Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and detailed syllabus

Third Year

in

Biomedical Engineering

(Semester V and VI)

Revision: 1 (2019)
With effect from the Academic Year: 2021-2022

Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Proposed Scheme for Third Year Undergraduate Program B.Tech in Biomedical Engineering : Semester V (Autonomous)
(Academic Year 2021-2022)

Semester V

Sr	Course Code	Course	Teaching Scheme				Semester End Examination (A)						Continuous Assessment (B)					Aggregate (A+B)	Credits earned	
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Term Work Total	CA Total (B)			
1	DJ19BMC501	Radiography Imaging	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	**4**
	DJ19BML501	Radiography Imaging Laboratory	--	2	--	1	--	--	25	--	--	25	--	--	--	25	25	50	1	
2	DJ19BMC502	Microcontrollers	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	**4**
	DJ19BML502	Microcontrollers Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	25	25	50	1	
3	DJ19BMC503	Biomaterials and Medical Implants	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	**3**
4	DJ19BMC504	Discrete Time Signal Processing	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	**4**
	DJ19BML504	Discrete Time Signal Processing Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
5@	DJ19BMEC5011	Foundations of Data Analytics	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	**4**
	DJ19BMEL5011	Foundations of Data Analytics Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
	DJ19BMEC5012	Data Networks and IoT	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	
	DJ19BMEL5012	Data Networks and IoT Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
	DJ19BMEC5013	Laser and Fibre Optics	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	
	DJ19BMEL5013	Laser and Fibre Optics Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
6	DJ19BMSBL3	Data Base Management Laboratory	--	4	--	2	2	--	--	--	25	25	--	--	--	50	50	75	2	**2**
7#	DJ19IHL2	Professional and Business Communication Laboratory	--	4	--	2	--	--	--	--	--	--	--	--	--	50	50	50	2	**2**
8	DJ19ILL1	Innovative Product Development - III	--	2	--	1	--	--	25	--	--	25	--	--	--	25	25	50	1	**1**
		Total	**15**	**18**	**--**	**24**	**19**	**375**	**50**	**--**	**50**	**475**	**125**	**125**	**125**	**225**	**350**	**825**	**24**	

@ Any 1 elective course

2 hrs. of theory (class wise) and 2 hrs of activity based laboratory (batch wise)

Prepared by Checked by **Head of the Department** **Vice Principal** **Principal**

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DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
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NAAC Accredited with "A" Grade (CGPA : 3.18)

Proposed Scheme for Third Year Undergraduate Program B.Tech in Biomedical Engineering : Semester VI (Autonomous)
(Academic Year 2021-2022)

Semester VI

Sr	Course Code	Course	Teaching Scheme				Semester End Examination (A)						Continuous Assessment (B)					Aggregate (A+B)	Credits earned	
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Term Work Total	CA Total (B)			
1	DJ19BMC601	Therapeutic and Surgical Instruments	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19BML601	Therapeutic and Surgical Instruments Laboratory	--	2	--	1	--	--	25	--	--	25	--	--	--	25	25	50	1	
2	DJ19BMC602	Biological Modelling and Simulation	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19BML602	Biological Modelling and Simulation Laboratory	--	2	--	1	--	--		--	--	--	--	--	--	25	25	25	1	
3	DJ19BMC603	Healthcare Informatics	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19BML603	Healthcare Informatics Laboratory	--	2	--	1	--	--	25	--	--	25	--	--	--	25	25	50	1	
4	DJ19BMC604	Digital Image Processing	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19BML604	Digital Image Processing Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	25	25	50	1	
5@	DJ19BMEC6011	Machine Learning	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19BMEL6011	Machine Learning Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
	DJ19BMEC6012	Rehabilitation Engineering	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	
	DJ19BMEL6012	Rehabilitation Engineering Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
	DJ19BMEC6013	Embedded Systems and RTOS	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	
	DJ19BMEL6013	Embedded Systems and RTOS Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
5	DJ19BMSBL4	GUI and Application Development Laboratory	--	4	--	2	2	--	--	--	25	25	--	--	--	50	50	75	2	2
6	DJ19ILL2	Innovative Product Development - IV	--	2	--	1	2	--	25	--	--	25	--	--	--	25	25	50	1	1
7	DJ19A5	Environmental Studies	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		Total	**16**	**16**	**--**	**23**	**21**	**375**	**50**	**--**	**75**	**500**	**125**	**125**	**125**	**200**	**325**	**825**	**23**	

@ Any 1 Elective Course

Prepared by Checked by **Head of the Department** **Vice Principal** **Principal**

Syllabus for Third Year Biomedical Engineering - Semester V (Autonomous)
(Academic Year 2021-22)

Program: Third Year Biomedical Engineering	**Semester: V**
Course: Radiography Imaging	**Course Code: DJ19BMC501**
Course: Radiography Imaging Laboratory	**Course Code: DJ19BML501**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**50**
3	**2**	**--**	**4**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				25	**--**	**--**	**15**	**10**	**25**	

Objectives:

1. To familiarize the learners with the various Imaging techniques in medicine operating principles and quality control aspects of various imaging modalities.
2. To keep the learners abreast with the technological developments in the field of Medical Imaging.

Outcomes: On completion of the course, learner will be able to:

1. Describe X ray imaging modality with the help of X ray tube construction, X ray generators and the total radiographic system.
2. Discuss the need of real time imaging and the modalities of real time imaging viz. Fluoroscopic Imaging and Digital Subtraction Angiography.
3. Describe the technique of Computed Tomography, the CT scanner configuration, reconstruction techniques and clinical applications and advancements in CT
4. Apply the knowledge of X ray physics to study its applications in Radiotherapy.

Detailed Syllabus: (unit wise)

Unit	**Description**	**Duration**
1	**X-Ray Imaging:** Fundamentals of X-ray – electromagnetic radiation, interactions between X-rays and matter, intensity of X-ray beam, attenuation, generation and detection of X-rays, X-ray generators, filters, beam restrictors and grids, intensifying screens, fluorescent screens, computed radiography and digital radiography, radiation safety, mammography	**12**
2	**Fluoroscopic Imaging:** X ray image intensifier, flat panel detectors, digital subtraction angiography	**06**

3	**Computed tomography:** Scanner configurations/generations, CT system: scanning unit(gantry), detectors, CT number ,data acquisition system, spiral CT: technology and applications, reconstruction techniques:- Radon transform, iterative, filtered back projection, Fourier reconstruction, CT artefacts, clinical applications of CT	**12**
4	**Advancements in CT:** Multi-detector computed tomography (MDCT), CT-angiography, contrast agents in CT, dual energy CT	**06**
5	**Linear Accelerators:** Production and transport of the RF wave, major components of linear accelerator, clinical applications	**06**

List of laboratory experiments: (any eight)

1. Study of X ray tube
2. Study of X ray Tube housing
3. Comparison of technical specifications of different X ray machines
4. Comparison of technical specifications of different CT Scanners
5. Generation of Sinogram of the image
6. CT windowing on an image
7. Back projection reconstruction
8. Iterative reconstruction technique
9. Generation of pseudo color image
10. Study of fluoroscopy machine
11. Hospital visit to radiology Department
12. Presentation on the relevant topic

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. Christensen's Physics of Diagnostic Radiology , Thomas S. Curry, James E. Dowdey, Robert C. Murry, Lippincott Williams & Wilkins Publications, 1990, 11th Edition
2. Medical Imaging Physics, William R. Hendee, E. Russell Ritenour, Wiley Publications, 2002, 4th edition

Reference Books:

1. Biomedical Technology and Devices, James Moore, CRC Press Books, 2013, 2nd edition
2. Biomedical Engineering Handbook , Bronzino, CRC Press Books, 4th edition
3. Physics of Diagnostic images, Dowsett, CRC Press Books, 2nd edition

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral examination will be based on the entire syllabus including the practical's performed during laboratory sessions.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks

ii. Journal documentation (Write-up and/or Power Point Presentation and/or Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year Biomedical Engineering - Semester V (Autonomous)
(Academic Year 2021-2022)

<table>
<tr><td colspan="8">Program: Third Year Biomedical Engineering</td><td colspan="3">Semester: V</td></tr>
<tr><td colspan="8">Course: Microcontrollers</td><td colspan="3">Course Code: DJ19BMC502</td></tr>
<tr><td colspan="8">Course: Microcontrollers Laboratory</td><td colspan="3">Course Code: DJ19BML502</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme
(Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="2">Lectures</td><td rowspan="2">Practical</td><td rowspan="2">Tutorial</td><td rowspan="2">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">2</td><td rowspan="2">--</td><td rowspan="2">4</td><td colspan="3">Laboratory Examination</td><td colspan="2">Term work</td><td rowspan="2">Total Term work</td><td rowspan="2">50</td></tr>
<tr><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>25</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Pre-requisite: Knowledge of

1. Digital logics and circuits-Analysis and Design

Objectives:

- To create a strong foundation of Microcontroller through 8051 architecture.
- To create a strong foundation in microcontroller-based system design and programming.

Outcomes: On completion of the course, learner will be able to:

- Explain the basics and features of 8051 Microcontroller
- Program 8051 controller
- Design and implement 8051 based systems for application development.
- Explain advanced features of Cortex M3 architecture.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Microcontroller:** Harvard & Von-Neumann architectures, microprocessors and microcontrollers, types of buses: address, data and control bus. types of memories: RAM, ROM and flash, little endian and big-endian memory systems. **8051 Microcontroller:** Features and architecture of 8051: variants and comparison. pin diagram of 8051, CPU timing: T states, instruction cycle, machine cycle and the concepts of read / write cycles. memory organization, special function registers and program status word, parallel I/O ports, integrated peripherals such as timers/counters, serial port. Interrupt structure, priorities and interrupt vector table, power saving modes.	**12**
2	**8051 programming** Assembly language programming process and programming tools, C language programming process and programming tools, addressing modes and Instruction set, programming practice using assembly language and/or embedded C language.	**08**
3	**Microcontroller design and Interfacing** Interfacing with external memories, interfacing with keyboard, 7 segment display and with LCD, interfacing with sensors and ADC, interfacing with relay, solenoid, DC motor and stepper motor, interfacing with PC using RS232 standard.	**08**
4	**Timer module:** Timer and counter modes of timer module: precise delays and waveform generation using timer mode, interrupt and non-interrupt mode of timer, counting events using counter mode. **Serial Communications and Interface Standards** Synchronous and asynchronous serial communications. serial communications using UART –interrupt and non-interrupt modes. wired communications: SPI, I2C, USB. interface standards: RS232, RS485.	**06**
5	**ARM Cortex M3** Overview of ARM family, comparison of RISC and CISC architectures. Cortex-M3 architecture, pipelining, BUS interfaces. programmers' model: register set, program status register, operation modes and states. memory system and memory protection unit (MPU). Exceptions, interrupts architecture: nested vectored interrupt controller. power management. watchdog timer and systick timer. addressing modes and instruction set overview.	**08**

List of Laboratory Experiments: (any eight)

Practical's may be performed in hardware mode and/or in software (simulation/emulation) mode.

1) Demonstrate basic I/O toggling and interrupts
2) Demonstrate zero crossing detector via interrupts and service through ISR
3) Demonstrate precise delay generation and generation of trigger pulses using timer
4) Generate waveforms and PWM using timer
5) Demonstrate event counter using timer module
6) Demonstrate interfacing with relay and DC motor (using H bridge)
7) Demonstrate speed control of DC motor through PWM
8) Interfacing with stepper motor
9) Interfacing with 7 segment display
10) Interfacing with keyboard
11) Demonstrate data logging (data logger)
12) Interfacing with PC using UART and RS232 standard

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. The 8051 Microcontroller and Embedded Systems Using Assembly and C, M. A. Mazidi, J. C. Mazidi, Rolin D. McKinlay, Pearson Education.
2. The Definitive guide to ARM CORTEX-M3 & CORTEX-M4 Processors, Joseph Yiu, Elsevier.

Reference Books:

1. The 8051 Microcontroller, Kenneth J. Ayala, Cengage Learning India Pvt. Ltd.
2. ARM Architecture: Reference Manual, David Seal, Addison Wesley.
3. ARM System Developers Guide: Designing and Optimising System Software, Andrew Sloss, Dominic Symes, Chris Wright, Publisher Elsevier Inc.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Practical and Oral examination will be based on the entire syllabus including, the practical's performed during laboratory sessions.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments and minimum 2 assignments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks
ii. Journal Documentation (Write-up, Power Point Presentation and Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Syllabus for Third Year Biomedical Engineering - Semester V (Autonomous)
(Academic Year 2021-2022)

<table>
<tr><td colspan="8">Program: Third Year Biomedical Engineering</td><td colspan="3">Semester : V</td></tr>
<tr><td colspan="8">Course: Biomaterials and Medical Implants</td><td colspan="3">Course Code: DJ19BMC503</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="5">Semester End Examination Marks (A)</td><td colspan="4">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Types of applications of biomaterials used inside the body.
2. Basic Human Anatomy studied in Secondary school.

Objectives:

1. To develop knowledge of the fundamentals of materials used for manufacturing implants that has wide application in healthcare industry.
2. To develop the fundamentals of materials used for MEMS.

Outcomes: On completion of the course, learner will be able to:

1. Describe the definition, classification and general applications of biomaterials and to illustrate the surface characterization techniques.
2. Describe properties and applications of polymeric, degradable and composite biomaterials.
3. Describe properties and applications of metals and ceramic biomaterials.
4. Select the materials on the basis of testing of the biomaterials done biologically, mechanically, physio-chemically and thermally before implantation in the human body.
5. Select the materials used for a specific MEMS application.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction**: Introduction of biomaterials, Classification of biomaterials, General applications. **Techniques for characterization of Surface properties of Biomaterials:** Electron Spectroscopy for Chemical Analysis (ESCA), Secondary Ion Mass Spectrometry (SIMS), Infrared Spectroscopy, Contact Angle Method.	**08**
2	**Polymeric and degradable Biomaterials used in fabrication of biodevices and implants:** Classification, Polyurethanes, PTFE, Polyethylene, Polypropylene, Polyacrylates, PMMA, PHEMA, Hydrogel, Silicone rubber, Biopolymers, Thermoplastics and Thermosetting plastics, Degradable biomaterials (PGA and PLA), Applications of polymers in drug delivery systems. **Composite biomaterials in fabrication of biodevices and implants:** Properties, Classification and applications of composite biomaterials, Applications of composites in drug delivery systems.	**08**
3	**Metallic biomaterials used in fabrication of bio-devices and implants and their Biocompatibility:** Stainless steel, Titanium, Titanium based alloys, Cobalt – Chromium alloys. **Ceramic biomaterials used in fabrication of biodevices and implants:** Classification, Alumina, Zirconia and types, Bioglass, Calcium Phosphate, Tricalcium Phosphate.	**08**
4	**Biological Testing of Biomaterials:** Physiochemical Tests, Mechanical Tests, In-vitro and In-vivo Tests, Different forms of corrosion, Wear, Electrochemical corrosion testing.	**07**
5	**Materials used for MEMS:** Single crystal silicon, Polysilicon, Porous Silicon, SiO_2, Piezoelectric materials, PMMA, Parylene, Polyimide, PDMS, SU8, Aluminium, Tungsten, Silicon Nitride, Silicon Carbide.	08

Books Recommended:

Text books:

1. Biomaterial Science and Engineering, J.B. Park, Springer, 2014 edition.
2. Fundaments of Biomedical Engineering, G S. Sawhney, New Age International Pvt. Ltd., 2007, First edition.
3. Biomaterials Science - An Introduction to Materials in Medicine. B.D. Ratner, A.S. Hoffmann, F. J. Schoen, J. E. Lemons, Academic Press, 1997 edition.
4. MEMS and MICROSYSTEMS Design and Manufacture, Tai-Ran Hsu, McGraw-Hill Education, 2017, First edition.
5. Fundamentals of Microfabrication, Marc J. Madou , CRC Press, 1997, First edition.

Reference Books:

1. Encyclopedia of Medical Devices and Instrumentation, Vol. I, II, III, IV, John G. Webster, Marcel Dekkar Publishers, 2006, second edition.
2. Encyclopedia – Handbook of Biomaterials and Bioengineering
   Part-A: Materials Vol I, II, Donald L. Wise, Marcel Dekkar Inc. Publishers,1995.
   Part – B: Applications, Vol. I, II, Donald L. Wise, Marcel Dekkar Inc. Publishers,1995
3. Design engineering of biomaterials for medical devices, David Hill, John Willey Publications, 1998, First edition.
4. Biological Performance of Materials: Fundamentals of Biocompatibility, Jonathan Black, CRC Press, 2005, Fourth edition.
5. MEMS Design and Fabrication, Edited By Mohamed Gad-el-Hak, Taylor and Francis Group, CRC Press, 2019, First edition.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year Biomedical Engineering - Semester V(Autonomous)
(Academic Year 2021-2022)

Program: Third Year Biomedical Engineering	**Semester: V**
Course: Discrete Time Signal Processing	**Course Code: DJ19BMC504**
Course: Discrete Time Signal Processing Laboratory	**Course Code: DJ19BML504**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**25**
3	**2**	**--**	**4**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	**--**	**--**	**15**	**10**	**25**	

Pre-requisite: Knowledge of

1. Basics of Mathematics
2. Classification of signals &systems, operations on Signals, Fourier Transform

Objectives:

1. To build a strong base for developing algorithms for signal processing systems.
2. To develop competency in terms of logical thinking, programming and application skills.
3. To train and motivate students for pursuing higher education and research for developing cutting edge technologies.

Outcomes: On completion of the course, learner will be able to:

1. Analyze DT signals & Systems
2. Analyze LTI systems using Z-transform.
3. Demonstrate use of DFT in analyzing LTI systems.
4. Determine DFT coefficients using FFT algorithms to minimize hardware complexity.
5. Design and analyze FIR and IIR filters for the given Specifications.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Signals & Systems**: Discrete time signals & systems, classification of signals and systems, operations on signals.	**07**
2	**Z Transform & IZT:** Z Transform (ZT), properties of ZT, Inverse ZT, application of ZT and IZT.	**08**
3	**Introduction to DFT:** DFT**,** properties of DFT. overlap and add & overlap and save methods, DIT and DIF FFT algorithms.	**07**
4	**IIR Filter:** IIR Filter design methods- bilinear transformation, impulse invariance.	**10**
5	**FIR Filter:** Linear phase FIR filters. FIR filter design using window technique.	**10**

List of Laboratory Experiments: (any five)

(Using medical signals)

1. Simulations of standard signals
2. Operations on signals
3. Linear convolution
4. Circular convolution
5. Sampling theorem
6. Z-Transform
7. Impulse response
8. Discrete Fourier Transform (DFT)
9. DIT FFT
10. DIF FFT
11. Design and simulation of FIR filter
12. IIR filters using Butterworth approximation

List of Tutorials: (any six)

(Using medical signals)

1. Operations on signals
2. Classification of system
3. ZT
4. IZT
5. Application of ZT IZT
6. DFT
7. Convolution
8. Overlap and add, overlap and save methods of convolution
9. FFT
10. FIR filter design
11. IIR filter design

Any other experiment/tutorial based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. Digital Signal Processing Principles Algorithms and Application,Proakis &Manolakis , PHI ,Third edition
2. Digital Signal Processing, Sanjit K. Mithra, Tata Mc-graw Hill
3. Digital Signal Processing. Salivahanan, C.Gnanapriya, Tata McGraw Hill

Reference Books:

1. Digital signal processing, A.V. Oppenheim and R.W.Schafer,PHI
2. Understanding Digital Signal Processing,Richard G. Lyons, Pearson Publication

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 5 experiments, 6 Tutorials

Term work shall carry total 25 marks based on the performance in the experiments/tutorials

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Second Year Biomedical Engineering - Semester V (Autonomous)
(Academic Year 2021-2022)

Program: Third Year Biomedical Engineering	**Semester: V**
Course: Foundations of Data Analytics	**Course Code:DJ19BMEC5011**
Course: Foundations of Data Analytics Laboratory	**Course Code:DJ19BMEL5011**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**25**
3	**2**	**--**	**4**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	**--**	**--**	**15**	**10**	**25**	

Pre-requisite: Probability, Statistics, Python programming

Objectives:

1. To illustrate importance of data and its significance in predictions
2. To familiarize learner with the techniques used for data analysis

Outcomes: On completion of the course, learner will be able to:

1. Classify data, understand its attributes and visualize it
2. Execute preprocessing techniques on data
3. Apply hypothesis test on the data
4. Apply analysis of variance on the data
5. Implement data mining techniques

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1.	**Data** Data objects and attributes: nominal, binary, ordinal, numeric, discrete, continuous; Characteristics of data sets: dimensionality, sparsity, resolution Types of data sets: record data, data matrix, graph-based data, sequential data, sequence data, time series data, spatial data Measuring data similarity and dissimilarity: dissimilarity matrix, proximity measures for nominal, binary and ordinal attributes, dissimilarity of numeric data, dissimilarity of attributes of mixed types, cosine similarity Data visualization: stem and leaf plot, histogram, box plot, pie chart, percentile plot,	**06**

	empirical cumulative distribution function, scatter plot, contour plot, surface plots, vector field plots, lower dimensional slices, visualizing higher dimensional data using matrices, parallel coordinates, star coordinates and Chernoff faces	
2.	**Data Preprocessing** Data Quality: measurement error, data collection error, noise, artifacts, precision, bias, accuracy, outliers, missing values, inconsistent values, duplicate values Data Cleaning: handling missing values and noisy data Data Integration: entity identification, redundancy and correlation analysis, tuple duplication Data Reduction: wavelet transform, principle component analysis, attribute subset selection, parametric data reduction, histogram, clustering, sampling, data cube aggregation Data Transformation: smoothing, attribute construction, aggregation, normalization; Data Discretization: binning, histogram analysis, cluster, decision tree, correlation analysis Data Augmentation: SMOTE, Border line SMOTE, ADASYN Outlier detection: types of outliers, challenges, statistical method, proximity-based method, clustering-based method	**12**
3.	**Hypothesis Testing for data driven decision making** Test of significance, null and alternative hypothesis, type I and type II error, factors affecting type II error, probability of type II error, power of test, p Value, critical region, level of significance, confidence interval value Tests using Z-statistics: difference between sample proportion and population proportion, difference between two sample proportion, difference between sample mean and population mean with known σ and unknown σ, difference between two sample means, one tailed and two tailed tests Test using t-statistics: difference between sample mean and population mean, difference between two independent sample means, difference between means from the same group Test using F-statistics: equality of population variance Test using chi-square statistics: test of independence, goodness of fit	**08**
4.	**Analysis of Variance (ANOVA) for data analysis** Sample size calculation, One Way ANOVA, Two Way ANOVA, POST-HOC Analysis (Tukey's Test), Randomized Block Design	**06**
5	**Data Mining** Need, types of data mining: clustering, classification and association mining Association Mining: market basket analysis, frequent itemsets, closed item sets, association rules, Apriori algorithm, improving efficiency of Apriori, mining using pattern growth approach, pattern evaluation methods, mining multilevel Association and multidimensional Association	**10**

List of Laboratory Experiments: (any eight)

1. Perform basic operations on relational database using SQL
2. Implement visualizing technique for data with small number of attributes
3. Implement visualizing technique for spatial data
4. Implement visualizing technique for data with many attributes
5. Perform data cleaning on given dataset
6. Perform data augmentation on given dataset
7. Implement PCA on given dataset
8. Implement factor analysis on given dataset
9. Implement LDA on given dataset
10. Implement data discretization on given dataset
11. Perform goodness of fitand test of independence using chi-square test
12. Perform hypothesis testing using t test
13. Perform hypothesis testing using Z test
14. Implement one-way and two-way ANOVA
15. Implement Apriori algorithm for mining frequent itemset
16. Implement FP Tree algorithm for mining frequent itemset

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text Books:

1. Data Mining Concepts and Techniques, Jiawei Han, MichalineKamber, JianPei, Morgan Kaufmann, 2014, third edition.
2. Introduction to Data Mining, Pang N. Tan, MichaelSteinbach, VipinKumar, Pearson Education, 2009, fourth edition.
3. Fundamentals of mathematical statistics, S. C. Gupta, V. K. Kapoor, Sultan Chand, 2002, tenth edition

Reference Books:

1. Data Mining Introductory and Advanced Topics, Margaret H. Dunham, Pearson Education, 2002
2. Testing Statistical Hypotheses, E. L. Lehmann, Joseph P. Romano, Springer, 2008, third edition.

Syllabus for Second Year Biomedical Engineering - Semester V (Autonomous)
(Academic Year 2021-2022)

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks
ii. Journal documentation (Write-up and/or Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year Biomedical Engineering - Semester VI (Autonomous)
(Academic Year 2021-22)

Program: Third Year Biomedical Engineering	**Semester: VI**
Course: Data Networks and IoT	**Course Code: DJ19BMEC5012**
Course: Data Networks and IoT Laboratory	**Course Code: DJ19BMEL5012**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**25**
3	**--**	**--**	**4**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				-	-	-	**15**	**10**	**25**	

Pre-requisite: Knowledge of

1. Microcontrollers
2. Analog and Digital communications

Objectives: To

1. Understand network topologies and network devices
2. Understand layered architecture of data network and functions of each layer.
3. Understand OSI, TCP/IP and IoT stack.
4. Understand IoT stack, IoT access technologies and application protocols

Outcomes: On completion of the course, learner will be able to:

1. Explain network topologies and devices
2. Explain different layers of TCP/IP protocol suite and their functions
3. Explain the concept of IoT and IoT system architecture.
4. Explain IoT access technologies and application protocols
5. Explain difference in FOG, EDGE and Cloud computing
6. Analyze connectivity in IoT

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to data networks:** Data rate, Throughput and Bandwidth. Modes of communication: Simplex, half and full duplex. Types of network: PAN, LAN, MAN, WAN. Network model: need of layered protocol architecture, OSI model and TCP/IP model, Comparison of OSI and TCP/IP. Computer network topologies: mesh, star, bus and ring Interconnecting devices: hub, bridges, switches, router, gateway. Addressing: Physical / Logical /Port addressing.	**06**
2	**Physical Layer:** Transmission media, transmission impairments. Multiplexing: FDM, TDM, WDM, CDM. Switched communication networks: circuit switching networks, packet switching networks, virtual circuit switching and datagram switching. Access Technologies: IEEE 802.3 (Ethernet), IEEE 802.11 (Wi-Fi). **Data Link layer:** Functions: framing, addressing, synchronization, error control, flow control, multi-access. **Network Layer:** Functions, network addressing and network routing, network layer protocols: IPv4, IPv6. Comparison of IPv4 and IPv6. **Transport Layer: f**unctions, protocols: TCP and UDP. **Application Layer: f**eatures and functions, application layer protocols: HTTP, HTTPS, FTP, DNS, SMTP, SSH.	14
3	**Introduction to IoT:** Things/objects in IoT, Block diagram of an IoT device (node), Characteristics of IoT, Functional blocks of IoT, Communication models. IoT Levels and Deployment Templates. IoT enabling technologies. Cloud and different forms of cloud services.	**06**
4	**IOT stack, Network and Communication Aspects:** M2M stack and examples, IoT stack and examples, IoT stack variants, Difference between IoT and M2M. Edge computing, FOG computing and Cloud computing. **IoT Access Technologies**: Physical and MAC layers, IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11 and LoRaWAN. **Network Layer Protocols**: IPv4 and IPv6, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks. **Application Layer Protocols**: CoAP and MQTT.	**10**
5	**Components of IoT:** IoT platform design methodology. IoT end device computing –Boards based on Microcontroller and SoC. sensor technology, sensor data communication protocols: UART, SPI, I2C. **IOT Case Studies:** Home Automation, Smart Cities, Environment, Agriculture, Retail sector, Healthcare and lifestyle, Logistics.	**06**

List of Laboratory Experiments: [at least 8]

Practical's may be performed in hardware mode and/or in software (simulation/emulation) mode.

1. To implement basic lan network/s and their interconnections using cisco packet tracer / NS2.
2. To implement wired and wireless lan networks and their interconnections using cisco packet tracer / NS2.
3. To demonstrate I/O operations, interrupts, ADC and other onboard features using any one hardware platform (Arduino/Raspberry Pi/BeagleBone).
4. To demonstrate interfacing various sensors and storing data on-board [and on-board processing of data] using any one hardware platform (Arduino/Raspberry Pi/BeagleBone).
5. To demonstrate interfacing various sensors and communicating data using Internet using any one hardware platform (Arduino/Raspberry Pi/BeagleBone).
6. To demonstrate CoAP protocol (client – server model) with SOC platform as server.
7. To demonstrate CoAP protocol (client – server model) with SOC platform as client.
8. To demonstrate MQTT broker (publish - subscribe model) with SOC platform as broker.
9. To demonstrate MQTT broker (publish - subscribe model) with SOC platform as publisher.
10. To demonstrate the use of cloud storage.

Books Recommended:

Text books:

1. Data and Computer communications, william stallings, Pearson Education.
2. Data communication and networking, Behrouz A. Forouzan, McGraw Hill Education.
3. Communication Networks, Alberto Leon Garcia, McGraw Hill Education.
4. Internet of Things: A Hands-On Approach, Arshdeep Bahga, Vijay Madisetti, universities press.

Reference Books:

1. Computer Networks, S. Tanenbaum, Pearson Education.
2. Computer Networking: A Top-Down Approach, J. F. Kurose and K. W. Ross, Addison Wesley.
3. IOT fundamentals, David, Gonzalo, Patrick, Cisco press.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral examination will be based on the entire syllabus including, the practical's performed during laboratory sessions.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks

ii. Journal Documentation (Write-up, Power Point Presentation and Assignments: 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year Biomedical Engineering - Semester V (Autonomous)
(Academic Year 2021-22)

Program: Third Year Biomedical Engineering	**Semester: V**
Course: Laser and Fibre Optics	**Course Code: DJ19BMEC5013**
Course: Laser and Fibre Optics Laboratory	**Course Code: DJ19BMEL5013**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**25**
3	**2**	**--**	**4**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	**--**	**--**	**15**	**10**	**25**	

Pre-requisite: Knowledge of

1. Basic physics

Objectives:

1. To understand the fundamentals in Laser and Fiber Optics.
2. To understand the applications of Laser and Fiber optics in health sector.

Outcomes: On completion of the course, learner will be able to:

1. Describe the fundamentals and clinical applications of Laser and Fiber Optics.
2. Correlate the knowledge of medicine and engineering for the wellness of human being
3. Explain the safety aspects while dealing with Laser and Fiber Optic Units.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1.	**Laser Fundamentals:** Fundamental wave properties and quantum properties of light, energy levels and radiative properties, absorption and stimulated emission, laser amplifiers, laser oscillation above threshold, requirements for obtaining population inversion, laser pumping requirements and techniques, laser resonators, cavity modes, laser interaction with tissue- effects and principles, thermal interaction between laser and tissue.	**10**
2.	**Laser types, construction and working:** Laser system involving low density gain medium: He-Ne laser, Argon ion laser, He-Cadmium laser, Carbon dioxide laser, Excimer laser, Nitrogen laser**, l**aser system involving high density gain medium: solid state laser like Ruby laser, Nd-YAG laser, Titanium Sapphire laser, fiber lasers, semiconductor diode laser	**10**

3.	**Laser safety:** Practical laser safety requirements, environmental safety, equipment safety, personnel protection, education/training for handling laser equipment, role of laser safety officer, standards of practice for the use of laser in medicine and surgery, hospital laser committee	**06**
4.	**Optic fibers fundamentals:** Light transmission in optical fibers- principles, optical properties of optical fibers, fiber materials, types of optical fibers, modes, losses, fabrication of optical fibers, methods and principle, fiber splicing, fiber optic imaging, biomedical optical fibers	**10**
5.	**Laser and fiber optics in surgery:** Introduction, fiber optic laser systems in cardiovascular disease, gastroenterology, gynecology, neurosurgery, oncology, ophthalmology, orthopedics, otolaryngology (ENT), urology, and flow diagram for laser angioplasty, Laser and Fiber optics used in skin	**06**

List of Laboratory Experiments:

1. Demonstrations in hospital / Industry.
2. Discussion on research articles and recent developments in the field of medicine.
3. Group ppresentations on the latest technology in hospitals based on the topics covered in the syllabus.
4. 7 Assignments based on the entire syllabus.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. 1. Lasers and Optical Fibers in Medicine, AbrahimCatzir, Academic press, 1998
2. Optical Fiber Communication, Gerd Keiser, McGraw-Hill Education, 2015, 5th edition
3. Laser Fundamentals,William T.Silfvast, Cambridge University Press, 2012, 2nd edition

Reference Books:

1. Therapeutic Lasers, G David Baxter, Churchill Living stone publications, 1994
2. Medical Laser and their safe use, David H Shiny Stiffen and L Trokel Springer Publications, 1993
3. Element of Fiber optics, S. L. Wymer Regents PHI, 1993
4. Lasers in Urologic Surgery, Joseph A.Smith,Jr, Barry S.Stein, Ralph C.BensonJr, Mosby Pub, 1993

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks

ii. Journal documentation (Write-up and/or Power Point Presentation and/or Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year Biomedical Engineering - Semester V (Autonomous)
(Academic Year 2021-2022)

<table>
<tr><td colspan="8">Program: Third Year Biomedical Engineering</td><td colspan="2">Semester: V</td></tr>
<tr><td colspan="8">Course: Data Base Management Laboratory</td><td colspan="2">Course Code: DJ19BMSBL3</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="6">Evaluation Scheme</td></tr>
<tr><td colspan="3">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3">--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="2">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">75</td></tr>
<tr><td rowspan="2">--</td><td rowspan="2">4</td><td rowspan="2">--</td><td rowspan="2">2</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>25</td><td>30</td><td>20</td><td>50</td></tr>
</table>

Pre-requisite: Knowledge of

Knowledge of basic computer programming

Objectives:

1. To familiarize the client and server-basedweb scripting and dynamic web application development
2. To design, organize, maintain and retrieve information efficiently and effectively from a database.

Outcomes: On completion of the course, learner will be able to:

1. Illustrate the fundamentals of a database systems
2. Design and query database using SQL.
3. Design the database Joins commands
4. Develop web application using variousenvironmenttools
5. Implement projects using frontend and backend tools

Following points will be explained and discussed during practical session and practical's will be conducted as per the practical list	
Module	
1	**Introduction Database Concepts:** Introduction, Characteristics of databases, File system V/s Database system, Users of a Database system Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence.
2	**Entity– Relationship Data Model:** Conceptual Modeling of a database, The Entity-Relationship (ER) Model, Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Weak Entity Types Generalization, Specialization and Aggregation.
3	**Relational Model and Relational Algebra:** Introduction to Relational Model, Relational Model Constraints and Relational Database Schemas, Concept of Keys: Primary Kay, Secondary key, Foreign Key, Mapping the ER and EER Model to the Relational Model, Introduction to Relational Algebra, Relational Algebraexpressions for Unary Relational Operations, Set Theory operations, Binary Relational operation Relational Algebra Queries.
4	**Structured Query Language (SQL):** Overview of SQL, Data Definition Commands, Set operations , aggregate function , null values, Data Manipulation commands, Data Control commands , Views in SQL, Complex Retrieval Queries using Group By, Recursive Queries.

List of Laboratory Experiments: (total of 8 experiments from list below that may include mini project)

1. Draw an ERdiagramfor a problemstatement.
2. ImplementBasicSQLcommands.
3. Access&modifyData usingSQL.
4. ImplementJoinsandViews.
5. Implement Subqueries.
6. Implement IntegrityConstraints.
7. Implement triggers.
8. Implementprocedures,functionsandcursors.
9. SimulateARIESrecoveryalgorithm.

Any other experiment based on Database may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. Database System Concepts , Korth, Slberchatz,Sudarshan, , 6th Edition, McGraw – Hill
2. Fundamentals of Database Systems, Elmasri and Navathe, 6th Edition, PEARSON Education.
3. Database Management Systems, G. K. Gupta, Tata McGraw-Hill Education, 2011
4. HTML5 Black Book, Kogent Learning Solutions Inc, Wiley India Pvt. Limited, 2011
5. Responsive Web Design with HTML5 and CSS3, Ben Frain, 2nd Edition, Packt Publishing, 2017
6. React Up Running Building Web Applications , Stoyan Stefanov, O'Reilly Media Inc., 2021

Reference Books:

1. Database Management Systems, Raghu Ramkrishnan and Johannes Gehrke, TMH
2. Database System Implementation , Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom,Pearson Ltd. 1/ e
3. Database Systems : A Practical Approach to Design, Implementation and Management, Thomas M. Connolly Carolyn Begg, 4/e, Pearson Education
4. WebTechnologies: BlackBook, DT EditorialServices,1st Edition,DreamtechPress,2018.

Evaluation Scheme:

Semester End Examination (A):

Oral& Practical examination of 2 Hrs. examination will be based on any experiment performed during the laboratory sessions.

Continuous Assessment (B):

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks

ii. Journal Documentation (Write-up, Power Point Presentation and Assignments: 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year Biomedical Engineering - Semester V (Autonomous)
(Academic Year 2021-22)

<table>
<tr><td colspan="8">Program: Third Year Biomedical Engineering</td><td colspan="4">Semester: V</td></tr>
<tr><td colspan="8">Course: Professional and Business Communication Laboratory</td><td colspan="4">Course Code: DJ19IHL2</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="4">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="3">Total Term work</td><td rowspan="3">50</td></tr>
<tr><td rowspan="2">--</td><td rowspan="2">4</td><td rowspan="2">--</td><td rowspan="2">2</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>30</td><td>20</td><td>50</td></tr>
</table>

Objectives:

1. To inculcate professional and ethical attitude at the workplace
2. To enhance communication and interpersonal skills
3. To develop effective presentation skills
4. To hone written skills for technical documentation

Outcomes: On completion of the course, learner will be able to:

1. Plan, organize and write technical documents like reports, proposals and research papers in the prescribed format using appropriate language and style with an understanding of ethics in written communication
2. Apply techniques of writing resume, participating in a group discussion and facing interviews
3. Develop interpersonal skills in professional and personal situations
4. Understand the documentation process of meetings and conduct meetings in a professional manner
5. Understand communication across cultures and work ethics
6. Design and deliver effective presentations using Power Point

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Technical Writing:** **Report Writing:** Types of report, parts of formal report, collection of data and survey analysis, pre-writing of report, language and style in reports, formatting of reports, referencing in report **Proposal Writing: Types** of technical proposals, format of proposal, language and style, presentation of proposal **Technical Paper Writing:** Parts of a technical paper, language and formatting, referencing in IEEE format **Plagiarism:** Types of plagiarism, consequences of plagiarism	**08**
2	**Employment Skills:** **Group Discussion:** Purpose of a GD, types of GD, criteria for evaluating a GD, Dos and Don'ts of a GD, Tips to be successful in GD **Cover Letter & Resume Writing:** Format and content of cover letter, types of resume, structure, content and formatting of resume **Interview Skills:** Types and modes of interview, Preparation for interview, Dos and Don'ts of interview, frequently asked questions during interview	**06**
3	**Introduction to Interpersonal Skills:** **Emotional Intelligence:** Definition, difference between IQ and EQ, how to develop EQ **Leadership:** Types of leadership, leadership styles, case studies **Team Building:** Difference between group and team, importance of team work, strategies to be a good team player **Time Management:** Importance of time management, cultural views of time, 80/20 rule, time wasters, setting priorities and goals **Conflict Management:** Types of conflicts, strategies to manage conflict, case studies	**05**
4	**Meetings and Documentation:** Planning and preparation for meetings, strategies for conducting effective meetings, notice, agenda and minutes of a meeting, business meeting etiquettes.	**02**
5	**Cross-cultural communication and Ethics:** Communication across cultures, professional and work ethics, responsible use of social media, introduction to Intellectual Property Rights. **Presentation Skills:** Presentation strategies, overcoming stage fear, techniques to prepare effective PowerPoint presentation .	**05**

List of Assignments

1. Business Proposal (PowerPoint presentation)
2. Resume writing
3. Interpersonal Skills (documentation of activity)
4. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
5. Business ethics
6. Presentation Skills

Books Recommended:

Reference Books

1. Fred Luthans, *"Organizational Behavior",* McGraw Hill, edition
2. Lesiker and Petit, *"Report Writing for Business",* McGraw Hill, edition
3. Huckin and Olsen, *"Technical Writing and Professional Communication",* McGraw Hill
4. Wallace and Masters, *"Personal Development for Life and Work",* Thomson Learning, 12th edition
5. Heta Murphy, *"Effective Business Communication",* Mc Graw Hill, edition
6. Sharma R.C. and Krishna Mohan, *"Business Correspondence and Report Writing",* Tata McGraw-Hill Education
7. Ghosh, B. N., *"Managing Soft Skills for Personality Development",* Tata McGraw Hill. Lehman,
8. Bell, Smith, "Management Communication" Wiley India Edition, 3rd edition.
9. Dr. Alex, K.," Soft Skills", S Chand and Company
10. Subramaniam, R., "Professional Ethics" Oxford University Press.

Evaluation Scheme:

Laboratory: (Term work)

1. Term work shall consist of 6 assignments, Group Discussion and Power Point Presentation based on the written report
2. The distribution of marks for term work shall be as follows:

Assignments …… (15) Marks
Project Report and Presentation…… (05) Marks
Group Discussion……. (05) Marks
TOTAL: ……... (25) Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year Biomedical Engineering - Semester V (Autonomous)
(Academic Year 2021-2022)

Program: Third Year Biomedical Engineering										**Semester: V**
Course: Innovative Product Development III										**Course Code: DJ19ILL1**
Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				-			-	-	-	-
				Laboratory Examination			**Term work**		**Total Term work**	**50**
-	**2**	--	**1**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				25	--	--	**15**	**10**	**25**	

Objectives:

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found out to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value-added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualize and create a successful product.

Outcome:

Learner will be able to:

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualizing a product, especially while working in a team.
3. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
4. Draw proper inferences through theoretical/ experimental/simulations and analyze the impact of the proposed method of design and development of the product.
5. Develop interpersonal skills, while working as a member of the team or as the leader.
6. Demonstrate capabilities of self-learning as part of the team, leading to life-long learning, which could eventually prepare themselves to be successful entrepreneurs.
7. Demonstrate product/project management principles during the design and development work and also excel in written (Technical paper preparation) as well as oral communication.

Guidelines for the proposed product design and development:

1. Students shall form a team of 3 to 4 students (max allowed: 5-6 in extraordinary cases, subject to the approval of the department review committee and the Head of the department).
2. Students should carry out a survey and identify the need, which shall be converted into conceptualization of a product, in consultation with the faculty supervisor/head of department/internal committee of faculty members.
3. Students in the team shall understand the effective need for product development and accordingly select the best possible design in consultation with the faculty supervisor.
4. Students shall convert the best design solution into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
5. Faculty supervisor may provide inputs to students during the entire span of the activity, spread over 2 semesters, wherein the main focus shall be on self-learning.
6. A record in the form of an activity log-book is to be prepared by each team, wherein the team can record weekly progress of work. The guide/supervisor should verify the recorded notes/comments and approve the same on a weekly basis.
7. The design solution is to be validated with proper justification and the report is to be compiled in a standard format and submitted to the department. Efforts are to be made by the students to try and publish a technical paper, either in the institute journal, "Techno Focus: Journal for Budding Engineers" or at a suitable publication, approved by the department research committee/ Head of the department.
8. The focus should be on self-learning, capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the year long course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over 4semesters,i.e. during the semesters III to VI.

Guidelines for Assessment of the work:

1. The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.
2. In the continuous assessment, focus shall also be on each individual student's contribution to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.
3. Distribution of marks individually for the both reviews as well as for the first review during the subsequent semester shall be as given below:
    A. Marks awarded by the supervisor based on log-book :20
    B. Marks awarded by review committee : 20
    C. Quality of the write-up : 10

Review/progress monitoring committee may consider the following points during the assessment.

In the semester V, the entire design proposal shall be ready, including components/system selection as well as the cost analysis. Two reviews will be conducted based on the presentation given by the student's team.

- First shall be for finalization of the product selected.
- Second shall be on finalization of the proposed design of the product.

The overall work done by the team shall be assessed based on the following criteria;

1. Quality of survey/ need identification of the product.
2. Clarity of Problem definition (design and development) based on need.
3. Innovativeness in the proposed design.
4. Feasibility of the proposed design and selection of the best solution.
5. Cost effectiveness of the product.
6. Societal impact of the product.
7. Functioning of the working model as per stated requirements.
8. Effective use of standard engineering norms.
9. Contribution of each individual as a member or the team leader.
10. Clarity on the write-up and the technical paper prepared.

The semester V reviews may be based on relevant points listed above, as applicable.

Guidelines for Assessment of Semester Reviews:

- The write-up should be prepared as per the guidelines given by the department.
- The design and the development of the product shall be assessed through a presentation and demonstration of the working model by the student team to a panel of Internal and External Examiners, preferably from industry or any research organizations having an experience of more than five years, approved by the Head of the Institution. The presence of the external examiner is desirable only for the 2nd presentation in semester VI. Students are compulsorily required to present the outline of the technical paper prepared by them during the final review in semester VI.

Proposed Syllabus for Third Year B.Tech in Biomedical Engineering - Semester VI (Autonomous)
(Academic Year 2021-2022)

Program: Biomedical Engineering	**Semester: VI**
Course: Therapeutic and Surgical Instruments	**Course Code: DJ19BMC601**
Course: Therapeutic and Surgical Instruments Laboratory	**Course Code: DJ19BML601**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**50**
3	**2**	**--**	**5**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				25	**--**	**--**	**15**	**10**	**25**	

Pre-requisite: Knowledge of

1. Basic Human Anatomy and Physiology.

Objectives:

1. To understand the basic principles and working of therapeutic instruments used for treatment and life support.
2. To understand the basic principles and working of surgical and instruments used in hospitals

Outcomes: On completion of the course, learner will be able to:

1. Distinguish and select the suitable mode of pacemaker and analyze the pacemaker circuit.
2. Apply the knowledge of electronics to analyze defibrillator circuits.
3. Explain the importance and application of Anesthesia machine, oximeter and Heart Lung Machine during Surgery.
4. Explain the basic principle, working and applications of surgical equipment with safety aspects.
5. Explain the application technique and analyze the circuit of therapy equipment.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Therapeutic Instruments:** Basic principle, working and technical specifications 1. Shortwave diathermy 2. Ultrasonic therapy unit 3. Microwave therapy unit 4. Nerve and Muscle Stimulator. 5. Hemodialysis machine with various types of dialyzers	**10**

2	**Cardiac Pacemakers:** Cardiac arrhythmia, need for a pacemaker, modes of operation, classification codes for pacemaker, external and implantable pacemaker, programmable pacemaker, power sources for pacemakers, leads and electrodes, recent developments of implantable pacemakers. **Biotelemetry and Telemedicine applications in healthcare:** Single channel and multi-channel telemetry system Telemedicine, its essential parameters, delivery modes and its applications.	**08**
3	**Cardiac Defibrillator:** Need for defibrillator, D. C. defibrillator, modes of operation and electrodes, performance aspects, implantable defibrillator, cardioverter.	**07**
4	**Surgical Operation Theatre Instruments:** **Operation Theatre Lights:** Basic principle of operation and types of Operation Theatre Lights **Operation Table:** Basic principle of operation and types of Operation Tables **Surgical Diathermy:** Basic principle of operation, modes of operation and the waveforms, electrodes and safety aspects in electronic surgical units.	**08**
5	**Surgery Supportive Instruments:** **Anesthesia Machine:** Need of anesthesia, gas supply, flow and delivery system vapor delivery and humidification and patient breathing capnography. **Oximeter:** Basic principle of oximetry, ear oximeter, fingertip oximeter and skin reflectance oximeter. **Heart Lung Machine:** Need of heart lung machine, its working principle and types of oxygenators.	**09**

List of laboratory experiments: (any eight)

1. Demonstration of shortwave diathermy machine
2. Demonstration of ultrasonic therapy unit
3. Demonstration of nerve and muscle stimulator
4. Implementation and testing of basic circuit of pacemaker.
5. Implementation of NAND gate oscillator in surgical diathermy.
6. Implementation of RLC over damped system.
7. Demonstration of D. C. Defibrillator.
8. Demonstration of surgical diathermy.
9. Demonstration of oximeter.
10. Study of operation table
11. Study of operation theatre lights
12. Design and Implementation of temperature controller circuit for hemodialysis machine
13. Industry / Hospital visits may be conducted.

Group presentation on the latest technology in hospitals based on the topics covered in the syllabus.
Any other experiment based on syllabus which will help learner to understand topic/concept.
Note: Experiments (including hospital visit) and presentation will be considered as practicals.

Books Recommended:

Text books:

1. Handbook of Biomedical Instrumentation, R S. Khandpur, 3rd edition, PH publications
2. Medical Instrumentation, Application and Design, J G. Webster, John Wiley publications
3. Biomedical Instrumentation and Measurements, L. Cromwell, F. J. Weibell, E A. Pfeiffer, PHI publications

Reference books:

1. Introduction to Biomedical Equipment Technology, Carr –Brown, PH publications
2. Encyclopedia of Medical Devices and Instrumentation, J. G. Webster. Vol I- IV, PH publications
3. Various instruments manuals.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks
ii. Journal Documentation (Write-up, Power Point Presentation and Assignments: 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year B.Tech in Biomedical Engineering - Semester VI (Autonomous)
(Academic Year 2021-2022)

Program: Third Year B.Tech in Biomedical Engineering	**Semester: VI**
Course: Biological Modelling and Simulation	**Course Code: DJ19BMC602**
Course: Biological Modelling and Simulation Laboratory	**Course Code: DJ19BML602**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**			
3	**2**	**--**	**4**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**	**Total Term work**	**25**
				--	**--**	**--**	**15**	**10**	**25**	

Pre-requisite: Knowledge of

1. Basic Human Anatomy studied in Secondary school.

Objectives:

1. To provide in-depth knowledge of modelling of physiological systems.
2. To understand basic concepts of modelling for designing biological model.

Outcomes: On completion of the course, learner will be able to:

1. Explain the concepts, usage and process of physiological modelling
2. Apply basic biophysical laws for calculation of membrane potential under different equilibrium conditions and develop simulation programs for understanding neuronal functions
3. Explain the function of complex closed loop systems like temperature control and neuromuscular system using modelling.
4. Explain the function of open loop system like eye movement system and differentiate open loop and closed loop system
5. Explain the usage of, and the assumptions behind biological models (immune response, drug delivery and insulin glucose feedback) in the working life.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1.	**Physiological Modelling:** Steps in modelling, purpose of modelling, lumped parameter models, distributed parameter models, compartmental modelling, modelling of circulatory system and respiratory system.	**07**
2.	**Model of Neurons:** Biophysics tools, equilibrium in a one ion system, Donnan equilibrium, space-charge neutrality, membrane with no-zero permeability, GHK equation, active transport (pump), action potential, electrical equivalent model of a biological membrane, the H-H model, the iron-wire model, channel characteristics, simulation of action potential, voltage propagation in a passive axon (cable equation).	**10**
3.	**Thermoregulatory systems:** Thermoregulatory mechanisms, model of thermoregulatory system, controller model, validation and application **Neuromuscular System:** Modelling of skeletal muscle, mono and polysynaptic reflexes, stretch reflex, reciprocal innervations, two control mechanism, golgi tendon, experimental validation, Parkinson's syndrome.	**07**
4.	**Eye Movement Model:** Eye movements, quantitative eye movement models, techniques for validating models, validation of other physiological systems	**12**
5.	**Modelling of other physiological systems:** Modelling of immune system, its behavior, linearized model of the immune response. Modelling of drug delivery systems and modelling of Insulin-Glucose feedback system and pulsatile insulin secretion.	**06**

List of Laboratory Experiments: (any eight)

1. Simulations thermometer system using MATLAB
2. Simulation of Nernst/Goldman Equation using MATLAB
3. Simulation of eye movement using MATLAB
4. Simulation using HHSim (Two practicals)
5. Simulation using Neurons in Action (Two practicals)
6. Developing a model of a neuron using NEURON
7. Electrical simulation of thermoregulatory model.

Any other experiment based on syllabus which will help learner to understand topic/concept.

Books Recommended:

Text books:

1. Bioengineering, Biomedical, Medical and Clinical Engg., A.T. Bahil.
2. Signals and systems in Biomedical Engg. S. R Devasahayam.
3. Bio-Electricity A quantitative approach by Barr and Ploncey

Reference books:

1. Biomedical Engineering Handbook by Bronzino (CRC Press)

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments, 1 Power Point Presentation and minimum 2 assignments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks
ii. Journal Documentation (Write-up, Power Point Presentation and Assignments: 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year Biomedical Engineering - Semester VI (Autonomous)
(Academic Year 2020-2021)

Program: Third Year Biomedical Engineering	**Semester: VI**
Course: Healthcare Informatics	**Course Code: DJ19BMC603**
Course: Healthcare Informatics Laboratory	**Course Code: DJ19BML603**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**50**
4	**2**	**--**	**5**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				25	**--**	**--**	**15**	**10**	**25**	

Pre-requisite: Knowledge of

1. Basic knowledge of various Departments of hospital.
2. Basic functioning of Hospital

Objectives:

1. To understand the healthcare interoperability semantic and syntactic.
2. To understand the standards of healthcare interoperability standards for Medical Images and Medical Messages

Outcomes: On completion of the course, learner will be able to:

1. Illustrate Healthcare interoperability standards
2. Fabricate HL7 Messages
3. Illustrate the semantic interoperability through DICOM
4. Edit and Compare DICOM file.
5. Illustrate various healthcare information system in hospital.

Module	Contents	Hours
1.	**Healthcare Interoperability:** Standards In Healthcare System, Categorizing Standards, Standard Development, Various Healthcare Informatics Standards, Need for a Lingua Franca, Electronic Health Records, Interoperability Modelling Basics	**04**
2.	**HL7 Version 2:** Message Syntax, Delimiters, Segment Definition, Message Header MSH, Patient Identification Details (PID) , Patent Visit (PV1), Request and Specimen Details (OBR) , Result Details (OBX), Z-Segments, Data, Simple Data Types, Complex Data Types, Codes and Identifiers, Names and Addresses, Other Complex Data Types.	**08**
3.	**DICOM standard:** Introduction, DICOM Grammar: VRs, DICOM Data Dictionary, DICOM Objects, DICOM Information Hierarchy, Modules, IODs and IEs.	**10**
4.	**DICOM Communications:** DICOM SOPs, Unit Identification on n/w, Services and Data, DIMSE Example: C-Echo, Storage, Query: Find, C-Find IOD, C-Find DIMSE, C-Cancel, Modality Worklist, Basic DICOM Retrieval: C-Get, Advanced DICOM Retrieval: C-Move, DICOM: Ping, Push and Pull. **DICOM Associations:** Association Establishment, Transfer Syntax, Application Context. **DICOM Media: Files, Folders, and DICOMDIRs:** DICOM File Format, DICOM File Services, Storing DICOM Data in PACS.	**12**
5.	**Information Systems in Medicine:** PACS Components, Generic workflow, PACS architectures. Introduction to RIS and HIS, HIS/RIS/PACS integration. IHE Workflow Model, IHE Domains.	**08**

List of Laboratory Experiments / Assignments / Tutorials: (any eight)

1. HL7 Chapter selection for each case
2. Reading ADT Message
3. Create ADT Message for clinical case
4. XML encoding of HL7 Message.
5. Editing DICOM File using hex-Editor
6. Communication between Storage SCU (PACS) and Image Server
7. RIS and HIS Communication
8. Viewing DICOM File group and Element wise using DICOM viewer
9. Comparing DICOM files using DICOM viewer

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text Books:

1. Principles of Health Interoperability HL7 and SNOMED (Health Information Technology Standards), Springer Publication by Tim Benson
2. Digital Imaging and Communication in Medicine by Oleg S. Pianykh, Springer Publication
3. CDA™ Book, By Keith Boone, Springer Publication

Reference Books:

1. Informatics in Medical Imaging, George C. Kagadis, Steve G. Langer CRC Press

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semesterout of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 7 experiments

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks
ii. Journal Documentation (Write-up, and Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year Biomedical Engineering - Semester VI (Autonomous)
(Academic Year 2021-2022)

Program: Third Year Biomedical Engineering	**Semester: VI**
Course: Digital Image Processing	**Course Code: DJ19BMC604**
Course: Digital Image Processing Laboratory	**Course Code: DJ19BML604**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**50**
3	**2**	**--**	**4**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	**--**	**25**	**15**	**10**	**25**	

Pre-requisite: Knowledge of

1. Basics of Mathematics
2. Signal Processing basics & different transforms

Objectives:

1. To introduce the learners the basic theory of digital image processing.
2. To understand the basic image enhancement,segmentation, compression, morphology, representation, description techniques & algorithms.
3. To develop hands-on experience in using computers to process images.
4. To familiarize with MATLAB / Labview / similar software for processing digital images

Outcomes: On completion of the course, learner will be able to:

1. Acquire the fundamental concepts of a digital image processing system such as image acquisition, enhancement, segmentation, transforms, compression, morphology, representation and description.
2. Analyze images in the spatial domain.
3. Analyze images in the frequency domain through the Fourier transform.
4. Implement image segmentation, morphology & compression.
5. Design and implement with MATLAB/C/LabVIEW/Python algorithms for digital image processing operations

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Basics of Image Processing & Image Enhancement**: **Spatial domain** - Image acquisition, Sampling, Quantization, Image Types, and Image formats. Point processing techniques, Neighborhood processing.	**11**
2	**Histogram Modelling & Image Enhancement: Frequency domain:** Histogram processing,2D-DFT, Properties of 2D-DFT, Low pass, High pass, Homomorphic filters	**6**
3	**Image Segmentation**: Basic relationships between pixels -Neighbors, Connectivity, Detection of discontinuities- Point, Line, Edge detection, Region-based segmentation.	**9**
4	**Image Compression**: Lossless compression - RLE, LZW Huffman, Arithmetic coding techniques. Lossy compression - IGS coding, Predictive coding, Transform coding	**8**
5	**Morphology, Representation and Description**: Dilation, Erosion, Opening, Closing, Hit-or-miss, Boundary extraction, Region filling, Thinning and thickening; Chain Codes	**8**

List of Laboratory Experiments: (any eight)
(Using Medical Images)

1. Point Processing – Digital Negative
2. Point Processing – Thresholding
3. Point Processing – Contrast Stretching
4. Point Processing – Grey level slicing
5. Point Processing – Power law transformation
6. Spatial domain Filtering-LPF(Averaging & Median)
7. Spatial domain Filtering-HPF & HBF
8. Histogram Processing (Histogram Stretching and Histogram Equalization).
9. Frequency Domain Filtering (Plotting 2D-DFT)
10. Frequency Domain Filtering (Low pass -Ideal, Butterworth and Gaussian Filters).
11. Frequency Domain Filtering (High Pass- Ideal, Butterworth and Gaussian Filters).
12. Segmentation-Gradient operators.(Sobel & Prewitt operators)
13. Morphology-Dilation Erosion.
14. Morphology-Opening Closing
15. Image Compression

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text Books:

1. Digital Image Processing, Gonzalez and Woods, Pearson Education.
2. Fundamentals of Digital Image Processing, A.K. Jain ,P.H.I.
3. Digital Image Processing and Analysis, Chanda Majumder,Prentice Hall India.

Reference Books:

1. Digital Image Processing and Computer Vision, Sonka, Hlavac, Boyle-Cengage learning.
2. Digital Image Processing, William Pratt- John Wiley.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Practical & Oral examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

1. Term work shall consist of minimum 8 experiments.
2. Term work shall carry total 25 marks based on the performance in the experiments

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year Biomedical Engineering - Semester VI (Autonomous)
(Academic Year 2021-2022)

<table>
<tr><td colspan="8">Program: Third Year Biomedical Engineering</td><td colspan="3">Semester: VI</td></tr>
<tr><td colspan="8">Course: Machine Learning</td><td colspan="3">Course Code: DJ19BMEC6011</td></tr>
<tr><td colspan="8">Course: Machine Learning Laboratory</td><td colspan="3">Course Code: DJ19BMEL6011</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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</table>

Pre-requisite:

Linear algebra, probability, statistics, data preprocessing, data mining, python programming

Course Objectives:

1. To introduce need and basic concept of machine learning
2. To implement techniques of machine learning in healthcare

Outcomes: Students will be able to

1. Illustrate concept, need and applications of machine learning
2. Implement regression models on the given data
3. Implement decision tree, support vector machine and naïve bayes algorithms
4. Implement unsupervised learning algorithm
5. Evaluate different machine learning model and improve their performance.

Syllabus for Third Year Biomedical Engineering - Semester VI (Autonomous)
(Academic Year 2021-2022)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Machine Learning** Definition of learning systems, goals and applications of machine learning, types of machine learning, issues in machine learning, steps involved in developing a machine learning applications	04
2	**Regression techniques** Regression basics: relationship between attributes using covariance and correlation, relationship between multiple variables Regression techniques and evaluation: linear regression, residual analysis, least square, gradient descent, identifying significant features, feature reduction using AIC, multi-collinearity, non-normality and heteroscedasticity, multiple linear regression, polynomial regression, hypothesis testing of regression model, confidence intervals of slope, r-square and goodness of fit, influential observations, bias-variance trade off, regularization methods: lasso, ridge and elastic net, categorical variables in regression, Non-linear regression, logit function and interpretation, types of error measures (ROCR), logistic regression, Maximum Likelihood Function.	10
3	**Decision tree, support vector machine and Bayesian learning** Decision tree: introduction, univariate tree, classification tree, entropy, gini index, misclassification error, CART algorithm, ID3 algorithm, regression tree, pruning, overfitting, identifying poisonous mushrooms using decision tree Support Vector Machines: Support Vectors, Functional Margin, Geometric Margin, Optimization problem, Lagrange Duality, KKT condition, Maximum margin with noise, Non-linear SVM and Kernel Function Bayesian Learning: Naïve Bayes, Bayesian Network, Representation in Bayesian Belief Network, Inference in Bayesian Network, Applications of Bayesian Network, Hidden markov model	12
4	**Unsupervised learning** K-Nearest Neighbor: Computational geometry, Voronoi Diagrams, Delaunay Triangulation, K-Nearest Neighbor algorithm, Aspects to consider while designing K-Nearest Neighbor Clustering: Distance measures, different clustering methods (distance, density, hierarchical), iterative distance-based clustering, k-means clustering, k-medoids, k-mode clustering, DBSCAN clustering, hierarchical clustering, measures of quality of clustering	10
5	**Evaluating and improving model performance** Confusion matrices, kappa statistic, sensitivity, specificity, precision, recall, F-measure, ROC curves, cross validation, bootstrap sampling, introduction to Ensemble Learning, bagging, boosting, impact on bias and variance, Random forest	06

List of Laboratory Experiments: (any eight)

1. Implement linear regression model for developing relationship between Vitamin-D and calcium in blood
2. Implement multiple linear regression model for developing several features of individual such as age, physical condition and location against existing medical expense
3. Implement Logistic Regression for cancer classification.
4. Implement decision tree to predict contact lens type.
5. Implement decision tree for medical decision analysis.
6. Implement CART decision tree algorithm to predict influenza in primary care patients
7. Implement naïve bayes algorithm for disease prediction.
8. Implement naïve bayes algorithm for classifying spam email.
9. Implement Support Vector Machine for prediction of medication adherence in heart failure patients.
10. Implement classification using KNN for prediction of heart disease.
11. Implement Bagging or Boosting method.
12. Implement K-means clustering for discovering asthma subtypes.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text Books

1. Introduction to Machine Learning, Ethem Alpaydın, PHI, 2015, third edition
2. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas C. Müller, Sarah Guido, O'reilly, 2017, third edition
3. Data Mining Concepts and Techniques, Jiawei Han, Michaline Kamber, Jian Pei, Morgan Kaufmann, 2014, third edition.

Reference Books

1. Machine Learning, Tom M. Mitchell, McGraw Hill, 2013, first edition
2. Machine Learning in Action, Peter Harrington, DreamTech Press, 2015, first edition
3. Data Mining Introductory and Advanced Topics, Margaret H. Dunham, Pearson Education, 2002

Syllabus for Third Year Biomedical Engineering - Semester VI (Autonomous)
(Academic Year 2021-2022)

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks
ii. Journal documentation (Write-up and/or Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year Biomedical Engineering - Semester VI (Autonomous)
(Academic Year 2021-22)

<table>
<tr><td colspan="8">Program: Third Year Biomedical Engineering</td><td colspan="3">Semester: VI</td></tr>
<tr><td colspan="8">Course: Rehabilitation Engineering</td><td colspan="3">Course Code: DJ19BMEC6012</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Human anatomy and Physiology
2. Basics of Biomechanics

Objectives:

1. To introduce learners to the concept of rehabilitation and the rehab team and its working
2. To familiarize the learners with the general principles of orthotics and prosthetics, its biomechanics, amputation and classifications. To give idea of Activities of daily living (ADL)
3. To introduce learners to basics of Kinetics and Kinematics, Flow properties of blood and give overview of Rehabilitation Engineering.
4. To understand common deformities, paraplegia, muscular dystrophy etc. and its rehabilitation

Outcomes: On completion of the course, learner will be able to:

1. State the definition, importance and working of Rehabilitation and the rehabilitation team in medical facility.
2. Describe various reasons for amputation, the levels of amputation; distinguish between prosthesis and orthotics, their types and classifications. Learners will also understand ADL, grouping, indices for measurement of independence.
3. Restate mechanical principles and Kinematics and kinetics, flow properties of blood
4. Gain knowledge of various common deformities, muscular dystrophy and functional abnormalities and its management via rehabilitation.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Rehabilitation:** What is rehabilitation, medical rehabilitation, preventive rehabilitation, impairment, disability and handicap, sociovocational rehabilitation, rehabilitation team: classification of members, medical, the rehabilitation team – the medical team, physical therapist, occupational therapist, prosthetist- orthotist, rehabilitation nurse, speech pathologist, psychologist and child development specialist, horticultural therapist, music therapist, creative movement therapist, dance and play therapist, recreational therapist, biomedical engineer.	**06**
2	**Orthotics, Amputation, and Prosthetics, Activities of Daily Living (ADL):** Orthotics: general principles of orthotics, biomechanics of orthotics, classification: upper & lower extremity orthotics, spinal orthotics, amputation & prosthetics: causes of amputation, types of amputation, and levels of amputation for upper and lower extremity, preoperative and post-operative period, pre-prosthetic stage, endo & exo-skeletal prosthetics, classification: upper & lower limb prosthetics, activities of daily living: ADL grouping, Barthel's index of ADL, functional independence, measures, environmental control system, communication, ADL training.	**13**
3	**Mechanical principles of Kinematics and Kinetics:** Planar classification of position and motion, rotary and translatory motion, degree of freedom, kinematic chain theories of motion, levers, torque, parallel force, resolution of force, calculation of muscle and joint forces, clinical application on weight and center of gravity ,applied weights and resistance, muscle force and leverage, joint forces, clinical application on stretching versus joint mobilization **Flow properties of blood:** an outline of blood rheology, constitutive equation of blood based viscometric data and casson's equation, laminar flow of blood in a tube, fluid mechanical interaction of RBCs with a solid wall, thrombus formation and dissolution, medical application of blood rheology	**10**
4	**Common deformities and role of surgery in rehabilitation engineering:** Types of deformities, management of 1st and 2nd degree deformities, common deformities of lower limb, treatment for partial foot deformities, deformities of the foot, arm deformities, torticollis	**05**
5	**An overview of rehabilitation of muscular dystrophy, paraplegia, and quadriplegia:** Muscular dystrophy, duchenne muscular dystrophy, rehabilitation, facioscapulohumeral muscular dystrophy, paraplegia: etiology, mechanism of injury, identification of level of lesion, management of active spinal cord injury, rehabilitation, gait training, quadriplegia: mobility, training, level of injury & outcome, management	**08**

List of Laboratory Experiments:

1. Demonstrations in hospital / Industry.
2. Discussion on research articles and recent developments in the field of medicine.
3. Group presentations on the latest technology in hospitals based on the topics covered in the syllabus.
4. 7 Assignments based on the entire syllabus.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. Handbook of Biomedical Instrumentation, R S. Khandpur. PH Publishers, 2014,3rd edition
2. Medical Instrumentation, Application and Design, J G. Webster, John Wiley, 2020, 5th edition
3. Introduction to Biomedical Equipment Technology, Carr –Brown, PH Pub, 2000, 4th edition

Reference Books:

1. Encyclopedia of Medical Devices and Instrumentation, J G. Webster. Vol I- IV, PH Pub
2. Various Instruments Manuals.
3. Various internet resources.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks

ii. Journal documentation (Write-up and/or Power Point Presentation and/or Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

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Proposed Syllabus for Third Year Biomedical Engineering - Semester VI (Autonomous)
(Academic Year 2020-2021)

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<tr><td colspan="8">Course: Embedded Systems and RTOS</td><td colspan="3">Course Code: DJ19BMEC6013</td></tr>
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</table>

Pre-requisite: Knowledge of

1. Microcontroller Basics and Embedded C programming

Objectives:

1. To study concepts involved in embedded systems hardware.
2. To understand RTOS and its various features through examples.

Outcomes: On completion of the course, learner will be able to:

1. Identify and describe various characteristic features and applications of embedded systems.
2. Analyse and identify hardware for embedded systems implementation.
3. Analyse and identify various software issues involved in Embedded systems for real time requirements.
4. Analyse and explain the design life-cycle for embedded system implementation.

Module	Contents	Hours
1	**Introduction to Embedded Systems** Characteristics and Design metrics of Embedded system. Real time systems: Need for Real-time systems, Hard-Soft Real-time systems. Challenges in Embedded system Design: Power, Speed and Code density.	**04**
2	**Embedded Hardware** Embedded cores, types of memories, sensors (optical encoders, resistive sensors) and actuators (solenoid valves, relay/switch, opto-couplers). Power supply considerations in embedded systems: low power features- idle & power down mode, sleep mode, brown-out detection. Communication Interfaces: comparative study of serial communication. UART, SPI, I2C, CAN, USB (v2.0), Bluetooth, Zig-Bee. Selection criteria of above interfaces.	**08**
3	**Embedded Software** Program Modelling concepts: DFG, FSM, UML Embedded C programming: data types, modifiers, qualifiers, functions, macros, interrupt service routine, device drivers. Real-time operating system: need of RTOS in embedded system software and comparison, foreground/background processes, interrupt latency, task, task states, multi-tasking, context switching, task scheduling, scheduling algorithms- rate monotonic scheduling, earliest deadline. Inter-process communication: semaphore, mailbox, message queues, event timers, task synchronisation- shared data, priority inversion, deadlock. Memory Management. Introduction to µCOS II RTOS: Study of Kernel structure of µCOS II, µCOS II functions for initialisation, task creation, inter-task communication and resource management, memory management.	**14**
4	**System Integration, Testing and Debugging Methodology** Embedded Product Design Life-Cycle (EDLC), Hardware-Software Co-design Testing & Debugging: Boundary-scan/JTAG interface concepts, Black-Box testing, White-Box testing, Hardware emulation, Logic analyser.	**08**
5	**Case Studies** Soft Real-time: Automatic Chocolate Vending machine using µCOS II RTOS- Requirement's study, Specification study using UML, Hardware architecture, Software architecture. Hard Real-time: Car Cruise-Control using µCOS II RTOS- requirements study, specification study using UML, Hardware architecture, Software Architecture.	**08**

List of Laboratory Experiments: (At least 8)

Practical's may be performed in hardware mode and/or in software (simulation/emulation) mode.

1. Demonstrate a C program with Embedded C language elements.
2. Demonstrate serial communications without RTOS.
3. Demonstrate state machine design without RTOS.
4. Demonstrate μCOS-II RTOS functions using example programs.
5. Demonstrate serial communications with RTOS.
6. Demonstrate design of state machine design with RTOS.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text Books:

1. Embedded Real Time System: Concepts, Design and Programming, Dr. K.V. K. K. Prasad, Dreamtech, New Delhi, Edition 2014.
2. MicroC / OS-II The Real-Time Kernel, Jean J. Labrosse, CMP Books, 2011, Edition 2nd.
3. Embedded Systems: Architecture, Programming and Design, Raj kamal, McGraw Hill Education (India) Private Limited, New Delhi, 2015, Edition 3rd.
4. Embedded Real Time Systems Programming, Sriram Iyer, Pankaj Gupta, Tata McGraw Hill Publishing Company ltd., 2003.

Reference Books:

1. An Embedded Software Primer, David Simon, Pearson, 2009.
2. Embedded Microcomputer Systems – Real Time Interfacing, Jonathan W. Valvano, Publisher - Cengage Learning, 2012 Edition 3rd.
3. ARM System Developers Guide Designing and Optimising System Software, Andrew Sloss, Domnic Symes, Chris Wright, Elsevier, 2004
4. Embedded System Design – A Unified Hardware/Software Introduction, Frank Vahid, Tony Givargis, John Wiley & Sons Inc., 2002.
5. Introduction to Embedded Systems, Shibu K V, Tata McGraw Hill Education Private Limited, New Delhi, 2009.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
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<tr><td colspan="8">Program: Third Year Biomedical Engineering</td><td colspan="2">Semester: VI</td></tr>
<tr><td colspan="8">Course: GUI and Application Development Laboratory</td><td colspan="2">Course Code: DJ19BMSBL4</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
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</table>

Pre-requisite: Knowledge of java programming, Use of API's.

Objectives:

1. Learn and apply the concepts of application development.
2. learn and Identify application architectures, protocols and technologies.
3. Learn about data flow and data processing in different applications.

Outcomes: On completion of the course, learner will be able to:

1. Identify and use different technologies for application development.
2. Identify various concepts of mobile programming that make it unique from programming for other platforms
3. Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.
4. Analyze and process the data received through applications.
5. Deploy applications to the Android marketplace for distribution.

Following points will be explained and discussed during practical session and practical's will be conducted as per the practical list	
Module	**PART A**
1	**Introduction to web technologies:** Web system architecture- 1,2,3 and n tier architecture, URL,domain name system, overview of HTTP and FTP, Cross browser compatibility issues, W3CValidators. Web Site Design Issues: Planning a Web Site – Objective and Goals, Audience,Organizingcontents, Publishingof Web Site. Functionof Web Server.
2	**Static web page design:** **HTML and HTML5:** Syntax and structure of HTML document,Formatting and Fonts, Anchors, Hyperlinks, Backgrounds, Images, Lists, Tables and Forms.HTML5 Semantic elements, Form elements, Media elements, Graphics elements, Input types,Geo-location. **CSSandCSS3:** SyntaxofCSS,Selectors–Element,Id,Class,Pseudo-class,Universal,InsertingCSSinanHTML,DefininginheritanceinCSS.CSS3Properties– Comments, Background, Color, Text, Fonts, Icons, Borders, Margins, Padding, Outline, Height/Width,Links,Lists,Tables,Display,Overflow,Float,Inline-block,Opacity,Position,Navigationbar, Dropdowns, Transitions, Animations, Transformations, Gradients. Responsive web designusingMedia Queries-SupportingDifferingViewports, EmbracingFluid Layout.
3	**Client side scripting – JavaScript:** Lexical structure – character set, whitespaces, line breaks,comments, identifiers, reserved words, Inserting JavaScript in HTML, Variables and their scope,Controlstructures,Functions,ObjectsinJavaScript-Builtin,BrowserobjectsandDOMobjects,event handling, formvalidationand cookies. **React JS:** Introduction to React, Adding React to HTML page, Introducing JSX, Renderingelements into DOM, Components and Props, State and lifecycle of React component, HandlingeventswithReactelements,Conditionalrendering,ListsandKeys,Forms,Liftingstateup,CreateReactapplication.
4	**Server side scripting and database connectivity – PHP and MySQL:** Introduction to PHP,Syntax, Comments, Variables and their scope, Constants, Data types, Control structures, Built-infunctions,AccessingformvariablesusingGETandPOSTmethods,Trackingusersusingcookiesand sessions. PHP and MySQL database connectivity - Creating a database using MySQL,Creating a HTML or PHP form, connecting the form with MySQL database and executing insert,update, delete and select queries on database using PHP- MySQL database connectivity. Websitesecurityvulnerabilities.
5	**Web Extensions – XML and XSL:** Introduction to XML, Syntax and structure of XML document, Element and naming rules, Attributes, Entity references, Comments, Namespaces, Document type definitions (DTD), XML schemas, Displaying raw XML documents. Introduction to XSL, XSL elements, Using XSL in XML documents, XSLT. Validating XML using DTD, Parsing XML data and storing in database.
Module	**PART B**
1	**Java Concepts:** Variables, Flow Control , arrays and matrices, working with strings, OOPs Concepts, Inheritance, Exception handling, Multi-threading and timers. User interface in Java, working with SWT, UI Event.

2	**Introduction to Android** Setting up android development environment. Android development Framework - Android-SDK, Eclipse Emulators – What is an Emulator / Android AVD, Creating & setting up custom Android emulator, Android Project Framework, First Android Application.
3	**Android Activities and UI Design:** Understanding Intent, Activity, Activity Lifecycle and Manifest Creating Application and new Activities Expressions and Flow control, Android Manifest Simple UI -Layouts and Layout properties, Introduction to GUI objects, **Advanced UI Programming:** Event driven Programming in Android (Text Edit, Button clicked etc.), Creating a splash screen, Event driven Programming in Android, Android Activity Lifecycle, Creating threads for gaming requirement, Understanding the Exception handler. Toast, Menu, Dialog, List and Adapters. **Notifications**: Notification Manager, Pending Intent, notifications (Show and Cancel)
4	**Multimedia**: Working with files, Providing feedback to the user, working with images and media, raw camera usage, Touch gestures. **Database**: Introducing SQLite, SQLite Open Helper and creating a database , Opening and closing a database, Working with cursors Inserts, updates, and deletes.
5	**Working with Web Services:** Soap and Rest overview, Working with SOAP, Working with Rest. **Location Based Services:** Using Location Based Services, Working with Google Maps

List of Laboratory Experiments / Assignments / Tutorials: (total of 16 experiments from list below)

PART A: (Minimum 8)

1. HTML
   a) Create astatic web page usingHTML.
   b) Createaclasstimetable usingHTML.
   c) Create aregistrationformusingHTML.
   d) CreateawebpageusingHTML5tags.
2. CSS
   a) Designaweb pageusingExternalorEmbedded StyleSheet.
3. CSS3
   a) Designaresponsiveweb pageusingmediaqueriesandCSS3.
   b) Designaweb pageusingBootstrap.
   c) DesignaresumeusingBootstrap.
   d) DesigntheadmissionformusingBootstrap.
4. JavaScript
   a) Programsbased onobjectsinJavaScript.
   b) Programto designacalculator usingJavaScript.
5. JavaScript
   a) Programsbasedonformvalidation.
6. ReactJS
   a) Createanapplication usingReact.

7. PHP
    a) InstallationandconfigurationofXAMPP/ WAMPServer.
    b) Programsbasedonbuilt-infunctions inPHP.
8. PHP&MySQL
    a) ImplementPHP–MySQLdatabaseconnectivity.
9. XML &XSL
    a) DesignXML usingXMLDTDandschema.
    b) ImplementingXSLelementsinXML.
    c) ValidatingXMLdata throughDTDandstoringindatabase.

Any other experiment based on Webpage designing may be included, which would help the learner to understand topic/concept.

PART B: (Minimum 8)

Practical's may be performed in hardware mode and/or in software (simulation/emulation)mode.

1. Develop an application to create "HelloWorld" application.
2. Develop an application that uses GUI components, fonts and colors.
3. Develop an application that layout managers and event listeners.
4. Develop an application that creates an alert and user feedbacks upon receiving a message.
5. Develop an application that makes use of database for storing and retrieving.
6. Develop an application that uses location based services.
7. Develop an application – calculator and/or alarm clock.
8. Develop an application that uses network services for communications.
9. Develop an application for IoT MQTT broker / publisher interface.
10. Develop an application for IoT client interface 1.
11. Develop an application for IoT server interface1.
12. Develop an application for data logging and communications.
13. Develop an application for automation interface.
14. Develop an application for event scheduling and task management.

Books Recommended:

Text books:

1. Android Wireless Application Development, Lauren Darcey and Shane Conder, Pearson

Education, 2nd ed. (2011)

Reference Books:

1. Professional Android 2 Application Development, Reto Meier, Wiley India Pvt Ltd
2. Beginning Android, Mark L Murphy, Wiley India Pvt Ltd
3. Android Application Development All in one for Dummies, Barry Burd, first edition

Evaluation Scheme:

Semester End Examination (A):

Laboratory:

1. Oral and practical examination will be based on the entire syllabus including, the practical's performed during laboratory sessions.

Continuous Assessment (B):

Laboratory: (Term work)

Term work shall consist of minimum 16 experiments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 30 Marks
ii. Journal Documentation (Write-up, Power Point Presentation and Assignments): 20 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Proposed Syllabus for Third Year Biomedical Engineering - Semester V (Autonomous)
(Academic Year 2021-2022)

<table>
<tr><td colspan="8">Program: Third Year Biomedical Engineering</td><td colspan="3">Semester: V</td></tr>
<tr><td colspan="8">Course: Innovative Product Development IV</td><td colspan="3">Course Code: DJ19ILL2</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td colspan="4">Laboratory Examination</td><td colspan="2">Term work</td><td rowspan="2">Total Term work</td><td rowspan="2">50</td></tr>
<tr><td rowspan="2">-</td><td rowspan="2">2</td><td rowspan="2">--</td><td rowspan="2">1</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>25</td><td>--</td><td>--</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Objectives:

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found out to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value-added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualize and create a successful product.

Outcome:

Learner will be able to:

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualizing a product, especially while working in a team.
3. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
4. Draw proper inferences through theoretical/ experimental/simulations and analyze the impact of the proposed method of design and development of the product.
5. Develop interpersonal skills, while working as a member of the team or as the leader.
6. Demonstrate capabilities of self-learning as part of the team, leading to life-long learning, which could eventually prepare themselves to be successful entrepreneurs.
7. Demonstrate product/project management principles during the design and development work and also excel in written (Technical paper preparation) as well as oral communication.

Guidelines for the proposed product design and development:

1. Students shall form a team of 3 to 4 students (max allowed: 5-6 in extraordinary cases, subject to the approval of the department review committee and the Head of the department).
2. Students should carry out a survey and identify the need, which shall be converted into conceptualization of a product, in consultation with the faculty supervisor/head of department/internal committee of faculty members.
3. Students in the team shall understand the effective need for product development and accordingly select the best possible design in consultation with the faculty supervisor.
4. Students shall convert the best design solution into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
5. Faculty supervisor may provide inputs to students during the entire span of the activity, spread over 2 semesters, wherein the main focus shall be on self-learning.
6. A record in the form of an activity log-book is to be prepared by each team, wherein the team can record weekly progress of work. The guide/supervisor should verify the recorded notes/comments and approve the same on a weekly basis.
7. The design solution is to be validated with proper justification and the report is to be compiled in a standard format and submitted to the department. Efforts are to be made by the students to try and publish a technical paper, either in the institute journal, "Techno Focus: Journal for Budding Engineers" or at a suitable publication, approved by the department research committee/ Head of the department.
8. The focus should be on self-learning, capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the year long course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over 4 semesters, i.e. during the semesters III to VI.

Guidelines for Assessment of the work:

1. The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.
2. In the continuous assessment, focus shall also be on each individual student's contribution to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.
3. Distribution of marks individually for the both reviews as well as for the first review during the subsequent semester shall be as given below:
    A. Marks awarded by the supervisor based on log-book :20
    B. Marks awarded by review committee : 20
    C. Quality of the write-up : 10

Review/progress monitoring committee may consider the following points during the assessment.

In the semester V, the entire design proposal shall be ready, including components/system selection as well as the cost analysis. Two reviews will be conducted based on the presentation given by the student's team.

- First shall be for finalization of the product selected.
- Second shall be on finalization of the proposed design of the product.

The overall work done by the team shall be assessed based on the following criteria;

1. Quality of survey/ need identification of the product.
2. Clarity of Problem definition (design and development) based on need.
3. Innovativeness in the proposed design.
4. Feasibility of the proposed design and selection of the best solution.
5. Cost effectiveness of the product.
6. Societal impact of the product.
7. Functioning of the working model as per stated requirements.
8. Effective use of standard engineering norms.
9. Contribution of each individual as a member or the team leader.
10. Clarity on the write-up and the technical paper prepared.

The semester V reviews may be based on relevant points listed above, as applicable.

Guidelines for Assessment of Semester Reviews:

- The write-up should be prepared as per the guidelines given by the department.
- The design and the development of the product shall be assessed through a presentation and demonstration of the working model by the student team to a panel of Internal and External Examiners, preferably from industry or any research organizations having an experience of more than five years, approved by the Head of the Institution. The presence of the external examiner is desirable only for the 2nd presentation in semester VI. Students are compulsorily required to present the outline of the technical paper prepared by them during the final review in semester VI.

Proposed Syllabus for Third Year Biomedical Engineering - Semester VI (Autonomous)
(Academic Year 2021-22)

Program: Third Year Biomedical Engineering										**Semester: VI**
Course: Environmental Studies										**Course Code: DJ19A5**
Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				--			--	--	--	--
				Laboratory Examination			**Term work**			
01	**--**	**--**	**--**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**	**Total Term work**	**--**
				--	--	--	--	--	--	

Pre-requisite: Interest in Environment and its impact on Human

Objectives:

1. Understand environmental issues such as depleting resources, pollution, ecological problems and the renewable energy scenario.
2. Familiarise environment related legislation

Outcomes: Students should be able to

1. Understand how human activities affect environment
2. Understand the various technology options that can make a difference

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Social Issues and Environment:** Ecological footprint and Carrying Capacity, Depleting nature of Environmental resources such as soil, water minerals and forests, Carbon emissions and Global Warming.	**04**
2	**Technological growth for Sustainable Development:** Social, Economic and Environmental aspects of Sustainable Development, Renewable Energy Harvesting ,Concept of Carbon credit, Green Building ,Power and functions of Central Pollution Control Board and State Pollution Control Board	**04**
3	**Environmental impact due to technology:** Impact of Energy on Environment, Flow of Energy in Ecological system, Environment Degradation due to Energy, Control of pollution from Energy, Consumer electronics, power saving devices, energy from waste, energy use and conservation	**05**

Books Recommended:

Textbooks:

1) Environmental Studies From Crisis to Cure, R. Rajagopalan, 2012
2) Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education, Erach Bharucha
3) Environmental Management Science and Engineering for industry by " Iyyanki V. Murlikrishna and valli Manickam"

Prepared by Checked by Head of the Department Principal