 2015
2. Ananthanarayanan & Panicker, "Microbiology II", 10<sup>th</sup> edition, Orient blackswan, 2017
3. Dubey RC and Maheswari DK. —A Text Book of Microbiology II Chand & Company Ltd, 2007

**EVALUATION PATTERN:**

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	
75	25	
100		100
60		40
100		



HO'D - BIOMEDICAL ENGINEERING  
KPP INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
AJIADUR COIMBATORE-641 407



## SEMESTER IV



U21SSG01	SOFT SKILLS – I (Common to all programmes)	Category: HSMC				
		L	T	P	J	C
		0	0	2	0	1

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To inculcate potential skills and to work as a team effectively
- To develop confidence and enhance interpersonal skills

## COURSE OUTCOMES:

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

CO1: Enhance decision making and negotiation skills (Analyze)

CO2: Maintain open, effective, and Professional Communication (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I VERBAL COMPETENCE

10

Verbal Analogy – Spotting Errors – Ordering of Sentences – Cloze Test – Effective Listening – Reading Comprehension

## UNIT II EFFECTIVE COMMUNICATION

10

Overcoming Communication Barriers – Body Language and its Etiquettes – Contextual Communication – 7C's of Communication – Listening to Documentaries

## UNIT III INTERPERSONAL SKILLS

10

Group Decision Making – Paralanguage – Negotiation Skills – Preparation & Planning, Bargaining & Problem Solving – Self Grooming – SWOT Analysis

## Contact Periods:

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

## TEXT BOOKS:

1. Prashant Sharma, "Soft Skills: Personality Development for Life Success", 1<sup>st</sup> Edition, BPB Publications, 2022
2. Suresh Kumar E, Sreehari P and Savithri J, "Communication Skills and Soft Skills: An Integrated Approach", 1<sup>st</sup> Edition, Dorling Kindersley, 2011

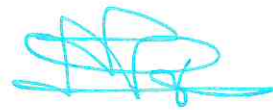
Page 99 of 237

**REFERENCES:**

1. Jeff Butterfield, "Problem Solving and Decision Making", 2<sup>nd</sup> Edition, Course Technology, 2010
2. Wushow Bill Chou, "Fast-Tracking your Career: Soft Skills for Engineering and IT Professionals", 1<sup>st</sup> Edition, IEEE Press, 2013

**EVALUATION PATTERN:**

Continuous Internal Assessments	Marks
Test - I	50
Test - II	50
<b>Total</b>	<b>100</b>



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
JOSHIUR COIMBATORE-641 407



## SEMESTER IV

U21BM404	DESIGN STUDIO II	Category: EEC				
		L	T	P	J	C
		0	0	0	2	1

## PRE-REQUISITES:

- U21BM307 - Design Studio I

## COURSE OBJECTIVES:

- To inculcate the problem-solving & Innovation mindset
- To provide a platform for self-learning, experimenting, solving the real-world problems and to develop a product
- To enable hands-on experience for active learning

## COURSE OUTCOMES:

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

CO1: Apply the problem-solving techniques (Design thinking & system thinking)

CO2: Create and validate low fidelity prototype / Experimental proof of concept. (TRL 4)

CO3: Demonstrate teamwork, project management, technical report writing and presentation skills

## CO-PO MAPPING:


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

## Course conduction:

- The students will be divided into batches (maximum 4 students / batch). They will be provided the space, time, resources, and a mentor for this design clinic 2 course.
- With the guidance of assigned mentor, the students will find & validate a problem statement, map to UNSGD, identify the skills required for the project and self-learn.
- Applying design thinking & system thinking concept the students will solve the problem and produce the version 1 of prototype. (TRL 4)
- The student will learn teamwork, project management, technical report writing and presentation skills through this course.

## Contact Periods:

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

  
HoD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407



**EVALUATION PATTERN:**

<b>Review 0</b> (Within 10 days of commencement of semester)	<b>Review 1</b> (Between 35 <sup>th</sup> to 40 <sup>th</sup> working day)	<b>Review 2</b> (Between 80 <sup>th</sup> to 90 <sup>th</sup> working day)	<b>Total</b>
<b>0</b>	<b>40</b>	<b>60</b>	<b>100</b>



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR, COIMBATORE-641 607

## SEMESTER V

U21BM501	MICROCONTROLLER AND ITS APPLICATIONS	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- U21ECG01 – Digital Electronics

## COURSE OBJECTIVES:

- To explain the architecture of RP2040 chip
- To outline the features of cortex M0+ chip
- To explore the peripherals in RP2040

## COURSE OUTCOMES:

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

CO1: Describe the architecture of RP2040 (Understand)

CO2: Illustrate the bus fabric and single cycle I/O of RP2040 (Apply)

CO3: Use appropriate configurations of cortex M0+ in system design (Apply)

CO4: Demonstrate the Programmable I/O in system design (Apply)

CO5: Categorize the peripherals for designing a system using RP2040 (Analyze)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I MICROCONTROLLER RP2040

9

Introduction – A system overview of the RP2040 chip – Pin Descriptions – GPIO Functions

## UNIT II SYSTEM DESCRIPTION

9

Bus Fabric: AHB-Lite Crossbar – Atomic Register Access – APB Bridge – Narrow IO Register Writes – Processor subsystem: SIO – Interrupts – Event Signals – Debug

## UNIT III CORTEX-M0+ AND DMA

9

Cortex-M0+ – Functional Description – NVIC – MPU – Debug – GPIO – DMA: Data requests, Interrupts and Memory

**UNIT IV THE PROGRAMMABLE INPUT/OUTPUT**

9

State machines – PIO Programs – Control Flow – Registers – Stalling – Pin Mapping – IRQ Flags – Interactions Between State Machines – Instruction Set – Functional Details

**UNIT V PERIPHERALS**

9

USB – UART – I2C – SPI – PWM – Timer – Watchdog – The Real-time Clock (RTC) – ADC – SSI

**Contact Periods:**

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

**TEXT BOOKS:**

1. RP2040 Datasheet, A microcontroller by Raspberry Pi, V1.8, Synopsys, Inc. 2022
2. Harry Fairhead, "Programming The Raspberry Pi Pico In C", 1<sup>st</sup> Edition, IO Press, 2021

**REFERENCES:**

1. Sai Yamanoor and Srihari Yamanoor, "Python Programming with Raspberry Pi", 1<sup>st</sup> Edition, Packt Publishing, 2017
2. Stephen Smith, "RP2040 Assembly Language Programming: ARM Cortex-M0+ on the Raspberry Pi Pico", Springer Science, 2022

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.





## SEMESTER V

U21BM502	BIOSIGNAL PROCESSING	Category: PCC				
		L	T	P	J	C
		2	0	2	0	3

**PRE-REQUISITES:**

- U21BM402 - Signals and Systems

**COURSE OBJECTIVES:**

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

**COURSE OUTCOMES:**

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

**CO1:** Design the different types of analog and digital IIR filters (Apply)

**CO2:** Design the FIR filters based on the given specifications (Apply)

**CO3:** Categorize the biosignals and methods for the artifact removal (Analyze)

**CO4:** Estimate the power spectrum and event detection (Understand)

**CO5:** Interpret the analysis and classification of events in biosignals (Understand)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I INFINITE IMPULSE RESPONSE FILTERS**

9

Analog Filter design – Butterworth filter – Chebyshev filter – Design of IIR filters from analog filters – Impulse invariance – Bilinear transformation – IIR realizations – Direct form – Cascade form – Parallel form

**UNIT II FINITE IMPULSE RESPONSE FILTERS**

9

FIR Design – FIR design by windows – Rectangular window – Hamming window – Hanning window – FIR design by frequency sampling method – FIR realizations – Direct form – Cascade form

**UNIT III BIOMEDICAL SIGNALS AND ARTIFACT REMOVAL**

9

Nature of biomedical signals – Characteristics – Objectives of biomedical signal analysis – Physiological artifacts and interference – Time domain filtering – Synchronous averaging filters – Moving average filters – Frequency domain filtering – Optimal filtering – Adaptive filtering using LMS algorithm



**UNIT IV POWER SPECTRUM ESTIMATION AND EVENT DETECTION 9**

Introduction – The Periodogram – Non parametric methods – Bartlett method – Welch method – Blackman and Tukey method – Performance characteristics – Event detection – QRS detection – Correlation analysis of EEG rhythms – Homographic filtering

**UNIT V PATTERN RECOGNITION AND DIAGNOSTIC DECISION 9**

Pattern classification – Supervised pattern classification – Linear discriminant analysis – Distance functions – Unsupervised pattern classification – Cluster seeking methods – Neural networks – Detection of Ectopic beats in ECG – Detection of knee joint cartilage pathology

**LIST OF EXPERIMENTS**

1. Design of IIR Butterworth filter (LPF, HPF, BPF and BSF)
2. Design of IIR Chebyshev filter (LPF and HPF)
3. Design of FIR filter using Hamming window
4. Design of FIR filter using Hanning window
5. Artifact removal – powerline interference
6. Adaptive filtering
7. Estimation of power spectral density in an ECG signal
8. Detection of QRS complex in ECG signal
9. Analysis of EEG signal
10. Determination of heart rate from the ECG signal

**Contact Periods:**

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

**TEXT BOOKS:**

1. John G Proakis and Dimitris G Manolakis, "Digital signal Processing: Principles, Algorithms and Applications", 4<sup>th</sup> Edition, Prentice Hall of India, New Delhi, 2007
2. Rangaraj M Rangayyan, "Biomedical Signal Analysis: A Case-Study Approach", 2<sup>nd</sup> Edition, Wiley India, New Delhi, 2015

**REFERENCES:**

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



## EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HO - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407





## SEMESTER V

U21BM505	BIOCONTROL SYSTEMS	Category: PCC				
		L	T	P	J	C
		2	0	0	2	3

## PRE-REQUISITES:

- U21MA202 - Transforms and its applications
- U21BM402 - Biophysical Signals and Systems

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

**CO1:** Interpret the transfer function of a control system using various techniques (Understand)

**CO2:** Infer the time and stability responses of the given system using mathematical methods (Understand)

**CO3:** Implement mathematical methods to identify the frequency response of the given system (Apply)

**CO4:** Describe the concepts of physiological system modelling (Understand)

**CO5:** Summarize the properties of physiological control systems (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I INTRODUCTION TO CONTROL SYSTEMS

9

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

## UNIT II TIME RESPONSE AND STABILITY ANALYSIS

9

Step and Impulse responses of first order and second order systems - Time domain specifications – Error coefficients and constants – Stability - Routh Hurwitz criteria - Root locus technique - Dominant poles - Relative stability

**UNIT III FREQUENCY RESPONSE ANALYSIS 9**

Frequency response analysis – Correlation between time and frequency response – Bode plot – Stability in frequency domain – Nyquist stability criteria - Nyquist plot

**UNIT IV PHYSIOLOGICAL CONTROL SYSTEMS 9**

Introduction to physiological control systems – Art of modeling physiological systems – Parametric and non-parametric models – Lumped and distributed parametric models - Positive and negative feedback physiological control systems

**UNIT V PROPERTIES OF PHYSIOLOGICAL CONTROL SYSTEM 9**

Generalized system properties - Adaptive and constrained systems - Models with combination of system elements – Linear model of respiratory mechanics - Linear model of lung mechanics

**Contact Periods:**

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

**TEXT BOOKS:**

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

**REFERENCES:**

1. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt. Ltd., New Delhi, 2015

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (Theory) (100 Marks)		Assessment II (Project) (100 Marks)			Theory Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Review I	Review II	Review III	
40	60	15	25	60	
25		25			
50					50
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

## SEMESTER V

U21SSG02	SOFT SKILLS - II	Category: HSMC				
		L	T	P	J	C
		0	0	2	0	1

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To understand the importance of communication and enhance self confidence
- To acquire employability skills

## COURSE OUTCOMES:

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

**CO1:** Actively participate in Group Discussion (Apply)

**CO2:** Enhance interview skills and make effective Presentation (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I PRESENTATION SKILLS

10

Presentation Techniques – Time Management Techniques – Body language – Managerial Skills – Making Effective Presentation

## UNIT II GROUP DISCUSSION AND PUBLIC SPEAKING

10

Introduction to Group Discussion – Understanding Group Dynamics – Group Discussion Strategies – Activities to Improve GD Skills – Public Speaking Techniques – Public Speaking Activity

## UNIT III INTERVIEW SKILLS

10

Listening to Interviews – Preparation for the Interview – Interview Techniques and Etiquettes – Handling Stress Interview – Mock Interview – Online Interview Techniques

## Contact Periods:

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

## TEXT BOOKS:

1. Prashant Sharma, "Soft Skills: Personality Development for Life Success", BPB Publications, 1<sup>st</sup> Edition, 2022
2. Leader Interpersonal and Influence Skills: The Soft Skills of Leadership", Routledge Publications, 2014



**REFERENCES:**

1. Ghosh B N, "Managing Soft Skills for Personality Development", 1<sup>st</sup> Edition, Tata McGraw-Hill, 2012
2. Nilin Bhatnagar and Mamta Bhatnagar, "Effective Communication and Soft Skills Strategies for Success", 1<sup>st</sup> Edition, Pearson Education, 2012

**EVALUATION PATTERN:**

Continuous Internal Assessments	Marks
Test - I	50
Test - II	50
Total	100



HO D - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER V

U21BM504	MICROCONTROLLER LABORATORY	Category: PCC				
		L	T	P	J	C
		0	0	4	0	2

## PRE-REQUISITES:

- U21EEG01 - Basics of Electrical and Electronics Engineering
- U21ECG01 - Digital Electronics

## COURSE OBJECTIVES:

- To explore the registers in microcontroller
- To program microcontrollers to work with peripherals

## COURSE OUTCOMES:

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

CO1: Experiment the arithmetic operations using microcontroller (Apply)

CO2: Demonstrate the GPIO operations in microcontroller (Apply)

CO3: Modify the GPIO operations in the microcontroller (Analyze)

CO4: Create waveforms using microcontroller (Apply)

CO5: Program the peripherals of the microcontrollers (Apply)

## CO-PO MAPPING:

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

## LIST OF EXPERIMENTS

1. Arithmetic Operations using microcontroller
2. Logical Operations using microcontroller
3. LED control using microcontroller
4. 7 Segment LED control using microcontroller
5. LCD controller using microcontroller
6. Stepper motor controller using microcontroller
7. Servo motor control using microcontroller
8. Waveform generation using microcontroller

**B.E. - BM - R2021 - CBCS**

9. ADC using microcontroller
10. Timer using Microcontroller

**Contact Periods:**


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

**REFERENCES:**

1. Harry Fairhead, "Programming the Raspberry Pi Pico", 1<sup>st</sup> Edition, IO Press, 2021
2. Sai Yamanoor and Srihari Yamanoor, "Python Programming with Raspberry Pi", 1<sup>st</sup> Edition, Packt Publishing, 2017

**EVALUATION PATTERN:**

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	
75	25	
100		100
40		60
100		

  
HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407



## SEMESTER V

U21BM506	PROTO STUDIO I	Category: EEC				
		L	T	P	J	C
		0	0	0	2	1

## PRE-REQUISITES:

- U21BM404 - Design Clinic II

## COURSE OBJECTIVES:

- To inculcate the problem-solving & Innovation mindset
- To provide a platform for self-learning, experimenting, solving the real-world problems and to develop a product
- To enable hands-on experience for active learning

## COURSE OUTCOMES:

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

CO1: Apply the problem-solving techniques (Design thinking & system thinking)

CO2: Create Minimum Viable Prototype (TRL 5)

CO3: Analyze product to technology fit

CO4: Demonstrate teamwork, project management, technical report writing and presentation skills

## CO-PO MAPPING:

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

## Course conduction:

- The students will be divided into batches (maximum 4 students / batch). They will be provided the space, time, resources, and a mentor for this Proto clinic 1 course.
- With the guidance from assigned mentor, the students will find & validate a problem statement, map to UNSGD, identify the skills required for the project and self-learn.
- The students will learn and apply design thinking, system thinking concept to solve the problem and produce the version 1 of MVP. (TRL 5)
- The student will learn teamwork, project management, product development, technical report writing and pitching through this course.


## Contact Periods:

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



EVALUATION PATTERN:

Review 0 (Within 10 days of commencement of semester)	Review 1 (Between 35 <sup>th</sup> to 40 <sup>th</sup> working day)	Review 2 (Between 80 <sup>th</sup> to 90 <sup>th</sup> working day)	Total
0	40	60	100



PROF - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER VI

U21BM601	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- U21BM302 - Biomedical Sensors and Instrumentation

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

CO1: Illustrate the working of equipment used for cardio and neuro care (Understand)

CO2: Explore equipment used for analysis and support of muscular and neurological equipment (Understand)

CO3: Illustrate the methods to measure the parameters related to respiratory and urinary system failure (Apply)

CO4: Describe the measurement techniques of sensory responses (Understand)

CO5: Summarize the principle of ultrasonic, thermography and its applications in medicine (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I CARDIAC AND NEUROLOGICAL EQUIPMENT

9

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

## UNIT II MUSCULAR AND BIOMECHANICAL EQUIPMENT

9

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



**UNIT III RESPIRATORY AND UROLOGY EQUIPMENT**

9

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

**UNIT IV SENSORY EQUIPMENT**

9

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

**UNIT V ULTRASONIC AND THERMOGRAPHY TECHNIQUE**

9

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

**Contact Periods:**

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

**TEXT BOOKS:**

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

**REFERENCES:**

1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", 2<sup>nd</sup> Edition, McGraw Hill, 2003
2. Khandpur R S, "Handbook of Biomedical Instrumentation", 3<sup>rd</sup> Edition, Tata McGraw-Hill, 2014
3. Geddes LA and Baker LE, "Principles of Applied Biomedical Instrumentation", 3<sup>rd</sup> Edition, Tata McGraw Hill, 2008
4. Leslie Cromwell, Fred J Weibell, Erich A Pfeiffer, "Biomedical Instrumentation and Measurement", 2<sup>nd</sup> Edition, Prentice Hall of India, 2015

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

## SEMESTER VI

U21BM602	HOSPITAL MANAGEMENT	Category: HSMC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES: Nil

## COURSE OBJECTIVES:

- To understand the opportunities for training and research in all aspects of hospital / health administration.
- To educate the students in the development of high quality of hospital care in the community to provide a satisfactory environment to the patient and clinical research.

## COURSE OUTCOMES:

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

**CO1:** Understands the principles of Hospital administration (Understand)**CO2:** Outline the problem encountered during outpatient and inpatient services (Understand)**CO3:** Recognize the importance of ancillary services in healthcare based upon the patient's perceived need (Understand)**CO4:** Explains the safety procedures followed for hospitals equipment and precautionary about disease transmission (Understand)**CO5:** Identify the importance of Human resource management in organizing the hospital (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I STANDARD OF HOSPITAL

9

Concept of Hospital Management - Role of Administrator - Responsibilities of Administrator - Hospital Design, Outlines for establishing Departmental Zones - Hospital Engineering, hospital visit and interaction with the design and set up the hospital rules.

## UNIT II HOSPITAL ORGANIZATION

9

Organization of Out-Patient Services - Problems encountered in functioning of O.P Department - Organization of In- Patient Services - Casualty & Emergency Services - Organization and management of Operation theatres



**UNIT III SERVICES IN HOSPITAL**

9

Organization of Ancillary Services: Lab Services - Department of Physiotherapy & Occupational Therapy - Organization of Blood Transfusion Services - Department of Radio - diagnosis - Hospital Pharmacy

**UNIT IV STERILIZATION AND HOSPITAL SAFETY**

9

Disease transmission, Sterilization and disinfection methods, Hospital safety - Radiation Safety, hazardous safety, safety disposal of biological waste - Maintenance of Equipment & Instruments.

**UNIT V SUPPORTIVE SERVICES IN HOSPITAL**

9

Organization and management of Nursing services and Dietary Services in hospital - House-keeping and maintenance - Medical Records - Staffing the hospital - Human resources management in hospital - Management Assisted by Computers: Reservation, Admission, Registration & Discharge Module

**Contact Periods:**

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

**TEXT BOOKS:**

1. Webster J.C. and Albert M.Cook, "Clinical Engineering Principle and Practice", Prentice Hall Inc., Englewood Cliffs, New Jersey, 1979.
2. Rao L.L., Hospital Management, Annamalai University Press, 2007.
3. Lele R.D., Computers in Medicine, Tata McGraw Hill, 2008.
4. Mohan Bansal, Medical informatics, Tata McGraw Hill, 2005.

**REFERENCES:**

1. Goyal R.C., "Handbook of hospital personal management", Prentice Hall of India, 1996.

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



## SEMESTER VI

U21BM603	BIOMECHANICS	Category: PCC				
		L	T	P	J	C
		2	0	2	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

**CO1:** Apply the basic concepts of biomechanics (Apply)

**CO2:** Illustrate significant mechanical properties of biosolids and biofluids (Understand)

**CO3:** Classify the significant mechanical properties of hard and soft tissues (Understand)

**CO4:** Outline the function of mechanics of joints (Apply)

**CO5:** Examine the applications of biomechanical studies in sports (Analyze)

## CO-PO MAPPING:

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

## SYLLABUS:

**UNIT I INTRODUCTION TO BIOMECHANICS 6**

Definition and perspective of biomechanics – Kinematics concept for analyzing human motion – kinetic concepts for analyzing human motion – Linear kinetics of human movement – Angular kinetics of linear movement – Equilibrium and human movements

**UNIT II MECHANICS OF BIOSOLIDS AND BIOFLUIDS 6**

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

**UNIT III MECHANICS OF HARD AND SOFT TISSUES 6**

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

**UNIT IV MECHANICS OF JOINTS**

6

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

**UNIT V SPORTS BIOMECHANICS**

6

Gait analysis – Qualitative biomechanical analysis to improve technique – Qualitative analysis of sports movements – Understand injury development – Geometry of motion – Force and pressure measurement

**LIST OF EXPERIMENTS (INDICATIVE)**

1. Measure the joint angle movements using goniometer.
2. Analyze mobility on motion capture system.
3. Foot pressure measurement using force plate.
4. Implementation of a skeletal tracking system using Skelcam.
5. Design and development of pedometers and activity tracker using accelerometers.
6. Gait analysis using motion capture system.

**Contact Periods:**

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

**TEXT BOOKS:**

1. Susan J Hall, "Basic Biomechanics", 7<sup>th</sup> Edition, McGraw Hill, 2015
2. Peter M McGinnis, "Mechanics of sports and exercise", 1<sup>st</sup> Edition, Human kinetics, 2013

**REFERENCES:**

1. Roger Bartlett, "Introduction to sports biomechanics", 2<sup>nd</sup> Edition, Routledge, 2007
2. Michael W Whittle, "Gait analysis: An Introduction", Butterworth Heinemann, 3<sup>rd</sup> Edition, Elsevier, 2007

**EVALUATION PATTERN:**

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25			
50				50	
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.



## SEMESTER VI

U21SSG03	SOFT SKILLS – III	Category: HSMC				
		L	T	P	J	C
		0	0	2	0	1

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To improve language adeptness and to enhance fluency in language.
- To Gain emotional intelligence and to manage stress.

## COURSE OUTCOMES:

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

CO1: Write reports and make reasoning and assertions (Apply)

CO2: Overcome stress and attain work-life balance (Analyse)

## CO-PO MAPPING:

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

## SYLLABUS:

**UNIT I LANGUAGE ADEPTNESS 10**

Sentence Completion – Report Writing – Logical Reasoning – Cause and Effect – Assertion and Reasoning – Digital Profiling – Creative Resume

**UNIT II STRESS MANAGEMENT 10**

Factors Causing Stress – Positive and Negative Stress – Effects of Stress – Stress Overcoming Techniques – Context Based Tasks

**UNIT III EMOTIONAL INTELLIGENCE 10**

Leadership effectiveness – Self-awareness – Self-management – Self-motivation – Empathy and Social Skills

## Contact Periods:

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

## TEXT BOOKS:

- Daniel Goleman, "Emotional Intelligence: Why it Can Matter More Than IQ", 1<sup>st</sup> Edition, Bloomsbury, 2009
- Alan Barker, "Improve Your Communication Skills : Present with Confidence; Write with Style; Learn Skills of Persuasion", 1<sup>st</sup> Edition, Kogan Page, 2010



**REFERENCES:**

1. Jeremy Stranks, "Stress at Work: Management and Prevention", 1<sup>st</sup> edition, Butterworth - Heinemann, 2005
2. Edward J Watson, "Emotional Intelligence: A Practical Guide on How to Control Your Emotions and Achieve Lifelong Social Success", 1<sup>st</sup> edition, Amazon Digital Services LLC, 2016.

**EVALUATION PATTERN:**

Continuous Internal Assessments	Marks
Test - I	50
Test - II	50
Total	100



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER VI

U21BM604	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY	Category: PCC				
		L	T	P	J	C
		0	0	4	0	2

## PRE-REQUISITES:

- U21BM304 – Biomedical Sensors and Instrumentation Laboratory

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

CO1: Measure different bioelectrical and non-electrical signals using various methods (Analyze)

CO2: Elucidate the concept of image formation using ultrasound scanners (Analyze)

CO3: Illustrate various therapeutic equipment (Apply)

CO4: Interpret the working of life saving equipment (Analyze)

CO5: Examine the electrical safety aspects of biomedical equipment (Analyze)

## CO-PO MAPPING:

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

## LIST OF EXPERIMENTS

- Measure the electrical signal recorded over the occipital cortex in response to light stimulus
- Study of Pacemaker and Defibrillator as a lifesaving unit.
- Study of electrical safety of equipment
- Analyze the working of electro surgical unit in cutting and coagulation
- Observe the use of high frequency electromagnetic current for the physical therapy and surge (ultrasound and shortwave)
- Record the ventilation capacity of lungs
- Analyze the method and instrument used to produce mechanical ventilation
- Spot the cleaning of blood using artificial kidney in case of renal failure
- Spot the working of heart lung machine



## B.E. - BM - R2021 - CBCS

10. Measure the hearing ability of an individual using an audiogram
11. Explore the working transducers and image formation in ultrasound scanners for any 2 application
12. Study of Transcutaneous electrical nerve stimulation using medical simulator

### Contact Periods:

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

### REFERENCES:

1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", 2<sup>nd</sup> Edition, McGraw Hill, 2003
2. Khandpur R S, "Handbook of Biomedical Instrumentation", 3<sup>rd</sup> Edition, Tata McGraw-Hill, 2014
3. Geddes LA and Baker LE, "Principles of Applied Biomedical Instrumentation", 3<sup>rd</sup> Edition, Tata McGraw Hill, 2008
4. Leslie Cromwell, Fred J Weibell, Erich A Pfeiffer, "Biomedical Instrumentation and Measurement", 2<sup>nd</sup> Edition, Prentice Hall of India, 2015

### EVALUATION PATTERN:

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	
75	25	
100		100
60		40
100		



HO - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407



## SEMESTER VI

U21BM605	PROTO STUDIO II	Category: EEC				
		L	T	P	J	C
		0	0	0	2	1

## PRE-REQUISITES:

- U21BM506 - Proto Studio I

## COURSE OBJECTIVES:

- To inculcate the problem-solving & Innovation mindset
- To provide a platform for self-learning, experimenting, solving the real-world problems and to develop a product
- To enable hands-on experience for active learning

## COURSE OUTCOMES:

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

**CO1:** Apply the problem-solving techniques (Design thinking & system thinking)

**CO2:** Create Minimum Viable Prototype (TRL 6)

**CO3:** Analyze product to market fit

**CO4:** Develop a business model

**CO5:** Demonstrate teamwork, project management, technical report writing and presentation skills

## CO-PO MAPPING:

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

## COURSE CONDUCTION:

- The students will be divided into batches (maximum 4 students / batch). They will be provided the space, time, resources, and a mentor for this Proto clinic 2 course.
- With the guidance from assigned mentor, the students will find & validate a problem statement, map to UNSGD, identify the skills required for the project and self-learn.
- The students will apply design thinking, system thinking concepts to solve the problem and produce the version 2 of MVP. (TRL 6)
- The student will learn teamwork, project management, product development, technical report writing and pitching through this course.

## Contact Periods:

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

EVALUATION PATTERN:

Review 0 (Within 10 days of commencement of semester)	Review 1 (Between 35 <sup>th</sup> to 40 <sup>th</sup> working day)	Review 2 (Between 80 <sup>th</sup> to 90 <sup>th</sup> working day)	Total
0	40	60	100



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER VII

U21BM701	RADIOLOGICAL EQUIPMENT	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- U21PH202 - Medical Physics
- U21BM301 - Human Anatomy and Physiology

## COURSE OBJECTIVES:

- To understand the concept of x-ray imaging
- To explore the concept of using magnetic and radiofrequency fields in imaging
- To identify the potential of radioisotopes in imaging application
- To know the working of ultrasound waves in capturing the state of the organ and function

## COURSE OUTCOMES:

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

**CO1:** Outline the effective production of x rays and their application in different ways (Understand)

**CO2:** Make use of various cases examined under CT and understand the influence of technical parameters in getting quality CT image (Apply)

**CO3:** Interpret the types of MRI images and study the current state of the organ (Apply)

**CO4:** Identify the potential of radioisotopes in imaging and the working of Gamma Camera (Apply)

**CO5:** Inspect the semiology of ultrasound images (Analyze)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I MEDICAL X-RAY EQUIPMENT

9

Nature of X-rays – Production of X-rays – X- ray machine – Anode cooling chart and tube rating chart – visualization of X-ray images – X-ray detectors and parameters – image intensifier system – Digital fluoroscopy – Digital subtraction angiography – Mammography

## UNIT II COMPUTER TOMOGRAPHY

9

Tomography principle – CT hardware – Physics of data acquisition – reconstruction from fan beam projections – spiral tomography – Single slice, multi slice and cone beam tomography – Scanner geometry – Technical parameters of CT devices



**UNIT III MRI**

9

Basic principles of image acquisition – Static coils, Gradient coils and shim coils – Radio frequency pulse – Pulse sequence – T1, T2 and T2\* images – TR, TE and tissue contrast – Slice selection and spatial encoding – Data space – Field of view – k-Space – scan parameters – Types of MRI imaging – fMRI, MRA, MRV

**UNIT IV NUCLEAR IMAGING SYSTEMS**

9

Radioisotopes – Gamma Camera – Performance parameters for gamma camera – SPECT – Detectors, performance of SPECT camera – PET – Detectors, Coincidence timing window, dual and triple head gamma camera, data acquisition methods – Design considerations and quality control tests for nuclear imaging systems – Computers in nuclear imaging systems

**UNIT V DIAGNOSTIC ULTRASOUND IMAGING**

9

Physics of ultrasound imaging – Instrumentation – Image display modes and storage – Transducers – Special imaging modes – Image quality and pitfalls – Doppler Sonography – Instrumentation and display – Source of artifacts – Interpretation of doppler spectrum and color doppler

**Contact Periods:**

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

**TEXT BOOKS:**

1. Khandpur, Raghbir Singh., "Handbook of biomedical instrumentation", 3<sup>rd</sup> Revised Edition, McGraw-Hill Education, 2014

**REFERENCES:**

1. Saha, Gopal B. "Physics and radiobiology of nuclear medicine", Springer Science & Business Media, 2012
2. Rumack, Carol M., and Deborah Levine, "Diagnostic Ultrasound" 5<sup>th</sup> Edition, Elsevier Health Sciences, 2017
3. Dale, Brian M., Mark A. Brown, and Richard C. Semelka, "MRI: basic principles and applications", John Wiley & Sons, 5<sup>th</sup> Edition, 2015

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



## SEMESTER VII

U21BM702	MEDICAL IMAGE PROCESSING	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- U21BM502 - Biosignal Processing

## COURSE OBJECTIVES:

- To interpret the fundamentals of image formation and operations.
- To apply the image enhancement and segmentation techniques in medical images.
- To use various algorithms for feature extraction and recognition.

## COURSE OUTCOMES:

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

**CO1:** Interpret the image formation, basic operations and transforms deployed on digital images (Understand)

**CO2:** Make use of different techniques employed for the enhancement of images (Apply)

**CO3:** Inspect segmentation methods and morphological operations on images (Apply)

**CO4:** Examine the image compression and reconstruction techniques (Analyze)

**CO5:** Analyze feature extraction algorithms and image classification methods (Analyze)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I FUNDAMENTALS OF DIGITAL IMAGES AND TRANSFORMS

9

Digital image processing – Origin, fundamentals, representation – Elements of visual perception – Image Sampling and Quantization – Neighborhood pixel relationships – Basic image operations – Image transform – 2D DFT, DCT, Haar and Hadamard transforms

## UNIT II IMAGE ENHANCEMENT AND RESTORATION

9

Basic gray level transformation – Histogram processing – Spatial domain filtering – Smoothing and sharpening – Frequency domain filtering – Color models – Image degradation – Noise models – Image restoration – Wiener filtering – Order statistics filter – Adaptive filters

**UNIT III IMAGE SEGMENTATION AND MORPHOLOGICAL OPERATIONS**

9

Detection of discontinuities – Detection of points, line and edges – Edge linking and boundary detection – Thresholding – Region-based segmentation – Morphological operations – Erosion and dilation – Opening and closing – Morphology based segmentation

**UNIT IV IMAGE COMPRESSION AND RECONSTRUCTION**

9

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

**UNIT V FEATURE EXTRACTION AND CLASSIFICATION**

9

Boundary descriptors – Regional descriptors – Principal Component Analysis – Classification based on supervised and unsupervised learning methods

**Contact Periods:**

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

**TEXT BOOKS:**

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

**REFERENCES:**

1. Sinha G. R, Patel, B. C., Medical Image Processing: Concepts and Applications, Prentice Hall, 2014

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407



## SEMESTER VII

U21BM707	REHABILITATION ENGINEERING	Category: PCC				
		L	T	P	J	C
		3	0	2	0	4

## PRE-REQUISITES:

- U21BM301 – Human Anatomy and Physiology
- U21BM603 – Biomechanics

## COURSE OBJECTIVES:

- To identify the engineering concepts that can be applied in rehabilitation medicine and the role of engineers in various rehabilitation disciplines
- To illustrate the different types of therapeutic exercise technique
- To interpret the various orthotic devices and prosthetic devices to overcome orthopedic problems

## COURSE OUTCOMES:

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

CO1: Summarize the principles of rehabilitation system (Understand)

CO2: Identify various exercises involved in rehabilitation process (Apply)

CO3: Analyze rehabilitation management in communication (Analyze)

CO4: Apply restoration techniques in rehabilitation (Apply)

CO5: Contrast the effectiveness of rehabilitation (Analyze)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I PRINCIPLE OF REHABILITATION ENGINEERING

6

Introduction to rehabilitation – Epidemiology of rehabilitation – Health – Levels of prevention – Preventive rehabilitation – Diagnosis of disability – Functional diagnosis – Importance of psychiatry in functional diagnosis – Impairment – disability – handicap – Primary and secondary disabilities – Clinical practice of rehabilitation engineering – Design based on human ability

## UNIT II THERAPEUTIC EXERCISE TECHNIQUE

6

Co-ordination exercises – Frenkels exercises – Relaxation exercises – Strengthening exercises – Types of contraction – Mobilization exercises – Endurance exercises

## UNIT III MANAGEMENT OF COMMUNICATION

6

Impairment – Aphasia – Types of aphasia – Treatment of aphasic patient – Augmentative communication – General form of communication – Types of visual aids – Hearing aids

**UNIT IV ORTHOTIC, PROSTHETIC DEVICES AND RESTORATION TECHNIQUES 6**

General orthotics – Classification of orthotics – Functional and regional General principles of orthosis – Calipers – FO – AFO – KAFO – HAFO – Body powered prosthetics – Myoelectric controlled prosthetics – Functional electrical stimulation systems – Restoration of hand function – Restoration of standing and walking

**UNIT V CASE STUDY 6**

Geriatric Rehabilitation – Visual and auditory challenges faced by geriatrics and methods to overcome those challenges– Pediatric rehabilitation – Visual and auditory challenges faced by cerebral palsy – Muscular dystrophy and autism children – Methods to overcome those challenges

**LIST OF EXPERIMENTS (INDICATIVE)**

1. Analyze lateral trunk control using rehametrics.
2. Observe the cognitive analysis on dynamic and static balance.
3. Real time monitoring of shoulder range of motion.
4. Record the anteroposterior centre of mass displacement.
5. Design, development and interfacing of EMG controlled prosthetics / bionic arm.
6. Study of hip flexion and adduction.

**Contact Periods:**

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

**TEXT BOOKS:**

1. S Sunder, "Textbook of Rehabilitation", 4<sup>th</sup> Edition, Jaypee Brothers Medical Publishers private limited, New Delhi, 2019
2. Joseph D. Bronzino, "The Biomedical Engineering Handbook", 3<sup>rd</sup> Edition, Taylor and Francis, 3 volume set, 2006

**REFERENCES:**

1. Rory A. Cooper, Hisaichi Ohnabe and Douglas A. Hodson, "An Introduction to Rehabilitation Engineering", 1<sup>st</sup> Edition, CRC Press, 2014
2. Marion A. Hersh and Michael A. Johnson, "Assistive Technology for Visually impaired and blind people", 1<sup>st</sup> Edition, Springer Verlag, 2014

**EVALUATION PATTERN:**

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.

## SEMESTER VII

U21BM708	MEDICAL IMAGE PROCESSING LABORATORY	Category: PCC				
		L	T	P	J	C
		0	0	2	0	1

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

**CO1:** Identify the basic operations that can be deployed on images (Apply)

**CO2:** Make use of image enhancement and segmentation techniques in the processing of medical images (Apply)

**CO3:** Compare lossless and lossy image compression techniques (Analyze)

**CO4:** Inspect the features of an image using various image descriptors and morphological operations (Analyze)

**CO5:** Examine performance metrics in biomedical images (Analyze)

## CO-PO MAPPING:

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

## LIST OF EXPERIMENTS

1. Basic operations and gray level transformations on images
2. Sampling and quantization
3. Image enhancement using spatial and frequency domain filtering
4. Denoising of medical images
5. Image segmentation using edge and region-based methods
6. Lossless and lossy compression on images
7. Image representation using descriptors
8. Texture and morphological analysis of medical images



**B.E. - BM - R2021 - CBCS**

9. Image reconstruction using Radon transform and its performance metrics
10. Mini Project

**Contact Periods:**

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

**REFERENCES:**

1. Chris Solomon, Toby Breckon, Fundamentals of Digital Image Processing: A Practical Approach with examples in Matlab, Wiley-Blackwell, 2010
2. Rafael C. Gonzalez, Richard Eugene Woods, Steven L. Eddins, Digital Image Processing using Matlab, Pearson Education India, 2004
3. Sinha G. R, Patel, B. C., Medical Image Processing: Concepts and Applications, Prentice Hall, 2014

**EVALUATION PATTERN:**

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	
75	25	
100		100
60		40
100		



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407

## SEMESTER VII

U21BM706	PROJECT WORK PHASE - I	Category: EEC				
		L	T	P	J	C
		0	0	0	4	2

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

- CO1:** Identify and define complex problems related to Biomedical Engineering (Apply)
- CO2:** Examine the technical aspects of the chosen project with comprehensive and systematic approach (Apply)
- CO3:** Apply appropriate methodologies to address identified problems and experimental procedures of developed technical project in a team (Apply)
- CO4:** Analyze and interpret the data with appropriate statistical and qualitative analysis techniques in Biomedical Engineering (Apply)
- CO5:** Communicate and report the solution for the problem identified in Biomedical Engineering (Apply)

## CO-PO MAPPING:

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

## STRATEGY

To identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design / fabrication or develop computer code. Demonstrate the novelty of the project through the results and outputs

## Contact Periods:

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



**EVALUATION PATTERN:**

Internal Assessment (60 Marks)			End semester Examinations (40 Marks)			
Review I	Review II	Review III	Project Report		Viva-Voce	
10	20	30	Supervisor	External	Internal	External
			10	10	10	10



HoD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407





## SEMESTER VIII

U21BM802	PROJECT WORK PHASE - II	Category: EEC				
		L	T	P	J	C
		0	0	0	16	8

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

**CO1:** Identify the leading problems related to Biomedical Engineering (Apply)

**CO2:** Compare the technical aspects of the chosen project with comprehensive and systematic approach (Analyze)

**CO3:** Apply appropriate research methodologies to investigate and address research problems in the chosen field of study (Apply)

**CO4:** Inspect and apply interdisciplinary knowledge and skills to address the defined complex problem (Analyze)

**CO5:** Communicate and report the project findings and future prospectus effectively (Apply)

## CO-PO MAPPING:

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

## STRATEGY

To identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design / fabrication or develop computer code. Demonstrate the novelty of the project through the results and outputs

## Contact Periods:

Lecture: - Periods    Tutorial: - Periods    Practical: - Periods

Project: 280 Periods

Total: 280 Periods

**EVALUATION PATTERN:**

Internal Assessment (60 Marks)			End semester Examinations (40 Marks)			
Review I	Review II	Review III	Project Report		Viva-Voce	
10	20	30	Supervisor	External	Internal	External
			10	10	10	10



PhD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407



## SEMESTER VIII

U21BMI01	INDUSTRIAL TRAINING/ INTERNSHIP	Category: PEC				
		L	T	P	J	C
		0	0	1	0	2

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To understand the work of a Biomedical Engineer in the Industry
- To apply Engineering knowledge in the industry and analyze the real-time problems
- To identify problem statement from the knowledge obtained from the internship

## COURSE OUTCOMES:

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

- CO1 Apply Engineering knowledge in real-world during the internship training (Apply)
- CO2 Analyze the real-time problems in hospitals (Analyze)
- CO3 Apply the societal, health, safety, and cultural impacts of engineering solutions developed during the internship (Apply)
- CO4 Apply sustainable practices and environmentally friendly solutions in internship training (Apply)
- CO5 Demonstrate ethical behavior and professional responsibility in the workplace (Apply)
- CO6 Practice collaborative work with team members in the industry, contributing effectively to achieve learning (Apply)
- CO7 Communicate technical information clearly and effectively through oral presentations and written reports (Apply)
- CO8 Apply Industrial discipline and professional development in engineering practice (Apply)
- CO9 Design and evaluate medical solutions through training during internship (Evaluate)
- CO10 Solve medical data problems using algorithms and software learned from the internship (Apply)

HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407



## CO-PO MAPPING:

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	3	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO7	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO8	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO9	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO10	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO	3	2	-	-	-	3	3	3	3	3	-	3	3	1
Correlation levels:      1: Slight (Low)      2: Moderate (Medium)      3: Substantial (High)														



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407



U21BMP01	NANOTECHNOLOGY IN MEDICINE	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To acquire the knowledge on general principles and properties of nanomaterials
- To understand essential concepts used in nanomaterial synthesis
- To obtain an understanding of the applications of nanotechnology in various fields of engineering and the medical domain

**COURSE OUTCOMES:**

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

**CO1:** Interpret the basic principles and properties of nanomaterials (Understand)

**CO2:** Illustrate the different classes of nanomaterials (Understand)

**CO3:** Describe the preparation of nanomaterials (Understand)

**CO4:** Explain the characterization techniques in nanotechnology (Understand)

**CO5:** Identify the applications of nanotechnology in healthcare (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I INTRODUCTION TO NANOTECHNOLOGY**

9

Definition of nanosystem – Size dependent phenomena – Surface to volume ratio – Fraction of surface atoms and surface energy – Properties (optical, mechanical, electronic and magnetic) – Quantum dots – Quantum wells – Quantum wires

**UNIT II DIFFERENT CLASSES OF NANOMATERIALS**

9

Carbon nanotubes – Nanocomposites – Nanoceramics – Biological nanomaterials – Nanomaterials for equipment design: smart textiles and wearable devices

**UNIT III PREPARATION OF NANOMATERIALS**

9

Top down and Bottom up approach of building nanomaterials – Electro deposition – Plasma arc discharge – Pulsed laser deposition – Sol-gel method – Ball milling – Molecular beam epitaxy (MBE)

**UNIT IV EXPERIMENTAL TECHNIQUES IN NANOTECHNOLOGY****9**

Characterization – X- ray diffraction (XRD) – Atomic force microscopy – Scanning Tunneling microscopy (STM) – Scanning probe microscopy (SPM) – Optical and Raman spectroscopy

**UNIT V APPLICATIONS OF NANOTECHNOLOGY IN HEALTHCARE****9**

Properties of nanocarriers – Drug delivery systems used in nanomedicine – Enhanced Permeability and Retention effect – Blood-brain barrier – Active and passive targeting of diseased cells – Nanotechnology in defense – Environmental application – Health and environmental impacts of nanotechnology

**Contact Periods:**

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

**TEXT BOOKS:**

1. Wai-Yeung Wong, Qingchen Dong, "Functional Nanomaterials: Synthesis, Properties, and Applications", Wiley VCH, 1<sup>st</sup> edition, 2022
2. T.Pradeep, "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd., 1<sup>st</sup> edition, 2012
3. Sabu Thomas, Nandakumar Kalarikal, A Manuel Stephan, B. Raneesh and A.K. Haghi., "Advanced Nanomaterials – Synthesis, Properties and Applications", CRC Press, Taylor & Francis group, 1<sup>st</sup> edition, 2014

**REFERENCES:**

1. Hanson, G.W, "Fundamentals of Nanoelectronics", Pearson Education, 1<sup>st</sup> edition, 2012
2. A.K.Bandyopadhyay, "Nanomaterials", New Age International Publishers, 1<sup>st</sup> edition, 2010
3. Mick Wilson, Kannangara Geoff Smith, Michelle Simmons, Burkhard Raguse, "Nanotechnology - Basic Science and Emerging Technologies", Overseas Press Private Limited, 1<sup>st</sup> edition 2010

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	20	100
Total				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HoD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 APASUR COIMBATORE-641 407





U21BMP02	ADVANCES IN DRUG DELIVERY	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To summarize the different drug delivery routes
- To interpret the drug delivery vehicles and transporters
- To explore the concept of targeted drug delivery

**COURSE OUTCOMES:**

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

**CO1:** Describe the phenomenon related to oral drug delivery (Understand)

**CO2:** Compare the pulmonary and transdermal drug delivery methods (Understand)

**CO3:** Identify the role of drug delivery vehicles (Apply)

**CO4:** Make use of transporters in drug delivery (Apply)

**CO5:** Explain the methods of targeted drug delivery and cancer theragnostics (Understand)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      ORAL DRUG DELIVERY      9**

Drug delivery – Target bioavailability – Barriers to drug delivery – Physiological barriers – Chemical barriers – Biochemical barriers – Drug modifications – Physicochemical properties – Formulations – PK-PD modeling – Source of variability of drug response

**UNIT II      PULMONARY AND TRANSDERMAL DRUG DELIVERY      9**

Aerosol technology – Disease therapy – Formulation variables – Regulatory considerations – Transdermal patch delivery system – Patchless transdermal drug delivery system – Recent advances

**UNIT III      DRUG DELIVERY VEHICLES      9**

Drug delivery vehicle properties – Targeting – Size and surface – Liposomes – Polymer based nanocarriers – Dendrimers – Metal nanoparticles – Silica

**UNIT IV TRANSPORTERS IN DRUG DELIVERY**

9

Drug transport in absorption and excretion – Intestinal transport – Hepatic transport – Renal transport – BBB transport – ABC transporter family – SLC transporter family

**UNIT V TARGETED DELIVERY OF DRUGS AND CANCER THERNOSTICS**

9

Introduction – Microbially triggered release – pH dependent release – Osmotic release – Pressure controlled delivery – Nanoparticle approaches – Image guided drug delivery and therapy – Optical imaging – MRI – Nuclear imaging – Ultrasound

**Contact Periods:**

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

**TEXT BOOKS:**

1. Binghe Wang, Longqin Hu, Teruna J. Siahaan, "Drug Delivery: Principles and Applications", John Wiley & Sons, 2<sup>nd</sup> edition, 2016
2. Yie W. Chien, "Novel Drug Delivery Systems", CRC Press, 2<sup>nd</sup> edition, 2019

**REFERENCES:**

1. Anya M. Hillery, Kinam Park, "Drug Delivery: Fundamentals & Applications", CRC Press, 2<sup>nd</sup> edition, 2017

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407



U21BMP03	IMMUNOENGINEERING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21BM401 – Microbiology and Pathology

**COURSE OBJECTIVES:**

- To discuss the structure, functions and integration of immune system
- To explain the antigen-antibody interactions and protecting the body from foreign pathogens
- To understand genetics of transplantation and tumour development

**COURSE OUTCOMES:**

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

**CO1:** Explain the various types of cells and organs involved in immune system (Understand)

**CO2:** Illustrate the pathways involved in cell mediated and humoral immune responses (Understand)

**CO3:** Apply the concepts of immunology in vaccine development and treatment of infectious diseases (Apply)

**CO4:** Describe the basic concepts in transplantation and tumour immunology (Understand)

**CO5:** Identify the reason behind the allergy hypersensitivity and autoimmune disorders and its treatment (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I IMMUNE SYSTEM AND ANTIGENS 9**

Cells of immune system – Innate immunity and acquired immunity – Antigens: chemical and molecular nature – Types of immune responses – Monoclonal antibodies

**UNIT II ANTIBODIES AND CELLULAR RESPONSES 9**

T-cells and B-cells – Development, Maturation, Activation and Differentiation – Antibodies: structure and functions – Antigen-antibody reactions – Regulation of T-cell and B-cell responses

**UNIT III INFECTIONS AND IMMUNITY 9**

Injury – Inflammation and types – Immune responses to infections – Immunity to viruses, bacteria, fungi and cytokines – AIDS and Immunodeficiencies – Resistance



**UNIT IV TRANSPLANTATION AND TUMOR IMMUNOLOGY** 9  
 Transplantation – Genetics of transplantation – Laws of transplantation – Tumor immunology – Tumor antigens – Tumor immune response – Tumor diagnosis – Tumor immunotherapy

**UNIT V ALLERGY, HYPERSENSITIVITY AND AUTOIMMUNITY** 9  
 Allergy – Hypersensitivity – Types of hypersensitivity – Autoimmunity – Auto immune disorders and diagnosis

**Contact Periods:**

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

**TEXT BOOKS:**

1. Peter J. Delves., Seamus J. Martin., Dennis R. Burton., Ivan M. Roitt., "Essential Immunology", Wiley-Blackwell; 13<sup>th</sup> edition, 2017
2. Abbas, K.A., Litchman, A.H., Pober, J.S., "Cellular and Molecular Immunology", Elsevier., 9<sup>th</sup> edition, 2017
3. William E.P., "Fundamental Immunology", Lippinkott Williams and Wilkins a Wolters Kluwer business, 7<sup>th</sup> edition, 2012

**REFERENCES:**

1. Ashim K.C., "Immunology and Immunotechnology", Oxford University Press, 1<sup>st</sup> edition, 2006
2. Kubly J., "Immunology", WH Freeman & Co., 8<sup>th</sup> edition, 2018
3. Christine D., "Clinical Immunology and Serology: A laboratory Perspective"; F.A. Davis Co. Philadelphia, 3<sup>rd</sup> edition, 2009

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407



U21BMP04	BIOSENSORS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21BM306 – Biomedical Sensors and Instrumentation

**COURSE OBJECTIVES:**

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

**COURSE OUTCOMES:**

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

**CO1:** Explain the basic principles and working of biosensors (Understand)

**CO2:** Classify the various types of transducers and their corresponding applications (Understand)

**CO3:** Illustrate the types of bio-molecules for immobilization (Understand)

**CO4:** Interpret the working principles of several of types of chemical biosensors (Understand)

**CO5:** Identify the applications of biosensors with respect to its types (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I INTRODUCTION TO BIOSENSORS**

9

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

**UNIT II BIORECEPTORS AND BIOSENSOR SYSTEMS**

9

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

**UNIT III OPTICAL BIOSENSORS**

9

Principles of Optical biosensing – Immobilization of bio-recognition elements – Types of optical biosensor – Surface plasmon resonance – Advantages and disadvantages – Applications

**UNIT IV CHEMICAL BIOSENSORS**

9

Blood gas and pH sensors – Bio-analytical sensor – Enzymatic biosensors – pO<sub>2</sub> and pCO<sub>2</sub> sensor – Manufacturing techniques of biosensors

**UNIT V APPLICATION AND USES OF BIOSENSORS**

9

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

**Contact Periods:**

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

**TEXT BOOKS:**

1. Ozkan, S.A., Uslu, B., & Sezgintürk, M.K, "Biosensors: Fundamentals, Emerging Technologies, and Applications", CRC Pres, 1<sup>st</sup> edition, 2022
2. S Sunder, "Textbook of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 4<sup>th</sup> edition, 2019

**REFERENCES:**

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, 3<sup>rd</sup> edition, 2014
2. Joseph D. Bronzino, "The Biomedical Engineering Handbook", Taylor and Francis, 3 Volume set, 3<sup>rd</sup> edition, 2006

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HoD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407



U21BMP05	TISSUE ENGINEERING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21BM301 - Human Anatomy and Physiology

**COURSE OBJECTIVES:**

- To understand the fundamentals of tissue engineering and its objectives
- To infer different types of stem cells in regenerative medicine
- To explore various biological material properties in tissue engineering

**COURSE OUTCOMES:**

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

**CO1:** Explain the components of tissue engineering (Understand)

**CO2:** Illustrate stem cell potential in regenerative medicine (Understand)

**CO3:** Understand the imaging technique used in tissue engineering (Understand)

**CO4:** Make use of concepts of biological materials in tissue engineering (Apply)

**CO5:** Apply tissue engineering in different biomedical applications (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I INTRODUCTION TO TISSUE ENGINEERING**

9

Tissue exchange and tissue development – Objectives of tissue engineering – Cell cycle and differentiation – Cell adhesion – Cell migration – Cell aggregation and tissue equivalent

**UNIT II STEM CELLS**

9

Definition of stem cells – Types of stem cells – Differentiation – Dedifferentiation – Maturation, Proliferation – Pluripotency and Immortalization – Sources of stem cells – Hematopoietic – Fetal-cord blood – Placenta – Bone marrow – Primordial germ cells

**UNIT III COMPONENTS OF TISSUE ENGINEERING**

9

Cell and drug delivery systems – Transplantation – Implantation – Synthetic components – Nanotechnology in tissue engineering – Imaging methods: Fluorescent microscopy – Confocal microscopy



**UNIT IV BIOMATERIALS IN TISSUE ENGINEERING****9**

Degradable and Non-degradable biomaterials – Extracellular matrix – Decellularization Polymers: synthetic and natural – Cell interaction with polymers – applications of polymers

**UNIT V APPLICATION OF TISSUE ENGINEERING****9**

Replacement Engineering – Artificial organs – Cartilage, Tendons – Ligaments – Regenerative engineering: Nerve regeneration – Cardiac tissue regeneration – Muscle regeneration

**Contact Periods:**

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

**TEXT BOOKS:**

1. Ulrich Meyer, Thomas Meyer, Jörg Handschel, Hans Peter Wiesmann, "Fundamentals of Tissue Engineering and Regenerative Medicine", Springer, 1<sup>st</sup> edition, 2009
2. W.Mark Saltzman, "Tissue Engineering – Engineering principles for design of replacement - organs and tissue" Oxford University Press Inc New York, 1<sup>st</sup> edition, 2000
3. CS Potten, "Stemcells", Elsevier publications, 1<sup>st</sup> edition, 1997

**REFERENCES:**

1. Gray E.Wnek, Gray L Browlin, "Encyclopedia of Biomaterials and Biomedical Engineering", Marcel Dekker Inc New York, 1<sup>st</sup> edition, 2004
2. R.Lanza, J. Gearhart et al (Eds), "Essential of Stem Cell Biology", Elsevier Academic press, 1<sup>st</sup> edition, 2006

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 APASUR COIMBATORE-641 407

U21BMP06	BIOPRINTING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21BM303 – Biomaterials and Artificial Organs

**COURSE OBJECTIVES:**

- To infer the basic mechanisms of bioprinting
- To select the suitable bioink and biomaterials for bioprinting in medical applications
- To explain the various techniques used for bioprinting
- To utilize the concept of bioprinting in organ construction

**COURSE OUTCOMES:**

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

**CO1:** Explain the insight of bioprinting and cell culture process (Understand)

**CO2:** Describe the properties and types of bioink system (Understand)

**CO3:** Illustrate the various 3D bioprinting techniques (Understand)

**CO4:** Summarize 4D bioprinting approach and apply regulatory policies (Understand)

**CO5:** Apply the bioprinting concept in organ constructing applications (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I INTRODUCTION TO BIOPRINTING 9**

Bioprinting – Types of Bioprinting – Process parameters in designing – Biomaterials for bioprinting – Therapies for tissue substitute – Cell source – Processing of cells for bioprinting – Cell culture models

**UNIT II BIOINKS 9**

Bioinks – Ideal material properties for bioink – Printability and cellular response– Hydrogels – Crosslinking of hydrogels for bioink– Bioink system – Single-material– Multimaterial

**UNIT III BIOPRINTING TECHNIQUES 9**

Stereolithography – Fused deposition modeling – Inkjet printing – Process parameter – Extrusion Bioprinting – Types– Characteristics and advantages – Laser Assisted bioprinting –Types and its Characteristics



B.E. – BM – R2021 – CBCS

**UNIT IV 4D BIOPRINTING AND REGULATORY ISSUES**

9

4D Bioprinting – Features and approaches – Deformation of materials – Cellular self-assembly – Computational modeling – Clinical safety and efficacy – Regulatory challenges in Bioprinting

**UNIT V MEDICAL APPLICATIONS OF BIOPRINTING**

9

Bioprinting of heart – Bioprinting of kidney – Bioprinting of liver – Bioprinting of lung

**Contact Periods:**

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

**TEXT BOOKS:**

1. Chee Kai Chua, "Bioprinting Principles and its applications", World Scientific Publishing, 1<sup>st</sup> edition, 2015
2. Zhang et al., "3D Bioprinting and Nanotechnology in Tissue Engineering and Regenerative Medicine", Academic Press, 1<sup>st</sup> edition, 2015

**REFERENCES:**

1. Atala et al., "Essentials of 3D Biofabrication and Translation", Academic Press, 1<sup>st</sup> edition, 2015
2. Yang Wu, Jerry fuh, Ibrahim Tarik Ozbolat, "3D Bioprinting in Tissue and Organ Regeneration", Academic Press, 1<sup>st</sup> edition, 2022
3. Yong He, Qing Gao and Yifei Jin, "Cell Assembly with 3D Bioprinting", John Wiley & Sons, 1<sup>st</sup> edition, 2022

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				200	
				40	60
					100

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HO'D - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407

## VERTICAL I - BIO ENGINEERING

U21BMP07	BIOPHOTONICS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- U21PH202 - Medical Physics

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

CO1: Examine the biophotonics tools and light tissue interaction processes (Understand)

CO2: Evaluate the characteristics and concepts of light waves, polarization, quantization, photon energy interference and coherence (Apply)

CO3: Update the techniques of biopolymers, optical biopsy and molecule detection (Understand)

CO4: Interpret various detectors for detecting the presence of ionizing radiation (Understand)

CO5: Identify the applications of biophotonics with biosensors (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I OVERVIEW OF BIOPHOTONICS

9

Nature of light – Biophotonics spectral windows – Light absorption – Macromolecules – Biological cells – Diverse applications

## UNIT II PROPERTIES OF LIGHT AND BIOPHOTONICS LASER

9

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

## UNIT III PHOTOBIOLOGY

9

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

**UNIT IV LIGHT ACTIVATED THERAPY**

9

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

**UNIT V BIOSENSORS AND TECHNOLOGY APPLICATIONS OF BIOPHOTONICS**

9

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

**Contact Periods:**

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

**TEXT BOOKS:**

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

**REFERENCES:**

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

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407





U21BMP08	ETHICAL ISSUES & INTELLECTUAL PROPERTY RIGHTS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To understand the ethical issues involved in doing research using animals and human
- To explore the ethical conduct in credit sharing, social and environmental responsibility
- To interpret the patenting systems in India and abroad

**COURSE OUTCOMES:**

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

CO1: Describe the fundamentals of Engineering Ethics (Understand)

CO2: Identify the ethical issues in research with animals and human (Understand)

CO3: Summarize the features of credit sharing and issues related to society and environment (Understand)

CO4: Exemplify the importance of Intellectual Property Rights (Understand)

CO5: Explain the process of patenting in India and abroad (Understand)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I ENGINEERING ETHICS**

9

Definition – Societies for engineers – Code of Ethics – Ethical Issues involved in cross border research – Ethical and Unethical practices – Case studies – Situational decision making

**UNIT II ETHICAL ISSUES IN RESEARCH WITH ANIMALS AND HUMAN**

9

Ethical considerations – Conducting research with animal subjects – Guidelines for the use of animal subjects – Guidelines for the collection and use of blood, tissue and other samples from human – Obtaining consent for collection – Transparency in handling the samples – Use of human subjects in research – Clinical trials – Voluntariness – Competence

HOD - BIOMEDICAL ENGINEERING

KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY

ARASUR COIMBATORE - 641 407

**UNIT III CREDIT SHARING, SOCIETY AND ENVIRONMENT**

9

Responsibilities and sharing of authorship in publishing – Patenting research – Integrity and quality of the data – Ethical conduct in the labs – Ethical issues related to the society and environment

**UNIT IV INTELLECTUAL PROPERTY RIGHTS**

9

Objectives of the patent system – Patentable inventions in India and abroad – Geographical indications and sui generis systems – Implications of TRIP – GATT agreements

**UNIT V PATENTING**

9

Salient features of patent law in India – The process of patenting in India and abroad – Process of challenging and protecting patents – Opportunities challenges for biogenetics – Patent infringement

**Contact Periods:**

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

**TEXT BOOKS:**

1. Charles B. Fleddermann, "Engineering Ethics", 4th edition, Prentice Hall, 2012
2. Emanuel E J, et al, "Ethical and Regulatory Aspects of Clinical Research", 1st edition, Johns Hopkins University Press, 2003

**REFERENCES:**

1. Nikolaus Thumm, "Intellectual Property Rights", 1st edition, Springer – Verlag, 2000

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407

## VERTICAL II – MEDICAL DEVICE DEVELOPMENT AND MANAGEMENT

U21BMP09	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To acquire knowledge on global trend, development methodologies of products and services
- To conceptualize innovative ideas, customer requirement and establishing target specifications
- To understand Return on Investment, Minimum Viable Product and Project Management

**COURSE OUTCOMES:**

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

**CO1:** Explain product development, planning and management (Understand)

**CO2:** Interpret development process, product design architecture (Understand)

**CO3:** Demonstrate the concept of proto typing and product specification (Understand)

**CO4:** Illustrate Minimum viable product and market fit (Apply)

**CO5:** Use the Design Process and Ideas to Action Project (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT**

9

Global trends analysis and product decision – Social, technical, economic and environmental trends – Political/Policy trends – Introduction to product development methodologies and management – Overview of products and services – Types of product development – Overview of product development methodologies – Product life cycle – Product development planning and management

**UNIT II DEVELOPING INNOVATIVE IDEAS FOR PRODUCT LEADERS**

9

Introduction to creative design, prototyping and testing – Development processes and organizations – Concept selection and product specification – Product design and architecture – Industrial design needs and considerations – Design of manufacturing process

**UNIT III PRODUCT MANAGEMENT ESSENTIALS**

9

The customer needs process – Aids for product development and prototypes – Concept generation: the five step method – Establishing target specifications – Setting the final specifications – Design for the environment and manufacturing process



**UNIT IV ESTABLISHING PRODUCT-MARKET FIT**

9

Establishing product – Market fit – Specifying feature set – Understanding return on investment – Deciding on Minimum Viable Product (MVP) – Creating prototype – Marketing versus product tests – Quantitative tests versus qualitative tests – Fidelity for prototypes – Testing MVP with customers – Improving product-market fit

**UNIT V CREATIVE DESIGN, PROTOTYPING, AND TESTING**

9

Specialization in product ideation, design and management – Wire framing and proto type modeling – Product architecture – Choosing wire framing and prototyping tools – Open source – Robust design – Robust design process – Ideas to action project – Project management – Project planning and execution

**Contact Periods:**

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

**TEXT BOOKS:**

1. Book specially prepared by NASSCOM as per the MOU.
2. <https://www.coursera.org/specializations/product-ideation-design-and-management>
3. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, 5<sup>th</sup> edition, 2011
4. John W Newstrom and Keith Davis, "Organizational Behavior", Tata McGraw Hill, 11<sup>th</sup> edition, 2005

**REFERENCES:**

1. Hiriappa B, "Corporate Strategy – Managing the Business", Author House, 1<sup>st</sup> edition, 2013
2. Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 1<sup>st</sup> edition, 2004
3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning -Concepts", 2<sup>nd</sup> edition, Prentice Hall, 2003
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, 7<sup>th</sup> edition, 2013

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

## VERTICAL II – MEDICAL DEVICE DEVELOPMENT AND MANAGEMENT

U21BMP10	MEDICAL DEVICE DESIGN	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To illustrate the basic steps of designing a medical device
- To explore the different techniques in design process
- To interpret the challenges in post market surveillance

## COURSE OUTCOMES:

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

**CO1:** Infer the basic procedure of medical device design (Understand)

**CO2:** Classify the various stages of design process (Understand)

**CO3:** Illustrate ideas and concepts in device designing (Understand)

**CO4:** Interpret the process for validation and verification of medical devices (Understand)

**CO5:** Identify the challenges after post market survey of the product (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I INTRODUCTION TO MEDICAL DEVICES

9

Medical Devices - Design Life Cycle – Medical design classification – Rules and Models – EU Classification – USA Classification – case study on classification

## UNIT II DESIGN PROCESS

9

Design Process versus Design Control – Design Models – Pahl and Beitz, and Pugh model – Divergent – Convergent Model – Audit /Review Procedure – Design Process – Product Design Specification – Finding, Extracting, and Analyzing the Content



**UNIT III IDEAS AND CONCEPTS**

9

Creative Space – Generating Concepts/Ideas – Selecting Concepts and Ideas – Quality in design – Design of Experiments/2k Factorial Experiments – Failure Mode and Effect Analysis – Computer-Aided Design – D4X – Design for Usability

**UNIT IV EVALUATION AND SUPPLY CHAIN**

9

Evaluation – Risk Analysis – Criteria-Based Evaluation – Computer-Based Evaluation – Clinical Studies and Clinical Trials – Identifying Potential Suppliers – Packaging – Procurement – Labelling and Marking

**UNIT V POST MARKET SURVEILLANCE**

9

PMS and Its Role in Design – Protecting Your IP – Types – Regulatory Approval to Market – Class I Devices – FDA Process – EC process – Unique Selling Points – Key Opinion Leaders – Insurance

**Contact Periods:**

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

**TEXT BOOKS:**

1. Peter J. Ogradnik, "Medical Device Design", Academic press, Elsevier, 2<sup>nd</sup> edition, 2020.
2. DeMarco, Carl T., "Medical Device Design and Regulation", American Society for Quality ASQ), 1<sup>st</sup> edition, 2011.

**REFERENCES:**

1. J. Paulo Davim, "The design and manufacture of medical devices", Woodhead Publishing, 1<sup>st</sup> edition, 2012
2. Richard C.Fries, "Handbook of Medical Device Design", CRC Press, 1<sup>st</sup> edition, 2000
3. Vikki Hazelwood, "Foundations and Strategies for Medical Device Design", McGrawhill, 1<sup>st</sup> edition, 2021

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407



## VERTICAL II – MEDICAL DEVICE DEVELOPMENT AND MANAGEMENT

U21BMP11	QUALITY MANAGEMENT AND ACCREDITATION IN HEALTHCARE	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To understand the importance of quality and safety in healthcare sector
- To interpret the data collection, processing and analysis
- To explore the accreditation bodies and their roles

## COURSE OUTCOMES:

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

**CO1:** Explain the evolution of quality management (Understand)

**CO2:** Describe the fundamentals of healthcare quality management (Understand)

**CO3:** Explore the various medical device regulatory bodies and certifications (Understand)

**CO4:** Demonstrate the different certifications proposed for purposes of medical device testing (Understand)

**CO5:** Discuss appropriate assessment method to maintain quality healthcare (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I      EVOLUTION OF QUALITY MOVEMENT

9

Quality assurance – total quality management – continuous quality improvement – Theories and principle of Quality Assurance: Principles – Juran – Trilogy – Kaizen – Philip Crosby's principle – Need and Benefits for quality management in healthcare – Quality Management Programme – ISO clauses – quality manual – quality of clinical services – Critical Pathways

## UNIT II      HEALTHCARE QUALITY MANAGEMENT

9

Quality – Healthcare Quality – Quality Management Activities – Quality Management in Industry and Healthcare – External Forces Impacting Healthcare Quality Management – Measuring Performance – Measurement in Quality Management – Characteristics – Categories – Selecting Performance Measures – Constructing Measures – Measures of Clinical Decision Making – Evaluating Performance – Display and Trend formats

**UNIT III BENCH MARKING OF QUALITY STANDARD**

9

FDA regulations – Accreditation for hospitals – JCI – NABH and NABL – BIS – ACHS – Security & Safety of Hospital – Property – Staff & Patients – Radiation safety – Safety precautions – hazardous effects of radiation – allowed levels of radiation – ICRP regulations for radiation safety – Disposal of Biological waste

**UNIT IV MEDICAL DEVICE EVALUATIONS**

9

Functional Safety in Medical Industry – Ultrasound Testing – Electromagnetic Compatibility Testing – Sterilization Practices Control and Validation for Medical Devices – Biological – Physical and Chemical Testing for Medical Devices – Environmental Testing – Cyber security Testing and Assessment Services

**UNIT V ASSESSING QUALITY HEALTHCARE**

9

Patient Safety Organization-Governmental & Independent – Measuring Quality care – Evaluation of hospital services – Six sigma way – Quality Assurance in Hospitals SOP's – Patient Orientation for Total Patient Satisfaction – 5S techniques

**Contact Periods:**

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

**TEXT BOOKS:**

1. Karen Parsley, Karen Parsley and Philomena Corrigan, Quality improvement in Healthcare, Nelson Thrones Pub, 2<sup>nd</sup> edition, 2002
2. Patric Espath, Introduction to Healthcare Quality Management, AUPHA Press, 1<sup>st</sup> edition, 2000

**REFERENCES:**

1. B.M.Sakharkar, Principles of Hospital administration and Planning, Jaypee Brothers, Medical Publishers (P) Ltd, 2<sup>nd</sup> edition, 2009
2. Joseph F Dyro, "Clinical Engineering Handbook", Elsevier Publishers, 1<sup>st</sup> edition, 2004
3. Cesar A. Cacere and Albert Zana, "The Practice of Clinical Engineering", Academic press, New York, 1<sup>st</sup> edition, 1977
4. Webster J.G and Albert M. Cook, Clinical Engineering, Principles & Practices, Prentic Hall Inc., Englewood Cliffs, New Jersey, 1<sup>st</sup> edition, 1979

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



## VERTICAL II – MEDICAL DEVICE DEVELOPMENT AND MANAGEMENT

U21BMP12	PATIENT SAFETY, STANDARDS AND ETHICS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To familiarize with the patient safety cultures, standards for laboratories and radiation areas
- To understand the purpose of quality assurance in healthcare
- To identify the patient and provider rights and legal issues in biomedical care

## COURSE OUTCOMES:

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

**CO1:** Interpret the patient safety as an organizational function (Understand)

**CO2:** Apply the various standards related with electrical and clinical laboratories (Apply)

**CO3:** Identify the importance of patient safety against radiation hazards (Apply)

**CO4:** Explain the quality control and assurance activities to be followed in hospitals (Understand)

**CO5:** Outline the ethical issues related to hospital administration and realize the responsibilities and rights of both patient and provider (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I PATIENT SAFETY: AN ORGANIZATIONAL FUNCTION

9

Aspects of patient safety – Safety Cultures – Patient Roles in Patient Safety – Healthcare associated Infections – Risk factors for Adverse drug events – Rapid Response Systems – Patient Restraints

## UNIT II ELECTRICAL HAZARDS AND LABORATORY SAFETY

9

Review of Electrical concepts – Electrical Hazards – Electrical related Standards – Standards for Clinical Laboratories – Standard Operating Procedures – Hazardous Waste Disposal – Biological Safety Cabinets – Safety Personnel Responsibilities

## UNIT III RADIATION AREA SAFETY

9

OSHA Ionizing Radiation Standards – Surveys and Monitoring – Caution Signs – Storage and Handling Procedures – Radiation Safety Committee – Radioactive Waste Management – Wireless Medical Telemetry – Safety Recommendations for nonionizing radiation in Healthcare Facilities



**UNIT IV QUALITY ASSURANCE THROUGH CLINICAL AUDIT****9**

Purpose of Quality Assurance – Clinical audit – Establishing Criteria for Diagnosis, Investigations and Treatment – Quality Assurance Committee (QAC) – Comprehensive Quality Assurance System (CQAS) – Total Quality Management (TQM) in Health Care

**UNIT V ETHICAL AND LEGAL ASPECTS OF HOSPITAL ADMINISTRATION****9**

General Acts/Legislations – Medical/Professional Acts – Law of Torts – Consumer Protection Act (CPA) – Hospital's Responsibilities – Professional Negligence – Medical Indemnity Insurance against Malpractice suits

**Contact Periods:**

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

**TEXT BOOKS:**

1. Sakharkar BM, "Principles of Hospital administration and Planning", JAYPEE Brothers, Medical Publishers (P) Ltd., 2<sup>nd</sup> edition, 2009
2. James T. Tweedy, "Healthcare Hazard Control and Safety Management", CRC Press, 3<sup>rd</sup> edition, 2014

**REFERENCES:**

1. Sharon Myers "Patient Safety & Hospital Accreditation - A Model for Ensuring Success", Springer Publishers, 1<sup>st</sup> edition, 2012
2. Donaldson, Liam, Walter Ricciardi, Susan Sheridan, and Riccardo Tartaglia. "Textbook of patient safety and clinical risk management", Springer Nature, 1<sup>st</sup> edition, 2021
3. Vincent, Charles, "Patient safety", John Wiley & Sons, 1<sup>st</sup> edition, 2011
4. Ramakrishna, Seeram, Lingling Tian, Charlene Wang, Susan Liao, and Wee Eong Teo. "Medical devices: regulations, standards and practices", Woodhead Publishing, 1<sup>st</sup> edition, 2015

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.





## VERTICAL II – MEDICAL DEVICE DEVELOPMENT AND MANAGEMENT

U21BMP13	MEDICAL DEVICE REGULATIONS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To understand the regulations for medical devices
- To explore the assessment methods adopted for the quality sustenance in hospitals
- To identify the various regulatory standards and certifications

## COURSE OUTCOMES:

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

**CO1:** Explain the international regulatory framework of medical device (Understand)

**CO2:** Describe the quality management system and risk management (Understand)

**CO3:** Discuss the technical documentations involved in regulatory process (Understand)

**CO4:** Explore premarket phase of medical device regulatory process (Understand)

**CO5:** Outline the post market phase and various regulatory standards and certifications (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

**UNIT I      OVERVIEW OF THE INTERNATIONAL REGULATORY FRAMEWORK FOR MEDICAL DEVICES      9**

Established and emerging markets – Credibility and authority of approvals – Medical device life cycle – Definitions of medical devices – Active implantables and in vitro diagnostics – Borderline products – Combination products – EU – US – Australian – Canadian – Japanese regulations for combination products – Risk-based Classification – Classification philosophies

**UNIT II      QUALITY MANAGEMENT SYSTEM AND RISK MANAGEMENT      9**

General principles and the use of standards – Standards organizations – Standards applicable to medical devices – Software and firmware – Software regulations – RF wireless devices –

Cybersecurity – Hazardous substances contained in electronic devices – Medicines and biologics  
 – Tissues of animal origin susceptible to TSE – Phthalates – Allergens

### UNIT III TECHNICAL DOCUMENTATION 9

Documentation mandated by EU – US – Australian – Canadian – Japanese – GHTF summary technical documentation – Example of STED-Aligned DHF – Manufacturing information – Verification and validation – Clinical evaluation – Regulated product submission – Regulatory submissions repository – Case study: The Scattered DHF

### UNIT IV PRE-MARKET PHASE 9

Design controls – Information management during the Pre-Market phase – D and D planning stage – D and D process stage – Product identification and traceability – Case study – Regulatory submissions – Approvals and registrations

### UNIT V POST-MARKET PHASE 9

Product launch – Continued regulatory compliance – Change management – Post-Market surveillance – Regulatory systems and processes – Case study: Square peg in a round hole note on ISO 13485 – ISO 15378 – ISO 14971 – ISO 10993 – IEC 60601

#### Contact Periods:

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

#### TEXT BOOKS:

1. Almir Badnjević, "Inspection of Medical Devices: For Regulatory Purposes", Springer, 1<sup>st</sup> edition, 2018
2. Val Theiz, "Medical Device regulatory practices: An international Perspective", Pan Stanford, 1<sup>st</sup> edition, 2015

#### REFERENCES:

1. Jack Wong, "Medical Regulatory Affairs: An International Handbook for Medical Devices and Healthcare Products" Jenny Stanford Publishing; 3<sup>rd</sup> edition, 2022
2. Jack Wong, Handbook of Medical Device Regulatory Affairs in Asia: Second edition, Jenny Stanford Publishing; 2<sup>nd</sup> edition, 2018

#### EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



## VERTICAL II – MEDICAL DEVICE DEVELOPMENT AND MANAGEMENT

U21BMP14	HEALTHCARE DATA ANALYTICS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To familiarize with the basics of data mining techniques
- To understand predictive and time series models
- To explore technologies and tools in healthcare application

## COURSE OUTCOMES:

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

**CO1:** Understand the basic functionalities of Data Mining Techniques (Understand)

**CO2:** Understand data mining in predictive modelling (Understand)

**CO3:** Discuss big data analytics and time series analytics (Understand)

**CO4:** Explore the technologies and tools for data analytics (Understand)

**CO5:** Apply the concepts of data mining in healthcare applications (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

**UNIT I      DATA MINING      9**

Relation To statistics – databases – data Mining functionalities – steps in data mining process – architecture of typical data mining systems – classification of data mining systems – overview of data mining techniques

**UNIT II      PREDICTIVE MODELING      9**

Mining association rules in large databases – classification and prediction: Issues regarding classification and prediction – classification by decision tree induction – Bayesian classification – other classification methods – prediction – clusters analysis: types of data In cluster analysis – categorization of major clustering methods

**UNIT III      OVERVIEW OF BIG DATA ANALYTICS      9**

Introduction to big data – big data analytics applications – Time series analysis – Introduction to map Reduce / hadoop



**UNIT IV TECHNOLOGIES AND TOOLS FOR DATA ANALYTICS**

9

Data visualization techniques using R Tool: Histograms – Box plots – Scatter plots – Time series – spatial Data – spark – Introduction to exploratory data mining – association Rule mining – clustering and classification techniques using WEKA Tool

**UNIT V DATA ANALYTICS APPLICATIONS IN HEALTHCARE**

9

Clinical prediction models – Temporal pattern mining methods – Visual analytics – Data analytics to pervasive healthcare – Fraud detection – Drug discovery along with systems for medical imaging and decision support

**Contact Periods:**

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

**TEXT BOOKS:**

1. Jiawei Han, Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 1<sup>st</sup> edition, 2011
2. Chandan K. Reddy, Charu C. Aggarwal, "Healthcare Data Analytics", Chapman and Hall/CRC Data Mining and Knowledge Discovery Series 1<sup>st</sup> edition, 2020
3. Cathy O'Neil and Rachel Schutt, "Doing Data Science, Straight Talk from the Frontline", O'Reilly, 1<sup>st</sup> edition, 2014


**REFERENCES:**

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 1<sup>st</sup> edition, 2011
2. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, 4<sup>th</sup> edition, 2015

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.


  
 HoD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407

## VERTICAL II – MEDICAL DEVICE DEVELOPMENT AND MANAGEMENT

U21BMP15	MEDICAL WASTE MANAGEMENT	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To understand the hazardous materials used in hospital and its impact on health
- To familiarize with various waste disposal procedures and management
- To interpret the regulations and safety norms to be followed in medical waste management

## COURSE OUTCOMES:

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

CO1: Identify different types of wastes generated from hospitals (Understand)

CO2: Understand the basic steps to be followed while segregating wastes (Understand)

CO3: Summarize various treatment techniques for medical wastes (Understand)

CO4: Illustrate and manage different types of hazardous medical wastes methods (Understand)

CO5: Outline various regulations and safety norms (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I INTRODUCTION TO MEDICAL WASTE 9

General and Hazardous health care waste, Infectious waste, Genotoxic waste, Waste sharps – Colour coding – Sources of health care wastes – bio hazard symbols

## UNIT II HANDLING MEDICAL WASTE MANAGEMENT 9

Basic steps in segregation – Sharp decontaminating – Disinfections container for autoclaving – Sharp waste containers for storage and transportation – Shredding – Incrimination – Hydropulping – Plasma torch

## UNIT III CONVENTIONAL TREATMENT TECHNOLOGIES 9

Wet thermal technology – Incineration – Microwave technology – Rotoclave system – Hydroclave system – Electro Thermal Reactivation (ETP) Treatment Process – Electron beam technology – Plasma pyrolysis





**UNIT IV HAZARDOUS WASTES TREATMENT**

9

Hazardous substance safety – OSHA hazard communication standard – DOT hazardous material

regulations – Medical gas systems – Respiratory protection

**UNIT V LEGISLATION AND POLICIES ON MEDICAL WASTE MANAGEMENT**

9

Biomedical waste management and handling rules, 1998 and its amendment – Safe disposal of radioactive waste rules, 1995 guideline of BARC – CPCB guidelines

**Contact Periods:**

Lecture: 45 Periods    Tutorial: – Periods    Practical: – Periods    Project: – Periods

Total: 45 Periods

**TEXT BOOKS:**

1. Tweedy, James T., "Healthcare hazard control and safety management", CRC Press Taylor and Francis, 1<sup>st</sup> edition, 2014
2. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd, 1<sup>st</sup> edition, 2012

**REFERENCES:**

1. Safe disposal of Radioactive waste Rules, 1995 guideline of BARC
2. R.C.Goyal, "Hospital Administration and Human Resource Management II", PHI publications, 4<sup>th</sup> edition, 2006

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HoD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 KARASUR COIMBATORE-641 407

## VERTICAL II – MEDICAL DEVICE DEVELOPMENT AND MANAGEMENT

U21BMP16	TESTING AND CALIBRATION	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To provide an understanding of the regulatory requirements and ethical considerations in conducting usability testing for medical devices
- To obtain knowledge and skills necessary to plan, conduct, analyze, and report the results of usability tests for medical devices
- To understand the principles and practices of calibration of medical devices

## COURSE OUTCOMES:

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

- CO1:** Design a usability testing plan for a medical device that meets regulatory requirements and ethical considerations (Understand)
- CO2:** Demonstrate a usability test for a medical device, collect and analyze data, and report the results effectively (Apply)
- CO3:** Make use of the results of a usability test to improve the design of a medical device and contribute to the overall safety and efficacy of medical devices (Apply)
- CO4:** Outline the regulatory requirements and guidelines for calibration of medical devices (Understand)
- CO5:** Apply advanced calibration techniques for specific medical devices (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

**UNIT I INTRODUCTION TO USABILITY TESTING OF MEDICAL DEVICES 9**

Introduction – Testing – Regulatory requirements – Types – User groups – Ethical considerations – Planning – Setting up a usability test environment – Recruiting participants – Conducting a successful usability test for medical devices

**UNIT II CONDUCTING USABILITY TESTING OF MEDICAL DEVICES 9**

Preparing usability test materials for medical devices – Conducting usability tests – Collecting and analyzing data – Quantitative and qualitative methods for analyzing usability data – Reporting usability test results – Techniques to improve medical device design – Iterative usability testing – Usability testing in post-market surveillance

**UNIT III ADVANCED TOPICS IN USABILITY TESTING OF MEDICAL DEVICES** 9

Human factors engineering – Risk management – Usability testing for combination products and connected health – Medical software and mobile medical applications – Home use medical devices – labelling – Global considerations – Future trends in medical device usability testing

**UNIT IV INTRODUCTION TO CALIBRATION OF MEDICAL DEVICES** 9

Calibration and its importance – Regulatory requirements and guidelines – Types of medical devices and their calibration requirements – Calibration methods and procedures – Traceability and uncertainty in calibration – Calibration documentation and record keeping – selection and qualification of calibration service providers – Evaluation and validation of calibration results – Common calibration errors and their prevention

**UNIT V CALIBRATION OF CRITICAL DEVICES** 9

Calibration of diagnostic imaging equipment – Electromedical equipment laboratory equipment – Surgical instruments – Patient monitoring devices – Rehabilitation and physiotherapy equipment – Infusion pumps and syringe drivers – Blood glucose meters and hematology analyzers – Point-of-care testing devices

**Contact Periods:**

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

**TEXT BOOKS:**

1. Michael E. Wiklund, Jonathan Kendler, and Allison Y. Strohlic, "Usability Testing of Medical Devices", 1<sup>st</sup> edition, CRC Press, 2010
2. "Specific Criteria for Calibration of Medical Devices", NABL 126, NABL, 01/06/2021

**REFERENCES:**

1. Wiklund, Michael E., and Andrea Dwyer. "Medical Device Use Error: Root Cause Analysis." 1<sup>st</sup> edition, CRC Press, 1<sup>st</sup> edition, 2014
2. McLeod, CC, and M Schneider. "Human Factors Methods for Improving Performance in the Process Industries", 1<sup>st</sup> edition, Wiley, 2007
3. Richard Aston, "Principles of Biomedical Instrumentation and Measurement", 1<sup>st</sup> edition, Pearson Education, 1<sup>st</sup> edition, 2012

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Presentation / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.







U21BMP17	SPORTS BIOMECHANICS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21BM605 - Biomechanics

**COURSE OBJECTIVES:**

- To illustrate the applications of biomechanical studies in sports mechanics
- To summarize the fundamental concepts of sports biomechanics
- To analyze qualitative and quantitative analysis of human movements

**COURSE OUTCOMES:**

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

**CO1:** Apply the basic concepts of sports biomechanics (Apply)

**CO2:** Illustrate significant qualitative analysis of human movements (Understand)

**CO3:** Delineate the significant quantitative analysis of human movements (Understand)

**CO4:** Outline the characteristics of sports performance (Understand)

**CO5:** Examine the applications of biomechanical studies in sports (Analyze)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      INTRODUCTION**

9

Essence of sports biomechanics – Kinetics and kinematics of human movements – Movement patterns – Comparison of qualitative and quantitative movement – Muscle and ligament property – Factors affecting properties of biological tissue

**UNIT II      QUALITATIVE ANALYSIS OF MOVEMENTS**

9

Fundamentals of movement – Linear motion and the centre of mass – Linear motion and the center of mass – Coordination of joint rotations – Qualitative analysis preparation stage – Observation stage – Evaluation and diagnosis stage – Intervention stage

**UNIT III      QUANTITATIVE ANALYSIS OF MOVEMENT**

9

Introduction – Movement recording using videography – Experimental procedures – Data processing – Projectile motion – Rotation in three-dimensional space – Understand injury development – Geometry of motion

**UNIT IV IMPROVEMENT OF SPORTS PERFORMANCE****9**

Principles of coordinated movement – Structural analysis of movement – Biomechanical principles of coordinated movement – Temporal and phase analysis – Kinesiological analysis of sports movements – limitations of kinesiological analysis

**UNIT V APPLICATIONS****9**

Qualitative analysis – Batting – Catching – Kicking – Throwing technique – Dribbling technique – Squat – Drop jump – Injury risk

**Contact Periods:**

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

**TEXT BOOKS:**

1. Roger Bartlett, "Introduction to sports biomechanics", 3<sup>rd</sup> edition, Routledge, 2021
2. Duane Knudson, "Fundamentals of Biomechanics", 2<sup>nd</sup> edition, Springer, 2007

**REFERENCES:**

1. Roger Bartlett & Melanie Bussey, "Sports Biomechanics: Reducing Injury Risk and Improving Sports Performance", Routledge, 2012
2. Susan J Hall, "Basic Biomechanics", 7<sup>th</sup> edition, McGraw Hill, 2015

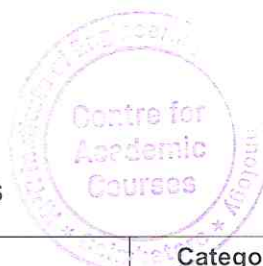
**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations	
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments		
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test			
40	60	40	60			
Total					200	100
					40	60
					100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HoD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 APASUR, COIMBATORE-641 407



U21BMP18	BIOFLUIDS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To understand the basics of fluid mechanics
- To analyze cellular, ocular, cardiovascular and respiratory fluid mechanics
- To learn mathematical modelling of fluid biological systems

**COURSE OUTCOMES:**

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

**CO1:** Identify the properties and behavior of biological fluids (Understand)

**CO2:** Explain the mechanics and mechanical interactions of cellular structures (Understand)

**CO3:** Understand the rheology of blood components (Understand)

**CO4:** Summarize the influence of biofluids in the cardio respiratory mechanism (Understand)

**CO5:** Interpret the numerical methods to solve fluid flow problems (Understand)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      BIOFLUID MECHANICS**

9

Intrinsic fluid properties – Pressure-flow relationship for Non-Newtonian Fluids – Fluid mechanics in straight tube – Structure of blood vessels – Material properties and modelling of Blood vessels

**UNIT II      CELLULAR MECHANICS**

9

Cellular Biomechanics – Eukaryotic cell architecture, Cytoskeleton, Cell-matrix interactions – Mechanical property measurement – Optical Trapping – Magnetic bead microrheometry – Micropipette aspiration

**UNIT III      BLOOD RHEOLOGY AND BLOOD VESSEL MECHANICS**

9

Rheological characteristics of blood – Viscosity of blood – Biomechanics of red cell membrane – Apparent and relative viscosity – Blood viscosity variation – Rheology of Blood In Micro vessels – Fahraeus-Lindquist effect and its inversion – Arterial wall as membrane – Uniaxial and Biaxial loading



**UNIT IV CARDIO RESPIRATORY MECHANICS****9**

Heart – Cardiac muscle characterization – Native heart valves – Prosthetic heart valve fluid dynamics – Cardiac cycle – Pressure volume diagrams – Changes in contractility – Ventricular performance – Congestive heart failure

**UNIT V COMPUTATIONAL FLUID DYNAMICS****9**

Computational fluid dynamics (CFD) Code – Problem solving with CFD – Conservation Laws of Fluid Motion and boundary conditions – Turbulence and its model – Finite volume method for diffusion problems – Convection-Diffusion problems

**Contact Periods:**

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

**TEXT BOOKS:**

1. Krishnan B. Chandran, Ajit P. Yoganathan, Stanley E. Rittgers, "Biofluid Mechanics - The human circulation II", CRC Taylor and Francis, 1<sup>st</sup> edition, 2007
2. Y.C Fung, "Biomechanics - Mechanical properties of living tissues II", Springer Verlag, 2<sup>nd</sup> edition, 1993

**REFERENCES:**

1. Jung HeeSeo, Vijay Vedula, Theodore Abraham and Rajat Mittal, "Multiphysics computational models for cardiac flow and virtual cardiography II", Int. J. Numer. Meth. Biomed. Engng., Published online in Wiley Online Library, 2013
2. Lee Waite, Jerry Fine, "Applied Biofluid Mechanics II", McGraw Hill, 1<sup>st</sup> edition, 2007
3. John K-J Li, "Dynamics of Vascular System II", World Scientific, 1<sup>st</sup> edition, 2004

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HoD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COMBATORRE-641 407



U21BMP19	PHYSIOLOGICAL MODELLING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21BM505 - Biocontrol Systems

**COURSE OBJECTIVES:**

- To gain knowledge on system modeling in physiology
- To explore the different models of physiological systems
- To explain the application of Physiological models

**COURSE OUTCOMES:**

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

**CO1:** Infer the basics for the modeling of physiological systems (Understand)

**CO2:** Construct the linear physiological models (Apply)

**CO3:** Identify the various distributed modeling systems (Apply)

**CO4:** Develop the nonlinear models of physiological systems (Apply)

**CO5:** Model the time-varying and stochastic physiological systems (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      INTRODUCTION**

9

Purpose of system modeling – Modeling process: Model formulation, Model identification, Model validation, Model simulation – Control in physiological systems: Enzymes, Hormones

**UNIT II      LINEAR MODELING**

9

Windkessel circulatory model – Model for elimination of a drug from the bloodstream – Gas exchange model – Model of swinging limb – Glucose regulatory system

**UNIT III      DISTRIBUTED MODELING**

9

Blood tissue exchange: The single-capillary model, capillary interstitial fluid model – Model for estimation of hepatic transport – Renal medulla: Formulation for the tubular structures – Interstitial compartment

**UNIT IV NONLINEAR MODELING**

9

Action potential model – Enzyme dynamics – Baroreceptors – Insulin receptor regulation – Thyroid hormone regulation – Modeling the chemical control of breathing

**UNIT V TIME-VARYING AND STOCHASTIC MODELING**

9

Cardiac modeling – Cellular modeling: conceptual model, mathematical model – Insulin secretion – Metabolic Endocrine System – Markov model

**Contact Periods:**

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

**TEXT BOOKS:**

1. Cobelli, Claudio, and Ewart Carson, "Introduction to modeling in physiology and medicine", Academic Press, 2019
2. Michael C.K. Khoo, "Physiological control systems: analysis, simulation, and estimation", 2<sup>nd</sup> edition John Wiley & Sons, 2018

**REFERENCES:**

1. Michael Chappell, Stephen Payne, "Physiology for Engineers: Applying Engineering Methods to Physiological Systems", Springer, 2016
2. Marmarelis, "Nonlinear Dynamic Modelling of Physiological Systems", Wiley-IEEE Press, 2004
3. Suresh R. Devasahayam, "Signals and Systems in Biomedical Engineering: Physiological Systems Modeling and Signal Processing", 3<sup>rd</sup> edition Springer, 2019
4. John Enderle, Susan Blanchard, Joseph Bronzino, "Introduction to Biomedical Engineering", 2<sup>nd</sup> edition, Academic Press, 2005

**EVALUATION PATTERN:**

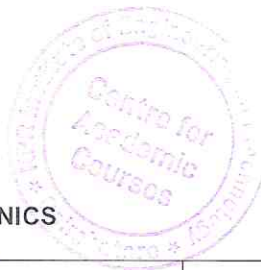
Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 APASUR COIMBATORE-641 407





U21BMP20	ASSISTIVE TECHNOLOGY	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21BM306 - Biomedical Sensors and Instrumentation

**COURSE OBJECTIVES:**

- To make the students aware of the available assistive technology to improve the quality of life of disabled persons
- To know the challenges in design and implementation of these assistive products
- To engage the students in creating simple applications using the available technology

**COURSE OUTCOMES:**

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

**CO1:** Analyze the use of CAT models in different applications and comprehend the need of the model in design of assist devices (Understand)

**CO2:** Depict the design of available speech, text and Braille conversion applications (Apply)

**CO3:** Examine various cases and understand the pros and cons of implementing OCR and DAISY technology (Apply)

**CO4:** Develop a simple module for implementing assist technology for daily living with their expertise (Apply)

**CO5:** Identify the role of assistive technologies in education, employment and recreation (Understand)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I INTRODUCTION TO ASSISTIVE TECHNOLOGY SYSTEMS**

9

Social context of disability – Quality of life on using assistive technology – Modeling assistive technology systems – Comprehensive Assistive Technology (CAT) models – Usage of CAT models in real time

**UNIT II SPEECH, TEXT AND BRAILLE CONVERSION TECHNOLOGY**

9

Prerequisite for speech, text and conversion technology – Pattern and speech recognition systems – Principles of speech synthesis – Text to Braille and Braille to Text conversion systems – Commercial equipment and its application – Haptic Technology

**UNIT III ASSISTIVE TECHNOLOGY FOR ACCESSING BOOKS AND DOCUMENTS 9**

Challenges in accessing printed pages – Optical Character Recognition (OCR) technology – Reading systems – DAISY technology – Accessing textbooks and newspapers – Accessible music software for print impaired people

**UNIT IV ASSISTIVE TECHNOLOGY FOR DAILY LIVING 9**

Personal Care – Timekeeping, Alarms and Alerting – Assistive Technology for food preparation and consumption – Environmental control – Mobility Aids – Money, Finance and shopping – Communication and access to public information

**UNIT V ASSISTIVE TECHNOLOGY FOR EDUCATION, EMPLOYMENT AND RECREATION 9**

Accessing Educational processes and approaches – Educational Technologies, devices and tools technologies for professional, person-centered employment – Games, Puzzles, Toys – Access to sports and outdoor games – Assistive technology in tourists places – Wayfinding systems

**Contact Periods:**

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

**TEXT BOOKS:**

1. Bryant, Diane P., and Brian R. Bryant "Assistive technology for people with disabilities", Pearson Higher Ed, 2011
2. Hersh, Marion A Ed., and Michael A. Johnson, "Assistive technology for visually impaired and blind people", Springer, 2008

**REFERENCES:**

1. Suraj Singh Senjam, "Introduction to Assistive Technology", Nova Science Publishers, 2021
2. Emily C. Bouck, "Assistive Technology", SAGE Publications, Inc, 2016

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.





U21BMP21	ERGONOMICS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To illustrate the principles of ergonomics
- To comprehend the mechanics of muscle physiology
- To discover design aspects of biomedical devices

**COURSE OUTCOMES:**

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

**CO1:** Describe the process of visual and auditory ergonomics (Understand)

**CO2:** Elucidate the concept of muscle physiology (Understand)

**CO3:** Explain the techniques used in controls and displays based on ergonomics (Understand)

**CO4:** Illustrate the functions of anthropometry (Understand)

**CO5:** Interpret the concepts of ergonomics in various field of application (Understand)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      VISUAL AND AUDITORY ERGONOMICS**

9

Process of seeing – Visual capabilities – Factors affecting visual acuity and contrast sensitivity – Human factor aspects of hard copy text and computer screen text – Factors in selecting graphic representations symbols – Qualitative visual display – Process of hearing – Principles of auditory display

**UNIT II      MUSCLE PHYSIOLOGY**

9

Muscle physiology – Muscle metabolism – Respiratory response – Joint motion study – Measure of physiological in-efficiency and energy consumption – Work rest cycles – Aspects of manual and posture study – Material handling (MMH) bio-mechanical recommended limits of MMH



**UNIT III CONTROLS AND DISPLAYS**

9

Spatial compatibility physical arrangement of displays and controls – Movement capability – Rotary controls and rotar displays movement of displays orientation of the operator and movement relationships control orders and control responses – Human limitations in tracking task

**UNIT IV ANTHROPOMETRY**

9

Anthropometry – Anthropometric design principles – Work space envelope – Factors in design of work space surfaces – Principles of seat design – Principles of control panel – Organization classification of human errors theories of accident causation – Reducing accidents by altering behavior

**UNIT V APPLICATIONS OF ERGONOMICS**

9

Computer design – Control panel design of an electronic instrument – Computer key board – Hand drill – Biomedical applications – Design optimization of medical equipment

**Contact Periods:**

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

**TEXT BOOKS:**

1. Pascale Carayon, "Handbook of Human Factors and Engineering", 2nd edition, CRC Press, 2011
2. Martin Helander, "Guide to Human Factors and Ergonomics", 2nd edition, CRC Press, 2005

**REFERENCES:**

1. Stephen Pheasant, Christine M. Haslegrave, "Bodyspace: Anthropometry, Ergonomics and the Design of Work", 3rd edition, CRC Press, 2016
2. Robert. N. Bailey, "Human Performance Engineering", 3rd edition, Prentice Hall, 1996
3. Shrawan Kumar, "Biomechanics in Ergonomics", 2nd edition, CRC Press, 2007

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.





U21BMP22	HAPTICS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To explore the basics of haptics
- To familiarize with the perceptions of haptics
- To study the haptic interfaces and its applications

**COURSE OUTCOMES:**

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

CO1: Describe the fundamentals of haptics (Understand)

CO2: Illustrate the static perception of the haptics (Apply)

CO3: Illustrate the dynamic perception of the haptics (Apply)

CO4: Discuss the interfaces in a haptic system (Understand)

CO5: Demonstrate the applications of haptics (Understand)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I FUNDAMENTALS OF HAPTICS**

9

Tactile System – Sense of Touch – Tactile Receptors – Kinesthesia – Thermal Sensing – Motor System – Sensorimotor Control of the Hand

**UNIT II STATIC PERCEPTION**

9

Perception of force magnitude and postural arm dynamics: Introduction – Methods – Procedure – Position disturbance signal design – Data analysis – Statistics

**UNIT III DYNAMIC PERCEPTION**

9

Discrimination of distance: Reference Distance – Movement axis – Movement mode – Materials and methods – Procedure – Data Analysis

**UNIT IV HAPTIC INTERFACES**

9

Haptic interaction, mechanical variables and haptic signals – The physics of haptic interaction – The importance of haptics in perception research – Haptic interface characteristics – The events

happening when touching real and virtual objects: similarities and differences

**UNIT V APPLICATIONS**

9

Taste of vision for blind – Haptic Walker – Haptic sensing of virtual textiles – Haptic design of handles – Vestibular sensory substitution using tongue electro tactile display

**Contact Periods:**

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

**TEXT BOOKS:**

1. Jones, Lynette "Haptics, 1st edition", The MIT press, 1<sup>st</sup> edition 2018
2. Van Beek, Femke Elise, "Making Sense of Haptics: Fundamentals of Perception and Implications for Device Design", Springer, 1<sup>st</sup> edition, 2018
3. Grunwald, Martin, "Human haptic perception: Basics and applications", Springer Science and Business Media, 1<sup>st</sup> edition, 2008

**REFERENCES:**

1. McDaniel, Troy, and Sethuraman Panchanathan, "Haptic Interfaces for Accessibility, Health, and Enhanced Quality of Life", Springer, 1<sup>st</sup> edition, 2020
2. <https://online.stanford.edu/courses/soe-yhapatics-introduction-haptics>
3. <https://www.learnhaptics.org/>

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
Individual Assignment / Case Study / Presentation / Project / MCQ	Written Test	Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	
Total				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.







## VERTICAL III - MECHANICS

U21BMP23	IMPLANT SELECTION AND DEVELOPMENT	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21BM301 - Human Anatomy and Physiology

**COURSE OBJECTIVES:**

- To familiarize with the basics of implants and their design principles
- To identify the design parameters of implants
- To explore the different implantable blood interfacing devices and organs

**COURSE OUTCOMES:**

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

**CO1:** Explain the significance of implants (Understand)

**CO2:** Illustrate the implant design principles, parameters and solutions (Understand)

**CO3:** Identify suitable material for blood interfacing implants (Apply)

**CO4:** Explain different types of soft tissue replacement and hard tissue replacement (Understand)

**CO5:** Assess compatibility and functioning of artificial organs inside the living system (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I INTRODUCTION TO IMPLANTS**

9

Introduction - Outlook for organ replacements - Design consideration - Evaluation process - Immunological considerations - Blood transfusions

**UNIT II PRINCIPLES OF IMPLANT DESIGN**

9

Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration

**UNIT III DESIGN PARAMETERS**

9

Local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration

**UNIT IV BLOOD INTERFACING IMPLANTS**

9

Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood

**UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS**

9

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions

**Contact Periods:**

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

**TEXT BOOKS:**

1. Yannas, I. V, "Tissue and Organ Regeneration in Adults", New York, NY: Springer, 2001
2. Kopff W.J, Artificial Organs, John Wiley and sons, New York, 1st edition, 1976

**REFERENCES:**

3. J D Bronzino, Biomedical Engineering handbook Volume II, (CRC Press / IEEE Press), 2000
4. R S Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 2003
5. John Enderle, Joseph D.Bronzino, Susan M.Blanchard, "Introduction to Biomedical Engineering", Elsevier, 2005

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					
40				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



HOOD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407

## VERTICAL III - MECHANICS

U21BMP24	BONE REMODELING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To understand the bone mechanics
- To interpret the bone remodeling biology and diseases
- To explore the mathematical methods of bone remodeling

## COURSE OUTCOMES:

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

**CO1:** Explain the mechanics of human bone (Understand)

**CO2:** Compare the bone cells and bone remodeling cycle (Understand)

**CO3:** Classify the different bone diseases (Understand)

**CO4:** Apply the mathematical models in bone remodeling (Apply)

**CO5:** Interpret the application of finite element analysis in bone remodeling (Understand)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I BONE MECHANICS

9

Hierarchical organization of bone – Cortical bone macromechanical properties – Preparation of bone samples for mechanical testing – Cortical bone characteristics – Cortical bone ailments – Genetic disorders – Triggered bone ailments – Fractures – Bone as composite structure

## UNIT II BONE REMODELING BIOLOGY

9

Bone cells – Osteoblasts – Osteoclasts – Osteocytes – Bone remodeling cycle – Bone cell interactions – Effect of osteoblasts on osteoclasts – Effect of osteoclasts on osteoblasts – Factors influencing bone

## UNIT III BONE DISEASES

9

Osteoporosis – Rickets – Osteomalacia – Paget disease – Osteogenesis imperfecta – Multiple myeloma – Bone cancer





**UNIT IV MATHEMATICAL MODELING IN BONE REMODELING**

9

Bone remodeling in vitro – Mechanical models – Isotropic models – Anisotropic models – Biological models – Biomechanical models – Mechanobiological models

**UNIT V FINITE ELEMENT MODELING AND ANALYSIS**

9

Finite element modeling of healthy bone – Finite element modeling of pathologic bone – Mathematical models treating bone diseases – Bone disease treatment modeling

**Contact Periods:**

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

**TEXT BOOKS:**

1. Rabeb Ben Kahla, Abdelwahed Barkaoui, "Bone Remodeling Process: Mechanics, Biology and Numerical Modeling", 1<sup>st</sup> edition, Academic Press, 2021
2. Julius Wolff, "The Law of Bone Remodeling", 1<sup>st</sup> edition, Springer Berlin, Heidelberg, 2012

**REFERENCES:**

1. Qing-Hua Qin, "Mechanics of Cellular Bone Remodeling", 1<sup>st</sup> edition, CRC Press, 2017
2. Gregory R Mundy, "Bone Remodelling and its Disorders", CRC Press, 2<sup>nd</sup> edition, 2021

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.


  
 HoD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 APAS, K. J. SOMAYAJI ROAD, CHENNAI - 600 096


**VERTICAL IV – INTELLIGENT SYSTEMS FOR  
MEDICINE**

U21BMP25	INTERNET OF MEDICAL THINGS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To familiarize with Internet of Things (IoT) and its applications in healthcare
- To explore wearables in healthcare
- To study cloud of things and security of IoT

**COURSE OUTCOMES:**

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

**CO1:** Describe the fundamentals of IoT (Understand)

**CO2:** Demonstrate IoMT, the concepts of IoT in healthcare (Apply)

**CO3:** Examine the technologies in wearables for healthcare measurement (Analyze)

**CO4:** Discuss the prevalence of cloud in IoT (Understand)

**CO5:** Examine current security and privacy concerns related to the connected devices (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      FUNDAMENTALS OF IoT**

9

Introduction – IoT Characteristics – Architectures for IoT – Sensors, Actuators, and Data Storage – Communication Protocols – User Interface Properties – IoT in Healthcare (IoMT): Benefits, Developments, and Challenges

**UNIT II      INTERNET OF MEDICAL THINGS**

9

Robotics in medicine – Data-driven medicine – Image management and video surveillance applied in medicine – Cybersecurity: The need for security in medical IT systems – Three Scenarios in Data Protection

**UNIT III      WEARABLES IN HEALTHCARE**

9

Wearable Devices in the Medical Field – Antennas in diagnosis and treatment – wearable sensors for measuring fatigue – Experimental studies; Aerobic and anaerobic

**UNIT IV THE CLOUD OF THINGS****9**

Cloud Computing: Cloud Middleware – The Cloud of Things – Mobile Cloud Computing – MAI versus XaaS – The Cloud of Things Architecture

**UNIT V CYBERSECURITY AND THE INTERNET OF THINGS****9**

Cybersecurity – New security and privacy challenges – Healthcare: Interoperability and Security Issues – Risks in the connected home – First Steps Toward Managing Discrimination, Privacy, Security, and Consent

**Contact Periods:**

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

**TEXT BOOKS:**

1. Cardona M, Solanki VK, Cena CE, "Internet of Medical Things: Paradigm of Wearable Devices", 1<sup>st</sup> edition, CRC Press; 2021 Feb 25
2. Zhou, H., "The internet of things in the cloud. Boca Raton", 1<sup>st</sup> edition, CRC press, 2012

**REFERENCES:**

1. Hillar, G.C., "Hands-On MQTT Programming with Python: Work with the lightweight IoT protocol in Python", 1<sup>st</sup> edition, Packt Publishing Ltd, 2018
2. Norris, Donald "The internet of things: Do-it-yourself at home projects for arduino, raspberry pi, and beaglebone black", 1<sup>st</sup> edition, McGraw-Hill Education, 2015
3. Spanulescu, Sever "Esp32 Programming for the Internet of Things", 1<sup>st</sup> edition, Lulu Press Inc, 2018
4. Pfister, Cuno, "Getting started with the Internet of things: connecting sensors and microcontrollers to the cloud", 1<sup>st</sup> edition, O'Reilly Media, Inc., 2011
5. <https://www.coursera.org/learn/iot-cyber-security/home/>

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Presentation / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



U21BMP49	AI AND ML FOR MEDICAL DIAGNOSTICS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To be able to define a health-based applications using machine learning Approaches
- To conceptualize the health diagnostics with the aid of evaluation parameters
- To Predict, prognosis & forecast the probable course of a disease using emerging technologies

**COURSE OUTCOMES:**

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

**CO1:** Discuss the fundamentals of machine learning Life cycle model (Understand)

**CO2:** Outline the classification models for disease detection (Understand)

**CO3:** Represent evaluation metrics for AI models (Apply)

**CO4:** Apply the concept of diagnosing MRI images using image segmentation (Apply)

**CO5:** Applications of AI and Metaverse in health care sectors (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      INTRODUCTION TO APPLIED MACHINE LEARNING**

9

Introduction to Machine Learning Process – Classification, Regression and Learning – Machine Learning in the Real World – Features and transformations of raw data – Learning data – Sources of Training Data – Ethical Issues – Image Classification Example – Machine Learning Process Life cycle – Example

**UNIT II      DISEASE DETECTION WITH COMPUTER VISION**

9

Medical Image Diagnosis – Eye Disease and Cancer Diagnosis – Building and Training a Model for Medical Diagnosis – Training, Prediction, and Loss – Image Classification and Class Imbalance – CNN Architectures – Working with a Small Training Set – Generating More Samples – Model Testing – Exercise – Disease Detection with Computer Vision

**UNIT III EVALUATING MODELS FOR MACHINE LEARNING**

9

Sensitivity, Specificity and Evaluation Metrics – Accuracy in Terms of Conditional Probability  
 Sensitivity, Specificity and Prevalence – PPV, NPV – Confusion Matrix – ROC Curve and Threshold  
 – Varying the Threshold – Sampling from the Total Population – Confidence Intervals and 95%  
 Confidence Interval

**UNIT IV DIAGNOSING MRI IMAGES**

9

Medical Image Segmentation – MRI Data and Image Registration Segmentation – Two and three  
 Dimensional – U Net – Data Augmentation for Segmentation – Loss Function for Image segmentation  
 – Different Populations and Diagnostic Technology – External Validation – Measuring Patient  
 Outcomes

**UNIT V MEDICAL PROGNOSIS**

9

Medical Prognosis – Examples of Prognostic Tasks – Atrial Fibrillation – Liver Disease Mortality Risk  
 of Heart Disease – Risk Score Computation – Evaluating Prognostic Models – Concordant Pairs,  
 Risk Ties, Permissible Pairs – C-Index

**Contact Periods:**

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

**TEXT BOOKS:**

1. Arjun Panesar, "Machine Learning and AI for Healthcare", Springer Nature, Feb 2019
2. De Gruyter, "Artificial Intelligence for Data-Driven Medical Diagnosis", Feb 2021

**REFERENCES:**

1. <https://in.coursera.org/learn/machine-learning-applied>
2. <https://in.coursera.org/learn/ai-for-medical-diagnosis>
3. <https://www.coursera.org/learn/ai-for-medical-prognosis>

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

**VERTICAL IV – INTELLIGENT SYSTEMS FOR  
MEDICINE**

U21BMP27	VIRTUAL REALITY IN HEALTHCARE	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

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

**COURSE OUTCOMES:**

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

**CO1:** Outline input and output devices in VR systems (Understand)

**CO2:** Differentiate various modelling techniques in developing process (Apply)

**CO3:** Explain the safety considerations involved in VR (Understand)

**CO4:** Identify the VR technology enabled assistive devices (Apply)

**CO5:** Summarize the applications of VR in healthcare (Understand)

**CO-PO MAPPING:**

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

**SYLLABUS****UNIT I      INTRODUCTION**

9

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

**UNIT II      DEVELOPMENT PROCESS**

9

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

**UNIT III      HEALTH AND SAFETY CONSIDERATIONS**

9

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



**UNIT IV WEB AND MOBILE**

9

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

**UNIT V APPLICATIONS**

9

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

**Contact Periods:**

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

**TEXT BOOKS:**

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

**REFERENCES:**

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

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.

## VERTICAL IV – INTELLIGENT SYSTEMS FOR MEDICINE

U21BMP50	MEDICAL DATA VISUALIZATION	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- U21AMG04 - Artificial Intelligence and Machine Learning

## COURSE OBJECTIVES:

- To interpret medical data using various visualization techniques
- To apply the visualization techniques to real-world medical data

## COURSE OUTCOMES:

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

**CO1:** Understand the basic principles of data visualization (Understand)

**CO2:** Develop proficiency in visualizing 2D, 3D medical images and interactive visualizations (Apply)

**CO3:** Designing and creating clinical dashboards that effectively visualize different types of clinical data (Apply)

**CO4:** Interpret techniques for visualizing genomic data, including genome browsers and viewers, and effectively visualize gene expression data (Apply)

**CO5:** Apply techniques for integrating machine learning with medical data visualization, building predictive models (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I INTRODUCTION TO MEDICAL DATA VISUALIZATION 9

Introduction and Overview of medical data and its complexity – Basic principles of data visualization – Types of medical data – Tools for medical data visualization: Tableau, Python libraries like Matplotlib and Plotly

## UNIT II VISUALIZING MEDICAL IMAGING DATA 9

medical imaging modalities (e.g., MRI, CT, X-ray) – Image formats and standards (e.g., DICOM) – visualizing 2D and 3D medical images – Volume rendering, surface rendering, and other advanced techniques – Creating interactive visualizations

**UNIT IV GENOMIC DATA VISUALIZATION**

9

Basics of genomics and genetic variation - Common genomic data types (e.g., DNA sequences, gene expression data) - Genome browsers and viewers - Visualizing gene expression data (e.g., heatmaps, scatter plots)

**UNIT V ADVANCED TOPICS IN MEDICAL DATA VISUALIZATION**

9

Integration of machine learning techniques with medical data visualization - Predictive modeling and decision support systems - Building a predictive model and visualizing results - Techniques for creating interactive visualizations

**Contact Periods:**

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

**TEXT BOOKS:**

1. Gerardus Blokdyk, "Data Visualization In Healthcare A Complete Guide", 2020 Edition
2. Bernhard Preim, "Visualization In Medicine Theory Algorithms And Applications", (The Morgan Kaufmann Series in Computer Graphics) 1<sup>st</sup> edition, 2007


**REFERENCES:**

1. <https://cloud.google.com/resources/looker-data-visualization-ebook>
2. <https://rockcontent.com/blog/healthcare-data-visualization/>

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.


  
 HoD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407





U21BMP29	BRAIN COMPUTER INTERFACE AND APPLICATIONS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21BM306 – Biomedical Sensors and Instrumentation

**COURSE OBJECTIVES:**

- To outline the fundamentals of Brain Computer Interfacing (BCI)
- To familiarize with the hardware and software involved in a BCI system
- To illustrate BCI with p300 and BCILAB

**COURSE OUTCOMES:**

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

**CO1:** Describe the fundamentals of BCI (Understand)

**CO2:** Restructure a BCI system based on the hardware sequence (Apply)

**CO3:** Illustrate the software requirement for a BCI system (Apply)

**CO4:** Demonstrate the relevance and processing of P300 (Apply)

**CO5:** Experiment BCI using BCILAB (Analyze)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      BRAIN-COMPUTER INTERFACE      9**

The basic design and operation of a Brain – Computer Interface (BCI) system – Six important themes – Choosing signal types and brain areas – Recognizing and avoiding artifacts – Goal selection or process control

**UNIT II      BCI HARDWARE      9**

Sensors – Amplifiers – Analog-to-Digital Conversion – Hardware interfaces – Client hardware

**UNIT III      BCI SOFTWARE      9**

Components of BCI implementation – Design principles for R&D BCI software – Overview of general purpose BCI research software – evaluating BCI hardware and software – Latency overview

**UNIT IV P300 EVENT-RELATED POTENTIALS**

9

The P300 ERP and P300 – Based BCIs – The Oddball paradigm – P300 origin and function – P300-based BCIs – P300 Based BCI Study: The aims and limitations – Alternative electrode montages – Alternative signal processing methods

**UNIT V BCILAB**

9

Prerequisites – Defining an Approach – Steps – Scripting Online Analyses in BCILAB – Scripting Offline Analyses in BCILAB

**Contact Periods:**

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

**TEXT BOOKS:**

- Jonathan R. Wolpaw & Elizabeth Winter Wolpaw. "Brain-computer interfaces.", 1<sup>st</sup> edition, Oxford University Press, 2012
- Rajesh P. N. Rao "Brain-computer interfacing: an introduction", 1<sup>st</sup> edition, Cambridge University Press, 2013

**REFERENCES:**

- About Ella Hassanien, and Ahmad Taher Azar, "Brain-computer interfaces - Current Trends and Applications", 1<sup>st</sup> edition, Springer International Publishing Switzerland, 2015
- [https://scn.ucsd.edu/wiki/Introduction\\_To\\_Modern\\_Brain-Computer\\_Interface\\_Design](https://scn.ucsd.edu/wiki/Introduction_To_Modern_Brain-Computer_Interface_Design)

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

## VERTICAL IV – INTELLIGENT SYSTEMS FOR MEDICINE

U21BMP30	WEARABLE DEVICES	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21BM306 - Biomedical Sensors and Instrumentation

**COURSE OBJECTIVES:**

- To learn the importance of wearable device
- To know the technologies influencing the concept of wearable devices
- To explore the application of wearable devices in enhancing the quality of life

**COURSE OUTCOMES:**

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

**CO1:** Explain the requirements needed for the design of wearable devices (Understand)

**CO2:** Study cases related to contact and non-contact wearables (Apply)

**CO3:** Identify the influence of wearables in enhancing the quality of day-to-day activities (Analyze)

**CO4:** Describe wearable device for emergency support of elderly (Understand)

**CO5:** Review the existing wearable textiles and their field of application (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I INTRODUCTION**

9

Basic wearable computing requirements – Types of wearable applications – Ergonomics in wearable – Simple user interface design for wearable computing – Materials and components for constructing simple devices – Software and power requirements

**UNIT II SKIN CONTACT AND NON-CONTACT WEARABLES**

9

ECG lead construction methodologies – PPG based non-invasive methods for vital signal monitoring Movement analysis of human limb (EMG electrode based) – Brain computer interface (EEG electrode based) – Non contact wearable for sleep monitoring

**UNIT III WEARABLES FOR PERSONALIZED HEALTH CARE MONITORING**

9

Blood glucose meters – Blood Pressure – Pulse oximeters – Weight and body analysis – Pedometer Data Gloves – Wearables for blind

**UNIT IV WEARABLES FOR EMERGENCY RESPONSE SYSTEM**

9

Data description – Feature extraction techniques for implementation – Feature classification method – IoT and machine learning algorithms – Design of IoT based fall detection system for elderly



**UNIT V WEARABLE TEXTILE SYSTEMS**

9

Textile wearable integration system – Textile requirements for integrated sensors – Fiber based sensors – Fiber sensor prototypes – Production of fibers for wearables – Spatial sensing using fiber-based sensors – Fiber based sensing modalities

**Contact Periods:**

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

**TEXT BOOKS:**

1. Tong, Raymond, ed, "Wearable technology in medicine and health care" Academic Press, 2018
2. Gargiulo, Gaetano D., and Ganesh R. Naik, "Wearable/Personal Monitoring Devices Present to Future" Springer Singapore Pte. Limited, 2021


**REFERENCES:**

1. Samraj, Andrews, "Skin-Close Computing and Wearable Technology", CRC Press, 2021

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

  
 HoD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 APASUR COIMBATORE-641 407

**VERTICAL IV – INTELLIGENT SYSTEMS FOR  
MEDICINE**

U21BMP31	VIRTUAL INSTRUMENTATION AND DAQ SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21EEG01 - Basics of Electrical and Electronics Engineering

**COURSE OBJECTIVES:**

- To learn computer-based interface system
- To practice LabVIEW programming environment
- To develop applications using virtual instrumentation technique

**COURSE OUTCOMES:**

On completion of the course the students will be able to

**CO1:** Illustrate the fundamentals of Virtual Instrumentation (Understand)

**CO2:** Develop LabVIEW programming (Apply)

**CO3:** Apply the LabVIEW programming for report generation (Apply)

**CO4:** Interface data acquisition system with real-time application (Apply)

**CO5:** Elucidate the applications of virtual instrument system (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS**
**UNIT I      INTRODUCTION TO VIRTUAL INSTRUMENTATION      9**


Historical perspective – Advantages of virtual instrument – Physical quantities and analog interfaces – User Interfaces and architecture – Comparison of conventional instruments with virtual instruments

**UNIT II      LabVIEW PROGRAMMING      9**

Front panel – Block diagram, Tools, Control and Function palette – Modular programming – VI and sub VI – Structures – FOR loops – WHILE loops – Case – Sequence Structures – Event structures – Formula nodes – Local and global variables

**UNIT III      ARRAYS, CLUSTERS AND REPORT GENERATION      9**

Arrays, Clusters, String functions – File I/O – Time and Dialog control – Waveform – Graph – Chart operations – String functions – Report generation



**UNIT IV DATA ACQUISITION SYSTEM**

9

Review of Transducer and Signal conditioning – DAQ hardware – AI – AO-DI/O-DAQ assistant and configurations – Instrument control – GPIB – VISA – Instrument drivers – Serial port communication

**UNIT V APPLICATIONS OF VIRTUAL INSTRUMENTATION**

9

Networking basics for biomedical applications – Simulation of system using VI – Image acquisition and processing – Sound I/O – Motion control

**Contact Periods:**

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

**TEXT BOOKS:**

1. Sanjay Gupta, Joseph, "Virtual Instrumentation using LabVIEW", 2<sup>nd</sup> edition, Tata McGraw Hill, 2017.
2. Gary W. Johnson and Richard Jennings, "LabVIEW – Graphical Programming", 4<sup>th</sup> edition, Tata McGraw Hill, 2016.

**REFERENCES:**

1. Bruce mihure, Austin and Texas, "LabVIEW for data acquisition", 1<sup>st</sup> edition, Prentice Hall of India, New Delhi, 2001.
2. LabVIEW Basics I and II Manual, 1<sup>st</sup> edition, National Instruments, India, 2020.
3. Barry E. Paton, "Sensor, Transducers and LabVIEW", 1<sup>st</sup> edition, Prentice Hall of India, New Delhi, 2000.

**EVALUATION PATTERN:**

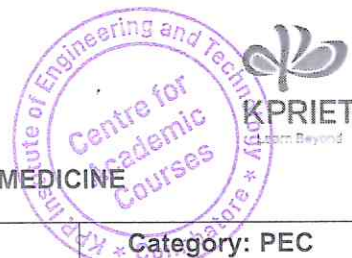
Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				200	
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.





## VERTICAL IV – INTELLIGENT SYSTEMS FOR MEDICINE



U21BMP51	CYBERSECURITY FOR HEALTHCARE DATA	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To Apply the cybersecurity in healthcare
- To Analyze threats and issues in securing medical data in Cloud
- To Evaluate methodologies to protect medical data

**COURSE OUTCOMES:**

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

**CO1:** Apply the foundational concepts of cybersecurity in Healthcare (Apply)

**CO2:** Explain the types of Ransomware attacks and prevention techniques (Understand)

**CO3:** Apply Strategies to prevent Cybersecurity attacks on cloud medicine (Apply)

**CO4:** Explain HIPAA and enforcement laws to protect medical data (Understand)

**CO5:** Apply Risk management techniques and Cyber policies for medical data safety (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS****UNIT I INTRODUCTION TO CYBERSECURITY**

9

Introduction – History of Internet – Classification of Cyber Crimes – Malware and its types – General threats – General phishing, Spear Phishing – Viruses – Ransomware – Denial of Service Attacks – Specific threats – Ethics – Tools and Strategies needed to maintain vigilance

**UNIT II RANSOMWARE IN THE HEALTHCARE INDUSTRY**

9

Introduction – Basics of Ransomware – Existing Legal framework of Ransomware Attacks – Preventing and Managing Ransomware Attack – Alternative solutions to Ransomware problems – Imposing a tax on Ransomware payments – Case Study: ransomware attacks on major healthcare providers

**UNIT IV HEALTH INSURANCE PORTABILITY AND ACCOUNTABILITY ACT****9**

HIPAA Breach of Unsecured PHI - Breach Notifications - Cyber Extortion in Healthcare - HIPAA and Breach Notification Requirements - Attorneys' General Enforcement of HIPAA - Private Plaintiffs' Indirect Enforcement of HIPAA - GDPR and their implications for healthcare data security.

**UNIT V PRIVACY AND CYBERSECURITY RISKS****9**

Risk Identification - Risk Avoidance and Mitigation – Technology and Related Practices - User Training and Restrictions - Risk Transfer - Cyber Policies - Property Policies - Fidelity and Crime Policies - Commercial General Liability Policies - Professional Liability - Social Engineering Defense Strategies

**Contact Periods:**

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

**TEXT BOOKS:**

1. Jeetendra Pande, "Introduction to Cyber Security", Uttarakhand Open University 2017.
2. W Andrew H Gantt III, "Healthcare Cybersecurity", American Bar Association, 2021.

**REFERENCES:**

1. Luis Ayala, "Cybersecurity for Hospitals and Healthcare Facilities", Apress, 2016
2. Kaspian, P. (2024). \*The Healthcare CISO's Guide to Cybersecurity Transformation
3. ChartLogic. (2024). \*Navigating Cybersecurity in Healthcare 2024: Trends & Challenges
4. UpGuard. (2024). \*The Ultimate Cybersecurity Guide for Healthcare in 2024

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.





U21BMP33	BIOMEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

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

**COURSE OUTCOMES:**

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

**CO1:** Illustrate the micro fabrication technologies (Understand)

**CO2:** Describe the engineering mechanics concepts involved in different structures (Apply)

**CO3:** Identify the suitable biosensors and micro actuators for BioMEMS applications (Understand)

**CO4:** Comprehend the fluid dynamics concepts for micro actuations (Understand)

**CO5:** Apply the knowledge in specific applications (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS****UNIT I      FABRICATION TECHNOLOGIES**

9

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

**UNIT II      ENGINEERING MECHANICS FOR MICROSYSTEMS DESIGN**

9

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

HoD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407



**UNIT III MICRO SENSORS AND MICRO ACTUATORS 9**

Biosensors – Chemical sensors – Optical sensors – Thermal sensors – Thermocouples – Thermal resistors – Piezoelectric sensors – Micro actuators – Thermal forces – Shape memory alloys – Electrostatic forces – Piezoelectric actuation – Microaccelerometer

**UNIT IV MICROFLUIDIC DEVICES AND COMPONENTS FOR BIO- MEMS 9**

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

**UNIT V SENSING TECHNOLOGIES FOR BIO-MEMS APPLICATIONS 9**

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

**Contact Periods:**

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

**TEXT BOOKS:**

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

**REFERENCES:**

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

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



## VERTICAL V – ADVANCED HEALTHCARE SYSTEMS

U21BMP34	CRITICAL CARE EQUIPMENT	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

- To familiarize with the basic operations involved in critical care unit
- To identify the equipment involved in patient monitoring system
- To explore the different medical gases and airway equipment

## COURSE OUTCOMES:

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

**CO1:** Explain the basic intravenous lines and catheters given to the patient in critical care (Understand)

**CO2:** Summarize about the working of anesthesia and breathing system (Understand)

**CO3:** Identify the various types of medical gases and airway equipment (Apply)

**CO4:** Infer the different parameters used in patient monitoring (Apply)

**CO5:** Inspect the life support and emergency resuscitation devices (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

**UNIT I      CRITICAL CARE INTRAVENOUS LINES      9**

Intravenous cannulae – Central venous catheters – Other vascular access devices monitoring – Incentive spirometry – Syringe pump – Pulmonary artery catheters – Renal replacement therapy in critical care

**UNIT II      ANESTHESIA AND BREATHING SYSTEM      9**

Anesthesia – Working, Types, Administration – Nerve stimulators – Nerve stimulator needles – Spinal needles – Epidural needles – Epidural catheters – Sub-Tenon's set – Introduction to breathing systems – Bag valve mask – Pressure valve – Reservoir bag – Breathing Tubes

**UNIT III      AIRWAY EQUIPMENT AND MEDICAL GASES      9**

Venturi mask – Sealing face masks – Magill forceps – Nasopharyngeal airways – Laryngoscopes – Medical gas cylinders – Medical vacuum and suction – Scavenging

**UNIT IV MONITORING EQUIPMENT**

9

The fuel cell – Oxygen failure alarm (Ritchie whistle) Monitoring the patient – Capnograph waveforms – Pneumotachographs – Coagulation testing: TEG and Rotem – Hygrometers

**UNIT V LIFE SUPPORT AND EMERGENCY RESUSCITATION DEVICES**

9

Cardiopulmonary Resuscitation Equipment – Automated external defibrillator (AED) machine – Oxygen therapy – Extracorporeal membrane oxygenation (ECMO) machines

**Contact Periods:**

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

**TEXT BOOKS:**

1. Daniel Aston , Angus Rivers, Asela Dharmadasa "Equipment Anaesthesia in and Critical Care", Orient blackswan, 1<sup>st</sup> edition, 2014
2. Tom Peck, Sue Hill, Mark Williams, "Pharmacology for Anaesthesia and Intensive Care", WB, Cambridge university Press, 3<sup>rd</sup> edition, 2007

**REFERENCES:**

1. Edward Scarth, Susan Smith, "Drugs in Anaesthesia and Intensive Care", Oxford University Press, 5<sup>th</sup> edition, 2016

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



## VERTICAL V – ADVANCED HEALTHCARE SYSTEMS

U21BMP35	HUMAN ASSIST DEVICES	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To understand the working of available assist devices in emergency and critical care
- To obtain the knowledge on the principles of sensory assist devices
- To explore the difference between prosthesis and orthoses

**COURSE OUTCOMES:**

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

- CO1:** Examine the working of each part of the emergency assist device and their specific application (Understand)
- CO2:** Analyze the design of types of artificial kidney available in the field and summarize the characteristics (Understand)
- CO3:** Identify the important factors to be considered for the design of sensory assist devices (Understand)
- CO4:** Explore the use of orthoses for critical conditions and understand the need for patient specific design (Understand)
- CO5:** Study the mechanics of mobility devices and relate the same to the human body (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I EMERGENCY ASSIST DEVICES**

9

Percutaneous mechanical circulatory support – Ventricular Assist Devices (VAD) – Biventricular Assist Devices (BAD) – Cardiac Extracorporeal membrane oxygenation (ECMO) – Heart Lung Machine (HLM)

**UNIT II HEMODIALYZERS**

9

Artificial kidney – Dialysis action – Hemodialyzer unit – Membrane dialysis – Portable dialyzer monitoring and functional parameters

**UNIT III SENSORY ASSIST DEVICES**

9

Hearing aids and types – Bone Anchored Hearing AIDS (BAHA), signal processing and design considerations – Cochlear implant devices – Cornea and retinal implants procedure – Prosthetic eye

**UNIT IV ORTHOSES OF SPINE AND LIMB**

9

Orthoses for spinal deformities, trauma and post operative care – Principle and components of upper limb orthoses – Foot and knee orthoses – Limb joint arthroplasty

**UNIT V ASSIST DEVICES FOR MOBILITY**

9

Cranes, crutches and walkers – Wheeled Mobility – Seating, positioning, device prescription, remote settings for wheelchair – Adaptation for sports – Neuromuscular electrical stimulation applications – Exoskeletal assist device for mobility

**Contact Periods:**

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

**TEXT BOOKS:**

1. Webster, Joseph, and Douglas Murphy., "Atlas of Orthoses and Assistive Devices E-Book", Elsevier Health Sciences, 5<sup>th</sup> edition, 2019
2. Valchanov, Kamen, Nicola Jones, and Charles W. Hogue, eds. "Core Topics in Cardiothoracic Critical Care", Cambridge University Press, 2018

**REFERENCES:**

1. Borle, Sean. "Artificial Eyes by B. Sheen" The Deakin Review of Children's Literature , 1<sup>st</sup> edition, 2018
2. Khandpur R S, "Handbook of biomedical instrumentation", McGraw-Hill Education, 3<sup>rd</sup> revised edition, 2014

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



U21BMP36	COMMUNICATION NETWORK SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To understand the basic concepts of analog and digital communication
- To use multi user radio communication and its standards
- To apply cellular, satellite and bluetooth techniques in various applications

**COURSE OUTCOMES:**

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

**CO1:** Discuss the basics of analog modulation techniques (Understand)

**CO2:** Identify digital communication techniques methods and efficiency (Understand)

**CO3:** Demonstrate application of wireless communication and standards (Understand)

**CO4:** Illustrate the mechanism for cellular systems access (Apply)

**CO5:** Use satellite and Bluetooth technology in applications (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I ANALOG COMMUNICATION 9**

Introduction to communication – Amplitude modulation – Frequency modulation – Frequency spectrum – Bandwidth – Percentage modulation – modulation index – Power calculation

**UNIT II DIGITAL COMMUNICATION 9**

Amplitude shift Keying – Frequency shift keying – Phase shift keying – Quadrature phase shift keying – Quadrature amplitude modulation – Transmitter – Advantages and disadvantages – Comparison of various systems – Bit rate and bandwidth

**UNIT III MULTI USER RADIO COMMUNICATION 9**

Introduction to Analog, Digital and wireless Cellular communication – Advanced mobile telephonesystems – Standard 95 (IS 95) – Global system for mobile communication – services – architecture – radio sub systems – specifications



**UNIT IV CELLULAR SYSTEMS AND ACCESS SYSTEMS**

9

Cellular concepts – Frequency reuse – Channel allocation – Hands off mechanism – Frequency division multiple access – Time division multiple access – Code division multiple access – Comparison

**UNIT V SATELLITE AND BLUETOOTH**

9

Satellite communication – Earth station – Satellite channel – Frequency band – Satellite Channel – Multiple access – Digital broadcast satellite – Bluetooth – Networking – Specification – Error correction – Applications

**Contact Periods:**

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

**TEXT BOOKS:**

- Wayne Tomasi, "Advanced Electronic Communication Systems", Pearson Education, 6<sup>th</sup> edition 2015
- P. Ramakrishna Rao, "Communication Systems", McGraw Hill Education, 1<sup>st</sup> edition, July 2017

**REFERENCES:**

- A. Bruce Carlson, Paul Crilly, Janet Rutledge, "Communication Systems", McGraw Hill Education, 4<sup>th</sup> edition, 2001
- R. P. Singh, S. Sapre, "Communication Systems: Analog and Digital", McGraw Hill Education, 3<sup>rd</sup> Edition, 2017

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.



U21BMP37	ROBOTICS IN MEDICINE	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- Nil

**COURSE OBJECTIVES:**

- To impart basic understanding of robotics
- To explore kinematic motion planning for various robotic configurations
- To comprehend on the application of robotics in the field of healthcare

**COURSE OUTCOMES:**

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

**CO1:** Infer with the basics of robotic systems (Understand)

**CO2:** Elucidate the kinematics, motion planning and control involved in design of robotic systems (Understand)

**CO3:** Outline the concepts of robotics for surgery (Understand)

**CO4:** Analyze the technical aspects of robotic technology in image guided interventions (Analyze)

**CO5:** Illustrate the role of robotics in assistive technology (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      INTRODUCTION**

9

Automation and Robots – Classification – Specification – Notations – Direct kinematics – Dot and cross products – Coordinate frames – Rotations – Homogeneous coordinates – Link coordinates – Arm equation – Four-axis robot

**UNIT II      KINEMATICS**

9

Inverse Kinematics – General properties of solutions tool configuration – Four axis – Workspace analysis – Trajectory planning work envelope – Examples – Workspace fixtures – Pick and place operations – Continuous path motion – Interpolated motion and straight-line motion

**UNIT III      ROBOTICS IN SURGERY**

9

Minimally invasive surgery and robotic integration – Surgical robotic sub systems – Synergistic control – Control modes – Orthopedic surgery – Cardiac surgery – Neurosurgery

**UNIT IV IMAGE GUIDED INTERVENTIONS**

9

Robot compatibility with medical imagers – Image segmentation and modelling – Tracking devices – Frames and Transformations – Surgical navigation

**UNIT V ROBOTS IN PATIENT CARE**

9

Rehabilitation for Limbs – Assistive robots – Types of assistive robots – Biologically inspired robots – Application in Rehabilitation – Interactive therapy – Bionic Arm

**Contact Periods:**

Lecture: 45 Periods      Tutorial: – Periods      Practical: – Periods      Project: – Periods

Total: 45 Periods

**TEXT BOOKS:**

1. Robert Schilling, "Fundamentals of Robotics - Analysis and Control", Prentice Hall, 1<sup>st</sup> edition, 2003
2. J.J.Craig, "Introduction to Robotics", Pearson Education, 3<sup>rd</sup> edition, 2005

**REFERENCES:**

1. Paula Gomes, "Medical robotics minimally invasive surgery", Woodhead, 1<sup>st</sup> edition, 2012
2. Jocelyne Troccaz, "Medical Robotics", Wiley-ISTE, 1<sup>st</sup> edition, 2012
3. Matthew, Mauro M.D, "Image-Guided Interventions", Saunders, 2<sup>nd</sup> edition, 2013
4. Fu K.S, Gonzales R, Lee C.S.G, "Robotics", McGraw Hill, 1<sup>st</sup> edition, 2008

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course



HOd - BIOMEDICAL ENGINEERING  
KPR INSTITUTE OF ENGINEERING  
AND TECHNOLOGY  
ARASUR COIMBATORE-641 407



## VERTICAL V – ADVANCED HEALTHCARE SYSTEMS

U21BMP38	NUCLEAR MEDICINE	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21PH202 - Medical Physics
- U21BM301 - Human Anatomy and Physiology

**COURSE OBJECTIVES:**

- To make the students get familiarized with use of radioisotopes in the field of therapy
- To explore the usage of SPECT and PET concepts in therapy
- To make the students understand concept of organ specific therapy

**COURSE OUTCOMES:**

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

- CO1:** Summarize the fundamentals of radioactivity (Understand)
- CO2:** Examine the potential of radiopharmaceuticals used in SPECT (Understand)
- CO3:** Examine the potential of radiopharmaceuticals used in PET (Understand)
- CO4:** Identify the need of organ specific therapy and their potential application to cancer and other disorder treatment (Apply)
- CO5:** Analyze various cases related to organ specific therapy and conclude about the pros and cons of the treatment (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I FUNDAMENTALS OF RADIOACTIVITY 9**

Radioisotopes–Therapeutic radiopharmaceuticals – Radioactive Decay – Natural and Artificial source of radiation – Interaction of charged and neutral particle with matter – Radiation detectors – ICRP

**UNIT II SINGLE PHOTON EMISSION RADIOPHARMCEUTICALS 9**

General localization mechanism for SPECT pharmaceuticals – <sup>99m</sup>Tc labeled radiopharmaceuticals – Indium 111 labeled radiopharmaceuticals – Radio iodinated imaging agents – Lung ventilation radiopharmaceuticals

**UNIT III POSITRON EMISSION RADIOPHARMCEUTICALS 9**

Radiolabeling strategies – F, C, Ga labelled radiopharmaceuticals –Tissue hypoxia imaging agents – Amyloid imaging agents – Neo angiogenesis imaging agents – Apoptosis imaging agents

**UNIT IV RADIONUCLIDE THERAPY FOR ORGAN SPECIFIC APPLICATIONS - I 9**

Musculoskeletal disease – Hemato-oncology – Thyroid disorders – non-thyroidal endocrinological disorders

**UNIT V RADIONUCLIDE THERAPY FOR ORGAN SPECIFIC APPLICATIONS - II 9**

Neuro endocrine tumors – Tumors of liver and Biliary tract – Pediatrics – Molecular guidance for planning external guidance radiation therapy

**Contact Periods:**

Lecture: 45 Periods    Tutorial: – Periods    Practical: – Periods    Project: – Periods

Total: 45 Periods

**TEXT BOOKS:**

1. Volterrani, Duccio, et al., eds. "Nuclear Medicine Textbook: Methodology and Clinical Applications" New York, NY, USA: Springer, 1<sup>st</sup> edition, 2019
2. Youxin Mao, "Biomedical Imaging", In-tech India, 1<sup>st</sup> edition, 2010

**REFERENCES:**

1. Saha, Gopal B. "Physics and radiobiology of nuclear medicine", Springer Science & Business Media, 1<sup>st</sup> edition, 2012

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.

## VERTICAL V – ADVANCED HEALTHCARE SYSTEMS

U21BMP39	EMBEDDED SYSTEMS FOR BIOMEDICAL APPLICATIONS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- Nil

## COURSE OBJECTIVES:

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

## COURSE OUTCOMES:

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

**CO1:** Explain the fundamentals of an embedded system (Understand)

**CO2:** Infer the custom-single purpose processors (Understand)

**CO3:** Identify the general-purpose processors (Apply)

**CO4:** Analyze the communication interfaces (Analyze)

**CO5:** Apply the architecture of embedded kernel and software for Medical Application and the RTOS (Apply)

## CO-PO MAPPING:

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

## SYLLABUS:

## UNIT I INTRODUCTION TO EMBEDDED SYSTEM

9

Embedded System Overview – Design challenge – Processor technology – General purpose Processor, Single Purpose Processor, Application Specific Processor -IC technology – Full-Custom VLSI, Semi-custom VLSI – Design technology

## UNIT II CUSTOM SINGLE PURPOSE PROCESSOR

9

Single purpose processors – RT level combinational logic – Sequential logic – RT level – Custom single purpose processor design – RT level and optimization techniques – Optimizing the Original program – Optimizing FSM – Optimizing FSM – Optimizing the FSM

## UNIT III GENERAL PURPOSE PROCESSORS

9

Basic architecture – Operation – Pipelining – Programmer's view – Development environment – Application Specific Instruction set Processors (ASIPs) – Micro controllers and digital signal processors – Case Study: General purpose processors in Medical Devices



**UNIT IV COMMUNICATION INTERFACES**

9

Communication basics – Serial Communication – USB – IEEE 1394 - Parallel Communication – PCI Bus – Arm Bus – Wireless Communication – IrDA - IEEE 802.11 – Bluetooth – Case study: Patient monitoring systems

**UNIT V REAL TIME OPERATING SYSTEMS**

9

Architecture of the kernel – Tasks and task scheduler – Interrupt Service Routines – Semaphores – Mutexes – Mailboxes – Message queues – Event registers – Pipes – Signals – Timers – Priority inversion problem – Embedded operating systems – Types of Embedded OS – Application in Medical Imaging systems

**Contact Periods:**

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

**TEXT BOOKS:**

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


**REFERENCES:**

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

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total					
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.


  
 HOD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407

## VERTICAL V – ADVANCED HEALTHCARE SYSTEMS

U21BMP40	VLSI FOR MEDICAL DEVICES	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

## PRE-REQUISITES:

- U21BM203 – Devices and Integrated Circuits
- U21ECG01 - Digital Electronics

## COURSE OBJECTIVES:

- To gain knowledge on MOS Transistors and Inverters
- To explore the construction of different MOS Logic Circuits
- To explain the design principles and application of VLSI circuits for medical devices

## COURSE OUTCOMES:

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

**CO1:** Infer the basics of fabrication of various MOS Transistors (Understand)

**CO2:** Understand the operation and characteristics of MOS Inverters (Understand)

**CO3:** Outline the function of various MOS Logic Circuits (Understand)

**CO4:** Identify the design principles and methodologies of VLSI circuits (Apply)

**CO5:** Make use of VLSI circuits for modelling of medical devices (Apply)

## CO-PO MAPPING:

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

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

## SYLLABUS:

## UNIT I INTRODUCTION TO MOS TECHNOLOGIES

9

Basics of MOS Transistors: Enhancement mode and Depletion mode, I-V characteristics, C-V Characteristics – Fabrication Process: nMOS, CMOS and BiCMOS – E-beam Mask

## UNIT II MOS INVERTERS

9

Ideal Inverter – nMOS Inverter – Resistive load Inverter – Inverters with n-type MOSFET load – CMOS inverter – Static and Switching Characteristics

## UNIT III OVERVIEW OF LOGIC CIRCUITS

9

Combinational MOS logic circuits – Sequential MOS logic circuits – Dynamic logic circuits – Low-power CMOS logic circuits – BiCMOS logic circuits

**UNIT IV VLSI DESIGN METHODOLOGIES**

VLSI Design Flow – Design Hierarchy – Design styles: Filed Programmable Gate Array (FPGA), Gate Array (GA), Standard Cell Based Design – Design Quality

**UNIT V APPLICATIONS OF VLSI CIRCUITS**

VLSI in Ultrasonic Imaging – VLSI in Electrocardiography – VLSI in Holter Monitoring – Safety and Reliability Considerations for VLSI in Medical Electronics

**Contact Periods:**

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

**TEXT BOOKS:**

1. Sung Mo Kang, Yusuf Leblebici and Chulwoo Kim, "CMOS Digital Integrated Circuits – Analysis and Design", 4<sup>th</sup> Edition, Mc Graw Hill India, 2016
2. Douglas A. Pucknell and Kamran Eshraghian, "Basic VLSI Design", Prentice-Hall Inc., 3<sup>rd</sup> Edition, 1995

**REFERENCES:**

1. Neil H.E. Weste and David Money Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson Education India, 4<sup>th</sup> Edition, 2011
2. Norman G. Einspruch and Robert D. Gold, "VLSI in Medicine", Academic Pres, Inc., 2011
3. Krzysztof Iniewski, "VLSI Circuits for Biomedical Application", Artech House, Inc., 2008
4. Sudeb Dasgupta, "CMOS Digital VLSI Design", <https://nptel.ac.in/courses/108107129>

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I  (100 Marks)		Assessment II  (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Roll Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.







U21BMP41	OPHTHALMOLOGY SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

U21BM301 – Human Anatomy and Physiology

**COURSE OBJECTIVES:**

- To enhance the understanding of physiology and the equipment associated with ophthalmology
- To enrich students with the knowledge of common eye diseases
- To kindle the knowledge of community activities for ophthalmology

**COURSE OUTCOMES:**

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

**CO1:** Explain the physiology and pathology of vision (Understand)**CO2:** Identify the suitable equipment for ophthalmic diagnosis (Apply)**CO3:** Relate physics of refraction to ophthalmic lenses and its uses (Understand)**CO4:** Interpret Common eye diseases (Understand)**CO5:** Infer the effects of community activities for Ophthalmology (Understand)**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      BASIC MEDICAL SCIENCE OF OPHTHALMOLOGY****9**

Physiology of eyeball – Physiology of vision including colour vision – Ocular movements and binocular vision – Accommodation and convergence – Microbiology – Introduction to the various organisms responsible for ocular diseases (bacteria, virus and fungi) – Infections and its prevention

**UNIT II      OPHTHALMIC EQUIPMENTS AND TECHNIQUES****9**

Vision testing – Various components of vision, principles of testing for visual acuity – Ophthalmic diagnosis equipment – Trial set, slit lamp, focimeter – Synoptophore, keraoscopy and ophthalmoscope – LASIK for eye surgery

**UNIT III      OPTICS AND REFRACTION****9**

Physics and optics – Law of refraction and reflection spherical and cylindrical surfaces – Optical aberrations of ophthalmic glasses – Ophthalmic lenses – Contact lenses– uses and abuses – Checking of spectacles – Retinoscopy and subjective testing

**UNIT IV COMMON OCCULAR DISEASES**

9

Common eye diseases – Types of conjunctivitis including trachoma – Corneal ulcers and opacities – Iritis and cataract – Glaucoma – Recognition and diagnosis – Squint – Assessment of binocular vision. – Systemic disorders – diabetes and hypertension.

**UNIT V COMMUNITY OPHTHALMOLOGY**

9

Health education – National plan for control of blindness – Screening of school children for eye problems – Rehabilitation of blind and vocational training for blind – Role of ophthalmic assistants in eye camps.

**Contact Periods:**

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

**TEXT BOOKS:**

1. Dr. Rajib Mandal, "A Comprehensive Textbook for Diploma in Ophthalmic Technology Professionals", Astitva Prakashan publisher, 1<sup>st</sup> edition, 2024
2. Sanjeev Kumar Mittal and Rajkumar Agarwal, "Textbook of Ophthalmology", Thieme Medical Publishers, 1<sup>st</sup> edition, 2021

**REFERENCES:**

1. Gallow L R, "Common Eye Diseases and Their Management", 4<sup>th</sup> edition, Springer London Ltd, 2016
2. Praveen Vashist, Noopur Gupta, Suraj Singh Senjam, Vivek Gupta, "Textbook of Community Ophthalmology", 2<sup>nd</sup> edition, McGraw Hill Publisher, 2003

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				200	100
				40	60
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.

U21BMP42	PULMONOLOGY SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

U21BM301 – Human Anatomy and Physiology

**COURSE OBJECTIVES:**

- To familiarize with the basics of implants and their design principles
- To identify the design parameters of implants
- To explore the different implantable blood interfacing devices and organs

**COURSE OUTCOMES:**

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

CO1: Examine the processes, mechanism and physiology in respiratory system (Apply)

CO2: Analyze the lung volumes and capacities using spirometry (Analyze)

CO3: Break down the physio-pathological conditions of lungs in terms of their physiology (Analyze)

CO4: Differentiate the appropriateness of the equipment for pulmonary diagnosis and treatment (Analyze)

CO5: Identify the clinical applications of various pulmonary devices and equipment (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      ANATOMY OF LUNG**

9

Introduction to Respiratory System – Gross Anatomy – Microscopic Anatomy of the Respiratory System – Mechanics of Breathing – Neural Control of Breathing – Blood Supply to the Lungs – Lymphatic Drainage of the Lungs – Pleura and Pleural Cavity

**UNIT II      LUNG VOLUME**

9

Lung Volumes and Capacities – Spirometry: Measurement Techniques and Interpretation, Factors Affecting Lung Volumes, Clinical Significance of Lung Volume Measurements – Flow-Volume Loops and Their Interpretation – Lung Compliance and Elasticity – Alveolar Ventilation and Dead Space – Physiological and Pathological Changes in Lung Volumes



**UNIT III PATHOPHYSIOLOGY OF LUNG DISORDERS**

Respiratory Pathophysiology – Obstructive Lung Diseases: COPD and Asthma – Restrictive Lung Diseases: Interstitial Lung Disease and Pulmonary Fibrosis, Infectious Lung Diseases: Pneumonia and Tuberculosis – Lung Cancer: Pathogenesis and Types, Occupational Lung Diseases

**UNIT IV PULMONARY FUNCTION TESTS**

Spirometry and Flow – Volume Loops, Diffusing Capacity Testing – Bronchial Provocation Testing – Exercise Testing and Cardiopulmonary Exercise Testing – Arterial Blood Gas Analysis – Fractional Exhaled Nitric Oxide Testing – Interpretation of Pulmonary Function Test Results

**UNIT V EQUIPMENT USED IN PULMONOLOGY**

Nasal Cannula, Oxygen Masks, and Venturi Masks, CPAP and BiPAP – Nebulizers and Metered-Dose Inhalers – Incentive Spirometry and Positive Expiratory Pressure Devices – Polysomnography and Home Sleep Studies – Endotracheal Tubes and Tracheostomy Tubes – Infusion Pumps

**Contact Periods:**

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

**TEXT BOOKS:**

1. Broaddus, V. Courtney, Robert J. Mason, Joel D. Ernst, Talmadge E. King, Stephen C. Lazarus, John F. (John Frederic) Murray, Jay A. Nadel, Arthur S. (Arthur Samuel) Slutsky, and Michael B. Gotway, eds. Murray & Nadel's Textbook of Respiratory Medicine. Sixth edition. Philadelphia, Pennsylvania: Saunders, an imprint of Elsevier Incorporated, 2016.
2. Albert, Richard K., Stephen G. Spiro, and James R. Jett. Clinical Respiratory Medicine. 4th ed. Saunders, 2012.

**REFERENCES:**

1. Grippi, Michael, Jack A. Elias, Jay A. Fishman, Allan I. Pack, Robert M. Senior, Robert Kotloff, and Mark A. Perrella. Fishman's Pulmonary Diseases and Disorders. 5th ed. McGraw-Hill Education, 2015.
2. Loscalzo, Joseph, Andrew P. King, Joseph A. Lieberman, and Bruce A. Molitoris. Textbook of Pulmonary and Critical Care Medicine. 2nd ed. Lippincott Williams & Wilkins, 2011.
3. Levitzky, Michael G. Pulmonary Physiology. 9th ed. McGraw-Hill Education, 2018.

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
Case Study	Written Test	Project	Written Test		
40	60	40	60	200	
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.

U21BMP43	GYNAECOLOGY AND OBSTETRIC SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

U21BM301 - Human Anatomy and Physiology

U21BM701 - Radiological Equipment

**COURSE OBJECTIVES:**

- To understand the anatomy of female reproductive system and gynaecological disorders
- To familiarize with different diagnostic techniques in gynaecology and obstetrics

**COURSE OUTCOMES:**

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

CO1: Explain the anatomy and physiology of the female reproductive system (Understand)

CO2: Summarize the various gynaecological disorders (Understand)

CO3: Describe about the process of pregnancy and childbirth (Understand)

CO4: Identify the different diagnostic techniques in gynecology and obstetrics (Apply)

CO5: Assess the advanced techniques for diagnosis and therapy (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      ANATOMY AND PHYSIOLOGY OF FEMALE REPRODUCTIVE SYSTEM      9**

Female reproductive system – Vagina – Cervix – Uterus – Ovaries – Fallopian tubes – Menstrual cycle – Hormonal regulation – Menopause

**UNIT II      GYNAECOLOGICAL DISORDERS      9**

Menstrual disorders – Amenorrhea – Dysmenorrhea – Polycystic ovary syndrome – Pelvic Inflammatory disease – Endometriosis – Cervical cancer – Ovarian cancer – Vaginal cancer

**UNIT III      PREGNANCY AND CHILDBIRTH      9**

Pregnancy – Symptoms and Signs – Fetal development – Mechanism of labor – Stages of labor – Delivery

**UNIT IV      DIAGNOSTIC TECHNIQUES IN GYNAECOLOGY AND OBSTETRICS      9**

Laboratory tests: Blood and urine tests, hormonal assays in gynaecological disorders, tumor markers in cancers – Imaging modalities: Ultrasonography, MRI, CT and PET – Diagnostic Procedures: Colposcopy, Biopsy, Fetal echocardiography



**UNIT V      ADVANCED TECHNOLOGIES**

Three-dimensional and four-dimensional ultrasound – Fetal therapy – Intrauterine therapy – Artificial Intelligence and Machine Learning in diagnosis – Point-of-care testing

**Contact Periods:**

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

**TEXT BOOKS:**

1. Andrew Thomson, Brian A. Magowan, Elizabeth A. Layden, Mayank Madhra, Philip Owen, Clinical Obstetrics and Gynaecology, Elsevier Health Sciences, 5<sup>th</sup> edition, 2022
2. Kevin Hayes, Lawrence Impey, Sabaratnam Arulkumaran, Sally Collins, Simon Jackson, Oxford Handbook of Obstetrics and Gynaecology, Oxford University Press, 3<sup>rd</sup> edition, 2013

**REFERENCES:**

1. Christoph Lees, Keith Edmonds, Tom Bourne, Dewhurst's Textbook of Obstetrics & Gynaecology, John Wiley & Sons, 9<sup>th</sup> edition, 2018
2. Lawrence Impey, Tim Child, Obstetrics and Gynaecology, John Wiley & Sons, 4<sup>th</sup> edition, 2012

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	
				100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.



HOD - BIOMEDICAL ENGINEERING  
 KPR INSTITUTE OF ENGINEERING  
 AND TECHNOLOGY  
 ARASUR COIMBATORE-641 407





U21BMP44	NEUROLOGY SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

U21BM301 – Human Anatomy and Physiology

**COURSE OBJECTIVES:**

- To familiarize with the anatomy and physiology of brain
- To identify the diagnostic aspects of neurology
- To explore the different therapeutic principles and applications of neurology

**COURSE OUTCOMES:**

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

CO1: Demonstrate the physiological events of seizures and epilepsy in human brain (Understand)

CO2: Illustrate about neuro immunology and its electrophysiological diagnosis (Understand)

CO3: Identify suitable neuro investigations in the brain (Apply)

CO4: Explain different types of cognitive neurology with its techniques (Understand)

CO5: Assess the recent advances of neurology (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I      SEIZURES AND EPILEPSY      9**

Introduction – Diagnosis by clinical judgment – Existing electro diagnosis test– EEG and video EEG in brain imaging and its applications –Technical expertise on need of the hour treatments

**UNIT II      NEURO IMMUNOLOGY      9**

Introduction – Diseases under neuro immunology, Electrophysiological diagnosis, and technical expertise on need of the hour treatments for disabled, , PNS conditions such as GBS, CIDP, Myasthenia gravis, polymyositis

**UNIT III      NEURO INVESTIGATIONS      9**

CT, MRI, PET, Functional MRI EEG. Evoked potentials electrophysiology – Neurosonology and its applications

**UNIT IV      COGNITIVE NEUROLOGY      9**

Simple tests to detect cognitive decline lobar function tests – Recent trends in cognitive rehabilitation – Basics of primary and secondary neuropsychiatric conditions such as anxiety, depression, schizophrenia, acute psychosis

**UNIT V RECENT ADVANCES IN NEUROLOGY**

Gene therapy, stem cell therapy DBS MRI GUSG for parkinsonism technology in rehabilitation – Man machine interface, robotics – Transcranial magnetic/ electrical stimulation

**Contact Periods:**

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

**TEXT BOOKS:**

1. Clinical Neurology and Neuroanatomy: A Localization – Based Approach, Aaron Berkowitz, 2<sup>nd</sup> Edition 2021

**REFERENCES:**

1. Handbook of Neurological examination, Navaneet Kumar, Kindle Edition, 2021
2. Wyllies Treatment of Epilepsy Principles and Practice 7<sup>th</sup> South Asia Edition 2023
3. Understanding Parkinsonism: The Clinical Perspective, Amit Batla, Deepti Vibha, 2017
4. Focused Neurology, S.Sreenivas. Kindle Edition, 2021
5. Neurological Examination: A Structured Approach Sarma, Kindle Edition, 2021

Continuous Internal Assessments					End Semester Examinations	
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments		
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test			
40	60	40	60			
Total					40	60
					100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.





U21BMP45	ORTHOPEDIC SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

U21BM603 – Biomechanics

**COURSE OBJECTIVES:**

- To analyze methods for restoring functionality in orthopedic patients
- To evaluate the effectiveness of interventions on individual performance in orthopedic settings
- To assess and compare therapeutic exercise techniques used in rehabilitation to achieve optimal outcomes for orthopedic patients

**COURSE OUTCOMES:**

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

- CO1: Infer the biomechanics and physiological processes involved in musculoskeletal system (Understand)
- CO2: Illustrate the factors influencing bone remodeling dynamics in different physiological and pathological conditions (Understand)
- CO3: Outline the etiology and pathophysiology of different bone disorders (Understand)
- CO4: Explain the biomechanics of common orthopedic injuries and conditions (Understand)
- CO5: Apply restoration techniques in rehabilitation (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I ANATOMY AND PHYSIOLOGY OF THE MUSCULOSKELETAL SYSTEM 9**

Structure and function of bones, joints, muscles, ligaments, and tendons – Classification of bones and joints – Biomechanics of the musculoskeletal system – Cellular and tissue physiology of bone and cartilage

**UNIT II BONE REMODELING 9**

Bone cells – Osteoblasts – Osteoclasts – Osteocytes – Bone remodeling cycle – Bone cell interactions – Effect of osteoblasts on osteoclasts – Effect of osteoclasts on osteoblasts – Factors influencing bone

**UNIT III BONE DISORDERS 9**

Osteoporosis – Rickets – Osteomalacia – Paget disease – Osteogenesis imperfecta – Multiple myeloma – Bone cancer



**UNIT IV FRACTURES AND TRAUMATIC INJURIES**

Fractures: Types, Injury mechanism – Management: Casting, splinting and surgical fixation – Osteoarthritis – Rheumatoid arthritis – osteoporosis – Injuries: Sprains and strains, Tendon injuries, Ligament injuries, Rotator cuff injuries

**UNIT V ORTHOPEDIC DEVICES AND IMPLANTS**

CT guided bone mineral density – BMD Assessment – Dexa scan – Body powered prosthetics – Myoelectric controlled prosthetics – Joint Replacement Implants – Internal fixation device

**Contact Periods:**

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

**TEXT BOOKS:**

1. John P. Bilzerian, Lawrence G. Raisz, and T. John Martin, "Principles of Bone Biology", 4<sup>th</sup> Edition, Academic Press, 2022
2. S Sunder, "Textbook of Rehabilitation", 4<sup>th</sup> Edition, Jaypee Brothers Medical Publishers private limited, New Delhi, 2019

**REFERENCES:**

1. Paul Tornetta III, William Ricci, Charles M. Court-Brown, Margaret M. McQueen, Michael McKee, "Fractures in adult", 9<sup>th</sup> edition, LWW, 2019
2. Susan J Hall, "Basic Biomechanics", 7<sup>th</sup> Edition, McGraw-Hill, 2015
3. S. Brent Brotzman, MD, and Kevin E. Wilk, "Handbook of Orthopedic Rehabilitation", 2<sup>nd</sup> edition, 2007

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	60
				100	

\*Role presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.





U21BMP46	UROLOGIC AND NEPHRALGIC SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

U21BM301 – Human Anatomy and Physiology

**COURSE OBJECTIVES:**

- To familiarize with the anatomy and physiology of the urinary system's various components
- To infer the potential urological and nephrological disorders
- To identify different diagnostic and therapeutic methods to treat urological and nephrological conditions

**COURSE OUTCOMES:**

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

CO1: Explain the anatomy and physiology of various components of urinary system (Understand)

CO2: Infer the potential urological conditions (Understand)

CO3: Interpret the nephrological disorders (Understand)

CO4: Identify different diagnostic methods for urological and nephrological conditions (Apply)

CO5: Identify various therapeutic techniques for urological and nephrological disorders (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I URINARY SYSTEM**

9

Anatomy and Physiology: Kidney, Nephron, Ureter, Urinary bladder – Blood supply and innervation – Lymphatic drainage – Developmental anomalies and congenital malformations

**UNIT II UROLOGICAL DISORDERS**

9

Urinary tract infections – Renal calculi – Urinary Incontinence – Benign prostatic hyperplasia – Bladder cancer – Renal failure

**UNIT III NEPHROLOGICAL DISORDERS**

9

Chronic and acute kidney diseases – Glomerulonephritis – Polycystic kidney disease – Hydronephrosis – Diabetic nephropathy – Hypertensive nephropathy – Acute tubular necrosis

**UNIT IV DIAGNOSTIC TECHNIQUES IN UROLOGY AND NEPHROLOGY**

9

Imaging modalities in urology: X-ray, ultrasound, CT scan, MRI – Urinalysis and urine culture techniques – Biomarkers for urological diseases: PSA, creatinine

**UNIT V TREATMENT MODALITIES IN UROLOGY AND NEPHROLOGY**

Catheters – Urinary stents – Endoscopes and robotic systems – Pharmacotherapy – Minimally invasive procedures: TURP, lithotripsy

**Contact Periods:**

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

**TEXT BOOKS:**

1. John Reynard, Simon F. Brewster, Suzanne Biers, Naomi Laura Neal, "Oxford Handbook of Urology", 4<sup>th</sup> edition, Oxford University Press, 2019
2. Richard J. Johnson, Jorgen Floege, Marcello Tonelli, "Comprehensive Clinical Nephrology", 7<sup>th</sup> edition, Elsevier Inc, 2024
3. Freddie C. Hamdy, Ian Eardley, "Oxford Textbook of Urological Surgery", 1<sup>st</sup> edition, Oxford University Press, 2017

**REFERENCES:**

1. Pasquale Martino, Andrea B. Galosi (eds.), "Atlas of Ultrasonography in Urology, Andrology, and Nephrology", 1<sup>st</sup> edition, Springer International Publishing, 2017
2. Antonio Granata, Michele Bertolotto, "Imaging in Nephrology", 1<sup>st</sup> edition, Springer, 2021

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60		
Total				40	60
				100	

\*Role play/ Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.







## VERTICAL VI – MEDICAL SYSTEMS

U21BMP47	CHEMOTHERAPY TECHNIQUES	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

U21BM701 – Radiological Equipment

**COURSE OBJECTIVES:**

- To Understand the mechanisms of action of chemotherapy agents
- To Apply appropriate techniques for the safe administration of chemotherapy
- To Analyze side effects severity for improved patient care

**COURSE OUTCOMES:**

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

CO1: Explain the basic principle, working and indications of chemotherapy (Understand)

CO2: Explain Occupational Hazards and management of Hazards materials (Understand)

CO3: Examine vital signs and lab parameters to assess chemotherapy response (Apply)

CO4: Analyze patient factors affecting chemotherapy side effects severity (Analyze)

CO5: Apply symptom management for improved patient comfort in palliative care (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS:****UNIT I FUNDAMENTALS OF CHEMOTHERAPY**

9

Introduction – Working, Chemotherapy Agents and Mechanisms of Action – Safety Protocols – Chemotherapy Dosage – Indications of Chemotherapy – Types of Indications – Legal and Ethical Considerations

**UNIT II OCCUPATIONAL HAZARDS**

9

Medical devices used in Chemotherapy – Handling Medical devices in Chemotherapy – Engineer, Patient and Caregiver – Sterile Technique in Chemotherapy Preparation and Administration – Hazardous Materials Handling and Disposal –Types of hazards

**UNIT III CHEMOTHERAPY ADMINISTRATION AND PREPARATIONS**

Routes of Chemotherapy Administration – Central Venous Access Devices and Care – Drug Reconstitution and Dilution Techniques – Administration of Pre-medications and Antiemetic – Infusion Protocols – Emergency Procedures during Chemotherapy Infusion – PET Scan

9

**UNIT IV MODALITIES FOR MANAGEMENT OF SIDE EFFECTS**

Side effects of Chemotherapy – Management of Dermatological Reactions – Chemotherapy – Induced Alopecia – Management of Neutropenia and Infection – Psychological Support and Coping Strategies – Pharmacological Interventions for Neuropathy and Pain – Head and Limb Cooling Pads

9

**UNIT V PALLIATIVE CARE AND SUPPORT**

Principles and Goals of Palliative Care in Chemotherapy – Symptom Management and Relief in Palliative Chemotherapy – Communication Strategies for End-of-Life Care Discussions – Advance Care Planning and Documentation – Advocacy for Quality-of-Life Issues – Palliative Care Principles for Technicians.

**Contact Periods:**

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

**TEXT BOOKS:**

1. Muhammad T. Amjad, Anusha Chidharla, Anup Kasi. "Cancer Chemotherapy", StatPearls Publishing, 2024
2. Roland T. Skeel and Samir N. Khleif, "Handbook of Cancer chemotherapy", 8<sup>th</sup> Edition, LWW, 2012

**REFERENCES:**

1. Ann Berger, Jamie H Von Roenn, and John L. Shuster, "Principles and Practice of Palliative care and supportive oncology", 3<sup>rd</sup> Edition, LWW, 2007

**EVALUATION PATTERN:**

EVALUATION PATTERN:					End Semester Examinations
Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

\*Role play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.



U21BMP48	PEDIATRIC SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

Nil

**COURSE OBJECTIVES:**

- To understand the anatomical structures and physiological functions of the various systems in pediatrics
- To familiarize with various diagnostic and therapeutic techniques used in pediatric care
- To explore the applications of biomedical engineering in pediatric healthcare

**COURSE OUTCOMES:**

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

- CO1: Explain the anatomy and physiology of different systems in human body for pediatrics (Understand)
- CO2: Interpret the physiological changes and abnormalities associated with cardio, gastro, neuro and genetics (Understand)
- CO3: Identify the diagnostic techniques used for pediatrics (Apply)
- CO4: Make use of therapeutic devices in pediatric care (Apply)
- CO5: Apply the principles and techniques of rehabilitation in pediatric healthcare (Apply)

**CO-PO MAPPING:**

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

**SYLLABUS****UNIT I      PEDIATRIC CARE**

9

Perinatal medicine – Respiratory physiology – Cardiovascular system – Renal physiology – Epidemiology of pediatric diseases

**UNIT II      PATHOPHYSIOLOGY**

9

Cardiovascular disorders: Cyanotic heart disease, Dysrhythmias, Cardiomyopathy – Gastrointestinal and abdominal disorders: Abdominal wall defects, Short bowel syndrome, Rectal bleeding – Renal system disorder: Acute kidney injury, Cystic disease of the kidneys, Hematuria – Congenital anomalies: Malformations and deformation, Down syndrome, Congenital heart defects, Congenital ascites and Umbilical hernia



**UNIT III PEDIATRIC INTENSIVE CARE AND MONITORING**

Infusion pumps – Syringe pumps – HHHFNC, CPAP/NIV – Mechanical Ventilator monitoring – Pediatric surgical and interventional procedure

9

**UNIT IV TREATMENT MODALITIES**

Vitals monitoring – SpO<sub>2</sub> – BP – ECG – Audiometry – OAE, ABR/BERA, Hearing aids, Ophthalmoscope – red reflex, fundus examination

9

**UNIT V PEDIATRIC REHABILITATION AND ASSISTIVE TECHNOLOGIES**

Pediatric assessment tools and standardized measures – Physical therapy, Occupational therapy and Speech therapy – Orthoses and Prostheses – Mobility Aids – Communication Devices – Sensory Aids – VR & AR applications

**Contact Periods:**

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

**TEXT BOOKS:**

1. Sunil Sinha, Lawrence Miall and Luke Jardine, "Essential Neonatal Medicine", 6<sup>th</sup> edition, John Wiley & Sons, 2018
2. Sandra Lee Gardner, Brian S. Carter, Mary I Enzman-Hines and Susan Niermeyer, "Handbook of Neonatal Intensive Care", 9<sup>th</sup> edition, Elsevier, 2020

**REFERENCES:**

1. Richard A. Polin and Mervin C. Yoder, "Workbook in Practical Neonatology", 6<sup>th</sup> edition, Elsevier, 2020
2. Adam W. Lowry, Kushal Y. Bhakta and Pratip K. Nag, "Handbook of Pediatrics and Neonatology", The McGraw-Hill Companies, 2011
3. Elizabeth Sanders, "Neonatal Intensive Care: Issues, Insights and Studies", Nova Publications, 2016

**EVALUATION PATTERN:**

Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

\*Role play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course coordinator can choose any one / two components based on the nature of the course.





## KPR Institute of Engineering and Technology

Learn Beyond

(Autonomous, NAAC "A")

---

0422 2635600, +91 75488 88444

[admission@kpriet.ac.in](mailto:admission@kpriet.ac.in)

Avinashi Road, Arasur, Coimbatore - 641407

---

[kpriet.edu.in](http://kpriet.edu.in)      /KPRIETonline